A P P E N D I X 'C'

LABORATORY TEST CERTIFICATES

MORRISON GEOTECHNIC

Brisbane | Gold Coast | Maroochydore
Unit 1, 5 Brendan Drive (PO Box 2011), Nerang Q 4211 P (07) 5596 1599 F (07) 5527 2027
ABN 51 009 878 899
www.morrisongeo.com.au

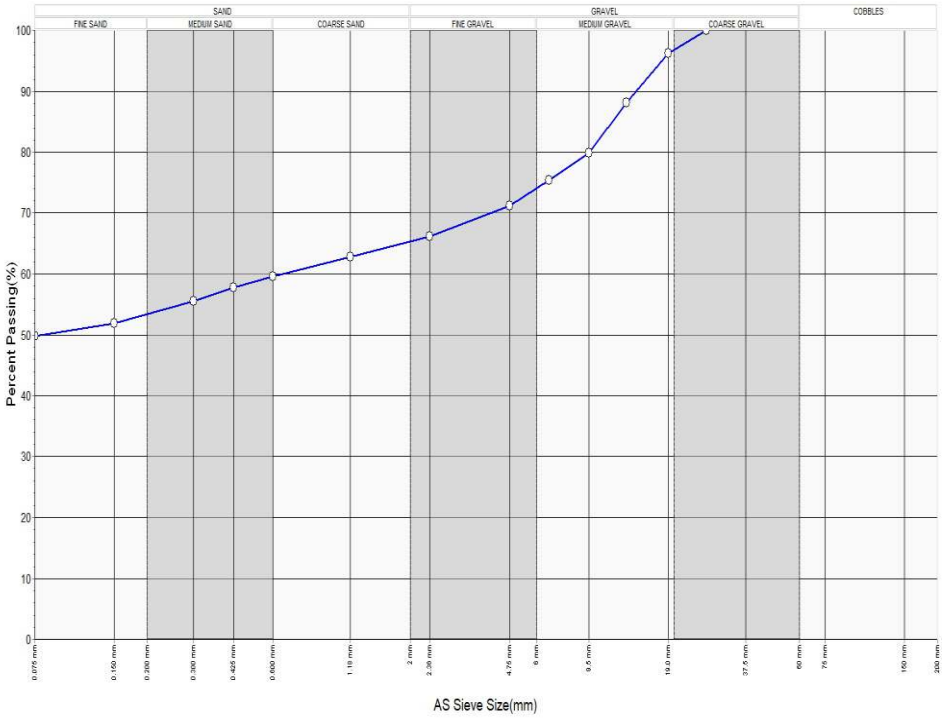
Quality of Materials Report

Client :	**WOOD & GRIEVE ENGINEERS**	Report Number:	**GE18-144.1/1**
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 :	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	
BH 3	
1.5 - 2.5	
DISTURBED	
SAMPLE	
Test Number :	
Lot Number :	
Specification Number :	

AS Sieve Size(mm)	Percent Passing	Specification Limits
100		
75.0		
63.0		
53.0		
37.5		
26.5	**100**	
19.0	**96**	
16.0		
13.2	**88**	
9.5	**80**	
6.7	**75**	
4.75	**71**	
2.36	**66**	
1.18	**63**	
0.600	**60**	
0.425	**58**	
0.300	**56**	
0.150	**52**	
0.075	**50**	



		Test Method	Results		
Liquid Limit (%) :		**AS1289.3.1.2**	**47**	Shrinkage Comments :	**cracking and curling**
Plastic Limit (%) :		**AS1289.3.2.1**	**33**	Mould Length (mm) :	**250.4**
Plasticity Index (%) :		**AS1289.3.3.1**	**14**	Sample History	
Linear Shrinkage (%) :		**AS1289.3.4.1**	**8.5**		
Soil Description :					

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APPROVED SIGNATORY

IAN MASMAN - MANAGER
NATA Accreditation Number
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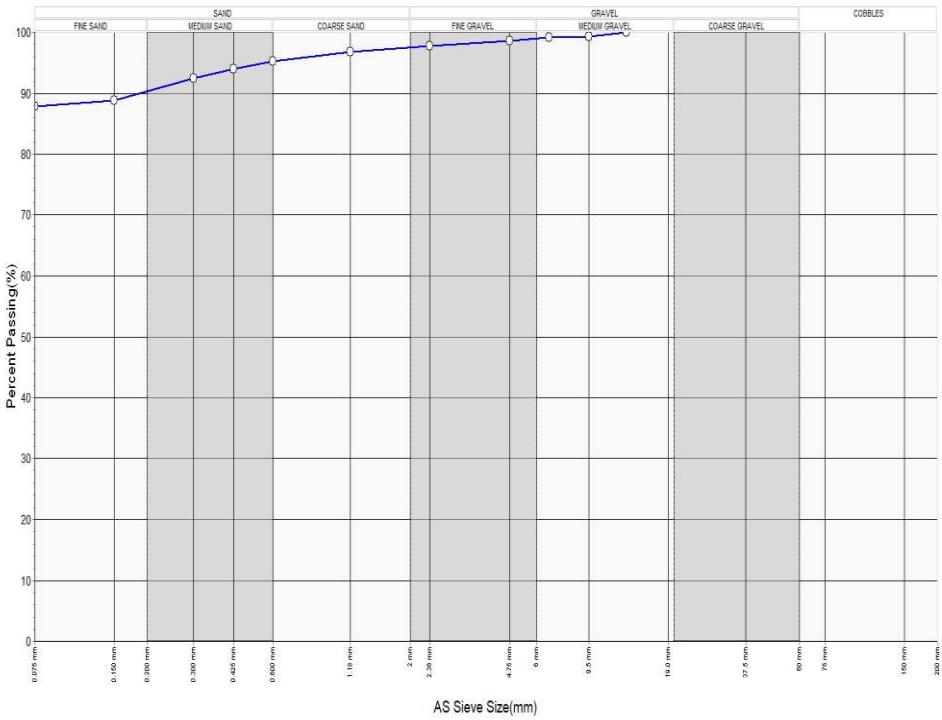
Quality of Materials Report

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
Sampling Method :	-
Sampled By :	LEIGH BEXLEY
Date Sampled :	3/08/2018
Date Tested :	13/08/2018
Material Type :	DISTURBED
Material Source :	INSITU
Remarks :	

SAMPLE LOCATION	
BH 7	
0.1 - 0.5	
DISTURBED	
SAMPLE	
Test Number :	
Lot Number :	
Specification Number :	

AS Sieve Size(mm)	Percent Passing	Specification Limits
100		
75.0		
63.0		
53.0		
37.5		
26.5		
19.0		
16.0		
13.2	**100**	
9.5	**99**	
6.7	**99**	
4.75	**99**	
2.36	**98**	
1.18	**97**	
0.600	**95**	
0.425	**94**	
0.300	**92**	
0.150	**89**	
0.075	**88**	



		Test Method	Results		
Liquid Limit (%) :		**AS1289.3.1.2**	**42**	Shrinkage Comments :	**cracking and curling**
Plastic Limit (%) :		**AS1289.3.2.1**	**27**	Mould Length (mm) :	**250.1**
Plasticity Index (%) :		**AS1289.3.3.1**	**15**	Sample History	
Linear Shrinkage (%) :		**AS1289.3.4.1**	**10**		
Soil Description :					

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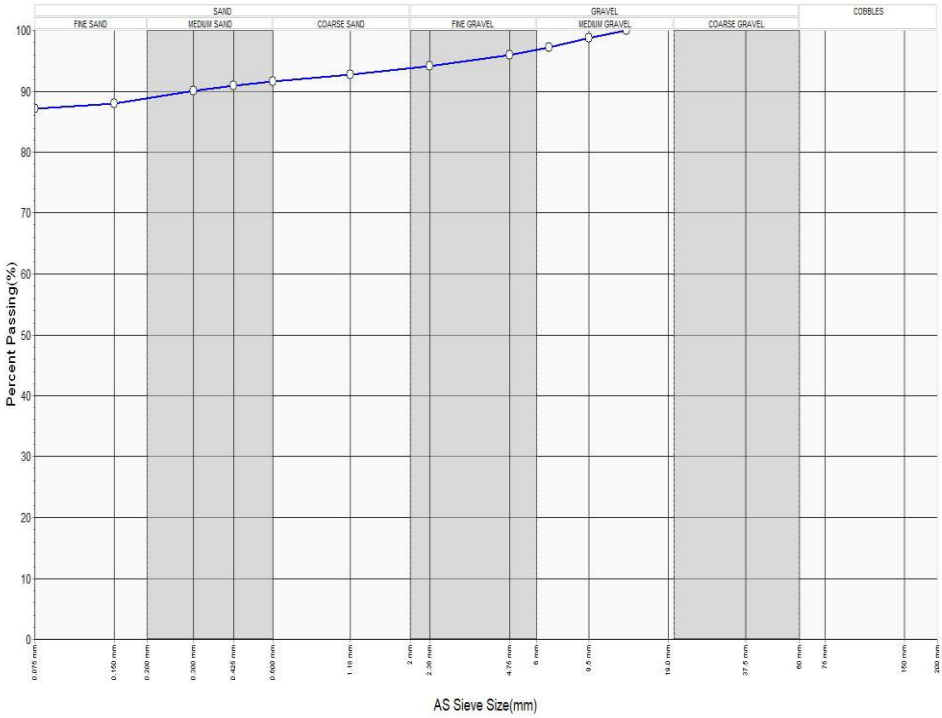
Quality of Materials Report

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
Sampling Method :	-
Sampled By :	LEIGH BEXLEY
Date Sampled :	3/08/2018
Date Tested :	13/08/2018
Material Type :	BULK SAMPLE
Material Source :	INSITU
Remarks :	

SAMPLE LOCATION	
BH 10	
1.0 - 1.5	
BULK	
SAMPLE	
Test Number :	
Lot Number :	
Specification Number :	

AS Sieve Size(mm)	Percent Passing	Specification Limits
100		
75.0		
63.0		
53.0		
37.5		
26.5		
19.0		
16.0		
13.2	**100**	
9.5	**99**	
6.7	**97**	
4.75	**96**	
2.36	**94**	
1.18	**93**	
0.600	**92**	
0.425	**91**	
0.300	**90**	
0.150	**88**	
0.075	**87**	



		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 Index (%) :		**AS1289.3.3.1**	**17**	Sample History	
Linear Shrinkage (%) :		**AS1289.3.4.1**	**12**		
Soil Description :					

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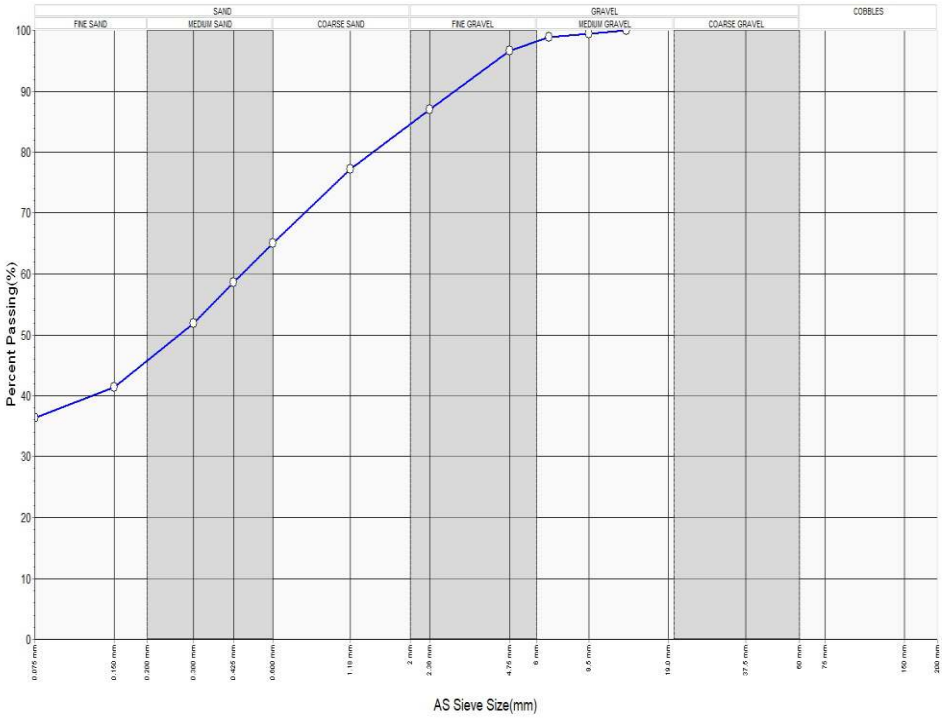
Quality of Materials Report

Client :	**WOOD & GRIEVE ENGINEERS**	Report Number:	**GE18-144.4/1**
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 :	245185
Sampling Method :	-
Sampled By :	LEIGH BEXLEY
Date Sampled :	3/08/2018
Date Tested :	13/08/2018
Material Type :	BULK SAMPLE
Material Source :	INSITU
Remarks :	

SAMPLE LOCATION	
BH 17	
0.3 - 1.0	
BULK	
SAMPLE	
Test Number :	
Lot Number :	
Specification Number :	

AS Sieve Size(mm)	Percent Passing	Specification Limits
100		
75.0		
63.0		
53.0		
37.5		
26.5		
19.0		
16.0		
13.2	**100**	
9.5	**99**	
6.7	**99**	
4.75	**97**	
2.36	**87**	
1.18	**77**	
0.600	**65**	
0.425	**59**	
0.300	**52**	
0.150	**41**	
0.075	**36**	



		Test Method	Results		
Liquid Limit (%) :		**AS1289.3.1.2**	**40**	Shrinkage Comments :	**cracking and curling**
Plastic Limit (%) :		**AS1289.3.2.1**	**32**	Mould Length (mm) :	**250.4**
Plasticity Index (%) :		**AS1289.3.3.1**	**8**	Sample History	
Linear Shrinkage (%) :		**AS1289.3.4.1**	**5.5**		
Soil Description :					

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Material Test Report

Report Number: **GE18/144-1A**
Issue Number: 1
Date Issued: 30/11/2018
Client: WOOD & GRIEVE ENGINEERS
LEVEL 2, 232 St PAULS TERRACE, FORTITUDE VALLEY QLD 4006
Project Number: GE18/144
Project Name: GEOTECHNICAL INVESTIGATION
Project Location: TWEED VALLEY HOSPITAL, CUDGEN ROAD, KINGSCLIFF
Work Request: 64
Sample Number: G18-64A
Date Sampled: 26/11/2018
Sample Location: **BH 40 RL 23.00 (0.4 - 0.8)**

MORRISON GEOTECHNIC
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NATA WORLD RECOGNISED ACCREDITATION

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Ian Masman
Branch Manager
NATA Accredited Laboratory Number: 1169

Particle Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
19 mm	**100**			0		
13.2 mm	**97**			3		
9.5 mm	**92**			5		
6.7 mm	**89**			3		
4.75 mm	**86**			3		
2.36 mm	**83**			3		
1.18 mm	**81**			2		
0.6 mm	**80**			1		
0.425 mm	**80**			0		
0.3 mm	**79**			1		
0.15 mm	**77**			2		
0.075 mm	**76**			1		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	50		
Plastic Limit (%)	34		
Plasticity Index (%)	**16**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	11.5		
Cracking Crumbling Curling	Cracking & Curling		

Material Test Report

Report Number: **GE18/144-1A**
Issue Number: 1
Date Issued: 30/11/2018
Client: WOOD & GRIEVE ENGINEERS
LEVEL 2, 232 St PAULS TERRACE, FORTITUDE VALLEY QLD 4006
Project Number: GE18/144
Project Name: GEOTECHNICAL INVESTIGATION
Project Location: TWEED VALLEY HOSPITAL, CUDGEN ROAD, KINGSCLIFF
Work Request: 64
Sample Number: G18-64B
Date Sampled: 26/11/2018
Sample Location: **BH 28 RL 17.88 (0.5 - 0.9)**

MORRISON GEOTECHNIC
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Approved Signatory: Ian Masman
Branch Manager
NATA Accredited Laboratory Number: 1169

Particle Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
19 mm	**100**			0		
13.2 mm	**100**			0		
9.5 mm	**98**			1		
6.7 mm	**97**			1		
4.75 mm	**96**			1		
2.36 mm	**94**			2		
1.18 mm	**92**			2		
0.6 mm	**91**			1		
0.425 mm	**90**			1		
0.3 mm	**89**			1		
0.15 mm	**87**			2		
0.075 mm	**86**			1		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	56		
Plastic Limit (%)	41		
Plasticity Index (%)	**15**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	7.0		
Cracking Crumbling Curling	None		

Material Test Report

Report Number: **GE18/144-1B**
Issue Number: 1
Date Issued: 03/12/2018
Client: WOOD & GRIEVE ENGINEERS
LEVEL 2, 232 St PAULS TERRACE, FORTITUDE VALLEY QLD 4006
Project Number: GE18/144
Project Name: GEOTECHNICAL INVESTIGATION
Project Location: TWEED VALLEY HOSPITAL, CUDGEN ROAD, KINGSCLIFF
Work Request: 64
Sample Number: G18-64A
Date Sampled: 26/11/2018
Sample Location: **BH 40 RL 23.00 (0.4 - 0.8)**

MORRISON GEOTECHNIC
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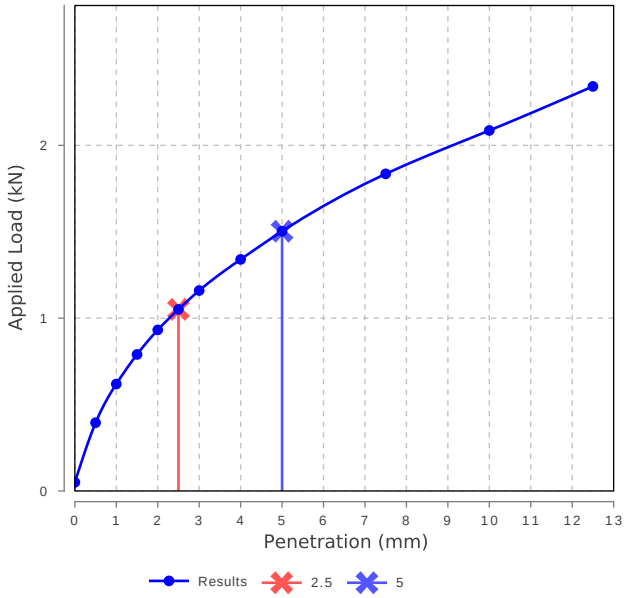
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Ian Masman
Branch Manager
NATA Accredited Laboratory Number: 1169

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**8**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	visual		
Maximum Dry Density (t/m^3)	1.36		
Optimum Moisture Content (%)	35.0		
Laboratory Density Ratio (%)	99.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.35		
Field Moisture Content (%)	36.1		
Moisture Content at Placement (%)	35.0		
Moisture Content Top 30mm (%)	43.2		
Moisture Content Rest of Sample (%)	40.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	24		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

California Bearing Ratio



Particle Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
19 mm	**100**			0		
13.2 mm	**97**			3		
9.5 mm	**92**			5		
6.7 mm	**89**			3		
4.75 mm	**86**			3		
2.36 mm	**83**			3		
1.18 mm	**81**			2		
0.6 mm	**80**			1		
0.425 mm	**80**			0		
0.3 mm	**79**			1		
0.15 mm	**77**			2		
0.075 mm	**76**			1		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	50		
Plastic Limit (%)	34		
Plasticity Index (%)	**16**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	11.5		
Cracking Crumbling Curling	Cracking & Curling		

Material Test Report

Report Number: **GE18/144-1B**
Issue Number: 1
Date Issued: 03/12/2018
Client: WOOD & GRIEVE ENGINEERS
LEVEL 2, 232 St PAULS TERRACE, FORTITUDE VALLEY QLD 4006
Project Number: GE18/144
Project Name: GEOTECHNICAL INVESTIGATION
Project Location: TWEED VALLEY HOSPITAL, CUDGEN ROAD, KINGSCLIFF
Work Request: 64
Sample Number: G18-64B
Date Sampled: 26/11/2018
Sample Location: **BH 28 RL 17.88 (0.5 - 0.9)**

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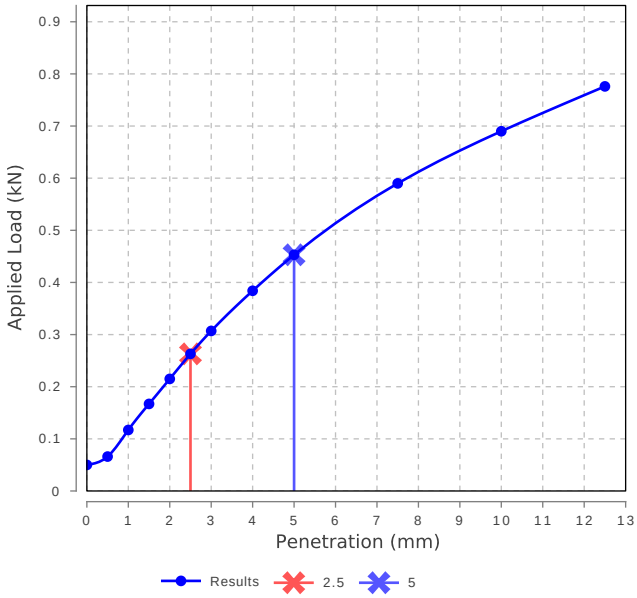
Approved Signatory: Ian Masman
Branch Manager
NATA Accredited Laboratory Number: 1169

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**2.5**	100	100
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Tactile		
Maximum Dry Density (t/m^3)	1.27		
Optimum Moisture Content (%)	40.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m^3)	1.27		
Field Moisture Content (%)	32.8		
Moisture Content at Placement (%)	39.7		
Moisture Content Top 30mm (%)	40.4		
Moisture Content Rest of Sample (%)	38.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	24		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		

California Bearing Ratio



Particle Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
19 mm	**100**			0		
13.2 mm	**100**			0		
9.5 mm	**98**			1		
6.7 mm	**97**			1		
4.75 mm	**96**			1		
2.36 mm	**94**			2		
1.18 mm	**92**			2		
0.6 mm	**91**			1		
0.425 mm	**90**			1		
0.3 mm	**89**			1		
0.15 mm	**87**			2		
0.075 mm	**86**			1		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	56		
Plastic Limit (%)	41		
Plasticity Index (%)	**15**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	7.0		
Cracking Crumbling Curling	None		

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Shrink Swell Index Report

Client :	**WOOD & GRIEVE ENGINEERS**	Report Number:	**GE18-144.5/1**
Address :		Report Date :	**15/08/2018**
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 0.15 - 0.24 U50	BH 4 0.1 - 0.29 U50	BH 12 0.5 - 0.76 U50	BH 18 0.5 - 0.7 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	Silty Clay - Brown	Silty Clay - Brown	Silty Clay - Brown
Cracking :	Y	Y	Y	Y
Crumbling :	Y	Y	Y	Y
Remarks :				

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IAN MASMAN - MANAGER
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Material Test Report

Report Number: **GE18/144-1**
Issue Number: 2 - *This version supersedes all previous issues*
Date Issued: 30/11/2018
Client: WOOD & GRIEVE ENGINEERS
LEVEL 2, 232 St PAULS TERRACE, FORTITUDE VALLEY QLD 4006
Project Number: GE18/144
Project Name: GEOTECHNICAL INVESTIGATION
Project Location: TWEED VALLEY HOSPITAL, CUDGEN ROAD, KINGSCLIFF
Work Request: 64

MORRISON GEOTECHNIC
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Approved Signatory: Ian Masman
Branch Manager
NATA Accredited Laboratory Number: 1169

Shrink Swell Index AS 1289 7.1.1 & 2.1.1		
Sample Number	G18-64C	G18-64D
Sampling Method	AS1289 1.3.1	AS1289 1.3.1
Date Sampled	26/11/2018	26/11/2018
Date Tested	26/11/2018	26/11/2018
Material Source	Insitu	Insitu
Sample Location	BH 26 RL 19.69 (0.5 - 0.8)	BH 28 RL 17.88 (0.5 - 0.85)
Inert Material Estimate (%)	0	0
Pocket Penetrometer before (kPa)	**	**
Pocket Penetrometer after (kPa)	**	**
Shrinkage Moisture Content (%)	32.2	32.7
Shrinkage (%)	**2.6**	**3.6**
Swell Moisture Content Before (%)	28.6	29.9
Swell Moisture Content After (%)	30.9	31.2
Swell (%)	**0.0**	**0.0**
Shrink Swell Index Iss (%)	**1.4**	**2.0**
Visual Description	Sandy Gravelly Clay, red/brown	Sandy Gravelly Clay, red/brown
Cracking	Moderately Cracked	Moderately Cracked
Crumbling	No	No
Remarks	**	**

Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.
NATA Accreditation does not cover the performance of pocket penetrometer readings.

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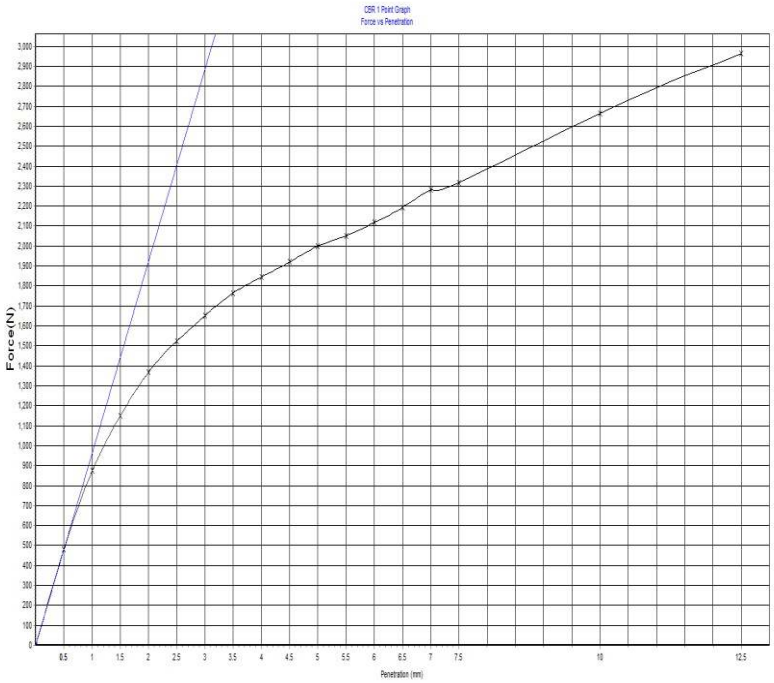
California Bearing Ratio Report (1 Point)

Client :	**WOOD & GRIEVE ENGINEERS**	Report Number:	**GE18-144.6/1**
Address :		Report Date :	**15/08/2018**
Project Number :	**GE18/144**	Order Number :	
Project Name :	**GEOTECHNICAL INVESTIGATION**	Test Method :	**AS1289.6.1.1**
Location:	**TWEED VALLEY HOSPITAL, CUDGEN ROAD , KINGSCLIFF**	**Page 1 of 1**	

		SAMPLE LOCATION
Sample Number :	245182	
Date Sampled :	3/08/2018	BH 8
Date Tested :	10/08/2018	0.1 - 1.1
Sampled By :	LEIGH BEXLEY	BULK
Sampling Method :	-	SAMPLE
Material Source :	INSITU	Lot Number :
Material Type :	BULK SAMPLE	Test Number :
Remarks :		

Moisture Method :	AS 1289.2.1.1
Maximum Dry Density (t/m³) :	1.579
Optimum Moisture Content (%) :	25.5
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) :	1.571
Dry Density After Soak (t/m³) :	1.568
Moisture Content Before Soak (%) :	25.6
Moisture Content After Soak (%) :	29.0
Density Ratio After Soak (%) :	99
Field Moisture Content (%) :	28.0
Top Moisture Content - After Penetration (%) :	29.9
Total Moisture Content - After Penetration (%) :	27.0
Soak Condition :	Soaked
Soak Period (days) :	4
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 :	

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NATA Accreditation Number : 1169

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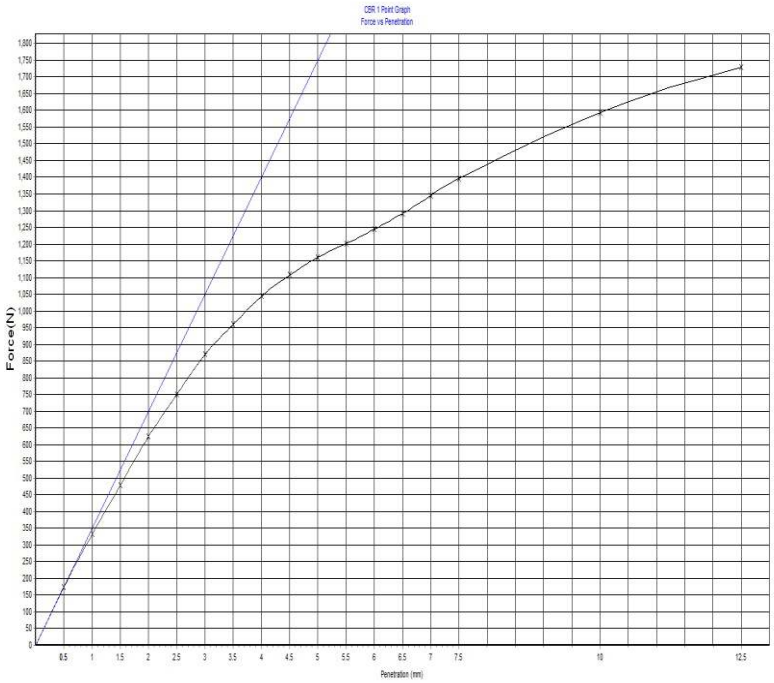
California Bearing Ratio Report (1 Point)

Client :	**WOOD & GRIEVE ENGINEERS**	Report Number:	**GE18-144.7/1**
Address :		Report Date :	**15/08/2018**
Project Number :	**GE18/144**	Order Number :	
Project Name :	**GEOTECHNICAL INVESTIGATION**	Test Method :	**AS1289.6.1.1**
Location:	**TWEED VALLEY HOSPITAL, CUDGEN ROAD , KINGSCLIFF**	**Page 1 of 1**	

		SAMPLE LOCATION
Sample Number :	245183	
Date Sampled :	3/08/2018	BH 10
Date Tested :	10/08/2018	1.0 - 1.5
Sampled By :	LEIGH BEXLEY	BULK
Sampling Method :	-	SAMPLE
Material Source :	INSITU	Lot Number :
Material Type :	BULK SAMPLE	Test Number :
Remarks :		

Moisture Method :	AS 1289.2.1.1
Maximum Dry Density (t/m³) :	1.358
Optimum Moisture Content (%) :	36.7
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	100
Achieved Percentage of OMC :	100.0
Dry Density Before Soak (t/m³) :	1.358
Dry Density After Soak (t/m³) :	1.359
Moisture Content Before Soak (%) :	36.7
Moisture Content After Soak (%) :	38.0
Density Ratio After Soak (%) :	100
Field Moisture Content (%) :	38.2
Top Moisture Content - After Penetration (%) :	38.5
Total Moisture Content - After Penetration (%) :	36.6
Soak Condition :	Soaked
Soak Period (days) :	4
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 :	

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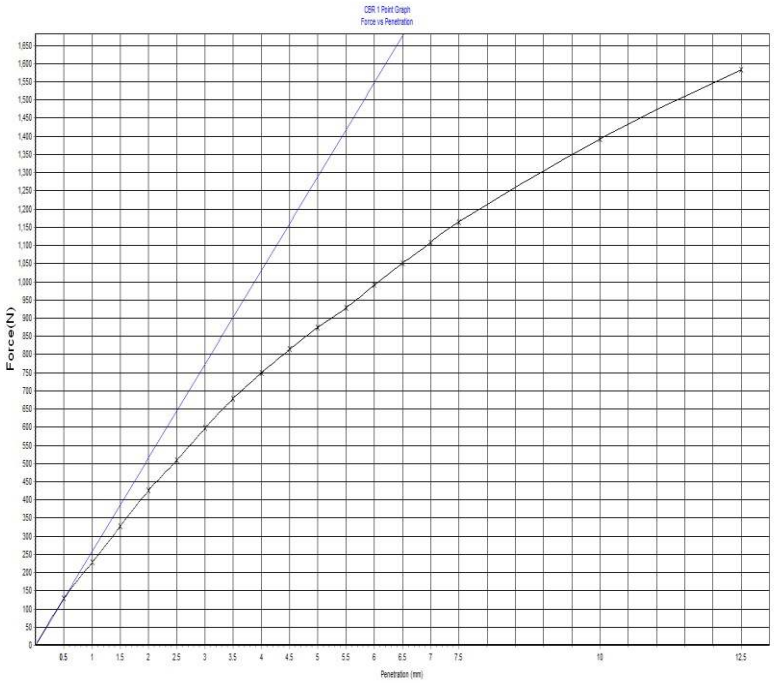
California Bearing Ratio Report (1 Point)

Client :	**WOOD & GRIEVE ENGINEERS**	Report Number:	**GE18-144.8/1**
Address :		Report Date :	**15/08/2018**
Project Number :	**GE18/144**	Order Number :	
Project Name :	**GEOTECHNICAL INVESTIGATION**	Test Method :	**AS1289.6.1.1**
Location:	**TWEED VALLEY HOSPITAL, CUDGEN ROAD , KINGSCLIFF**	**Page 1 of 1**	

		SAMPLE LOCATION
Sample Number :	245185	
Date Sampled :	3/08/2018	BH 17
Date Tested :	10/08/2018	0.3 - 1.0
Sampled By :	LEIGH BEXLEY	BULK
Sampling Method :	-	SAMPLE
Material Source :	INSITU	Lot Number :
Material Type :	BULK SAMPLE	Test Number :
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 (%) :	37.5
Total Moisture Content - After Penetration (%) :	32.7
Soak Condition :	Soaked
Soak Period (days) :	4
Swell (%) :	0.0



CBR Surcharge (kg) :	4.5	CBR 2.5mm (%) :	4.0
Oversize (%) :		CBR 5.0mm (%) :	**4.5**
Oversize Material Replaced (%) :		**CBR Value (%) :**	**4.5**

Site Selection :	
Soil Description :	

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POINT LOAD TEST REPORT

Client:	**Wood & Grieve Engineers**	**Report No:**	**GE18/144.1**
Client Address:	**Level 2, 232 St Pauls Terrace, Fortitude Valley QLD 4006**	**Report Date:**	**08.07.18**
Job No:	**GE18/144**	**Sample Date:**	**03.08.18**
Project:	**Geotechnical Investigation - Proposed Tweed Valley Hospital**	**Order No:**	
Location:	**Lot 102 on DP870722, Cudgen Road, Kingscliff**	**Test Method:**	**AS4133 4.1**

Sample Number	Date of Test	Location	Depth (m)	Sample Type	Is (MPa)	Is (50) (MPa)	Loading Direction	Descriptive Term
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	#VH
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	M
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).

# Denotes sample failed along defect plane

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

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

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POINT LOAD TEST REPORT

Client:	Wood & Grieve Engineers	**Report No:**	GE18/144.2
Client Address:	Level 2, 232 St Pauls Terrace, Fortitude Valley QLD 4006	**Report Date:**	08.08.18
Job No:	GE18/144	**Sample Date:**	01.08.08
Project:	Geotechnical Investigation - Proposed Tweed Valley Hospital	**Order No:**	
Location:	Lot 102 on DP870722, Cudgen Road, Kingscliff	**Test Method:**	AS4133 4.1

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).

# Denotes sample failed along defect plane

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

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POINT LOAD TEST REPORT

Client:	Wood & Grieve Engineers	**Report No:**	GE18/144.3
Client Address:	Level 2, 232 St Pauls Terrace, Fortitude Valley QLD 4006	**Report Date:**	08.08.18
Job No:	GE18/144	**Sample Date:**	31.07.08
Project:	Geotechnical Investigation - Proposed Tweed Valley Hospital	**Order No:**	
Location:	Lot 102 on DP870722, Cudgen Road, Kingscliff	**Test Method:**	AS4133 4.1

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).

# Denotes sample failed along defect plane

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

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POINT LOAD TEST REPORT

Client:	Wood & Grieve Engineers	**Report No:**	GE18/144.4
Client Address:	Level 2, 232 St Pauls Terrace, Fortitude Valley QLD 4006	**Report Date:**	08.08.18
Job No:	GE18/144	**Sample Date:**	30.07.08
Project:	Geotechnical Investigation - Proposed Tweed Valley Hospital	**Order No:**	
Location:	Lot 102 on DP870722, Cudgen Road, Kingscliff	**Test Method:**	AS4133 4.1

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).

# Denotes sample failed along defect plane

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

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POINT LOAD TEST REPORT

Client:	Wood & Grieve Engineers	**Report No:**	GE18/144.5
Client Address:	Level 2, 232 St Pauls Terrace, Fortitude Valley QLD 4006	**Report Date:**	08.08.18
Job No:	GE18/144	**Sample Date:**	30.07.08
Project:	Geotechnical Investigation - Proposed Tweed Valley Hospital	**Order No:**	
Location:	Lot 102 on DP870722, Cudgen Road, Kingscliff	**Test Method:**	AS4133 4.1

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).

# Denotes sample failed along defect plane

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

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POINT LOAD TEST REPORT

Client:	Wood & Grieve Engineers	**Report No:**	GE18/144.6
Client Address:	Level 2, 232 St Pauls Terrace, Fortitude Valley QLD 4006	**Report Date:**	08.08.18
Job No:	GE18/144	**Sample Date:**	30.07.08
Project:	Geotechnical Investigation - Proposed Tweed Valley Hospital	**Order No:**	
Location:	Lot 102 on DP870722, Cudgen Road, Kingscliff	**Test Method:**	AS4133 4.1

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	H
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).

# Denotes sample failed along defect plane

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

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POINT LOAD TEST REPORT

Client:	Wood & Grieve Engineers	**Report No:**	GE18/144.7
Client Address:	Level 2, 232 St Pauls Terrace, Fortitude Valley QLD 4006	**Report Date:**	08.08.18
Job No:	GE18/144	**Sample Date:**	03.08.18
Project:	Geotechnical Investigation - Proposed Tweed Valley Hospital	**Order No:**	
Location:	Lot 102 on DP870722, Cudgen Road, Kingscliff	**Test Method:**	AS4133 4.1

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	H
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).

# Denotes sample failed along defect plane

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

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POINT LOAD TEST REPORT

Client:	**Wood & Grieve Engineers**	**Report No:**	**GE18/144.8**
Client Address:	**Level 2, 232 St Pauls Terrace, Fortitude Valley QLD 4006**	**Report Date:**	**28.11.18**
Job No:	**GE18/144**	**Sample Date:**	**BH29: 16.11.18 / BH43: 5.11.18**
Project:	**Geotechnical Investigation - Proposed Tweed Valley Hospital**	**Order No:**	
Location:	**Lot 102 on DP870722, Cudgen Road, Kingscliff**	**Test Method:**	**AS4133 4.1**

Sample Number	Date of Test	Location	Depth (m)	Sample Type	Is (MPa)	Is (50) (MPa)	Loading Direction	Descriptive Term
724	23.11.18	Borehole BH29	16.90	Core	15.57	15.29	Diametral	EH
725	23.11.19	Borehole BH29	18.10	Core	0.49	0.48	Diametral	M
726	23.11.20	Borehole BH29	18.95	Core	7.85	7.70	Diametral	VH
727	23.11.21	Borehole BH29	19.41	Core	5.20	5.11	Diametral	VH
728	23.11.22	Borehole BH29	20.60	Core	1.00	0.98	Diametral	M
729	23.11.23	Borehole BH29	21.20	Core	0.40	0.39	Diametral	M
730	23.11.24	Borehole BH29	22.98	Core	0.31	0.31	Diametral	M
731	23.11.25	Borehole BH43	1.55	Core	10.87	10.67	Diametral	EH
732	23.11.26	Borehole BH43	3.31	Core	7.47	7.33	Diametral	VH
733	23.11.27	Borehole BH43	5.12	Core	10.15	9.96	Diametral	VH
734	23.11.18	Borehole BH43	6.34	Core	0.47	0.46	Diametral	M
735	23.11.19	Borehole BH43	9.30	Core	11.94	11.73	Diametral	EH
736	23.11.20	Borehole BH43	15.20	Core	5.91	5.80	Diametral	VH
737	23.11.21	Borehole BH43	16.41	Core	8.77	8.61	Diametral	VH
738	23.11.22	Borehole BH43	18.74	Core	9.38	9.20	Diametral	VH

Remarks:

All samples are basalt rock.

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

NATA WORLD RECOGNISED ACCREDITATION

CONSULT AUSTRALIA

Accredited for compliance with ISO/IEC 17025.

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

MORRISON GEOTECHNIC

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POINT LOAD TEST REPORT

Client:	Wood & Grieve Engineers	**Report No:**	GE18/144.9
Client Address:	Level 2, 232 St Pauls Terrace, Fortitude Valley QLD 4006	**Report Date:**	28.11.18
Job No:	GE18/144	**Sample Date:**	BH43: 5.11.18 / BH44: 21.11.18 / BH45: 9.11.18
Project:	Geotechnical Investigation - Proposed Tweed Valley Hospital	**Order No:**	
Location:	Lot 102 on DP870722, Cudgen Road, Kingscliff	**Test Method:**	AS4133 4.1

Sample Number	Date of Test	Location	Depth (m)	Sample Type	Is (MPa)	Is (50) (MPa)	Loading Direction	Descriptive Term
739	23.11.23	Borehole BH44	1.20	Core	10.07	9.89	Diametral	VH
740	23.11.24	Borehole BH44	2.95	Core	10.94	10.74	Diametral	EH
741	23.11.25	Borehole BH44	5.38	Core	12.24	12.02	Diametral	EH
742	23.11.26	Borehole BH44	7.12	Core	10.84	10.64	Diametral	EH
743	23.11.27	Borehole BH44	8.25	Core	11.29	11.09	Diametral	EH
744	23.11.18	Borehole BH45	1.50	Core	9.13	8.97	Diametral	VH
745	23.11.19	Borehole BH45	4.23	Core	11.84	11.62	Diametral	EH
746	23.11.20	Borehole BH45	5.76	Core	0.87	0.85	Diametral	M
747	23.11.21	Borehole BH45	6.00	Core	12.03	11.81	Diametral	EH
748	23.11.22	Borehole BH45	7.06	Core	10.49	10.30	Diametral	EH
749	23.11.23	Borehole BH45	8.20	Core	9.48	9.31	Diametral	VH
750	23.11.24	Borehole BH45	9.00	Core	11.04	10.84	Diametral	EH
751	23.11.25	Borehole BH45	9.35	Core	0.16	0.15	Diametral	L
752	23.11.26	Borehole BH45	10.50	Core	0.15	0.15	Diametral	L
753	23.11.27	Borehole BH45	11.52	Core	0.14	0.14	Diametral	L

Remarks:

All samples are basalt rock.

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

NATA WORLD RECOGNISED ACCREDITATION

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MORRISON GEOTECHNIC

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POINT LOAD TEST REPORT

Client:	Wood & Grieve Engineers	**Report No:**	GE18/144.11
Client Address:	Level 2, 232 St Pauls Terrace, Fortitude Valley QLD 4006	**Report Date:**	28.11.18
Job No:	GE18/144	**Sample Date:**	BH45: 9.11.18 / BH46: 6.11.18
Project:	Geotechnical Investigation - Proposed Tweed Valley Hospital	**Order No:**	
Location:	Lot 102 on DP870722, Cudgen Road, Kingscliff	**Test Method:**	AS4133 4.1

Sample Number	Date of Test	Location	Depth (m)	Sample Type	Is (MPa)	Is (50) (MPa)	Loading Direction	Descriptive Term
754	23.11.18	Borehole BH45	12.96	Core	0.13	0.13	Diametral	L
755	23.11.19	Borehole BH45	14.84	Core	0.24	0.24	Diametral	L
756	23.11.20	Borehole BH45	15.54	Core	2.48	2.44	Diametral	H
757	23.11.21	Borehole BH45	16.40	Core	8.63	8.47	Diametral	VH
758	23.11.22	Borehole BH45	16.80	Core	3.30	3.24	Diametral	VH
759	23.11.23	Borehole BH45	17.60	Core	9.79	9.61	Diametral	VH
760	23.11.24	Borehole BH45	18.40	Core	9.53	9.36	Diametral	VH
761	23.11.25	Borehole BH45	20.10	Core	6.13	6.02	Diametral	VH
762	23.11.26	Borehole BH46	2.05	Core	8.02	7.87	Diametral	VH
763	23.11.27	Borehole BH46	3.35	Core	11.65	11.44	Diametral	EH
764	23.11.18	Borehole BH46	7.06	Core	8.18	8.03	Diametral	VH
765	23.11.19	Borehole BH46	7.45	Core	5.59	5.49	Diametral	VH
766	23.11.20	Borehole BH46	8.85	Core	8.92	8.76	Diametral	VH
767	23.11.21	Borehole BH46	13.16	Core	7.49	7.35	Diametral	VH
768	23.11.22	Borehole BH46	15.73	Core	6.55	6.43	Diametral	VH
769	23.11.23	Borehole BH46	17.35	Core	12.00	11.78	Diametral	EH

Remarks:

All samples are basalt rock.

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

NATA WORLD RECOGNISED ACCREDITATION

CONSULT AUSTRALIA

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

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POINT LOAD TEST REPORT

Client:	Wood & Grieve Engineers	**Report No:**	GE18/144.12
Client Address:	Level 2, 232 St Pauls Terrace, Fortitude Valley QLD 4006	**Report Date:**	28.11.18
Job No:	GE18/144	**Sample Date:**	BH47: 19.11.18 / BH48: 7.11.18 / BH49: 19.11.18
Project:	Geotechnical Investigation - Proposed Tweed Valley Hospital	**Order No:**	
Location:	Lot 102 on DP870722, Cudgen Road, Kingscliff	**Test Method:**	AS4133 4.1

Sample Number	Date of Test	Location	Depth (m)	Sample Type	Is (MPa)	Is (50) (MPa)	Loading Direction	Descriptive Term
770	23.11.24	Borehole BH47	8.62	Core	12.76	12.53	Diametral	EH
771	23.11.25	Borehole BH47	11.80	Core	11.48	11.27	Diametral	EH
772	23.11.26	Borehole BH47	13.90	Core	12.07	11.85	Diametral	EH
773	23.11.27	Borehole BH47	15.90	Core	6.73	6.60	Diametral	VH
774	23.11.18	Borehole BH48	2.65	Core	11.94	11.72	Diametral	EH
775	23.11.19	Borehole BH48	5.45	Core	11.72	11.51	Diametral	EH
776	23.11.20	Borehole BH48	8.27	Core	0.26	0.26	Diametral	L
777	23.11.21	Borehole BH48	10.30	Core	0.17	0.17	Diametral	L
778	23.11.22	Borehole BH48	13.35	Core	8.99	8.83	Diametral	VH
779	23.11.23	Borehole BH48	14.10	Core	7.90	7.76	Diametral	VH
780	23.11.24	Borehole BH48	17.70	Core	7.18	7.05	Diametral	VH
781	23.11.25	Borehole BH49	1.25	Core	9.90	9.72	Diametral	VH
782	23.11.26	Borehole BH49	2.64	Core	10.68	10.48	Diametral	EH
783	23.11.27	Borehole BH49	10.00	Core	10.78	10.59	Diametral	EH
784	23.11.18	Borehole BH49	12.30	Core	10.54	10.35	Diametral	EH
785	23.11.19	Borehole BH49	14.25	Core	3.17	3.11	Diametral	VH

Remarks:

All samples are basalt rock.

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

NATA WORLD RECOGNISED ACCREDITATION

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

MORRISON GEOTECHNIC

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POINT LOAD TEST REPORT

Client:	**Wood & Grieve Engineers**	**Report No:**	**GE18/144.14**
Client Address:	**Level 2, 232 St Pauls Terrace, Fortitude Valley QLD 4006**	**Report Date:**	**28.11.18**
Job No:	**GE18/144**	**Sample Date:**	**BH50: 8.11.18 / BH51 13.11.18 / BH52: 23.11.18**
Project:	**Geotechnical Investigation - Proposed Tweed Valley Hospital**	**Order No:**	
Location:	**Lot 102 on DP870722, Cudgen Road, Kingscliff**	**Test Method:**	**AS4133 4.1**

Sample Number	Date of Test	Location	Depth (m)	Sample Type	Is (MPa)	Is (50) (MPa)	Loading Direction	Descriptive Term
786	23.11.20	Borehole BH50	15.27	Core	6.34	6.22	Diametral	VH
787	23.11.21	Borehole BH50	16.82	Core	11.59	11.38	Diametral	EH
788	23.11.22	Borehole BH50	18.08	Core	13.48	13.24	Diametral	EH
789	23.11.23	Borehole BH50	20.15	Core	3.99	3.92	Diametral	VH
790	23.11.24	Borehole BH51	10.82	Core	10.16	9.97	Diametral	VH
791	23.11.25	Borehole BH51	14.10	Core	0.17	0.17	Diametral	L
792	23.11.26	Borehole BH51	15.70	Core	6.47	6.35	Diametral	VH
793	23.11.27	Borehole BH51	17.85	Core	9.07	8.91	Diametral	VH
794	23.11.18	Borehole BH51	19.00	Core	6.86	6.73	Diametral	VH
795	23.11.19	Borehole BH51	19.90	Core	3.65	3.58	Diametral	VH
796	23.11.20	Borehole BH52	4.27	Core	9.56	9.38	Diametral	VH
797	23.11.21	Borehole BH52	8.10	Core	9.38	9.20	Diametral	VH
798	23.11.22	Borehole BH52	9.68	Core	9.33	9.16	Diametral	VH
799	23.11.23	Borehole BH52	12.31	Core	0.14	0.14	Diametral	L
800	23.11.24	Borehole BH52	15.70	Core	0.30	0.30	Diametral	L-M
801	23.11.25	Borehole BH52	20.70	Core	7.42	7.29	Diametral	VH

Remarks:

All samples are basalt rock.

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

NATA WORLD RECOGNISED ACCREDITATION

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

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POINT LOAD TEST REPORT

Client:	**Wood & Grieve Engineers**	**Report No:**	**GE18/144.15**
Client Address:	**Level 2, 232 St Pauls Terrace, Fortitude Valley QLD 4006**	**Report Date:**	**28.11.18**
Job No:	**GE18/144**	**Sample Date:**	**BH52: 13.11.18 / BH53: 21.11.18 / BH54: 20/11/18**
Project:	**Geotechnical Investigation - Proposed Tweed Valley Hospital**	**Order No:**	
Location:	**Lot 102 on DP870722, Cudgen Road, Kingscliff**	**Test Method:**	**AS4133 4.1**

Sample Number	Date of Test	Location	Depth (m)	Sample Type	Is (MPa)	Is (50) (MPa)	Loading Direction	Descriptive Term
802	23.11.26	Borehole BH52	21.80	Core	9.55	9.37	Diametral	VH
803	23.11.27	Borehole BH52	23.00	Core	12.15	11.93	Diametral	EH
804	23.11.18	Borehole BH53	4.83	Core	3.30	3.24	Diametral	VH
805	23.11.19	Borehole BH53	7.22	Core	3.04	2.98	Diametral	H
806	23.11.20	Borehole BH53	13.70	Core	11.37	11.16	Diametral	EH
807	23.11.21	Borehole BH53	16.20	Core	7.13	7.06	Diametral	VH
808	23.11.22	Borehole BH53	17.83	Core	1.27	1.24	Diametral	H
809	23.11.23	Borehole BH53	19.10	Core	0.61	0.60	Diametral	M
810	23.11.24	Borehole BH53	21.32	Core	8.03	7.88	Diametral	VH
811	23.11.25	Borehole BH53	23.50	Core	11.04	10.84	Diametral	EH
812	23.11.26	Borehole BH53	24.54	Core	10.20	10.01	Diametral	EH
813	23.11.27	Borehole BH54	5.35	Core	9.50	9.32	Diametral	VH
814	23.11.18	Borehole BH54	13.90	Core	6.89	6.77	Diametral	VH
815	23.11.19	Borehole BH54	16.05	Core	8.26	8.11	Diametral	VH
816	23.11.20	Borehole BH54	17.90	Core	3.97	3.90	Diametral	VH
817	23.11.21	Borehole BH54	18.75	Core	9.68	9.50	Diametral	VH

Remarks:

All samples are basalt rock.

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

NATA WORLD RECOGNISED ACCREDITATION

CONSULT AUSTRALIA

Accredited for compliance with ISO/IEC 17025.

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

MORRISON GEOTECHNIC

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POINT LOAD TEST REPORT

Client:	**Wood & Grieve Engineers**	**Report No:**	**GE18/144.17**
Client Address:	**Level 2, 232 St Pauls Terrace, Fortitude Valley QLD 4006**	**Report Date:**	**28.11.18**
Job No:	**GE18/144**	**Sample Date:**	**BH55: 15.11.18**
Project:	**Geotechnical Investigation - Proposed Tweed Valley Hospital**	**Order No:**	
Location:	**Lot 102 on DP870722, Cudgen Road, Kingscliff**	**Test Method:**	**AS4133 4.1**

Sample Number	Date of Test	Location	Depth (m)	Sample Type	Is (MPa)	Is (50) (MPa)	Loading Direction	Descriptive Term
818	23.11.22	Borehole BH55	15.23	Core	6.25	6.14	Diametral	VH
819	23.11.23	Borehole BH55	16.60	Core	10.07	9.89	Diametral	VH
820	23.11.24	Borehole BH55	18.44	Core	9.13	8.97	Diametral	VH
821	23.11.25	Borehole BH55	19.90	Core	8.94	8.78	Diametral	EH

Remarks:

All sample are basalt rock.

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

NATA WORLD RECOGNISED ACCREDITATION

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

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PERMEABILITY BY FALLING HEAD TEST REPORT

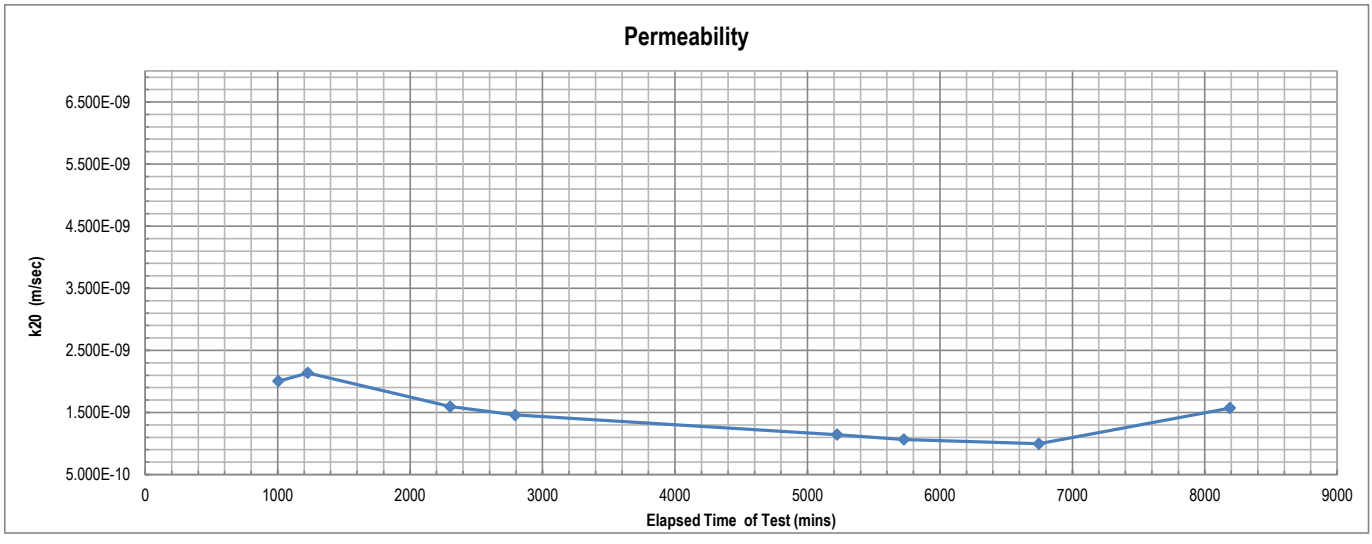
Test Method AS 1289 6.7.2, 5.1.1 , KH2 (Based on K H Head (1988) Manual of Laboratory Testing,10.7)

Client	Morrison Geotechnic Pty Ltd	**Report No.**	18110281-FHPT
		Workorder No.	0005126
Address	PO Box 2011 Nerang QLD 4211	**Test Date**	14/11/18-21/11/18
		Report Date	21/11/2018
Project	GE18/216 - Tweed Valley Hospital - Lot 102 Cudgen Rd, Kingscliff		
Client ID	BH7	**Depth (m)**	0.20-0.80
Description	Silty CLAY-red	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.31**	Hydraulic Gradient	**9.4**
Optimum Moisture Content (%)	**31.5**	Surcharge (kPa)	**3.0**
Placement Moisture Content (%)	**31.4**	Head Pressure Applied (kPa)	**10.79**
Moisture Ratio (%)	**99.5**	Water Type	**Deaerated**
Placement Wet Density (t/m^3)	**1.69**	Percentage Material Retained/Sieve Size (mm)	**0 % /9.5 mm**
Density Ratio (%)	**98.2**	Sample Height and Diameter (mm)	**116.63 / 101.14 mm**

PERMEABILITY $k_{(20)}$ = 1.6×10^{-09} (m/sec)



Remarks: The above specimen was remoulded at 98% Standard Dry Density and at Optimum Moisture Content as advised by the client

Sample/s supplied by client The compaction data was supplied by the client.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

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PERMEABILITY BY FALLING HEAD TEST REPORT

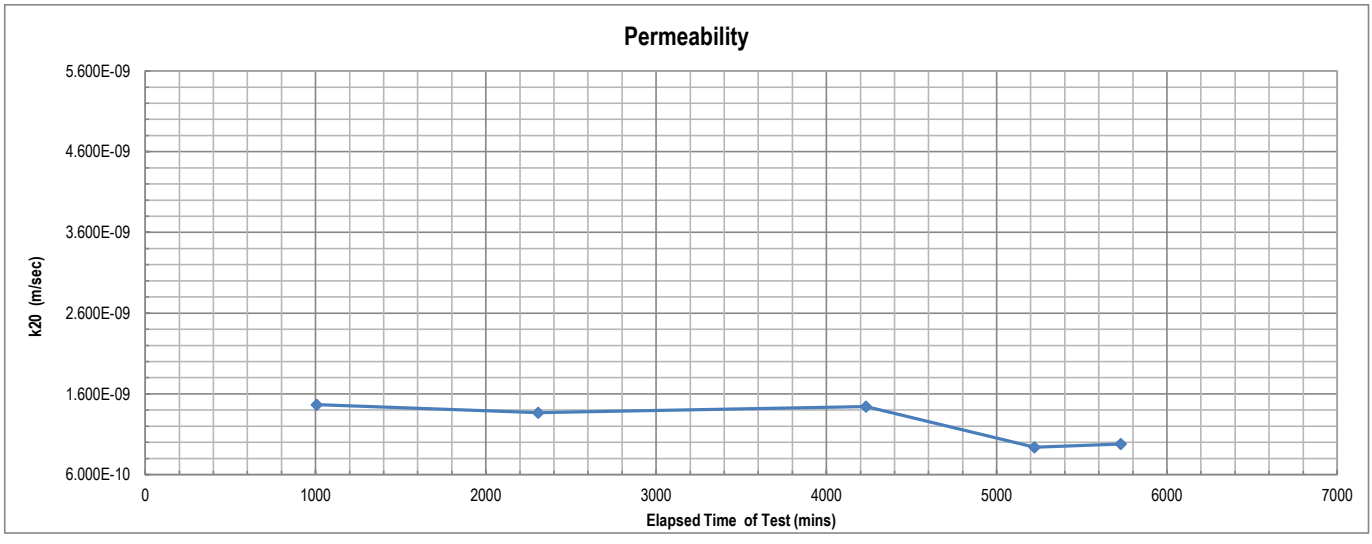
Test Method AS 1289 6.7.2, 5.1.1 , KH2 (Based on K H Head (1988) Manual of Laboratory Testing,10.7)

Client	Morrison Geotechnic Pty Ltd	**Report No.**	18110282-FHPT
		Workorder No.	0005126
Address	PO Box 2011 Nerang QLD 4211	**Test Date**	14/11/2018
		Report Date	20/11/2018
Project	GE18/216 - Tweed Valley Hospital - Lot 102 Cudgen Rd, Kingscliff		
Client ID	BH10	**Depth (m)**	0.20-0.80
Description	SILTY CLAY-red brown	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.41**	Hydraulic Gradient	**9.4**
Optimum Moisture Content (%)	**31.5**	Surcharge (kPa)	**3.0**
Placement Moisture Content (%)	**31.2**	Head Pressure Applied (kPa)	**10.79**
Moisture Ratio (%)	**99.2**	Water Type	**De-ionized**
Placement Wet Density (t/m^3)	**1.82**	Percentage Material Retained/Sieve Size (mm)	**0 % /9.5 mm**
Density Ratio (%)	**98.2**	Sample Height and Diameter (mm)	**116.41 / 100.58 mm**

PERMEABILITY $k_{(20)} =$ **9.6×10^{-10} (m/sec)**



Remarks: The above specimen was remoulded to a target of 98% of Standard Dry Density and at 100% of Optimum Moisture Content.

Sample/s supplied by client The compaction data was supplied by the client.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Channon

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

PERMEABILITY - Percolation Test

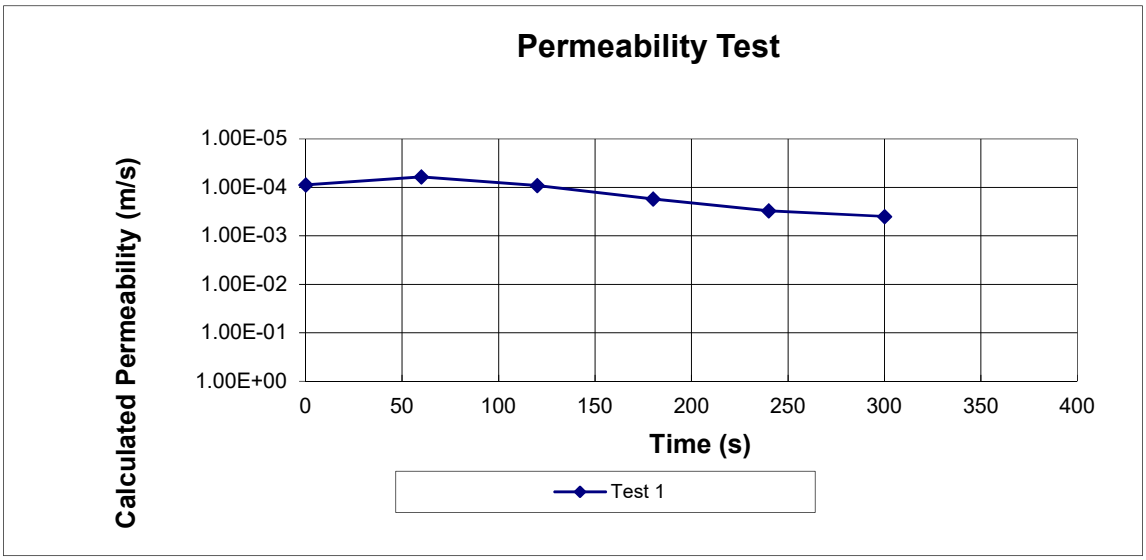
Project	Tweed Valley Hospital		
Project Number	Test 1	**Date**	3/08/2018
Test Location	BH22	**Tester**	BE

Depth of Hole	500	mm
Diameter of Hole	100	mm
Length of Test Section	400	mm

Date	Time	Time since start of test (t) (s)	Depth of water from Reference level (d) (mm)	Δt	Δd	Permeability (P) (m/s)
3/8/18	12:00:00	0	340	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

Time for 25mm drop

Permeability (m/s)	1.9E-04
mm/hr	670.3


Permeability Test
Calculated Permeability (m/s)
1.00E-05
1.00E-04
1.00E-03
1.00E-02
1.00E-01
1.00E+00
0
50
100
150
200
250
300
350
400
Time (s)
Test 1

PERMEABILITY - Percolation Test

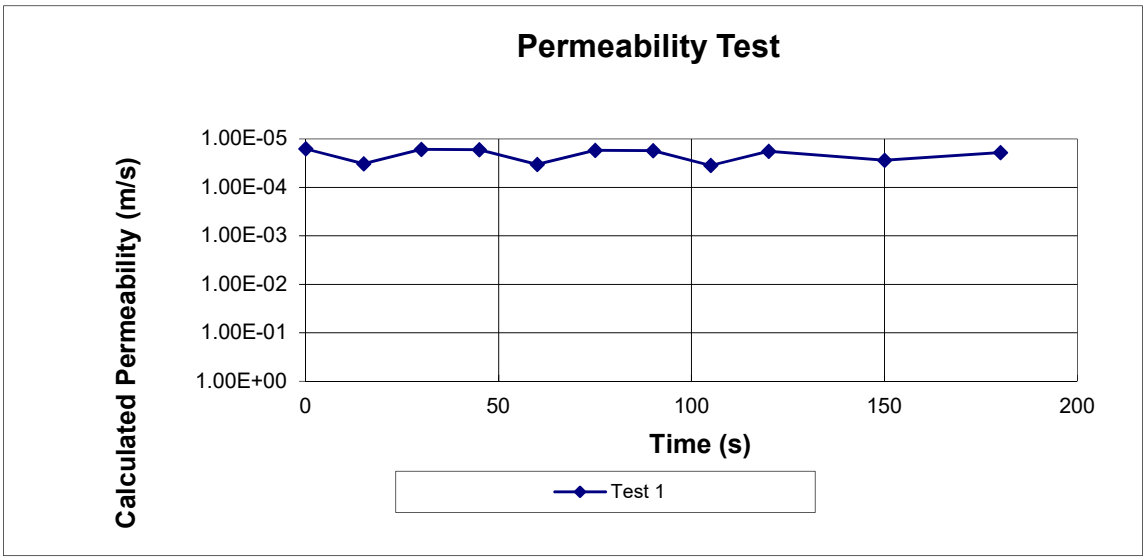
Project	Tweed Valley Hospital		
Project Number	Test 2	**Date**	24/10/2018
Test Location	BH22	**Tester**	CL

Depth of Hole	500	mm
Diameter of Hole	100	mm
Length of Test Section	400	mm

Date	Time	Time since start of test (t) (s)	Depth of water from Reference level (d) (mm)	Δt	Δd	Permeability (P) (m/s)
24/10/18	11:45:00	0	500	0	0	
	11:45:15	15	495	15	5	1.59E-05
	11:45:30	30	485	15	10	3.24E-05
	11:45:45	45	480	15	5	1.64E-05
	11:46:00	60	475	15	5	1.66E-05
	11:46:15	75	465	15	10	3.37E-05
	11:46:30	90	460	15	5	1.71E-05
	11:46:45	105	455	15	5	1.73E-05
	11:47:00	120	445	15	10	3.51E-05
	11:47:30	150	435	30	10	1.79E-05
	11:48:00	180	420	30	15	2.76E-05
	11:48:30	210	410	30	10	1.89E-05
	11:49:00	240	395	30	15	2.92E-05
	11:49:30	270	385	30	10	2.01E-05
	11:50:00	300	375	30	10	2.06E-05
	11:50:30	330	365	30	10	2.11E-05
	11:51:00	360	350	30	15	3.27E-05
	11:51:30	390	340	30	10	2.25E-05
	11:52:10	420	330	40	10	2.31E-05

Time for 25mm drop

Permeability (m/s)	2.3E-05
mm/hr	83.5


Permeability Test
Calculated Permeability (m/s)
1.00E-05
1.00E-04
1.00E-03
1.00E-02
1.00E-01
1.00E+00
0
50
100
150
200
Time (s)
Test 1

PERMEABILITY - Percolation Test

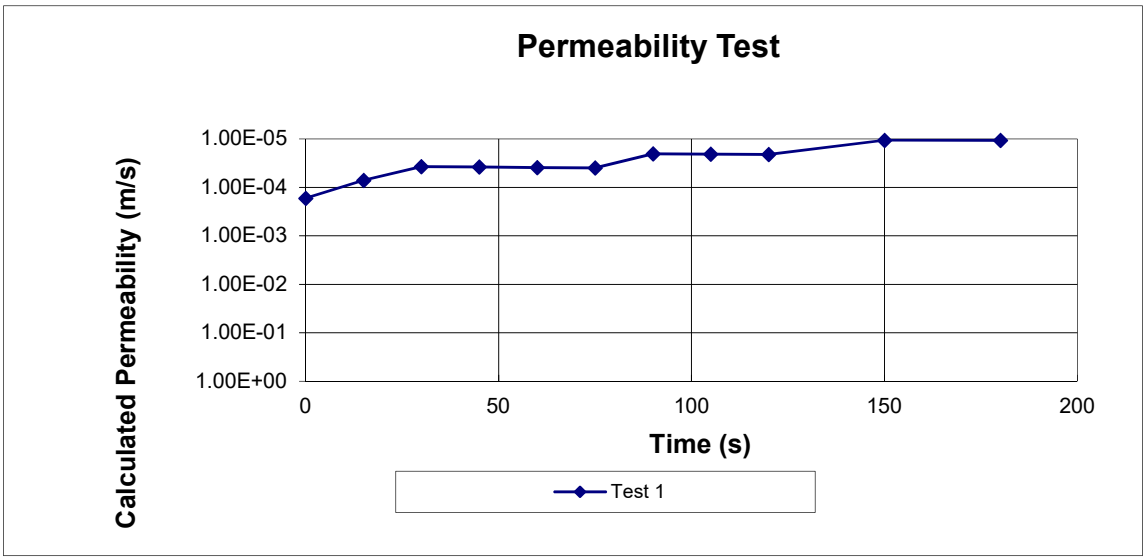
Project	Tweed Valley Hospital		
Project Number	Test 3	**Date**	24/10/2018
Test Location	BH22	**Tester**	CL

Depth of Hole	500	mm
Diameter of Hole	100	mm
Length of Test Section	400	mm

Date	Time	Time since start of test (t) (s)	Depth of water from Reference level (d) (mm)	Δt	Δd	Permeability (P) (m/s)
24/10/18	11:45:00	0	500	0	0	
	11:45:15	15	450	15	50	1.67E-04
	11:45:30	30	430	15	20	7.17E-05
	11:45:45	45	420	15	10	3.70E-05
	11:46:00	60	410	15	10	3.79E-05
	11:46:15	75	400	15	10	3.88E-05
	11:46:30	90	390	15	10	3.97E-05
	11:46:45	105	385	15	5	2.02E-05
	11:47:00	120	380	15	5	2.05E-05
	11:47:30	150	370	30	10	2.08E-05
	11:48:00	180	365	30	5	1.06E-05
	11:48:30	210	360	30	5	1.08E-05
	11:49:00	240	350	30	10	2.19E-05
	11:49:30	270	335	30	15	3.40E-05
	11:50:00	300	320	30	15	3.55E-05
	11:50:30	330	310	30	10	2.45E-05
	11:51:00	360	300	30	10	2.53E-05
	11:51:30	390	290	30	10	2.60E-05
	11:52:10	420	270	40	20	5.47E-05

Time for 25mm drop

Permeability (m/s)	4.1E-05
mm/hr	149.0


Permeability Test
Calculated Permeability (m/s)
1.00E-05
1.00E-04
1.00E-03
1.00E-02
1.00E-01
1.00E+00
0
50
100
150
200
Time (s)
Test 1

PERMEABILITY - Percolation Test

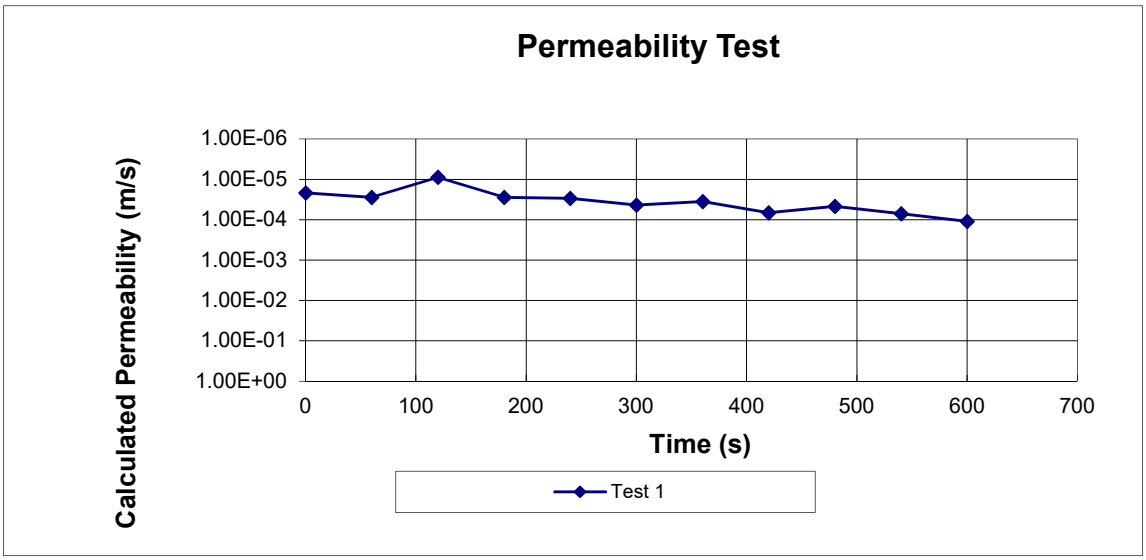
Project	Tweed Valley Hospital		
Project Number	Test 1	**Date**	3/08/2018
Test Location	BH23	**Tester**	BE

Depth of Hole	500	mm
Diameter of Hole	100	mm
Length of Test Section	400	mm

Date	Time	Time since start of test (t) (s)	Depth of water from Reference level (d) (mm)	Δt	Δd	Permeability (P) (m/s)
3/8/18	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 Test
Calculated Permeability (m/s)
1.00E-06
1.00E-05
1.00E-04
1.00E-03
1.00E-02
1.00E-01
1.00E+00
0
100
200
300
400
500
600
700
Time (s)
Test 1

PERMEABILITY - Percolation Test

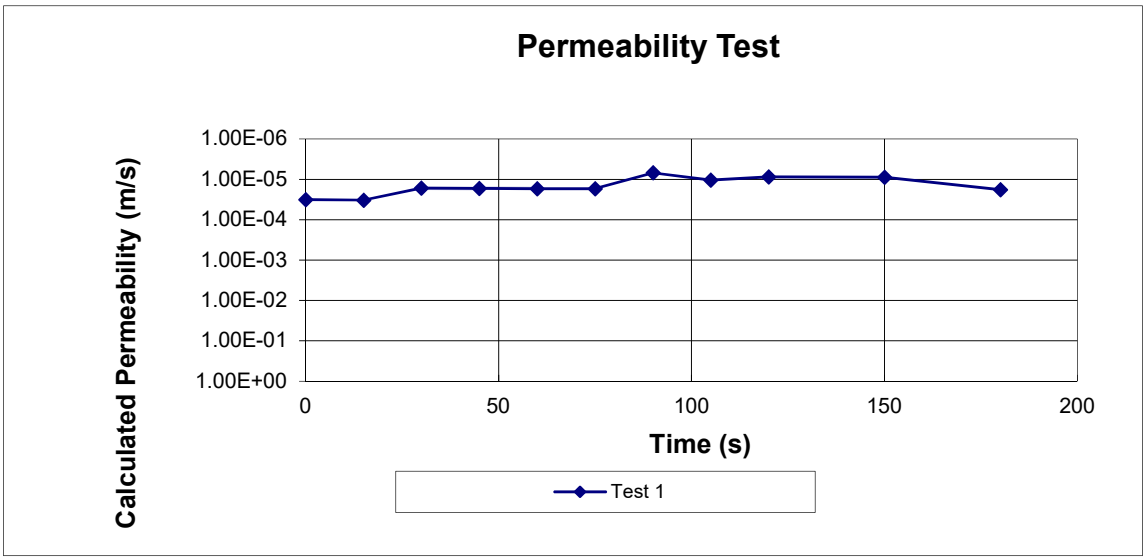
Project	Tweed Valley Hospital		
Project Number	Test 2	**Date**	24/10/2018
Test Location	BH23	**Tester**	CL

Depth of Hole	500	mm
Diameter of Hole	100	mm
Length of Test Section	400	mm

Date	Time	Time since start of test (t) (s)	Depth of water from Reference level (d) (mm)	Δt	Δd	Permeability (P) (m/s)
24/10/18	11:45:00	0	500	0	0	
	11:45:15	15	490	15	10	3.21E-05
	11:45:30	30	480	15	10	3.27E-05
	11:45:45	45	475	15	5	1.66E-05
	11:46:00	60	470	15	5	1.68E-05
	11:46:15	75	465	15	5	1.69E-05
	11:46:30	90	460	15	5	1.71E-05
	11:46:45	105	458	15	2	6.89E-06
	11:47:00	120	455	15	3	1.04E-05
	11:47:30	150	450	30	5	8.73E-06
	11:48:00	180	445	30	5	8.82E-06
	11:48:30	210	435	30	10	1.79E-05
	11:49:00	240	425	30	10	1.83E-05
	11:49:30	270	420	30	5	9.31E-06
	11:50:00	300	410	30	10	1.89E-05
	11:50:30	330	405	30	5	9.63E-06
	11:51:00	360	395	30	10	1.96E-05
	11:51:30	390	390	30	5	9.98E-06
	11:52:10	420	380	40	10	2.03E-05

Time for 25mm drop

Permeability (m/s)	1.7E-05
mm/hr	60.9


Permeability Test
Calculated Permeability (m/s)
1.00E-06
1.00E-05
1.00E-04
1.00E-03
1.00E-02
1.00E-01
1.00E+00
0
50
100
150
200
Time (s)
Test 1

PERMEABILITY - Percolation Test

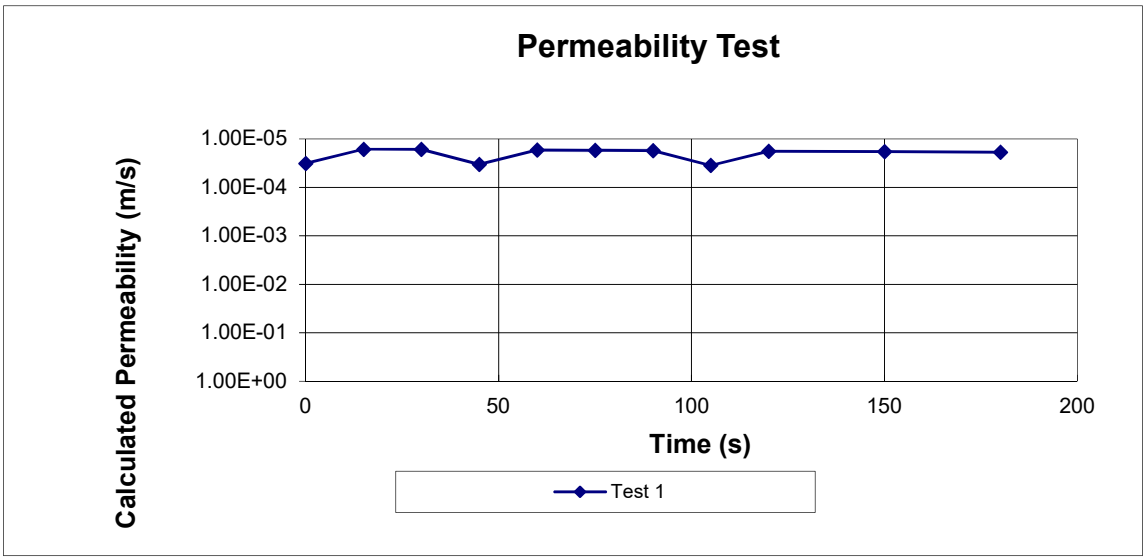
Project	Tweed Valley Hospital		
Project Number	Test 3	**Date**	24/10/2018
Test Location	BH23	**Tester**	CL

Depth of Hole	500	mm
Diameter of Hole	100	mm
Length of Test Section	400	mm

Date	Time	Time since start of test (t) (s)	Depth of water from Reference level (d) (mm)	Δt	Δd	Permeability (P) (m/s)
24/10/18	0:45:00	0	500	0	0	
	0:45:15	15	490	15	10	3.21E-05
	0:45:30	30	485	15	5	1.63E-05
	0:45:45	45	480	15	5	1.64E-05
	0:46:00	60	470	15	10	3.33E-05
	0:46:15	75	465	15	5	1.69E-05
	0:46:30	90	460	15	5	1.71E-05
	0:46:45	105	455	15	5	1.73E-05
	0:47:00	120	445	15	10	3.51E-05
	0:47:30	150	435	30	10	1.79E-05
	0:48:00	180	425	30	10	1.83E-05
	0:48:30	210	415	30	10	1.87E-05
	0:49:00	240	405	30	10	1.92E-05
	0:49:30	270	395	30	10	1.96E-05
	0:50:00	300	385	30	10	2.01E-05
	0:50:30	330	375	30	10	2.06E-05
	0:51:00	360	360	30	15	3.19E-05
	0:51:30	390	350	30	10	2.19E-05
	0:52:10	420	340	40	10	2.25E-05

Time for 25mm drop

Permeability (m/s)	2.2E-05
mm/hr	77.6

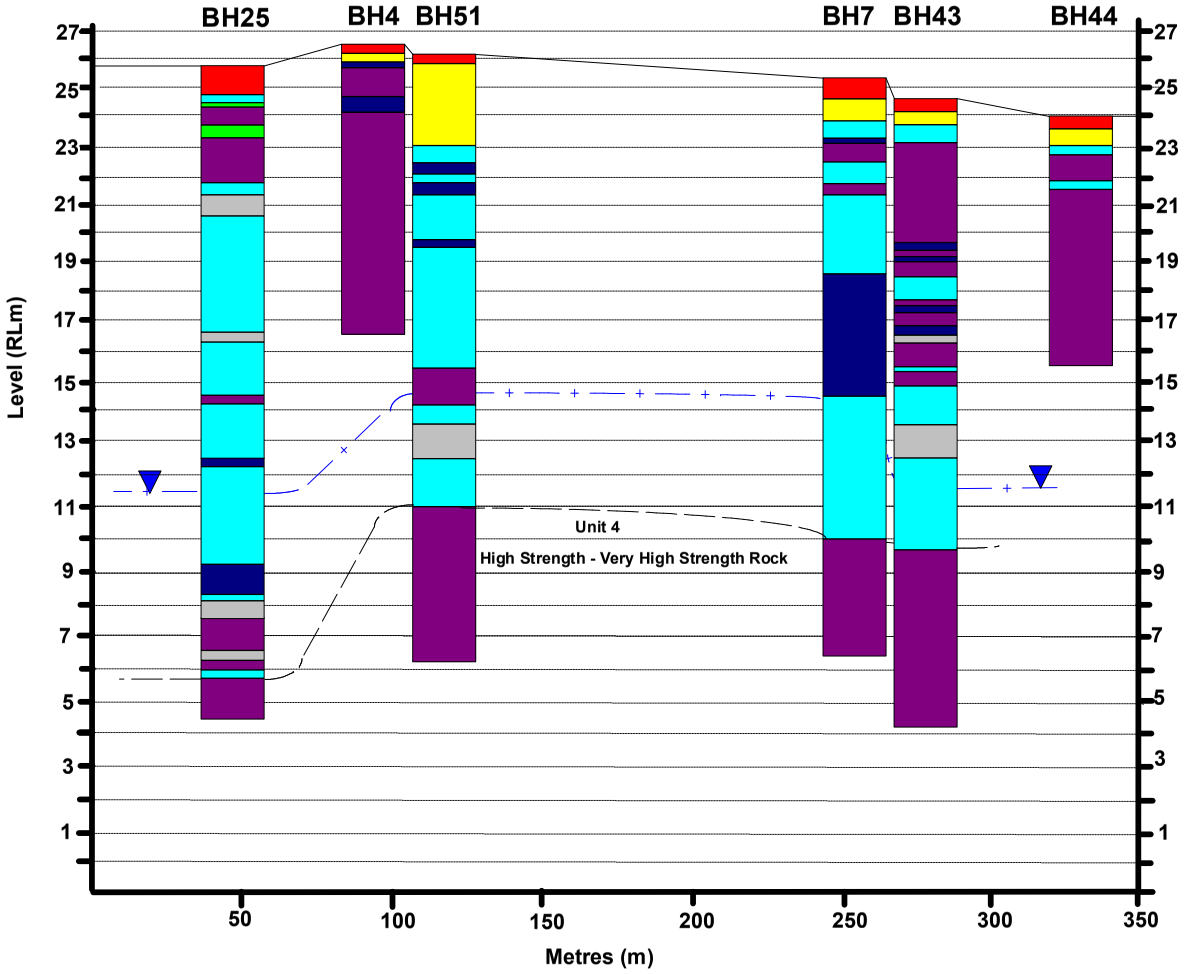

Permeability Test
Calculated Permeability (m/s)
1.00E-05
1.00E-04
1.00E-03
1.00E-02
1.00E-01
1.00E+00
0
50
100
150
200
Time (s)
Test 1

A P P E N D I X 'D'

CROSS SECTIONS OF BOREHOLES – SECTIONS A, B, C AND D)

INFERRED CROSS SECTION A

PROPOSED TWEED VALLEY HOSPITAL - CUDGEN ROAD, KINGSCLIFF



MORRISON GEOTECHNIC

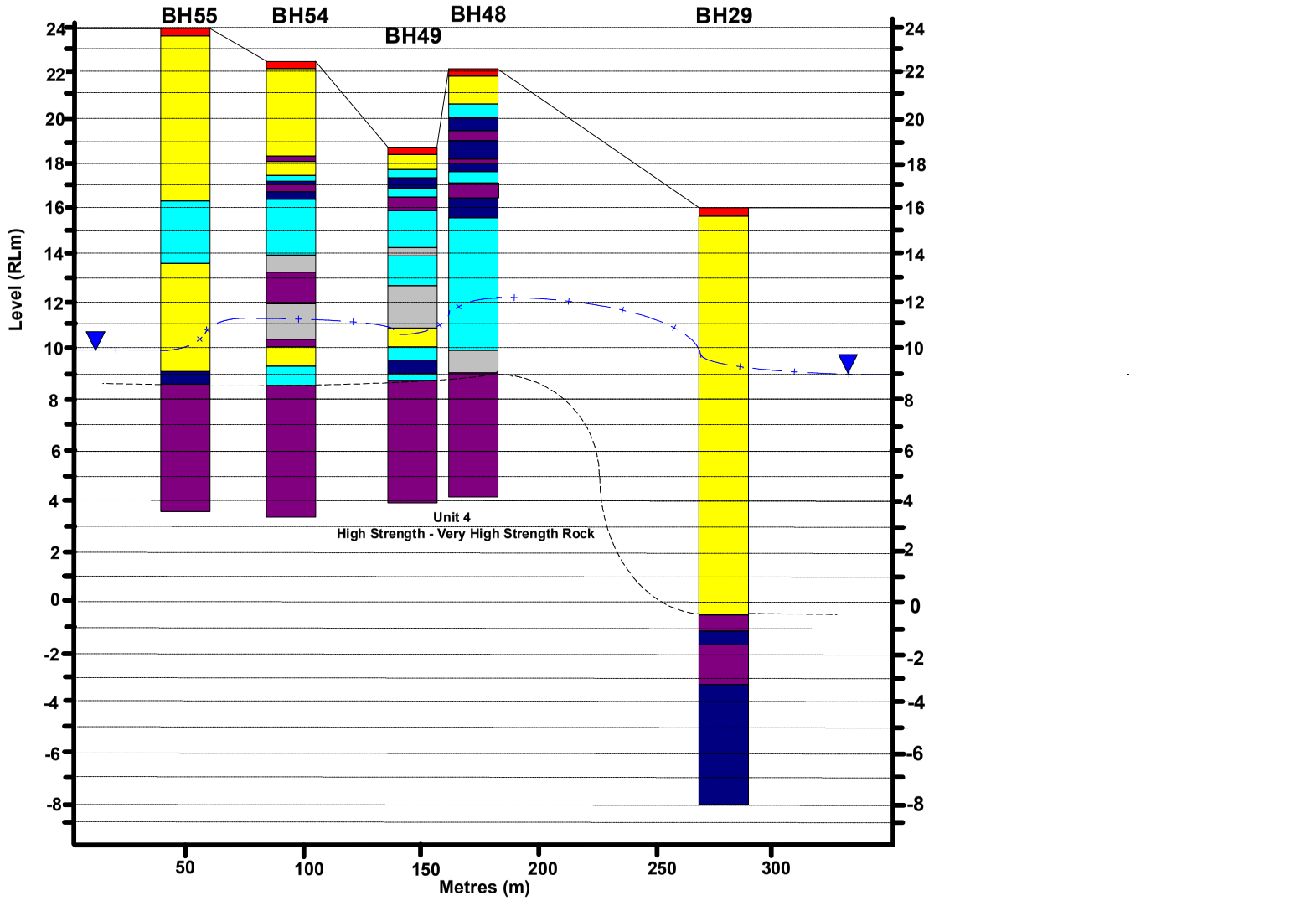
ABN: 51 009 878 899
Unit 1/5 Brendan Drive Nerang 4211 Ph: 5596 1599
Email: goldcoastlab@morrisongeo.com.au Fax: 5527 2027

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

Map Description :	**INFERRED CROSS SECTION A**		
Client :	**WOOD & GRIEVE ENGINEERS**		
Project :	**TWEED VALLEY HOSPITAL, KINGSCLIFF**		
Project No :	**GE18/144**	Date: **28/11/18**	Scale : Not to Scale

INFERRED CROSS SECTION B

PROPOSED TWEED VALLEY HOSPITAL - CUDGEN ROAD, KINGSCLIFF



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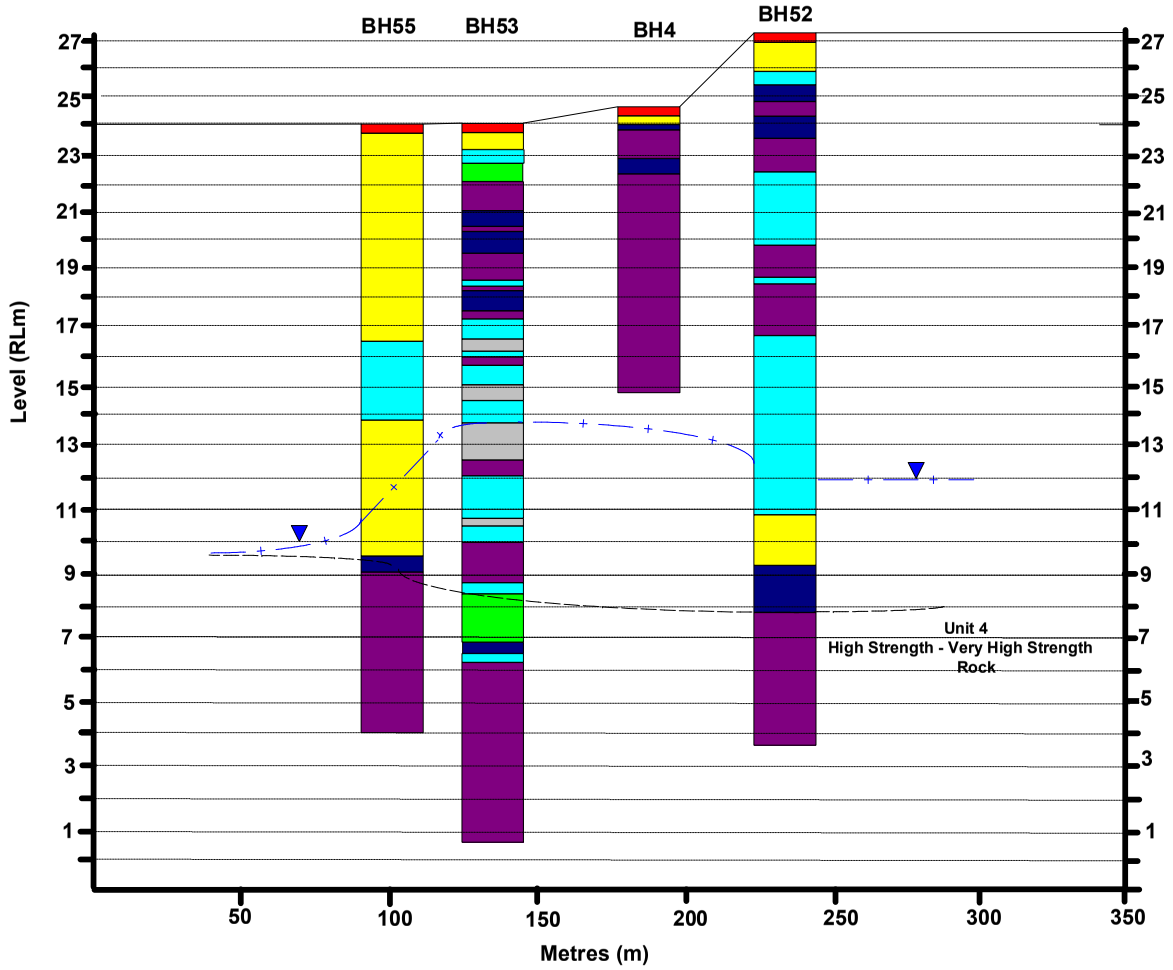
Engineers: D.Riley, J.Daly, S.Wynne, D.Dragun, B.Taylor
D.Vanderhor & B.Elsmore
Geologists: L.Bexley & R.Howchin

Map Description :	**INFERRED CROSS SECTION A**		
Client :	**WOOD & GRIEVE ENGINEERS**		
Project :	**TWEED VALLEY HOSPITAL, KINGSCLIFF**		
Project No :	**GE18/144**	Date: **28/11/18**	Scale : Not to Scale

INFERRED CROSS SECTION C

PROPOSED TWEED VALLEY HOSPITAL - CUDGEN ROAD, KINGSCLIFF



MORRISON GEOTECHNIC

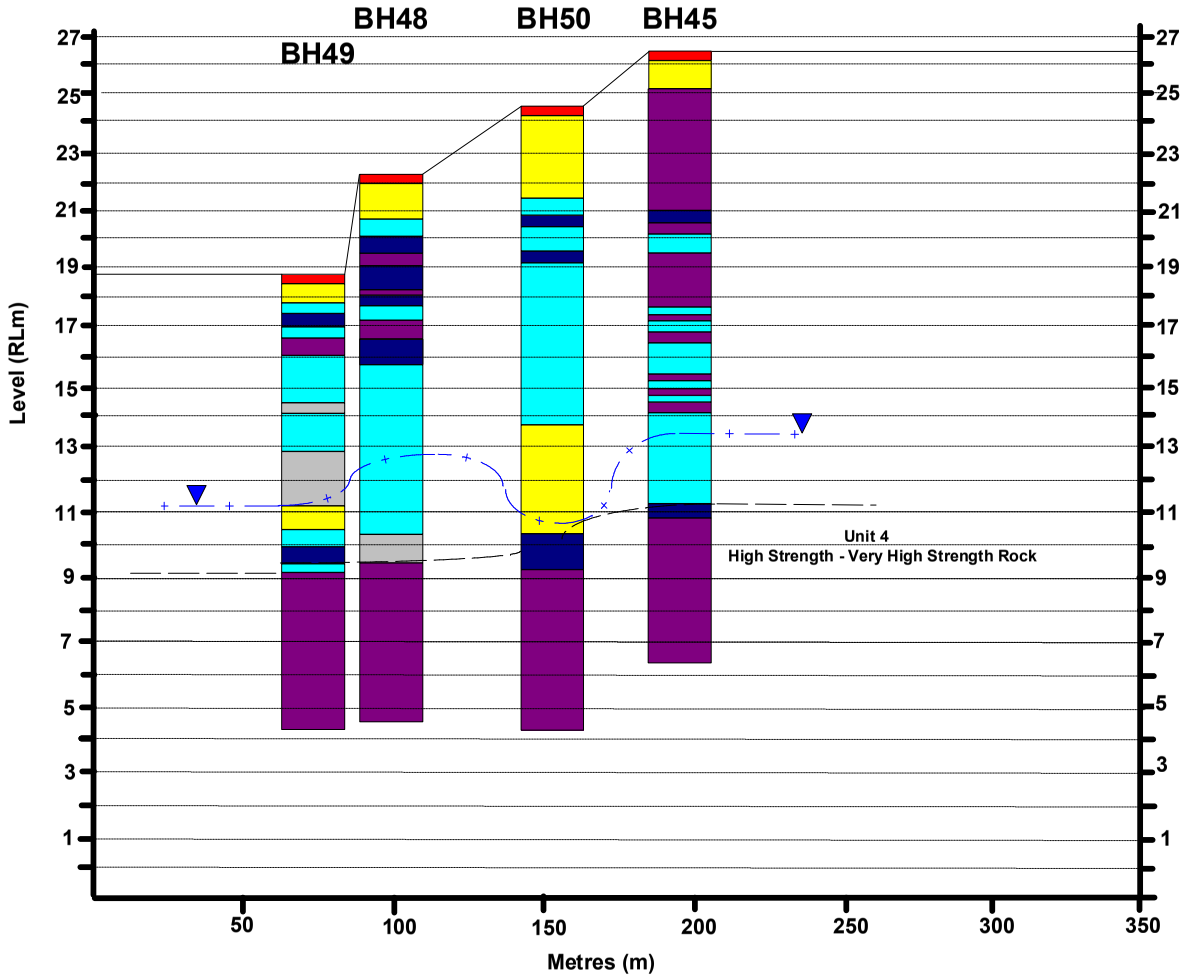
ABN: 51 009 878 899
Unit 1/5 Brendan Drive Nerang 4211 *Ph: 5596 1599*
Email: goldcoastlab@morrisongeo.com.au *Fax: 5527 2027*

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

Map Description :	**INFERRED CROSS SECTION C**		
Client :	**WOOD & GRIEVE ENGINEERS**		
Project :	**TWEED VALLEY HOSPITAL, KINGSCLIFF**		
Project No :	**GE18/144**	Date: **28/11/18**	Scale : Not to Scale

INFERRED CROSS SECTION D

PROPOSED TWEED VALLEY HOSPITAL - CUDGEN ROAD, KINGSCLIFF



Slopewash Silty Clay | Residual Silty Clay | Bedrock (XW/XW-DW) | Bedrock (DW) | Bedrock (DW-SW) | Bedrock (SW/SW-Fr) | Core Loss

MORRISON GEOTECHNIC

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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

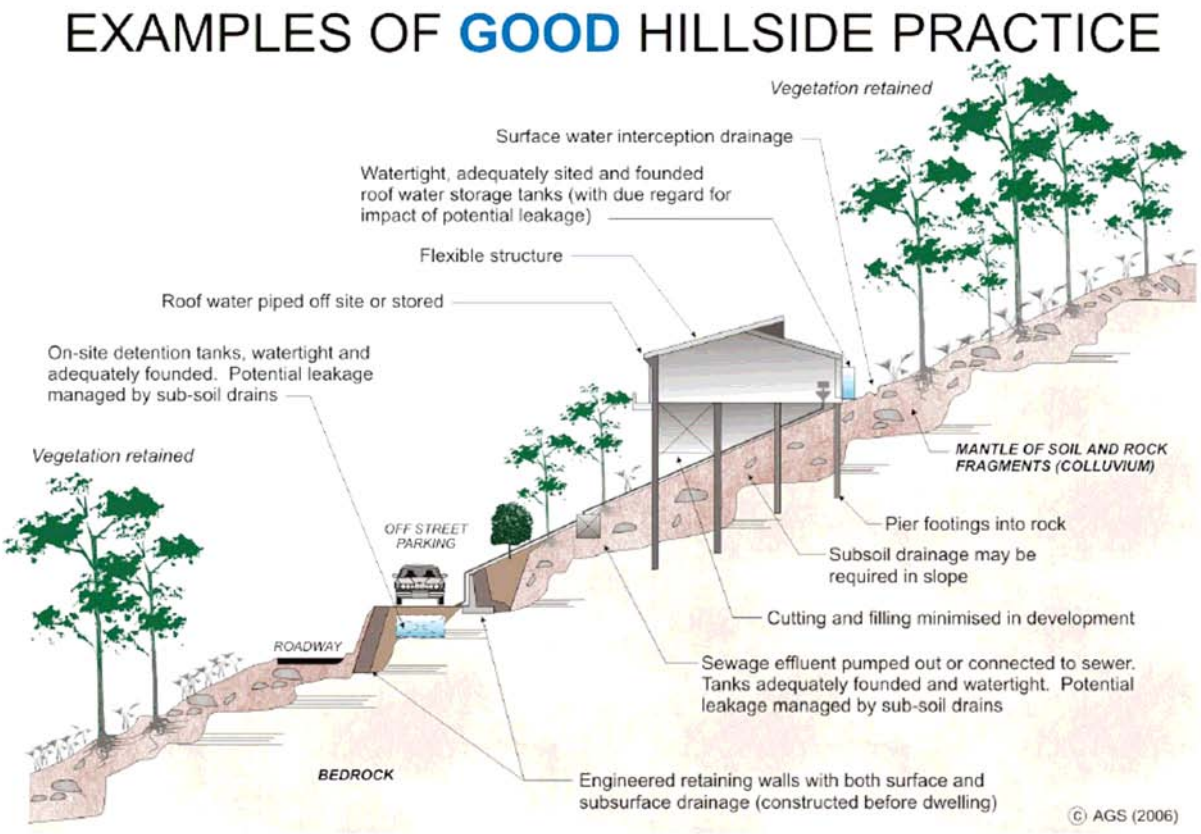
Map Description :	**INFERRED CROSS SECTION C**		
Client :	**WOOD & GRIEVE ENGINEERS**		
Project :	**TWEED VALLEY HOSPITAL, KINGSCLIFF**		
Project No :	**GE18/144**	Date: **28/11/18**	Scale : Not to Scale

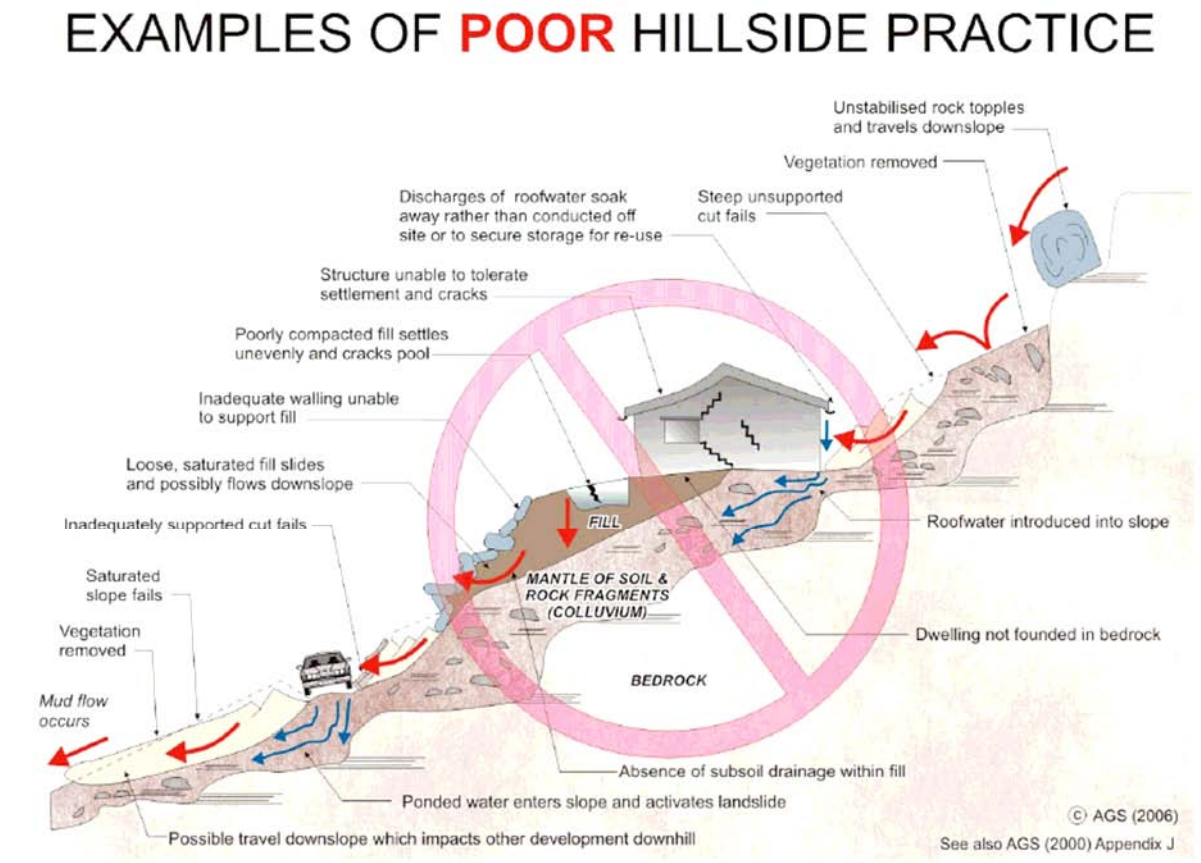
A P P E N D I X 'E'

GUIDELINES FOR HILLSIDE CONSTRUCTION

SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

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


EXAMPLES OF GOOD HILLSIDE PRACTICE
Vegetation retained
Surface water interception drainage
Watertight, adequately sited and founded roof water storage tanks (with due regard for impact of potential leakage)
Flexible structure
Roof water piped off site or stored
On-site detention tanks, watertight and adequately founded. Potential leakage managed by sub-soil drains
Vegetation retained
MANTLE OF SOIL AND ROCK FRAGMENTS (COLLUVIUM)
OFF STREET PARKING
Pier footings into rock
Subsoil drainage may be required in slope
Cutting and filling minimised in development
ROADWAY
Sewage effluent pumped out or connected to sewer. Tanks adequately founded and watertight. Potential leakage managed by sub-soil drains
BEDROCK
Engineered retaining walls with both surface and subsurface drainage (constructed before dwelling)
© AGS (2006)


EXAMPLES OF POOR HILLSIDE PRACTICE
Unstabilised rock topples and travels downslope
Vegetation removed
Discharges of roofwater soak away rather than conducted off site or to secure storage for re-use
Steep unsupported cut fails
Structure unable to tolerate settlement and cracks
Poorly compacted fill settles unevenly and cracks pool
Inadequate walling unable to support fill
Loose, saturated fill slides and possibly flows downslope
Inadequately supported cut fails
FILL
Roofwater introduced into slope
Saturated slope fails
MANTLE OF SOIL & ROCK FRAGMENTS (COLLUVIUM)
Vegetation removed
Dwelling not founded in bedrock
BEDROCK
Mud flow occurs
Absence of subsoil drainage within fill
Ponded water enters slope and activates landslide
© AGS (2006)
Possible travel downslope which impacts other development downhill
See also AGS (2000) Appendix J

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 *geoenvironmental* 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 conveyed 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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