NSW Department of Commerce | NSW Water Solutions

Hunter Water Corporation

TILLEGRA DAM DESIGN - CONSULTANCY 361802

Storage Rim Stability and Seepage Potential
Engineering Geotechnical Report

VOLUME III

Report No. 08–GN31A–R2 Final Report V 4.1
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Engineering Geological Borehole Logs – DDH1 to DD9, DD29 and DDH30 (with core photographs)

EXPLANATION OF LOGGING TERMS FOR ENGINEERING GEOLOGY BOREHOLE LOGGING

ROCK SUBSTANCE WEATHERING CLASSIFICATION

RS	Residual soil
EW	Extremely weathered
HW	Highly weathered
MW	Moderately weathered
SW	Slightly weathered
F(s)	Fresh (stained defects)
F	Fresh

ESTIMATED STRENGTH CLASSIFICATION

EW	Extremely weak
VW	Very weak
W	Weak
MS	Medium strong
S	Strong
VS	Very strong
ES	Extremely strong

DEFECTS

Defects include all joints, bedding planes, fracture zones, seams, veins and cleavage partings.

RQD

Rock quality designation:

$$RQD = \frac{\text{length of core in pieces 100mm or longer}}{\text{length of run}} \times 100\%$$

WATER

Water table, with date

Water inflow

Partial drilling water loss

Complete drilling water loss

Angles of joint inclination (and other geological features and drill holes) are angles between the feature and a horizontal plane. In core, angles of joints (and other geological structures) are angles between the structure and the plane normal to the axis of the core. In vertical holes these angles are then the true inclination (dip) of the structure.

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GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1 Sheet 1 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, PROPOSED SPILLWAY CREST
CO-ORDINATES E 376501 N 6422961
R.L. COLLAR 173.7m DATUM AHD BEARING 090° M INCLINATION 60° from horizontal
DRILL DELTA 1000, TRACK MOUNTED · CONTRACTOR McDERMOTT DRILLING ·
CORE BARRELL HQ TRIPLE · DRILLER SHAUN TAYLOR
COMMENCED 9.12.07 COMPLETED 18.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS W/PT
0					NON CORE							
1.00	HQ	RI			CORING COMMENCES AT 1.0m							
1.17					TUFFACEOUS SANDSTONE, medium to fine gr., brown/greybrown.							
1.19					META-SHALE, dk grey, laminated at 15°					1.17 1.19 2xs PARTINGS, 15°, planar, rough, Fe st	72%	
		RUN 2			TUFFACEOUS SANDSTONE fine grained, grey/greybrown/brown. Includes META-SHALE lamination as shown at 15°.	SW/FR	S			1.65 1.70 PARTING FRAGMENTS, 10 to 15°, planar, rough, Fe st. 1.80 DRILLING BREAK		
1.75						MW/MSW	VWS/MS			1.95 Numerous PARTINGS, 15°/JOINTS, 30 to 60°, planar, rough, Fe/mn st.	45%	
2.42										2.42		
2.60						MW	MS			2.62 Numerous PARTINGS, 15° with several JOINTS, 30 to 45°, planar, rough, Fe st. Occasional sandy clay coatings to rare full 2mm thick.	18%	
3										3.00		
3.14		RUN 3			META-SHALE, grey/brown, laminated at 15°		W/MS			3.14 3.15 Numerous PARTINGS, 15°, planar, rough, Fe st.		NO TEST
3.30					CORE LOSS 0.05m							
3.50					META-SHALE continues					3.30 3.68 As above.		
		RUN 4			TUFFACEOUS SANDSTONE, fine grained, brown.	MW	MS				76%	
3.95					META-SHALE, brown/greybrown, laminated at 10 to 15°					3.82 4.13 Numerous PARTINGS, 15°, with several JOINTS, 45 to 70°, planar, rough, Fe st, occasional sandy clay coating.		
4												
4.06					TUFF, s/s, fine grained, brown					4.22		
4.22		RUN 5			META-SHALE, brown/greybrown, laminated at 10 to 15°	MSW	MS			4.66 As above.	18%	
4.66					CORE LOSS 0.15m							
4.81					META-SHALE continues as above.	MW	MS			4.81 4.97 As above.		
4.92		RS			TUFF s/s, fine gr. brown							

Remarks: BOX 1 ENDS AT 4.66m
Job / Report No. GN25A
Logged by: JOHN YOUNG
Date: 18.12.07
Site Supervisor MARK ASHOWER

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GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DH 1 Sheet 2 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT PROPOSED SPILLWAY CREST
CO-ORDINATES E 376501 N 6422961
R.L. COLLAR 173.7m DATUM AHD BEARING 090° M INCLINATION 60° from Horizontal

DRILL DELTA 1000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 9.12.07
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 18.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
5					TUFFACEOUS SANDSTONE continues, fine grained, brown/grey/brown.	MW	MS			5.07 Joint, 45°/Parting, 15, fragments, planar, rough, Fe st. Core fragmented from 5.16 to 5.44m		
5.15						HW	VW					
5.44						MW	MS			5.47		
5.47		RUN 7			CORE LOSS 0.27m						0%	
5.74						MW	MS			5.74 Core fragmented		
5.80		RUN 8			Interbedded fine gr. TUFFACEOUS SANDSTONE / META-SHALE, pale grey/brown/orangebrown. Laminated (where visible) at 15° to 20°	HW	VW			5.80 PARTING, 10°, planar, rough, Fe st.	65%	
6												
6.06		RUN 9				MW	MS			6.06 Core fragmented 6.16	0%	
6.16					CORE LOSS 0.17m							
6.33					As above	MW	MS			6.33 Core fragmented 6.43		
6.43		RUN 10			CORE LOSS 0.67m						0%	NO TEST
7												
7.10	HQ	RUN 11			CORE LOSS 0.54m (1.21m TOTAL).						0%	
7.64					As above	MW	MS			7.64 Parting fragments, 20°, planar, rough, Fe st.	0%	
7.74		12			NON CORE (casing reseated)					7.74		
7.82					As above.					7.82 As above 8.00	0%	
7.98		13										
8.00					8.03m	MW	MS			8.00		
8.32		RUN 14			TUFFACEOUS SANDSTONE, very fine/fine grained, brown (to 8.32m) then grey. Includes occasional META-SHALE laminations to 8.52m depth, at 10 to 15°					8.14 Boxing break 8.30 4x's Partings, 10 to 15°, planar, rough, Fe st. 8.47 8.57	80%	
8.70		RUN 15								8.70 Drilling break		
9						F(S)	S/VS			9.02 Parting, 15°, planar, rough, Fe st. 9.15 Boxing break 9.30 Handling break 9.48 2x's Partings, 10°, planar, rough, Fe st. 9.49	90%	L1
10					9.85m Includes elongate subangular META-SHALE clasts to 40mm length					9.87 Parting, 15°, planar, rough, Fe st.		

Remarks: BOX 2 ENDS AT 9.15m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 18.12.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1 Sheet 3 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, PROPOSED SPILLWAY CREST
CO-ORDINATES E 376501 N 6422961
R.L. COLLAR 172.7m DATUM AHD BEARING 090 M INCLINATION 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 9.12.07 COMPLETED 18.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
10				TUFFACEOUS SANDSTONE continues, fine grained, grey. Elongate META-SHALE clasts persist to 10.40m					10.04 JOINT, 45°, planar, rough, Fe st.		
10.40				10.40m					10.15 BOXING BREAK		
									10.30 PARTING, 10°, planar, rough, fest.		
10.66				10.66 Elongate META-SHALE clast 40mm long					10.74 Probable PARTING, 15°, irregular, rough, Fe st.		
									10.87 HANDLING BREAK		
11		RUN 6			F(3)	S/HS			11.13 BOXING BREAK		1.11
	HQ			TUFFACEOUS SANDSTONE, fine grained, grey.					12.38 } Several JOINTS, 60°, planar to curved, rough, Fe/Mn st. 12.60		
11.70									11.70 DRILLING BREAK		
									11.78 JOINT, 65°, planar, rough, Fe/Mn st		
12		RUN 7							11.96 Probable DRILLING BREAK		
									12.17 BOXING BREAK		
									12.58 DRILLING BREAK	70%	
									12.60 JOINT, 70°, planar, rough, Fe st.		
12.78									12.78 DRILLING BREAK		
13		RUN 8							13.07 BOXING BREAK		1.01
									13.25 } 2x's JOINTS, 60 to 70°, intersecting, planar, rough, Fe st, very minor clay coating 13.40		
									13.53 } 3x's PARTINGS, 5°, planar, rough, Fe/Mn st. 13.61 13.68	62%	
13.87									13.87 DRILLING BREAK		
14		RUN 9							14.14 BOXING BREAK		
									14.22 JOINT, 50°, planar, rough, Fe/Mn st.		
									14.42 JOINT, 60°, planar, rough, Fe/Mn st.	72%	
									14.50 } 3x's JOINTS, 60°, parallel, planar, rough, Fe/Mn st. 14.62		
14.70									14.70 DRILLING BREAK		
15		RUN 10							14.93 JOINT, 50°, planar, rough, Fe/Mn st.		

Remarks: BOX 3 ENDS AT 13.07m
Job / Report No. GN 25A
Logged by: JOHN YOUNG
Date: 8.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1

Sheet 4 of 12 Sheets

PROJECT	TILLEGRA DAM	CO-ORDINATES	R.L. COLLAR 172.7m
LOCATION	RIGHT ABUTMENT, PROPOSED SPILLWAY CREST.	E 376501	DATUM AHD
		N 6422961	BEARING 090°M
			INCLINATION 60° from horizontal
DRILL	DELTA 2000, TRACK MOUNTED	CONTRACTOR	MCDERMOTT DRILLING
CORE BARRELL	HQ TRIPLE	DRILLER	SHAUN TAYLOR
COMMENCED	9.12.07	COMPLETED	18.12.07

DRILLING DATA / ROCK SUBSTANCE

DEPTH (R.L.) METRES	Method	Casing, Run	Description (Rock type: grainsize, texture, colour, composition, structure, hardness)	Weathering	Estimated Strength
15 – 15.07	HQ	RUN 10 CONT	Fine gr. TUFF. S/S. continues. Very fine grained from 15.07m		
15.64					
15.80 – 15.90		RUN 11	15.80m – Includes META-SHALE laminations at 10° – 15.90m	F(s)	S/VS
16			TUFFACEOUS SANDSTONE continues, very fine/fine grained, grey.		
16.60		RUN 12			
17.00 – 17.06			17.00m – Includes META-SHALE laminations at 15° – 17.06m		
17.13 – 17.29			17.13 – Interbedded META-SHALE and very fine gr. TUFF. S/S, grey/dk grey, banded at 15° – 17.29		
17.29		RUN 13	TUFFACEOUS SANDSTONE, fine grained, grey.		
17.57 – 17.70			17.57m – Includes META-SHALE laminations at 10 to 15° – 17.70m		
18			TUFFACEOUS SANDSTONE continues, fine/medium gr., grey.		
		RUN 14			
18.99 – 19.05			18.99m – META-SHALE, dk. grey, laminated at 10° – 19.05m		MS/S
19			TUFF. S/S., fine/medium grained, grey.		S/VS
19.43 – 19.53		RUN 15	19.43m – META-SHALE, dk. grey, laminated at 10° – 19.53m		MS/S
			TUFF. S/S., fine gr., grey.		S/VS
19.78 – 19.94			19.78m – META-SHALE, dk grey/grey brown, laminated at 15° – 19.94m		MS
19.94 – 20			TUFF. S/S fine gr. grey.		S/VS

ROCK MASS DEFECTS

Depth	Defect Description (Type, inclination, planarity, roughness, coatings or infillings)	R.Q.D.	Tests WPT
15.07	JOINT, 30°, with intersecting PARTING, 15°, both planar, rough, Fe/Mn st.	65%	
15.21	As above		
15.37	JOINT, 60°, planar, rough, Fe st.		
15.57	JOINT, 50°, planar, rough, Fe st.		
15.80 – 15.90	JOINT, 60°, with associated PARTINGS, 10°, planar, rough, Fe/Mn st.	74%	1 UL
16.00 – 16.21	As above.		
16.53	DRILLING BREAK		
16.74	PARTING, 10°, planar, rough, Fe st.		
16.82	JOINT, 55°, planar, rough, Fe st.		
16.98	DRILLING BREAK	70%	
17.18 – 17.25	Several PARTINGS, 15°, planar, rough, Fe st (possibly DRILLING/HANDLING induced)		
17.60	PARTING, 10°, planar, rough, Fe st.	100%	
17.70 – 17.90	2x's JOINTS, 65°, planar, rough, Fe/Mn st.		
17.99	PARTING, 10°, planar, rough, Fe/Mn st.		
18.51	DRILLING BREAK		14 UL
18.57	JOINT, 60°, planar, rough, Fe st.		
18.80	BOXING BREAK		
18.90	DRILLING BREAK	65%	
18.99 – 19.02	2x's PARTINGS, 10°, planar, rough, Fe st.		
19.30 – 19.50	JOINT, 60°, with associated PARTINGS, 10 to 15°, planar, rough/very rough, Fe/Mn st.		
19.65	PARTING, 10°, planar, rough, Fe st. minor carbonate coating.	50%	
19.85 ↓	PARTING FRAGMENTS, 15°, planar, rough, Fe st, sandy clay fill		

Remarks: BOX 4 ENDS AT 16.98 m

Job /Report No. GN25A

Logged by: JOHN YOUNG **Date:** 8.1.02 **Site Supervisor** MARK ASHOVER

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

NSW Department of Commerce

BOREHOLE No. DDH 1 — Sheet 5 of 12 Sheets

PROJECT: TILLEGRA DAM	CO-ORDINATES	R.L. COLLAR: 173.7m	
LOCATION: RIGHT ABUTMENT, PROPOSED SPILLWAY CREST	E 376501	DATUM: AHD	
	N 6422961	BEARING: 090 M	
		INCLINATION: 60° from horizontal	
DRILL: DELTA 2000, TRACK MOUNTED	CONTRACTOR: McDERMOTT DRILLING	COMMENCED: 9.12.07	
CORE BARRELL: HQ TRIPLE	DRILLER: SHAUN TAYLOR	COMPLETED: 18.12.07	

DEPTH (R.L.) METRES	Method	Casing, Run	GRAPHIC LOG	DESCRIPTION — ROCK TYPE	WEATHERING	ESTIMATED STRENGTH	DEFECT DESCRIPTION	R.Q.D.	TESTS (WPT)
20 – 20.27	HQ	R15	Sandstone	TUFFACEOUS SANDSTONE continues, fine gr., grey.		S/VS	20.05 As above; 20.17 PARTING, 15°, planar, rough, Fe st, minor clayey coating; 20.24 JOINT, 30°, planar, rough, Fe st.		
20.27 – 20.30			Shale	20.27m META-SHALE, dk grey, laminated at 10°		MS/S	20.30 – 20.35 PARTING FRAGMENTS, planar, rough, Fe st.		
20.35 – 20.53		RUN 16	Sandstone	20.35m TUFF. S/S., fine gr., grey. 20.53 Includes elongated META-SHALE clasts to 45mm			20.46 PARTING, 5°, planar, rough, Fe st.	95%	
20.70 – 21.81		RUN 17	Sandstone	TUFFACEOUS SANDSTONE continues, fine gr., grey.	F(s)	S/VS	20.70 DRILLING BREAK; 20.76 HANDLING BREAK; 20.82 BOXING BREAK; 20.97 JOINT, 60°, planar, rough, Fe st.; 21.36 JOINT, 30°, planar, rough, Fe/Mn st.; 21.45 As above; 21.54 Probable PARTING, 15°, planar, very rough, Fe/Mn st.; 21.70 PARTING, 15°, planar, rough, Fe st, minor carbonate coating.; 21.87 JOINT, 65°, planar, rough, Fe st.	65%	14 UL
21.81 – 22.97		RUN 18	Shale	21.81 META-SHALE, dark grey with occasional grey bands, thinly laminated / laminated at 10 to 15°		MS/S	22.18 JOINT, 50°, planar, rough, Fe st.; 22.27 PARTING, 15°, planar, rough, Fe st.; 22.40 As above.; 22.57 Probable DRILLING BREAK; 22.66 – 22.97 PARTING FRAGMENTS, 10 to 15°, planar, rough, Fe st.	78%	
22.97 – 23.70			Core loss	CORE LOSS 0.73m (Inner barrel not locked in)					
23.70 – 24.96		RUN 19 (23.85–24.03), RUN 20 (to 24.71), R21	Shale	META-SHALE continues	F(s); SW(Fe)	MS/S	23.70 – Numerous PARTINGS / PARTING FRAGMENTS, 10 to 15°, planar, rough, Fe st. Includes several JOINTS, 60°, planar, rough, Fe st.; 24.96 BOXING BREAK	0%; 0%	2.5 UL

Depth marks: 20, 20.27, 20.30, 20.35, 20.53, 20.70, 21, 21.81, 22, 22.22, 22.97, 23, 23.20, 23.70, 23.85, 24, 24.03, 24.71, 24.96

Remarks: BOX 5 ENDS AT 20.82m   BOX 6 ENDS AT 25.00m

Job / Report No. GN25A

Logged by: JOHN YOUNG   Date: 2.1.08   Site Supervisor: MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1 Sheet 6 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, PROPOSED SPILLWAY CREST
CO-ORDINATES E 376701 N 6427961
R.L. COLLAR 172.7m DATUM AHD BEARING 090°M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 9.12.07 COMPLETED 18.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS W/PT
25					TUFFACEOUS SANDSTONE (from 25.00m), fine grained, grey.		S/VS					
25.22					25.27m META-SHALE, dk grey, laminated at 15°		VS/M			25.29 DRILLING BREAK		
25.29					25.29m							
					TUFFACEOUS SANDSTONE, continues, fine gr., grey							
25.85					25.85					25.86 PARTING, 15°, planar, rough, Fe st.		
26					Occasional carbonate veining generally to 1mm thick (mostly infilling joints)		S/MS			26.00 JOINT, 20°, planar, rough, Fe st.	83%	2.5 UL
26.20		RUN 1.1 CONTINUED										
						F(s)				26.48 JOINT, 40°, planar, very rough, Fe st.		
26.60					26.60					26.61 PARTING, 15°, planar, rough, Fe st		
26.70					Interbadded META-SHALE, dk. grey, and very fine grained TUFF. SS., grey. Laminated at 10 to 15°, banded.		S			26.70 JOINT, 45°, planar, rough, Fe st		
26.75										26.78 } 26.96 } 3x's PARTINGS, 15°, planar, rough (possibly drilling induced)		
26.95					26.95							
27	HQ				TUFFACEOUS SANDSTONE, fine grained, grey.		S/MS			27.00 BOXING BREAK		
27.64		RUN 1.2			27.64					27.64 Possible PARTING, 15°, planar, rough. (may be drilling induced)		
					Interbadded META-SHALE, dk grey, and very fine grained TUFFACEOUS SANDSTONE, grey. Laminated at 10 to 15°, banded.	F						
28							S			28.00 As above.		6 UL
					(META-SHALE is dominant rocktype)					28.70 JOINT, 70°, planar, rough, carbonate coated.	97%	
					Rare carbonate veining persists, generally to 1mm thickness							
29										28.96 BOXING BREAK		
										29.45 Probable DRILLING BREAK		
29.67												
29.70		RUN 1.3								29.70 PARTING, 15°, planar rough, Fe st, minor carbonate coating.		
						F(s)				29.75 BOXING BREAK		
30												

Remarks: BOX 7 ENDS AT 28.96m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 9.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1

Sheet 1 of 12 Sheets

PROJECT TILLEGRA DAM

LOCATION RIGHT ABUTMENT, PROPOSED SPILLWAY CREST.

CO-ORDINATES E 376501 N 6422961

R.L. COLLAR 173.7m DATUM AHD BEARING 090°M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR

COMMENCED 9.12.07 COMPLETED 18.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
30					Interbedded META-SHALE/ very fine grained TUFFACEOUS SANDSTONE continues. Laminated at 15°. (META-SHALE dominant)					30.12 JOINT, 50°, with associated PARTINGS, 10°, planar, rough, Fe st. 30.20		
										30.43 PARTING, 15°, with associated JOINT, 50°, planar, rough.		
										30.64 Probable DRILLING BREAK		
										30.90 As above 30.95 BOXING BREAK 31.08 HANDLING BREAK		
31					Rare carbonate veining, less than 1mm-thick					31.10 PARTING, 15°, planar, rough, Fe st		
						$F_{(S)}$	S			31.38 JOINT, 75°, planar, rough, minor Fe st, carbonate coated. Several associated PARTINGS, 15°, planar, rough. 31.78	76%	0 UL
										31.97 Probable DRILLING BREAK		
32	HQ	RUN 25 CONTINUED								32.10 As above		
32.18					32.18m TUFFACEOUS SANDSTONE, very fine grained, grey.		S/HS			32.20 PARTING, 10°, planar, rough, minor fest.		
										32.45 Possible PARTING, 15°, planar, rough.		
32.58					32.58m					32.55 32.58 } 3m's PARTINGS, 15°, planar, rough, fest		
32.70					META-SHALE, dk. grey, with very fine grained TUFFACEOUS SANDSTONE laminations, grey.					32.70 DRILLING BREAK		
										32.92 BOXING BREAK		
33							S			33.11 PARTING, 15°, planar, rough, minor Fe st.		
					Thinly laminated/laminated at 15°					33.20 As above.		
33.30		RUN 24			33.30m TUFFACEOUS SANDSTONE, very fine grained, grey.		S/HS					
33.56					33.56m					33.50 Several JOINTS, 60 to 70°, planar, rough, Fe st (heavily).	65%	8 UL
					META-SHALE, dk. grey, with (minor) very fine grained TUFFACEOUS SANDSTONE laminations, grey.					33.93		
34					Thinly laminated to laminated at 15°.		S			34.01 PARTING, 15°, planar, rough. Fe st. 34.15 34.28 34.30 34.40 } 4m's JOINTS, 30 to 50°, planar, rough, minor carbonate coating		
					Rare carbonate veining generally to 1mm-thickness persists					34.50 JOINT, 45°, planar, rough, Fe st.		
										34.74 Probable DRILLING BREAK		
										34.93 BOXING BREAK		
35												

Remarks: BOX 8 ENDS AT 32.92m

Job / Report No. GN 25A

Logged by: JOHN YOUNG

Date: 9.1.08

Site Supervisor MARK ASHOVER

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

NSW Department of Commerce

BOREHOLE No. DDH 1 — Sheet 8 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, PROPOSED SPILLWAY CREST.
CO-ORDINATES E 376501 N 6472961
R.L. COLLAR 173.7m DATUM AHD BEARING 090°M INCLINATION 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 9.12.07 COMPLETED 18.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
36	HQ	RUN 24 CONT.			Continues as above.					36.07 PARTING, 10°, planar, rough, Fe st, carbonate coated.		
					META-SHALE with very fine grained TUFFACEOUS SANDSTONE laminations.					36.44 JOINT, 50°, planar, rough, minor carbonate coating.		
36.70					Thinly laminated/ laminated at 10 to 15°.					36.67 DRILLING BREAK.		
					Rare carbonate veining persists, less than 1mm thick.	F (S)	S			36.70 DRILLING BREAK		
36										36.90 BOXING BREAK		
										36.12 HANDLING BREAK		
										36.17 PARTING, 15°, planar, rough, Fe st.		
										36.49 Probable DRILLING BREAK		
										36.62 JOINT, 65°, planar, rough, minor Fe st, minor carbonate coating.		
										36.80 JOINT, 70°, planar, rough, minor Fe st, carbonate coated.	65%	BUL
37												
37.09					37.09m TUFFACEOUS SANDSTONE, fine grained, grey		S/MS			37.09		
37.28					37.28m META-SHALE, dk gray, with with very fine grained TUFFACEOUS SANDSTONE laminations (at 15°)		S			37.34 JOINT, 60°, planar, rough, minor Fe st, carbonated coated.		
37.47										37.47 DRILLING BREAK		
37.70					37.70m					37.58 37.70 37.80 } 2 x's PARTINGS, 15°, planar, rough, Fe st		
38												
38.20		RUN 23			TUFFACEOUS SANDSTONE, fine grained ranging to fine-medium with depth, grey.					38.20 JOINT, 60°, planar, rough, Fe st.	100%	
										38.44 As above		
										38.58 As above		
38.70							MS/S			38.70 PARTING, 10°, planar, rough, Fe st.		
39		RUN 21										FUL
										39.22 JOINT, 45°, planar, rough, carbonate coated		
39.45					39.45m META-SHALE, dk grey, laminated at 10-		MS/S			39.40 39.46 } 2 x's PARTINGS, planar, rough, Fe st. 10°		
39.52					39.52m					39.52 HANDLING BREAK		
					TUFFACEOUS SANDSTONE continues as above.	F	S/MS			39.70 BOXING BREAK		
40												

Remarks: Box 9 ENDS AT 36.80m — Job / Report No. GN 25A
Logged by: JOHN YOUNG — Date: 9.1.08 — Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1 Sheet 9 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, PROPOSED SPILLWAY CREST
CO-ORDINATES E 376701 N 6422961
R.L. COLLAR 173.7m AHD
DATUM
BEARING 090° M
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 9.12.07
COMPLETED 18.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
40				TUFF. S/S. continues as above		S/VS					
40.09				40.09m Interbedded META-SHALE, dk grey and fine grained TUFFACEOUS SANDSTONE, grey (approx. equal proportions). Laminated to very thinly bedded at 15°		S			40.09 Probable DRILLING BREAK 40.20 JOINT, 65°, planar, rough, carbonate coated 40.60 Possible PARTING, 15°, planar, rough, carbonate coated. 40.70 BOXING BREAK		5 UC
40.94		RUN 27 CONTINUED		40.94m					40.92 Possible PARTING, 15°, planar, rough carbonate coated.	98%	
41				41.07m Includes elongate META-SHALE clasts to 35mm.							
41.07											
41.17											
41.20									41.28 Probable DRILLING BREAK.		
41.70	HQ			TUFFACEOUS SANDSTONE, fine grained, grey.	F				41.70 DRILLING BREAK		
42											11 UC
									42.51 JOINT, 45°, planar, rough, minor carbonate coating 42.65 JOINT, 60, as above.		
42.70					—				42.70 2x's JOINTS, 65°, planar, rough, Fe st., minor carbonate coating 42.88		
43											
		RUN 28				S/VS			43.31 DRILLING BREAK 43.37 JOINT, 60°, planar, rough, carbonate coated 43.47 JOINT, 65°, as above.	96%	
43.50									43.63 HANDLING BREAK 43.72 PARTING, 15°, planar, rough, minor Fe st.		
					F(s)						
44									44.00 JOINT, 60°, planar, rough, Fe st.		
44.20											
									44.40 JOINT, 60°, planar, rough, minor Fe st., carbonate coated.		
44.70		RUN 29							44.70 DRILLING BREAK		30 UC
45											

Remarks: BOX 10 ENDS AT 40.70m BOX 11 ENDS AT 44.70m
Job / Report No. GN25A

Logged by: JOHN YOUNG
Date: 9.1.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1
Sheet 10 of 17 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, PROPOSED SPILLWAY CREST
CO-ORDINATES E 376501 N 6422961
R.L. COLLAR 173.7m AHD
BEARING 090°M
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRUCK MOUNTED
CORE BARRELL HQ TRIPLE
CONTRACTOR McDERMOTT DRILLING
DRILLER SHAUN TAYLOR
COMMENCED 9.12.07
COMPLETED 18.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
45												
					TUFFACEOUS SANDSTONE continues, fine grained, grey					45.20 JOINT, 60°, with associated PARTING, 5°, planar, rough, Fe st.		
										45.54 HANDLING BREAK		
										45.65 BOXING BREAK		
										45.82 HANDLING BREAK		
46		RUN 29 CONTINUED								46.00 JOINT, 50°, planar, rough, Fe st	83%	
										46.28 JOINT, 65°, planar, rough, Fe st, carbonate coated.		
46.57	HQ					F(6)	≤1/2			46.57 DRILLING BREAK		
										46.70 } HANDLING BREAKS 46.75 }		
										46.85 JOINT, 50°, planar, rough, Fe st.		
47		RUN 30								47.05 As above	100%	30 UL
47.70		RUN 31								47.70 PARTING, 15°, planar, rough, Fe st.		
48										48.28 JOINT, 45°, planar, rough, minor Fe st.		
										48.43 As above		
										48.65 BOXING BREAK		
										48.74 JOINT, 50°, stepped, rough, Fe st.	45%	
										48.94 JOINT, 60°, planar, rough, Fe st.		
49										49.20 JOINT, 70°, planar, rough, Fe st.		
										49.65 JOINT, 60°, planar, rough, Fe st.		
										49.81 DRILLING BREAK		
49.93 EOH										49.93 DRILLING BREAK		

Remarks: Box 12 ENDS AT 48.65m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 9.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1

Sheet 11 of 12 Sheets

PROJECT	TILLEGRA DAM	CO-ORDINATES	E 376701 / N 6422961
LOCATION	RIGHT ABUTMENT, PROPOSED SPILLWAY CREST.	R.L. COLLAR	172.7m
		DATUM	AHD
		BEARING	090°M
		INCLINATION	60° from horizontal
DRILL	DELTA 2000, TRACK MOUNTED	CONTRACTOR	McDERMOTT DRILLING
CORE BARREL	HQ TRIPLE	DRILLER	SHAUN TAYLOR
COMMENCED	9.12.07	COMPLETED	18.12.07

DRILLING DATA / ROCK SUBSTANCE / ROCK MASS DEFECTS

Columns: DEPTH (R.L.) METRES | Method | Casing, Run | Water | GRAPHIC LOG | DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness | WEATHERING | ESTIMATED STRENGTH | DEFECT SPACING (mm) 2000 600 200 60 20 | VISUAL LOG | DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings | R.Q.D. | TESTS WPT

Method: HQ

Runs: RUN 32 CONT (50–50.70); RUN 33 (50.70–53.70); RUN 34 (53.70–)

Depth markers: 50, 50.20, 50.70, 51, 52, 53, 53.38, 53.50, 53.63, 53.70, 53.96, 54, 54.17, 54.33, 54.40, 55

Rock substance

- TUFFACEOUS SANDSTONE continues, fine grained, grey.
- Rare carbonate veining persists, less than 1mm thickness.
- Weathering: F(s); Strength: S/VS
- 53.38m — Interbedded META-SHALE, dk grey, and TUFF. S/S., grey, very fine grained. Thinly laminated to laminated at 10 to 15°. — 53.63m (Strength: S)
- TUFFACEOUS SANDSTONE, fine grained, grey. (Strength: S/VS)
- 53.96m — Interbedded META-SHALE/TUFF. S/S. Thinly lam./lam. at 15° — 54.17m (Strength: S)
- 54.17m – 54.33m (Strength: S/VS)
- 54.33m — META-SHALE, dk grey. Laminated at 15° — 54.40m (Strength: MS/S)
- TUFFACEOUS SANDSTONE continues, fine grained, grey. (Strength: S/VS)

Defect description

- 50.47 JOINT, 45°, planar, rough, Fe st.
- 50.70 DRILLING BREAK
- 51.20 JOINT, 40°, planar, rough, Fe st.
- 51.70 BOXING BREAK
- 51.87 – 52.17 JOINT, 90°, planar, rough, Fe st (with associated HANDLING BREAKS).
- 52.70 JOINT, 50°, planar, rough, minor Fe st.
- 52.77 HANDLING BREAKS
- 52.94 JOINT, 60°
- 53.35 – 53.48 – 53.58 – 53.63: 4x's Possible PARTINGS, 10 to 15°, planar, rough, minor Fe st. at 53.58 and 53.63m.
- 53.67 DRILLING BREAK
- 53.82 JOINT, 45°, planar, rough, Fe st.
- 54.37 Probable DRILLING BREAK
- 54.50 Possible PARTING, 15°, planar, rough, minor Fe st.

R.Q.D. / Tests

- WPT: 30UL (50–50.20); 1UL (Run 33); L1UL (Run 34)
- R.Q.D.: 98% (Run 33); 90% (Run 34)

Remarks:	BOX 13 ENDS AT 52.70m	Job / Report No.	GN 25A
Logged by:	JOHN YOUNG	Date:	9.1.08
Site Supervisor	MARK ASHOVER		

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1

Sheet 12 of 12 Sheets

PROJECT: TILLEGRA DAM	CO-ORDINATES	R.L. COLLAR: 173.7m	
LOCATION: RIGHT ABUTMENT, PROPOSED SPILLWAY CREST.	E 376701	DATUM: AHD	
	N 6422961	BEARING: 090° M	INCLINATION: 60° from horizontal
DRILL: DELTA 2000, TRACK MOUNTED	CONTRACTOR: McDERMOTT DRILLING	COMMENCED: 9.12.07	
CORE BARRELL: HQ TRIPLE	DRILLER: SHAUN TAYLOR	COMPLETED: 18.12.07	

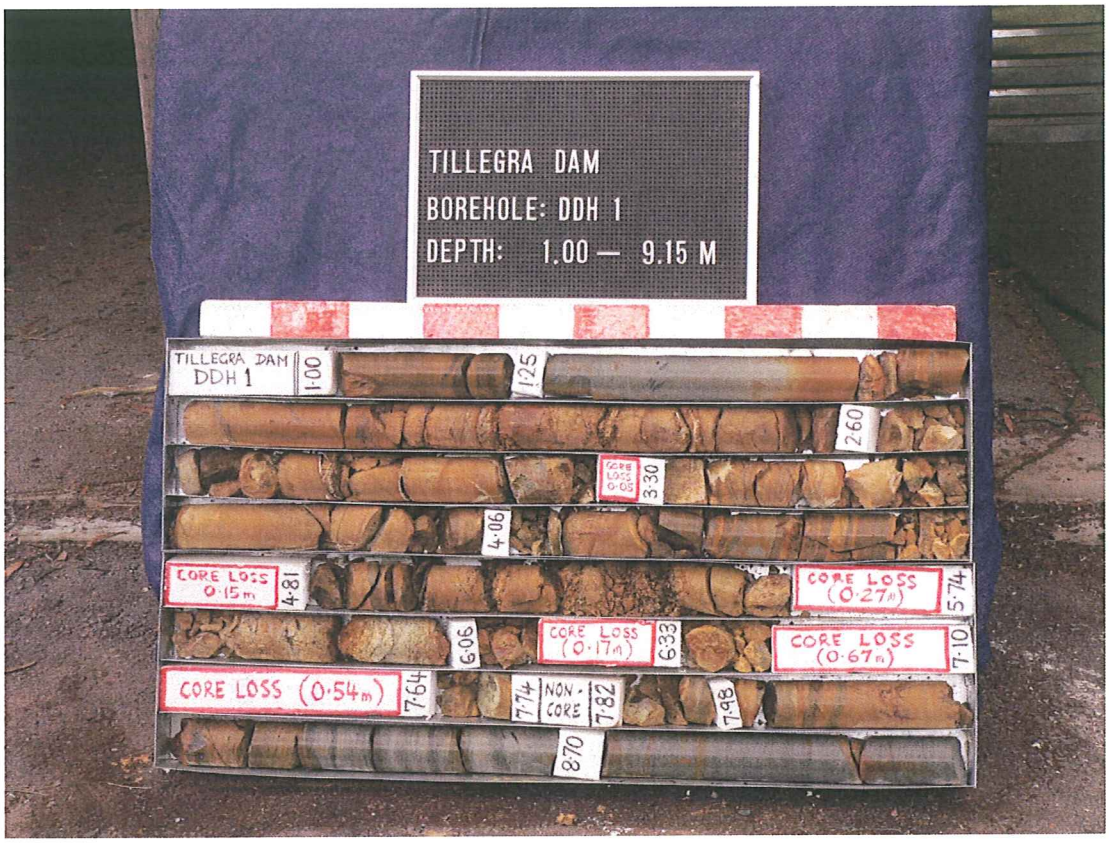
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
55 – 56.40	HQ	RUN 34 CONTINUED			TUFFACEOUS SANDSTONE continues, fine grained, grey.	F(s)	S/VS			55.40 – 55.47 } 2x's JOINTS, 50°, planar, rough, Fe st.		LIUL
										56.10 Possible JOINT, 50°, planar rough, carbonate coated (may be drilling induced)		
										56.17 DRILLING BREAK		
56.40 – 56.50					CORE LOSS 0.10m ^ Left down hole					56.40 DRILLING BREAK		
56.50					HOLE ENDS AT 56.50m							

Depth scale: 55, 56, 57, 58, 59, 60

Remarks: BOX 14 ENDS AT 56.50m ^ END OF HOLE

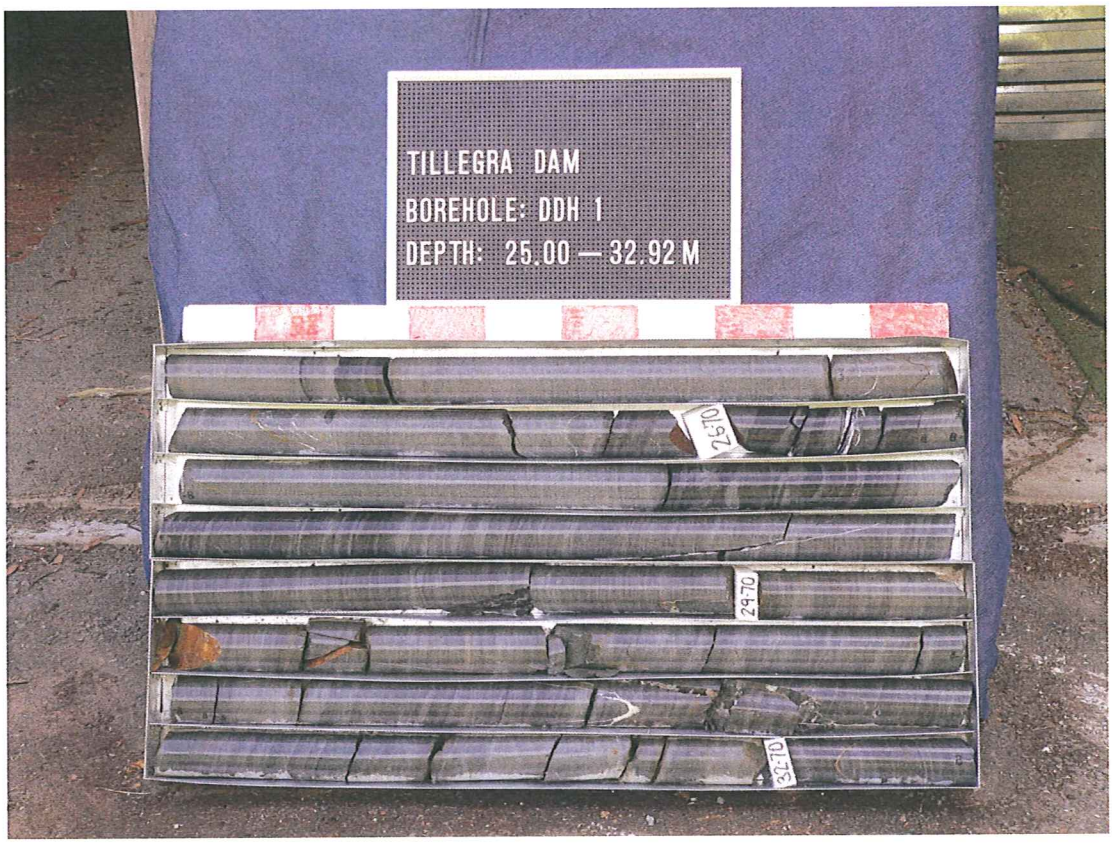
Job / Report No. GN 25A

Logged by: JOHN YOUNG | Date: 9.1.08 | Site Supervisor: MARK ASHOVER

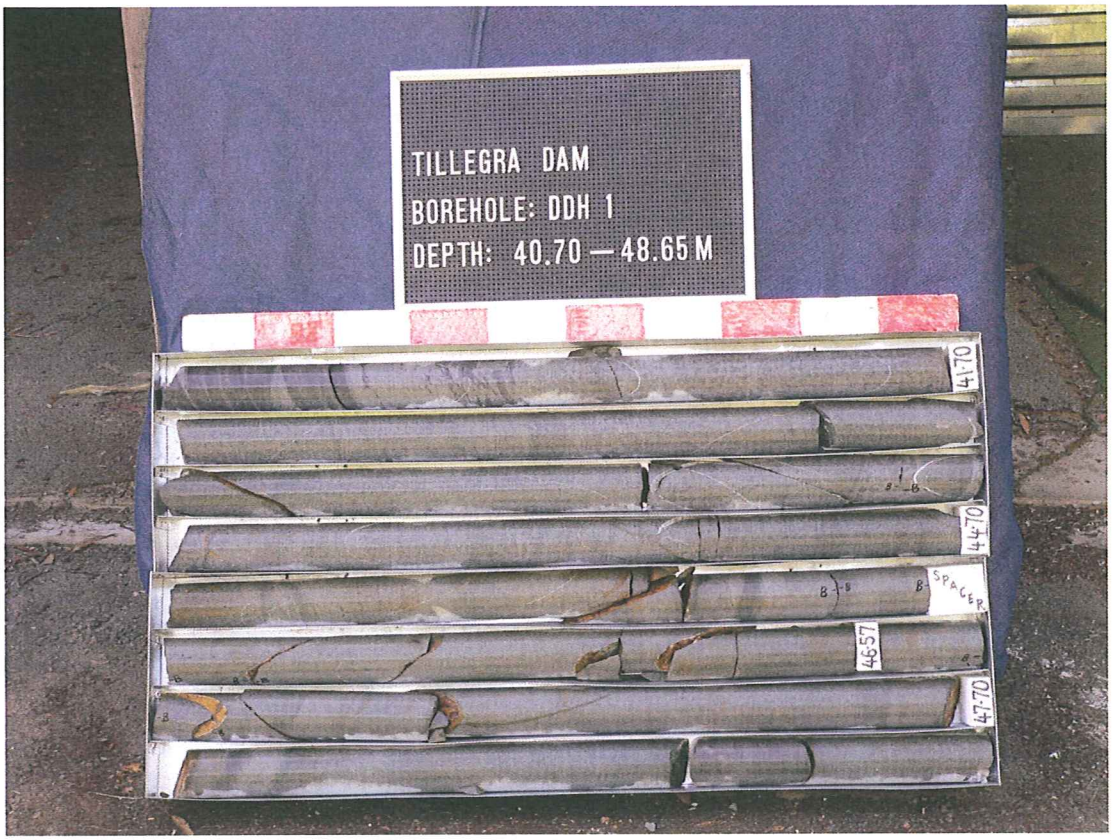

TILLEGRA DAM
BOREHOLE: DDH 1
DEPTH: 1.00 — 9.15 M
TILLEGRA DAM
DDH 1
1·00
1·25
2·60
CORE LOSS 0·05
3·30
4·06
CORE LOSS 0·15m
4·81
CORE LOSS (0·27m)
5·74
6·06
CORE LOSS (0·17m)
6·33
CORE LOSS (0·67m)
7·10
CORE LOSS (0·54m)
7·64
7·74
NON-CORE
7·82
7·98
8·70


TILLEGRA DAM
BOREHOLE: DDH 1
DEPTH: 9.15 — 16.98 M
11·70
12·78
13·87
14·70
15·64
16·60


TILLEGRA DAM
BOREHOLE: DDH 1
DEPTH: 16.98 — 25.00 M
17-29
17-70
19-43
20-30
20-70
22-22
CORE LOSS (0.73m - INNER NOT LOCKED IN)
23-70
24-03
24-71


TILLEGRA DAM
BOREHOLE: DDH 1
DEPTH: 25.00 — 32.92 M
26-10
29-70
32-10


TILLEGRA DAM
BOREHOLE: DDH 1
DEPTH: 32.92 — 40.70 M
35·70
SPACER
(36·80)
37·47
38·70


TILLEGRA DAM
BOREHOLE: DDH 1
DEPTH: 40.70 — 48.65 M
41·70
44·70
SPACER
46·57
47·70


TILLEGRA DAM
BOREHOLE: DDH 1
DEPTH: 48.65 — 56.50 M
48.65
50.70
53.70
SPACER

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

NSW Department of Commerce

BOREHOLE No. DDH 2 — Sheet 1 of 7 Sheets

PROJECT: TILLEGRA DAM
LOCATION: RIGHT SPILLWAY CHANNEL

CO-ORDINATES: E 376684, N 6427075

R.L. COLLAR: 107.2m
DATUM: AHD
BEARING: 090°M
INCLINATION: 60° from horizontal

DRILL: DELTA 2000, TRACK MOUNTED
CONTRACTOR: McDERMOTT DRILLING
CORE BARRELL: HQ TRIPLE
DRILLER: SHAUN TAYLOR
COMMENCED: 24.1.08
COMPLETED: 29.1.08

DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS NA
0–3.45					NON CORE							
3.45					CORING COMMENCES AT 3.45m							
3.45–4.20	HQ	RUN 1			Meta-sedimentary rock fragments (gravel) in a clayey silty sand matrix. Pale yellowbrown/greybrown, very stiff. Gravel: angular, ranging from 2 to 3mm to 50mm, gen HW, ranging to MW						NA	
4.20–4.35				X	CORE LOSS 0.15m							
4.35–5		RUN 2			As above (Probable slopewash).						NA	

Remarks:

Job / Report No. GN25A

Logged by: JOHN YOUNG — Date: 25.1.08 — Site Supervisor: MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 2

Sheet 2 of 7 Sheets

PROJECT TILLEGRA DAM

LOCATION RIGHT SPILLWAY CHANNEL

CO-ORDINATES E 376684 N 6423075

R.L. COLLAR 107.2m

DATUM AHD

BEARING 090 m

INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED

CONTRACTOR McDERMOTT DRILLING

COMMENCED 24.1.08

CORE BARRELL HQ TRIPLE

DRILLER SHAUN TAYLOR

COMPLETED 29.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS					
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS	NA
5					continues as above								
5.85	HQ	RUN 2 CONT.			Matrix predominantly pale grey / grey brown, moist, stiff / v. stiff.								
6													
7		RUN 3											
8													
8.85													
9		RUN 4											
10													

Remarks: BOX 1 ENDS AT 7.32m

Job / Report No. GN 25A

Logged by: JOHN YOUNG

Date: 29.1.08

Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 2
Sheet 3 of 7 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT SPILLWAY CHANNEL
CO-ORDINATES E 376684 N 6423075
R.L. COLLAR 107.2m
DATUM AHD
BEARING 090 M
INCLINATION 60° from horizontal

DRILL DEETA 2000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
COMMENCED 24.1.08
CORE BARREL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED 29.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS N/A
10					Continues as above							
11		RUN 5 CONTINUED									N/A	
11.85												
12												
12.40	HQ				12.40m Silty clay with gravel, dark grey, moist, stiff.							
13		RUN 6			Gravel fraction subangular/angular, metasedimentary. Generally HW, rarely to 75mm dimension							
13.30					13.30						N/A	
14					Meta-sedimentary gravel in clay silty sand/silty clayey sand matrix, generally pale grey, with orange/brown streaks, moist stiff. Gravel fraction angular to subrounded, HW to MW, ranging from several mm's to 50mm dimension.							
14.85												
15		27										

Remarks: BOX 2 ENDS AT 11.40m
Job / Report No. GN25A

Logged by: JOHN YOUNG
Date: 29.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 2
Sheet 4 of 7 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT SPILLWAY CHANNEL
CO-ORDINATES E 376684 N 6423075
R.L. COLLAR 107.2m
DATUM AHD
BEARING 090°m
INCLINATION 60° from horizontal

DRILL DELTA 1000, TRACK MOUNTED
CORE BARRELL HQ TRIPLE
CONTRACTOR McDERMOTT DRILLING
DRILLER SHAUN TAYLOR
COMMENCED 24.1.08
COMPLETED 29.1.08

DRILLING DATA				ROCK SUBSTANCE					ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS N/A
15					Continues as above							
					15.40m Well rounded gravel in a sandy clay/clayey sand matrix, generally pale gray/pale grey brown, with narrow orange brown zones. Gravel fraction ranges from several mm's to (say) 50mm dia., mostly fresh rock.							
16	HQ	RUN 5 CONTINUED									NR	
17												
17.10												
17.85											NR	
18												
		RUN 9			18.70m META-SHALE, brown/grey brown, thinly laminated/laminated at 10 to 15°							
18.70						MW	W/MS			18.70 } FRACTURE FRAGMENTS (gravel recovery), planar, rough, Fe st, occ. clay coated, 10 to 15 (where visible).	0%	
18.80										18.80 }		
19					CORE LOSS 0.28m							
19.08										19.08 } Numerous FRACTURES, 10 to 15° with associated JOINT 70°, planar, rough, Fe st, commonly clay coated.		
19.20					META-SHALES continue as above.	MW	SW/MS				0%	
19.33						EW	EW					
19.54						MW	SW/MS					
19.58		RUN 10			CORE LOSS 0.05m					19.53 }		
					META-SHALE, dk grey with pale brown laminations (banded). Thinly laminated/laminated at 10 to 15°	SW/MS	MS			19.58 FRACTURE, 15°, planar, rough, Fe st 19.67 JOINT, 30°, planar, rough, Fe st. 19.77 Probable DRILLING BREAK. 19.87 JOINT, 50°, planar, rough, Fe st.		
20												

Remarks: BOX 3 ENDS AT 15.40m BOX 4 ENDS AT 19.58m
Job / Report No. GN25A

Logged by: JOHN YOUNG
Date: 29.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 2 Sheet 5 of 7 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT SPILLWAY CHANNEL
CO-ORDINATES E 376684 N 6423075
R.L. COLLAR 107.2m DATUM AHD BEARING 090°M INCLINATION 60° from horizontal

DRILL DELTA 1000, TRUCK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 24.1.08 COMPLETED 29.1.08

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run, Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
20	HQ	RUN 11 CONT.		META-SHALE continues as above	SW/MW	MS			20.08 } Several JOINTS, 20 to 45°, planar, rough, Fe/Mn st. 20.17		
									20.33 JOINT, 45°, planar, very rough, Fe st.		
									20.47 PARTING, 10°, planar, rough, Fe st.		
									20.59 Probable DRILLING BREAK		
									20.72 JOINT, 50°, planar, rough, Fe st		
20.87									20.87 As above.		
20.90				20.90m TUFFACEOUS SANDSTONE, fine grained, grey/brown	MW						
21											
21.13				21.13m META-SHALE, dk grey/grey/brown, thinly laminated at 10 to 15°	SW/F(s)				21.11 As above		
									21.21 } As's PARTINGS, 10 to 15°, planar, rough, Fe/Mn st 21.33 21.40		
21.48				21.48m					21.47 JOINT, 60°, planar, rough, Fe st, sandy clay coating		
21.52				TUFFACEOUS SANDSTONE, medium grained, grey/grey/brown	F(s)				21.65 PARTING, 10° planar, rough, Fe st.		
21.65											
21.87				21.85m Includes META-SHALE lamination at 10°	MW/SW	S/MS					
21.90											
22		RUN 12			F(s)						
22.04				22.04m META-SHALE, dk grey/grey-brown, thinly laminated at 10°	SW	MS			21.85 JOINT, 30°, planar, rough, Fe st.		
22.14				22.14m					22.06 JOINT, 60°, planar, rough, Fe st.		
				TUFFACEOUS SANDSTONE, fine grained, grey					22.18 } Several intersecting JOINTS, 20 to 75°, planar, rough, Fe/Mn st. 22.25		
									22.46 HANDLING BREAK		
22.72									22.67 DRILLING BREAK		
22.86				22.86m Includes META-SHALE lamination at 15°	F(s)	S/MS			22.86 PARTING, 15°, planar, rough, Fe st.		
23											
									23.40 DRILLING BREAK		
23.85				23.85m Includes META-SHALE lamination as shown at 10°					23.85 DRILLING BREAK		
23.95				23.95m							
24				24.00m							
24.07				24.01m	SW						
24.16		RUN 13		24.16m					24.14 PARTING, 10°, planar, rough, Fe st.		
				TUFFACEOUS SANDSTONE continues.	F(s)				24.35 BOXING BREAK		
24.52									24.52 } Numerous JOINTS, 20 to 60°, planar rough, Fe st. Clay coating at 24.83m		
				24.70m META-SHALE lamination at 10°	SW						
24.80				24.80m META-SHALE, dk grey laminated at 10 to 15°		MS			24.92 } PARTING at 24.98m, 10°, planar, rough, Fe st.		
25				24.98m							

Remarks: BOX 5 ENDS AT 23.40m
Job / Report No. GN 25A

Logged by: JOHN YOUNG Date: 1.2.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 2 — Sheet 6 of 7 Sheets

PROJECT: TILLEGRA DAM
LOCATION: RIGHT SPILLWAY CHANNEL
CO-ORDINATES: E 376684, N 6422075
R.L. COLLAR: 107.2m
DATUM: AHD
BEARING: 090°m
INCLINATION: 60° from horizontal

DRILL: DELTA 1000, TRACK MOUNTED
CONTRACTOR: McDERMOTT DRILLING
CORE BARRELL: HQ TRIPLE
DRILLER: SHAUN TAYLOR
COMMENCED: 24.1.08
COMPLETED: 29.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
25					TUFFACEOUS SANDSTONE, fine grained, grey.	F(s)						
25.13										25.13 } Probable DRILLING BREAKS		
25.20					25.20m					25.20 }		
25.30					25.30m Includes META-SHALE laminations as shown at 10 to 15°	SW				25.30 BOXING BREAK		
25.43												
25.50					25.50m					25.67 JOINT, 60°, with associated PARTING, 15°, planar, rough.		
25.80					25.80 Grades to medium grained, TUFFACEOUS SANDSTONE		S/US					
26		RUN 14 CONTINUED										
26.25					26.25m META-SHALE, dark grey, laminated at 10° (poorly defined)	F(s)	MS/S			26.20 } Several JOINTS, 30 to 70°, planar, rough, Fast.		
26.67					26.67m					26.67 }		
26.75					TUFFACEOUS SANDSTONE, medium grained, grey.		S/US					
26.85	HQ									26.85 Several DRILLING BREAKS around 26.85m		
27.00					27.00m META-SHALE, dark grey, lam. at 10°		MS/S			27.00 } Several parallel JOINTS, 70°, planar, rough, minor carbonate coating.		
27.15					27.19m					27.15 }		
27.30		RUN 15			TUFFACEOUS SANDSTONE, fine grained, grey. (Includes elongate META-SHALE clasts to 27.45m, subrounded to 30mm dimension.					27.30 DRILLING BREAK		
27.45						F						
28										28.00 BOXING BREAK		
							S/US			28.57 HANDLING BREAK	100%	
										28.72 JOINT, 50°, planar, rough. carbonate coated.		
29										29.00 BOXING BREAK		
29.85		16								29.85 DRILLING BREAK		
30												

Remarks: BOX 6 ENDS AT 27.15m
Job / Report No. GN25A

Logged by: JOHN YOUNG
Date: 1.2.08
Site Supervisor: MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 2
Sheet 7 of 7 Sheets

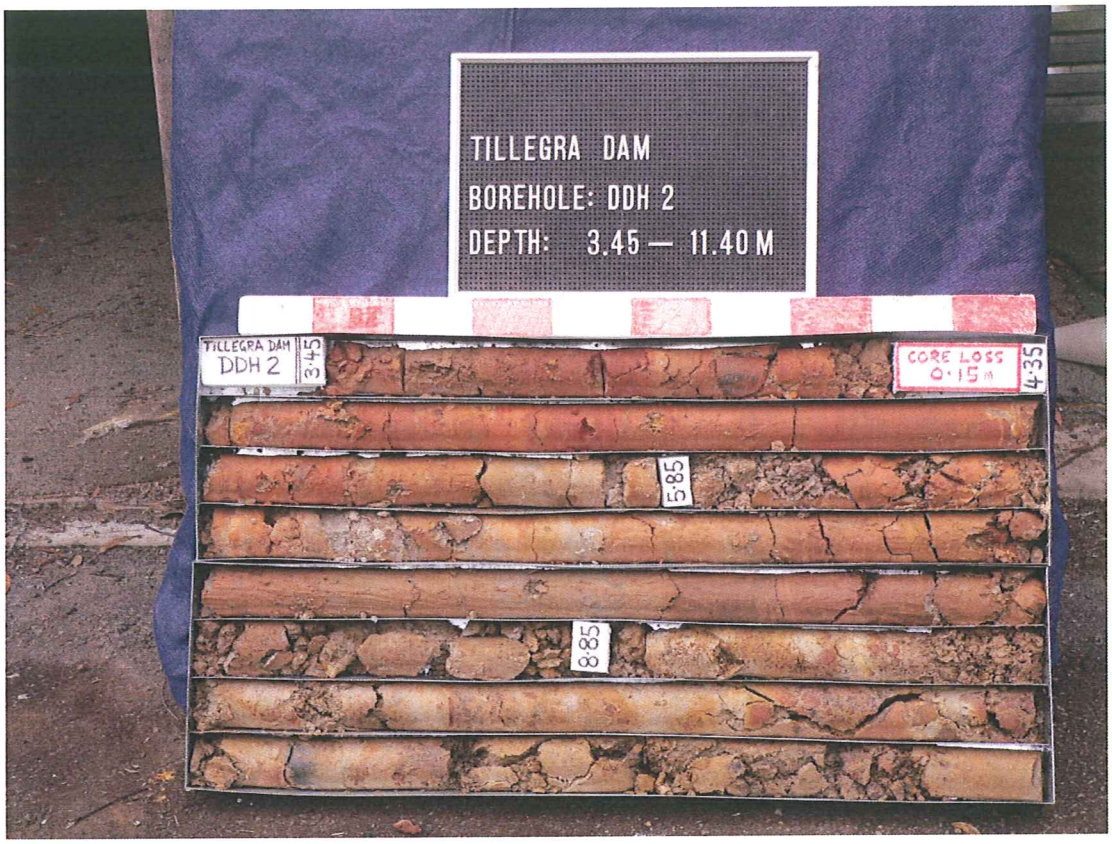
PROJECT TILLEGRA DAM
LOCATION RIGHT SPILLWAY CHANNEL
CO-ORDINATES E 376684 N 6422075
R.L. COLLAR 107.2m
DATUM AHD
BEARING 090°M
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
COMMENCED 24.1.08
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED 29.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS					
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS	N/A
30					TUFFACEOUS SANDSTONE continues, fine grained, grey.					30.33 Possible Joint, 50°, planar, rough. 30.41 As above, 30°. 30.55 Joint, 65°, planar, rough, carbonate fill to 1mm.			
31		RUN 16 CONTINUED								31.03 BOXING BREAK 31.10 Probable DRILLING BREAK			
31.25					31.25m Medium grained, poorly defined bedding at 10° Includes subangular lithic clasts to 3mm dimension						100%		
32	HQ					F	S/MS			31.92 DRILLING BREAK			
32.85										32.85 DRILLING BREAK 32.93 BOXING BREAK			
33													
34		RUN 17								33.90 DRILLING BREAK 34.09 Joint, 20°, planar, rough, carbonate coated.	100%		
34.80					HOLE ENDS AT 34.80m					34.80 DRILLING BREAK			
35													

Remarks: BOX 7 ENDS AT 31.03m BOX 8 ENDS AT 34.80m = END OF HOLE
Job / Report No. GN25A

Logged by: JOHN YOUNGS
Date: 1.2.08
Site Supervisor MARK ASHOVER


TILLEGRA DAM
BOREHOLE: DDH 2
DEPTH: 3.45 — 11.40 M
TILLEGRA DAM
DDH 2
3·45
CORE LOSS
0·15 m
4·35
5·85
8·85


TILLEGRA DAM
BOREHOLE: DDH 2
DEPTH: 11.40 — 19.58 M
11·85
14·85
17·10
17·85
CORE LOSS
(0·28m)
19·08
19·58


TILLEGRA DAM
BOREHOLE: DDH 2
DEPTH: 19.58 — 27.15 M
20.85
22.72
23.85
SPACER
26.85
SPACER
(27.05m)


TILLEGRA DAM
BOREHOLE: DDH 2
DEPTH: 27.15 — 34.80 M
29.85
SPACER
32.85
34.80
END
DDH 2

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 3
Sheet 1 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, INTERSECTION OF ℄ AND DIVERSION TUNNEL
CO-ORDINATES E 376494 N 6423242
R.L. COLLAR 118.7m
DATUM AHD
BEARING 070°m
INCLINATION 60° from horizontal
COMMENCED
COMPLETED 23.1.08
DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
0					NON CORE							
					CORING COMMENCES AT 0.70m							
0.70	HQ	RUN 1			META-SHALE, brown/greybrown/dark grey, banded. Thinly laminated to laminated at 10 to 15°	SW/F(S)	MS/S			0.70 / 0.81 } JOINT, 80, with associated PARTINGS, 15°, planar, rough, Fe/Mn st.	50%	
1										1.00 / 1.11 } 3x's PARTINGS, 10 to 15°, planar, rough, Fe st.		
										1.20 / 1.22 } PARTING FRAGMENTS, 10°, planar, rough, Fe/Mn st.		
										1.50 PARTING, 10°, planar, rough, Fe st, clay coated.		
1.70		RUN 2			TUFF. s/s, very fine grained, grey, with META-SHALE laminations at 10 to 15°					1.70 JOINT, 60°, planar, rough, Fe st		
1.86										1.86 DRILLING BREAK		
2.02											83%	
2.12		RUN 3			META-SHALE, greybrown/grey/dark grey, banded. Thinly laminated to laminated at 10°					2.07 / 2.17 } Severed PARTINGS, 10°, planar, rough, Fe st.		
2.26										2.32 Probable DRILLING BREAK		
2.45		RUN 4								2.44 / 2.47 } 2x's PARTINGS, 10°, planar, rough, Fe st.	55%	No TEST
										2.67 PARTING, 10°, planar, rough, Fe st		
2.75											78%	
2.83					TUFFACEOUS SANDSTONE, very fine grained, grey.					2.83 DRILLING BREAK		
3		RUN 5				F(S)	S/HS			3.25 JOINT, 65°, planar, rough, Fe st		
										3.30 BOXING BREAK		
										3.51 HANDLING BREAK		
3.83											100%	
4										4.10 HANDLING BREAK		
4.33		RUN 6								4.33 DRILLING BREAK		1m
4.85					4.85 Brown/greybrown	MW	S			4.85 PARTING, 10°, planar, rough, Fe st.		
5										4.93 ↓ See over		

Remarks: BOX 1 ENDS AT 4.33m
Job / Report No. GM25A
Logged by: JOHN YOUNG
Date: 23.1.08
Site Supervisor MARK ASHOVER

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

NSW Department of Commerce

BOREHOLE No. DDH 3

Sheet 2 of 9 Sheets

PROJECT TILLEGRA DAM

LOCATION RIGHT ABUTMENT, INTERSECTION OF ℄ AND DIVERSION TUNNEL

CO-ORDINATES E 376494 N 6423242

R.L. COLLAR 118.7m AHD

DATUM

BEARING 070° M

INCLINATION 60° from horizontal

DRILL DELTA 7000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 17.1.08

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 23.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
5					TUFFACEOUS SANDSTONE continues, very fine grained, brown/grey brown.					5.14 JOINT / PARTING FRAGMENTS, 45 to 60° and 10° respectively, planar, rough, Fest 5.32 PARTING, 10°, planar, rough, Fe st. 5.40 As above.		
	HQ	RUN 6 CONT.				MW	S			5.48 Joint, 45°, planar, rough, Fe st. 5.59 Numerous PARTINGS, 5 to 15°, planar, rough, Fe/Mn st. 5.88	50%	
5.83 5.92					5.92m					6.00 PARTING, 10°, planar, rough, Fe/Mast.		
										6.11 6.22 6.29 6.34 6.46 5x's PARTINGS, 5 to 15°, planar, rough, Fe/Mn st.		
										6.81 Joint, 50°, planar, rough, Fe st.		
					Grey.					6.97 Joint, 60°, planar, rough, Fe/Mn st.	67%	14L
7		RUN 7				F(s)	S/VS			7.14 DRILLING BREAK 7.20 Joint, 45°, planar, rough, Fe st. 7.29 DRILLING BREAK		
7.43										7.43 As above		
		RUN 8								7.85 8.00 2x's Joints, 65°, planar, rough, Fe st.		
8										8.15 HANDLING BREAK 8.25 Boxing BREAK	60%	
8.177										8.40 Joint, 65°, planar, rough, Fe st.		
8.70					8.70m					8.67 Joint, 50°, planar, rough, Fe/Mn st.		
8.83 8.92					Brown/grey brown, includes META-SHALE	MW	S			8.77 8.88 Several PARTINGS, 10°, with Joint, 45°, planar, rough, Fe st.		
9					8.92m lamination at 8.82m, 10°.					9.05 DRILLING BREAK		
		RUN 9			TUFFACEOUS SANDSTONE continues, very fine grained, grey	F(s)	S/VS			9.25 Boxing BREAK 9.35 Joint, 60°, planar, rough, minor Fe st.		21L
10												

Remarks: BOX 2 ENDS AT 8.25m

Job / Report No. GN25A

Logged by: JOHN YOUNG Date: 23.1.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 3 — Sheet 2 of 4 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, INTERSECTION OF ℄ AND DIVERSION TUNNEL
CO-ORDINATES E 376494 N 6422242
R.L. COLLAR 118.7m DATUM AHD BEARING 070°M INCLINATION 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 17.1.08 COMPLETED 23.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
10					TUFFACEOUS SANDSTONE continues, very fine grained, grey.					10.05 Probable DRILLING BREAK 10.11 HANDLING BREAK 10.28 BOXING BREAK 10.37 HANDLING BREAK 10.48 Possible JOINT, 60°, planar, rough, carbonate coated 10.61 As above 10.70 } 2x's PARTINGS, 15°, planar, rough, minor Fe st. 10.73 }		
11	HQ	RUN 9 CONTINUED			Includes occasional carbonate veins, generally less than 1mm	F(5)	S/W			11.13 Possible JOINT, 60°, planar, rough, carbonate coated 11.28 DRILLING BREAK 11.45 DRILLING BREAK	100%	
11.83										11.83 DRILLING BREAK		
12										12.11 HANDLING BREAK 12.22 Probable JOINT, 50°, planar, rough, minor Fe st., carbonate coated		L1 UL
										12.64 JOINT, 60°, planar, rough, minor Fe st., carbonate coated. 12.78 Possible JOINT, 60°, planar, rough, carbonate coated 12.88 Possible JOINT, 45°, as above.		
13										13.10 Probable DRILLING BREAK 13.22 JOINT, 45°, curved, rough, Fe st	76%	
13.48 13.51					13.48m — 13.51m META-SUBLE laminations at 5 and 10°					13.45 PARTING, 5°, planar, rough, Fe st 13.53 As above, minor Fe st.		
13.70		RUN 10			13.70m — Tuff. S/s continues, medium grained					13.70 Possible PARTING, 15°, planar, rough, carbonate coated (may be drilling induced)		
14					Very fine grained, grey					13.87 Possible JOINT, 40°, planar, rough, carbonate coated. 14.13 } 2x's parallel JOINTS, 75°, planar, rough, minor Fe st. 14.37 }		
14.44												
14.73		RUN 11								14.70 DRILLING BREAK	100%	
15										14.93 } See over		15UL

Remarks: Box 3 ENDS AT 12.22m — Job / Report No. GN 25A

Logged by: JOHN YOUNG — Date: 23.1.08 — Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 3 Sheet 4 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, INTERSECTION OF ℄ AND DIVERSION TUNNEL
CO-ORDINATES E 376494 N 6423247
R.L. COLLAR 118.7m DATUM AHD BEARING 070° M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRUCK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 12.1.08 COMPLETED 23.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
15		RUN 12 CONTINUED			TUFFACEOUS SANDSTONE continues, very fine grained, grey.					Several parallel JOINTS, 75°, planar, rough, heavy Fe/Mn st.		
15.28										15.28		
15.47					15.47m Medium grained					15.47 JOINT, 45°, planar, rough, Fe st		
										15.52 PARTING, 5°, planar, v. rough, Fe st		
										15.60 Probable DRILLING BREAK		
15.72					15.72m	F(s)	S/VS			15.70		
										15.81 JOINT, 65°, planar, rough, Fe/Mn st.		
										15.96 BOXING BREAK		
16					Very fine grained.							15 UL
										16.40 JOINT, 65°, planar, rough, Fe st.	70%	
										16.56 DRILLING BREAK		
16.70					16.70m		MS/S			16.70 Numerous PARTINGS, 10°, planar, Fe st.		
16.88					16.88m laminated at 10°					16.91		
17	HQ				TUFFACEOUS SANDSTONE, very fine grained to fine-medium grained with depth, grey.		S/VS					
17.30										17.42 JOINT, 60°, planar, rough, Fe st.		
17.60					17.60m					17.63 PARTING, 10°, planar, rough, minor Fe st.		
17.73					META-SHALE, dark grey, with TUFF. S/S. laminations at 10°, fine grained, grey.		MS/S			17.73 As above		
17.92										17.92 2 x PARTINGS, 5°, planar, rough, minor Fe st.		
18										17.94		
18.03		RUN 13			18.03m TUFF. S/S., v. fine/fine grained, grey.		S/VS				98%	
18.20					18.20m META-SHALE, grey/dk. grey, banded. Thinly laminated at 5 to 10°		MS/S			18.21 Probable DRILLING BREAK		
										18.41 HANDLING BREAK		
18.50										18.50 PARTING, 5°, planar, rough, Fe st.		
18.51					18.51m TUFF. S/S., v. fine/fine gr.		S/VS					10 UL
18.69					18.69m META-SHALE, dk grey, thinly laminated at 5°		MS/S			18.73 As above		
18.78					18.78m TUFF. S/S., fine gr., grey.		S/VS					
18.95					18.95m META-SHALE, grey/dk grey, banded at 10°		MS/S			18.98 PARTING, 10°, as above		
19												
19.05		RUN 14			19.05m TUFF. S/S., fine gr., grey.		S/VS					
19.17					19.17m META-SHALE, grey/dk grey, banded Thinly laminated at 5 to 10°		MS/S			19.20 As above.		
19.37					19.37m					19.37 Intersecting JOINT, 30° and PARTING, 5°, planar, rough, Fe st		
					TUFFACEOUS SANDSTONE, fine grained, grey.		S/VS					
										19.78 BOXING BREAK		
20										19.94 PARTING, 10°, irregular, rough, Fe st.		

Remarks: BOX 4 ENDS AT 15.96m BOX 5 ENDS AT 19.78m
Job / Report No. GN25A

Logged by: JOHN YOUNG Date: 23.1.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 3 — Sheet 5 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, INTERSECTION OF ℄ AND DIVERSION TUNNEL
CO-ORDINATES E 376494 N 6423242
R.L. COLLAR 118.7m AHD
DATUM
BEARING 070° M
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMMENCED 12.1.08
COMPLETED 23.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
20					TUFFACEOUS SANDSTONE continues, very fine/fine grained, grey.							
	HQ	RUN 14 LOST.				F (s)	S/VS			20.42 PARTING, 15°, planar, rough, Fe st.	100%	10 UL
20.80										20.72 DRILLING BREAK		
21										21.14 Probable DRILLING BREAK		
21.38		RUN 15			21.30m					21.30		
					Grey/greybrown	SW				Numerous JOINTS/JOINT FRAGMENTS, 60 to 70°, planar, rough, Fe st. (sheared)	35%	>100 UL
22												
22.17					22.18m	MW	HW					
22.55					Brown 22.55m					22.68		
22.75										22.70 DRILLING BREAK		
					Grey. (very fine/fine grained).	F (s)	S/VS			22.86 JOINT, 60°, planar, rough, Fe st		
23		RUN 16								23.03 As above	100%	
23.20										23.27 DRILLING BREAK		
23.37												
		RUN 17								23.71 BOXING BREAK	100%	78 UL
23.80										23.80 DRILLING BREAK		
		18								24.05 JOINT, 60°, planar, rough, Fe st.		
24.00										24.00 DRILLING BREAK		
		RUN 19								24.14 JOINT, 60°, planar, rough, Fe st		
										24.56 JOINT, 65°, planar, rough, Fe st.	100%	
										24.65 JOINT, 45°, planar, rough, Fe st.		
25												

Remarks: BOX 6 ENDS AT 23.71m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 23.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 3
Sheet 6 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, INTERSECTION OF ℄ AND DIVERSION TUNNEL
CO-ORDINATES E 376494 N 6472242
R.L. COLLAR 118.7m
DATUM AHD
BEARING 070°M
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMMENCED 12.1.08
COMPLETED 23.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
25 25.10	HQ	Runs 20	W		TUFFACEOUS SANDSTONE continues, very fine/fine grained, grey.					25.03 } DRILLING BREAKS 25.10 } 25.35 JOINT, 65°, planar, rough, Fe st 25.52 As above		
26						F(3)	S/MS			26.00 } 2x's JOINTS, 70°, planar, rough, Fe st 26.46 }	70%	38 UL
26.80 26.90 27		Runs 7.1			26.90m Grades to medium grained from 26.90m. Includes sub angular, equidimensional lithic clasts to 3mm.					26.80 DRILLING BREAK 27.24 BOXING BREAK 27.71 DRILLING BREAK		
28										28.11 PARTING, 15°, planar, rough, Fe st.	70%	>100 UL
29 29.06					29.06m META-SHALE, dk grey, thinly laminated / laminated at 10°		MS/S			28.72 JOINT, 55°, planar, rough, Fe st. 28.77 DRILLING BREAK		
29.33 29.49 29.52		RT22			29.33m TUFF, S/S., medium grained, grey. 29.49 META-SHALE, dark grey. Thinly laminated / laminated at 10°. Includes occasional TUFF S/S laminations, very fine grained.		S/VS MS/S			29.14 Possible JOINT, 65°, planar, rough, (may be drilling induced) 29.21 } JOINT/PARTING FRAGMENTS (gravel recovery), planar, rough, Fe st (partly handling induced). 29.33 } 29.49 } Numerous PARTINGS, 10°, with associated JOINT, 80°, planar, rough, Fe st. 29.78	90% 0%	
29.83 30		BX4								29.85 } 29.90 } 2x's PARTINGS, 10°, planar, rough, Fe st.		8 UL

Remarks: BOX ENDS AT 27.24m
Job / Report No. GN25A

Logged by: JOHN YOUNG
Date: 24.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 3 Sheet 7 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, INTERSECTION OF ℄ AND DIVERSION TUNNEL
CO-ORDINATES E 376494 N 6423242
R.L. COLLAR 118.7m DATUM AHD BEARING 070°M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 17.1.08
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 23.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
30		RUN 29.60			META-SHALE continues as above. Includes very fine grained TUFF. s/s laminations (at 5 to 10°).		MS/S			30.05 Numerous PARTINGS, 5° to 10°, with associated JOINTS, 45° to 60°, planar rough, Fe st. Clay filled 10mm thick in parting at 30.26m	78%	
30.66										30.66		
										30.75 PARTING, 10°, planar, rough, minor Fe st.		
31.00					31.00m TUFF. s/s., very fine grained, grey.		S/S			31.00 As above		
31.22					31.22m					31.22 As above		
	HQ				META-SHALE dark grey, with very fine grained TUFFACEOUS SANDSTONE laminations, grey, banded. Thinly laminated/ laminated at 5° to 15°					31.41 Numerous PARTINGS, 10° to 15°, planar, rough, Fe st. 31.50 31.61 31.70 31.76 Includes crushed zone from 31.72 to 31.76m 31.82	1.59	8 UL
32						F(S)	MS/S			32.02 32.07 32.14 Numerous PARTINGS, 10°, planar, rough, minor Fe st. Crushed zone 10mm thick at 32.07m. 32.20 32.25 JOINT, 60°, planar, rough. 32.29 32.48 Probable DRILLING BREAKS		
32.30										32.32 PARTING, 5°, planar, rough, Fe st. 32.83 DRILLING BREAK		
32.83												
33										33.02 Possible PARTING, 5°, planar, rough, minor Fe st. 33.13 Probable DRILLING BREAK		
33.15		RUN 34			33.15m TUFFACEOUS SANDSTONE, very fine grained, grey.		S/S					
33.42					33.42m					33.42 JOINT, 80°, with numerous associated PARTINGS, planar, rough, Fe st. Joint carbonate coated. 33.95		7 UL
					META-SHALE, dk grey, with very fine grained TUFF, SANDSTONE laminations/ interbeds, grey. Thinly laminated to very thinly bedded at 5 to 15°		MS/S				2.08	
34										34.22 Probable DRILLING BREAK		
										34.43 PARTING, 15°, planar, rough, Fe st. 34.47 PARTING, 5°, as above		
34.60					34.60m TUFFACEOUS SANDSTONE, fine-medium to medium grained, grey.		S/VS			34.62 34.67 34.72 3x's PARTINGS, 15°, planar, rough, Fe st.		
35										34.98 JOINT, 65°, planar rough, Fe st.		

Remarks: BOX & ENDS AT 31.00m Job /Report No. GN 25A

Logged by: JOHN YOULSG Date: 24.1.08 Site Supervisor MARK ASHOVER

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

NSW Department of Commerce

BOREHOLE No. DDH 3

Sheet 8 of 9 Sheets

PROJECT TILLEGRA DAM	CO-ORDINATES	R.L. COLLAR 118.7m	
LOCATION RIGHT ABUTMENT, INTERSECTION OF ℄ WITH DIVERSION TUNNEL	E 376494	DATUM AHD	
	N 6423242	BEARING 070°M	
		INCLINATION 60° from horizontal	
DRILL DELTA 2000, TRUCK MOUNTED	CONTRACTOR McDERMOTT DRILLING	COMMENCED 12.1.08	
CORE BARRELL HQ TRIPLE	DRILLER SHAUN TAYLOR	COMPLETED 23.1.08	

Depth (R.L.) metres	Method	Casing, Run	Graphic log	Description — Rock type	Weathering	Estimated strength	Defect description	R.Q.D.	Tests (WPT)
35 – 35.16	HQ	R26	Sandstone	TUFFACEOUS SANDSTONE continues, fine-medium to medium grained, grey.	F(s)	S/VS	35.09 JOINT, 65°, planar, rough, Fe st.; 35.12 DRILLING BREAK		7 UL
35.16 – 35.83		RUN 27					35.22 PARTING, 5°, planar, rough, Fe st.; 35.43 JOINT, irregular, rough, Fe st., 45°; 35.68 PARTING, 5°, planar, rough, Fe st; 35.83 DRILLING BREAK	100%	
35.83 – 36.02				36.02m					
36.02 – 36.42			Shale	META-SHALE, dark grey, thinly laminated at 5°		MS/S	36.02 – 36.42 JOINT, 80°, with numerous associated PARTINGS, 5°, planar, rough, Fe st.		
36.42 – 38.42		RUN 28	Sandstone	36.42m TUFFACEOUS SANDSTONE, fine-medium to medium grained, grey. Includes occasional carbonate veins, generally less than 1mm	F	S/VS	36.85 JOINT, 60°, planar, rough, Fe st.; 37.31 Probable DRILLING BREAK; 37.70 DRILLING BREAK; 37.84 HANDLING BREAK; 38.42 DRILLING BREAK	77%	1.5 UL
38.42 – 38.83		RUN 29					38.74 DRILLING BREAK; 38.81 DRILLING BREAK	100%	
38.83 – 40		RUN 30		39.03m Very fine grained			39.05 – 39.49 Several JOINTS, 60°, with associated PARTINGS, 5° to 10°, planar, rough, often carbonate coated.; 39.52 Possible PARTING, 5°, planar, rough, carbonate coated.; 39.67 – 39.95 JOINT/PARTING FRAGMENTS, 60 to 70° and 10° respectively, planar, rough, often carbonate coated.		1.5 UL

Defect spacing (mm): 2000, 600, 200, 60, 20

Remarks: BOX 9 ENDS AT 35.05m BOX 10 ENDS AT 38.74m

Job / Report No. GN 25A

Logged by: JOHN YOUNG Date: 24.1.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 3 — Sheet 9 of 9 Sheets

PROJECT: TILLEGRA DAM
LOCATION: RIGHT ABUTMENT, INTERSECTION OF ℄ AND DIVERSION TUNNEL
CO-ORDINATES: E 376494, N 6423242
R.L. COLLAR: 118.7m AHD
DATUM:
BEARING: 070° M
INCLINATION: 60° from horizontal

DRILL: DELTA 1000, TRACK MOUNTED
CONTRACTOR: McDERMOTT DRILLING
CORE BARRELL: HQ TRIPLE
DRILLER: SHAUN TAYLOR
COMMENCED: 17.1.08
COMPLETED: 23.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
40	HQ	RUN 30 CONTINUES			TUFFACEOUS SANDSTONE continues, very fine grained, grey.					40.03 Possible PARTING, 5°, planar, rough.		
										40.35 Probable DRILLING BREAK.		
40.68					40.68m Medium-coarse grained	F	S/W S			40.68 Possible PARTING, 10°, planar, rough, carbonate fill to 2mm		
41										41.01 DRILLING BREAK	100%	1.5 uc
41.24					41.24m META-SHALE laminations at 10°					41.21 Possible PARTING, 10°, planar, rough.		
					Medium-coarse grained TUFF. S/S. continues					41.37 DRILLING BREAK		
										41.51 As above		
										41.61 As above		
										41.69 DRILLING/HANDLING BREAK		
41.85					END OF HOLE					41.85 DRILLING BREAK		
42												
43												
44												
45												

Remarks: BOX 11 ENDS AT 41.85m = END OF HOLE
Job / Report No. GN 29A

Logged by: JOHN YOUNG
Date: 24.1.08
Site Supervisor: MARK ASHOVER


TILLEGRA DAM
BOREHOLE: DDH 3
DEPTH: 0.70 — 4.33 M
TILLEGRA DAM
DDH 3
0·70
1·70
2·12
2·45
2·83
4·33


TILLEGRA DAM
BOREHOLE: DDH 3
DEPTH: 4.33 — 12.22 M
5·83
7·43
8·83
11·83


TILLEGRA DAM
BOREHOLE: DDH 3
DEPTH: 12.22 — 19.78 M
SPACER
SPACER
14·44
14·73
17·73
18·50
SPACER
(1985)


TILLEGRA DAM
BOREHOLE: DDH 3
DEPTH: 19.78— 27.24 M
20·80
22·75
23·31
23·80
24·00
25·10
SPACER
26·80


TILLEGRA DAM
BOREHOLE: DDH 3
DEPTH: 27.24 — 35.05 M
29.33
29.52
29.83
30.66
32.83


TILLEGRA DAM
BOREHOLE: DDH 3
DEPTH: 35.05 — 41.85 M
35.16
35.83
SPACER
38.42
38.83
SPACER
41.85
END DDH 3

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1 Sheet 1 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, U/S DIVERSION PORTAL
CO-ORDINATES E 376309 N 6423179
R.L. COLLAR 122.4m AHD
DATUM
BEARING 085° M
INCLINATION 60° from horizontal

DRILL DELTA 1000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE. DRILLER SHAUN TAYLOR.
COMMENCED 8.1.08
COMPLETED 11.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
0					NON CORE							
0.90					CORING COMMENCES AT 0.90m							
1		RUN 1			TUFFACEOUS SANDSTONE, fine grained, grey/brown Includes angular lithic clasts to 5mm dimension, lighter coloured, creating a speckled appearance.	MW/SW	MS			0.90 - JOINT/PARTING FRAGMENTS. PARTINGS, 10 to 15°, planar, rough, Fe/Mn st. Rare sandy clay coatings. JOINTS, 30 to 80°, planar, rough, Fe/Mn st. Occasional sandy clay coatings.	0%	
1.75												
2												
2.10		RUN 2			2.10m Grey/brown/brown.	MW					0%	
2.31					CORE LOSS 0.20 = non core, casing reseated.					2.31		
2.51		RUN 3								2.51 - Numerous JOINTS, 45 to 65°, planar, rough, Fe/Mn st.	0%	
2.70	HQ				TUFFACEOUS SANDSTONE continues as above.	MW/SW	MS					
3												
3.06		RUN 4								3.06 3.12 JOINT, 30°, planar, rough, Fe/Mn st.	40%	
3.25					3.25m							
3.40					Includes META-SHALE laminations at 10 to 15°	SW	S			3.40 JOINT, 40°, planar, rough, Fe/Mn st 3.50 JOINT, 80°, with associated PARTINGS, 15°, planar, rough, Fe/Mn st, clay 3.60 BOXING BREAK coated, rootlets.		
3.45												
3.70		RUN 5			3.70 META-SHALE lamination at 15°					3.72 PARTING, 15°, planar, rough, Fe st.	45%	
3.80					3.88 META-SHALE laminations at 10 to 15°							
3.88												
4.00					4.05 META-SHALE lamination at 10°					4.04 JOINT, 60°, planar, rough, Fe st. 4.12 PARTING, 15°, planar, rough, Fe st		
4.05												
4.20		RUN 6			TUFFACEOUS SANDSTONE continues.	MW	MS			4.20 - JOINT/PARTING FRAGMENTS, 45 to 60° and 15° respectively, planar, rough, Fe/Mn st	0%	12 UL
4.85										4.85		
5.00					CORE LOSS 0.15m							

Remarks: BOX I ENDS AT 4.60m
Job / Report No. GN 2FA
Logged by: JOHN YOUNG
Date: 10.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 4 Sheet 2 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, U/S DIVERSION PORTAL
CO-ORDINATES E 376309 N 6423179
R.L. COLLAR 122.4 m
DATUM AHD
BEARING 085°M
INCLINATION 60° from horizontal

DRILL DELTA 7000, TRACK MOUNTED
CONTRACTOR MCDERMOTT DRILLING
COMMENCED 8.1.08
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED 11.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
5						MW						
5.35					TUFFACEOUS SANDSTONE continues, fine grained with angular clasts rarely to 3mm dimension, grey/brown. (speckled appearance)	MW/SW	MS			5.60 Numerous JOINTS, 30 to 60°, with associated PARTINGS, 10 to 15°, planar, rough, Fe/Mn st.		
										5.39		
										5.50 PARTING, 10°, planar, rough, Fe/Mn st.		
										5.63 As above		
6.00					6.00m					6.00	45%	
	HQ	RUN 7			Grey.					6.14 PARTING, 10°, planar, rough, Fe st.		12 cl
										6.40 As above		
						FR(S)	S/HS			6.62 BOXING BREAK 6.69 JOINT, 20°, planar, rough, Fe st. 6.75 } 2x's PARTINGS, 10°, planar, rough, Fe st. 6.77 }		
7										7.02 Several JOINTS, 70°, planar, rough Fe st.		
7.20										7.20		
		RUN 8								7.29 2x's JOINTS, 90°, planar, rough, Fe st.		
										7.55		
										7.72 JOINT, 20°, planar, rough, Fe st		
8.00					8.00m METH-SHALE lamination at 15°					8.00 PARTING, 10°, planar, rough, Fe/Mn st.		
					TUFFACEOUS SANDSTONE continues as above.					8.22 As above	75%	13 cl
										8.43 } As above. 8.54 }		
										8.75 JOINT, 60°, planar, rough, Fe st.		
9										8.98 3x's PARTINGS, 10 to 15°, planar, rough, Fe st.		
										9.26		
										9.35		
9.51		RUN 9								9.44 JOINT, 60°, planar, rough, Fe st.	100%	
9.67										9.62 As above		
9.80		RUN 10								9.67 Numerous PARTINGS, 15°, with associated JOINTS, 45 to 60°, planar, rough, Fe/Mn st.		11 cl
10												

Remarks: BOX 2 ENDS AT 8.54m
Job / Report No. GN 25A
Logged by: JOHN YOULDEN
Date: 10.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 4
Sheet 3 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, U/S DIVERSION PORTAL
CO-ORDINATES E 376309 N 6423179
R.L. COLLAR 122.4 m AHD
BEARING 025° M
INCLINATION 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARREL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 8.1.08
COMPLETED 11.1.08

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run, Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
10				TUFFACEOUS SANDSTONE continues, fine grained, grey, angular lithic clasts persist generally to 1mm dimension (speckled).		S/HS			10.02 As above.		
10.20		RIG							10.20 DRILLING BREAK		
									10.30 BOXING BREAK		
									10.42 JOINT, 55°, planar, rough, Fe/Mn st.		
		RUN 11		10.81m META-SHALE, dk grey, 10.86m laminated at 10°		MEL			10.86 Probable DRILLING BREAK		
10.81 10.86											
11									11.09 PARTING, 10°, planar, rough, Fe/Mn st.		
	HQ				F(S)				11.28 JOINT, 50°, planar, rough, Fe/Mn st.		
				TUFFACEOUS SANDSTONE continues							
									11.80 JOINT, 45°, planar, rough, Fe st.	75%	11 UL
						S/HS			11.94		
12									Numerous JOINTS, 45°, planar, rough, Fe/Mn st.		
									12.27		
12.80									12.75		
13.00 13.02				13.00 META-SHALE lamination 13.02 at 10°					JOINT, 80 to 90°, with associated PARTINGS, 15°, and other intersecting JOINTS, 45 to 60°, planar, rough, Fe/Mn st.		
13.20									13.74		
		RUN 12							13.94 JOINT, 60°, planar, rough, Fe/Mn st.		4 UL
14				TUFFACEOUS SANDSTONE continues					14.13 JOINT, 70°, planar, rough, Fe/Mn st.	72%	
									14.42		
									14.56 PARTING, 5°, planar, rough, Fe st.		
15											

Remarks: BOX 3 ENDS AT 12.27
Job / Report No. GM 25A

Logged by: JOHN YOUNGS
Date: 11.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 4 Sheet 4 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, U/S DIVERSION PORTAL
CO-ORDINATES E 376309 N 6423179
R.L. COLLAR 122.4m DATUM AHD BEARING 085°M INCLINATION 60° from horizontal
DRILL DELTA, 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 8.1.08 COMPLETED 11.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
15	HQ	RUN 12 cont.			TUFFACEOUS SANDSTONE continues, fine grained, grey, includes angular lithic clasts generally in the size range 1to 2mm (lightly coloured, flecked).					15.25 DRILLING BREAK.		4 UL
15.80										15.80 Joint, 70°, planar, rough, Fe/Mn st, partly carbonate coated. Intersecting PARTING at 16.01m, 10°, planar, rough, Fe st		
16						F(5)	S/VS					
16.08										16.18 DRILLING BREAK		
16.20												
		RUN 13								16.71 Joint, 75°, planar, rough, Fe/Mn st, Intersecting Joint, 60°, at 16.87m, as above.		
17										17.15		
										17.18 PARTING, 10°, planar, rough, Fe st		1 UL
										17.45 Joint, 65°, planar, rough, Fe/Mn st.		
										17.60 DRILLING BREAK	78%	
18										18.18 BOXING BREAK		
18.86					18.86m META-SHALE, dk grey, thinly laminated at 15°							
18.94					18.94m							
19					TUFFACEOUS SANDSTONE continues.					19.05 3x± possible PARTINGS, 10°, planar, rough, minor Fe st (may be drilling induced) 19.10 19.13		
19.20					19.35m							
19.35		RUN 14			Angular lithic clasts range to 4mm dimension. (persists to approx. 20m)					19.40 Intersecting Joints, 45° and 60°, planar, rough, Fe st (minor)		
										19.54 Probable DRILLING BREAK		
										19.77 Joint FRAGMENTS, 45° to 60°, planar, rough, Fe/Mn st.		
20												

Remarks: BOX 4 ENDS AT 16.18 m
Job / Report No. GN25A
Logged by: JOHN YOUNG
Date: 11.8.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 4 Sheet 5 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, U/S DIVERSION PORTAL
CO-ORDINATES E 376309 N 6422179
R.L. COLLAR 122.4m DATUM AHD BEARING 085° M INCLINATION 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR MCDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 8.1.08 COMPLETED 11.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
20					TUFFACEOUS SANDSTONE continues, fine grained, grey. Lightly coloured, angular lithic clasts generally to 1mm dimension, rarely 2mm					20.05 BOXING BREAK 20.18 Probable DRILLING BREAK 20.34 DRILLING BREAK 20.64 } 3x's PARTINGS, 15° to 20°, planar, rough, Fe st. 20.71 } 20.85 } 20.95 } Several HANDLING BREAKS 21.06 } plus BOXING BREAK at 21.06m		
21	HQ	RUN 14									85%	1 UL
21.80										21.58 Possible JOINT, 50°, planar, rough, minor Fe st, carbonate fill 1-2mm thick (may be drilling induced).		
22						(6)	S/HS			22.07 DRILLING BREAK		
22.20												
22.42					22.42m META-SHALE lamination at 15°							
23		RUN 15			TUFFACEOUS SANDSTONE continues.					23.05 BOXING BREAK	100%	0 UL
24										24.06 BOXING BREAK 24.24 Probable DRILLING BREAK 24.50 Interacting PARTING, 15, and JOINT, 45°, planar, rough, Fe st.		
25										24.88 PARTING, 10°, planar, rough, Fe st.		

Remarks: BOX 5 ENDS AT 20.05m BOX 6 ENDS AT 24.06m
Job / Report No. GN25A
Logged by: JOHN YOUNG Date: 11/12.1.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 4 — Sheet 6 of 9 Sheets

PROJECT: TILLEGRA DAM	CO-ORDINATES	R.L. COLLAR: 122.4m	
LOCATION: RIGHT ABUTMENT, u/s DIVERSION PORTAL	E 376309 / N 6423179	DATUM: AHD / BEARING: 085° M / INCLINATION: 60° from horizontal	
DRILL: DELTA 2000, TRACK MOUNTED	CONTRACTOR: McDERMOTT DRILLING	COMMENCED: 8.1.08	
CORE BARRELL: HQ TRIPLE	DRILLER: SHAUN TAYLOR	COMPLETED: 11.1.08	

DRILLING DATA / ROCK SUBSTANCE / ROCK MASS DEFECTS

Columns: DEPTH (R.L.) METRES | Method | Casing, Run | Water | GRAPHIC LOG | DESCRIPTION (ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness) | WEATHERING | ESTIMATED STRENGTH | DEFECT SPACING (mm) 2000 600 200 60 20 | VISUAL LOG | DEFECT DESCRIPTION (TYPE: Inclination, planarity, roughness, coatings or infillings) | R.Q.D. | TESTS WPT

Method: HQ. Runs: R15 (to 25.20), RUN 16 (25.20–28.20), RUN 17 (28.20–). Weathering: F(s). Estimated strength: S/VS; MS/S, S/VS, MS/S (29.47–30).

Depth (m)	Rock substance description	Defect description
25	TUFFACEOUS SANDSTONE continues as above	25.09 BOXING BREAK
25.20		25.20 DRILLING BREAK
		25.43 HANDLING BREAK
26.00	26.00m Lithic clasts less <1mm, less obvious.	26.00 BOXING BREAK
		26.17 DRILLING BREAK
		26.38 JOINT, 60°, planar, rough, Fe st.
		26.95 BOXING BREAK
27		
27.82	27.82m META-SHALE lamination at 10°	27.79 / 27.82 } HANDLING BREAKS
28	TUFFACEOUS SANDSTONE continues, very fine/fine grained, grey.	27.98 BOXING BREAK
		28.14 DRILLING BREAK
28.20		28.37 Probable DRILLING BREAK
28.76	28.76m TUFFACEOUS S/S, very fine gr., with META-SHALE laminations, dk grey, at 10°	28.75 As above (carbonate coated)
		28.80 Possible PARTING, 10°, planar, rough, Fe st.
		28.88 BOXING BREAK
		28.97 DRILLING BREAK
29 / 29.04	29.04m TUFF. S/S., very fine/fine grained, grey.	
29.30	29.30 META-SHALE lamination at 10° TUFF. S/S as above	29.30 / 29.34 } 2x's possible PARTINGS, 10 and 15°, planar, rough (maybe drilling induced).
29.47	29.47m META-SHALE, grey, laminated at 10°.	29.47 – 29.65 } Numerous PARTINGS, 5 to 10°, with intersecting JOINT, 45°, planar, rough, Fe st.
29.65	29.65m TUFF. S/S., fine grained, grey.	29.75 PARTING, 10°, planar, rough, Fe st.
29.82	29.82m META-SHALE, grey/dk. grey, laminated at 10 to 15°	29.80 / 29.82 } HANDLING/BOXING BREAKS
30		29.93 ↳ See over

R.Q.D.: RUN 16 100%; RUN 17 68%. Tests: Nil (Run 16); Nil (Run 17).

Remarks: BOX 7 ENDS AT 27.98m

Job/Report No. GN 25A

Logged by: JOHN YOUNG — Date: 12.1.08 — Site Supervisor: MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 4

Sheet 7 of 9 Sheets

PROJECT TILLEGRA DAM

LOCATION RIGHT ABUTMENT, U/S DIVERSION PORTAL

CO-ORDINATES E 376309 N 6423179

R.L. COLLAR 122.4m DATUM AHD BEARING 685°M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 8.1.08

CORE BARRELL HQ TRIPLE DRILLER SHALIN TAYLOR COMPLETED 11.1.08

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
30	HQ	RUN 17 cont.		META-SHALE continues,		MS/S			Numerous PARTINGS, 15°, with several associated JOINTS, 30to60°, planar, rough, Fe/Mn st. Includes carbonate vein 12mm thick at 30.24m		
30.20				30.20m TUFFACEOUS SANDSTONE, fine-grained, grey. Occasional carbonate veining, generally 4 1mm					30.45		
30.91									30.66 2x's JOINTS, 60°, with associated PARTINGS, 10°, planar, rough, Fest. 30.86		
31.01		RUN 18		31.01m Very fine grained.		S/VS				67%	
31.18				31.18m	F(S)				31.10 PARTING, 15°, planar, rough, Fest. 31.18 DRILLING BREAK		
31.20		RUN 19		Fine grained.					31.34 PARTING, 15°, planar, rough, Fe st.		
									31.60 JOINT, 65°, planar, rough, Fe st.		
31.85				31.85m META-SHALE, dk grey, laminated at 15to20°		MS/L			31.85 Probable DRILLING BREAK 31.91 PARTING, 20°, stepped, rough, Fest.	76%	TN 17
31.96				31.96m							
32									32.14 JOINT, 45°, planar, rough, Fe st.		
32.16				32.16m					32.28 Several JOINTS, 45to50°, with associated PARTINGS, 10°, planar, rough, Fe st. 32.42		
32.50				Interbedded META-SHALE, dk grey, and TUFFACEOUS SANDSTONE, grey. Thinly laminated to very thinly bedded at 10to15°.		S			32.50 PARTINGS, 10°, planar, rough, Fe st. 32.54		
									32.60 DRILLING BREAKS 32.78 32.88		
33		RUN 20							32.97 Probable DRILLING BREAK		
									33.12 DRILLING BREAK		
									33.22 Numerous probable PARTINGS, 15°, planar, rough. 33.45	60%	
33.60				33.60m					33.52 DRILLING BREAKS 33.60		
				TUFFACEOUS SANDSTONE, fine-medium grained, grey.	F				33.68 Probable DRILLING BREAK		
34.00				34.00m META-SHALE laminations at 10°					34.00 As above		
34.20		RUN 21				S/VS			34.20 DRILLING BREAK 34.33 BOXING BREAK		
34.59				34.59m META-SHALE laminations at 15°					34.57 HANDLING BREAK		TN 17
34.78				34.78m META-SHALE, dk grey, with Tuff. s/b interbeds, laminated to very thinly bedded at 10°, banded.		S			34.75 As above 34.82 Numerous probable PARTINGS, 10°, planar, rough. 34.98		
35											

Remarks: BOX 8 ENDS AT 31.60m

Job / Report No. GN 25A

Logged by: JOHN YOUNGS

Date: 12.1.08

Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 4 Sheet 3 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, WS DIVERSION PORTAL
CO-ORDINATES E 376309 N 6423179
R.L. COLLAR 122.4m DATUM AHD BEARING 085° M INCLINATION 60° from horizontal
DRILL DELTA 4000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 8.1.08
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 11.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
35				Continues as above.					35.17 DRILLING BREAK 35.25 HANDLING BREAK 35.30 BOXING BREAK		
35.38				35.38m					35.47 35.62 } HANDLING BREAKS 35.83		
36		RUN 21		TUFFACEOUS SANDSTONE, medium grained, grey, mottled appearance.					36.08 Probable DRILLING BREAK 36.12 BOXING BREAK 36.21 36.38 } HANDLING BREAKS 36.44 Probable DRILLING BREAK	95%	
37					F	4 MPa			36.78 DRILLING BREAK		11 m
37.20	HQ								37.20 DRILLING BREAK		
38		RUN 22							38.19 BOXING BREAK	100%	
38.84 38.94 39				38.84m Includes META-SHALE 38.94m laminations at 10°							
39.20									39.20 BOXING BREAK		
39.40				39.40m Very fine grained					39.47 Possible PARTING, 10°, planar, rough.		
39.65				39.65m Fine-medium grained							
40											

Remarks: BOX 9 ENDS AT 35.30m BOX 10 ENDS AT 39.20m Job / Report No. GN 25A

Logged by: JOHN YOUNG Date: 12.1.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 4

Sheet 9 of 9 Sheets

PROJECT TILLEGRA DAM

LOCATION RIGHT ABUTMENT, U/S DIVERSION PORTAL

CO-ORDINATES E 376309 N 6423179

R.L. COLLAR 122.4m DATUM AHD BEARING 085°M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 8.1.08

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 11.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS					
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS	WPT
40		R2L			TUFFACEOUS SANDSTONE continues as above	F	S/W						C/UC
40.20										40.20 DRILLING BREAK			
					HOLE ENDS AT 40.20m								
41													
42													
43													
44													
45													

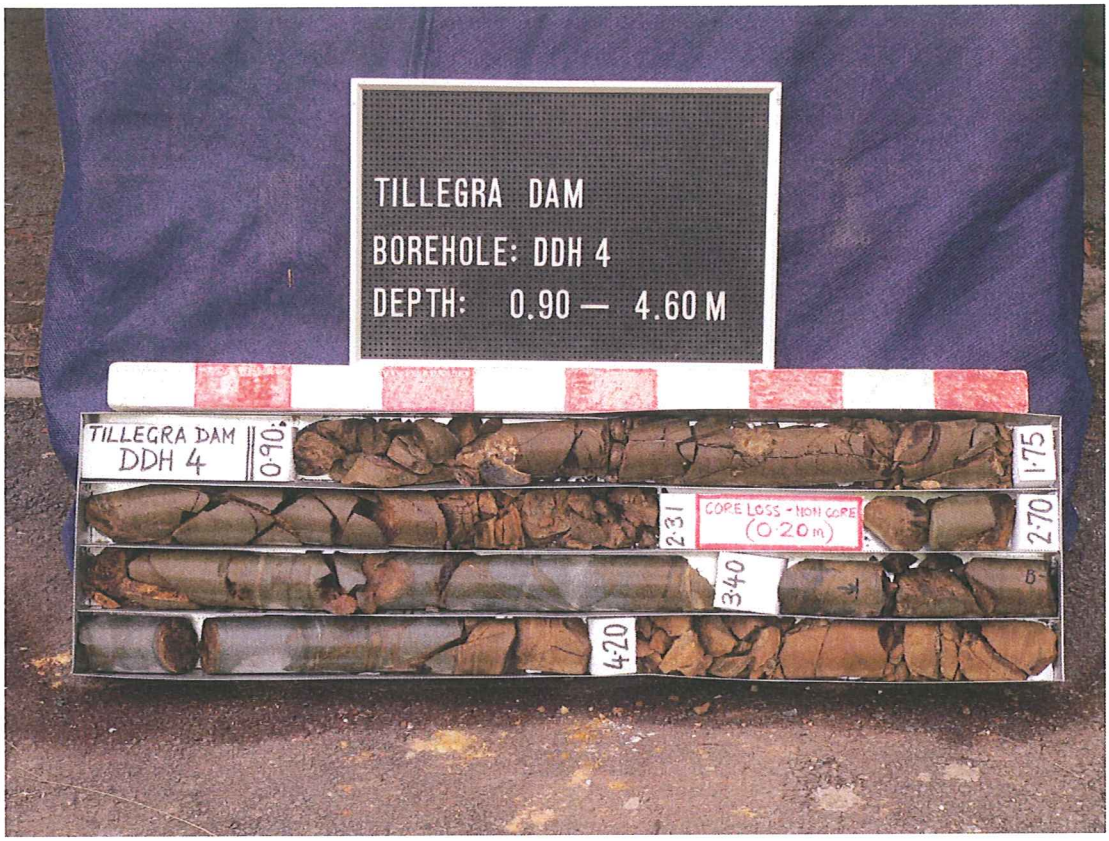
Remarks: BOX 11 ENDS AT 40.20m

Job / Report No. GN25A

Logged by: JOHN YOUNGS

Date: 12.1.08

Site Supervisor MARK ASHOVER


TILLEGRA DAM
BOREHOLE: DDH 4
DEPTH: 0.90 — 4.60 M
TILLEGRA DAM
DDH 4
0·90
1·75
2·31
CORE LOSS - NON CORE
(0·20 m)
2·70
3·40
4·20


TILLEGRA DAM
BOREHOLE: DDH 4
DEPTH: 4.60 — 12.27 M
CORE LOSS
(0·15 m)
5·00
7·20
9·51
9·67
10·20


TILLEGRA DAM
BOREHOLE: DDH 4
DEPTH: 12.27 — 20.05 M
13:20
16:20
19:20
19:77


TILLEGRA DAM
BOREHOLE: DDH 4
DEPTH: 20.05 — 27.98 M
22:20
25:20


TILLEGRA DAM
BOREHOLE: DDH 4
DEPTH: 27.98 — 35.30 M
28·20
SPACER
SPACER
30·91
31·20
SPACER (31·60m)
32·50
34·20
SPACER
SPACER (35·30)


TILLEGRA DAM
BOREHOLE: DDH 4
DEPTH: 35.30 — 40.20 M
SPACER
37·20
40·20 END

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 5

Sheet 1 of 8 Sheets

PROJECT TILLEGRA DAM

LOCATION LOWER LEFT ABUTMENT (UPSTREAM TOE)

CO-ORDINATES E 376387 N 6423509

R.L. COLLAR 97.7m DATUM AHD

BEARING 085° M

INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR

COMMENCED 4.12.07

COMPLETED 8.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
0					NON CORE							
1												
1.70					CORING COMMENCES AT 1.70m							
1.82	HQ	RUN 1	FZ		META-SHALE, dark grey/ greybrown, banded. Laminated at 10°	SW	MS			1.70 Several JOINTS, 50 to 70°, with numerous PARTINGS, 10°, planar, rough, generally Fe st. Sandy clay fill 2mm thick at 2.08m	0%	0%
1.97												
2.29		RUN 2								2.35		
2.75		RUN 4			Includes v. thin TUFFACEOUS s/s interbeds towards 2.77m					2.46 4x's PARTINGS, 10 to 15°, planar, rough, minor Fe staining on some planes. 2.61 2.67 2.75	80%	
2.77					2.77m							
3		RUN 5			TUFFACEOUS SANDSTONE, very fine/fine grained, grey/ greybrown.	MW				2.95 Numerous JOINTS, 30 to 50° and PARTINGS, 10°, planar, rough, Fe st, occasional clay coating. 3.47	40%	NO TEST
3.08												
3.18												
3.38												
3.62		RUN 6			3.62m	SW					100%	
3.80					META-SHALE, dark grey, laminated at 5° to 10°		S/MW			3.73 Several JOINTS, 60°, with associated PARTINGS, 5 to 10°, planar, rough, Fe st. 3.94		
3.82												
3.94												
4.62		RUN 7				F(S)				4.17 JOINT, 50, planar, rough, Fe st. 4.31 PARTING, 5°, planar, rough, Fe st. 4.46 DRILLING BREAK	58%	1.5 UL
4.62		RUN 8								4.57 4.67 4x's PARTINGS, 10°, planar, rough, Fe st. 4.83 4.95		
5												

Remarks:

Job / Report No. GN25A

Logged by: JOHN YOUNG

Date: 18.12.07

Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 5
Sheet 2 of 8 Sheets

PROJECT TILLEGRA DAM
LOCATION LOWER LEFT ABUTMENT (UPSTREAM TOE)
CO-ORDINATES E 376387 N 6423509
R.L. COLLAR 97.7m AHD
DATUM
BEARING 085° M
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
COMMENCED 4.12.07
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED 8.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
5		RUN 8 CONT		META-SHALE continues, dark grey, laminated at 5° to 10°					5.20 BOXING BREAK	45%	
5.75		RUN 9							5.65 } JOINT, 60, with associated PARTINGS, 5°, planar, rough, Fe st. 5.75 }		
6		RUN 10							5.97 PARTING, 10°, planar, rough, Fe st.	63%	1.6 UL
6.30					F(3)	MW/S			6.10 } Several JOINTS, 30°, with associated PARTINGS, 10 to 15°, planar, rough, Fe st. 6.40 }		
6.82		RUN 11							6.46 } 2x's PARTINGS, 10°, planar, rough, Fe st. 6.57 }	80%	
6.97				6.97m					6.72 } JOINT, 70°, with associated PARTINGS, 15°, planar, rough, Fe/Mn st. 7.18 }	0%	
7											
7.10				TUFFACEOUS SANDSTONE, fine grained, grey.					7.41 Probable DRILLING BREAK		
	HQ	RUN 12							7.64 JOINT, 30°, planar, rough, Fe st	95%	32 UL
8									8.00 JOINT, 60°, planar, rough, Fe/Mn st.		
8.39		RUN 13				S/HS			8.25 } 2x's JOINTS, 65°, planar, rough, Fe st. 8.39 }	100%	
									8.60 PARTING, 15°, planar, rough, Fe st.		
8.75		RUN 14							8.70 } 2x's JOINTS, 65°, planar, rough, Fe st. 8.95 }		
9										70%	
9.17				9.17 Includes alongside META- 9.20 SHALE clasts to 35mm. dimension.							
9.53				9.53m META-SHALE, dk grey/black, laminated at 5° to 10°					9.53 } 2x's PARTINGS, 10°, planar, rough Fe st. 9.58 }		
9.73		RUN 15				MW/S			9.73 DRILLING BREAK 9.80 BOXING BREAK		
9.98				9.93 TUFFACEOUS S/S, fine gr. grey.					9.93 HANDLING BREAK		

Remarks: BOX 1 ENDS AT 5.10m BOX 2 ENDS AT 8.25m
Job / Report No. GNZ5A

Logged by: JOHN YOUNG
Date: 18.12.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 5
Sheet 3 of 8 Sheets

PROJECT TILLEGRA DAM
LOCATION LOWER LEFT ABUTMENT (UPSTREAM TOE)
CO-ORDINATES E 376387 N 6423509
R.L. COLLAR 97.7m
DATUM AHD
BEARING 087°M
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
COMMENCED 4.12.07
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED 8.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
10					TUFFACEOUS SANDSTONE continues, fine gr., grey.		S/VS					
10.43					10.43 Elongate META-SHALE clasts to 20mm							
10.57					10.57m					10.54 PARTING, 5°, planar, rough, minor fest	82%	32 UC
10.80		RUN 15 CONT			Interbedded META-SHALE/ TUFFACEOUS SANDSTONE, grey/dk grey, banded.	F (S)				10.67 } 3 x's PARTINGS, as above. 10.68		
10.83										10.83 DRILLING BREAK		
11	HQ				Laminated to thinly bedded at 10°.		MS/S					
		RUN 16								11.28 Probable DRILLING BREAK	100%	
11.57										11.46 PARTING, 5°, planar, rough, fe st. 11.54 As above with carbonate fill 1mm thick		
11.75					11.78					11.75 DRILLING BREAK		
12					TUFFACEOUS SANDSTONE, fine grained, grey.							74 UC
		RUN 17				F	S/VS			12.17 JOINT, 30°, planar, rough		
12.58					12.58 Includes elongate					12.40 } Intersecting JOINTS, 65°, planar, rough 12.60 }		
12.67					12.65 META-SHALE clasts to 15mm dimension					12.78 } JOINT, 80°, planar, rough, minor carbonate coating 13.75 }	65%	
13										13.35 } Intersecting JOINTS, 70 and 60°, planar, rough, minor carbonate coating. 13.65 }		
										13.23 JOINT, 60°, planar, rough, minor carbonate coating.		
14										13.99 } 2 x's PARTINGS, 10°, planar, rough, carbonate coated to fill 5mm thick 14.02 }		
14.03		RUN 18								14.40 JOINT, 60°, planar, rough, minor carbonate coating.	100%	
										14.57 Probable DRILLING BREAK		
14.75										14.75 DRILLING BREAK		
15												114 UC

Remarks: BOX 3 ENDS AT 12.78 m
Job / Report No. GN 26A

Logged by: JOHN YOUNG
Date: 18.12.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 5 Sheet 4 of 8 Sheets

PROJECT TILLEGRA DAM
LOCATION LOWER LEFT ABUTMENT (UPSTREAM TOE)
CO-ORDINATES E 376387 N 6423509
R.L. COLLAR 97.7m AHD
DATUM
BEARING 085° M
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
COMMENCED 4.12.07
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED 8.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS					
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.		TESTS WPT
15					TUFFACEOUS SANDSTONE continues, fine grained, grey								
										15.26 Possible PARTINGS, 10 to 15°, planar, rough, minor carbonate coating (may be drilling induced)			
										15.42			
										15.70			
										15.75			
										15.80 JOINT, 75°, planar, rough, carbonate coated.			
16						F	S/VS			16.10			70 44
		RUN 19 CONTINUED								16.45 Possible JOINT, 50, planar, rough.			
										16.79 JOINT, 45°, planar, rough, minor carbonate coating			
										16.85 JOINT, 60°, as above.			
17										17.18 JOINT, 30°, planar, rough, minor carbonate coating			
17.35	HQ									17.42 JOINT, 60°, planar, rough, carbonate coated			
17.75										17.75 DRILLING BREAK			
										17.94 Possible PARTING, 10°, planar, rough. carbonate coated			
18										18.10 JOINT, 45°, planar, rough, carbonate coated.			70 12
		RUN 20								18.20 Probable PARTING, 15°, planar, rough,			
										18.42 JOINT, 60°, planar, rough, carbonate coated.			
										18.55 DRILLING BREAK			
										18.66			
19										JOINT, 90°, planar (undulating) rough, carbonate coated.			
19.10		RUN 21											
20													

Remarks: BOX 4 ENDS AT 16.79m
Job / Report No. GN25A

Logged by: JOHN YOUNG
Date: 18.12.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 5 Sheet 5 of 8 Sheets

PROJECT TILLEGRA DAM
LOCATION LOWER LEFT ABUTMENT (UPSTREAM TOE)
CO-ORDINATES E 376387 N 6423509
R.L. COLLAR 97.7m DATUM AHD BEARING 087°M INCLINATION 60° from horizontal

DRILL DELTA 1000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 4.12.07 COMPLETED 9.12.07

DRILLING DATA | ROCK SUBSTANCE | ROCK MASS DEFECTS

DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
20.07					TUFFACEOUS SANDSTONE continues, fine grained, grey.					20.10 See above 20.18 PARTING, 15°, planar, rough, carbonate coated. 20.40 Several JOINTS, 60 to 90°, planar, rough, minor carbonate coating. 20.65 20.70 Probable DRILLING BREAKS. 20.75	50%	12 UL
20.75		RUN 22										
21		RUN 23								21.10 JOINT, 50°, planar, rough, carbonate coated. 21.34 As above	100%	
21.46		RUN 24				F	50/15			21.46 DRILLING BREAK 21.70 JOINT, 60°, planar, rough, carbonate coated.		
22										21.70 JOINT FRAGMENTS, 70 to 80°, planar, rough, generally with minor carbonate coating.	72%	25 UL
22.14	HQ	RUN 25									0%	
22.81												
22.98					22.98 META-SHALE, dark grey, laminated at 5 to 10°		15/5W				15%	
23					23.23							
23.23		RUN 26			TUFFACEOUS SANDSTONE, fine grained, grey.		50/15			23.86 23.62 JOINT, 70°, planar, rough, carbonate coated. 23.67 DRILLING BREAK		
23.75		RUN 27								23.79 JOINT, 40°, planar, rough, minor carbonate coating		17 UL
24										24.07 JOINT, 50°, as above. 24.30 BOXING BREAK 24.53 DRILLING BREAK 24.62 Probable DRILLING BREAK 24.70 DRILLING BREAK		
25												

Remarks: BOX 5 ENDS AT 20.58m BOX 6 ENDS AT 24.30m
Job / Report No. GN25A

Logged by: JOHN YOUNG Date: 18.12.07 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 5 Sheet 6 of 2 Sheets

PROJECT TILLEGRA DAM
LOCATION LOWER LEFT ABUTMENT (UPSTREAM TOE)
CO-ORDINATES E 376387 N 6422509
R.L. COLLAR 97.7m DATUM AHD BEARING 085°M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 4.12.07
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 8.12.07

DRILLING DATA			ROCK SUBSTANCE			ROCK MASS DEFECTS			
DEPTH (R.L.) METRES	Method / Casing, Run / Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20 / VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
25	HQ RUN 17 CONTINUED		TUFFACEOUS SANDSTONE continues, fine grained, grey.	F	S/VS		25.02 HANDLING BREAK 25.30 BOXING BREAK 25.68 HANDLING BREAK	100%	
26							26.10 JOINT, 60°, planar, rough, minor carbonate coating. 26.30 BOXING BREAK 26.35 JOINT, 60°, planar, rough, carbonate coated. 26.60 / 26.63 Probable DRILLING/HANDLING BREAKS		L1 UL
26.75							26.75 DRILLING BREAK 26.87 / 26.90 2x's JOINTS, 50°, planar, rough, minor carbonate coating.		
27	HQ RUN 18						27.08 JOINT, 70°, planar, rough, minor carbonate coating.	97%	
							27.30 BOXING BREAK 27.40 Probable DRILLING BREAK		
28							27.86 Possible PARTING, 5°, planar, rough. 28.00 JOINT, 70°, planar, rough, minor carbonate coating 28.17 Possible PARTING, 5°, planar, rough. 28.27 / 28.30 / 28.34 Probable DRILLING/HANDLING BREAKS		12 UL
28.58							28.58 / 28.70 Intersecting JOINTS, 60 and 70°, planar, rough		
29	HQ RUN 19						29.00 JOINT, 45°, planar, rough, carbonate coated. 29.17 JOINT, 85°; planar (undulating), rough, carbonate coated/ Associated PARTINGS 10° planar rough, carbonate coated/ infills 6mm thick at 29.51m 29.51 29.57 / 29.62 2x's PARTINGS, planar, rough, minor carbonate coating. 29.78 DRILLING BREAK	50%	
29.75							29.92 / 29.96 2x's JOINTS 30 to 45°, planar, rough, minor carbonate coating		
30									

Remarks: BOX 7 ENDS AT 28.30m — Job / Report No. GN15A

Logged by: JOHN YOUNG — Date: 18.12.07 — Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 5 Sheet 7 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION LOWER LEFT ABUTMENT (UPSTREAM TOE)
CO-ORDINATES E 376387 N 6423509
R.L. COLLAR 97.7m DATUM AHD BEARING 085° M INCLINATION 60° from horizontal
DRILL DELTA 1000 TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 4.12.07
CORE BARREL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 5.12.07

DRILLING DATA				ROCK SUBSTANCE			ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
30					TUFFACEOUS SANDSTONE continues, fine grained, grey.					30.28 } JOINT FRAGMENTS, 70 to 75°, planar, rough, minor carbonate coating 30.45	65%	
31		RUN 30.0								30.90 JOINT, 60°, planar, rough (possibly drilling induced)		
31.10		RUN 31				F	S/HS			31.10 JOINT, 65°, planar, rough, carbonate coated.	100%	12 UL
31.65		RUN 32								31.65 DRILLING BREAK 31.76 BOXING BREAK		
32										32.04 JOINT, 65°, planar, rough, carbonate coated.		
	140									34.17 } 2 x's JOINTS, 45°, planar rough, minor carbonate coating 34.24 }	70%	
										34.36 JOINT, 50°, as above.		
32.75										32.73 } JOINT FRAGMENTS, 70°, planar, rough. 32.80 }		
33 33.03					33.03 Interbedded fine gr. TUFF. S/S and META-SHALE, grey/dk grey, banded, laminated to v. thinly bedded at 10 to 15°					33.00 JOINT, 65°, planar, rough.		
33.43					33.43 TUFFACEOUS SANDSTONE, fine to medium grained (w/ data depth), grey. Includes META-SHALE laminations as shown at 10°					33.15 JOINT, 45°, planar, rough, carbonate coated. 33.43 DRILLING BREAK		4 UL
33.75 33.78 33.84		RUN 33								33.75 BOXING BREAK.	45%	
34										34.16 } 3 x's JOINTS, 50 to 60°, planar, rough, partly carbonate coated. 34.28 } 34.43 }		
										34.51 DRILLING BREAK		
34.59		RUN 34								34.65 JOINT, 50°, planar, rough, carbonate coated. 34.78 BOXING BREAK		
35										34.92 JOINT, 50°, planar, rough, carbonate coated.		

Remarks: BOX & ENDS AT 31.76m
Job / Report No. GN12EA

Logged by: JOHN YOUNG Date: 18.12.07 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 5
Sheet 3 of 3 Sheets

PROJECT TILLEGRA DAM
LOCATION LOWER LEFT ABUTMENT (UPSTREAM TOE)
CO-ORDINATES E 376387 N 6423509
R.L. COLLAR 97.7m
DATUM AHD
BEARING 085°M
INCLINATION 60° from horizontal

DRILL DELTA 2000 TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
COMMENCED 4.12.08
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED 8.12.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS					
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS	WPT
35	HQ Run 34 cont.				TUFFACEOUS SANDSTONE continues, medium grained, grey.	F	S/W			35.10 } JOINT FRAGMENTS, 30 to 60°, planar, rough, carbonate coated to filled 4mm thick. 35.27			
										35.29 } 2 x's JOINTS, 30 and 45°, planar, rough, minor carbonate coating 35.65 35.75 DRILLING BREAK	99%	4 UL	
35.75					HOLE ENDS AT 35.75m.								
36													
37													
38													
39													
40													

Remarks: BOX 9 ENDS AT 35.75m = END OF HOLE
Job / Report No. GN25A

Logged by: JOHN YOUNGS
Date: 18.12.07
Site Supervisor MARK ASHOVER


TILLEGRA DAM
BOREHOLE: DDH 5
DEPTH: 1.70 — 5.20 M
TILLEGRA DAM
DDH 5
1·70
1·82
1·97
2·29
2·75
3·18
3·82
4·62


TILLEGRA DAM
BOREHOLE: DDH 5
DEPTH: 5.20 — 12.78 M
5·75
6·30
6·82
7·10
SPACER
8·39
8·75
9·73
10·83
11·75


TILLEGRA DAM
BOREHOLE: DDH 5
DEPTH: 12.78 — 20.58 M
14·03
14·75
17·75
17·10
20·05


TILLEGRA DAM
BOREHOLE: DDH 5
DEPTH: 20.58 — 28.30 M
20·75
21·46
22·14
22·81
23·75
26·75


TILLEGRA DAM
BOREHOLE: DDH 5
DEPTH: 28.30 — 35.75 M
28·58
SPACER
29·75
SPACER
SPACER
31·10
31·65
32·75
34·59
35·75
END

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 6

Sheet 1 of 9 Sheets

PROJECT TILLEGRA DAM

LOCATION MIDDLE LEFT ABUTMENT (CENTRELINE).

CO-ORDINATES E 376456 N 6423606

R.L. COLLAR 127.6m DATUM AHD BEARING 090°M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRUCK MOUNTED CONTRACTOR McDERMOTT DRILLING

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR

COMMENCED 26.11.07 COMPLETED 3.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
0					NON CORE							
1												
1.50					CORING COMMENCES AT 1.50m					1.50		
	HQ	RUN 1			TUFFACEOUS SANDSTONE, fine grained, brown/orangebrown.	SW/MW	M/MS			1.59 DRILLING BREAK 1.64 PARTING 15°, planar, rough, Fe st. 1.70 JOINT 60°, planar, rough, Fe st. 1.84 As above 1.97 PARTING, 15°, planar, rough, Fe st		
2										2.11 JOINT, 60°, planar, rough, Fe st.	88%	
										2.55 As above.		
2.75					Pale brown/grey/brown.					2.75 DRILLING BREAK		NO TEST
3										3.10 JOINT, 45°, planar, rough, Fe st.		
										3.28 BOXING BREAK		
						MW	MS			3.50 Probable DRILLING BREAK 3.67 JOINT, 60°, planar, rough, Fe st clay coated.	80%	
3.80												
4										3.90 JOINT, 70°, planar, rough, Fe st. sandy clay fill to 3mm 4.18		
4.25										4.24 Probable DRILLING BREAK		
		RUN 2								4.57 2x½ JOINTS, 60°, intersecting, planar, rough, Fe st 4.72	76%	L1 UL
										4.80 JOINT, 60°, planar, rough, Fe/Mn st.		
5										4.95 As above.		

Remarks:

Job / Report No. GN25A

Logged by: JOHN YOUNG Date: 7.12.07 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 6
Sheet 2 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION MIDDLE LEFT ABUTMENT (CENTRELINE)
CO-ORDINATES E 376456 N 6423606
R.L. COLLAR 127.6m AHD
BEARING 090°M
INCLINATION 60° from horizontal

DRILL DELTA 7600, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMMENCED 26.11.07
COMPLETED 3.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
5					TUFFACEOUS SANDSTONE continues, pale brown/ grey brown.	MW	MS			5.20 JOINT, 65°, planar, rough, Fe/Mn st.		
		RUN 3 cont								5.35 Intersecting joints, 45 and 60°, planar, rough, minor Fe st.		
5.71										5.71 Intersecting joints, both 60°, as above.		
5.95										5.95 PARTING, 5°, planar, very rough		
6					META-SHALE, dk. grey, laminated at 15°	F(s)						
6.10										6.10 PARTING, 5°, planar, rough, sandy clay fill to 2mm		
		RUN 4	H.Q.		TUFFACEOUS SANDSTONE, fine-medium grained, grey brown (SW) to grey.	SW	S			6.28 JOINT, 30°, planar, rough, Fe/Mn st		
										6.46 Probable PARTING, 15°, planar, very rough, partly sandy clay coated	95%	
6.80										6.75 JOINT, 30°, planar, rough, Fe st		
6.90										6.90 BOXING BREAK		
7												
7.10					Coarse, gravelly lens 30 mm thick	SW/F(s)				7.10 DRILLING BREAK.		
7.25										7.25 JOINT, 65°, planar, rough, Mn st, minor clay coating		
7.50						SW				7.52 JOINT, 60°, planar, rough, Fe st.		
7.60										7.79 DRILLING BREAK		
8						F(s)				8.00 PARTING, 5°, planar, rough, Fe st, minor clay fill to 1mm	88%	0 UL
		RUN 5								8.45 As above		
										8.51 JOINT, 45°, planar, rough, Fe/Mn st		
8.62					META-SHALE lamination, 5°					8.63 PARTING, 5°, planar, rough Fe st		
8.70										8.67 Probable DRILLING BREAK.		
		RUN 6								8.90 JOINT, 60°, planar, rough, Fe st, sandy clay fill to 5mm		
8.95					TUFFACEOUS SANDSTONE, fine grained, grey/ grey brown (SW).	SW						
9										9.15 } Several JOINTS, 30 to 70°, planar, rough, Fe/Mn st, clay fill to 3mm	76%	
9.15						MW	MS			9.35 }		
9.50										9.50 } JOINT, 70°, planar, rough, Fe/Mn st.		
		RUN 7								9.85 }	75%	
9.70												
9.80						F(s)	S					
10												

Remarks: BOX 1 ENDS AT 5.20m BOX 2 ENDS AT 8.65m
Job / Report No. GN 25A
Logged by: JOHN YOUNG
Date: 7.12.07
Site Supervisor MARK ASHOVER

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

NSW Department of Commerce

BOREHOLE No. DDH 6 — Sheet 3 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION MIDDLE LEFT ABUTMENT (CENTRELINE)
CO-ORDINATES E 376456 N 6423606
R.L. COLLAR 127.6m **DATUM** AHD **BEARING** 090°M **INCLINATION** 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED **CONTRACTOR** McDERMOTT DRILLING **COMMENCED** 26.11.07
CORE BARRELL HQ TRIPLE **DRILLER** SHAUN TAYLOR **COMPLETED** 3.12.07

DEPTH (R.L.) METRES	Method	Casing, Run	Water	DESCRIPTION ROCK TYPE	WEATHERING	ESTIMATED STRENGTH	DEFECT DESCRIPTION	R.Q.D.	TESTS WPT
10 – 10.25	HQ	R7		TUFFACEOUS SANDSTONE continues, fine grained,	F(s)	S	10.18 JOINT, 30°, planar, rough, Fe/Mn st.; 10.25 PARTING, 15°, planar, rough, Fe st.		0 UL
10.25 – 11.47	HQ	RUN 8		Interbedded META-SHALE and fine grained TUFFACEOUS SANDSTONE. brown / greybrown, banded. Laminated to very thinly bedded at 5 to 10°	MW/SW	W/MS; EW (10.66); W/MS; EW (11.14–11.19); W/MS	10.62 Probable DRILLING BREAK; 10.66 PARTING, 5°, planar, rough, Fe st.; 10.71 – gravelly clayey zone 20mm thick; JOINT, 45°, planar, rough Fe/Mn st.; 10.95–11.07 3x's JOINTS, planar, rough, 50°, Fe/Mn st.; 11.14–11.19 PARTING FRAGMENTS 10°, crushed clayey zone.; 11.27–11.60 JOINT/PARTING FRAGMENTS, 65 and 5°, planar, rough, Fe/Mn st, minor clay infill to 2mm (may be handling induced)	57%	
11.47 – 11.74		RUN 9		11.74m			11.74 JOINT, 30°, planar, rough, Fe/Mn st.	50%	
11.74 – 12.51		RUN 10		Grey / dark grey, banded.	F(s)	MS	11.80, 11.89, 11.96 3x's PARTINGS, 5°, planar, rough, Fe st.; 12.28 PARTING, 10°, planar, rough, Fe/Mn st.; 12.47 2x's JOINTS, 40°, planar, rough, Fe/Mn st.; 12.51 PARTING, 5°, planar, rough, Fe st.		1 UL
12.51 – 15		RUN 11		TUFFACEOUS SANDSTONE, fine grained, grey/ greybrown/brown. Includes META-SHALE interbeds (as shown) dark grey/greybrown, laminated at 5 to 10°	F(s); MW (13.50–13.60); MW/HW; SW (14.10–14.20); F(s)	S; VW/W; S	12.70 JOINT, 60°, planar, rough, Mn st.; 12.81 PARTING, 5°, planar, rough, Fe/Mn st.; 13.02, 13.08, 13.10 3x's PARTINGS, 5 to 15°, planar, rough, Fe/Mn st.; 13.25 Probable DRILLING BREAK; 13.44 JOINT, 60°, planar, rough, Fe/Mn st.; 13.50 PARTING, 5°, planar, rough, Fe/Mn st.; 13.65–14.10 JOINT, FRAGMENTS, 60 to 5°, planar, rough, Fe st.; 14.32 Probable DRILLING BREAK; 14.52 PARTING, 10°, planar, rough, Mn st.; 14.60 As above; 14.68 As above; 14.82 JOINT, 60°, planar (stepped), rough Mn st.; 14.97 DRILLING BREAK	62%; 70%	2 UL

Depth marks: 10, 10.25, 10.66, 11, 11.14, 11.19, 11.47, 11.74, 12, 12.51, 12.80, 13.00, 13.15, 13.25, 13.28, 13.33, 13.50, 13.60, 14, 14.10, 14.20, 14.25, 14.52, 14.68, 15

Remarks: BOX 3 ENDS AT 12.51m
Job / Report No. GN 25A
Logged by: JOHN YOUNG **Date:** 7.12.07 **Site Supervisor** MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 6 Sheet 4 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION MIDDLE LEFT ABUTMENT (CENTRELINE)
CO-ORDINATES E 376456 N 6423606
R.L. COLLAR 127.6m AHD
DATUM
BEARING 090°M
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMMENCED 26.11.07
COMPLETED 3.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
15					Fine gr. TUFFACEOUS S/S continues	F(s)	S					
15.10							MS					
15.20		RUN 12 CONT			META-SHALE, dark grey/ grey brown/ brown, banded. Laminated at 5 to 10°	MW	W/MS					
15.40						F(s)	MS					
15.66					CORE LOSS 0.05m							
15.71										15.71 } Joint/parting fragments, 60 and 5°, planar, rough, Fe/Mn st. 15.81		
							MS			15.91 } 4x's Partings, 5 to 10°, planar, rough, Fe/Mn st. 15.99		
16						F(s)				16.13		
16.17		RUN 13								16.17		
16.25					TUFFACEOUS SANDSTONE, fine grained, grey.		S			16.25 DRILLING BREAK		
										16.47 Joint, 60°, planar, rough, Fe/Mn st.		
16.68					16.68m							
	HQ				Grey/brown/brown, includes coarse grained bands up to 20mm thick	MW	W			16.87 } Joint/ parting fragments, 50 and 5 to 10°, planar, rough, Fe/Mn st, clay coated to sandy clay filled 2mm thick. 17.10		
17							MS					
17.26							W			17.26 } As above (partly fragmented by drilling probes). 17.35		
17.35					17.35m					17.44 Joint, 60, planar, rough. Mn st.		
					Grey, fine-grained	F(s)	S			17.54 Joint, 45°, planar, rough, Fe/Mn st.		
17.86					17.86m					17.86 Joint, 70°, planar, rough, Fe/Mn st.		
18					Grey/brown	SW						
18.08						MW	W			18.08 } Probable parting fragments, crushed, Fe st. 18.11		
18.11					18.11							
					Grey	F(s)	S/VS					
18.44										18.44 Joint, 65°, planar, rough, Fe/Mn st.		
					CORE LOSS 0.23m							
18.67										18.67 As above		
18.80					TUFFACEOUS SANDSTONE continues, very fine/ fine grained, grey.					18.71 As above		
19		RUN 14										
						F(s)	S/VS			19.13 } 2x's Partings, 10°, planar, rough Mn st. 19.16		
19.25										19.25 DRILLING BREAK		
		RUN 15										
										19.76 Joint, 70°, planar, rough, carbonate coated.		
20										19.87 Joint, 60°, as above.		

Remarks: Box 4 ENDS AT 16.47m
Job / Report No. GN 25A
Logged by: JOHN YOUNG
Date: 7.12.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 6 Sheet 5 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION MIDDLE LEFT ABUTMENT (CENTRELINE)
CO-ORDINATES E 376456 N 6423606
R.L. COLLAR 127.6m DATUM AHD BEARING 090° M INCLINATION 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 26.11.07
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 7.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
20.05					TUFF. s/s cont., v. fine gr.					20.10 PARTING, 5°, planar, rough, Fe stained		
20.24					Interbedded META-SHALE and very fine gr. TUFFACEOUS SANDSTONE, lt grey/grey, banded, laminated at 5°-					20.22 Probable DRILLING BREAK (w/ts PARTING direction).		
										20.52 JOINT, 50°, planar, rough, carbonate coated		
					TUFFACEOUS SANDSTONE, very fine/fine-grained, grey.					20.90 DRILLING BREAK		
21		RUN 15 cont.								21.10 JOINT, 60°, planar, rough, Fe st.	100%	
					Includes carbonate healed joints to 1mm thick, 60° to 30°.					21.25 BOXING BREAK		
										21.70 JOINT, 60°, planar, rough, carbonate coated		
21.78										21.76 DRILLING BREAK		
22		RUN 16				F(3)	S/VS				100%	
22.25										22.22 DRILLING BREAK		
	HQ									22.44 PARTING, 5°, planar, rough, carbonate coated.		11/11
23		RUN 17								23.20 JOINT, 65°, planar, rough, carbonate coated.	100%	
										23.31 PARTING, 5°, planar, rough, Fe st.		
										23.51 JOINT, 20°, planar, rough, carbonate coated.		
										23.73 JOINT, 70°, planar, rough, carbonate coated.		
										23.87 PARTING, 5°, planar, rough, carbonate coated		
24.00		RUN 18								24.00 DRILLING BREAK		
										24.05 JOINT, 60°, planar, rough, carbonate coated		
										24.10 BOXING BREAK		
										24.15 JOINT, 70°, planar, rough, carbonate coated.	100%	
										24.15 JOINT, 45°, as above.		
										24.35 HANDLING BREAK		
25												

Remarks: BOX 5 ENDS AT 20.23m BOX 6 ENDS AT 24.10m
Job / Report No. GN29A
Logged by: JOHN YOUNG Date: 17.12.07 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 6
Sheet 6 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION MIDDLE LEFT ABUTMENT (CENTRELINE)
CO-ORDINATES E 3764456 N 6422606
R.L. COLLAR 127.6m DATUM AHD BEARING 090°M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 26.11.07
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 7.12.07

DRILLING DATA | ROCK SUBSTANCE | ROCK MASS DEFECTS

DEPTH (R.L.) METRES	Method	Casing, Run, Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
25									25.07 BOXING BREAK		WPT
25.14		RIG		TUFFACEOUS SANDSTONE continues, very fine/fine-grained, grey.					25.15 DRILLING BREAK		
26									26.19 BOXING BREAK.		
27		HQ RUN 16			FG	S/VS			27.10 BOXING BREAK	100%	
27.50				Includes 27.50 META-SHALE laminations at 5°.					27.50 PARTING, 5°, slightly curved, rough, Fe st.		
27.71				27.71m TUFF. s/s, coarse gr., grey, includes MS clasts to 35mm.					27.67 Possible PARTING, 5°, planar, rough		
27.88				27.88m					27.71 PARTING, 5°, planar, rough, minor Fe st.		
27.96				META-SHALE, dark grey, laminated at 5 to 10°					27.82 } JOINT/PARTING FRAGMENTS, 10 and 5°, planar, rough, minor Fe st (may be drilling induced)		
28		RUN 17				MS/S			28.04 BOXING BREAK	100%	
28.25									28.10 PARTING, 5°, planar, rough, Fe st		
28.29				28.29m TUFFACEOUS SANDSTONE, fine to coarse-grained with depth, grey.		S/CS			28.25 DRILLING BREAK		
28.70				28.70m META-SHALE, dark grey, laminated at 5°.		MS/S			28.34 PARTING, 5°, curved, rough, Fe st.		
28.99									28.49 JOINT, 25°, planar, rough, Fe st.	44%	
29									28.66 } JOINT/PARTING FRAGMENTS, 60 and 5°, planar, rough, Fe staining on some planes.		
29.06				29.06m TUFFACEOUS s/s, medium gr., grey.		S/VS			29.03		
29.20		RUN 19		29.20m META-SHALE with TUFF. s/s interbeds, dk grey/grey/pale brown, bedded, laminated to v. thinly bedded at 10°		MS/S			29.20 } As above 29.32	92%	
29.70				29.70m TUFFACEOUS SANDSTONE, medium/coarse gr., grey.		S/VS			29.47 Possible JOINT, 45°, irregular, v. rough 29.64 Probable DRILLING BREAK 29.70 PARTING, 10°, planar, rough, Fe st.		
30									29.98 BOXING BREAK		

Remarks: BOX 7 ENDS AT 28.04m — Job / Report No. GN 26A

Logged by: JOHN YOUNG — Date: 17.12.07 — Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 6 Sheet 7 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION MIDDLE LEFT ABUTMENT (CENTRELINE)
CO-ORDINATES E 376456 N 6422606
R.L. COLLAR 127.6m DATUM AHD BEARING 090°M INCLINATION 60° from horizontal

DRILL DELTA 1000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 26.11.07
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 3.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS W/PT
30					TUFFACEOUS SANDSTONE cont. medium/coarse grained, grey		S/MS			30.17 PARTING, 5°, planar, smooth, minor Fe staining.		
30.37					30.37m META-SHALE, dk grey, laminated at 15°		MS/S					
30.46		RUN 19 CONTINUED			30.46m					30.42 PARTING, 15°, planar, rough, minor Fe staining.		
					TUFFACEOUS SANDSTONE, medium/coarse grained, grey.							
31						F(s)	S/MS			31.00 BOXING BREAK 31.10 JOINT, 65°, planar, rough, Fe st.		
31.25										31.25 DRILLING BREAK		
31.33					31.33m Fine-grained							
31.48		RUN 20			31.48m							
					Medium/coarse gr.							
31.91										31.91 BOXING BREAK 31.95 JOINT, 50°, planar, rough, Fe st.		
32	HQ										48%	
32.15					32.15							
					TUFFACEOUS SANDSTONE very fine grained, with META-SHALE laminations, dk grey/grey, banded at 10° to 15°.					32.22 BOXING BREAK		
33										33.00 HANDLING BREAK		
33.27					33.27					33.22 Possible PARTING, 20°, planar, rough, minor Fe staining.		
					TUFFACEOUS SANDSTONE, medium/coarse grained, grey.							
33.77					33.77m Includes META-SHALE lamination at 15°					33.90 BOXING BREAK.		
34												
34.25					34.25m META-SHALE lamination at 15°					34.22 DRILLING BREAK		
34.71		RUN 21					S/MS			34.71 PARTING, 15°, planar, rough, Fe st 34.78 HANDLING BREAK 34.90 BOXING BREAK 35.00 PARTING, 10°, planar, rough, minor Fe st.		
35												

Remarks: BOX 8 ENDS AT 31.91m
Job / Report No. GN25A
Logged by: JOHN YOUNG Date: 17.12.07 Site Supervisor MARK ASHOVER

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

NSW Department of Commerce

BOREHOLE No. DDH 6 — Sheet 8 of 9 Sheets

PROJECT: TILLEGRA DAM	CO-ORDINATES E 376456 N 6423606	R.L. COLLAR: 127.6m; DATUM: AHD; BEARING: 090° M; INCLINATION: 60° from horizontal	
LOCATION: MIDDLE LEFT ABUTMENT (CENTRELINE)			
DRILL: DELTA 2000, TRACK MOUNTED	CONTRACTOR: McDERMOTT DRILLING	COMMENCED: 26.11.07	
CORE BARRELL: HQ TRIPLE	DRILLER: SHAUN TAYLOR	COMPLETED: 2.12.07	

Depth (R.L.) metres	Method	Casing, Run	Graphic log / Description (rock type: grainsize, texture, colour, composition, structure, hardness)	Weathering	Estimated strength	Defect description (type, inclination, planarity, roughness, coatings or infillings)	R.Q.D.	Tests WPT
35	HQ	RUN 21 CONT.	TUFFACEOUS SANDSTONE, fine to medium grained, grey.	F(S)	S/VS	35.19 – 35.28 Probable DRILLING BREAKS	94%	
35.52			35.52m Includes META-SHALE lamination at 10°			35.76 JOINT, 60°, planar, rough. 35.82 BOXING BREAK		
35.88, 36			35.88m META-SHALE, dark grey, laminated at 10 to 15°		—	35.93 PARTING, 5°, with associated JOINT, 60°. Planar, rough, Fe st		
36.34, 36.40, 36.55, 36.63			Includes thin TUFFACEOUS S/S interbeds as shown.		MS/S	36.18 PARTING, 5°, planar, crushed clayey zone 5mm thick. 36.48 Probable DRILLING BREAK		5U1
						36.81 JOINT, 50°, planar, rough, Fe st.		
37, 37.13						37.03 – 37.13 JOINT/PARTING FRAGMENTS, 60° and 10°, planar, rough, some planes Fe st. (some breaks may be drilling induced)		
		RUN 22				37.25 Probable DRILLING BREAK. 37.43 As above		
37.48			37.48m TUFFACEOUS SANDSTONE, medium/coarse grained, grey		S/VS	37.74 Possible JOINT, 45°, planar, rough, carbonate coated.	65%	
38						37.94 JOINT, 45°, planar, rough, Fe st.		
38.11			38.11m		—	38.11 – 38.21 PARTING FRAGMENTS, 10 to 20°, planar, rough, Fe st.		
38.25			META-SHALE, dark grey, laminated at 10 to 15°		MS/S	38.37 Intersecting JOINTS, both 30°, planar, rough, Fe st. 38.47 – 38.56 JOINT, 60°, fragmented, planar, rough, Fe st.		
						38.75 PARTING, 10°, planar, rough, Fe st.		
39, 39.07		RUN 23				38.97 – 39.14 Numerous PARTINGS, 10 to 15°, planar, rough, minor Fe staining. 39.14 – 39.27 PARTING FRAGMENTS, crushed zone, clayey from 39.14 to 39.19m. (sheared).		7U1
						39.41, 39.50, 39.60, 39.63, 39.72 Numerous PARTINGS, 10 to 15°, planar, rough, generally Fe st.	74%	
39.52			39.52m TUFFACEOUS SANDSTONE, fine grained, grey.		S/VS			
39.85, 40			39.85m META-SHALE, dark grey, laminated at 10°		MS	39.72 – 39.95 JOINT, 70°, planar, rough, minor Fe staining. 39.95 See over		

Remarks: BOX 9 ENDS AT 35.82m BOX 10 ENDS AT 39.73m

Job / Report No. GN 25A

Logged by: JOHN YOUNG **Date:** 17.12.07 **Site Supervisor:** MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 6 — Sheet 9 of 9 Sheets

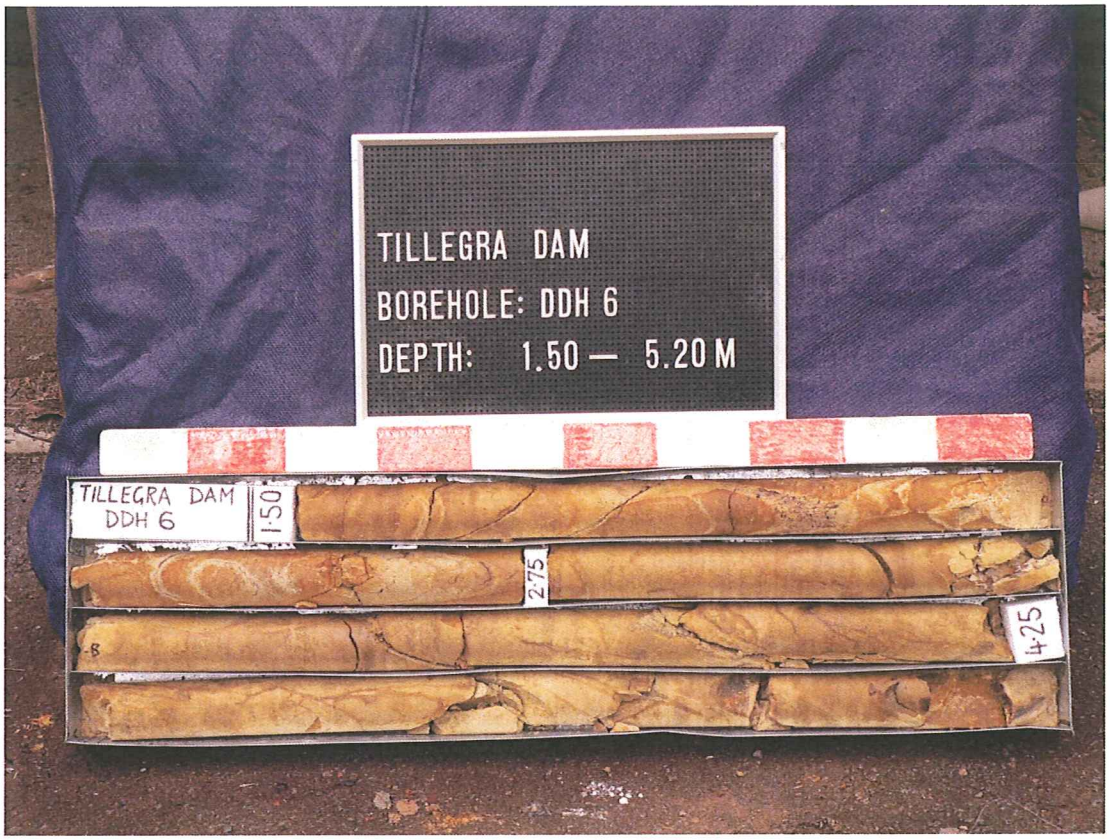
PROJECT TILLEGRA DAM
LOCATION MIDDLE LEFT ABUTMENT (CENTRELINE)
CO-ORDINATES E 376456 N 6423606
R.L. COLLAR 127.6m AHD
DATUM
BEARING 090°M
INCLINATION 60° from horizontal

DRILL DELTA 7000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
CORE BARREL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMMENCED 26.11.07
COMPLETED 3.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS					
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS	WPT
40					META-SHALE continues, dark grey, laminated at 10°								
40.12		NMLC								JOINT FRAGMENTS, 50 to 70°, with associated PARTINGS, 10°, planar, rough, Fe st, minor clay coating	0%		
						F(s)	MS			40.53			
40.67										40.67			
										Numerous PARTINGS, 10°, planar rough, occasional carbonate coating.			
40.82										40.82			
40.89										40.89			
40.97										40.97			
41										41.07			
41.14										41.14			
41.27					41.27m					41.30			
		49			TUFFACEOUS SANDSTONE, fine grained, grey.		S/MS						21 UC
41.67					41.67m					41.67 BOXING BREAK			
					Interbedded META-SHALE/ TUFFACEOUS S/S, grey/dk grey, banded, lam. to v. thinly bedded at 15°	F	S			41.70 HANDLING BREAK			
42.00					42.00m								
		RUN 2			TUFFACEOUS SANDSTONE, fine grained grey							T&T	
42.20					42.20 META-SHALE laminations at 15°								
					Medium grained								
42.63					42.63		S/MS			42.67 BOXING BREAK			
					Fine grained								
42.94					42.94m					42.94			
43					META-SHALE, dk grey/grey, banded, laminated at 15°		MS/S			2 v's intersecting JOINTS, 50 and 70°, planar, rough, minor carbonate coating.			
43.20					CORE LOSS 0.05m. Left down hole					43.20			
43.25					HOLE ENDS AT 43.25m								
44													
45													

Remarks: BOX 12 ENDS AT 43.25m = END OF HOLE — Job / Report No. GN 25A

Logged by: JOHN YOUNG — Date: 18.12.07 — Site Supervisor MARK ASHOVER


TILLEGRA DAM
BOREHOLE: DDH 6
DEPTH: 1.50 — 5.20 M
TILLEGRA DAM
DDH 6
1·50
2·75
4·25


TILLEGRA DAM
BOREHOLE: DDH 6
DEPTH: 5.20 — 12.51 M
5·71
SPACER
7·25
8·70
SPACER
(8·65m)
9·56
10·25
11·47
11·74


TILLEGRA DAM
BOREHOLE: DDH 6
DEPTH: 12.51 — 20.23 M
13·25
CORE LOSS 0·05
15·71
16·25
CORE LOSS (0·23m)
18·67
19·25


TILLEGRA DAM
BOREHOLE: DDH 6
DEPTH: 20.23 — 28.04 M
21·78
22·25
24·00
25·25
27·96


TILLEGRA DAM
BOREHOLE: DDH 6
DEPTH: 28.04 — 35.82 M
28.25
28.99
31.25
34.25
SPACER
(35.82)


TILLEGRA DAM
BOREHOLE: DDH 6
DEPTH: 35.82 — 43.25 M
37.13
39.07
40.13
40.67
DOWN HOLE 0.05
43.25
END DDH 6

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 7

Sheet 1 of 7 Sheets

PROJECT TILLEGRA DAM

LOCATION UPPER LEFT ABUTMENT (SADDLE)

CO-ORDINATES E 376506 N 6423774

R.L. COLLAR 147.5m AHD

BEARING 060°M

INCLINATION 60° from horizontal

DRILL DELTA 2000, TRUCK MOUNTED CONTRACTOR McDERMOTT DRILLING

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR

COMMENCED 22.11.07

COMPLETED 25.11.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
0					NON CORE							
1												
1.50	HQ	Run 1			CORING COMMENCES AT 1.50m							
2		Run 2			META-SHALE, brown/dark grey, banded, laminated at 5° to 10°		MS			1.50 PARTING FRAGMENTS, 5°, planar, gen. rough, Fe st, clay coated to clay fill 12mm thick 1.76 1.87 PARTING, 5°, planar, rough, Fe st, clay coated 1.95 As above, minor crushing 2.03 PARTING/JOINT FRAGMENTS, planar, rough, Fe st, minor clay coating, 5° (bedding) to 70° 2.57 2.60 2x5 PARTINGS, 5°, planar, rough, Fe st, clay coated. 2.61	15%	
2.20												
2.76						MW	VW					
2.89												
3		Run 3					MS			2.78 PARTING/JOINT FRAGMENTS, planar, rough, Fe st, gen. clay coated, 5 to 10° (Bedding) to 75	0%	NO TEST
3.26												
3.69										Includes clay fill from 3.69 to 3.77m (80mm).		
3.77												
3.80												
4.00		Run 4					MS/MS					
4.24					TUFFACEOUS SANDSTONE, fine grained, pale brown, includes elongate, subangular META-SHALE clasts to 35mm					4.20	45%	
4.56		Run 5					MS			4.33 JOINT, 30°, planar, rough, Fe/Mn st. 4.44 PARTING, 5°, planar, rough, minor Fe/Mn st. 4.56 As above.		
4.80					META-SHALE, brown/dark grey, banded, laminated at 5° to 10°					4.84 As above, minor fragmentation, clay coated. 4.94 JOINT, 30°, planar, rough, Fe/Mn st.	85%	
5												

Remarks:

Job / Report No. GN25A

Logged by: JOHN YOUNG Date: 5.12.07 Site Supervisor MARK ASHOVER

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

NSW Department of Commerce

BOREHOLE No. DDH 7 — Sheet 2 of 7 Sheets

PROJECT	TILLEGRA DAM	CO-ORDINATES	E 376506 / N 6423774
LOCATION	UPPER LEFT ABUTMENT (SADDLE)	R.L. COLLAR	147.5m
		DATUM	AHD
		BEARING	060°M
		INCLINATION	60° from horizontal
DRILL	DELTA 2000, TRACK MOUNTED	CONTRACTOR	McDERMOTT DRILLING
CORE BARRELL	HQ TRIPLE	DRILLER	SHAUN TAYLOR
COMMENCED	22.11.07	COMPLETED	25.11.07

DRILLING DATA — Depth (R.L.) Metres; Method; Casing, Run; Water
ROCK SUBSTANCE — Graphic Log; Description (Rock type: grainsize, texture, colour, composition, structure, hardness); Weathering; Estimated Strength
ROCK MASS DEFECTS — Defect Spacing (mm) 2000 600 200 60 20; Visual Log; Defect Description (Type, inclination, planarity, roughness, coatings or infillings); R.Q.D.; Tests WPT

Depth (m)	Method / Run	Description	Weathering	Strength	Defect Description	R.Q.D.	Tests
5 – 6.02	HQ; Run 7 (to 5.35), Run 8	META-SHALE continues, brown/dark grey, banded. Laminated at 5 to 10°	MW; MW/SW; EW (5.82–5.88); MW/SW	MS; EW (5.82–5.88)	5.02–5.55 Numerous PARTINGS/PARTING FRAGMENTS, planar, rough, Fe/Mn st., occasionally clay coated. 5.68–5.77 JOINT, 30°, with associated PARTINGS, 5°, planar, rough, Fe/Mn st. 5.82–6.20 Several JOINTS, 45 to 65°, with associated PARTINGS, 5 to 15°, planar, rough, Fe/Mn st., occasionally clay coated.	0 (Run 7); 25% (Run 8)	NO TEST
6.02 – 6.65	Run 8 / Run 9 (from 6.30)	TUFFACEOUS SANDSTONE, fine grained, pale brown.	MW	MS	6.20 JOINT, 45°, planar, rough, Fe st, clay coated. 6.40 JOINT 30°, as above. 6.45 PARTING, 5°, planar, rough, Fe/Mn st. 6.54 JOINT, 45°, planar, rough, Fe st, clay coated.		
6.65 – 6.80	Run 9		HW	VW	6.65–6.80 PARTINGS, 10°, planar, rough, Fe/Mn st.		
6.80 – 8.43	Run 9; Run 10 (7.30–8.16); Run 11 (8.16–)	META-SHALE, dark grey / minor brown banding. Laminated at 10°. Includes occasional fine grained TUFFACEOUS SANDSTONE laminations	MW/SW	MS	6.90–7.47 JOINT/PARTING FRAGMENTS, 60 to 70° (joints) and 5 to 10° (bedding) planar, rough, Fe/Mn st., occasional clay coating. 7.57 JOINT, 40°, planar, rough, Fe/Mn st., minor clay coating. 7.70–8.43 Several JOINTS, 90° (parallel to core axis), with associated PARTINGS, 5 to 10°, planar, rough, Fe/Mn st, occasional clay coating.	25% (Run 9); 17% (Run 10); 0% (Run 11)	Lithol
8.43 – 8.53	Run 11	CORE LOSS 0.10m					
8.53 – 10	Run 11; Run 12 (to 9.49); Run 13 (9.49–9.80); Run 14 (9.80–)	TUFFACEOUS SANDSTONE, fine grained, pale brown / grey/brown. Includes occasional elongate META-SHALE clasts and laminations at 10 to 15°	MW (to SW)	MS	8.53 PARTING 10°, with JOINT, 65°, planar, rough, Fe st. 8.76 JOINT, 60°, with associated PARTING, 10°, planar, rough, minor clay coating. 8.90 JOINT, 40°, planar, rough, Fe st, clay coated. 9.00 JOINT, 60°, with associated PARTINGS, 10°, Fe/Mn stained. 9.20 JOINT, 40°, planar, rough, Fe st. 9.30–9.49 Several JOINTS, 60°, planar, rough, Fe/Mn st. 9.55 BOXING BREAK. 9.65 JOINT, 45°, planar, rough, Fe st. 9.92 PARTING, 5°, planar, rough, Fe st.	45% (Run 12); 80% (Run 13)	Dul

Remarks: Box 1 ENDS AT 5.02m   Box 2 ENDS AT 8.53m

Job / Report No. GN25A

Logged by: JOHN YOUNG   **Date:** 5.12.07   **Site Supervisor** MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 7 Sheet 3 of 7 Sheets

PROJECT TILLEGRA DAM
LOCATION UPPER LEFT ABUTMENT (SADDLE)
CO-ORDINATES E 376506 N 6423774
R.L. COLLAR 147.5m DATUM AHD BEARING 060°M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 22.11.07 COMPLETED 25.11.07

DRILLING DATA			ROCK SUBSTANCE			ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
10				TUFFACEOUS SANDSTONE cont. fine gr., pale brown/grey brown	MW(to SW)	MS					
10.18		Run 13		META-SHALE, dark grey/grey brown, laminated at 10 to 15°					10.18 } Several JOINTS, 30 to 50°, planar, rough, Fe/Mn st. 10.20 }		
10.30											
10.46									10.46 PARTING, 20°, planar, rough, Fe/Mn st.		
				TUFFACEOUS SANDSTONE, fine grained, pale grey with grey brown bands					10.73 DRILLING BREAK		
11		Run 14			F(S)	S/MS					
	HQ								11.30 PARTING, 15°, planar, rough, Fe st		
									11.43 BOXING BREAK		
									11.55 JOINT, 60°, planar, rough, Fe st.		
11.80											
12					SW				11.95 PARTING, 15°, planar, rough, Fe/Mn st.	100%	0 WL
12.40									12.43 BOXING BREAK		
									12.73 PARTING, 5°, undulating, very rough, Fe st.		
13											
13.30									13.30 DRILLING BREAK		
									13.42 BOXING BREAK		
					F(S)				13.60 HANDLING BREAK		
14		Run 15									28 WL
									14.42 BOXING BREAK		
14.94					SW				14.86 Probable DRILLING BREAK		
15											

Remarks: BOX 3 ENDS AT 12.43m
Job / Report No. GN25A
Logged by: JOHN YOUNG Date: 6.12.07 Site Supervisor MARK ASHOVER

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

NSW Department of Commerce

BOREHOLE No. DDH 7 — Sheet 4 of 7 Sheets

PROJECT: TILLEGRA DAM
LOCATION: UPPER LEFT ABUTMENT (SADDLE)
CO-ORDINATES: E 376506, N 6423774
R.L. COLLAR: 147.5m
DATUM: AHD
BEARING: 060°M
INCLINATION: 60° from horizontal

DRILL: DELTA 2000, TRACK MOUNTED
CONTRACTOR: McDERMOTT DRILLING
COMMENCED: 22.11.07
CORE BARRELL: HQ TRIPLE
DRILLER: SHAUN TAYLOR
COMPLETED: 25.11.07

Depth (R.L.) Metres	Method	Casing, Run	Description (Rock type: grainsize, texture, colour, composition, structure, hardness)	Weathering	Estimated Strength	Defect Description (Type, inclination, planarity, roughness, coatings or infillings)	R.Q.D.	Tests (WPT)
15 – 16.30	HQ	RUN 15 CONT.	TUFFACEOUS SANDSTONE continues, fine grained, pale grey with greybrown bands (SW). Carbonate veining in part up to 1mm thick (healed joints).	SW (15–15.50); F(s) (15.50–16.50)	S/VS	15.18 Possible PARTING, 5°, planar, rough, minor Fe staining; 15.30 JOINT, 60°, planar, rough, Fe st.; 15.60 Probable DRILLING BREAK; 16.15 JOINT, 60°, planar, rough, Fe st.; 16.30 DRILLING BREAK	95%	28 UL
16.30 – 17.30	HQ	RUN 16	(16.96) META-SHALE, greybrown, laminated at 15°. Includes laminated/very thin TUFFACEOUS SANDSTONE interbeds, very fine grained.	SW (16.50–17.70)	MS	16.43 PARTING, 5°, planar, rough, Fe st.; 16.77 – 17.67 Numerous JOINTS, 40 to 65°, with PARTINGS, 15°, planar, generally rough. Fe/Mn st.	44%	
17.30 – 19.30	HQ	RUN 17	(17.70) TUFFACEOUS SANDSTONE, very fine/fine grained, greybrown (SW) with pale grey bands. Includes rare elongate META-SHALE clasts to 35mm dimension.	F(s) (18.10–18.75)	S	18.00 Probable DRILLING BREAK; 18.32 BOXING BREAK; 18.75 PARTING, 5°, planar, rough, Fe st.; 19.10 JOINT, 50°, planar, rough, Fe/Mn st.; 19.30 DRILLING BREAK	80%	17 UL
19.30 – 20	HQ	RUN 18		SW		19.55 – 19.75 Several JOINTS, 60 and 80°, planar, rough, Fe/Mn st.; 19.92 JOINT, 60°, planar, rough, Fe/Mn st.	60%	21 UL

Depth marks: 15, 15.50, 16, 16.30, 16.50, 16.96, 17, 17.30, 17.70, 18, 18.10, 18.75, 18.80, 19, 19.30, 20

Remarks: Box 4 ENDS AT 16.30 m
Job/Report No. GN 25A
Logged by: JOHN YOUNG
Date: 6.12.07
Site Supervisor: MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 7 Sheet 5 of 7 Sheets

PROJECT TILLEGRA DAM
LOCATION UPPER LEFT ABUTMENT (SADDLE)
CO-ORDINATES E 376506 N 6423774
R.L. COLLAR 147.5m AHD
DATUM
BEARING 060° M
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 22.11.07
COMPLETED 25.11.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS					
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS	WPT
20					TUFFACEOUS SANDSTONE continues, fine grained grey brown (5YR) / pale grey.								
20.45		R/B cont				SW				20.14 JOINT FRAGMENTS, 60 to 80°, planar, rough, Fe/Mn st.			
										20.50			
					Includes occasional carbonate healed joints up to 1mm thick.					20.65 JOINT, 70 to 90°, planar, rough, Fe st.				
21											70%		
21.25		RUN 19											
21.48						$F_{(S)}$	S			21.45			
21.98										21.98 PARTING, 5°, planar, very rough, Fe/Mn st.			
22		RUN 20								22.17			
22.20	HQ					SW				JOINT FRAGMENTS, 30 to 70°, planar, rough, Fe/Mn st.			
22.58										22.58			
23										23.02 PARTING, 5°, planar, rough, Fe st.	80%		
										23.20 JOINT, 45°, planar, rough, Fe st.			
23.40		RUN 21			23.40m Very fine grained	$F_{(S)}$	S/MS			23.47 PARTING, 10°, planar, rough, Fe/Mn st.			
23.57					23.57m								
										23.90 As above			
24.00										24.00 JOINT, 45°			
		RUN 22			Medium grained					24.10 BOXING BREAK			
24.50					24.50m						100%		
					Fine grained.					24.68 PARTING, 10°, planar, very rough, Fe st.			
25										24.93 As above			

Remarks: Box 5 ENDS AT 20.24m Box 6 ENDS AT 24.10m
Job / Report No. GN25A

Logged by: JOHN YOUNG
Date: 6.12.07
Site Supervisor MARK ASHOVER

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

NSW Department of Commerce

BOREHOLE No. DDH 7

Sheet 6 of 7 Sheets

PROJECT: TILLEGRA DAM
LOCATION: UPPER LEFT ABUTMENT (SADDLE)

CO-ORDINATES: E 376706, N 6423774

R.L. COLLAR: 147.5m
DATUM: AHD
BEARING: 060° M
INCLINATION: 60° from horizontal

DRILL: DELTA 2000, TRACK MOUNTED
CONTRACTOR: McDERMOTT DRILLING
CORE BARRELL: HQ TRIPLE
DRILLER: SHAUN TAYLOR
COMMENCED: 22.11.07
COMPLETED: 25.11.07

DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm)	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
25	HQ	RUN 22			TUFFACEOUS SANDSTONE continues, fine grained, generally pale grey, with grey breccia (SCO) intervals.	F(S)				25.10 BOXING BREAK; 25.25 HANDLING BREAK; 25.30 DRILLING BREAK		L/UL
25.30												
25.55					—25.55m							
					Medium grained. Includes subangular clasts generally to 2mm dimension, rarely 5mm.	SW				25.72 JOINT, 45°, planar, rough, Fe st.; 25.80 – 25.95 2x's JOINTS, 50 and 60°, planar, rough, Fe st.		
25.95										26.10 PARTING, 15°, planar, rough, Fe st		
		RUN 23								26.35 As above	90%	
						F(S)	S/VS			26.73 Probable DRILLING BREAK		
27										26.94 PARTING, 20°, planar, rough, Fe st.; 27.13 JOINT, 60°, planar, rough, Fe st.; 27.24, 27.31 DRILLING BREAKS		L/UL
27.65										27.65 PARTING, 20°, planar, rough, Fe st.		
27.90		RUN 24			—27.90m Fine grained					27.78, 27.90 HANDLING BREAKS	92%	
28												
28.10					—28.10m					28.07 JOINT, 60°, planar, rough, Fe/Mn st.		
28.30					Fine-medium grained.					28.30 DRILLING BREAK; 28.50 DRILLING BREAK		
										28.88 – 29.02 2x's PARTINGS, 15°, planar, rough, Fe st, carbonate coating at 28.88m		
29												
29.07		RUN 25				SW				29.10 – 29.27 JOINT FRAGMENTS, 45 to 65°, planar, rough, Fe/Mn st.	90%	L/UL
29.27										29.41 JOINT, 70°, planar, rough, Fe st; 29.54 As above.		
						F(S)						
30										30.00 BOXING BREAK		

Remarks: BOX 6 ENDS AT 28.07m

Job /Report No. GN25A

Logged by: JOHN YOUNG
Date: 6.12.07
Site Supervisor: MARK ASHOVER

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

NSW Department of Commerce

BOREHOLE No. DDH 7 — Sheet 7 of 7 Sheets

PROJECT: TILLEGRA DAM
LOCATION: UPPER LEFT ABUTMENT (SADDLE)
CO-ORDINATES: E 376506, N 6423774
R.L. COLLAR: 147.5m
DATUM: AHD
BEARING: 060° M
INCLINATION: 60° from horizontal
DRILL: DELTA 2000, TRACK MOUNTED
CONTRACTOR: McDERMOTT DRILLING
COMMENCED: 22.11.07
CORE BARRELL: HQ TRIPLE
DRILLER: SHAUN TAYLOR
COMPLETED: 25.11.07

DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE (Grainsize, texture, colour, composition, structure, hardness)	WEATHERING	ESTIMATED STRENGTH	DEFECT DESCRIPTION — TYPE (Inclination, planarity, roughness, coatings or infillings)	R.Q.D.	TESTS WPT
30	HQ	RUN 25 CONT			TUFFACEOUS SANDSTONE continues, grey.	Fr(s)	S/VS	30.10 JOINT, 60°, planar, rough, minor Fe st carbonate coated		
30.20								30.24 JOINT, 30°, planar, rough, Fe st.		
30.38					Fine-medium grained. Includes subrounded clasts to 1mm dimension			30.38 DRILLING BREAK		11 UL
30.80		RUN 26						30.88 BOXING BREAK	100%	
31								31.04 HANDLING BREAK		
31.30 / 31.33		RUN 27			— 31.33m; Fine grained			31.30 DRILLING BREAK		
								31.75 Possible PARTING, 10°, planar, rough, minor Fe st,		
								31.90 BOXING BREAK		
32								32.00 PARTING, 10°, planar, rough, Fe st		0 UL
								32.35 DRILLING BREAK		
32.50					— 32.50m			32.46 JOINT, 60°, planar, rough, Fe st, carbonate coated.		
					Medium grained. Includes subrounded clasts to 2mm dimension. Occasion carbonate healed joints/partings persist.			32.66 – 32.87 JOINT, 75°, planar, rough, Fe st carbonate coated.	96%	
33								33.27 DRILLING BREAK		
								33.60 JOINT, 30°, planar, rough, Fe st, carbonate coated.		
33.94 / 34					— 33.94m; Fine grained			33.94 – 33.04 2x's PARTINGS, 5°, planar, rough, Fe st.		
34.30					HOLE ENDS AT 34.30m			34.30 DRILLING BREAK		
35										

Remarks: Box 8 ENDS AT 31.90m Box 9 ENDS AT 34.30m - END OF HOLE
Job/Report No.: GN25A.
Logged by: JOHN YOUNG
Date: 6.12.07
Site Supervisor: MARK ASHOVER


TILLEGRA DAM
BOREHOLE: DDH 7
DEPTH: 1.50 — 5.02 M
TILLEGRA DAM
DDH 7
1·50
2·20
2·85
3·36
3·80
4·56


TILLEGRA DAM
BOREHOLE: DDH 7
DEPTH: 5.02 — 12.43 M
5·28
5·35
6·30
7·30
8·16
CORE LOSS
0·10 m
8·53
9·46
10·30


TILLEGRA DAM
BOREHOLE: DDH 7
DEPTH: 12.43 — 20.34 M
13:30
SPACER
16:30
17:30
19:30


TILLEGRA DAM
BOREHOLE: DDH 7
DEPTH: 20.34 — 28.07 M
20.45
21.48
22.30
24.00
25.30
27.65


TILLEGRA DAM
BOREHOLE: DDH 7
DEPTH: 28.07 — 34.30 M
28-30
30-38
31-30
34-30
END DDH 7

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8

Sheet 1 of 10 Sheets

PROJECT TILLEGRA DAM

LOCATION LEFT ABUTMENT, PROPOSED SPILLWAY CREST

CO-ORDINATES E 376697 N 6423872

R.L. COLLAR 165.6m DATUM AHD BEARING 060°M INCLINATION 60° from horizontal

DRILL DELTA 1000 TRUCK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 16.11.07

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 22.11.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS	WPT
0				NON CORE								
1												
1.50				CORING COMMENCES 1.50m								
1.65				META-SHALE, very fine gr. dark grey/greybrown.	MW	MS			1.50 PARTING/JOINT FRAGMENTS, planar, generally rough, Fe/Mn stained, 15° (bedding) to 70° 1.65	0%		
1.75		RUN 1		CORE LOSS 0.10m								
2.00				As above (laminated/ thinly bedded at 15°)	MW	MS			1.75 As above, clay filled parting at 2.00m, 15mm thick 2.00	0%		
2.25		RUN 2		CORE LOSS 0.25m								
2.43		RUN 3		As above					2.25 As above. Clayey fill from 2.33 to 2.43 and again from 2.50 to 2.83m (30mm thick). Defects commonly clay coated.	0%		
2.68						MS				0%		
2.99				TUFFACEOUS SANDSTONE, fine grained, pale brown.	MW	MS/S			2.99 Numerous PARTINGS/JOINTS, planar, smooth to rough, Fe/Mn stained, generally clay coated. Mostly 15° (bedding) to 70° 3.65	0%		
3.31												
3.47				META-SHALE, very fine gr, dark grey/greybrown, laminated to very thinly bedded at 15°		MS				17%		
3.72									3.72 PARTING, 15°, planar, rough, Fe st. 3.88 JOINT, 50°, planar, rough, Fe/Mn st.			
3.80												
4		RUN 4		TUFFACEOUS SANDSTONE, fine grained, generally pale brown, indistinct bedding at 15° to 20°		MS/S			4.05 PARTING, 15°, planar, rough, minor clay coating 4.05 JOINT/PARTING FRAGMENTS, 15° to 70°, planar, rough, Fe st. 4.20	10%		
4.20												
4.44					MW/SW	S						
4.73		RUN 5										
5				META-SHALE interbed from 4.90 to 5.00m	MW	MS/S			4.68 PARTING, 15°, planar, rough, Fe/Mn st. 4.79 JOINT, 45°, planar, rough, Fe st. clay coated 4.94 2x's PARTINGS, 15°, 5.00 planar, rough, Fe st, clay coated.	84%		

Remarks: BOX ENDS AT 5.00 m

Job/Report No. GN25A

Logged by: JOHN YOUNG Date: 27.11.07 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8

Sheet 2 of 10 Sheets

PROJECT	TILLEGRA DAM	CO-ORDINATES	R.L. COLLAR 165.6m
LOCATION	LEFT ABUTMENT, PROPOSED SPILLWAY CREST	E 376697	DATUM AHD
		N 6423872	BEARING 060 M
			INCLINATION 60° from horizontal
DRILL	DELTA 2000 TRACK MOUNTED	CONTRACTOR McDERMOTT DRILLING	COMMENCED 15.11.07
CORE BARRELL	HQ TRIPLE	DRILLER SHAUN TAYLOR	COMPLETED 22.11.07

DRILLING DATA | ROCK SUBSTANCE | ROCK MASS DEFECTS

DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
5 – 5.10 – 5.15		R8			5.00 META-SHALE interbed; TUFF. S/S, fine gr. pale brown; META SHALE interbed, 20°	MW	MS			5.00 – 5.10 – 5.15 – 5.35: 4x's PARTINGS, 15 to 20°, planar generally rough, Fe/Mn stained, minor clay coating.		
5.35					TUFFACEOUS SANDSTONE, fine grained, generally grey brown. Poorly defined bedding at 20°					5.54 JOINT, 60°, planar, rough, Fe/Mn st., minor clay coating		
										5.72 – 5.80: 2x's JOINTS, as above		
										5.95 BOXING BREAK	95%	
6		RUN 9								6.08 JOINT, 50, planar, rough, Fe/Mn st.		
										6.20 PARTING, 20°, planar, rough, Fe/Mn st.		
6.41						MW/SW	MS/S			6.35 – 6.41: JOINT FRAGMENTS, 60°, planar, rough, Fe/Mn st., minor clay coating.		5UL
										6.61 DRILLING BREAK associated with JOINT, 70°		
		RUN 10								6.80 JOINT, 45°, planar, rough, Fe st.	61%	
										6.94 JOINT, 50°, planar, rough, Fe/Mn st.		
7										7.13 DRILLING BREAK		
7.23	HQ									7.23 JOINT, 50°, planar, rough, Fe/Mn st.		
7.50										7.41 – 8.13: JOINT FRAGMENTS. 3x's parallel JOINTS at 20°, with opposing Joints at 50°, planar, rough, Fe st, with carbonate fill. (shear zone)		
7.65		RUN 11				HW	W				19%	
8 – 8.10 – 8.13 – 8.18				⊠	CORE LOSS 0.05m							
										8.21 JOINT, 45°, planar, rough, Fe/Mn st		
		RUN 12			TUFFACEOUS SANDSTONE continues. Includes subangular clasts to 2mm dimension					8.47 – 8.85: Numerous JOINTS, 60, planar, rough, Fe/Mn stained.	35%	
										8.93 PARTING, 20°, planar, rough, Fe/Mn stained.		
9										9.04 – 9.47: JOINT, 70°, with opposing PARTINGS/JOINTS, 20 to 50°, planar, rough, Fe/Mn st, minor carbonate coating.		1.8UL
9.18		RUN 13				MW/SW	MS/S				0%	
9.54		RUN 14									85%	
10										9.91 PARTING, 20°, planar, rough, Mn st.		

Remarks: BOX 1 ENDS AT 5.00 m. BOX 2 ENDS AT 8.62 m

Job / Report No. GN 25A

Logged by: JOHN YOUNG | Date: 27.11.07 | Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8

Sheet 3 of 10 Sheets

PROJECT: TILLEGRA DAM
LOCATION: LEFT ABUTMENT, PROPOSED SPILLWAY CREST
CO-ORDINATES: E 376697, N 6423872
R.L. COLLAR: 165.6m
DATUM: AHD
BEARING: 060 M
INCLINATION: 60° from horizontal
DRILL: DELTA 2000, TRACK MOUNTED
CONTRACTOR: McDERMOTT DRILLING
COMMENCED: 15.11.07
CORE BARRELL: HQ TRIPLE
DRILLER: SHAUN TAYLOR
COMPLETED: 22.11.07

DEPTH (R.L.) METRES	Method	Casing, Run	Water	DESCRIPTION: ROCK TYPE (Grainsize, texture, colour, composition, structure, hardness)	WEATHERING	ESTIMATED STRENGTH	DEFECT DESCRIPTION: TYPE (Inclination, planarity, roughness, coatings or infillings)	R.Q.D.	TESTS WPT
10 – 12.44	HQ	RUN 16 (to 10.23), RUN 17		TUFFACEOUS SANDSTONE continues, generally fine grained with subangular clasts 1 to 2mm dimension, greybrown	MW/SW	MS/S	10.04 JOINT, 60°, planar, rough, Mn st. 10.23 DRILLING BREAK 10.34 – 10.45 2x's JOINTS, 65°, planar, rough, Fe/Mn stained. 10.64 PARTING, 20°, planar, rough, Fe/Mn stained 11.02 – 11.12 2x's PARTINGS, as above. 11.30 BOXING BREAK 11.64 JOINT, 45°, irregular (stepped) rough, Fe/Mn stained 12.05 PARTING, 10°, planar, rough, Fe/Mn stained. 12.23 – 12.70 JOINT/PARTING FRAGMENTS, 15 (bedding) to 65°, planar, rough, Fe/Mn stained.	90%	1.8 UL
12.44 – 13.42		RUN 16 (12.50 – 13.08), RUN 17 (13.08 – 13.23)		META-SHALE with fine gr. TUFFACEOUS SANDSTONE interbeds, greybrown/brown. Laminated to very thinly bedded at 10 to 15°.		Generally MS	12.94 – 13.00 2x's PARTINGS, 15°, planar, rough, Fe/Mn st. 13.08 JOINT, 45°, planar, rough, Fe st. 13.13 PARTING, 10°, planar, rough, Fe st. 13.22 – 13.54 Several JOINTS, 45 to 60°, with PARTINGS, 15°, planar, rough Fe/Mn stained	77% / 100	
13.42 – 15		RUN 18 (13.23 – 14.56), RUN 19		TUFFACEOUS SANDSTONE, fine grained, brown/greybrown.	MW/SW (14.06 – 14.38: HW/MW; 14.56 –: MW/SW)	MS/S (14.06 – 14.38: W/MS; 14.56 –: MS/S)	13.75 JOINT, 60°, planar, rough, Fe st. 13.82 JOINT, 45°, as above. 14.06 – 14.38 JOINT, 80°, with opposing PARTINGS/JOINTS, 15 to 45°, planar, rough, Fe/Mn st. 14.78 JOINT, 60°, curved, rough, Fe/Mn st. 14.97 BOXING BREAK	47%	2.5 UL

Remarks: BOX 3 ENDS AT 12.30m

Job/Report No. GN 25A.

Logged by: JOHN YOUNG
Date: 27.11.07
Site Supervisor: MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8

Sheet 4 of 10 Sheets

PROJECT TILLEGRA DAM

LOCATION LEFT ABUTMENT, PROPOSED SPILLWAY CREST

CO-ORDINATES E 376697 N 6422872

R.L. COLLAR 165.6m AHD

DATUM

BEARING 060° M

INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED

CORE BARRELL HQ TRIPLE

CONTRACTOR McDERMOTT DRILLING

DRILLER SHAUN TAYLOR

COMMENCED 15.11.07

COMPLETED 22.11.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
15				TUFFACEOUS SANDSTONE continues, fine grained.	MW/SW	MS/S			15.04 PARTING, 10°, planar, rough, Fe st. 15.06 JOINT, 40°, irregular, rough, Fest 15.20 JOINT, 45°, planar, rough, Fe st.		
15.40 15.45		RUN 19 cont.		META-SHALE interbed, 10°					15.41 15.44 2x's PARTINGS, 10 to 15°, planar, rough, Fe stained		
15.75				TUFFACEOUS SANDSTONE, medium grained.	SW	S			JOINT, 90°, wavering, rough, Fe stained.	65%	1.5UL
16.00				Includes subangular, elongate clasts to 25mm dimension.					16.10		
16.23									16.13 JOINT, 65°, planar, rough, Fe stained.		
16.70 16.78				META-SHALE interbed, 10°	MW/SW	MS/S			16.67 Probable DRILLING BREAK.		
16.90									16.85 JOINT, 45°, planar, rough, Fe stained		
17	HQ			TUFFACEOUS SANDSTONE, medium grained. Includes subangular clasts to 3mm dimension							
									17.35 JOINT, 40°, planar, rough, Fe stained		
									17.60 JOINT, 65°, planar, rough, Fe stained	100%	TOL
									16.82 BOXING BREAK		
17.94 18		RUN 20		TUFFACEOUS SANDSTONE, interbedded fine/medium/coarse grained. Very thinly to thinly bedded at 15°	SW/F(S)	S/VS			18.29 PARTING, 10°, planar, rough, Fe stained.		
18.63									18.73 HANDLING BREAK 18.84 BOXING BREAK		
19 19.10				Grades into medium grained around 19.10m	F(S)				19.20 DRILLING BREAK		
19.23		RUN 21							19.68 HANDLING BREAK. 19.83 BOXING BREAK 19.95 JOINT, 5°, planar, rough, Fe st.	100%	
20											

Remarks: BOX 4 ENDS AT 15.90m BOX 5 ENDS AT 19.83m

Job / Report No. GN26A

Logged by: JOHN YOUNG

Date: 27.11.07

Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8

Sheet 5 of No Sheets

PROJECT TILLEGRA DAM

LOCATION LEFT ABUTMENT, PROPOSED SPILLWAY CREST.

CO-ORDINATES E 376697 N 6423872

R.L. COLLAR 165.6m DATUM AHD BEARING 060 M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR MCDERMOTT DRILLING

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR

COMMENCED 15.11.07 COMPLETED 22.11.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS					
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS	NPT
20					TUFFACEOUS SANDSTONE continues, medium grained. Includes rare subangular clasts to 5mm dimension					20.25 Joint, 70°, planar, rough, carbonate coated, slightly fe st.			
										20.83 BOXING BREAK			
21	HQ	RUN 21 CONTINUED				F(s)	S/VS				100%		
										21.40 DRILLING BREAK			
22													0 L/L
22.23										22.23 DRILLING BREAK			
		RUN 22								22.78 BOXING BREAK			
23											100%		
										23.75 BOXING BREAK			
24													
										24.76 PARTING, 15°, planar, rough, minor fe staining			
25										25.00 DRILLING BREAK			

Remarks: BOX 6 ENDS AT 23.75m

Job / Report No. GN 25A

Logged by: JOHN YOUNG

Date: 27.11.07

Site Supervisor MARK ASHOWER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8 Sheet 6 of 10 Sheets

PROJECT TILLEGRA DAM
LOCATION LEFT ABUTMENT, PROPOSED SPILLWAY CREST.
CO-ORDINATES E 376697 N 6423872
R.L. COLLAR 167.6m AHD
BEARING 060° M
INCLINATION 60° from horizontal
DRILL DELTA 1000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 15.11.07
COMPLETED 22.11.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS					
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS	WPT
25													
25.23		LB22			TUFFACEOUS SANDSTONE, continues, medium grained					25.60 DRILLING BREAK 25.19 DRILLING BREAK 25.52 PARTING, 20°, slightly irregular, rough, Fe st.			0 UL
										25.80 BOXING BREAK			
26 26.06	HQ				Fine grained, very thinly bedded at 15°					26.18 26.36 26.42 26.52 — 4x5 PARTINGS, 15°, planar, rough, Fe stained.	98%		
26.60		RUN 23	100% drilling water loss		(Includes META-SHALE laminations at 26.50 to 26.52m).	F(S)	S/VS			26.80 BOXING BREAK			> 100 UL
27					TUFFACEOUS SANDSTONE continues, medium gr.								
27.70										27.70 JOINT, 60°, planar, rough, Fe/Mn stained. 100% WATER LOSS.			
28 28.07		RUN 24			Fine grained					28.12 DRILLING BREAK	80%		
28.23													
28.40					Grades to medium gr.					28.45 PARTING, 15°, planar, rough, Fe stained 28.62 BOXING BREAK			
29		RUN 25			TUFFACEOUS SANDSTONE continues, medium gr. Includes rare subangular clasts to 4mm dimension.					29.64 BOXING BREAK	80%		> 100 UL
										29.89 29.99 — 2x4 JOINTS, 45°, planar, rough, Fe stained.			
30													

Remarks: BOX 7 ENDS AT 27.70m
Job / Report No. GN 29A
Logged by: JOHN YOUNGS
Date: 27.11.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8 — Sheet 7 of 10 Sheets

PROJECT: TILLEGRA DAM
LOCATION: LEFT ABUTMENT, PROPOSED SPILLWAY CREST
CO-ORDINATES: E 376697, N 6423872
R.L. COLLAR: 165.6m AHD
BEARING: 060° M
INCLINATION: 60° from horizontal
DRILL: DELTA 2000, TRACK MOUNTED CONTRACTOR: McDERMOTT DRILLING
CORE BARREL: HQ TRIPLE DRILLER: SHAUN TAYLOR
COMMENCED: 15.11.07
COMPLETED: 22.11.07

DRILLING DATA			ROCK SUBSTANCE			ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
30 (30.09)				TUFFACEOUS SANDSTONE cont., medium grained							
				Fine grained	$F_{(s)}$	S/VS			30.30 DRILLING BREAK		
30.40		RUN 27 CORE LOSS		Grades into medium gr. around 30.40m					30.41 JOINT, 60°, planar, rough, Fe st.		
									30.53 DRILLING BREAK		
30.71				CORE LOSS 0.05m					30.60 } JOINT, 60°, planar, rough, Fe st. (fragmented). 30.71		
30.76				TUFFACEOUS SANDSTONE, medium grained.					30.76 } JOINT, 85°, planar, rough, Fe st. 31.00	100%	> 100 UL
31											
31.13		RUN 28									
31.27	HQ			Fine grained					31.23 DRILLING BREAK.		
					$F_{(s)}$	S/VS					
31.57		RUN 29		Medium/coarse grained					31.63 BOXING BREAK		
32										100%	
									32.40 PARTING, 15°, planar, rough, Fe st.		
									32.60 BOXING BREAK		
31.82				Includes subangular, elongate clasts to 50mm dimension					32.62 JOINT, 60°, planar, rough.		< 1 UL
33.00									33.10 PARTING, 15°, planar, rough, Fe st.		
				Coarse grained TUFFACEOUS SANDSTONE continues					33.40 PARTING, 20°, planar, rough.		
				Fine grained.					33.65 PARTING, 15°, planar, rough, Fe st.		
33.65									33.71 JOINT, 45°, planar, rough, Fe st.		
		RUN 30		Fine-medium grained.					33.95 DRILLING BREAK	90%	
34									34.10 JOINT, 45, planar, rough, Fe stained, carbonate fill 1mm thick.		
34.23				Includes subangular, elongate clasts to 25mm dimension.					34.23 JOINT, 45°, planar, rough, Fe st.		
34.40									34.40 DRILLING BREAK		
		RUN 31		Fine-medium grained.					34.60 BOXING BREAK		60 UL
35.85				Fine grained, laminated to very thinly bedded at 10°					34.88 } 3x's PARTINGS, 10°, planar, rough, Fe st. 34.98		
35											

Remarks: Box 8 ENDS AT 31.62m — Job / Report No. GN 25A

Logged by: JOHN YOUNG — Date: 27.11.07 — Site Supervisor: MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8

Sheet 8 **of** 10 **Sheets**

PROJECT TILLEGRA DAM	**CO-ORDINATES** E 376697 N 6423872	**R.L. COLLAR** 165.6m	**DATUM** AHD
LOCATION LEFT ABUTMENT, PROPOSED SPILLWAY CREST		**BEARING** 060°M	**INCLINATION** 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED	**CONTRACTOR** McDERMOTT DRILLING	**COMMENCED** 15.11.07	
CORE BARRELL HQ TRIPLE	**DRILLER** SHAUN TAYLOR	**COMPLETED** 22.11.07	

DRILLING DATA: Method: HQ. Casing, Run: R29 CONT; RUN 30 (36.23–37.23); RUN 31 (from 37.23)

DEPTH (R.L.) METRES	ROCK TYPE / DESCRIPTION	WEATHERING	ESTIMATED STRENGTH	DEFECT DESCRIPTION	R.Q.D.	TESTS
35 – 35.10	Fine gr. TUFFACEOUS S/S – Includes META-SHALE lamination at 10°	F(s)	S/VS	35.15 – 35.40: 4x's JOINTS, 50 to 60°, planar rough, Fe st.		
35.25 – 35.40	Fine grained.	MW	MS			
35.40 – 36.57	Fine-medium grained TUFFACEOUS SANDSTONE	F(s)	S/VS	35.55 BOXING BREAK; 35.70 – 35.79: 2x's PARTINGS, 15°, with intersecting JOINT, 75°. All planar, rough, Fe st.; 35.92 JOINT, 45°, planar, rough, Fe st.; 36.05 As above; 36.15 DRILLING BREAK; 36.23 – 36.28: PARTING FRAGMENTS, 15°, planar rough, Fe st; 36.55 BOXING BREAK	60%	60 UL
36.57 – 37.06		SW		36.60 – 36.92: 2x's JOINTS, 60 to 70°, with intersecting PARTINGS, 20°. All planar, rough, Fe st.	25%	
37.06 – 37.23	META-SHALE, brown to dark grey, laminated at 10 to 15°. Includes several TUFFACEOUS S/S laminations.	MW	W / MS	37.12 – 37.23: PARTING FRAGMENTS, 10 to 15°, planar, rough, Fe st. (minor shear zone associated with bedding).		
37.40 – 38.00	TUFFACEOUS SANDSTONE, fine grained. Poorly defined bedding at 15 to 20°	F(s)	S/VS	37.45 JOINT, 45°, planar, rough, Fe st.; 37.60 Probable DRILLING BREAK		
38.00 – 39.03	Grades to fine-medium grained.			38.00 JOINT, 55°, planar, rough, Fe st.; 38.14 PARTING, 10°, planar, rough, minor Fe st.; 38.45 – 38.88: JOINT, 80 to 90°, planar to curved, rough, Fe st.; 38.96 JOINT, 40, planar, rough, Fe st.; 39.03 HANDLING BREAK	87%	32 UL
39.03 – 39.8	Fine grained, grading to fine-medium grained with depth.			39.36 BOXING BREAK		
39.8 – 40	META-SHALE lamination at 10°			39.86 PARTING, 10°, planar, rough, Fe st.; 40.00 As above		

Remarks: BOX 9 ENDS AT 35.55m BOX 10 ENDS AT 39.36m.

Job / Report No. GN 25A

Logged by: JOHN YOUNG **Date:** 28.11.07 **Site Supervisor** MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8 — Sheet 9 of 10 Sheets

PROJECT TULLEGRA DAM
LOCATION LEFT ABUTMENT, PROPOSED SPILLWAY CREST.
CO-ORDINATES E 376697 N 6423872
R.L. COLLAR 165.6m AHD
DATUM
BEARING 060° M
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 15.11.07
COMPLETED 22.11.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS					
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS	
40.60		R31			Interbedded fine grained TUFFACEOUS SANDSTONE with META-SHALE. Laminated to very thinly bedded at 15°		MS/S			40.05 PARTING, 15°, planar, rough, Fe st.			32 UL
40.73										40.73 DRILLING BREAK 40.20 } 2x's PARTINGS, 10°, planar, rough, Fe st. 40.30			
										40.49 } Numerous PARTINGS, 15°, planar, rough, Fe st. 40.73			
40.81						F(s)				40.86 JOINT, 60°, planar, rough, Fe st.	80%		
41		RUN 32			TUFFACEOUS SANDSTONE, fine grained.								
							S/VS			41.28 JOINT, 50°, planar, rough, Fe st.			
										41.42 } 2x's PARTINGS, 10 to 15°, planar, rough, Fe st. 41.46			
41.56										41.56 PARTING, 15°, planar, rough, Fe st.			
41.73													
41.91					Interbedded META-SHALE with very fine grained TUFFACEOUS SANDSTONE. Laminated to very thinly bedded at 10 to 15°					41.83 Possible DRILLING BREAK.			54 UL
42						HW	VW			41.91 } PARTING FRAGMENTS, 10°. (crushed from 41.95 to 42.04m and 42.20 to 42.25m), planar, rough, Fe st., clayey in crushed zones (shearing associated with bedding).			
42.08													
42.40	HQ						W/MS			42.40	100%		
42.44					TUFFACEOUS SANDSTONE, fine grained					42.41 JOINT, 40°, planar, rough, Fe st.			
42.75		RUN 33				F(s)	S/VS						
43													
43.23										43.23 DRILLING BREAK.			
					Interbedded META-SHALE with very fine grained TUFFACEOUS SANDSTONE, dark grey/grey. Laminated at 10 to 15°.					43.66 PARTING, 15°, planar, rough, minor Fe st.			50 UL
43.73										43.72 } Several JOINTS, 70 to 90°, planar, rough, Fe st.			
43.97					TUFFACEOUS SANDSTONE, fine grained						65%		
44													
44.14					Includes elongate clasts to 50 mm.					44.13			
		RUN 34								44.22 BOXING BREAK			
					Fine grained.					44.45 JOINT, 60°, planar, rough, Fe st, carbonate film 1mm thick			
45										44.97 ▽ See over			

Remarks: BOX 11 ENDS AT 43.23 — Job / Report No. GN 25A

Logged by: JOHN YOUNGS — Date: 28.11.07 — Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8 Sheet 1 of 1 Sheets

PROJECT TILLEGRA DAM
LOCATION LEFT ABUTMENT, PROPOSED SPILLWAY CREST
CO-ORDINATES E 376697 N 6423872
R.L. COLLAR 165.6m DATUM AHD BEARING 060°M INCLINATION 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN
COMMENCED 15.11.07 COMPLETED 22.11.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
45					TUFFACEOUS SANDSTONE continues, fine grained.	F(S)	S/VS			Several intersecting JOINTS, 70° and 50 to 60°, planar, rough, fe st.		
45.22		RISE			Includes elongate angular META-SHALE clasts to 40mm.					45.38		
45.33												
45.38												50 UL
					META-SHALE, dark grey, laminated at 10 to 15°					45.60 JOINT, 65°, planar, rough, carbonate coated.		
45.76		RUN 35								45.76 Probable PARTING, 10°, planar, rough, carbonate coated.		
										45.87 JOINT, 60°, planar, rough, carbonate coated		
46										45.95 PARTING, 10°, planar, smooth.	72%	
										46.10 HANDLING BREAK		
										46.13 BOXING BREAK		
46.23						F	MS/S			46.23 Probable DRILLING BREAK		
		RUN 36								46.43 } 2x 5° PARTINGS, 15°, planar,		
										46.50 } rough, minor carbonate coating.		
										46.72 Several JOINTS, 50 to 70°, planar, rough to smooth, carbonate coated.	60%	
46.89	HQ											
47										47.15		
47.25					TUFFACEOUS SANDSTONE, very fine gr., mid grey. Includes subrounded META-SHALE clasts towards 47.43		S			47.30 Possible PARTING, 10°, planar, rough, minor carbonate coating	55%	1 UL
47.43		RUN 37										
					META-SHALE, dark grey, laminated at 10 to 15°		MS/S			47.64 } DRILLING BREAKS		
47.64										47.68 }		
47.85					TUFFACEOUS SANDSTONE, fine gr, dark grey		S			47.93 Possible PARTING, 10°, planar, rough, minor carbonate coating		
47.93					META-SHALE, lam. at 10 to 15°		MS/S					
48.05					TUFFACEOUS SANDSTONE, v. fine to fine gr., mid grey.		S			48.13 As above		
48.22		RUN 38								48.23 DRILLING BREAK	66%	
					META-SHALE, dark grey, laminated at 10 to 15°. Includes occasional very fine-grained TUFFACEOUS SANDSTONE laminations.		MS/S			48.56 Possible PARTING, 10°, planar, rough, minor carbonate coating		
										48.67 } Intersecting JOINTS, 60°, planar, rough, carbonate coated		
										48.92 }		
49										48.93 Possible PARTING, 10°, planar, rough, minor carbonate coating		
										49.05 JOINT, 65°, planar, rough, carbonate coated		
49.18					CORE LOSS 0.05m - left down hole					49.18 DRILLING BREAK		
49.23					HOLE ENDS AT 49.23m							
50												

Remarks: BOX 12 ENDS AT 46.95m BOX 13 ENDS AT 49.23m END OF HOLE
Job / Report No.

Logged by: JOHN YOUNG Date: 5.12.07 Site Supervisor MARK ASHOVER


TILLEGRA DAM
BOREHOLE: DDH 8
DEPTH: 1.50 — 5.00 M
TILLEGRA DAM
DDH 8
1·50
CORE LOSS 0·10m
1·75
CORE LOSS (0·25m)
2·25
2·43
2·68
3·47
4·05
4·20


TILLEGRA DAM
BOREHOLE: DDH 8
DEPTH: 5.00 — 12.30 M
5·35
6·41
7·23
CORE LOSS 0·05m
8·18
9·18
9·54
10·23


TILLEGRA DAM
BOREHOLE: DDH 8
DEPTH: 12.30 — 19.83 M
12.50
13.08
13.23
14.56
SPACER (15.90)
16.23
19.23


TILLEGRA DAM
BOREHOLE: DDH 8
DEPTH: 19.83 — 27.70 M
22.23
25.23
27.70
100% WATER LOSS


TILLEGRA DAM
BOREHOLE: DDH 8
DEPTH: 27.70 — 35.55 M
28.23
30.76
31.23
33.65
34.23


TILLEGRA DAM
BOREHOLE: DDH 8
DEPTH: 35.55 — 43.23 M
36.23
37.23
40.23
SPACER
41.56
43.23


TILLEGRA DAM
BOREHOLE: DDH 8
DEPTH: 43.23 — 49.23 M
4533
4623
4687
4764
0-05 DOWN HOLE
4723
END DDH 8

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9
Sheet 1 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E 375664 N 6423067
R.L. COLLAR 163.4m DATUM AHD BEARING — INCLINATION VERTICAL

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARREL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 30.1.08 COMPLETED 13.2.09

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
0					NON CORE							
1												
1.40					CORING COMMENCES AT 1.40m							
1.52	HQ	RUN 1			TUFFACEOUS SANDSTONE, fine grained, grey-brown.				1.40	PARTING FRAGMENTS, 15°, with JOINTS, 45°, planar, rough, Fe/Mn st.	0%	
2									2.10			
									2.20	DRILLING BREAK		
2.67		RUN 2				MW/SW	S		2.42	Several JOINTS, 50 to 75°, with associated PARTINGS, 15°, planar, rough, Fe st, clay coated to 1/16 2mm thick.	38%	
									2.76			
3.00									3.00	DRILLING BREAK		
		RUN 3							3.20	JOINT, 60°, planar, rough, Fe st.		
									3.30	As above.		
3.52		RUN 4			3.52m META-SHALE, brown/grey-brown, laminated at 10 to 15°				3.45	Several JOINTS, 65 to 70°, with associated PARTINGS, 15°, planar, rough, Fe st, clay fill in 70° JOINT to 5mm thick.	80%	
3.76					3.76m	MW	MS					
4.00		RUN 5			TUFFACEOUS SANDSTONE, fine grained, grey-brown							
						MW/SW	S					
4.35					4.35m				4.35	JOINT, 50°, planar, rough, Fe/Mn st.	44%	
4.48		RUN 6			Grey from 4.35m				4.48	DRILLING BREAK		
4.65					4.67m Very coarse band	F(s)	S/VS		4.67	HANDLING BREAK		
4.75					4.75m Fine-medium gr., grey							
5									4.86	BOXING BREAK	55%	

Remarks: BOX 1 ENDS AT 4.86m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 15.2.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9 Sheet 2 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E 375664 N 6423067
R.L COLLAR 163.4m DATUM AHD BEARING — INCLINATION VERTICAL

DRILL DELTA 1000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 30.1.08 COMPLETED 13.2.08

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
5.05				TUFF. S/S. continues as above	[illegible]	S/VS					
				5.65m META-SHALE, grey/brown, laminated at 10 to 15°	SW	MS			5.16 } 2x's PARTINGS, 10°, planar, rough, Fe/Mn st.		
5.40				5.40 m							
		RUN 6 CONTINUED		TUFFACEOUS SANDSTONE, fine to medium grained with depth, grey.					5.66 DRILLING BREAK	136%	
									5.82 BOXING BREAK		
6.00	HQ				F(S)	S/VS			6.00 DRILLING BREAK		
		RUN 7									
6.80									6.80 JOINT, 60°, planar, rough, Fe/Mn st.		
6.87				6.97m		S					
				META-SHALE, grey/brown, thinly laminated/laminated at 10°	MW	MS			7.60 } JOINT, 45 to 65° / PARTING, 10 to 15°, FRAGMENTS, planar, rough, Fe/Mn st. 7.30		
7.31				7.31m							
						S			7.45 } 2x's PARTINGS, 10°, with JOINT, 45°, planar, rough, Fe st. 7.55	128%	
7.55				TUFFACEOUS SANDSTONE, fine grained, grey					7.66 JOINT, 30°, planar, rough, Fe st.		
7.81					F(S)				7.81 PARTING, 15°, planar, rough, Fe st		
					SW				8.00 DRILLING BREAK		
8.07											
									8.31 PARTING, 15°, planar, rough, Fe st.		
					F(S)	S/VS			8.70 BOXING BREAK		
9.00				9.00 m Grey/greybrown					9.00 } Several JOINTS, 60 to 80°, planar, rough, Fe/Mn st. 9.35		
9.30				9.30 m Grey.							
9.50		RUN 8		9.50m					9.60 JOINT, 50°, planar, rough, Fe/Mn st.	35%	
				Greybrown	MW/SW				9.71 BOXING BREAK		
									9.75 } Numerous JOINTS, 50°, planar, rough, Fe/Mn st. 10.00		
10											

Remarks: BOX 2 ENDS AT 8.70m
Job / Report No. GN25A

Logged by: JOHN YOUNG
Date: 15.2.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9
Sheet 3 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B

CO-ORDINATES
E 375664
N 6422067

R.L. COLLAR 163.4
DATUM AHD
BEARING —
INCLINATION VERTICAL

DRILL DELTA 7000, TRACK MOUNTED
CORE BARRELL HQ TRIPLE

CONTRACTOR
DRILLER

COMMENCED 30.1.08
COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
10.03 10.08		S			10.03m Greybrown to 10.07m TUFFACEOUS SANDSTONE continues, fine grained, grey					10.08 DRILLING BREAK		
						$F_{(5)}$				10.47 Joint, 55°, planar, rough, Fe/Mn st.		
										10.58 BOXING BREAK		
10.70					10.70 m					10.70 3x's Joints, 50 to 60°, planar, rough, Fe st. 10.95		
10.95 11		RUN 9			10.95m	MW/SW	S/W				88%	
	HQ				Grey.	$F_{(5)}$				11.50 Joint, 40°, planar, rough, Fe/Mn st. 11.60 BOXING BREAK 11.73 Joint, 50°, planar, rough, Fe/Mn st.		
11.80					11.80 m							
12.00					Greybrown/brown	MW	S			12.00 Numerous Joints, 30 to 50°, planar, rough, Fe/Mn st.	0%	
12.95 13		RUN 11										
					Fine grained TUFFACEOUS SANDSTONE continues. (to 15.10m)					13.45 13.60 Parting, 15°, planar, rough, Fe/Mn st. 13.67 3x's Joints, 50°, planar, rough, Fe/Mn st. 13.85		
14										13.96 Joint fragments, 30 to 75°, planar, rough, Fe/Mn st. (sheared) 14.29	50%	
										14.40 Joint, 60°, planar, rough, Fe/Mn st.		
										14.75 3x's Joints, 50 to 70°, planar, rough, Fe/Mn st. 15.00		
15.00												

Remarks: BOX 3 ENDS AT 12.50m

Job / Report No. GN25A

Logged by: JOHN YOUNG

Date: 15.2.08

Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9 Sheet 4 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E 375664 N 6422067
R.L. COLLAR 162.4m DATUM AHD BEARING — INCLINATION VERTICAL

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR MCDERMOTT DRILLING COMMENCED 30.1.08
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
15 (16.10)					TUFFACEOUS SANDSTONE continues, medium/coarse grained from 16.10m, grey							
16.40					15.40m — Very coarse band					15.32 Boxing break; 15.42 Drilling break; 15.55 Joint, 60°, planar, rough, Fe st.		
15.70					15.70m (bedding 10°)	F(s)	S/HS			15.66 Parting, 10°, planar, rough, Fe st.		
16					Fine grained, grey.					15.87 } 2 x s Joints, 50°, planar, rough, Fe st. 15.96 }		
										16.32 } Several Joints, 50 to 70°, planar, rough, Fe/Mn st. 16.42 }	95%	
16.55					16.55m Coarse band							
16.68					16.68m					16.72 Joint, 65°, planar, rough, Fe/Mn st		
17		RUN 12			Fine to fine-medium gr. with depth, grey.					17.10 Joint, 55°, as above. 17.20 As above		
17.45					17.45m Coarse band							
17.54					17.54m					17.54 Parting, 10°, planar, rough, Fe st.		
18.00					Fine to fine-medium grained with depth, grey.					18.00 } Joint, 65°, with Parting, 15°, planar, rough, Fe/Mn st. 18.12 }		
18.40					18.40m					18.31 Joint, 45°, planar, rough, Fe/Mn st.		
18.45					18.45m Medium-coarse							
18.50		RUN 13			18.50m META-SHALE laminations at 10°					18.50 Parting, 10°, planar, rough, Fe/Mn st.		
					Fine grained, grey							
18.88					18.88m Greybrown from 18.88m to 19.10m	MW/SW				18.88 As above		
19.00					19.00m META-SHALE laminations at 15°					19.00 } Joint, 60°, with Parting, 15°, planar, rough, Fe/Mn st. 19.10 }	53%	
19.10					19.10m							
					Fine grained, grey.					19.32 } Numerous Joints, 50 to 65°, with associated Partings, 15°, planar, rough, Fe/Mn st.		
19.42					19.42m META-SHALE, grey-brown, laminated at 1/15°							
19.52					19.52m TUFF. s/s, fine grained, grey.							
19.84					19.84m META-SHALE lam. at 15°							
19.93 (20)					19.93m Grey-Greybrown/brown	MW	MS					

Remarks: BOX Y ENDS AT 16.32m
Job / Report No. GN25A
Logged by: JOHN YOUNG Date: 15.2.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9 Sheet 5 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E 375664 N 6423067
R.L. COLLAR 163.4m DATUM AHD BEARING — INCLINATION VERTICAL

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 30.1.08
CORE BARRELL HQ TRIPLE DRILLER SHAWN TAYLOR COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
20.07					TUFFACEOUS SANDSTONE, fine grained, brown.	MW				As above		
20.36					20.36m				20.39			
		RUN 14			METASHALE, brown/ greybrown/grey, banded. Thinly laminated/ laminated at 10 to 15°	MW/SW			20.60	Numerous JOINTS, 60° (across bedding) and PARTINGS, 10 to 15°, planar, rough, Fe/Mn st.	71%	
21.00		RUN 15							21.15			
21.6							MS		21.43	As above	72%	
21.73	HQ				21.73m				21.65			
22		RUN 16			TUFFACEOUS SANDSTONE, fine-medium grained, brown.	MW			21.80		17%	
22.13					22.13m					As above		
22.60		RUN 17			METASHALE, brown/ greybrown/grey, banded. Thinly laminated/ laminated at 10 to 15°.							
23						MW/SW					0%	
23.15		RUN 18							23.15			
									23.26	As above		
									23.48			
23.98									23.62		20%	
24										As above		
		RUN 19			Includes occasional very thin TUFFACEOUS SANDSTONE interbeds, fine grained.						17%	
24.84												
25		20										

Remarks: BOX 5 ENDS AT 20.07m: BOX 6 ENDS AT 23.72m
Job / Report No. GN 25A

Logged by: JOHN YOUNG Date: 15.2.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9
Sheet 6 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E 375664 N 6423067
R.L. COLLAR 163.4m DATUM AHD BEARING — INCLINATION VERTICAL

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 30.1.08 COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
25	HQ	JOHN 2.0 CONTINUED			METH-SHALE continues as above.	MW/SW	MS			As above	44%	
25.64					25.64					25.64		
26					TUFFACEOUS SANDSTONE, fine grained, grey.					26.00 Possible PARTING, 10°, planar, rough (may be drilling induced)		
										26.38 As above		
										26.57 DRILLING BREAK		
										26.77 Possible PARTING, 15°, planar, rough		
										26.88 DRILLING BREAK		
27.00		JOHN 2.1				F	S/HS			27.60 DRILLING BREAK		
										27.38 BOXING BREAK		
										27.54 DRILLING BREAK		
										27.90 JOINT, 70°, planar, rough, minor carbonate coating		
28											100%	
										28.37 BOXING BREAK		
28.60					28.60m METH-SHALE laminations at 15°					28.60 Probable DRILLING BREAK		
29										29.00 JOINT, 75°, planar, rough, minor carbonate coating.		
					Fine grained TUFFACEOUS SANDSTONE continues.					29.36 BOXING BREAK		
										29.71 DRILLING BREAK		
										29.97 JOINT, 60°, planar, rough		
30.08										30.00 As above		

Remarks: BOX 7 ENDS AT 27.38m
Job /Report No. GN 25A

Logged by: JOHN YOUNG
Date: 15.2.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9

Sheet 7 of 12 Sheets

PROJECT TILLEGRA DAM

LOCATION QUARRY AREA B

CO-ORDINATES E 375664 N 6423067

R.L. COLLAR 163.4 DATUM AHD BEARING — INCLINATION VERTICAL

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 30.1.08

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS			
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D. / TESTS
30					30.01 META-SHALE laminations at 10°					30.20 Possible PARTING, 10°, planar, rough, minor carbonate coating.	
										30.35 BOXING BREAK	
					TUFFACEOUS SANDSTONE continues, fine grained, grey.						
31	HQ	RUN 12				F	5/15				100%
										31.35 BOXING BREAK	
31.90										31.80 Possible PARTING, 15°, planar, rough	
32										32.03 PARTING, 20°, planar, rough, Fe st.	
										32.20 Possible PARTING, 20°, planar, rough, minor Fe st.	
32.37					32.37m META-SHALE laminations at 15°					32.37 PARTING, 15°, planar, rough, minor Fe st	
32.42					32.48m						
					Medium grained TUFF. SANDSTONE from 32.48m, grey.					32.71 Intersecting Joints, 40 and 60°, planar, rough, minor Fe st.	
32.88					32.88m META-SHALE clast					32.88 Probable DRILLING BREAK	
33.00										33.00 DRILLING BREAK	
						F(x)					
					Medium to very coarse grained with depth.					33.37 BOXING BREAK	
		RUN 13								33.79 PARTING, 20°, planar, rough, Fe st.	
34										33.95 Probable DRILLING BREAK	
										34.15 HANDLING BREAK	
34.30					34.30m					34.34 BOXING BREAK	
					TUFFACEOUS SANDSTONE, fine grained, grey					34.61 PARTING, 20°, planar, rough, Fe st.	
35											

Remarks: BOX 8 ENDS AT 31.35m

Job / Report No. GN25A

Logged by: JOHN YOUNG

Date: 15.2.08

Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9
Sheet 8 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E 379664 N 6422067
R.L. COLLAR 163.4m
DATUM AHD
BEARING —
INCLINATION VERTICAL

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 30.1.08
COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE			ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
35					Fine grained TUFFACEOUS SANDSTONE continues.					35.30 PARTING, 5°, planar, rough, Fe st.		
35.54	HQ	RUN 24 CONTINUED			35.54m META-SHALE lamination at 5°					35.54 Possible PARTING, 5°, planar, rough.	100%	
36.00										35.97 DRILLING BREAK		
						F(s)				36.32 BOXING BREAK		
										36.67 Possible PARTING, 15°, planar, rough.		
36.88					36.88m META-SHALE lamination at 10°					36.88 PARTING, 5°, planar, rough, Fe st.		
37							S/VS			37.04 Possible PARTING, 10°, planar, rough		
										37.14 Intersecting JOINTS, 50 and 30°, planar, rough, Fe st.		
										37.31 BOXING BREAK		
		RUN 25								37.56 PARTING, 5°, planar, rough, partly Fe st.		
37.65										37.76 Possible PARTING, 10°, planar, rough.	100%	
38												
					Fine grained TUFFACEOUS SANDSTONE continues.					38.34 BOXING BREAK		
						F				38.66 JOINT, 60°, planar, rough, minor carbonate coating.		
39.00										39.00 DRILLING BREAK		
										39.30 BOXING BREAK		
										39.48 HANDLING BREAK		
39.85					39.85m META-SHALE lamination at 10°					39.85 JOINT, 60°, planar, rough.		
40												

Remarks: BOX 9 ENDS AT 35.30m BOX 10 ENDS AT 39.30m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 16.2.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9
Sheet 9 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B

CO-ORDINATES E 375664 N 6423067
R.L. COLLAR 163.4m
DATUM AHD
BEARING —
INCLINATION VERTICAL

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 30.1.08
COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
40					Fine grained TUFFACEOUS SANDSTONE continues, grey.					40.05 } 2x's JOINTS, 50°, planar, rough. 40.12 }		
										40.26 BOXING BREAK 40.32 JOINT, 60°, planar, rough		
40.50					40.90m							
					Fine-medium to coarse grained with depth (to 40.70m)					40.60 JOINT, 45°, as above 40.71 } 2x's JOINTS, 50 and 45°, as above 40.77 }		
										40.81 HANDLING BREAK		
40.90					40.90m							
41											98%	
					Fine to coarse grained with depth (40.90 to 41.55)					41.25 BOXING BREAK		
						F	S/W					
41.55					41.55m Fine grained							
41.68		110	RUN 15 CONTINUED		41.69m META-SHALE clasts							
					Fine gr. TUFF. S/S continues							
										41.96 DRILLING BREAK		
42.00										42.15 BOXING BREAK		
										42.36 JOINT, 60°, planar, rough		
42.50					42.50m							
					Medium grained.							
43												
										43.16 BOXING BREAK		
43.25					43.25m						100%	
					Fine grained					43.42 JOINT, 45°, planar, rough, Fe st		
43.55					43.55m							
					Medium grained					43.67 JOINT, 50°, planar, rough, Fe/Mn st, minor carbonate coating		
						F(s)						
44												
44.13					44.13					44.15 BOXING BREAK		
					Fine grained					44.24 JOINT, 45°, planar, rough, Fe st.		
										44.70 Several JOINTS, 45 to 75°, planar, rough, Fe st.		
45.00												

Remarks: BOX 11 ENDS AT 43.16m
Job / Report No. GN25A

Logged by: JOHN YOUNG
Date: 16.2.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9
Sheet 10 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E 375664 N 6423067
R.L. COLLAR 163.4m
DATUM AHD
BEARING —
INCLINATION VERTICAL

DRILL DELTA 1000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMMENCED 30.1.08
COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE			ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING / ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
45 45.10					Fine gr. TUFF, s/s, continues 45.10m				49.10 ↕ See above 45.14 BOXING BREAK 45.25 JOINT, 40°, planar, rough (may be drilling induced)		
					Medium to very coarse grained with depth.				45.50 As above 45.73 JOINT, 45°, planar, rough, fast		
46		RUN 27				F(s)			46.08 As above 46.20 As above		
46.27	HQ				46.27m Fine grained.				46.65 DRILLING BREAK	100%	
47						S/HS			47.05 BOXING BREAK 47.28 PARTING, 15°, planar, very rough, fast		
									47.60 ↕ PARTING, 15° and JOINT, 70°, planar, rough, fast. 47.84		
48.00									48.00 DRILLING BREAK		
48.40		RUN 28			48.40m Medium grained 48.50m				48.66 ↕ JOINT/PARTING FRAGMENTS, (crushed zone, core fragmented), planar, rough/very rough. 48.84	45%	
48.50					Grades to pale grey from 48.70m, medium to coarse grained with depth.				48.97 Possible PARTING, 70°, planar, rough 49.03 As above		
49									48.26 As above		
49.85					49.85m				49.95 BOXING BREAK		
50					Fine-medium gr. (pale grey)						

Remarks: BOX 12 ENDS AT 47.05m
Job / Report No. GN 25 A
Logged by: JOHN YOUNG
Date: 16.2.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DH 9

Sheet 11 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E 375664 N 6423067
R.L. COLLAR 163.4
DATUM AHD
BEARING —
INCLINATION VERTICAL

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 30.1.08
COMPLETED 12.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
50	HQ	RUN 29	LOST		TUFFACEOUS SANDSTONE continues as above, fine-medium grained, pale grey.							
50.40										50.35 PARTING, 20°, planar, rough, Fe st.	72%	
										50.76 } 3x's possible PARTINGS, planar, rough (may be drilling induced), 15°, slickensided. 50.89 50.96		
51.60		RUN 30								51.20 2x's possible PARTINGS, 15°, planar, rough, slickensided.		
										51.50 JOINT, 60°, planar, rough		
										51.71 PARTING, 10°, planar, rough, Fe st.		
						F(s)	S/HS			51.93 JOINT, 50, planar, smooth		
52											80%	
52.70					— 52.70 m Very coarse grained band.					52.74 PARTING, 15°, planar, rough, slickensided.		
										52.88 JOINT, 50°, planar, very rough		
53.00					— 53.00 m					53.05 BOXING BREAK		
										53.20 Probable DRILLING BREAK		
					Fine/fine-medium gr., pale grey.							
										53.68 } 2x's JOINTS, 50°, planar, rough, lower Fe st. 53.77		
54.00		RUN 31								54.00 JOINT, 55°, planar, rough, Fe st.	87%	
										54.21 PARTING, 10°, planar, rough, Fe st		
										54.38 JOINT, 60°, planar, rough, slickensided.		
										54.57 } Several JOINTS, 50 to 60°, planar, rough. 54.75		
										54.82 PARTING, 10°, planar, rough, Fe st.		
55												

Remarks: BOX 13 ENDS AT 50.96m BOX 14 ENDS AT 54.82m
Job / Report No. GN 25A

Logged by: JOHN YOUNG Date: 17.2.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9
Sheet 12 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA 8
CO-ORDINATES E 375664 N 6423067
R.L. COLLAR 163.4m DATUM AHD BEARING — INCLINATION VERTICAL

DRILL DELTA 1000, TRUCK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 7.1.08
CORE BARREL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
55												
55.18		PQ1			TUFFACEOUS SANDSTONE continues, fine to fine-medium gr., pale grey.					55.60 DRILLING BREAK 55.10 } 2x's PARTINGS, 15 and 70°, planar, smooth, Fe st. 55.18 }		
										55.28 } 3x's JOINTS, 45°, planar, smooth 55.34 } 55.40 }		
										55.78 BOXING BREAK		
56		RUN 57									100%	
56.45					56.45m META-SHALE laminations at 15°	F(3)	S/WS			56.45 PARTING, 15°, planar, rough		
										56.80 BOXING BREAK		
										56.95 JOINT, 60°, planar, rough, Fe st.		
57.00										57.00 DRILLING BREAK		
										57.11 As above		
										57.20 JOINT, 60°, planar, rough, Fe st.		
	HQ									57.76 BOXING BREAK		
58												
										58.17 JOINT, 60°, planar, rough, Fe/Mn st.		
		RUN 58								58.44 As above	100%	
										58.54 BOXING BREAK		
59												
										59.55 JOINT, 40°, planar, rough, Fe st.		
										59.72 As above		
60.00					HOLE ENDS AT 60.00m					60.00 JOINT, 60°, planar, smooth.		

Remarks: BOX 15 ENDS AT 58.54m BOX 16 ENDS AT 60.00m & END OF HOLE
Job / Report No. GN 25A

Logged by: JOHN YOUNG Date: 17.2.08 Site Supervisor MARK ASHOVER


TILLEGRA DAM
BOREHOLE: DDH 9
DEPTH: 1.40 — 8.70 M
TILLEGRA DAM
DDH 9
1·40
1·52
2·62
3·00
3·76
4·48
6·00


TILLEGRA DAM
BOREHOLE: DDH 9
DEPTH: 8.70 — 16.32 M
9·00
10·08
12·00
12·95
15·00


TILLEGRA DAM
BOREHOLE: DDH 9
DEPTH: 16.32 — 23.72 M
SPACER
18·00
20·07
21·00
21·60
22·63
23·15


TILLEGRA DAM
BOREHOLE: DDH 9
DEPTH: 23.72 — 31.35 M
23·98
24·84
RE-CORED TO 27 m
27·00
30·00


TILLEGRA DAM
BOREHOLE: DDH 9
DEPTH: 31.35 — 39.30 M
33.00
SPACER
SPACER
(35.30)
36.00
39.00


TILLEGRA DAM
BOREHOLE: DDH 9
DEPTH: 39.30 — 47.05 M
42.00
SPACER
45.00
SPACER


TILLEGRA DAM
BOREHOLE: DDH 9
DEPTH: 47.05 — 54.82 M
48·00
50·40
51·00
SPACER
54·00


TILLEGRA DAM
BOREHOLE: DDH 9
DEPTH: 54.82 — 60.00 M
55·18
57·00
SPACER
(58.54m)
60·00
END DDH 9

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 29

Sheet 1 of 6 Sheets

PROJECT: TILLEGRA DAM	CO-ORDINATES	R.L. COLLAR: 227.4 m	
LOCATION: LANDSLIP 2A	E 376556	DATUM: AHD	
	N 6425443	BEARING: ——	INCLINATION: VERTICAL
DRILL: TRUCK MOUNTED EDSON 3000	CONTRACTOR: APS DRILLING		COMMENCED: 14.8.08
CORE BARRELL: HQ TRIPLE	DRILLER: JOHN SIMON		COMPLETED: 15.8.08

DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
0m – 2.15					NON CORE CORING COMMENCES AT 2.15m							
2.15 – 2.65	HQ WIRELINE	RUN 1			TUFFACEOUS SANDSTONE, coarse grained, brown/greybrown, poorly defined bedding at 10°	MW	S			2.15 – 2.28: JOINT FRAGMENTS, 45 to 50°, planar, rough, minor Fe/Mn stain. 2.32 – 3.35: Numerous JOINTS, 30 to 70, with intersecting PARTINGS, 10 to 15°, planar, rough, generally Fe/Mn stained. Includes JOINT, 65°, at 2.50m with pale grey clay fill 5mm thick, rootlets.	75%	
2.65 – 3.35	HQ WIRELINE	RUN 2			META-SHALE, greybrown/grey, thinly laminated/laminated at 10°. Includes rare TUFFACEOUS SANDSTONE laminations.	MW/SW	MS/S				0%	
3.35 – 3.65	HQ WIRELINE	RUN 3			CORE LOSS 0.30m						15%	
3.65 – 4.88	HQ WIRELINE	RUN 4			TUFFACEOUS SANDSTONE, medium grained, brown to 3.71m, then grey. — 4.05m Grey with greybrown tinge — 4.28m Grey	MW (to 3.71); F(s) (to 3.95); SW (to 4.28); F(s) (to 4.88)	S (to 3.71); S/VS			3.65 – 3.71: 2x's PARTINGS, 10°, planar, rough, minor Fe stain. 3.89 – 3.95: DRILLING BREAKS 4.17: BOXING BREAK 4.28: PARTING, 10°, planar, very rough, Fe/Mn stained.	80%	NO TEST
4.88 – 5					— 4.88m Coarse grained, grey with greybrown tinge.	SW				4.88 →		

Remarks:

Job /Report No. GN31A

Logged by: JOHN YOUNG | Date: 4.9.08 | Site Supervisor: DOUGLAS PARTNERS

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DH 29
Sheet 2 of 6 Sheets

PROJECT TILLEGRA DAM
LOCATION LANDSLIP 2A
CO-ORDINATES E 376556 N 6425443
R.L. COLLAR 227.4m
DATUM AHD
BEARING
INCLINATION VERTICAL

DRILL TRUCK MOUNTED EDSON 2000
CONTRACTOR APS DRILLING
COMMENCED 14.8.08
CORE BARRELL HQ TRIPLE
DRILLER JOHN SIMON
COMPLETED 25.8.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
5					TUFFACEOUS SANDSTONE continues, coarse grained, grey with greybrown tinge	SW				5.07 As above 5.15 BOXING BREAK		
5.62		RUN 4 CONT.			5.63m Very fine grained, grey 5.95m	F(S)				5.60 DRILLING BREAK 5.70 5.75 } 2x's PARTINGS 10 to 15°, planar, rough, Fe/Mn stained.		
5.95					Coarse grained, grey with greybrown tinge.	SW				5.87 } JOINT, 70°, planar, rough, Fe/Mn st. 6.12		
6.30					6.30m Fine grained, grey. 6.43m					6.34 PARTING, 10°, planar, Fe stained, carbonate coated.		
6.43					Fine-medium to medium grained, grey-(fining up cycles).					6.66 } Several PARTINGS, 10°, with associated JOINTS, 20 to 45°, planar, rough, heavily Fe stained. 6.95		
7		HQ TRIPLE								7.09 JOINT, 60°, planar, rough, Fe/Mn stained	40%	NO TEST
7.95		RUN 5			Includes elongate META-SHALE clasts to 50mm dimension.	F(S)				7.82 BOXING BREAK 7.89 PARTING, 10°, planar, rough, Fe stained, minor carbonate coating.		
8										8.02 8.12 } DRILLING / HANDLING BREAKS 8.26 8.42		
										8.54 BOXING BREAK		
8.90					8.90m Grades to very coarse grained, includes subangular lithic fragments to 10mm					8.85 8.99 } DRILLING BREAKS		
9												
9.34					META-SHALE, dark grey, laminated at 10°		S			9.35 9.46 } 2x's PARTINGS, 10°, planar, rough, Fe stained, minor carbonate coating.		
9.42					TUFFACEOUS SANDSTONE, coarse grained, grey.							
10												

Remarks: BOX 1 ENDS AT 5.95m. BOX 2 ENDS AT 9.45m
Job / Report No. GN31A

Logged by: JOHN YOUNG
Date: 4.9.08
Site Supervisor DOUGLAS PARTNERS

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 29
Sheet 3 of 6 Sheets

PROJECT TULLEGRA DAM
LOCATION LANDSLIP 2A
CO-ORDINATES E 376556 N 6425443
R.L. COLLAR 227.4m
DATUM AHD
BEARING —
INCLINATION VERTICAL

DRILL TRUCK MOUNTED EDSON
CONTRACTOR APS DRILLING
COMMENCED 14.8.08
CORE BARRELL HQ TRIPLE
DRILLER JOHN SIMON
COMPLETED 25.8.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
10					TUFFACEOUS SANDSTONE continues, coarse grained, grey					10.42 BOXING BREAK		
11							S/VS			11.30 BOXING BREAK	98%	
11.83	HQ TRIPLE	RUN 6 CONTINUED			META-SHALE, dark grey, laminated, disturbed bedding in upper part, otherwise 10° to 15°.	F(S)	S			11.67 DRILLING BREAK 11.77 } 2 x's probable PARTINGS, 15°, planar, rough, minor Fe st., carbonate coating at 11.83m. 11.83 }		
12.00										12.00 DRILLING BREAK		
		RUN 7			TUFFACEOUS SANDSTONE, coarse grained, grey.		S/MS			12.45 JOINT, 60°, planar, rough, Fe st.		L1 UL
13										12.98 BOXING BREAK	100%	
										13.50 JOINT, 65°, planar, rough, Fe stained, minor carbonate coating.		
13.91										13.91 DRILLING BREAK		
14		RUN 8										
										14.86 BOXING BREAK 14.92 HANDLING BREAK		
15												

Remarks: BOX 3 ENDS AT 12.98m.
Job / Report No. GN31A

Logged by: JOHN YOUNG
Date: 4.9.08
Site Supervisor DOUGLAS PARTNERS

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 29
Sheet 4 of 6 Sheets

PROJECT TILLEGRA DAM
LOCATION LANDSLIP 2A
CO-ORDINATES E 376556 N 6425443
R.L. COLLAR 227.4m
DATUM AHD
BEARING —
INCLINATION VERTICAL

DRILL TRUCK MOUNTED EDSON 3000 CONTRACTOR APS DRILLING COMMENCED 14.8.08
CORE BARRELL HQ TRIPLE DRILLER JOHN SIMON COMPLETED 25.8.08

DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
15					TUFFACEOUS SANDSTONE continues, coarse grained, grey. Includes occasional carbonate veins 1 to 5mm thick (parallel to bedding).					15.20 JOINT, planar, rough, Fe stained, minor carbonate coating.		
		RUN 3 CONTINUED								15.47 } DRILLING BREAKS 15.63	100%	UCS
										15.82 BOXING BREAK		
16.00										16.00 DRILLING BREAK		
										16.32 } DRILLING BREAKS 16.69 16.88		
16.69		RUN 4			16.69m Includes elongate META-SHALE clasts. Lamination at 16.92m, 15°							
16.98					16.98m					16.98 BOXING BREAK		
17		HQ TRIPLE			TUFFACEOUS SANDSTONE continues as above	F (5)	S/HS			17.32 DRILLING BREAK	92%	
17.67					17.67m Includes elongate META-SHALE clasts to 70mm, subangular to subrounded.					17.62 PARTING, 10°, planar rough, Fe st., minor carbonate coating. 17.69 JOINT, 25°, planar, rough, Fe stained. 17.74 PARTING, 10°, planar, rough, Fe st., minor carbonate coating.		
18.00					18.00m					17.95 } Possible PARTINGS, planar, rough, minor carbonate coating - may be drilling induced. 18.03		UCS
					TUFFACEOUS SANDSTONE continues as above, coarse grained, grey. Includes rare carbonate veins 1mm thick, 15 and 60°.					18.28 As above		
										18.40 PARTING, 15°, planar, rough, Fe st.		
										18.85 BOXING BREAK		
19.00		RUN 10								19.00 DRILLING BREAK	100%	
										19.73 BOXING BREAK		
20										19.88 Probable DRILLING BREAK		

Remarks: BOX 4 ENDS AT 16.00m. BOX 5 ENDS AT 19.73m. Job / Report No. GN 31A

Logged by: JONAH YOUNG Date: 4.9.08 Site Supervisor DOUGLAS PARTNERS

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 29
Sheet 5 of 6 Sheets

PROJECT TILLEGRA DAM
LOCATION LANDSLIP 2A
CO-ORDINATES E 376576 N 6425443
R.L. COLLAR 227.4m
DATUM AHD
BEARING —
INCLINATION VERTICAL

DRILL Truck mounted EDSON 3000 CONTRACTOR APS DRILLING COMMENCED 14.8.08
CORE BARRELL HQ TRIPLE DRILLER JOHN SIMON COMPLETED 25.8.08

DRILLING DATA			ROCK SUBSTANCE			ROCK MASS DEFECTS			
DEPTH (R.L.) METRES	Method / Casing, Run / Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D. / TESTS
20	HQ TRIPLE / RUNS CONTINUED		TUFFACEOUS SANDSTONE continues, coarse grained, grey.					20.00 } 2x's possible JOINTS, 45°, planar rough, carbonate coated (may be drilling induced) 20.10	WPT 1UL
								20.34 Probable DRILLING BREAK	
								20.42 JOINT, 80°, planar, rough, Fe stained, carbonate coated.	
21				F(s)	S1/45			21.10	
								21.20 } 3x's PARTINGS, 10°, planar, rough, 21.27 } Fe stained.	
								21.58 BOXING BREAK	
								21.72 JOINT, 60°, planar, rough, Fe stained.	
21.95			21.95m						
22.00			Grading to very coarse grained, conglomeratic. Includes subangular to subrounded lithic clasts to 10mm dimension. Poorly defined bedding at 10° to 15°.					22.00 DRILLING BREAK 22.07 As above	
								22.50 BOXING BREAK	
22.60			22.60m					22.62 Probable DRILLING BREAK (10°). 22.72 PARTING, 10°, planar, rough, Fe stained, minor carbonate coating.	
23			Coarse grained.					23.17 DRILLING BREAK	100% 1UL
								23.50 BOXING BREAK	
								23.68 JOINT, 60°, planar, rough, minor Fe stain, carbonate filled to 2mm.	
								23.88 DRILLING BREAK	
24			Poorly defined bedding at 10°					24.27 DRILLING BREAK	
								24.48 BOXING BREAK	
25.00								25.00 DRILLING BREAK	

Remarks: BOX 6 ENDS AT 23.50 m. Job / Report No. GN31A

Logged by: JOHN YOUNG Date: 4.9.08 Site Supervisor DOUGLAS PARTNERS

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 29
Sheet 6 of 6 Sheets

PROJECT TILLEGRA DAM
LOCATION LANDSLIP 2A
CO-ORDINATES E 376556 N 6425443
R.L. COLLAR 229.4m
DATUM AHD
BEARING —
INCLINATION VERTICAL

DRILL TRUCK MOUNTED EDSON 3000 CONTRACTOR APS DRILLING
CORE BARRELL HQ TRIPLE DRILLER JOHN SIMON
COMMENCED 14.8.08
COMPLETED 25.8.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
25.00	HQ TRIPLE RUN TO CONTINUED				TUFFACEOUS SANDSTONE continues, grades to very coarse, conglomeratic from 25.00m. Subrounded lithic clasts to 12 mm.					25.00 DRILLING BREAK		WPT
					— 25.50	F(4)				25.34 DRILLING BREAK		
25.85					Coarse grained.							
25.90										25.80		
26										25.85		
26.10										25.90		
										25.95		
										26.10 DRILLING BREAKS	100%	
					HOLE ENDS AT 26.10m							
27												
28												
29												
30												

Remarks:
Job / Report No. GN31A

Logged by: JOHN YOUNG
Date: 4.9.08
Site Supervisor DOUGLAS PARTNERS


TILLEGRA DAM
LANDSLIP 2A
BOREHOLE DDH 29
DEPTH 2.15 — 5.95M


TILLEGRA DAM
LANDSLIP 2A
BOREHOLE DDH 29
DEPTH 5.95 — 12.98M


TILLEGRA DAM
LANDSLIP 2A
BOREHOLE DDH 29
DEPTH 12.98— 19.73M


TILLEGRA DAM
LANDSLIP 2A
BOREHOLE DDH 29
DEPTH 19.73— 26.10 M
END DDH 29

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 30 Sheet 1 of 6 Sheets

PROJECT TILLEGRA DAM
LOCATION LANDSLIP 2A
CO-ORDINATES E 376470 N 6429528
R.L. COLLAR 221.6m DATUM AHD BEARING — INCLINATION VERTICAL

DRILL TRUCK MOUNTED EDSON 3000 CONTRACTOR APS DRILLING
CORE BARRELL HQ TRIPLE DRILLER JOHN SIMON
COMMENCED 25.8.08 COMPLETED 28.8.08

DRILLING DATA | ROCK SUBSTANCE | ROCK MASS DEFECTS

DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
0m					NON CORE							
1												
1.55					CORING COMMENCES AT 1.55m							
1.75	HQ TRIPLE	1.55 TO 2.00			TUFFACEOUS SANDSTONE, coarse; grained, grey	SW				1.55 } JOINT / PARTING FRAGMENTS, planar, very rough, Fe/Mn stained 1.74	22%	
2.00										1.85 } JOINT, curved, rough, Fe/Mn stained 2.05		
2.15						F(s)	5/MS			2.15 } JOINT, 90°, undulating, very rough, Fe/Mn stained. 2.60	50%	NO TEST
2										2.73 } 2x's parallel JOINTS, 65°, planar, rough, Fe/Mn stained, altered carbonate coating. 2.18		
2.95					2.85m Grey/brown/brown.					2.77 JOINT, 65 to 80°, curved, rough, Fe st., clayey fill 6mm thick 3.65		
3.80					CONGLOMERATIC SANDSTONE subrounded lithic clasts to 10mm in medium grained matrix. brown/grey/brown.	MW	W/MS			3.80 } Probable PARTING FRAGMENTS, 15°, planar, rough, Fe stained 3.97 JOINT, 60°, planar, rough, Fe st., altered carbonate coating		
4												
4.15	NQ CORE				CORE LOSS 0.90m (minor sandy gravel recovery)					4.15 Probable JOINT, 60°, planar, very rough, Fe stained.	10%	
5												

Remarks: Job / Report No. GN31A

Logged by: JOHN VOLINCI Date: 5.9.08 Site Supervisor DOUGLAS PARTNERS

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 30
Sheet 2 of 6 Sheets

PROJECT TILLEGRA DAM
LOCATION LANDSLIP 2A
CO-ORDINATES E 376470 N 6425528
R.L. COLLAR 221.6m
DATUM AHD
BEARING
INCLINATION VERTICAL

DRILL TRUCK MOUNTED EDSON 3000 CONTRACTOR APS DRILLING
CORE BARRELL HQ TRIPLE DRILLER JOHN SIMON
COMMENCED 25.8.08
COMPLETED 28.8.08

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
5.05 (5.10)				CORE LOSS CONTINUES							
5.25				CONGLOMERATIC SANDSTONE continues	MW	S			5.05 Joint/parting fragments, 15 to 40°, planar, rough, Fe/Mn stained. 5.20		
		5.5		TUFFACEOUS SANDSTONE, medium/coarse grained, grey/brown to 5.75m, then grey.					5.43 Joint, 65°, planar, rough, Fe/Mn stained. 5.53 Parting, 10°, planar, rough, Fe/Mn st. 5.62 Joint, 60°, planar, rough, Fe/Mn st. 5.87 Parting, 10°, planar, rough, Fe st. Note: Vertical joint undulating in/out of core, very rough, Fe/Mn stained.		
6											
6.15				6.15m META-SHALE, dark grey, laminated at 10°.					6.15 (6.22) 3 x's partings, planar, rough, Fe/Mn stained 10°. 6.35 Parting, 10°, planar, rough, Fe st.		
6.45		HQ TRIPLE		6.45m TUFFACEOUS SANDSTONE, fine grained, grading to medium with depth, grey.	F(3)	S/VS			6.53 Joint, 55°, planar, smooth, Fe/Mn st. 6.62 (6.87) Joint, 70°, slightly curved, v. rough, Fe/Mn stained. Parting at 6.87, 10°, planar, rough, Fe/Mn st.	45%	
7		RUN 6									
7.03				7.18m Coarse grained, includes elongate META-SHALE clasts					7.02 (7.12) 2 x's partings, 10° planar rough, Fe/Mn st. 7.17 Probable drilling break	48%	NO TEST
7.27				7.27m META-SHALE, dk grey.					7.30 Joint, 50° planar, smooth, Fe/Mn st.		
7.37				7.37m TUFF. s/s, medium gr.							
7.47				7.47m META-SHALE, dk grey, laminated at 10°					7.53 (7.60) Joint/parting fragments, 10 to 50°, planar, rough, Fe st (may be drilling/handling induced).		
7.60 (7.63)				7.63m TUFFACEOUS SANDSTONE, coarse grained, grey, with elongate META-SHALE clasts.							
7.90				7.90m					7.87 DRILLING BREAK		
8		RUN 7							8.19 DRILLING BREAK		
				TUFFACEOUS SANDSTONE fine/medium grained, grey.					8.60 DRILLING BREAK	85%	
									8.80 Possible Parting, 15°, planar, rough, minor Fe stain.		
9									9.20 (9.60) Joint fragments, 60 to 70°, planar, rough, Fe/Mn stained.		
9.50		RUN 8							9.77 DRILLING BREAK		
9.80									9.85 Parting, 10°, planar, rough, Fe st.		
10				Medium grained.							

Remarks: BOX 1 ENDS AT 5.53m. BOX 2 ENDS AT 9.20m
Job / Report No. GN31A

Logged by: JOHN YOUNGS
Date: 5.9.08
Site Supervisor DOUGLAS PARTNERS

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 30
Sheet 3 of 6 Sheets

PROJECT TILLEGRA DAM
LOCATION LANDSLIP 2A
CO-ORDINATES E 376470 N 6425528
R.L. COLLAR 221.6m
DATUM AHD
BEARING —
INCLINATION VERTICAL

DRILL TRUCK MOUNTED EDSON 2000 CONTRACTOR APS DRILLING
CORE BARRELL HQ TRIPLE DRILLER JOHN SIMON
COMMENCED 25.8.08
COMPLETED 28.8.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS NPT
10					TUFFACEOUS SANDSTONE continues, medium grained grey.							NO TEST
										10.73 DRILLING BREAK		
11										10.95 JOINT, 40°, planar, rough, Fe st.		
11.40	HQ TRIPLE	RUN 3 CONTINUED			11.40m Very coarse band	F(s)	S/VS				100%	
11.47					11.47m Fine to medium gr with depth. Includes occasional M/S clasts.					11.53 Probable PARTING, 10°, planar very rough, Fe/Mn st.		
										11.65 BOXING BREAK		
11.82					11.82 TUFF, S/S continues, fine grained, grey. Includes META-SHALE laminations at 10°, plus elongate clasts					11.90 Probable DRILLING BREAK		
12										12.13 JOINT, 50, planar, rough, Fe stained.		
12.20					12.20 TUFFACEOUS SANDSTONE, medium grained, grey.							
12.55										12.55 DRILLING BREAK		0 UL
13		RUN 3										
										13.20 Probable DRILLING BREAK		
										13.53 BOXING BREAK		
										13.85 DRILLING BREAK (along carbonate vein at 10°)	100%	
14										14.10 DRILLING BREAK		
14.53					14.53 Includes elongate to rounded META-SHALE clasts.					14.51 BOXING BREAK		
										14.69 DRILLING BREAKS		
14.90										14.83		
15					14.90m							

Remarks: BOX 3 ENDS AT 12.55m
Job / Report No. GN 31A

Logged by: JOHN YOUNG
Date: 12.9.08
Site Supervisor DOUGLAS PARTNERS

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 30 Sheet 4 of 6 Sheets

PROJECT TILLEGRA DAM
LOCATION LANDSLIP 2A
CO-ORDINATES E 376470 N 6425528
R.L. COLLAR 221.6m DATUM AHD BEARING — INCLINATION VERTICAL

DRILL TRUCK MOUNTED EDSON 3000 CONTRACTOR APS DRILLING
CORE BARRELL HQ TRIPLE DRILLER JOHN SIMON
COMMENCED 25.8.08 COMPLETED 28.8.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
16												
15.20	HQ TRIPLE	RUN 10			TUFFACEOUS SANDSTONE, medium grained, grey.	F(S)	S/HS			15.20 DRILLING BREAK 15.29 – 15.43 Numerous breaks, probably drilling induced 15.55 DRILLING BREAK.	100%	0 UL
16										15.23 Probable DRILLING BREAK 15.90 PARTING, F, planar, rough, minor Fe st.		
16.55										16.46 BOXING BREAK 16.55 DRILLING BREAK.		
17										16.97 DRILLING BREAK (along carbonate vein at 10°) 17.18 JOINT, 55°, planar, rough, Fe/Mn st.		
17.62					17.62m					17.45 As above		
18		RUN 11			Coarse/very coarse grained. Includes subrounded lithic clasts to 10mm dia					18.10 BOXING BREAK.	100%	21 UL
19										19.08 BOXING BREAK 19.20 DRILLING BREAK		
19.55		RUN 12								19.55 DRILLING BREAK 19.73 DRILLING BREAK		
20										19.95 BOXING BREAK		

Remarks: BOX 4 ENDS AT 16.10m BOX 5 ENDS AT 19.95m
Job / Report No. GN31A

Logged by: JOHN YOUNG Date: 12.9.08 Site Supervisor DOUGLAS PARTNERS

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 30 Sheet 5 of 6 Sheets

PROJECT TILLEGRA DAM
LOCATION LANDSLIP 2A
CO-ORDINATES E 376470 N 6425528
R.L. COLLAR 22.6 m
DATUM AHD
BEARING —
INCLINATION VERTICAL

DRILL TRUCK MOUNTED EDSON 3000 CONTRACTOR APS DRILLING COMMENCED 25.8.08
CORE BARRELL HQ TRIPLE DRILLER JOHN SIMON COMPLETED 28.8.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
20	HQ TRIPLE	RUN 12 CONTINUED			TUFFACEOUS SANDSTONE continues as above, coarse/very coarsed grained.	FS				20.40 JOINT, 65°, planar, rough, Fe st, carbonate fill 3mm thick.		
										20.92 BOXING BREAK		
21											100%	L / UL
21.78					21.78m META-SHALE, dk grey, laminated at 10°					21.78 BOXING BREAK		
21.88					21.88m TUFFACEOUS SANDSTONE, fine gr., grey							
22												
22.10					22.10 Medium grained carbonate veining 1-2mm thick commonly at 50°							
22.40										22.40 Numerous DRILLING/HANDLING BREAKS		
22.47					META-SHALE, dk grey, bedding 10°	F	S/MS					
22.55										22.55		
					TUFFACEOUS SANDSTONE, medium to coarse grained with depth.					22.66 JOINT, 50° planar rough, minor carbonate coating.		
23		RUN 13										
										23.55 BOXING BREAK		
23.84					23.84 META-SHALE, dark grey, thinly bedded at 10°					23.84	100%	L / UL
24										JOINT (possibly drilling induced), 85°, subparallel to core axis, planar, rough, carbonate fill 1 to 2mm thick.		
24.10					24.10							
					TUFFACEOUS SANDSTONE, coarse/very coarse grained, grey.							
25												

Remarks: BOX 6 ENDS AT 23.55m
Job / Report No. GN 31A

Logged by: JOHN YOUNG
Date: 12.9.08
Site Supervisor DOUGLAS PARTNERS

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 30 Sheet 6 of 6 Sheets

PROJECT TILLEGRA DAM
LOCATION LANDSLIP ZA
CO-ORDINATES E 376470 N 6425528
R.L. COLLAR 221.6m DATUM AHD BEARING — INCLINATION VERTICAL

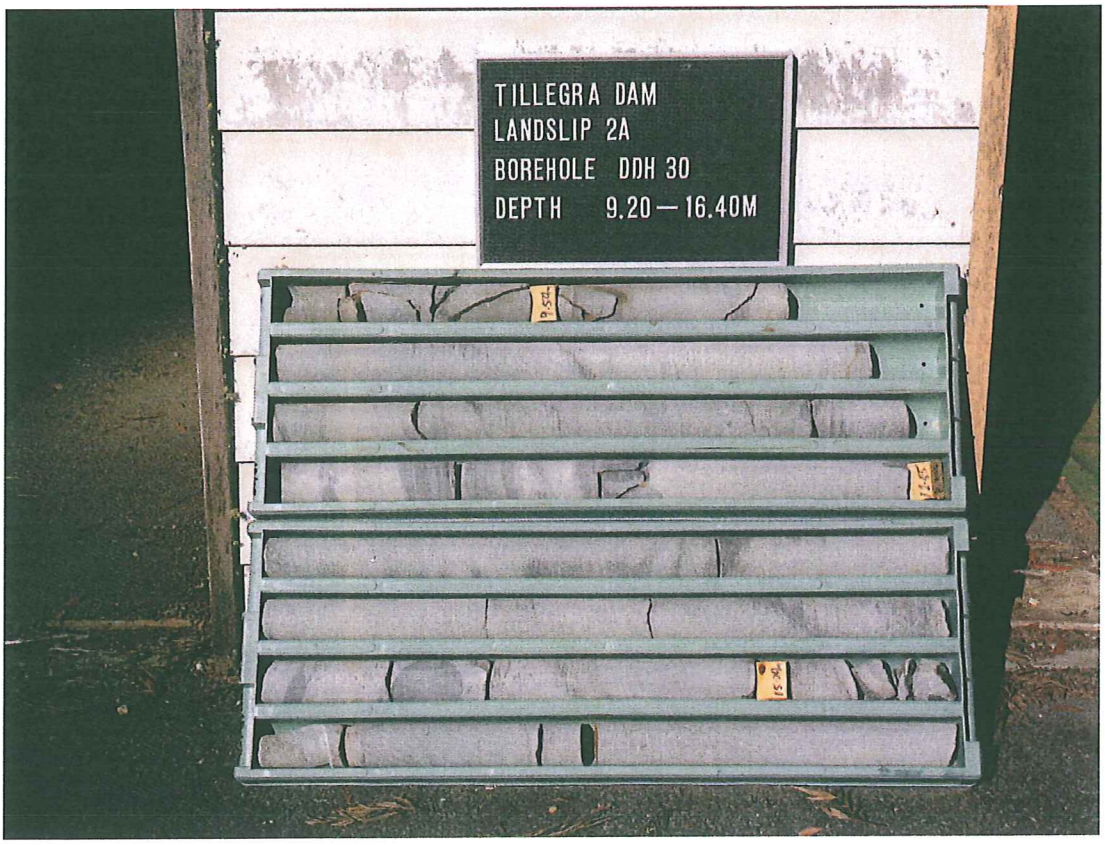
DRILL TRUCK MOUNTED EDSON 3000 CONTRACTOR APS DRILLING COMMENCED 25.8.08
CORE BARRELL HQ TRIPLE DRILLER JOHN SIMON COMPLETED 28.8.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS WPT
25					TUFFACEOUS SANDSTONE continuous, coarse/very coarse grained, grey.					as above		
25.55										25.70 25.77 DRILLING BREAK		
26						F	S/W			25.95 BOXING BREAK		< 1 UL
27	HQ TRIPLE									26.90 BOXING BREAK 27.03 27.07 27.16 3x's possible PARTINGS, 5° to 10°, planar, rough, minor carbonate coating (maybe drilling induced) 27.45 DRILLING BREAK 27.53 Possible PARTING, 5°, planar, rough, carbonate coated. 27.80 BOXING BREAK	92%	
28										28.46 HANDLING/DRILLING BREAK 28.55 DRILLING BREAK		
28.55					HOLE ENDS AT 28.55m							
29												
30												

Remarks: BOX 7 ENDS AT — BOX 8 ENDS AT 28.55m - END OF HOLE — Job / Report No. GN 31A

Logged by: JOHN YOUNG — Date: 12.9.08 — Site Supervisor DOUGLAS PARTNERS


TILLEGRA DAM
LANDSLIP 2A
BOREHOLE DDH 30
DEPTH 1.55 — 9.20M


TILLEGRA DAM
LANDSLIP 2A
BOREHOLE DDH 30
DEPTH 9.20 — 16.40M


TILLEGRA DAM
LANDSLIP 2A
BOREHOLE DDH 30
DEPTH 16.40—23.55M


TILLEGRA DAM
LANDSLIP 2A
BOREHOLE DDH 30
DEPTH 23.55—28.55M
END DDH 30

Appendix G

Summary of Water Pressure Test Results – DDH1 to DDH8

Borehole No	Depth (m)		Test Length(m)	Lugeon Value (UL)	Flow Type	Comments
	From	To				
DDH 1 (Right Abutment Spillway)	8.70	11.70	3.00	<1	Laminar	Close to wide defect spacing in test section. Fe-stained.
	11.20	17.70	6.50	1	Laminar	Very close to generally moderately wide defect spacing. Fe and Fe/Mn-stained. Minor clay coating on joint at 13.25 to 13.40m.
	17.20	24.03	6.83	14	Washout	Very close (in meta-shale) to generally moderately wide defect spacing. Fe-stained, occasionally Fe/Mn-stained. Rare (minor) carbonate coatings. Sandy clay fill in partings from 19.85 to 20.05m, minor clay coating on parting at 20.17m
	23.20	26.70	3.50	2.5	Washout	Very close defect spacing (in meta-shale) to wide defect spacing. Fe-stained.
	26.20	32.70	6.50	0	NA	Close to generally moderately wide/wide defect spacing. Fe-stained.
	32.20	38.70	6.50	8	Turbulent	Close to generally moderately wide/wide defect spacing. Fe-stained, heavily in several joints from 33.50 to 33.93m. Several joints/parting carbonate coated (34.15 to 34.40, 35.05, 35.44 36.62 and 36.80 to 37.09m).
	38.20	41.70	3.50	5	Turbulent	Moderately wide to wide defect spacing. Fe-stained to 39.75m (then fresh). Carbonate coated at 39.23, 40.20, 40.60 and 40.92m.
	41.20	44.70	3.50	<1	Laminar	Moderately wide to wide defect spacing. Minor Fe-staining from 42.70m. Carbonate coating on joints at 42.51, 42.70 to 42.88, 43.37, and 44.40m.
	44.20	50.70	6.50	30	Washout	Moderately wide to wide defect spacing. Fe-stained. Carbonate coated joints at 44.40 and 46.28m.
	50.20	53.70	3.50	1	Laminar	Moderately wide to generally wide defect spacing. Fe-stained
	53.50	56.50	3.00	<1	Laminar	Generally wide defect spacing. Fe-stained. Carbonate coated joint at 56.10m
DDH 3 (Mid Right Abutment C/L)	3.83	8.83	5.00	1	Laminar	Very close to wide defect spacing. Fe and Fe/Mn-stained.
	8.33	14.73	6.50	<1	Laminar	Close to wide defect spacing. Fe-stained. Numerous carbonated coated joints.
	14.33	17.73	3.40	15	Washout (Turbulent Flow)	Very close to moderately wide defect spacing. Fe and Fe/Mn-stained.
	17.30	20.80	3.50	10	Washout (Turbulent Flow)	Moderately wide to wide defect spacing. Fe-stained.
	20.30	23.80	3.50	>100	Turbulent	Sheared zone from 21.30 to 22.68m (extremely close/very close defect spacing). Otherwise wide. Fe-stained.
	23.30	26.80	3.50	38	Washout (Turbulent Flow)	Generally close to wide defect spacing. Fe-stained.
	26.30	29.52	3.22	>100	NA	Generally moderately wide to wide defect spacing. Fragmented core recovery from 29.21 to 29.33m. Fe-stained.
	29.83	32.83	3.00	8	Slight Washout	Very close to moderately wide defect spacing. Crushed zone from 31.72 to 31.76m and again at 32.07m (10mm thick). Fe-stained. Clay fill 10mm thick in parting at 30.26m
	32.30	35.83	3.53	7	Turbulent	Very close to moderately wide defect spacing. Fe-stained.
	35.30	38.83	3.53	1.5	Turbulent	Generally moderately wide to Wide defect spacing. Very close defects from 36.02 to 36.42m (partings with joint). Fe-stained to 37m.
	38.30	41.85	3.55	1.5	Turbulent	Very close to very wide defect spacing. Often carbonate coated.

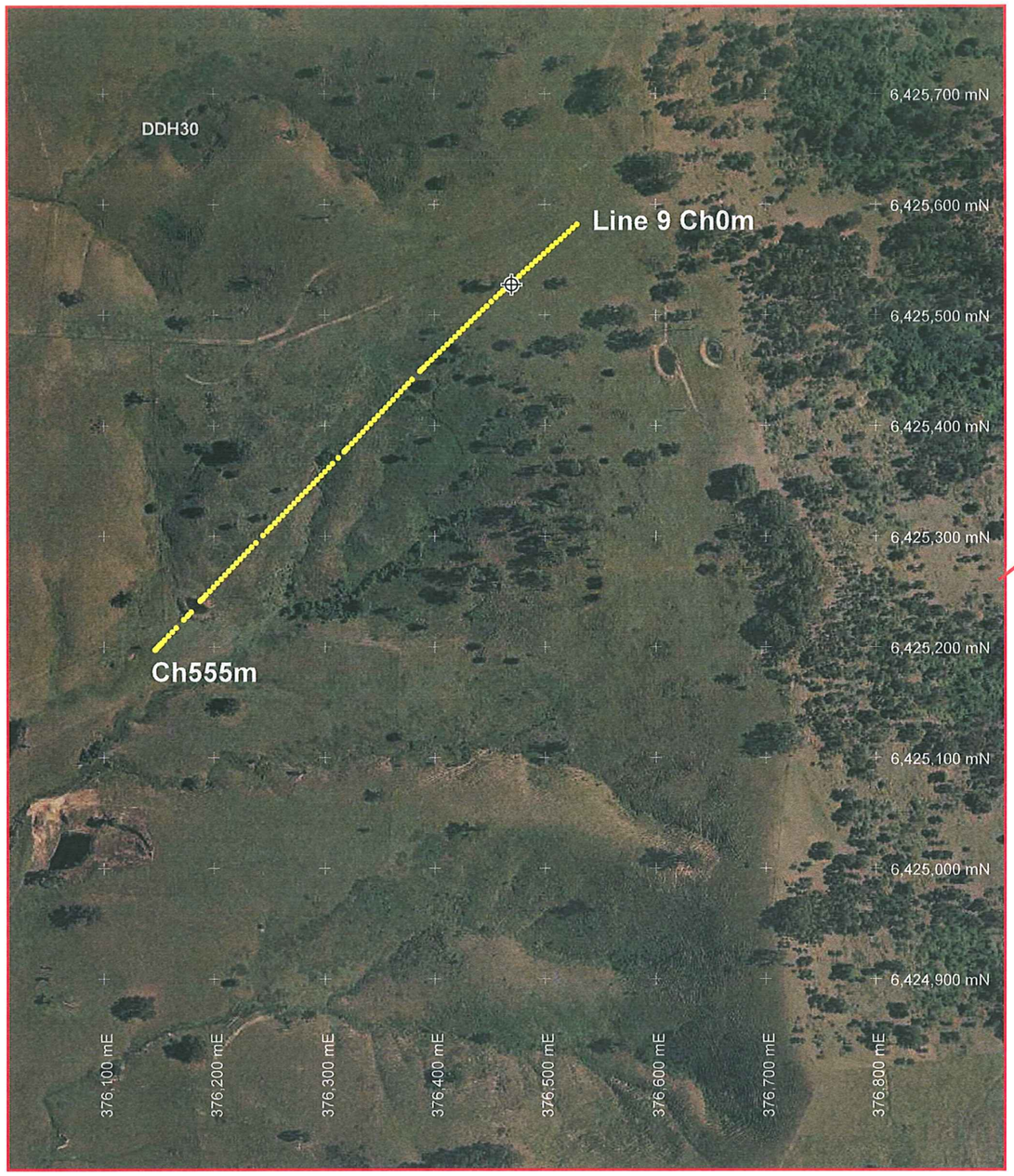
Borehole No	Depth (m)		Test Length(m)	Lugeon Value (UL)	Flow Type	Comments
	From	To				
DDH 4 (Upstream Diversion Portal)	3.80	7.20	3.40	12	Laminar	Extremely close to moderately wide defect spacing. Fe and Fe/Mn-stained.
	6.80	10.20	3.40	13	Laminar	Very close to moderately wide defect spacing. Fe and Fe/Mn-stained.
	9.80	13.20	3.40	11	Turbulent	Very close to wide defect spacing. Fe and Fe/Mn-stained.
	12.80	16.20	3.40	4	Dilation	Close to wide defect spacing. Fe and Fe/Mn-stained. Partly carbonate coated joint from 15.80 to 16.08m.
	15.80	22.20	6.40	1	Laminar	Generally moderately wide to wide defect spacing. Very closely spaced joint fragments from 19.77 to 20.00m. Fe and Fe/Mn-stained. Partly carbonate coated joint from 15.80 to 16.08m
	21.80	28.20	6.40	0	NA	Wide to very wide defect spacing. Fe-stained.
	27.80	34.20	6.40	<1	Laminar	Very close to moderately wide defect spacing, ranging to wide from 32.56m. Fe-stained, occasionally Fe/Mn-stained, to 32.75m. Carbonate vein 12mm thick at 30.24m.
	33.80	40.20	6.40	<1	Laminar	Wide to generally very wide defect spacing. Unstained.
DDH 5 (Lower Left Abutment U/S Toe)	3.80	6.82	3.02	1.5	Laminar	Very close to moderately wide/wide defect spacing. Fe-stained.
	6.80	10.83	4.03	32	Laminar	Generally close to moderately wide defect spacing. Fe stained, rarely Fe/Mn-stained.
	10.80	14.75	3.95	24	Laminar	Close to moderately wide/wide defect spacing. Fe-stained to 11.55m. Common (minor) carbonate coating, ranging to fill 5mm thick in partings at 13.99 and 14.02m.
	14.35	17.75	3.40	44	Turbulent	Close to moderately wide/wide defect spacing. Defects generally carbonate coated.
	17.35	20.75	3.40	12	Laminar	Very close to close defect spacing. Includes joint at 90° to Ø from 18.66 to 20.10m. Defects carbonate coated.
	20.35	23.75	3.40	25	Turbulent	Very close to moderately wide defect spacing. Includes an interval of very closely spaced joint fragments from 21.70 to 23.46m. Carbonate coated.
	23.75	26.75	3.00	<1	Laminar	Moderately wide to very wide defect spacing. Minor carbonate coatings.
	26.35	31.65	5.30	12	Turbulent	Very close to wide defect spacing. Carbonate coated.
	31.65	35.75	4.10	4	Laminar	Close to wide defect spacing. Carbonate coated, ranging to fill 4mm thick in joint fragments from 35.10 to 35.23m.

Borehole No	Depth (m)		Test Length(m)	Lugeon Value (UL)	Flow Type	Comments
	From	To				
DDH 6 (Middle Left Abutment C/L)	3.80	7.25	3.45	<1	NA	Close to moderately wide defect spacing. Fe and Fe/Mn-stained. Sandy clay coated/fill in defects at 6.10, 6.46 and 7.25m.
	6.80	10.25	3.45	0	NA	Close to moderately wide defect spacing. Fe and Fe/Mn-stained. Clay/sandy clay fill 1 to 5mm thick in joints at 7.25, 8.90 and between 9.15 and 9.35m.
	9.80	13.25	3.45	1	Laminar	Generally very close to moderately wide defect spacing. Includes crushed clayey zone from 11.14 to 11.19m (extremely close defect spacing). Fe and Fe/Mn-stained. Clay fill to 2mm thick in joint/parting fragments between 11.14 and 11.60m.
	12.80	16.25	3.45	<1	Laminar	Extremely close to moderately wide defect spacing. Core loss associated with joint/parting fragments from 15.66 to 15.71m. Fe/Mn-stained.
	15.80	19.25	3.45	3	Laminar	Extremely close to moderately wide defect spacing. Core loss from 18.44 to 18.67m. Narrow crushed zone from 18.08 to 18.11m. Fe and Fe/Mn-stained. Clay coated to sandy clay fill in joint/parting fragments between 16.87 and 17.10m.
	18.80	25.25	6.45	<1	NA	Generally moderately wide to wide defect spacing (very wide from 24.25m). Occasionally Fe and Fe/Mn-stained. Common carbonate coatings.
	24.80	31.25	6.45	<1	Laminar	Generally wide defect spacing. Close to moderately wide from 27.50 to 30.46m. Fe-stained.
	30.80	39.07	8.27	5	Washout	Generally moderately wide to wide defect spacing to 37.94m, then extremely close to moderately wide. Crushed clayey zone associated with parting at 36.28m. Fragmented joint from 38.47 to 38.56m. Fe-stained. Carbonate coated joint at 37.74m.
	38.35	43.25	4.90	<1	Laminar	Extremely close to moderately wide defect spacing to 41.30m, then generally wide. Includes fragmented joint 38.47 to 38.56m. Crushed clayey zone associated with partings from 39.14 to 39.19m. Fe-stained. Minor clay coating with joint fragments and associated partings between 39.95 and 40.53m. Occasional carbonate coatings over the test section.
DDH 7 (Upper Left Abutment)	6.80	10.30	3.50	<1	NA	Extremely close to moderately wide defect spacing. Core loss from 8.43 to 8.53m. Fe and Fe/Mn-stained. Occasional clay coatings.
	9.80	13.30	3.50	0	NA	Generally close to moderately wide/wide defect spacing. Fe and Fe/Mn-stained.
	12.80	16.30	3.50	28	Washout	Generally wide/very wide defect spacing. Fe and Fe/Mn-stained.
	16.30	19.30	3.00	12	Dilation (Turbulent Flow)	Moderately wide to wide defect spacing. Includes an interval of very close to close joint/parting defects between 16.77 and 17.67m. Fe and Fe/Mn-stained.
	18.80	22.30	3.50	<1	Laminar	Very close to moderately wide defect spacing. Fe and Fe/Mn-stained.
	21.80	25.30	3.50	<1	NA	Generally close to wide defect spacing. Includes an interval of very close joint fragments from 22.17 to 22.58m. Fe and Fe/Mn-stained.
	24.80	28.30	3.50	<1	NA	Close to wide defect spacing. Fe and Fe/Mn-stained.
	27.80	31.30	3.50	<1	Laminar	Moderately wide to wide defect spacing. Includes an interval of very close to close joint/parting defects from 28.88 to 29.54m. Fe and Fe/Mn-stained. Carbonate coating on parting at 28.88m and joint at 30.10m.
	30.80	34.30	3.50	0	NA	Close to wide defect spacing. Fe-stained. Carbonate coated joints at 32.46, from 32.66 to 32.87 and at 33.60m.

Borehole No	Depth (m)		Test Length(m)	Lugeon Value (UL)	Flow Type	Comments
	From	To				
DDH 8 (Left Abutment Spillway)	3.80	8.18	4.38	5	Washout	Extremely close to moderately wide defect spacing. Shear zone associated with jointing from 7.41 to 8.13m. Core loss from 8.13 to 8.18m. Fe and Fe/Mn-stained. Occasional clay coatings.
	8.10	12.50	4.40	1.8	Laminar	Close to moderately wide defect spacing. Core loss from 8.13 to 8.18m. Fe/Mn-stained. Minor carbonate coating associated with joint between 9.04 and 9.47m.
	12.45	16.23	3.78	2.5	Laminar	Generally very close to moderately wide defect spacing. Fe and Fe/Mn-stained.
	15.75	19.23	3.48	0	NA	Close to wide defect spacing. Fe-Stained.
	18.75	25.23	6.48	0	NA	Generally wide to very wide defect spacing. Fe-stained.
	24.75	28.23	3.48	>100	NA	Generally wide defect spacing. Complete drilling water loss at 27.70m at Fe/Mn-stained joint. Fe and Fe/Mn-stained.
	28.23	31.23	3.00	>100	NA	Very close to moderately wide defect spacing. Fragmented joint from 30.60 to 30.71m. Core loss from 30.71 to 30.76m. Fe-stained.
	31.23	34.23	3.00	<1	Laminar	Generally moderately wide to very wide defect spacing. Fe-stained. Carbonate fill 1mm thick in joint at 34.10m.
	33.75	37.23	3.48	60	Turbulent	Very close to wide defect spacing. Minor shear zone associated with bedding from 37.12 to 37.28m. Fe-stained.
	37.23	40.23	3.00	32	Turbulent	Moderately wide to wide defect spacing. Fe-stained.
	39.75	43.23	3.48	54	Washout (Turbulent Flow)	Extremely close to moderately wide defect spacing. Shear zone associated with bedding from 41.91 to 42.40m, includes clayey crushed zones. Fe-stained.
	42.75	46.23	3.48	50	Washout (Turbulent Flow)	Close to moderately wide defect spacing. Fe-stained to 45.40m. Carbonate coating on defects at 44.45, 45.76 and 45.87m.
	45.75	49.23	3.48	1	Laminar	Very close to wide defect spacing. Common carbonate coatings.

Appendix H

Seismic Refraction Survey – Landslip 2A



1:5000 @ A3

Drawing 1 Sheet Index

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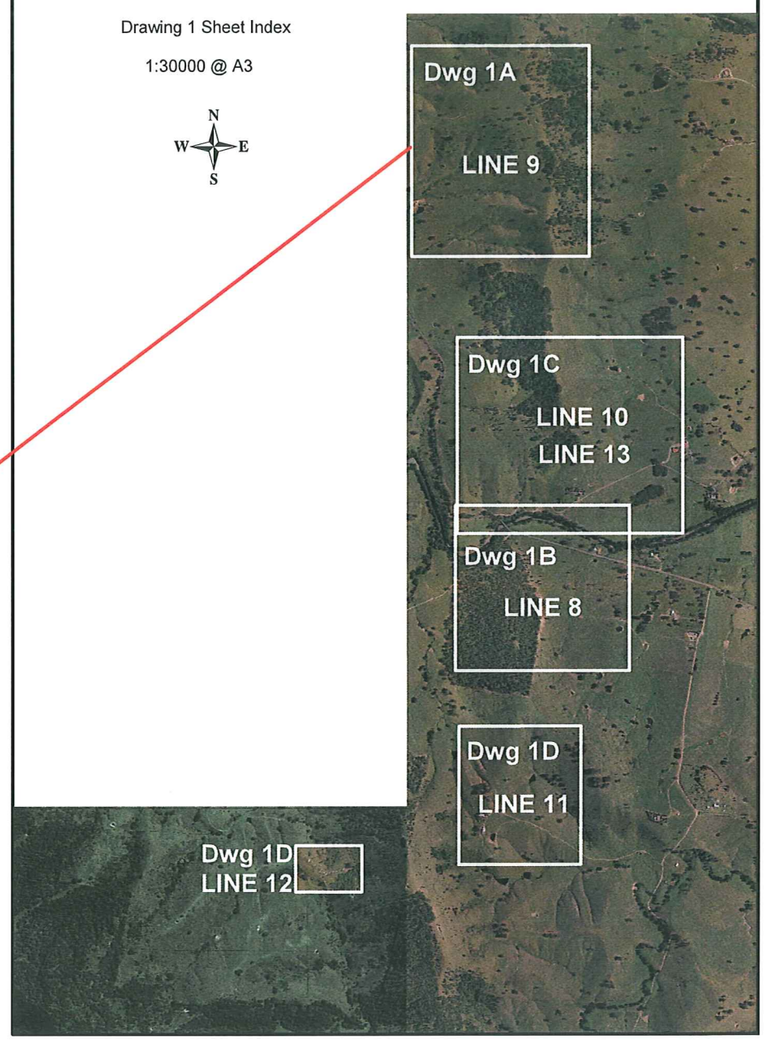


LEGEND

- Grid: GDA94 / MGA94 (Zone 56)
- Dept. of Commerce Borehole
- Geophone location along seismic line

Douglas Partners
Geotechnics . Environment . Groundwater

Brisbane, Cairns, Canberra, Darwin, Gold Coast, Melbourne, Minto, Newcastle, Perth, Sunshine Coast, Sydney, Townsville, Wollongong, Wyong

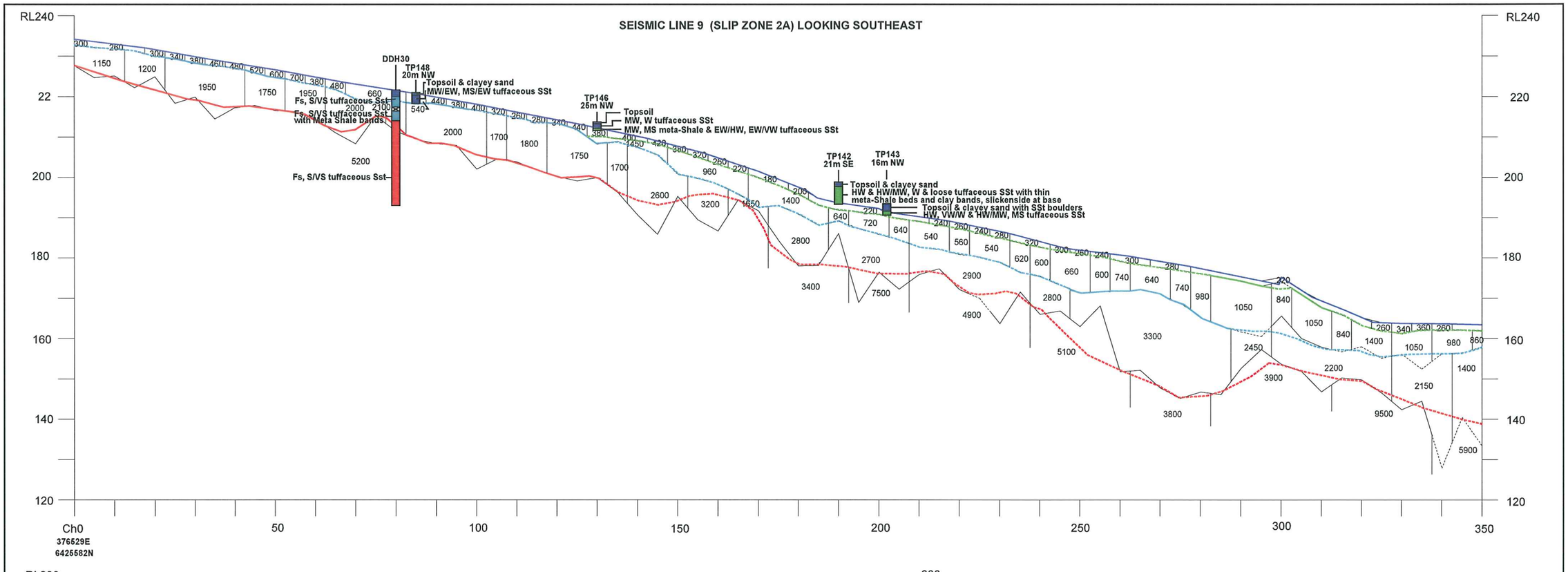
TITLE:

SEISMIC LINE 9 (SLIP ZONE 2A) AND TEST BORE LOCATIONS

SUPPLEMENTARY SEISMIC REFRACTION INVESTIGATION
PROPOSED TILLEGRA DAM SITE
TILLEGRA, NSW

CLIENT: NSW Department of Commerce			
DRAWN BY: JL	SCALE: As Shown	PROJECT No: 39721.06	OFFICE: SYDNEY
APPROVED BY:		DATE: 18 December 2008	DRAWING No: 1A

SEISMIC LINE 9 (SLIP ZONE 2A) LOOKING SOUTHEAST



LEGEND

376801E 6423939N	Co-ordinates from Hunter Water survey: GDA94 / MGA94 (Zone 56) in metres
RL220	Reduced surface levels (mAHD) from Hunter Water survey
	Simplified graphic log of Dept. of Commerce borehole or test pit, showing degree of weathering, rock strength, primary lithology/lithologies and relevant logged comments. Colours indicate possible correlations between geological units and interpreted seismic layers at the borehole or test pit locations.

BOREHOLE LOG ABBREVIATIONS

Degree of weathering

EW	Extremely Weathered
HW	Highly Weathered
MW	Moderately Weathered
SW	Slightly Weathered
Fs	Fresh but iron-stained
F	Fresh

Lithology

Sst	Sandstone
Sls	Siltstone

Rock strength

Department of Commerce terminology		Approximate AS equivalent terminology	
EW	Extremely Weak	EL	Extremely Low Strength
VW	Very Weak	VL	Very Low Strength
W	Weak	L	Low Strength
MS	Medium Strong	M	Medium Strength
S	Strong	M/H	Medium - High Strength
VS	Very Strong	VH	Very High Strength
ES	Extremely Strong	EH	Extremely High Strength

SEISMIC LEGEND

620 / 1250 / 2500 / 4000 / 6200 — Interpreted, smoothed, migrated layer boundaries and lateral velocity boundaries (velocities in m/sec, rounded)

Ground surface along seismic line

Interpreted layer boundary inferred from harmonic mean velocities or interpolated time-depths, where reciprocal coverage was not available

Raw (unsmoothed, unmigrated) layer boundary

Douglas Partners
Geotechnics Environment Groundwater

Brisbane, Cairns, Canberra, Darwin, Gold Coast, Melbourne, Minto, Newcastle, Perth, Sunshine Coast, Sydney, Townsville, Wollongong, Wyong

TITLE:

INTERPRETED SEISMIC SECTION, SLIP ZONE 2A
SUPPLEMENTARY SEISMIC REFRACTION INVESTIGATION
PROPOSED TILLEGRA DAM SITE, TILLEGRA NSW

CLIENT: NSW DEPARTMENT OF COMMERCE			
DRAWN BY: RGH	SCALE: As shown	PROJECT No: 39721.06	OFFICE: SYDNEY
APPROVED BY:		DATE: 16 Dec 2008	DRAWING No: 2

Appendix I

Laboratory Test Results

Geotechnical Centre
Unit W4K, 42 Wattle St, ULTIMO, NSW 2007
Telephone 02- 9552 4864 Facsimile 02-9552 3615

NSW Department of Commerce

CLIENT:	GEOTECHNICAL & ENVIRONMENTAL	BATCH No:	08050
	SOIL SUMMARY SHEET		
PROJECT:	TILLEGRA DAM	COMPILED BY:	MA
LOCATION:	SLIDE 2A	DATE:	10/09/2008

General Information Note: All test methods are as indicated on accompanying test reports.

Sample No.	6307	6308	6309			
Bore/Reference	TP142	TP142	TP143			
Depth (m)	N/A	5.5	1.9			
Sample Type	Disturbed	Disturbed	Disturbed			
Soil Colour & Description (v) indicates visual classification	Grey Sandy Silty Clay	Grey Brown Silty Clayey Sand	Grey Silty Sandy Clay			
Unified Classification	CH	CI	CH			

Moisture Content & Density

Field Moisture Content (%)	26.2	24.6				
Field Wet Density (t/m³)						
Field Dry Density (t/m³)						
Soil Particle Density (t/m³)						

Particle Size Distribution

Cobble Size (%)						
Gravel Size (%)						
Sand Size (%)	25	42	41			
Silt Size (%)	23	26	17			
Clay Size (%)	52	32	42			
Effective Size (mm)						
Uniformity Coefficient						
Curvature Coefficient						

Plasticity

Liquid Limit (%)	60	42	60			
Plastic Limit (%)	25	22	24			
Plasticity Index (%)	35	20	36			
Linear Shrinkage (%)						

Dispersion

Dispersal Index						
Percent Dispersion (%)						
Emerson Class No.	1	2	3			

Compaction

Compaction Type						
Optimum Moisture Content (%)						
Maximum Dry Density (t/m³)						

California Bearing Ratio

Placement Moisture Content (%)						
Placement Dry Density (t/m³)						
Swell under 4.5kg Surcharge (%)						
C.B.R. at 2.5% Penetration (%)						
C.B.R. at 5.0% Penetration (%)						

Shrink-Swell Index

Shrink Strain (%)						
Swell Strain (%)						
Shrink-Swell Index (Iss)						

Geotechnical Centre

Unit W4K, 42 Wattle Street, ULTIMO NSW 2007
Telephone 02 9552 4864 Facsimile 02 9552 3615
NATA Accreditation Number: 13380

NSW Department of Commerce

CLIENT: GEOTECHNICAL & ENVIRONMENTAL		REPORT No: 08050/6307/R1115
SOIL INDEX PROPERTIES		
PROJECT: TILLEGRA DAM		SAMPLE No: 6307
LOCATION: SLIDE 2A	HOLE No: TP142	DEPTH (m): N/A

SOIL INDEX PROPERTIES	RESULT		TEST METHOD
Moisture Content (as received)	:	26.2 %	AS 1289.2.1.1
Liquid Limit	:	60 %	AS 1289.3.1.1
Plastic Limit	:	25 %	AS 1289.3.2.1
Plasticity Index	:	35 %	AS 1289.3.3.1
Linear Shrinkage	:	-	AS 1289.3.4.1
Soil Particle Density	:	-	AS 1289.3.5.1
Classification	:	CH	AS 1726

Sample History: ☐ Natural State ☒ Air Dried ☐ Oven Dried

Method of Preparation: ☐ Wet Sieved ☒ Dry Sieved

Linear Shrinkage Sample: ☐ Curling ☐ Crumbling

Notes on test: Sample tested as received from client.

ATTERBERG LIMITS R1115 (ISSUE 4, 2005)

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Tested By: MA Date Tested: 05/09/2008

APPROVED SIGNATORY

Mark Ashover 10/09/2008

Geotechnical Centre

Unit W4K, 42 Wattle Street, ULTIMO NSW 2007
Telephone 02 9552 4864 Facsimile 02 9552 3615
NATA Accreditation Number: 13380

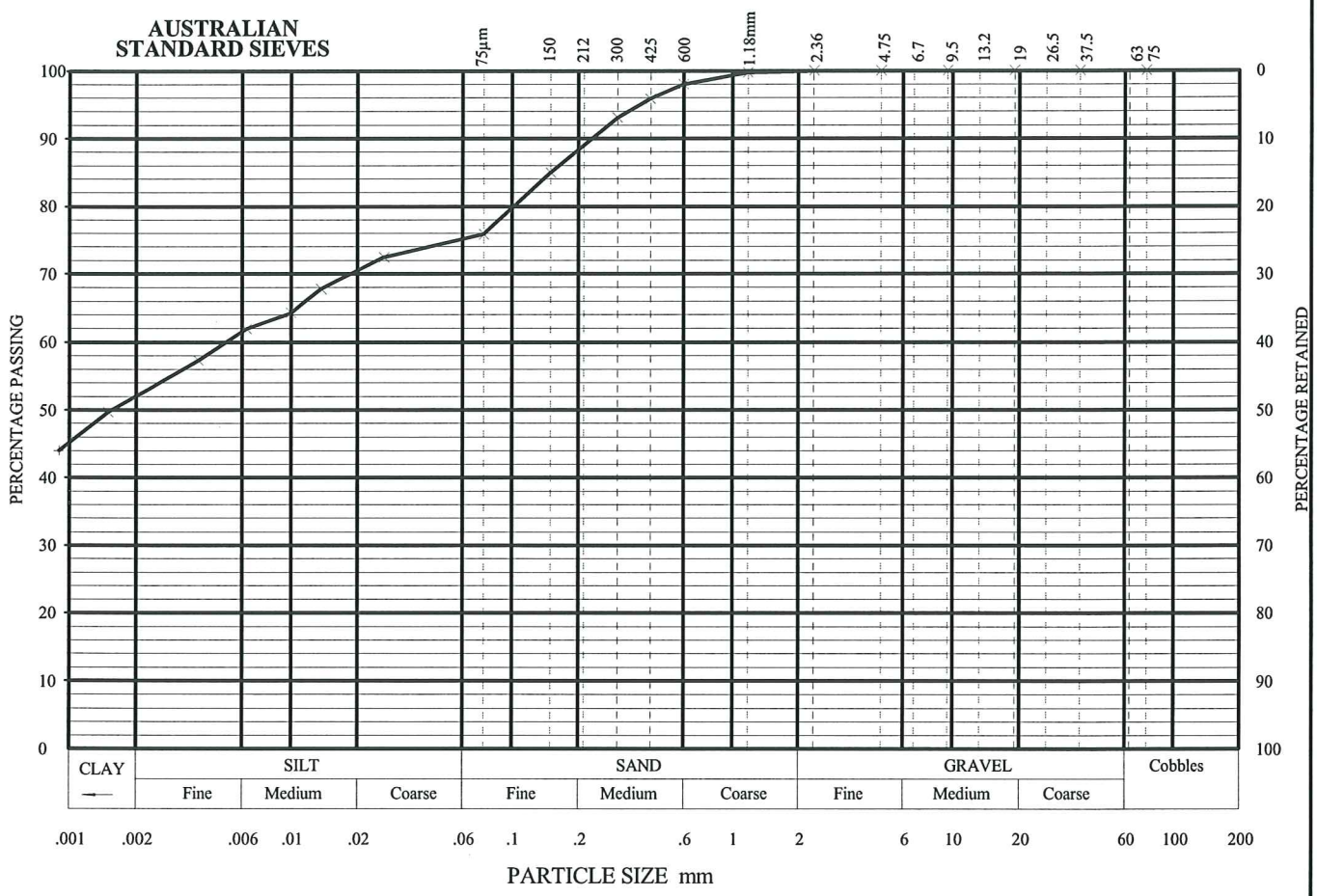
NSW Department of Commerce

CLIENT: GEOTECHNICAL & ENVIRONMENTAL | REPORT No: 08050/6307/R1119

PARTICLE SIZE DISTRIBUTION

PROJECT: TILLEGRA DAM | SAMPLE No: 6307

LOCATION: SLIDE 2A | HOLE No: TP142 | DEPTH (m): N/A



SIZE DISTRIBUTION

COBBLES	0 %
GRAVEL	0 %
SAND	25 %
SILT	23 %
CLAY	52 %
EFFECTIVE SIZE D10:	-
UNIFORMITY COEFFICIENT D60/D10(Cu):	-
CURVATURE COEFFICIENT $D30^2$ /(D60 x D10) (Cc):	-

Soil Particle Density: 2.65 t/m³ (estimated for analysis)

Method of dispersion: End-over-end shaking

Hydrometer: ASTM 152H

Dispersion chemical: Sodium hexametaphosphate + Anhydrous sodium carbonate

Notes on Test: Tested as received

Loss in pre-treatment: 0 %

Test Methods:
DPWS GM 9: Determination of the Particle Size Distribution of a Soil

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Tested By: MA Date Tested: 02/09/2008

APPROVED SIGNATORY M. Ashover

Mark Ashover 10/09/2008

PARTICLE SIZE DISTRIBUTION R1119 (ISSUE 4, 2005)

Geotechnical Centre

Unit W4K, 42 Wattle Street, ULTIMO NSW 2007
Telephone 02 9552 4864 Facsimile 02 9552 3615
NATA Accreditation Number: 13380

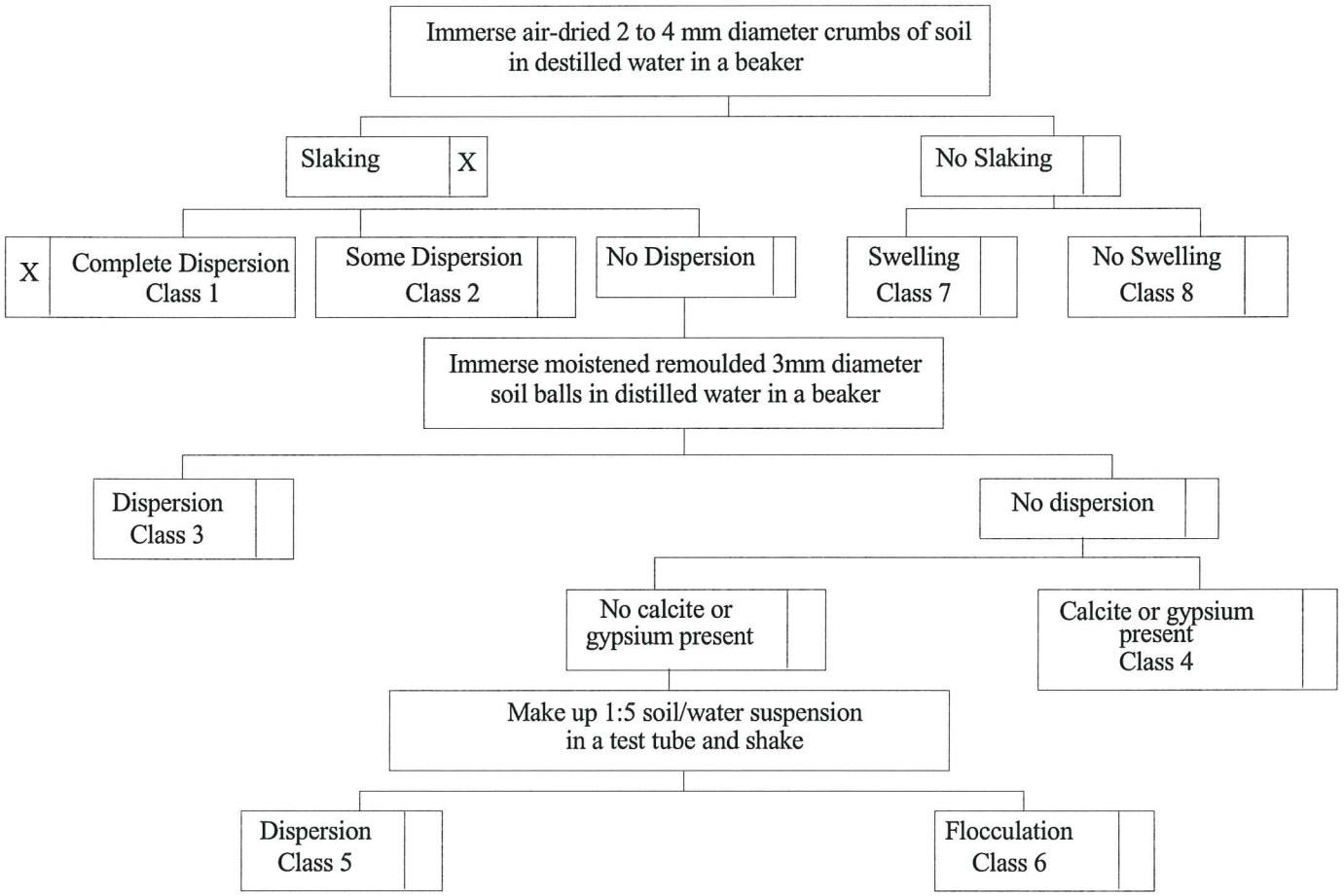
NSW Department of Commerce

CLIENT: GEOTECHNICAL & ENVIRONMENTAL	REPORT No: 08050/6307/R1118

DISPERSION TESTS

PROJECT: TILLEGRA DAM		SAMPLE No: 6307
LOCATION: SLIDE 2A	HOLE No: TP142	DEPTH (m): N/A

Determination of the Emerson Class Number of a soil



Emerson Class Number	(AS 1289.3.8.1)	1
Percent Dispersion	(AS 1289.3.8.2)**	No Test
Dispersal Index	(DPWS GM 15)	No Test

Sample Description: Grey Sandy Silty Clay

Type and temperature of water: Distilled, 21 ° C

Notes on test: Sample tested as received from client.

** 0.05mm size interpolated from hydrometer readings taken after 21min, 1hour and 2 hours.

NATA

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Tested By: MA Date Tested: 02/09/2008

APPROVED SIGNATORY M. Ashover

Mark Ashover 10/09/2008

Geotechnical Centre

Unit W4K, 42 Wattle Street, ULTIMO NSW 2007
Telephone 02 9552 4864 Facsimile 02 9552 3615
NATA Accreditation Number: 13380

NSW Department of Commerce

CLIENT: GEOTECHNICAL & ENVIRONMENTAL	REPORT No: 08050/6308/R1115

SOIL INDEX PROPERTIES

PROJECT: TILLEGRA DAM		SAMPLE No: 6308
LOCATION: SLIDE 2A	HOLE No: TP142	DEPTH (m): 5.50

SOIL INDEX PROPERTIES		RESULT		TEST METHOD
Moisture Content (as received)	:	24.6	%	AS 1289.2.1.1
Liquid Limit	:	42	%	AS 1289.3.1.1
Plastic Limit	:	22	%	AS 1289.3.2.1
Plasticity Index	:	20	%	AS 1289.3.3.1
Linear Shrinkage	:	-		AS 1289.3.4.1
Soil Particle Density	:	-		AS 1289.3.5.1
Classification	:	CI		AS 1726

Sample History: ☐ Natural State ☒ Air Dried ☐ Oven Dried

Method of Preparation: ☐ Wet Sieved ☒ Dry Sieved

Linear Shrinkage Sample: ☐ Curling ☐ Crumbling

Notes on test: Sample tested as received from client.

ATTERBERG LIMITS R1115 (ISSUE 4, 2005)

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Tested By: MA Date Tested: 05/09/2008

APPROVED SIGNATORY M. Ashover

Mark Ashover 10/09/2008

Geotechnical Centre

Unit W4K, 42 Wattle Street, ULTIMO NSW 2007
Telephone 02 9552 4864 Facsimile 02 9552 3615
NATA Accreditation Number: 13380

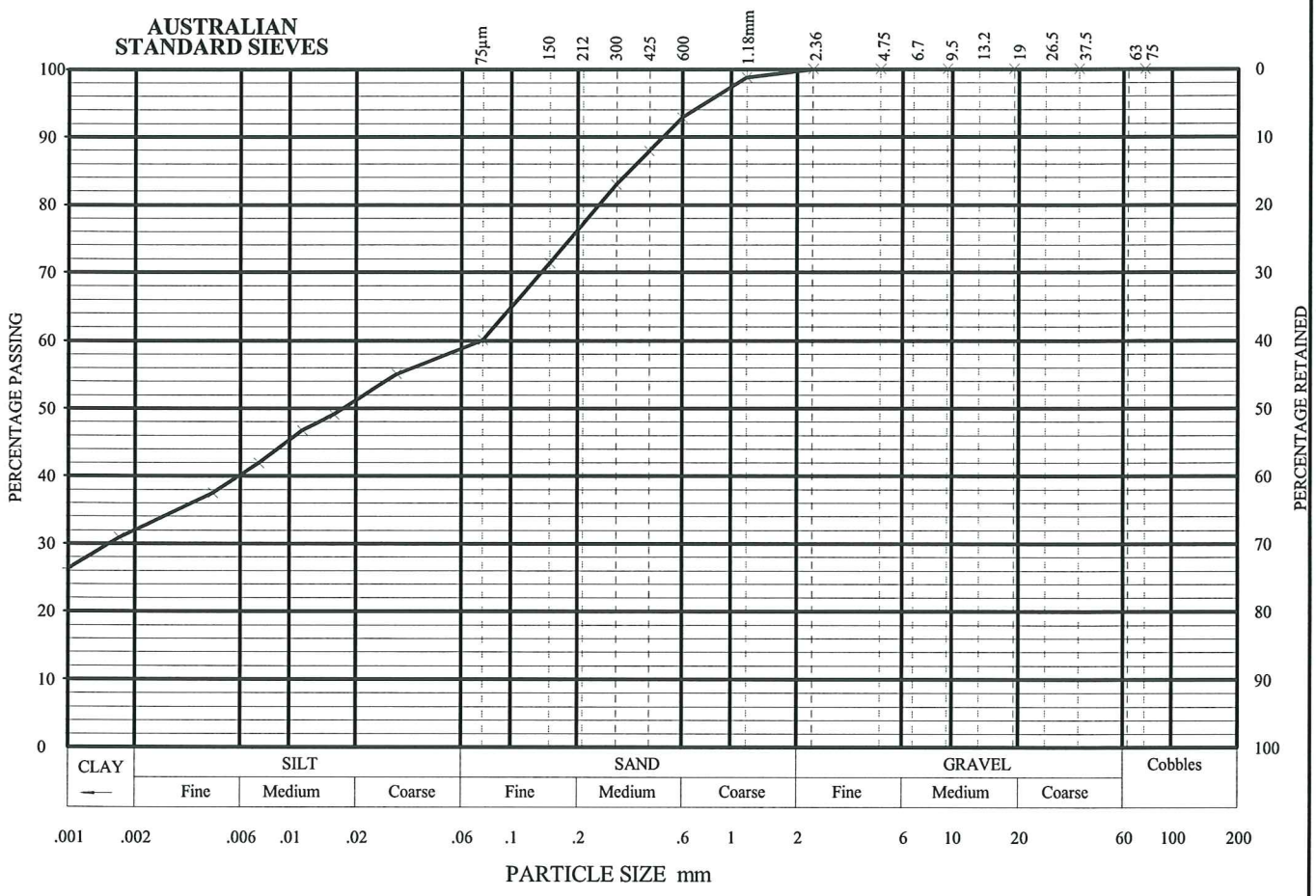
NSW Department of Commerce

CLIENT: GEOTECHNICAL & ENVIRONMENTAL | REPORT No: 08050/6308/R1119

PARTICLE SIZE DISTRIBUTION

PROJECT: TILLEGRA DAM | SAMPLE No: 6308

LOCATION: SLIDE 2A | HOLE No: TP142 | DEPTH (m): 5.50



SIZE DISTRIBUTION	
COBBLES	0 %
GRAVEL	0 %
SAND	42 %
SILT	26 %
CLAY	32 %
EFFECTIVE SIZE D10:	-
UNIFORMITY COEFFICIENT D60/D10(Cu):	-
CURVATURE COEFFICIENT $D30^2$ /(D60 x D10) (Cc):	-

Soil Particle Density: 2.65 t/m³ (estimated for analysis)

Method of dispersion: End-over-end shaking

Hydrometer: ASTM 152H

Dispersion chemical: Sodium hexametaphosphate + Anhydrous sodium carbonate

Notes on Test: Tested as received

Loss in pre-treatment: 0 %

Test Methods:
DPWS GM 9: Determination of the Particle Size Distribution of a Soil

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Tested By: MA Date Tested: 02/09/2008

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Mark Ashover 10/09/2008

PARTICLE SIZE DISTRIBUTION R1119 (ISSUE 4, 2005)

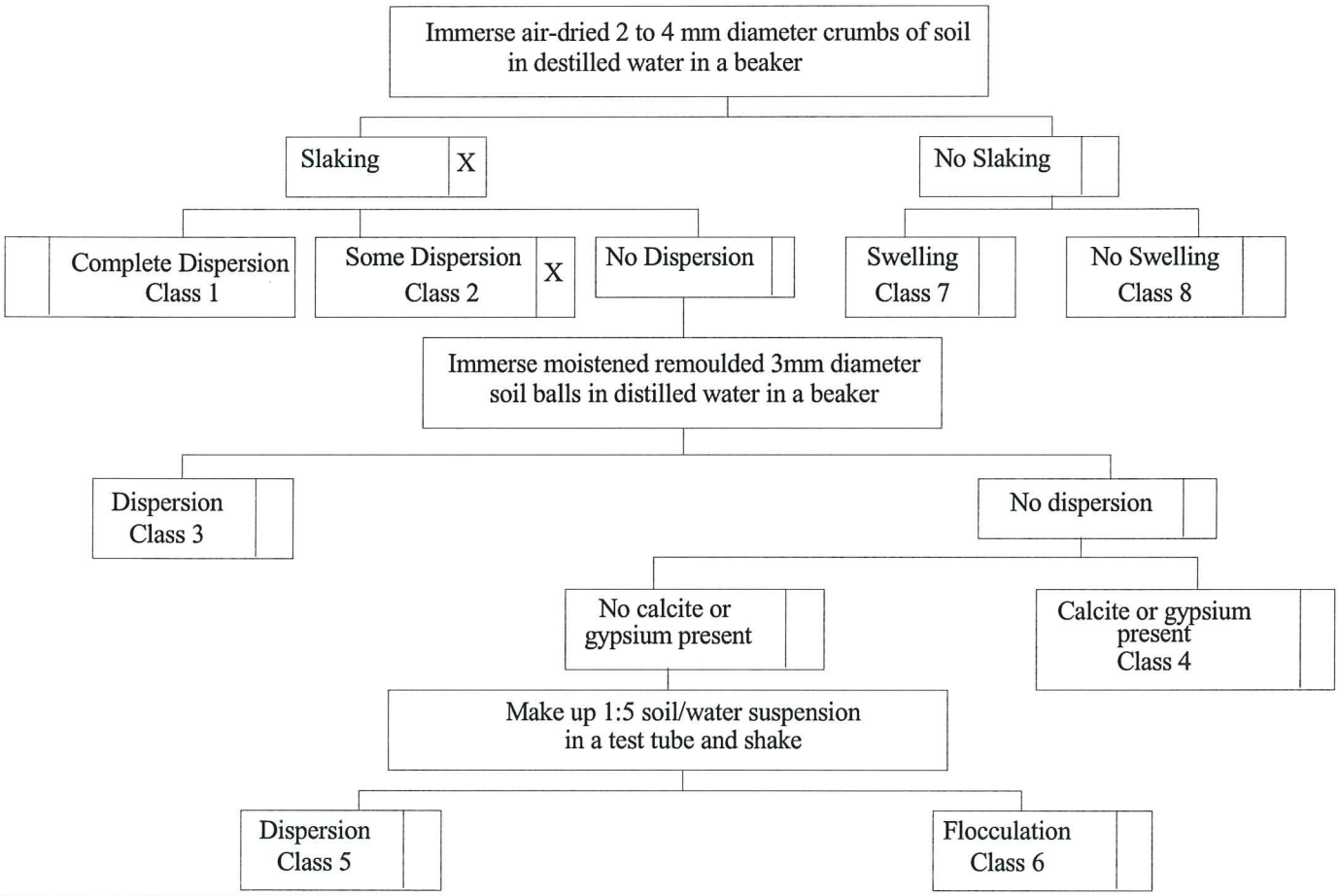
Geotechnical Centre

Unit W4K, 42 Wattle Street, ULTIMO NSW 2007
Telephone 02 9552 4864 Facsimile 02 9552 3615
NATA Accreditation Number: 13380

NSW Department of Commerce

CLIENT: GEOTECHNICAL & ENVIRONMENTAL		REPORT No: 08050/6308/R1118
DISPERSION TESTS		
PROJECT: TILLEGRA DAM		SAMPLE No: 6308
LOCATION: SLIDE 2A	HOLE No: TP142	DEPTH (m): 5.50

Determination of the Emerson Class Number of a soil



Emerson Class Number	(AS 1289.3.8.1)	2
Percent Dispersion	(AS 1289.3.8.2)**	No Test
Dispersal Index	(DPWS GM 15)	No Test

Sample Description: Grey Brown Silty Clayey Sand

Type and temperature of water: Distilled, 21 ° C

Notes on test: Sample tested as received from client.

** 0.05mm size interpolated from hydrometer readings taken after 21min, 1hour and 2 hours.

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Tested By: MA Date Tested: 02/09/2008

APPROVED SIGNATORY M. Ashover

Mark Ashover 10/09/2008

Geotechnical Centre

Unit W4K, 42 Wattle Street, ULTIMO NSW 2007
Telephone 02 9552 4864 Facsimile 02 9552 3615
NATA Accreditation Number: 13380

NSW Department of Commerce

CLIENT: GEOTECHNICAL & ENVIRONMENTAL	REPORT No: 08050/6309/R1115

SOIL INDEX PROPERTIES

PROJECT: TILLEGRA DAM	SAMPLE No: 6309
LOCATION: SLIDE 2A	HOLE No: TP143 / DEPTH (m): 1.90

SOIL INDEX PROPERTIES		RESULT		TEST METHOD
Moisture Content (as received)	:	-		AS 1289.2.1.1
Liquid Limit	:	60	%	AS 1289.3.1.1
Plastic Limit	:	24	%	AS 1289.3.2.1
Plasticity Index	:	36	%	AS 1289.3.3.1
Linear Shrinkage	:	-		AS 1289.3.4.1
Soil Particle Density	:	-		AS 1289.3.5.1
Classification	:	CH		AS 1726

Sample History: ☐ Natural State ☒ Air Dried ☐ Oven Dried

Method of Preparation: ☐ Wet Sieved ☒ Dry Sieved

Linear Shrinkage Sample: ☐ Curling ☐ Crumbling

Notes on test: Sample tested as received from client.

ATTERBERG LIMITS R1115 (ISSUE 4, 2005)

NATA

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Tested By: MA Date Tested: 08/09/2008

APPROVED SIGNATORY M. Ashover

Mark Ashover 10/09/2008

Geotechnical Centre

Unit W4K, 42 Wattle Street, ULTIMO NSW 2007
Telephone 02 9552 4864 Facsimile 02 9552 3615
NATA Accreditation Number: 13380

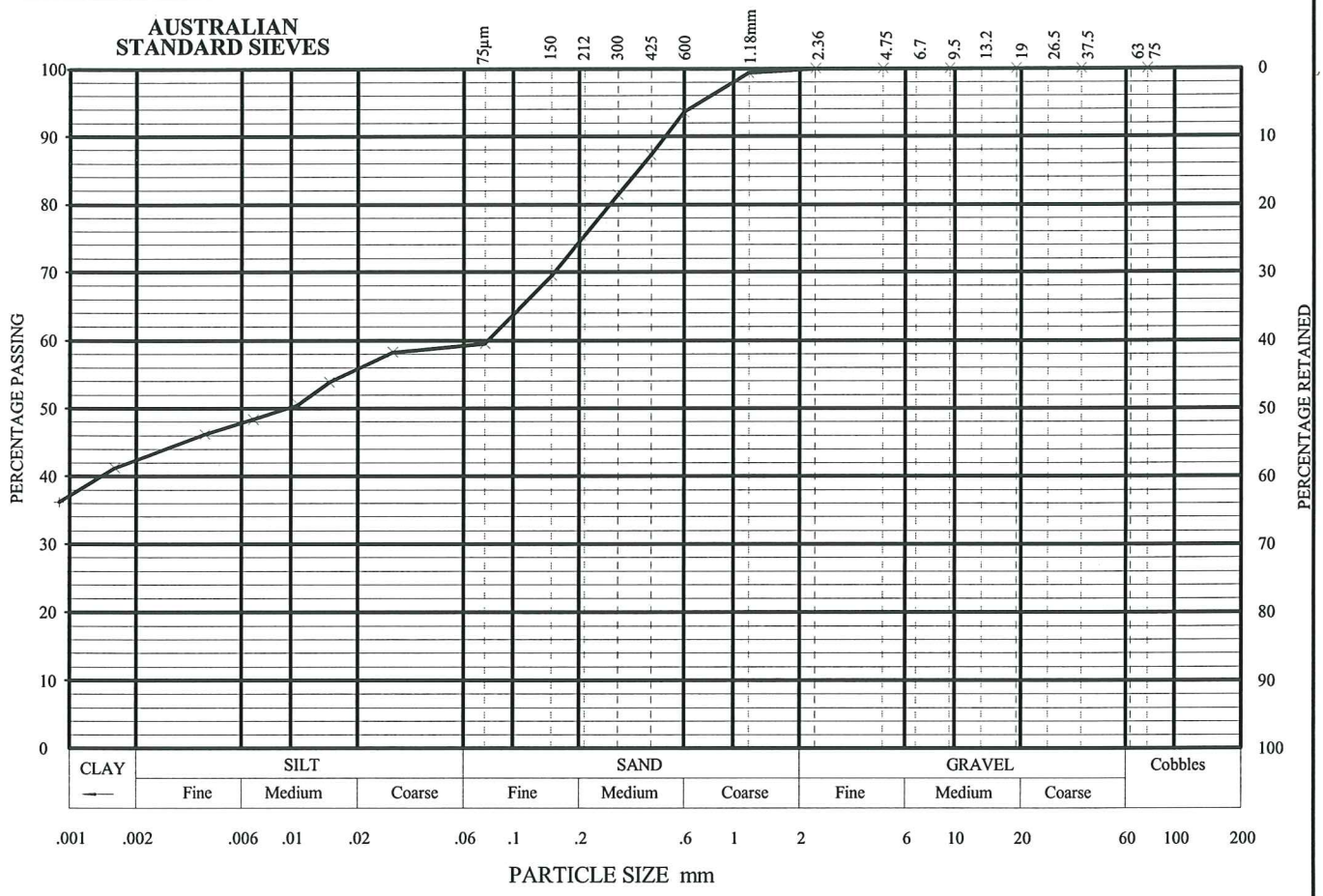
NSW Department of Commerce

CLIENT: GEOTECHNICAL & ENVIRONMENTAL | REPORT No: 08050/6309/R1119

PARTICLE SIZE DISTRIBUTION

PROJECT: TILLEGRA DAM | SAMPLE No: 6309

LOCATION: SLIDE 2A | HOLE No: TP143 | DEPTH (m): 1.90



SIZE DISTRIBUTION	
COBBLES	0 %
GRAVEL	0 %
SAND	41 %
SILT	17 %
CLAY	42 %
EFFECTIVE SIZE D10:	-
UNIFORMITY COEFFICIENT D60/D10(Cu):	-
CURVATURE COEFFICIENT $D30^2$ /(D60 x D10) (Cc):	-

Soil Particle Density: 2.65 t/m³ (estimated for analysis)

Method of dispersion: End-over-end shaking

Hydrometer: ASTM 152H

Dispersion chemical: Sodium hexametaphosphate + Anhydrous sodium carbonate

Notes on Test: Tested as received

Loss in pre-treatment: 0 %

Test Methods:
DPWS GM 9: Determination of the Particle Size Distribution of a Soil

PARTICLE SIZE DISTRIBUTION R1119 (ISSUE 4, 2005)

NATA

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Tested By: MA Date Tested: 02/09/2008

APPROVED SIGNATORY M. Ashover

Mark Ashover 10/09/2008

Geotechnical Centre

Unit W4K, 42 Wattle Street, ULTIMO NSW 2007
Telephone 02 9552 4864 Facsimile 02 9552 3615
NATA Accreditation Number: 13380

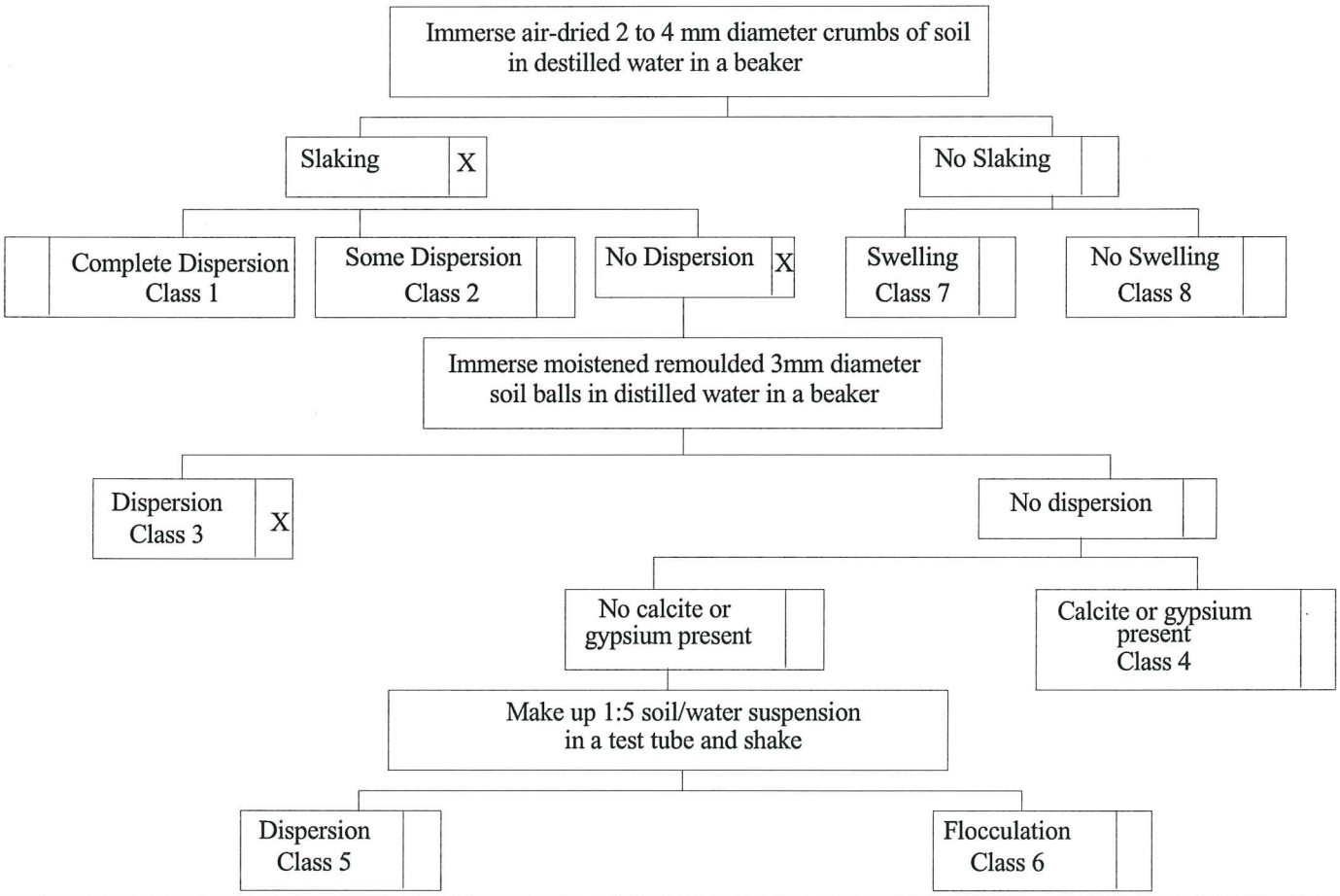
NSW Department of Commerce

CLIENT: GEOTECHNICAL & ENVIRONMENTAL	REPORT No: 08050/6309/R1118

DISPERSION TESTS

PROJECT: TILLEGRA DAM	SAMPLE No: 6309	
LOCATION: SLIDE 2A	HOLE No: TP143	DEPTH (m): 1.90

Determination of the Emerson Class Number of a soil



Emerson Class Number	(AS 1289.3.8.1)	3
Percent Dispersion	(AS 1289.3.8.2)**	No Test
Dispersal Index	(DPWS GM 15)	No Test

Sample Description: Grey Sandy Silty Clay

Type and temperature of water: Distilled, 21 ° C

Notes on test: Sample tested as received from client.

** 0.05mm size interpolated from hydrometer readings taken after 21min, 1hour and 2 hours.

NATA

This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025.

Tested By: MA Date Tested: 02/09/2008

APPROVED SIGNATORY M. Ashover

Mark Ashover 10/09/2008

DISPERSIVE SOILS R1118 (ISSUE 4, 2005)

MINERALOGY OF CLAY SAMPLE

BY

ZHONGSHENG LI AND COLIN R. WARD

SCHOOL OF BIOLOGICAL, EARTH AND ENVIRONMENTAL SCIENCES
UNIVERSITY OF NEW SOUTH WALES

FOR

DEARTMENT OF COMMERCE

ATTN: JOHN YOUNG, GEOTECH & ENVIRONMENTAL SECTION
PROJECT: TILLEGRA DAM GEOTECHNICAL INVESTIGATION

GEOLOGICAL ANALYSIS REPORT

Oct 10, 2008

PROCEDURE

One wet clay sample, supplied by John Young, was first oven dried at 50 degree, then finely powdered and analysed by X-ray powder diffraction using a Phillips X'pert diffractometer with copper Kα radiation. The minerals present were identified by reference to the JCPDS Powder Diffraction File. Quantitative analyses of mineral phases in the powdered samples were made using SIROQUANT™, commercial interpretation software written by CSIRO (J.C. Taylor, *Powder Diffraction*, 6, 2-9, 1991) based on the Rietveld XRD analysis technique.

The clay fraction (less than 2 μm effective diameter) of each sample was isolated by ultrasonic dispersion and subsequent settling. The clay fraction was investigated further by X-ray diffraction of oriented aggregates, using glycol and heat treatment. The relative proportions of the different clay minerals in this fraction for each sample were determined by the method of Griffin (in R.E. Carver, *Procedures in Sedimentary Petrology,* Wiley, 1971).

RESULTS

Table 1 provides data on the percentages of the individual minerals in the various samples from the SIROQUANT interpretation. The table lists the estimated weight percentage of the crystalline phases recognised in each sample, together with the relative error in the estimation (estimated standard deviation or ESD) for each individual mineral determination. The overall level of fit for the SIROQUANT evaluation in each case is given by the relevant global chi^2 value at the foot of each table. The total error for each mineral percentage can be calculated from the product of the ESD associated with that mineral and the square root of the global chi^2 value for the relevant SIROQUANT analysis.

Further notes on the clay fractions, based on the separate oriented aggregate XRD study, are provided in Table 2. These data may differ from those in Table 1; different fractions were analysed in each case, and different methods were used for mineral percentage estimations.

Table 1: Mineralogy of the clay powder by X-ray Powder Diffractometry

Sample: 6306, Pit 142, 1m depth

Phase	Weight (%)	Error of Fit
Quartz	21.5	0.58
Kaolinite	7.3	0.67
Montmorillonite	40.0	0.99
Feldspar (albite)	31.3	0.83

Scan File: C:\Misc 08\08172.cpb
Global Chi Squared: 6.29

Table 2: Mineralogy of <2 micron fraction by oriented aggregate XRD

Sample Number	Kaolinite %	Illite %	Expandable Clay %	Nature of Expandable Clay
6306	42	0	58	Montmorillonite

Zhongsheng Li
BSc, MSc, PhD, MAIG

Colin R. War
BSc, PhD, FAusIMM(CP), FAIG

Oct 10, 2008

Appendix J

Douglas Partners Borehole Logs (412 to 414, 421 to 423)

BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 231.7 AHD*
EASTING: 376674
NORTHING: 6425591
DIP/AZIMUTH: 90°/--

BORE No: 412
PROJECT No: 39721.01
DATE: 4-5 Mar 08
SHEET 1 OF 6

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
231	0	SILTY CLAY - stiff, dark brown silty clay, M>Wp										
		from 0.5m, grading to weathered rock										
	0.7	SANDSTONE - extremely low strength, extremely weathered brown and grey sandstone										
	1											
230	1.8	TUFFACEOUS SANDSTONE- high to very high strength, slightly weathered, slightly fractured, grey tuffaceous sandstone						1.8m: Unless otherwise stated defects are joints, 5° to 40°, ro, un, fe 1.95m: J, 85°, ro, un, extending to 2.3m				
	2							2.4m: DB	UCS			80.6 MPa
229								2.67m: DB				
								2.8m: DB	C	100	100	PL(D) = 5.52MPa
								2.9m: DB				
	3							3.2m: DB				
								3.35m: J, 85°, healed, un 3.42m: P, 5°, pl, ro 3.45m: J, 50°, pl, healed				
228	3.8	PEBBLY SANDSTONE - low to medium strength, highly weathered to moderately weathered brown pebbly sandstone						3.82m: P, clay infill 5mm thick 3.9m: J, 20°, ro, un, cy 3.94m: J,40°,un,ro,cy				
	4	from 4.1m, medium to high strength						4.1m: J, 50°, ro, un, cy	C	100	100	PL(D) = 0.95MPa
								4.25m: J, 85°, ro, un extending to 4.65m				
227								4.55m: P, un, ro				
								4.76m: J, 50°, ro, un, fe	C	100	100	

RIG: Scout 103 **DRILLER:** Chittleburgh (Total) **LOGGED:** Niland/Bear **CASING:** HQ to 1.8m

TYPE OF BORING: SFA to 1.8m then NMLC coring to 25m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Preferred route, approximately Ch 3515 offset 25m left.
* Surface levels interpolated by client from surface terrain model and are approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	

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BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 231.7 AHD*
EASTING: 376674
NORTHING: 6425591
DIP/AZIMUTH: 90°/--

BORE No: 412
PROJECT No: 39721.01
DATE: 4-5 Mar 08
SHEET 2 OF 6

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	5.0	PEBBLY SANDSTONE (Continued)						4.95m: J, 40°,pl, ro				
	5.15	TUFFACEOUS SANDSTONE - high to very high strength, moderately weathered, slightly fractured grey and brown tuffaceous sandstone with some siltstone bands 10mm to 50mm thick and sporadic fine to coarse pebbly bands						5.15m: J, 20°, un, ro, cy 5.26m: J, 25°, un, ro, fe	C	100	100	
226								5.5m: J, 85°, ro, un extending to 5.85m				
	6	at 6.1m, calcite vein approx 70°						5.98m: J, 45°, un, ro, di 6.01m: J, 45°, un, ro, he, di 6.25m: J, 75°, ro, un 6.3m: J, 75°, ro, fe, un 6.35m: J, 85°, ro, un, extending to 6.7m	C	100	100	
225												PL(A) = 1.74MPa PL(D) = 1.28MPa
	7	at 7.0m, DB shows fe, calcite and chlorite precipitate from 7.25m to 7.6m, subhorizontal to 20° siltstone bands						6.91m: J, 25°, un, ro 6.94m: J, 25°, he 7.35m: J, 35°, un, ro, fe 7.4m: J, 50°, un, ro, fe 7.45m: J, 45°, healed, un 7.6m: J, 30°, pl, sm, fe 7.62m: J, 15°, un, sm, fe From 7.70m to 7.92m, discontinuous fractures, sh to sv, healed	C	100	88	
224												
	8	from 8.3m, slightly weathered to fresh						8m: P, sh, ro, un 8.06m: J, 15°, un, ro, di				
223		from 8.7m, very high strength						8.66m: P, 5°, un, ro 8.69m: P, 5°, un, ro	C	100	98	PL(D) = 8.21MPa
	9											
222		from 9.75m to 10.7m, moderately weathered						9.78m: P, sh, un, ro, fe 9.86m: J, 30°, un, ro, fe	C	100	67	

RIG: Scout 103 **DRILLER:** Chittleburgh (Total) **LOGGED:** Niland/Bear **CASING:** HQ to 1.8m

TYPE OF BORING: SFA to 1.8m then NMLC coring to 25m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Preferred route, approximately Ch 3515 offset 25m left.
* Surface levels interpolated by client from surface terrain model and are approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	

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BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 231.7 AHD*
EASTING: 376674
NORTHING: 6425591
DIP/AZIMUTH: 90°/--

BORE No: 412
PROJECT No: 39721.01
DATE: 4-5 Mar 08
SHEET 3 OF 6

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	10.0	TUFFACEOUS SANDSTONE (Continued)										
		from 10.05m to 10.55m, with coarser grained lithic clasts						10.05m: J, 40°, un, ro 10.25m: J, 35°, un, ro 10.35m: J, 25°, un, ro	C	100	67	
221		from 10.7m to 12.1m, fresh						10.55m: J, 30°, un, ro 10.6m: J, sv, un, ro, fe 10.7m: J, 10°, un, ro				
	11	from 11.0m to 11.3m, with coarser grained lithic clasts										
220								11.45m: J, 50°, un, ro, fe 11.5m: J, sv, un, ro, fe, extending to 11.6m 11.6m: J, 85°, ro, un, fe extending to 11.8m 11.85m: DB				
	12							11.95m: J, 30°, un, ro	C	100	94	
		from 12.1m to 13.3m, moderately weathered to highly weathered, very low to medium strength						12.05m: J, sv, un, ro, clay veneer 12.08m: J, 30°, un, ro, clay veneer From 12.14m to 12.4m, highly weathered, clay filled and fg along joints 12.16m: J, 85°, pl, ro, cy 12.25m: J, 50°, pl, ro, cy filled				
		from 12.5m to 12.65m, with coarser grained lithic clasts										
219		from 12.65m to 15.12m, altered zone (chloritic alteration?), (mottled grey-green and orange-brown)						12.5m: J, 45°, curved, ro, fe				PL(A) = 0.86MPa
	13							13.06m: P, 5°, pl, sm, fe 13.12m: P, 5°, pl, sm, cy filled (5mm)				
		from 13.3m to 15.12m, moderately weathered, high to very high strength						13.23m: P, 5°,un, ro, fe 13.27m: J, sv, un, ro, fe				
218								13.64m: P, 5°, un, ro, fe				
	14											
								14.11m: J, 15°, pl, ro, fe	C	100	80	
		from 14.43m to 14.62m, slighly weathered to fresh, very high strength, (intrusion?)						14.43m: J, 50°, un, ro				PL(D) = 3.31MPa
217								14.62m: J, 15°, un, ro, fe 14.8m: P 14.84m: J, 10°, un, ro, fe				

RIG: Scout 103 **DRILLER:** Chittleburgh (Total) **LOGGED:** Niland/Bear **CASING:** HQ to 1.8m

TYPE OF BORING: SFA to 1.8m then NMLC coring to 25m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Preferred route, approximately Ch 3515 offset 25m left.
* Surface levels interpolated by client from surface terrain model and are approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	

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BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 231.7 AHD*
EASTING: 376674
NORTHING: 6425591
DIP/AZIMUTH: 90°/--

BORE No: 412
PROJECT No: 39721.01
DATE: 4-5 Mar 08
SHEET 4 OF 6

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	15.0	TUFFACEOUS SANDSTONE (Continued) at 15.2m to 15.5m, extremely low to very low strength, extremely weathered to highly weathered, orange-brown						14.92m: J, 15°, pl, ro, fe 15.1m to 15.5m - P at 10-50mm spacings	C	100	80	
216	16							15.5m to 17.8m - P at 50-200mm spacings 15.65m: J, 80° sv, ro, un, fe, ca, chlorite 300mm long 15.68m: J, 65°, pl, sm, fe 15.8m: J, 20°, pl, ro, fe (2nd J 5mm) 15.96m: J, 80°, pl, ro, fe, ca, chlorite 16.2m: J, sv, ro, un, fe 250mm long				
	16.0	TUFFACEOUS SANDSTONE - high to very high strength, moderately weathered, fractured grey and brown tuffaceous sandstone						16.55m: J, sv, ro, un, fe 250mm long 16.65m: J, su, ro, un, fe, 100mm long	C	100	82	
215	16.8	CONGLOMERATE - very high strength, moderately weathered grey conglomerate						16.9m: J, 80°, un, ro, fe, 300mm long				
	17							17.25m: J, 10°, ro, un, fe				
	17.5	TUFFACEOUS SANDSTONE - very high strength, moderately weathered to slightly weathered, blue grey tuffaceous sandstone						17.55m: J, 85°, healed, pl, ro, fe, extending to 18.2m				
214	18							18.25m: J, 45°, pl, ro, fe 18.28m: J, 70°, pl, ro, fe				
		from 18.2m to 18.35m, intersecting joints at 45° and 70°						18.65m: J, 15°, un, sm, fe	UCS			80.2 MPa
213								18.8m: J, 15°, un, sm, fe	C	100	73	PL(D) = 3.64MPa
	19							19m: J, 40°, pl, sm, fe 19.2m: J, 30°, sm, un, fe 19.28m: P, healed, pl, ro, fe, chlorite 19.35m to 19.60m - P at 20-70mm spacings with some clay veneers 19.65m: J, 40°, un, ro, fe				
	19.6	AGGLOMERATE - very high strength, moderately weathered, grey agglomerate							C	100	80	
212												

RIG: Scout 103 **DRILLER:** Chittleburgh (Total) **LOGGED:** Niland/Bear **CASING:** HQ to 1.8m

TYPE OF BORING: SFA to 1.8m then NMLC coring to 25m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Preferred route, approximately Ch 3515 offset 25m left.
* Surface levels interpolated by client from surface terrain model and are approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	

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BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 231.7 AHD*
EASTING: 376674
NORTHING: 6425591
DIP/AZIMUTH: 90°/--

BORE No: 412
PROJECT No: 39721.01
DATE: 4-5 Mar 08
SHEET 5 OF 6

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	20.0	AGGLOMERATE (Continued)						20.12m to 20.36m - J, 80°, un, ro, fe 20.17m to 20.29m - F, 60°, pl, he 20.40m to 20.46m - J, 50°, un, ro, fe 20.63m to 20.68m - P, 45°, pl, ro, fe 20.89m: P, sh, un, ro, fe				
211	21								C	100	80	
	21.25	TUFFACEOUS SANDSTONE - very high strength, moderately weathered, blue-grey and brown tuffaceous sandstone (altered)						21.15m: DB 21.25m: DB 21.38m to 21.48m - J, 70°, pl, ro				
210	21.65	AGGLOMERATE - very high strength, moderately weathered, green-grey to blue-grey agglomerate						21.87m to 22.03m - J, sv, un, ro, fe 22.06m: DB				
	22											
209	23							22.82m: J, sh, un, ro 23.03m: J, 20°, un, ro 23.14m to 23.17m - J, 35°, curved, sm, fe	C	100	100	
208	24							23.64m to 23.75m - J, 70°, pl, ro, fe 23.91m: J, 25°, un, ro, fe, ca 24.13m: J, sh, un, sm, fe 24.22m to 24.28m - J, 60°, curved, sm, fe 24.43m to 24.49m - J, 40°, un, ro, fe, ca				
207								24.67m: P, 20°, un, sm, fe - DI? 24.71m to 24.76m - J, 55°, un, ro				

Bore discontinued at 25.0m, limit of investigation

RIG: Scout 105 **DRILLER:** Chittleburgh (Total) **LOGGED:** Niland/Bear **CASING:** HQ to 1.8m

TYPE OF BORING: SFA to 1.8m then NMLC coring to 25m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Preferred route, approximately Ch 3515 offset 25m left.
* Surface levels interpolated by client from surface terrain model and are approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	

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BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 231.7 AHD*
EASTING: 376674
NORTHING: 6425591
DIP/AZIMUTH: 90°/--

BORE No: 412
PROJECT No: 39721.01
DATE: 4-5 Mar 08
SHEET 6 OF 6

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	25.0											
206												
	26											
205												
	27											
204												
	28											
203												
	29											
202												

RIG: Scout 103 **DRILLER:** Chittleburgh (Total) **LOGGED:** Niland/Bear **CASING:** HQ to 1.8m

TYPE OF BORING: SFA to 1.8m then NMLC coring to 25m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Preferred route, approximately Ch 3515 offset 25m left.
* Surface levels interpolated by client from surface terrain model and are approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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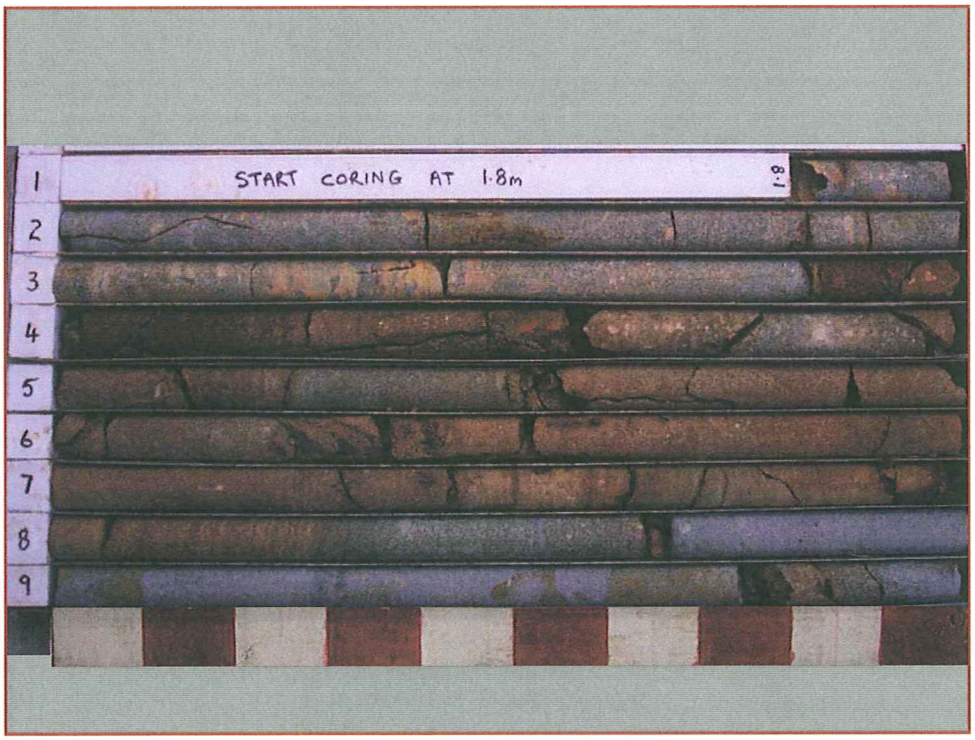
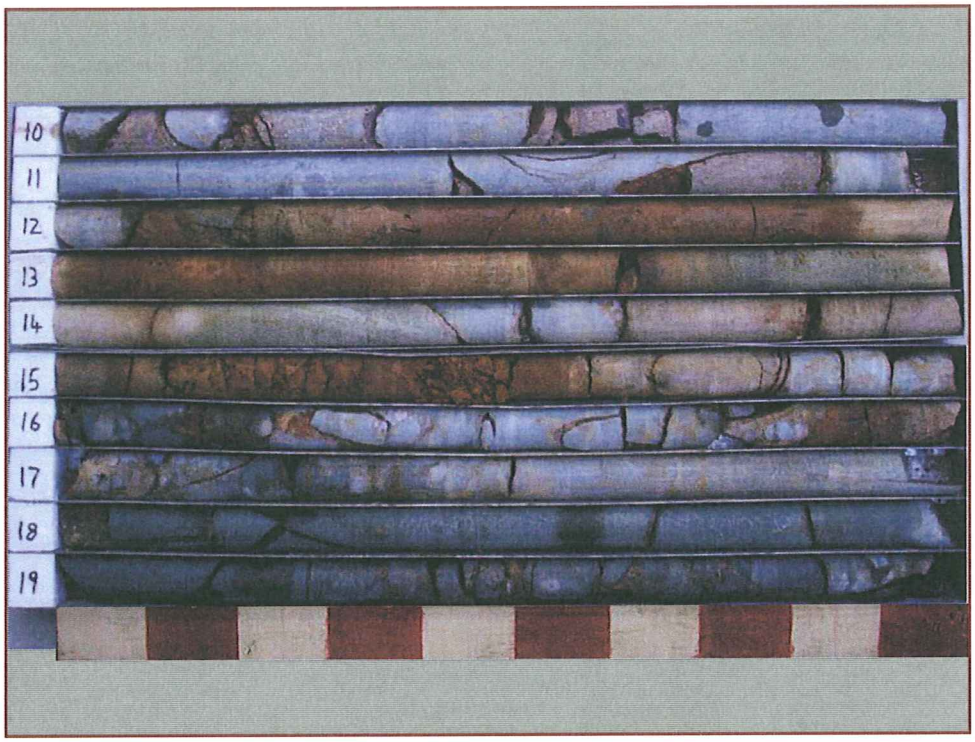
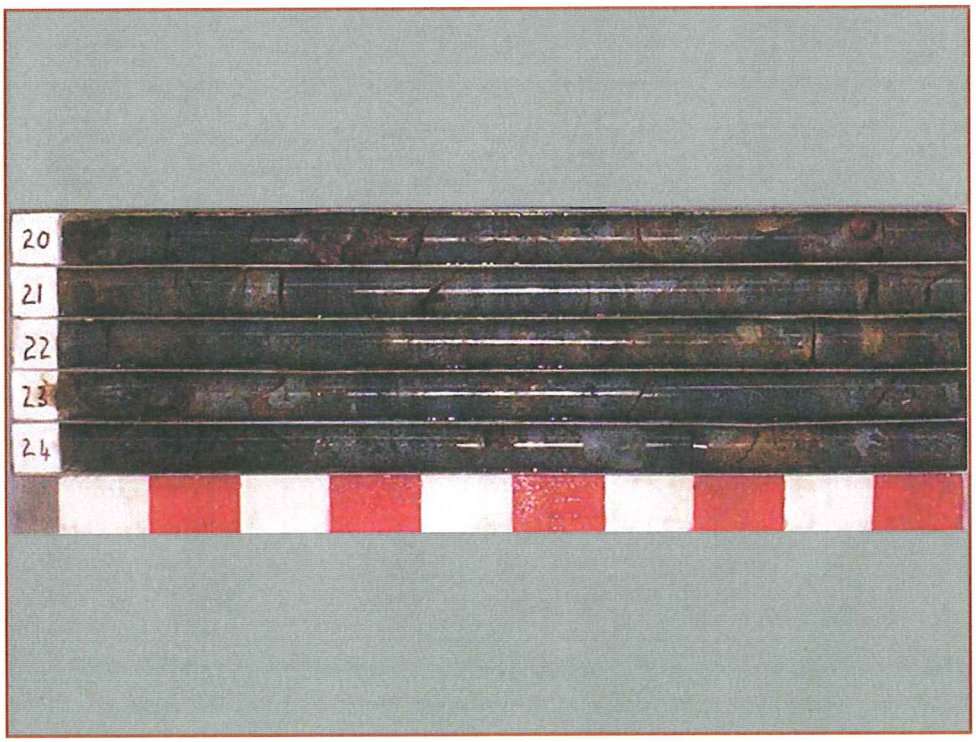
Bore 411 – 2.60 m to 14.20 m



Bore 412 – 1.80 m to 10.00 m



Bore 412 – 10.00 m to 20.00 m



Bore 412 – 20.00 m to 25.00 m

BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 244.0 AHD*
EASTING: 376219
NORTHING: 6427216
DIP/AZIMUTH: 90°/--

BORE No: 413
PROJECT No: 39721.01
DATE: 05 Mar 08
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
244	0.15	TOPSOIL - dark brown clayey silt, some rootlets										
		GRAVELLY SANDY CLAY - stiff to very stiff brown gravelly sandy clay, gravel and sand fine to coarse grained fines content decreasing with depth. Grading to extra weathered sandstone										
243	1											
	1.1	TUFFACEOUS SANDSTONE - high strength, moderately weathered, yellow brown tuffaceous sandstone						1.1m to 1.21m - Fg 1.2m: J, 40°, pl, sm 1.33m to 1.43m - J, sv, (78°-88°) un, ro 1.43m to 1.56m - Fg 1.56m to 1.70m - J, 85°, pl, sm, fe	C	100	56	PL(A) = 1.69MPa PL(D) = 2.25MPa
	1.55	LITHIC SANDSTONE - very high strength, slightly weathered brown and grey lithic sandstone with some pebbly sandstone bands										
242	2							2.01m to 2.16m - J, 75°, pl, sm, ca				PL(A) = 3.42MPa
								2.84m to 2.89m - J, 45°, un, ro 2.90m to 3.3m - J, sv, un, ro, fe (partially he)	C	100	94	
241	3							3.5m: DB 3.58m: P, sh, un, ro, fe 3.69m: P, sh, un, ro, fe 3.88m: DB				PL(D) = 4.98MPa PL(A) = 2.56MPa PL(A) = 3.66MPa
240	4	from 4.0m to 4.4m, subvertical cacite veins (healed joints?)						4.17m: DB 4.40m to 4.48m - J, 60°,irr/ un, ro, trace clay 4.48m: P, sh, pl, sm, fe 4.59m: P, 30°, pl, sm, fe	C	100	77	PL(A) = 3.55MPa PL(D) = 3.26MPa
		from 4.77m to 4.95m, subvertical calcite veins, partially open										

RIG: Scout 103 **DRILLER:** Chittleburgh (Total) **LOGGED:** Niland/ Rogers **CASING:** HQ to 1.1m

TYPE OF BORING: SFA to 1.1m then NMLC to 10m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Preferred route, approx Ch 5250 offset 20m right.
* Surface levels interpolated by client from surface terrain model and are approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	

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BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 244.0 AHD*
EASTING: 376219
NORTHING: 6427216
DIP/AZIMUTH: 90°/--

BORE No: 413
PROJECT No: 39721.01
DATE: 05 Mar 08
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Graphic Log	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
239	5.0	LITHIC SANDSTONE (Continued)		5.07m: DB				
		from 5.25m to 5.9m, some large subrounded pebble inclusions in sandstone		5.28m: P, sh, un, ro, fe				
				5.79m: P, sh, un, ro, fe				PL(A) = 2.6MPa
				5.85m: P, sh, un, ro, fe				
238	6			6.04m: P, sh, un, ro, fe	C	100	83	PL(D) = 6.9MPa
					UCS			79.6 MPa
				6.32m: J, 20°, irr, ro, fe				
				6.51m to 6.57m - J, 50°, pl, sm, fe, some fg				
				6.71m to 6.92m - J, 80°, pl, ro, fe				
	6.92	TUFFACEOUS SANDSTONE -high to very high strength, moderately weathered, grey tuffaceous sandstone with some siltstone bands 10mm to 50mm thick		6.92m: P, sh, un, ro, fe				
237	7			6.92m to 6.98m - Fg				
				7.12m: P, sh, pl, sm, fe				PL(A) = 1.94MPa
				7.22m: P, sh, un, ro, fe				PL(D) = 1.34MPa
				7.25m to 7.27m - Fg				
		from 7.39m to 7.6m, altered zone green, orange and brown (chloritic?)		7.3m: P, sh, un, ro				
				7.55m: J, un/st,40°, ro, fe and calcite				PL(A) = 2.99MPa
		from 7.84m to 7.9m, siltstone inclusions						PL(D) = 4.76MPa
				7.91m: J, 24°, irr/un, ro				
236	8			7.95m: DB				
				8.13m: DB				
					C	100	96	
				8.72m: DB				PL(A) = 3.47MPa
								PL(D) = 4.34MPa
235	9			9.30m to 9.33m - J, 30°, pl, ro, fe				
		from 9.45m to 9.55m, siltstone inclusions		9.30m to 9.42m - J, 70°, pl, sm, fe				
				9.42m: P, sh, un, ro, fe				
				9.58m: P, sh, irr/un, ro, fe				
				9.81m: P, sh, un, ro, fe				PL(D) = 5.59MPa
								PL(A) = 2.2MPa

Bore discontinued at 10.0m, limit of investigation

RIG: Scout 105 **DRILLER:** Chittleburgh (Total) **LOGGED:** Niland/ Rogers **CASING:** HQ to 1.1m

TYPE OF BORING: SFA to 1.1m then NMLC to 10m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Preferred route, approx Ch 5250 offset 20m right.
* Surface levels interpolated by client from surface terrain model and are approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 244.0 AHD*
EASTING: 376219
NORTHING: 6427216
DIP/AZIMUTH: 90°/--

BORE No: 413
PROJECT No: 39721.01
DATE: 05 Mar 08
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW, HW, MW, SW, FS, FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
244	10.0											
233	11											
232	12											
231	13											
230	14											

RIG: Scout 103 **DRILLER:** Chittleburgh (Total) **LOGGED:** Niland/ Rogers **CASING:** HQ to 1.1m

TYPE OF BORING: SFA to 1.1m then NMLC to 10m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Preferred route, approx Ch 5250 offset 20m right.
* Surface levels interpolated by client from surface terrain model and are approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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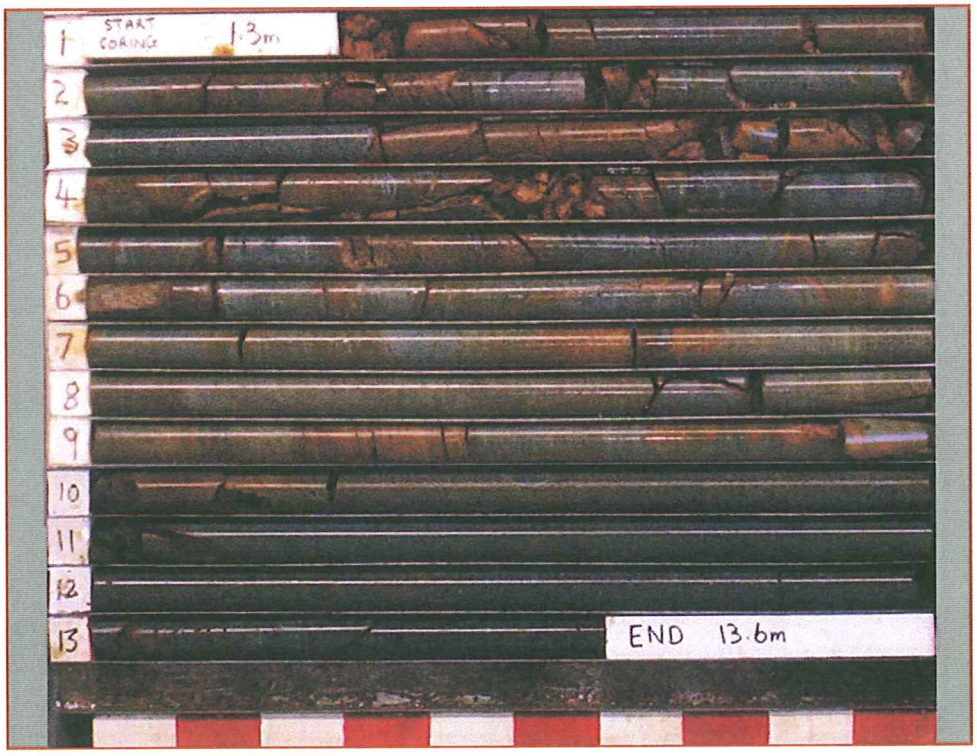
Bore 413 –1.10 m to 10.00 m



Bore 414 –1.30 m to 13.60 m

BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 247.2 AHD*
EASTING: 376615
NORTHING: 6425914
DIP/AZIMUTH: 90°/--

BORE No: 414
PROJECT No: 39721.01
DATE: 06 Mar 08
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
247	0.1	TOPSOIL - dark brown clayey silt, some rootlets										
		CLAY - firm grey clay damp to moist										
		becoming more sandy with depth. Grading to extremely weathered sandstone/rhyodacite										
246	1											
	1.3	SANDSTONE - high to very high strength, moderately to slightly weathered, banded brown and grey-green sandstone with fine cross-bedded lenses of mudstone						1.3m to 1.38m - Fg 1.45m to 1.50m - J, 55°, un, clay filled 1.55m: P, sh, un, ro, fe	C	100	76	PL(A) = 1.51MPa
		from 1.6m, high strength, slightly weathered, blue grey sandstone										
		from 1.82m to 2.67m, moderately weathered						1.86m: P, sh, Fg/clay filled 1.99m to 2.05m, J, 55°, un, ro 2.15m: DB				PL(D) = 2.86MPa
245	2							2.28m to 2.31m - Fg/clay filled 2.35m: P, Fg 2.43m to 2.48m - J, 60°, un, ro, clay filled 2.59m to 2.66m - Fg 2.76m to 2.82m - J, 50°, pl, ro 2.96m to 3.0m - J, 30°, pl, clay filled				
	3											
244		from 3.33m to 4.70m, moderately weathered to highly weathered						3.34m to 3.35m - J, 30°, pl, clay filled (4mm thick) 3.35m: P, sh, un, ro 3.35m to 3.57m - J, sv, un, ro, fe/clay filled 3.68m to 4.0m - Fg	C	100	35	
	4							4.0m to 4.06m - J, 60°, un, ro 4.13m to 4.48m - J, sv, un, ro, clay filled				PL(D) = 8.58MPa
243								4.48m to 4.60m - Fg 4.67m: P, 10°, pl, sm, fe 4.81m to 4.89m - J, 60°, un, ro, fe				PL(D) = 1.69MPa

RIG: Scout 103 **DRILLER:** Chittleburgh (Total) **LOGGED:** Niland/ Rogers **CASING:** HQ to 1.3m

TYPE OF BORING: SFA to 1.3m then NMLC coring to 13.6m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Preferred route, approx Ch 3860 offset 20m left.
* Surface levels interpolated by client from surface terrain model and are approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	

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BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 247.2 AHD*
EASTING: 376615
NORTHING: 6425914
DIP/AZIMUTH: 90°/--

BORE No: 414
PROJECT No: 39721.01
DATE: 06 Mar 08
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
242	5.0	SANDSTONE (Continued)						4.92m to 5.05m - J, 60°, un, ro, fe 5.13m: J, 30°, un, clay filled 5.17m: P, sh, pl, clay filled 5.31m to 5.35m - J, 45°, pl, ro 5.50m to 5.55m - J, 45°, pl, ro 5.68m: DB				PL(A) = 4.65MPa PL(D) = 4.65MPa
	5.31	CONGLOMERATE/AGGLOMERATE - high strength, moderately to slightly weathered, brown-grey conglomerate/agglomerate							C	100	93	
	5.69	SANDSTONE - high to very high strength, slightly weathered, blue-grey to grey-green and brown sandstone						5.87m: P, sh, pl, ro, fe 5.95m to 6.11m - J, 70°, un, ro				
241	6							6.16m: P, sh, un, clay filled 6.29m: DB 6.4m: P, 10°, pl, clay filled 6.46m to 6.84m - J, sv, he				PL(A) = 3.52MPa PL(D) = 2.46MPa
240	7							7.28m: P, sh, pl, sm, fe	UCS			PL(A) = 4.77MPa 56.5 MPa
		from 7.51m to 7.75m, high strength, moderately weathered						7.65m: DB	C	100	67	
239	8 8.0	SANDSTONE - very high strength, slightly weathered grey-green sandstone						8.67m to 8.8m - J, sv, un, ro, fe 8.8m: Fg 8.82m to 9.10m - J, sv, pl, sm, fe				PL(A) = 4.12MPa
238	9											PL(A) = 0.72MPa
		from 9.27m to 9.46m, medium strength, moderately weathered, orange-brown						9.32m: DB 9.34m: P, sh, pl, clay filled 9.42m: P, sh, pl, clay filled 9.45m: P, sh, pl, clay filled 9.85m to 10.12m, J, 80°, pl, ro, fe	C	100	70	

RIG: Scout 103 **DRILLER:** Chittleburgh (Total) **LOGGED:** Niland/ Rogers **CASING:** HQ to 1.3m

TYPE OF BORING: SFA to 1.3m then NMLC coring to 13.6m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Preferred route, approx Ch 3860 offset 20m left.
* Surface levels interpolated by client from surface terrain model and are approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 247.2 AHD*
EASTING: 376615
NORTHING: 6425914
DIP/AZIMUTH: 90°/--

BORE No: 414
PROJECT No: 39721.01
DATE: 06 Mar 08
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	10.0	from 10m to 10.2m, moderately to highly weathered, orange-brown SANDSTONE (Continued)						10.12m to 10.15m - J, 45°, pl, ro 10.28m: DB				PL(A) = 8.28MPa
237									C	100	70	
	11	from 11.15m, very high to extremely high strength, slightly weathered						10.91m to 11.16m - J, 85°, pl, sm				
236												
								11.82m: DB				PL(A) = 8.5MPa PL(D) = 8.92MPa
	12											
235									C	100	92	
												PL(A) = 7.84MPa PL(D) = 10.36MPa
	13							13.05m: J, clay filled				
234								13.30m to 13.34m - J, 50°, un, ro				
												PL(A) = 9.07MPa PL(D) = 8.17MPa
	13.6	Bore discontinued at 13.6m, limit of investigation										
	14											
233												

RIG: Scout 103 **DRILLER:** Chittleburgh (Total) **LOGGED:** Niland/ Rogers **CASING:** HQ to 1.3m

TYPE OF BORING: SFA to 1.3m then NMLC coring to 13.6m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Preferred route, approx Ch 3860 offset 20m left.
* Surface levels interpolated by client from surface terrain model and are approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 153.2 AHD*
EASTING: 377035
NORTHING: 6424898
DIP/AZIMUTH: 90°/--

BORE No: 421
PROJECT No: 39721.01
DATE: 17-18 Mar 08
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.05	FILL - gravelly silty clay, grey, dry										
153		SILTSTONE - extremely low strength, extremenly weathered grey siltstone										
	1											
152												
	2											
151												
	2.55	META SILTSTONE -medium to high strength, moderately weathered, fractured, grey brown meta siltstone						2.75m to 4.2m, unless otherwise stated, partings at 5° to 25°, ro, un, fe, typically 30-100mm spacings, fragmented in parts (shearzone)				PL(D) = 0.98MPa
	3	calcite veins and infilled joints between 3.10m and 3.38m, microfaulting evident along joints at 81° to 83° (2mm to 5mm displacement), (shear zone)						2.55m to 2.75m, fg zone 2.75m to 3.12m, J, 65°, irr, ro, ca filled, he 3.08m to 3.70m, multiple parallel and cross-cutting joint sets at 65° to 85°, 10mm to 30mm horizontal spacing, fe and ca, pl, sm, some fg, (shearzone)	C	100	35	PL(D) =0.65MPa
150								3.7m to 4.2m, multiple joints at 50-54°, pl to irr, sm to ro, some fe and calcite infill, 50-80mm spacing				
	4											
149		from 4.15m to 4.21m, extremely weathered to highly weathered, very low strength yellow brown sandstone band						4.15m to 4.2m, clay seam, ew zone 4.2m: Unless otherwise stated, joints 60° to 85°, ro, un, fe, extending 300mm at approximately 400mm spacings	C	82	0	
	4.6	CORE LOSS - from 4.6m to 4.8m						4.2m to 4.4m, multiple parallel J sets at 60° to 80°, curved, partially healed, calcite infill 3mm thick (15-20mm				
	4.8	META SILTSTONE - (See below)							C	100	0	

RIG: Scout 103 **DRILLER:** Chittleburgh (Total) **LOGGED:** Niland/ Rogers **CASING:** HW to 2.55m

TYPE OF BORING: SFA to 2.55m, then NLMC coring to 7.9m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Prefered route, approx Ch 2695 offset 20m right; Bore drilled on benched pad.
* Surface levels interpolated by client from surface terrain model and are approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

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Initials:
Date:

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BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 153.2 AHD*
EASTING: 377035
NORTHING: 6424898
DIP/AZIMUTH: 90°/--

BORE No: 421
PROJECT No: 39721.01
DATE: 17-18 Mar 08
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
148	5.0	from 5.0m to 5.15m, meta sandstone, fine grained, orange brown, iron stained META SILTSTONE - medium to high strength, moderately weathered, fractured to highly fractured, grey brown meta siltstone with some very low and low to medium strength bands in parts						horizontal spacing) 4.4m to 4.6m, highly fractured (shearzone), multiple sv joints 4.6m: CORE LOSS: 200mm 4.8m to 5.0m, parallel Jx2, 83°, irr, calcite infill, 1mm, partially open (drilling induced) with cross cutting J's at 82° and 84°, pl, sm, fe	C	100	0	PL(A) =0.23MPa PL(D) =0.70MPa
147	6							5.13m to 5.15m, J, 36°, irr, ro, fe 5.67m to 6.05m, parallel sv joints (83°-90°), calcite infill, he, 10mm horizontal spacing 5.76m to 5.90m, parallel Jx3, 30°-40°, pl to st, sm, fe, 40-60mm spacing 5.98m to 6.05m, cross cutting joint sets x2 at 40°, pl, sm, fe 6.07m to 6.17m, fg zone 6.27m to 6.37m, ew zone, friable 6.44m to 6.49m, fg zone 6.49m: Jx2, 20°, healed	C	100	23	
146	7							6.65m to 6.85m, J, 75°, irr, sm to ro, fe and ca 6.82m: J, 18°, irr, ro, fe 6.85m to 7.0m, J, 27°, pl, sm, fe, multiple sv joints and calcite veins 7.0m to 7.2m, fg zone, (sv joint sets, calcite) 7.2m to 7.85m, numerous joints at 25°-30°, pl to un, sm to ro, some fe and calcite				PL(D) =0.97MPa
	7.9	Bore discontinued at 7.9m, limit of investigation						7.2m to 7.37m, multiple sv joints, irr, fe, some calcite infilling 7.37m: p 7.8m to 7.86m, sv joints, healed, some calcite, irr				
145	8											
144	9											

RIG: Scout 103 **DRILLER:** Chittleburgh (Total) **LOGGED:** Niland/ Rogers **CASING:** HW to 2.55m

TYPE OF BORING: SFA to 2.55m, then NLMC coring to 7.9m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Prefered route, approx Ch 2695 offset 20m right; Bore drilled on benched pad.
* Surface levels interpolated by client from surface terrain model and are approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

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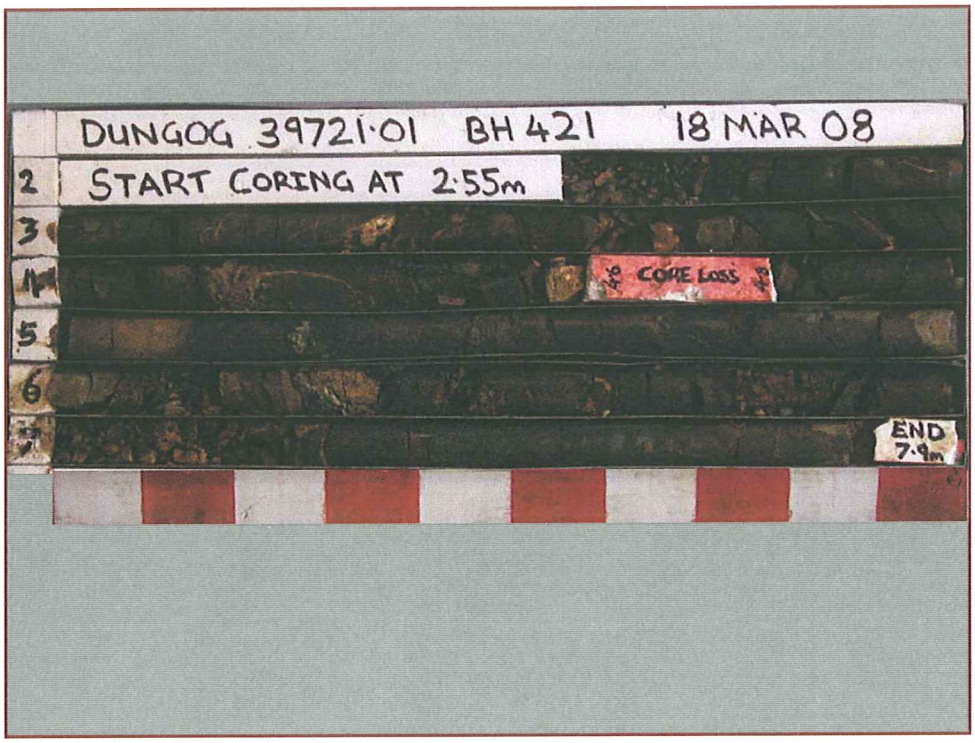

Bore 421 – 2.55 m to 7.90 m

DIVERSION OF SALISBURY ROAD TILLEGRA DAM PROJECT	PROJECT 39721.01	Douglas Partners Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 182.0 AHD*
EASTING: 376916
NORTHING: 6425026
DIP/AZIMUTH: 90°/--

BORE No: 422
PROJECT No: 39721.02
DATE: 26-28 May 08
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Type	Core Rec. %	RQD %	Test Results & Comments
182		CLAY AND GRAVEL - Hard brown clay and gravel and fine to medium sized subrounded gravel, M<Wp										
	0.7	AGGLOMERATE - Variable strength (very low to high), highly weathered, brown agglomerate						0.82m: P, sh, h 0.87m: J, 45°, h 0.94m: P, sh, un, ro From 1.0m to 1.05m Fg 1.09m: P, sh, clay infill 1.12m: J, 45°, h 1.18m: J, SV, h From 1.24m to 1.25m P, sh, clay lined 10mm thick 1.3m: P, sh, h 1.36m: J, 20°, h, clay lined 1.42m: P, sh, un, ro 1.5m: CORE LOSS: 150mm From 1.65m to 1.8m Fg From 1.8m to 2.0m Friable 2m: CORE LOSS: 50mm 2.06m: J, 20°, pl, sm, clay lined 1mm thick 2.36m: P, sh, un, sm 2.38m: P, sh, un, sm 2.42m: J, 45°, clay filled up to 5mm thick 2.53m: P, sh, Friable infill 5mm thick 2.6m: J, 70°, pl, sm, clay lined 1mm thick 2.75m: P, sh, un, ro 3.05m: P, sh, un, ro 3.1m: P, sh, un, ro 3.14m: P, sh, un, ro 3.2m: P, sh, un, ro 3.24m: P, sh, un, ro 3.28m: P, sh, un, ro 3.36m: J, 20°, un, ro 3.4m: J, 45°, h 3.44m: P, sh, un, ro 3.53m: P, sh, un, ro 3.55m: P, sh, un, ro, clay lined 2mm thick 3.7m: Fr, SV, h From 3.83m to 3.86m Fg 4m: Fr, SV, h 4.07m: P, sh, un, ro 4.24m: P, sh, h 4.34m: P, sh, un, ro-sm, clay lined 1mm thick From 4.44m to 4.7m Fg 4.75m: Fr, SV, pl, sm 4.9m: CORE LOSS:				
181	1								C	100	0	
	1.5	CORE LOSS - 0.15m							C	100	20	PL(D) = 0.02MPa
	1.65	AGGLOMERATE - Extremely low strength, extremely weathered brown agglomerate							C	70	20	
180	2								C	0	0	
	2.0	CORE LOSS - 0.05m							C	100	57	
	2.05	LITHIC SANDSTONE - Very high strength, fine grained, grey-blue lithic sandstone							C	100	33	
179	3								C	100	50	PL(A) = 3.5MPa
178	4								C	80	0	
	4.9	CORE LOSS - 0.1m										

RIG: Edson 3000 Truck **DRILLER:** J Simon (APS) **LOGGED:** Harris **CASING:** NW to 8m

TYPE OF BORING: Solid flight auger to 0.7m (TC bit refusal) then NMLC coring to 14m

WATER OBSERVATIONS: Free groundwater observed due to drilling fluids

REMARKS: Preferred route (E2), approx Ch 2870 on centreline
* Surface levels interpolated by client from surface terrain model and are approximate only.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 182.0 AHD*
EASTING: 376916
NORTHING: 6425026
DIP/AZIMUTH: 90°/--

BORE No: 422
PROJECT No: 39721.02
DATE: 26-28 May 08
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Type	Core Rec. %	RQD %	Test Results & Comments
177	5.0	AGGLOMERATE - Extremely low to medium strength, extremely weathered to highly weathered, brown agglomerate						100mm From 5.0m to 5.3m Fg	C	100	0	
	5.3	CORE LOSS - 0.1m						5.3m: CORE LOSS: 100mm	C	60	0	
	5.4	AGGLOMERATE - High to very high strength, highly weathered to moderately weathered brown agglomerate						5.43m: P, sh, un, ro 5.47m: J, 65°, un, ro 5.55m: J, 25°, un, ro 5.67m: J, 55°, un, ro 5.7m: J, 70°, un, ro 5.8m: J, 45°, un, ro 5.86m: J, 45°, un, ro	C	100	24	
176	6							5.95m: P, sh, un, ro From 6m to 6.15m Fg 6.15m: J, 45°, pl, ro-sm 6.2m: J, 45°, pl, ro-sm	C	100	0	
								6.25m: J, 45°, pl, ro-sm 6.3m: J, 45°, pl, ro-sm 6.42m: J, 45°, st, pl, sm 6.46m: J, 40°, pl, ro-sm 6.5m: J, 40°, pl, ro-sm 6.51m: P, sh, h 6.56m: P, sh, clay filled 3mm thick 6.6m: P, sh, clay filled 3mm thick	C	100	0	
175	7							6.67m: J, 75°, h 6.7m: J, 30°, pl, ro 6.86m: P, sh, un, ro 6.9m: P, sh, un, ro From 6.9m to 7.12m Fg 7.25m: J, 45°, un, ro 7.34m: J, 65°, un, ro 7.4m: J, 65°, un, ro 7.54m: P, sh, un, ro From 7.6m to 7.76m J/Fr, SV, un, ro 7.8m: J, 50°, pl, st, ro	C	100	38	
174	8							From 7.9m to 8m Fg 8.12m: P, sh, un, ro 8.24m: J, 45°, un, ro-sm, clay lined 1mm thick 8.32m: J, 20°, pl, ro-sm 8.35m: J, 20°, pl, ro-sm 8.4m: J, 20°, pl, ro-sm 8.64m: P, sh, un, ro 8.7m: J, 70° to 80°, pl	C	100	22	
	8.8	CORE LOSS - 0.2m						From 8.75m to 8.8m Fg 8.8m: CORE LOSS: 200mm	C	0	0	
173	9 9.0	AGGLOMERATE - Medium strength, moderately weathered, brown agglomerate (Matrix washed out during drilling)						From 9m to 9.25m Fg	C	100	0	
	9.25	CORE LOSS - 0.1m						9.25m: CORE LOSS: 100mm From 9.35m to 9.55m Fg	C	71	0	
	9.35	AGGLOMERATE - As above, 9.0m to 9.25m										
	9.55	CORE LOSS - 0.05m						9.55m: CORE LOSS: 50mm	C	50	0	
	9.6	AGGLOMERATE - High strength, slightly weathered, brown-grey agglomerate						9.7m: P, sh, st, sm 9.72m: J, 70°, h 9.79m: P, sh, un, ro 9.86m: P, sh, un, ro	C	94	25	PL(D) = 0.13MPa

RIG: Edson 3000 Truck **DRILLER:** J Simon (APS) **LOGGED:** Harris **CASING:** NW to 8m

TYPE OF BORING: Solid flight auger to 0.7m (TC bit refusal) then NMLC coring to 14m

WATER OBSERVATIONS: Free groundwater observed due to drilling fluids

REMARKS: Preferred route (E2), approx Ch 2870 on centreline
* Surface levels interpolated by client from surface terrain model and are approximate only.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 182.0 AHD*
EASTING: 376916
NORTHING: 6425026
DIP/AZIMUTH: 90°/--

BORE No: 422
PROJECT No: 39721.02
DATE: 26-28 May 08
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
172		AGGLOMERATE - High strength, slightly weathered, brown-grey agglomerate *(continued)*						From 10m to 10.12m Fg 10.2m: J, 70°, un, ir, ro 10.33m: J, 20°, pl, sm 10.35m: J, SV, ir, partially h From 10.4m to 10.75m Fg	C	94	25	
	10.75	CORE LOSS - 0.1m						10.75m: CORE LOSS: 100mm	C	100	0	
	10.85	AGGLOMERATE - High to very high strength, slightly weathered, grey-blue agglomerate						10.9m: P, sh, un, ro From 11.1m to 11.5m J/Fr, SV to 70°, un, ro, partially h	C	50	0	
171	11							11.53m: P, sh, un, ro 11.6m: J/Fr, SV, un, ro 11.76m: P, sh, un, ro 11.84m: J, 45°, h 11.89m: P, sh, un, ro	C	100	58	PL(D) = 1.9MPa
170	12							12.22m: J, 70°, un, ro 12.42m: P, sh, h 12.49m: J, 45°, un, ro-sm 12.65m: J, 45°, un, ro-sm 12.68m: J, 45°, un, ro 12.72m: J, 45°, un, ro 12.83m: P, sh, pl, ro 12.95m: P, sh, pl, ro	C	100	64	PL(D) = 1.8MPa
169	13	Rockmass fresh with staining below 13m						13.1m: P, sh, un, ro 13.2m: P, sh, un, ro 13.39m: P, sh, un, ro 13.49m: P, sh, h 13.52m: P, sh, h, calcite 13.57m: P, sh, h, calcite 13.63m: J, 45°, h 13.67m: J, 45°, h 13.69m: J, 30°, h, calcite vein 13.71m: J, 45°, un, ro 13.75m: J, 45°, pl, ro From 13.8m to 14m Fg	C	100	0	
168	14 14.0	Bore discontinued at 14.0m, limit of investigation										

RIG: Edson 3000 Truck **DRILLER:** J Simon (APS) **LOGGED:** Harris **CASING:** NW to 8m

TYPE OF BORING: Solid flight auger to 0.7m (TC bit refusal) then NMLC coring to 14m

WATER OBSERVATIONS: Free groundwater observed due to drilling fluids

REMARKS: Preferred route (E2), approx Ch 2870 on centreline
* Surface levels interpolated by client from surface terrain model and are approximate only.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

Douglas Partners
Geotechnics · Environment · Groundwater

BORE 422: 0.70 m to 10.00 m

BORE 422: 10.00 m to 14.00 m

DIVERSION OF SALISBURY ROAD **TILLEGRA DAM PROJECT**	**PROJECT** **39721.02**	**Douglas Partners** *Geotechnics • Environment • Groundwater*

BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 202.0 AHD*
EASTING: 376866
NORTHING: 6425265
DIP/AZIMUTH: 90°/--

BORE No: 423
PROJECT No: 39721.02
DATE: 14-26 May 08
SHEET 1 OF 4

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
202		SILTY CLAY AND GRAVEL - Hard, brown silty clay and gravel										
	0.7	GRAVEL AND CLAY - Extremely weathered brown gravel and clay (with soil like properties), with general composition of clay with embedded fine to coarse sized subrounded fragments of agglomerate and lithic sandstone							C	100	0	
									C	100	0	
201	1											
									C	100	0	
200	2											
									C	100	0	
199	3											
	3.15	CORE LOSS - 0.15m						3.15m: CORE LOSS: 150mm	C	57	0	
	3.3	GRAVEL AND CLAY - As above							C	57	0	
	3.9	CORE LOSS - 0.14m						3.9m: CORE LOSS: 140mm				
198	4											
	4.04	GRAVEL AND CLAY - As above										
	4.14	CORE LOSS - 0.34m						4.14m: CORE LOSS: 340mm	C	48	0	
	4.48	GRAVEL AND CLAY - As above										
	4.92	CORE LOSS - 0.2m						4.92m: CORE LOSS:	C	51	0	

RIG: Track Mounted **DRILLER:** J Simon (APS) **LOGGED:** Handley/Harris **CASING:** NW to 8.1m

TYPE OF BORING: Solid flight auger to 0.7m (TC bit refusal) then NMLC coring to 16.0m)

WATER OBSERVATIONS: Free groundwater observed due to drilling fluids. 90% water loss from 15.3m.

REMARKS: Preferred route (E2), approx Ch 3125 on centreline. Bore collapsing from GL to 8.1m while drilling.
* Surface levels interpolated by client from surface terrain model and are approximate only.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 202.0 AHD*
EASTING: 376866
NORTHING: 6425265
DIP/AZIMUTH: 90°/--

BORE No: 423
PROJECT No: 39721.02
DATE: 14-26 May 08
SHEET 2 OF 4

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
197	5.0	CORE LOSS - 0.2m *(continued)*						80mm 5m: CORE LOSS: 120mm	C	51	0	
	5.12	GRAVEL AND CLAY - Extremely weathered brown gravel and clay (with soil like properties), with general composition of clay with embedded fine to coarse sized subrounded fragments of agglomerate and lithic sandstone						5.2m: CORE LOSS: 300mm	C	25	0	
	5.2											
	5.5											
	5.65	CORE LOSS - 0.3m						5.65m: CORE LOSS: 200mm				
		GRAVEL - subangular fragments of lithic sandstone							C	100	0	
	5.85	CORE LOSS - 0.2m										
196	6								C	47	0	
	6.07	GRAVEL - subangular fragments of lithic sandstone						6.07m: CORE LOSS: 80mm				
	6.15	CORE LOSS - 0.08m							C	100	0	
		POSSIBLE BRECCIA ZONE - Extremely weathered, brown possible breccia zone with subangular gravel and clay							C	100	0	
								From 6.65m to 7.2m Friable	C	100	0	
195	7											
	7.08	LITHIC SANDSTONE - Extremely low strength, extremely weathered brown lithic sandstone, with interbedded layers of silty clay (soil properties), friable to 7.95m						7.25m: Fr, SV, un, ro-sm				
								7.48m: P, sh, clay lined 7.51m: P, sh, clay lined 7.56m: P, sh, clay lined 7.63m: P, sh, clay lined From 7.63m to 7.73m clay layer 100mm thick, 2 by J's, 55°, pl, sm, clay smear From 7.8m to 7.95m Friable clay 7.98m: P, sh, h, clay lined 1mm thick	C	100	10	
	7.95	LITHIC SANDSTONE - Very low to low strength, highly weathered brown lithic sandstone						8m: J, 45°, pl, sm, clay lined 2mm thick 8.06m: P, sh, un, sm, clay lined 3mm thick 8.1m: P, sh, un, sm 8.14m: P, sh, un, sm 8.17m: P, sh, un, sm 8.2m: P, sh, un, ro-sm 8.3m: P, sh, un, ro-sm 8.38m: P, sh, h 8.44m: J, 20°, st, un, ro-sm	C	100	0	PL(D) = 0.52MPa
194	8											
193	9							8.48m: J, 45°, h 8.54m: J, 45°, h 8.58m: J, 45°, st, un, partially h From 8.60m to 8.7m J, 65°, un, ro-sm From 8.7m to 8.8m Fr, SV, st, un, ro 8.85m: 2 by J's, 45°, un, ro-sm From 8.95m to 8.98m Fg 9m: J, 45°, un, ro-sm	C	100	0	PL(D) = 2.3MPa
	9.63	LITHIC SANDSTONE - High to very high strength, fresh, grey-blue lithic sandstone										

RIG: Track Mounted **DRILLER:** J Simon (APS) **LOGGED:** Handley/Harris **CASING:** NW to 8.1m

TYPE OF BORING: Solid flight auger to 0.7m (TC bit refusal) then NMLC coring to 16.0m)

WATER OBSERVATIONS: Free groundwater observed due to drilling fluids. 90% water loss from 15.3m.

REMARKS: Preferred route (E2), approx Ch 3125 on centreline. Bore collapsing from GL to 8.1m while drilling.
* Surface levels interpolated by client from surface terrain model and are approximate only.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	

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BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

SURFACE LEVEL: 202.0 AHD*
EASTING: 376866
NORTHING: 6425265
DIP/AZIMUTH: 90°/--

BORE No: 423
PROJECT No: 39721.02
DATE: 14-26 May 08
SHEET 3 OF 4

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
192		LITHIC SANDSTONE - High to very high strength, fresh, grey-blue lithic sandstone *(continued)*						From 9.05m to 9.1m Fg 9.12m: J, 45°, un, ro 9.15m: J, 45°, un, ro 9.2m: J, 45°, un, ro 9.3m: J, 65°, pl, ro-sm 9.45m: J, 45°, h 9.5m: J, 45°, h From 9.6m to 9.64m Fg From 9.65m to 10.1m Fr's, 45° to SV, hairline, h, calcited lined and 3 by J's, 65°, h 10.14m: P, sh, ir, st, ro 10.2m: J, 20°, h, calcite 10.47m: J, 20°, h, calcite 10.54m: J, 20°, pl, ro	C	100	0	
191	11							From 10.56m to 10.72m Fr's, sh to 45°, h, calcite hairline, h 10.77m: P, sh, ir, st, ro	C	100	0	
								From 10.8m to 11.3m Fr, SV, partially h, calcite 11.1m: P, sh, un, ro 11.33m: P, sh, un, ro 11.38m: J, 30° to sh, un, ro 11.42m: J, 30°, pl, un, ro 11.58m: P, sh, un, ro	C	100	20	
190	12							11.67m: J, 30°, un, ro 11.7m: J, 45°, un, ro 11.72m: J, 45°, un, ro	C	100	0	
	12.15	AGGLOMERATE - High to very high strength, slightly weathered to fresh grey-blue agglomerate						11.75m: J, 45°, h 11.82m: P, sh, un, ro 12.08m: P, sh, un, ro 12.1m: P, sh, un, ro 12.2m: P, sh, un, ro 12.26m: J From 12.26m to 12.65m Fg 12.68m: P, sh, un, ro 12.72m: P, sh, un, ro 12.8m: P, sh, un, ro 12.801m: J, 65°, un, ro	C	100	23	
189	13							13.28m: P, sh, un, ro 13.4m: J, 70° to SV, h, calcite 13.48m: J, 45°, h 13.55m: J/P, sh to 45°, un, ro	C	100	75	
								13.57m: P, sh, calcite, vien, h 13.71m: J, 30°, h, calcite 13.75m: P, sh, un, ro 13.8m: J, 50°, h From 13.9m to 14.4m Fr, SV, h, calcite 14m: P, sh, pl, sm, calcite 2mm thickness 14.27m: P, sh, pl, sm	C	100	0	
188	14							14.5m: P, sh, un, ro-sm 14.56m: P, sh, un, ro-sm 14.61m: P, sh, un, ro-sm 14.65m: J, 70°, h 14.75m: P, sh, pl, sm				PL(D) = 3.9MPa PL(A) = 3.7MPa
	14.56	LITHIC SANDSTONE - Very high strength, fresh, grey-blue lithic sandstone										

RIG: Track Mounted **DRILLER:** J Simon (APS) **LOGGED:** Handley/Harris **CASING:** NW to 8.1m

TYPE OF BORING: Solid flight auger to 0.7m (TC bit refusal) then NMLC coring to 16.0m)

WATER OBSERVATIONS: Free groundwater observed due to drilling fluids. 90% water loss from 15.3m.

REMARKS: Preferred route (E2), approx Ch 3125 on centreline. Bore collapsing from GL to 8.1m while drilling.
* Surface levels interpolated by client from surface terrain model and are approximate only.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	

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BOREHOLE LOG

CLIENT: Opus International Consultants (NSW) Pty Ltd
PROJECT: Tillegra Dam, Diversion of Salisbury Road
LOCATION: Localities of Bandon Grove, Munni and Underbank

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EASTING: 376866
NORTHING: 6425265
DIP/AZIMUTH: 90°/--

BORE No: 423
PROJECT No: 39721.02
DATE: 14-26 May 08
SHEET 4 OF 4

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
187		LITHIC SANDSTONE - Very high strength, fresh, grey-blue lithic sandstone *(continued)*						15.25m: J, 45°, h 15.33m: P, sh, un, ro 15.4m: J, 65°, pl, un, ro, calcite 15.5m: J, 65°, pl, un, ro, calcite 15.6m: J, 65°, pl, un, ro, calcite 15.68m: P, sh, un, ro 15.7m: P, sh, un, ro 15.8m: P, sh, un, ro 15.92m: P, sh, h 15.95m: CORE LOSS: 50mm	C	100	0	
186	15.95 16 16.0	CORE LOSS - 0.05m (down Borehole) Bore discontinued at 16.0m, limit of investigation										
185	17											
184	18											
183	19											

RIG: Track Mounted **DRILLER:** J Simon (APS) **LOGGED:** Handley/Harris **CASING:** NW to 8.1m

TYPE OF BORING: Solid flight auger to 0.7m (TC bit refusal) then NMLC coring to 16.0m)

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SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	

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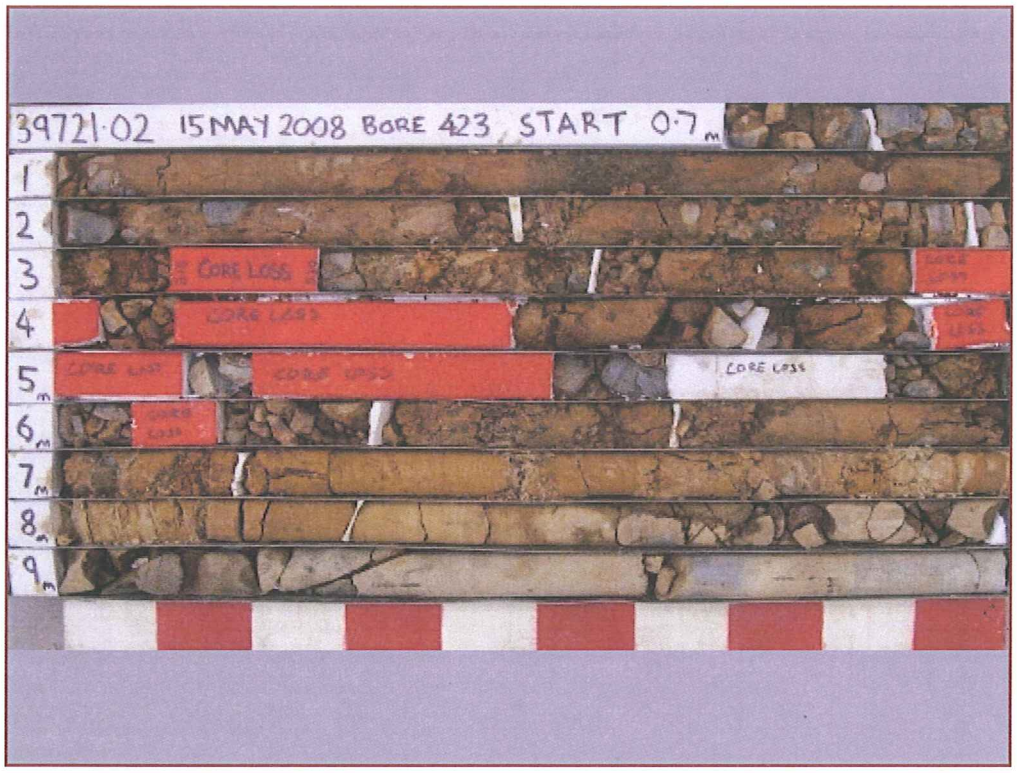
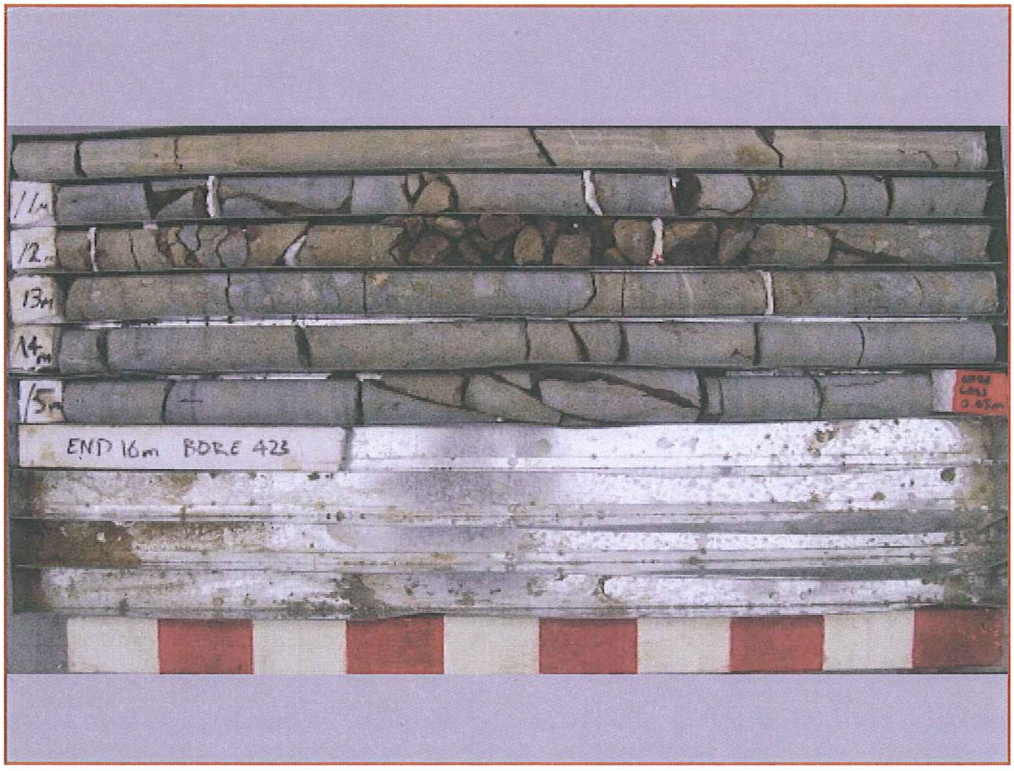


BORE 423 : 0.70 m to 10.00 m



BORE 423: 10.00 m to 16.00 m

DIVERSION OF SALISBURY ROAD TILLEGRA DAM PROJECT	**PROJECT 39721.02**	**Douglas Partners** Geotechnics • Environment • Groundwater

Appendix K

2-D Stability Analysis - Large Scale Slide in Domain 1 (Section AA')

Tillegra Dam
Storage Rim Stability Analysis
SlopeW 2-D Analysis

Section AA from Report GN31A Analysed - reference Figures 1A & 2A

Assumed Slip Plane Strength Parameters	c' = 0 kPa
	Φ = 12°

Case	Failure Plane Description	PZ3 (with Dam) (WT -30m) FOS (Ordinary)	PZ4 (with Dam) (WT -15m) FOS (Ordinary)	PZ5 (without Dam) FOS (Ordinary)	Comment
1	2.68 degree plane from natural surface level RL139.95 (CH 1175) to exit at toe, RL90.77 (CH 2225)	3.355	3.032	3.190	
2	5 degree plane from natural surface level RL 139.95 (CH 1175) to intersection of flat plane at RL89.68 (CH 1749.6) continuing to exit at CH 2250	2.271	2.098	2.194	PZ4: Failure Plane strength parameters to obtain FOS = 1.0, c' = 0 kPa, Φ = 5.788° PZ5: Failure Plane strength parameters to obtain FOS = 1.0, c' = 0 kPa, Φ = 5.535°
3A	5 degree plane from natural surface RL152.3 (CH 1223.8) to intersection of flat plane at RL123.89 (CH 1548.5) continuing to exit at CH 1950	3.780	3.351	3.391	
3B	Slip planes as for 3A above but with 45 degree exit at RL131.33 (CH 1875)	3.766	3.335	3.358	
4	8 degree plane from natural surface RL139.95 (CH 1175) to intersection of flat plane at RL89.68 (CH 1532.7) continuing to exit at CH 2250	2.536	2.354	2.431	
5	8 degree plane from natural surface RL177.4 (CH1335.3) to intersection of flat plane at RL131.33 (CH 1661.7) continuing to exit at CH 1875	1.550	1.347	1.350	
6	8 degree plane from natural surface level RL194.8 (CH 1423.4) to exit at toe, RL131.33 (CH 1875)	1.360	1.159	1.159	PZ4: Failure Plane strength parameters to obtain FOS = 1.0, c' = 0 kPa, Φ = 10.39° PZ5: Failure Plane strength parameters to obtain FOS = 1.0, c' = 0 kPa, Φ = 10.39°
7	8 degree plane from natural surface RL177.4 (CH1335.3) to intersection of flat plane at RL89.68 (CH 1959.4) continuing to exit at CH 2250	1.345	1.211	1.267	PZ4: Failure Plane strength parameters to obtain FOS = 1.0, c' = 0 kPa, Φ = 9.958° PZ5: Failure Plane strength parameters to obtain FOS = 1.0, c' = 0 kPa, Φ = 9.52°

Note: Ordinary method was used to calculate the FOS for all cases

Tillegra Dam
Storage Rim Stability Analysis
SlopeW 2-D Analysis

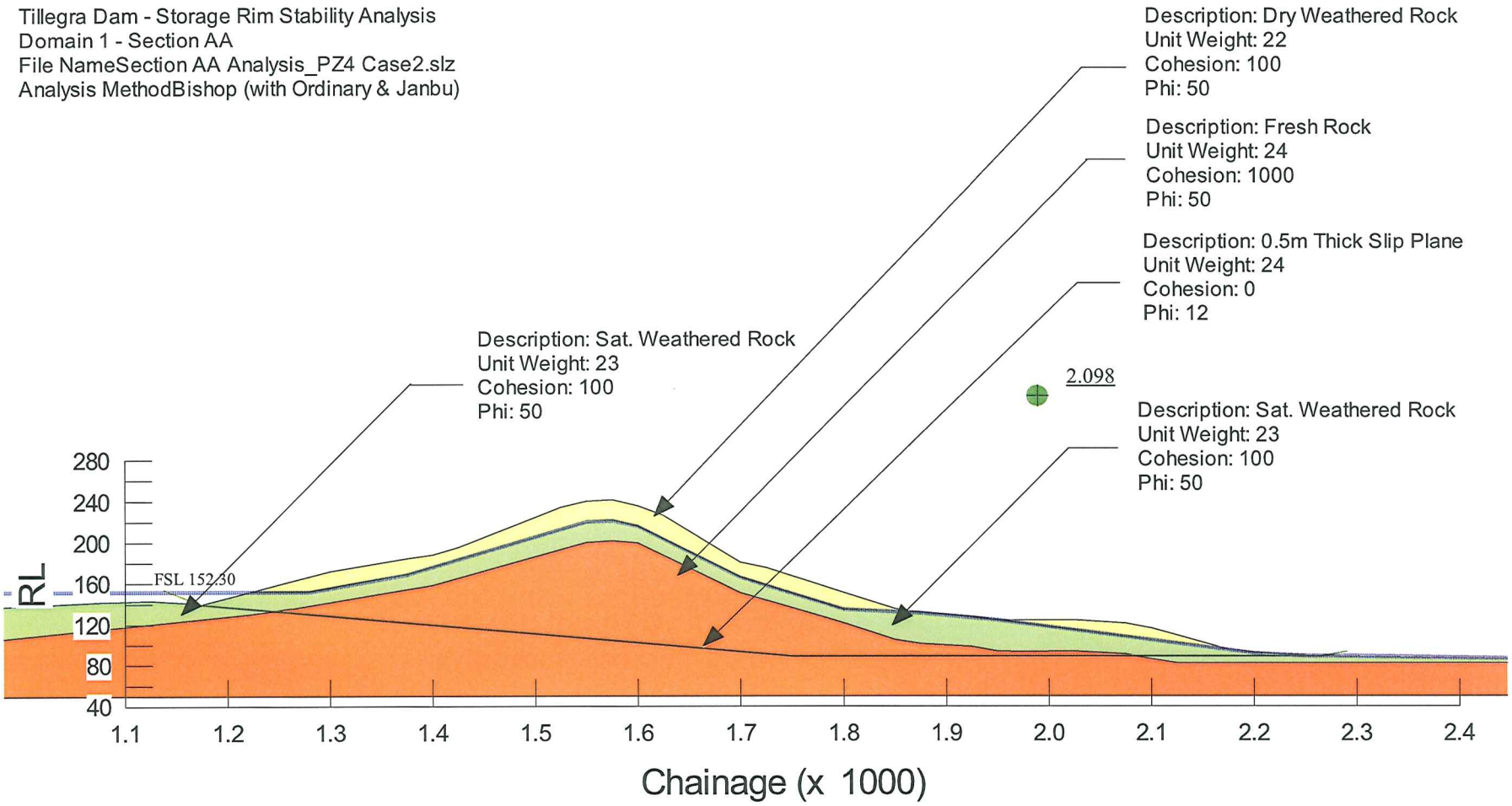
Section AA from Report GN31A Analysed - reference Figures 1A & 2A

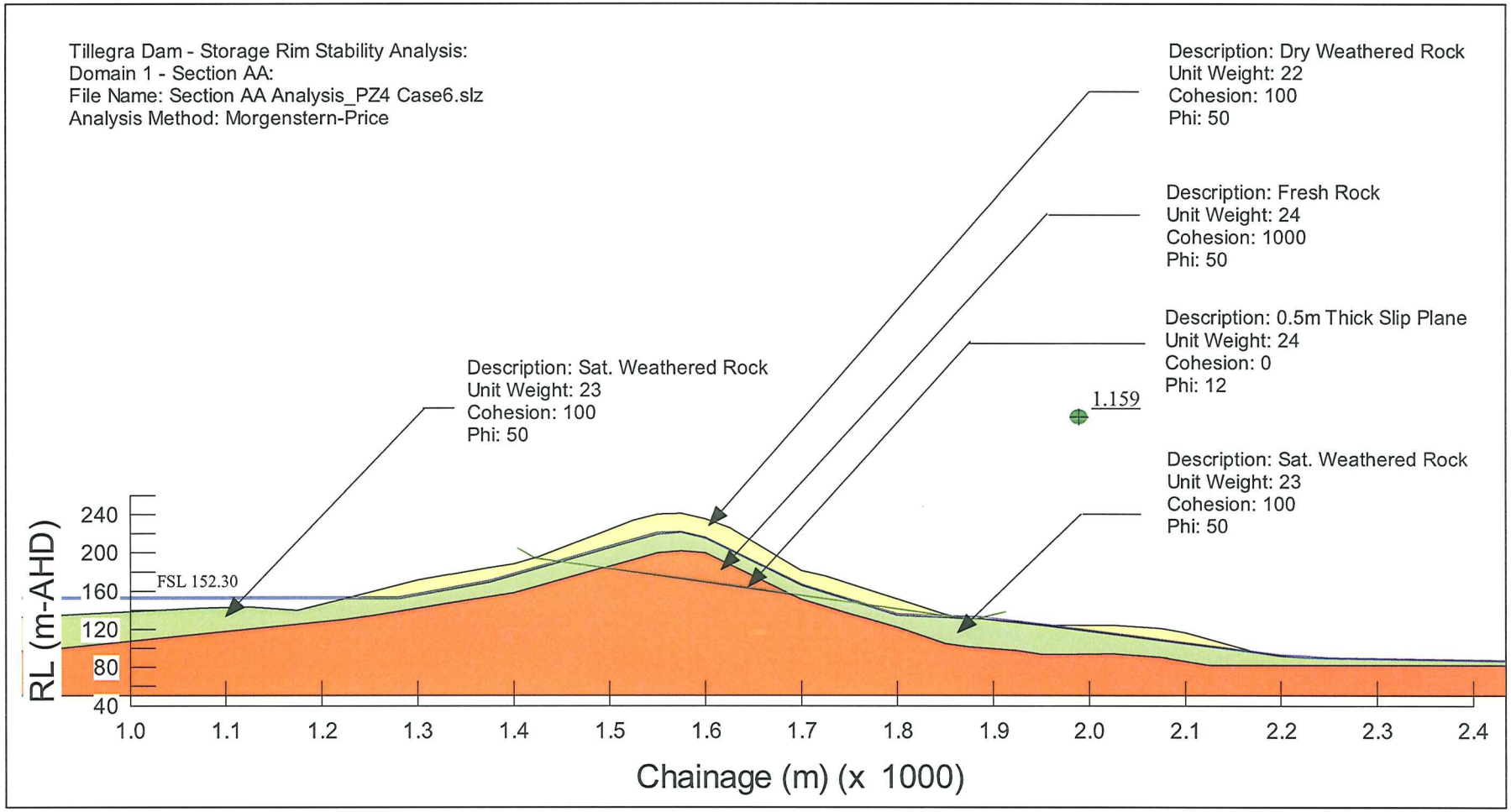
Assumed Slip Plane Strength Parameters	c' = 1000 kPa
	Φ = 40°

Case	Failure Plane Description	PZ3 (with Dam) (WT -30m) FOS (Ordinary)	PZ4 (with Dam) (WT -15m) FOS (Ordinary)	PZ5 (without Dam) FOS (Ordinary)	Comment
1	2.68 degree plane from natural surface level RL139.95 (CH 1175) to exit at toe, RL90.77 (CH 2225)	-	-	-	
2	5 degree plane from natural surface level RL 139.95 (CH 1175) to intersection of flat plane at RL89.68 (CH 1749.6) continuing to exit at CH 2250	-	19.787	20.166	
3A	5 degree plane from natural surface RL152.3 (CH 1223.8) to intersection of flat plane at RL123.89 (CH 1548.5) continuing to exit at CH 1950	-	-	-	
3B	Slip planes as for 3A above but with 45 degree exit at RL131.33 (CH 1875)	-	-	-	
4	8 degree plane from natural surface RL139.95 (CH 1175) to intersection of flat plane at RL89.68 (CH 1532.7) continuing to exit at CH 2250	-	-	-	
5	8 degree plane from natural surface RL177.4 (CH1335.3) to intersection of flat plane at RL131.33 (CH 1661.7) continuing to exit at CH 1875	-	-	-	
6	8 degree plane from natural surface level RL194.8 (CH 1423.4) to exit at toe, RL131.33 (CH 1875)	-	14.873	14.873	
7	8 degree plane from natural surface RL177.4 (CH1335.3) to intersection of flat plane at RL89.68 (CH 1959.4) continuing to exit at CH 2250	-	14.074	14.296	

Note: Ordinary method was used to calculate the FOS for all cases

Tillegra Dam - Storage Rim Stability Analysis
Domain 1 - Section AA
File NameSection AA Analysis_PZ4 Case2.slz
Analysis MethodBishop (with Ordinary & Janbu)

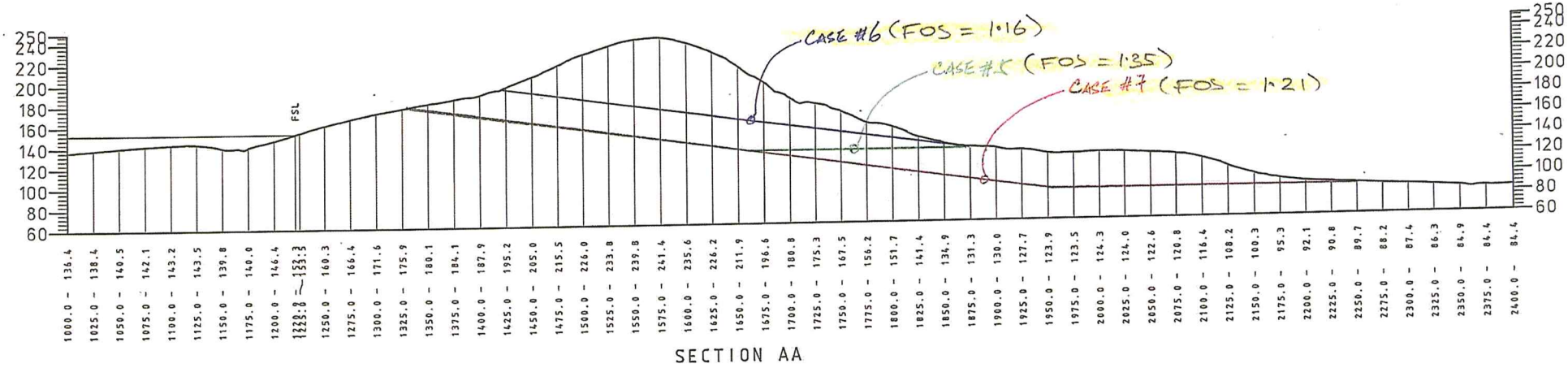



Tillegra Dam - Storage Rim Stability Analysis:
Domain 1 - Section AA:
File Name: Section AA Analysis_PZ4 Case6.slz
Analysis Method: Morgenstern-Price
Description: Dry Weathered Rock
Unit Weight: 22
Cohesion: 100
Phi: 50
Description: Fresh Rock
Unit Weight: 24
Cohesion: 1000
Phi: 50
Description: 0.5m Thick Slip Plane
Unit Weight: 24
Cohesion: 0
Phi: 12
Description: Sat. Weathered Rock
Unit Weight: 23
Cohesion: 100
Phi: 50
1.159
Description: Sat. Weathered Rock
Unit Weight: 23
Cohesion: 100
Phi: 50
FSL 152.30
RL (m-AHD)
240
200
160
120
80
40
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
2.2
2.3
2.4
Chainage (m) (x 1000)

B. Failure Planes Above FSL 152·3

Assumed Slip Plane Strength Parameters	$c' = 0$ kPa $\phi' = 12°$

Piezometric Profile P2K - Dam in Place



SECTION AA

0 40 80 160 240 320 400

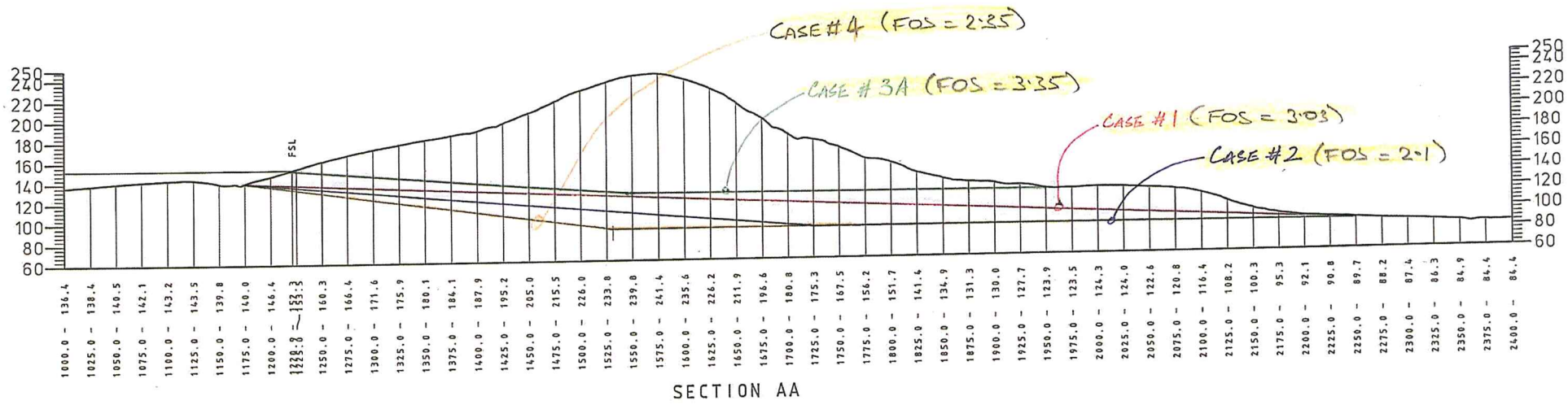
REDUCTION RATIO 1:4000 METRES

12:47:51 PM 18/09/2008 OrchardA T:\IS\SASIS\PROJ\Tillegra dam\JohnYoungData\JohnYoungSectionLocationX.dgn

A. Failure Planes at or Below FSL 152.3

Assumed Slip Plane	$c' = 0$ kPa
Strength Parameters	$\phi' = 12°$

Piezometric Profile P24 - Dam in Place



SECTION AA

0 40 80 160 240 320 400

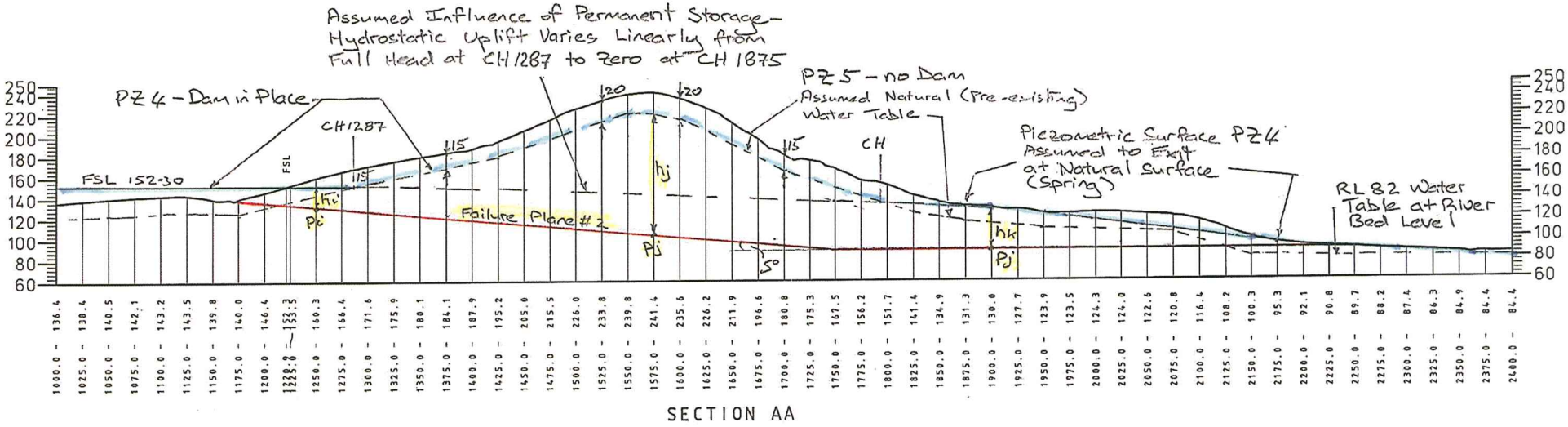
REDUCTION RATIO 1:4000 METRES

12:47:51 PM18/09/2008 OrchardA T:\IS\SASIS\PROJ\Tillegra dam\JohnYoungData\JohnYoungSectionLocationX.dgn

19 September 2008.

Pore Pressure Model Adopted for SLOPE/W Analysis

PZ 4 - Piezometric Surface with Dam in Place



Pore Pressure $P_i = h_i * \gamma_{water}$

0 40 80 160 240 320 400

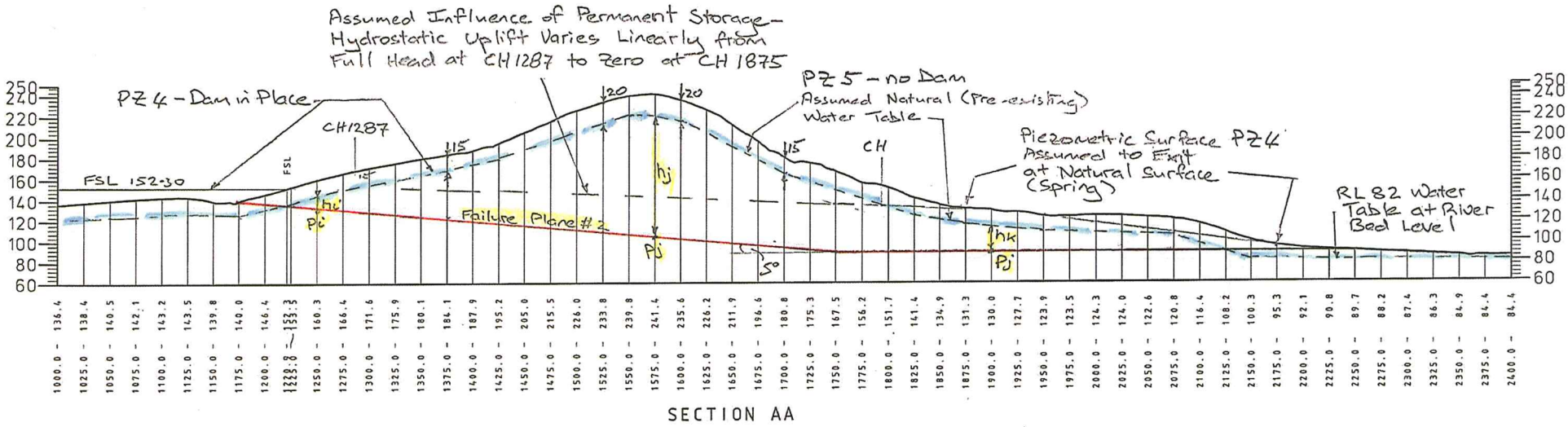
REDUCTION RATIO 1:4000 METRES

12:47:51 PM18/09/2008 OrchardA T:\IS\SASIS\PROJ\Tillegra dam\JohnYoungData\JohnYoungSectionLocationX.dgn

19 September 2008.

Pore Pressure Model Adopted for SLOPE/W Analysis

PZ5 – Pre-existing Piezometric Surface (No Dam)



Pore Pressure $P_i = h_i * \gamma_{water}$

0 40 80 160 240 320 400

REDUCTION RATIO 1:4000 METRES

12:47:51 PM18/09/2008 OrchardA T:\IS\SASIS\PROJ\Tillegra dam\JohnYoungData\JohnYoungSectionLocationX.dgn