

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-13, 1/4

Hole No.: **M98-13**
 Ground EL.: **563.674 m**
 Hole length: **30.00 m**

Location: **Saddle on the Right Bank**
 Drilling period: **Sep. 20 - Sep. 23, 1999**
 Hole Inclination: **90 degrees (Vertical)**

Azimuth: **-**
 Northing: **1,124,213.465 m**
 Easting: **3,067,664.082 m**

Date	Depth(m)	EL.(m)	Log.	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugeon value	Sample	Casing	Cementation	Depth (m)	
	1				0	0	110	F	5	d	D	Psammite schist, fine grained Highly weathered, crushed and washed in drilling.						1	
	2				60	18	230	C	3-2	c	CL	Psammite schist, fine grained light brown, highly schistose. Closely jointed with quartz and mica. Moderately weathered. Iron						2	
	3				46	12	290	E	5	d	D							3	
	4				65	0	180	C	3-4	c-d	CL	Psammite schist, fine grained Light grey, slightly to moderately schistose, with quartz, mica and a little amphibole. Microfolding at some parts. At 4.75 m, a 32 degree rough, fresh joint.	Le=(17) Pc=4.4				4		
	5				91	65	442	C	3	b	CM	At 4.75 m, a 32 degree rough, fresh joint. Rock is crushed in drilling and washed away in the sections of:- 2.3 m - 2.8 m and 8.85 m - 9.00 m.					5		
9/21	6				94	50												6	
	7				90	35												7	
	8			Psammite schist (Pelitic)	96	54		C-B	2	b-a	CH	7.5 m - 7.6 m, a stained vertical joint.						8	
	9				84	63												9	
	10				60	43	9.62 10.70 (3.40)	E	5	d	D	Core washed away in the section of 9.6 m - 10.0m						10	
	11				40	0	11.30 11.50	C	3-4	c	CL	Core wash in 10.40 m - 11.25 m.						11	
	12				70	27		F-B	5	d	D	11.25 m - 11.50 m, a quartz vein	No ground water					12	
	13				97	75						Psammite schist with quartz and mica, light greenish, highly schistose, closely jointed.	Le=(19) Pc=9.9				13		
	14				98	92						Fine grained psammite schist with chlorite, light green, fairly hard, fresh, not intensely schistose, slightly to moderately jointed.					14		
	15	15.00	548.674		97	48						At 14.45 m, a 75 degree joint.					15		
9/22	16				97	57		B	2	b	CH							16	
	17				94	75												17	
	18			Psammite schist	99	77							Le=(24) Pc=5.0					18	
	19				97	52												19	
	20				98	78	20.20					At 19.35 m, a 50 degree smooth joint, stained and coated with clay. 20.0 m - 22.0 m,						20	
	21				94	10		C-B	3-4	b	CM	Psammite schist, fine, with quartz and mica. Closely jointed, highly schistose and moderately weathered.						21	
	22				96	0	22.10											22	
	23	22.70	540.974		100	85							Le=0.9 Pc=1.2					23	
	24				99	70						At 23.50 m, a 10 degree smooth joint, stained.						24	
9/23	25			Green Schist	97	50						Deeper than 23 m, Fine grained psammite schist with chlorite and mica. Quartz specks at places w. Slightly schistose and weathered.						25	
	26				98	88		B	1-2	b-a	CH	24.5 m - 25.1 m, a vertical joint.						26	
	27	27.15	536.524		100	80						27.15m - 27.30 m, a quartz vein.	Le=(20) Pc=9.8					27	
	28				97	55												28	
	29			Psammite schist (Pelitic)	96	13	28.65 29.25 29.20	C-B	3-4	b	CM	At 28.0 m, a 38-degree rough fresh joint.						29	
	30	30.00	533.674		95	41	30.00	B	2	b-a	CH							30	
	31						30.00	C-B	3-4	b	CM								31

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-14, 2/6

Hole No.: **M98-14**
 Ground EL.: **382.011 m**
 Hole length: **180.00 m**

Location: **Dam Axis (Left bank)**
 Drilling period: **Jul. 2, 1999 - Aug. 15, 1999**
 Hole inclination: **90 degrees (Vertical)**

Azimuth: **-**
 Northing: **1,125,167.569**
 Easting: **3,067,834.841**

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugon value	Sample	Casing	Commentation	Depth (m)			
7.10	31			Green Schist	97	57	33.50	A-B	3-2	a	CH	Rock Type: Greenish grey thin alternating rock of light green to ash and white/grey bands, fairly schistose, composed of feldspar, biotite, amphibole, chlorite, quartz, etc. • 31.4-47.0: Relatively fine grained, well-schistosed, containing many minor folds, banded with greenish grey thin layers and white thin layers. 46.2-46.4: Slightly sheared. Rock pieces are flaky due to shear joints. Joint planes are almost fresh, along schistosity (50°), smooth and slippery. • 47.0-47.5: Fine grained, poor schistosed. Garnet crystals of less than 5 mm in diameter are scattered along schistosity (60°). • 49.5-68.5: Medium grained, whitish to greenish grey, relatively schistose, moderately schistosed. Schistosity is generally 70°, but modulated or folded frequently. Garnet crystals of 1 mm to 5 mm align along schistosity. 51.75-51.9: Sheared, jointed along schistosity. Lustrous alternate shows and clockwise rotation. 52.1-52.3: Irregular shaped mica foliation. 53.4-53.5: Irregular shaped quartz veins. 55.1-68.5: Irregularly folded and banded. Relatively high content of white minerals (feldspar and quartz). 56.1-57.4: Relatively greenish, low content of white minerals, fine grained. 57.4-68.5: Relatively high content of white minerals (feldspar and quartz). Schistosity is intensely folded. Most of the joints are along schistosity (60°). Rock condition: • 30.3-31.8, 33.0-34.5, 36.0-38.0, 41.0-44.5, 47.7-51.7, 54.8-59.6: Fresh and rarely jointed. • 31.8-33.0: Fresh, jointed along schistosity (50°). • 34.5-36.0: Fresh, jointed along schistosity (50-60°). • 38.0-41.0: Fresh, moderately sheared and closely jointed along schistosity (60°). • 44.5-47.7: Fresh, moderately sheared and jointed along schistosity (50-70°). 51.7-54.8: Fresh, jointed along schistosity (33-70°, undulated).									
	32				100	37	11.80	A-B	2-3	a	B									31	
	33					97	22	33.00	A-B	3	a		CH								32
	34					90	47		A-B	2	a		B								33
	35					95	37	34.50	A-B	3	a		CH								34
7.11	36			Green Schist	55	30	36.00	A-B	3	a	CH								35		
	37				97	91		A-B	2	a	B									36	
	38				99	76	38.00	A-B	2	a	B									37	
	39				98	10		A-B	3-2	a	CH									38	
	40				96	10		A-B	3-2	a	CH									39	
7.14	41			Green Schist	100	53	41.00												40		
	42				100	49														41	
	43				100	56		A-B	2-3	a	B									42	
	44				85	52														43	
	45				90	46	44.50													44	
7.15	46			Green Schist	98	0		B-A	4-3	a	CH								45		
	47				100	12	46.40	A-B	3	a	CH									46	
	48				93	22	47.70													47	
	49				99	58														48	
	50				100	43		A-B	2	a	B	B								49	
7.16	51			Green Schist	90	67													50		
	52				100	73	51.70													51	
	53				100	40														52	
	54				100	32		A-B	3	a	CH	CH								53	
	55				98	49	54.80													54	
7.17	56			Green Schist	97	85													55		
	57				95	65		A-B	2-3	a	B	B								56	
	58				100	47		A-B	2-3	a	B	B								57	
7.18	59			Green Schist	100	81													58		
	60				100	77	58.60	A-B	3	a	CH									59	

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-14, 3/6

Hole No.: M98-14
 Ground EL: 332.011 m
 Hole length: 180.00 m

Location: Dam Axis (Left bank)
 Drilling period: Jul. 2, 1999 - Aug. 15, 1999
 Hole inclination: 90 degrees (Vertical)

Altitude: -
 Northing: 1,125,167.569
 Easting: 3,067,834.841

Date	Depth(m)	EL(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	C.W.L. S.P.T.	Lugeon value	Sample	Casing	Cementation	Depth (m)						
7/18	61	228.411	[Wavy pattern]	Green Schist	100	53	61.20	A-B	3	a	CH	Rock type: Greenish grey thin alternating rock of light green bands and white grey bands, fairly schistose, composed of feldspar, biotite, amphibole, chlorite, quartz, act. 68.5-77.9: Relatively siliceous, highly schistose to banded, containing big garnet crystals of 2 mm to 5 mm in diameter, quartz, feldspar, chlorite, biotite, amphibole. Micro-folding is common. 71.8-72.4: Chlorite clots of 2 mm to 4 mm in diameter are scattered. 74.0-79.7: High content of quartz veins. 76.1-76.6: Chlorite clots of 2 mm to 4 mm in diameter are scattered. 77.9-83.6: Medium- to coarse-grained, relatively poor-schistose, greenish, containing many irregular-shaped quartz veins, containing garnet crystals of 2 mm to 4 mm in dia. 82.75-83.0, 83.75-84.0: Slightly sheared and jointed along schistosity. Rock condition: 59.6-83.6: Fresh and rarely jointed.	Ln-0.7 Po-12											
	62				100	66	A-B	2	a	B	61													
	63				100	74	A-B	3-2	a	CH														
64	98	13	A-B	3-2	a	CH					CH	63												
65	100	39					A-B	3-2	a	CH			CH	64										
66	100	60	A-B	3-2	a	CH					CH	65												
67	100	60					A-B	3-2	a	CH			CH	66										
68	100	42	A-B	3-2	a	CH					CH	67												
69	100	74					A-B	3-2	a	CH			CH	68										
70	100	100	A-B	3-2	a	CH					CH	69												
71	100	71					A-B	3-2	a	CH			CH	70										
72	98	46	A-B	3-2	a	CH					CH	71												
73	99	78					A-B	3-2	a	CH			CH	72										
74	99	85	A-B	3-2	a	CH					CH	73												
75	100	93					A-B	3-2	a	CH			CH	74										
76	100	69	A-B	3-2	a	CH					CH	75												
77	100	73					A-B	3-2	a	CH			CH	76										
78	97	57	A-B	3-2	a	CH					CH	77												
79	100	60					A-B	3-2	a	CH			CH	78										
80	100	62	A-B	3-2	a	CH					CH	79												
81	98	91					A-B	3-2	a	CH			CH	80										
82	100	95	A-B	3-2	a	CH					CH	81												
83	99	67					A-B	3-2	a	CH			CH	82										
84	99	76	A-B	3-2	a	CH					CH	83												
85	100	64					A-B	3-2	a	CH			CH	84										
86	99	60	A-B	3-2	a	CH					CH	85												
87	98	92					A-B	3-2	a	CH			CH	86										
88	100	43	A-B	3-2	a	CH					CH	87												
89	97	43					A-B	3-2	a	CH			CH	88										
90	100	66	A-B	3-2	a	CH					CH	89												
							A-B	3-2	a	CH			CH	90										

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-14, 4/6

Hole No.: M98-14
 Ground El.: 387.011 m
 Hole length: 180.00 m

Location: Dam Axis (Left bank)
 Drilling period: Jul 2, 1999 - Aug 15, 1999
 Hole inclination: 90 degrees (Vertical)

Arimuth: -
 Northing: 1,125,167.569
 Easting: 3,067,834.841

Date	Depth (m)	El. (m)	Log	Rock type	Core Recovery (%)	RQD	Depth (m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lagson value	Sample	Casing	Cementation	Depth (m)
7/31	91	289.861		Siliceous Schist	100	61	91.60	A-B	2-3	a-b	B	B	91.75-91.8 (60°), 91.95-92.0 (40°), 92.1-92.5 (30°), 92.7-92.8 (50°): Jointed along schistosity, intercalated with soft ..					91
	92				100	34												92
	92.15	289.861		Pelitic Schist	100	10	93.10	B-A	3-4	a-b	CH	CH	92.15-92.65: Black pelitic schist, fine grained, well schistosed (50°), containing big garnet crystals.	Ls=01 Po=11				93
	92.65	289.361			98	80												94
8/1	93			Green Schist	98	80						Rock type: Green schist, greyish green indistinct thin alternating rock, fairly schistosed, composed of feldspar, amphibole, biotite, garnet, chlorite, quartz, etc. • 92.65-92.85: Shale, jointed, intercalated with semi-consolidated clay materials of 15 mm to 20 mm thick. • 92.85-93.6: Fairly schistosed (50°), fresh without distinct joint. 92.85-93.9: Medium grained, containing thin white bands of feldspar. 93.9-94.0: Quartz vein of 10 cm thick, dipping 60°. 94.0-95.6: Coarse grained, containing many calcic quartz veins (Fe lens) along schistosity. • 95.6-97.3: Light colored, fine grained, poorly schistosed. • 97.3-97.65: Coarse grained, fairly schistosed. • 97.65-98.4: Very coarse grained, fairly schistosed, (50°) containing garnet crystals of 1 mm to 3 mm in dia. and lath-shaped amphibole of less than 1 cm long. • 98.4-100.3: Coarse grained, light green, fairly schistosed (40°). 99.5-100.3: High content of lath-shaped amphibole of less than 1 cm long, containing white (quartz/feldspar) bands of 5 mm to 2 cm thick along schistosity. • 100.3-100.8: Fairly schistosed (35°), fine grained, containing grey (biotite, feldspar rich) bands of 5 mm to 15 mm thick. • 100.8-101.6: Greenish light grey, coarse grained, poorly schistosed (45°). • 101.6-105.7: Fine grained, fairly schistosed, containing light grey bands of 5 mm to 10 mm thick. The bands are undulating and parallel to schistosity. Quartz veins of less than 5 mm thick exist at a right angle to the schistosity. • 105.7-110.35: Coarse grained, fairly schistosed (50°), containing biotite flake of 1 mm to 2 mm long, composed of greenish (biotite rich) bands and white (feldspar rich) bands of less than 1 cm thick. • 110.35-113.4: Very coarse grained, containing calcic quartz veins - lens of less than 3 cm thick. Garnet, amphibole, biotite crystals are scattered. 112.7-113.4: Rich in lath-shaped amphibole of less than 1 cm long. • 113.4-113.75: Fine grained, poorly schistosed to massive, containing quartzite vein of less than 1.5 cm thick dipping parallel to the schistosity. • 113.75-114.6: Medium grained, well schistosed (60°), composed of amphibole, feldspar, biotite, etc., intercalated with white thin layers of less than 2 mm thick. • 114.6-115.45: Quartz vein (60°), containing amphibole and pyrite dots. • 115.45-115.3: Green, medium grained, well schistosed (70°), containing many small flake of biotite, intercalated with quartz, feldspar thin layers of less than 2 mm thick along schistosity. 116.3-120.0: Dark green, fine grained, poor schistosed (50-60°). Rock condition: 91.6-93.1: Fresh, shaled, fairly jointed. 93.1-120.0: Fresh, rarely jointed.				95		
	94	100	43		95													
	95	100	65		96													
	96	95	84		97													
	97	100	73		98													
	98	100	58		99													
	99	100	84		100													
	100	100	65		101													
	101	100	55		102													
	102	100	80		103													
103	100	89	104															
104	100	77	105															
105	100	82	106															
106	100	85	107															
107	100	90	108															
108	100	96	109															
109	100	96	110															
110	100	70	111															
111	100	50	112															
112	100	92	113															
113	100	95	114															
114	100	92	115															
115	100	90	116															
116	100	97	117															
117	100	45	118															
118	100	97	119															
119	100	51	120															

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-14, 5/6

Hole No.: M98-14
 Ground EL.: 382.011 m
 Hole length: 189.00 m

Location: Dam Axis (Left bank)
 Drilling period: Jul. 2, 1999 - Aug. 15, 1999
 Hole Inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,125,167.569
 Easting: 3,067,834.841

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugon value	Sample	Casing	Cementation	Depth (m)	
8/7	121	245.161	[Wavy pattern]	Green Schist	100	83						120.0-136.85: Medium grained, poor-schistosed, composed of amphibole, biotite, feldspar, quartz, chlorite, containing indurated quartz veins. 120.0-120.05: Quartz vein. 122.85-123.3: Deformed, containing many quartz veins and biotite flakes. 129.4: Joint (70°), fresh, stepped with horizontal slickenside showing anti-clockwise rotation. 130.8-130.95: High content of biotite. 131.7-132.7: High content of undulid quartz/calcite veins and chlorite. 136.15-136.4: Joint (80°), fresh, distinct horizontal slickenside. Rock conditions: 12.0-136.85: Fresh, rarely jointed. Rock pieces are stiff. Joint planes are fresh and tight.							121
	122				100	94													122
	123				100	70													123
	124				100	62													124
	125				100	60													125
	126				100	60													126
	127				100	67													127
	128				100	78													128
	129				100	78													129
	8/8				130	245.161													[Wavy pattern]
131		98	76	131															
132		100	90	132															
133		100	60	133															
134		100	90	134															
135		100	36	135															
136		98	60	136															
137		97	73	137															
138		99	65	138															
139		100	71	139															
8/9	140	245.161	[Horizontal lines]	Psammite (Felsic) Schist	100	97						Rock type: Psammite schist (felsic) Dark grey, fairly schistosed, medium grained, composed of amphibole, feldspar, garnet, quartz, chlorite, pyrite, etc. 136.85 (Contact)-137.1: Quartz/calcite vein (T=20cm), dipping 50°, banded with dark layers of 1 mm to 2 mm thick. Contact is where it. 137.1-138.05: Dark greenish grey, medium to coarse grained, composed of very thin alternation of dark (amphibole rich) layers and light (quartz/feldspar rich) layers, containing micro-folding (Z-shaped). 138.6-140.2: Light greenish grey, medium grained, poor-schistosed (50°), high content of feldspar, quartz and biotite. 140.2-140.8: Fine- to medium grained, poor-schistosed, containing many lath-shaped amphibole crystals of less than 1 cm long. 140.8-141.15: Calcite layer of 20 cm thick, laminated (thin bed of meta limestone?). The lamination is irregularly undulated (Z-shaped). 141.15-143.0: Calcareous (calcareous sandstone origin), poor-schistosed, containing meta limestone layers of less than 5 cm thick, containing pyrite dots. 143.0-147.8: Slightly greenish, medium grained, poor-schistosed, intercalated with thin white (Quartz/calcite?) layers of less than 5 mm thick. 143.0-143.4: Foliated at an interval of 2 cm to 10 cm. Joint planes dip generally 60° without joint filler. 147.8-150.8: Alternating rocks of light grey layers, greenish layers, dark grey layers. Light grey layers consist of quartz/garnet mainly. Greenish layers include coarse- to medium grained amphibole. Dark grey layers are felsic and contain garnet crystals of less than 1cm in diameter.					140		
	141				100	89											141		
	142				100	61											142		
	143				100	60											143		
	144				94	34											144		
	145				92	80											145		
	146				100	41											146		
	147				100	100											147		
	148				100	54											148		
	149				100	44											149		
150	100	71	150																

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-14, 6/6

Hole No: M98-14
 Ground EL: 382.011 m
 Hole length: 180.00 m

Location: Dam Axis (Left bank)
 Drilling period: Jul. 2, 1992 - Aug. 15, 1992
 Hole inclination: 90 degrees (Vertical)

Azimuth:
 Northing: 1,125,167.569
 Easting: 3,067,834.841

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugson value	Sample	Casing	Cementation	Depth (m)		
8/11	151				100	53						• 150.8-154.4: Greenish grey, medium grained, poorly schistosed, containing thin amphibole rich layers of less than 1 cm thick. 151.4-151.5: Irregular shaped quartz vein, containing chlorite and pyrite. • 154.4-163.3: Medium grained, fairly schistosed, containing many lath-shaped amphibole crystals. 159.25-159.5, 159.55-160.0, 150.3-160.45: Carbonaceous layers along schistosity. 162.55-163.3: Containing quartz veins, accompanying biotite dots. • 163.3-167.9: Dark grey, fine grained, fairly schistosed, containing many garnet and biotite crystals of 2 mm to 6 mm in diameter. 167.0-167.1, 167.7-167.75: Irregular shaped quartz veins. 163.3-164.5: Fairly jointed along schistosity (50°-60°). • 167.9-170.5: Medium grained, poorly schistosed, high content of biotite. The schistosity is undulated frequently. • 170.5-170.6: Dark coloured, fine grained, well schistosed (30%), high content of garnet crystals of 2 mm to 4 mm in diameter. • 170.6-173.4: Medium grained, fairly schistosed, high content of lath-shaped amphibole of less than 2 cm long. The schistosity is undulated frequently. 173.4-179.3: Coarse grained, well schistosed, high content of amphibole and biotite. 179.3-180.0: Medium grained, fairly schistosed (80-90%).								
	152				100	77													151	
	153				100	79														152
	154				95	90														153
	155				98	81														154
	156				100	98														155
	157				100	100														156
	158				100	100														157
	159				97	92														158
	160				100	84														159
	161				100	93														160
	8/12	162				100	81													
163					100	81													162	
164					100	23													163	
165					100	57		A-B	2-1	a	B	B							164	
166					100	95													165	
167					98	85													166	
168					100	88													167	
169					99	94													168	
170					100	91													169	
171					100	87													170	
172					98	94													171	
8/14		173				99	91													172
	174				100	76													173	
	175				97	59													174	
	176				99	87													175	
	177				100	64													176	
	178				100	59													177	
	179				98	21													178	
	180				97	46													179	

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-15, 1/4

Hole No.: M98-15
 Ground EL.: 451.253 m
 Hole length: 100.00 m

Location: Dam Axis (Left bank)
 Drilling period: Aug. 23 - Sep. 25, 1999
 Hole inclination: 90 degrees (Vertical)

Altitude: -
 Northing: 1,125,237.329
 Easting: 3,067,757.588

Date	Depth (m)	EL. (m)	Log	Rock type	Core Recovery (%)	RQD	Depth (m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lagoon value	Sample	Casing	Cementation	Depth (m)
8/23	1				80	0						Green schist Light greenish grey, highly weathered, highly schistose, fine grained, with quartz mica schist.						1
	2				14	0												2
	3				0	0												3
	4				0	0												4
	5				0	0												5
8/24	6				20	0	5.65	F-E	5	d	D D	No core recovery from 1.25m to 5.60m in depth. Having a little quartz veins and specks.		Ln=(69) Po=3.3				6
	7				50	0	7											
	8				15	0	8											
8/29	9			Green schist	90	10		C	3	b-c	CM	At 6.15m, a 43 degree dipping smooth, fresh schistosity joint.		Ln=(75) Po=3.3				9
	10				58	20												10
	11				52	17												11
	12				26	0												12
8/30	13				16	0		C	4-5	e	CL	Agt. 10.15m, a 43 degree dipping rough fresh schistosity joint. Cores are crushed and washed away in sections of: 9.60 - 10.00m 10.65 - 11.00m 11.30 - 12.00m 12.20 - 13.50m 14.00 - 14.75m		Ln=14 Po=11			13	
	14				40	0											14	
	15				22	0											15	
	16				92	16											16	
8/31	17				90	14		C-B	3	b	CM	A smooth clay-coated schistosity joint of 40 degrees dipping at 14.75m. Weathering grows weaker downwards.					17	
	18				90	14											18	
	19				37	21											19	
	20				100	76											20	
1/9	21	22.35	478.903		94	51		C	4	b	CL	At 16.00m, a rough schistosity joint of 35 degrees dipping at 16.15m. At 18.20m, a rough, tight schistosity joint of 46 degree dip.		Ln=5.3 Po=12			21	
	22				100	77											22	
	23				98	49											23	
2/9	24			Siliceous schist	96	11		B-C	2-3	b-c	CH	At 19.30m, a 2cm thick quartz vein. At 19.50m, a smooth, tight joint at 25 degree.		Ln=20 Po=10			24	
	25				99	55											25	
	26				98	12											26	
	27				90	0											27	
3/9	28	28.10	423.153		92	32		B-C	3	b	CM	A rough, silt-coated joint of 41 degrees at 29.05m.		Ln=(24) Po=9.5			28	
	29				91	0											29	
	30				94	25											30	

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-15, 2/4

Hole No.: M98-15
 Ground EL.: 451.353 m
 Hole length: 100.09 m

Location: Dam Axis (Left bank)
 Drilling period: Aug. 13 - Sep. 23, 1992
 Hole Inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,125,000
 Easting: 3,967,834.841

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugron value	Sample	Casing	Corrosion	Depth (m)
	31				100	54						Green schist						31
	32				100	76						Rock of the same type continues.						32
	33				100	35						At 30.20 m, a 15 degree-dipping joint.						33
	34				98	80						At 32.00 m, a 30 degree-dipping smooth schistosity joint.		L=0.2 Po=13				34
	35				99	79						At 34.60 m, a 38 degree-dipping smooth schistosity joint. Two layers of 2 cm thick quartz veinlets at 34.80 m.						35
	36				100	29												36
	37				100	68												37
	38				98	54								L=0.1 Po=13				38
	39				100	82		B	2	b-a	CH	From 38 m to 45 m, the schistosity is weak.						39
	40				100	81						At 39.20 m, a 43 degree rough joint.						40
	41				98	67						At 40.00 m, a 25 degree stepped joint.						41
	42			Green schist	97	38						At 41.20 m, a 3 cm thick quartz vein.						42
	43				99	55						At 43 m, intensive microfolding with small grains of garnet.		L=0.1 Po=13				43
	44				97	46						At 44.40 m, a 4 cm thick quartz vein, with small grains of garnet.						44
	45				100	99						At 45.30 m, a 45 degree rough and tight joint						45
	46				94	56					CH		29.9 46.40m					46
	47				97	67												47
	48				97	69	49.10							L=0.6 Po=12				48
	49				97	38						A 2 cm thick quartz veinlet at 48.90 m of depth.						49
	50				100	67						A 2 cm thick quartz veinlet at 50.10 m.						50
	51				100	87												51
	52				100	51												52
	53				97	72		B	2	a-b	CH	At 53.00 m, a 45 degree smooth joint.		L=0.1 Po=13				53
	54				98	39												54
	55				95	30						54.00 m to 54.20m, quartz vein.						55
	56				99	72						At 54.90 m, a 52 degree rough, tight joint.						56
	57	57.20	394.053		100	74	57.10											57
	58				99	90						At 57.75 m, a 46 degree smooth and tight schistosity joint.		L=0.2 Po=13				58
	59			Siliceous schist	98	90		B-C	1-2	a	B							59
	60				100	82						At 59.90 m, a 36 degree smooth schistosity joint.						60

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-15, 3/4

Hole No.: M98-15

Location: Dam Axis (Left bank)

Azimuth: -

Ground EL.: 451.253 m

Drilling period: Aug. 23 - Sep. 23, 1999

Northing: 1,125,237.329

Hole length: 100.00 m

Hole Inclination: 90 degrees (Vertical)

Easting: 3,067,757.588

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugon value	Sample	Casing	Cementation	Depth (m)	
	61			Siliceous schist	100	90						Siliceous schist Getting talcosic downward. At 60.80 m, a 38 degree smooth, tight joint.						61	
	62				100	90													62
	63				100	76							Quartz veins in sections of 62.15 - 62.23 m and 63.50 - 63.57 m.		L=01 P=13				63
	64				100	82							Specks and veinlets of quartz are common.						64
	65				100	92													65
	66				100	90													66
	67				100	63													67
	68				100	90			B-C	1-2	a	B			L=01 P=13				68
	69				98	96						CH							69
	70				98	86							At 69.50 m, a 45 degree smooth, tight joint.						70
	71				92	84							At 70.60 m, a 45 degree smooth and tight schistosity joint.						71
	72				100	48													72
	73				100	94									L=01 P=13				73
	74				100	70							At 73.60 m, a 16 degree stepped tight joint.						74
	75				92	70													75
	76	76.00 76.30	375.253 374.953	Green schist Pelitic schist	100	98	76.30					75 to 76 m, quartz dominate. Schistosity is not clear. Including small garnet grains.						76	
	77	77.00	374.253	Psammitic schist (Pelitic)	97	26												77	
	78				99	37			B	3	a	CH	Psammitic schist (amphibole-garnet schist, quartz micaschist, etc.) Nearly the same rock type continues.		L=01 P=13			78	
	79				85	20							Colour of the rock grows greenish deeper than 78.45 m.					79	
	80				80	18			B	4	a	CM	A 45 degree smooth, tight joint at 78.80m.					80	
	81			100	58													81	
	82			100	79													82	
	83			100	41										L=01 P=13			83	
	84			100	72													84	
	85			100	59							At 84.05 m, a 36 degree smooth schistosity joint. Actinolite contained in 84.50 - 85.00 m.						85	
	86	86.13	365.103	Green schist	100	45												86	
	87				100	87													87
	88				100	88										L=01 P=13			88
	89				100	61							a 45 degree joint at 86.60 m, a 65 degree joint at 88.90 m, and a 35 degree joint at 89.80 m.					89	
	90			100	87													90	

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-15, 4/4

Hole No.: M98-15
 Ground EL.: 451.253 m
 Hole length: 100.00 m

Location: Dam Ads (Left bank)
 Drilling period: Aug 23 - Sep 23, 1999
 Hole inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,125,237.329
 Easting: 3,067,767.588

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L S.P.T.	Lugeon value	Sample	Casing	Corrosion	Depth (m)	
9.22	91	91.10		Green schist	100	84	91.65	B	1	a	B	Green schist						91	
	92			Pelitic schist	97	21							Pelitic schist deeper than 91.10m, complex of psammitic and pelitic schists. The pelitic schist is light greenish, fine grained, jointed, moderately schistose. Miccas and calcite included. Quartz veinlets and specks are also at places.					92	
	93	92.60		378.453		94	0	91.10	B	3.4	a	CH			Lu-01 Po-13				93
	94					97	85												
	95					99	87						CH						95
9.23	96			Psammitic schist (Pelitic)	100	84						At 95.60 m, a 42 degree smooth schistosity joint.						96	
	97				100	91		B	2	a-b	CH	At 95.60 m, a 35 degree smooth schistosity joint.						97	
	98				100	85								Lu-01 Po-13				98	
	99				100	76												99	
	100	100.00		351.253		100	64												100

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-16, 1/3

Hole No.: **M98-16**
 Ground EL.: **546.267 m**
 Hole length: **70.00 m**

Location: **Dam Axis (Left bank)**
 Drilling period: **Jul. 20, 1999 - Aug. 7, 1999**
 Hole inclination: **90 degrees (Vertical)**

Altitude: **•**
 Northing: **1,125,411.039**
 Easting: **3,067,732.004**

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugson value	Sample	Casing	Depths (m)	
	1		△ △ △	Tuff Deposit	0	0						0.0-1.0: Cutting composed of light grey and loose fine sand. 1.0-1.7: Cutting composed of light grey and loose coarse to medium sand.					1	
7/20	2	544.567	△ △ △		0	0	1.70										2	
	3				16	0			F	5	d	D D					3	
7/22	4				0	0						Schistose planes are composed of white mica showing slippery nature. Quartz veins in variable shapes and scales exist as follows: 2.2-2.4: Irregular-shaped quartz veins 6.3-7.0: lens-shaped quartz veins of less than 2 cm thick. 11.0-12.5: lens-shaped quartz veins of less than 2 cm thick. Rock conditions: 1.7-2.4: Highly weathered, composed of rock fragments of 2 cm to 5 cm in diameter. 2.4-4.8: Cutting composed of loose, light grey, medium-grained sand. 4.8-5.5: Highly to moderately weathered, reddish brown. Rock fragments are brownish and softened. Joint planes are stained to be dark brown. 5.5-6.0: Cutting composed of grey medium grained sand. 6.0-6.5: Moderately weathered. Rock fragments are stained and slightly softened. Joint planes are stained to be dark brown. 6.5-7.0: Slightly to moderately weathered and slightly altered. Rock fragments are slightly stained and slightly softened. Joint planes are stained, almost light. 7.0-12.4: Slightly to moderately weathered. Rock pieces are slightly stained. Most of joints are along schistosity (50°-70°). Joint planes are brownish and slightly softened. 12.4-15.0: Moderately to slightly weathered, fairly jointed. Rock pieces are slightly stained. Joint planes are brownish and slightly softened. 15.0-20.0: Slightly weathered, fairly jointed along schistosity (60°). Joint planes are stained, brownish. No distinct deterioration along the joints. 20.0-20.8: Slightly weathered, fairly stiff due to high content of silica. Joints are along schistosity (50°-60°) with an interval of 5cm to 30cm. 20.8-21.6: Slightly to moderately weathered, relatively friable due to high content of mica, fairly jointed. 21.0-21.5: Cutting 21.6-23.6: Slightly weathered, fairly jointed along schistosity (60°). Joint planes are stained, brownish. No distinct deterioration along the joints.				La-1(105) Poc 21		4
	5				18	0	4.80										5	
	6				50	0	5.50	D	3-4	c-d	CL						6	
7/23	7				80	15	6.00	F	5	d	D						7	
	8				95	28	6.50	C-D	4	c	CL						8	
7/24	9				98	0	7.00	C	3	b	CM						9	
	10				93	0	7.95	B-C	2-3	ba	CH						10	
	11			Siliceous Schist	100	22	9.55	C-B	3	b	CM						11	
	12				99	48	10.05	D-C	4	b-c	CL						12	
7/25	13				58	18	12.40										13	
	14				50	0											14	
	15				80	0	15.00	C-B	4	b-c	CL						15	
	16				90	0											16	
	17				99	27											17	
7/26	18				100	13			B-C	3-4	b	CM					18	
	19				99	0											19	
	20				98	30	20.00										20	
	21				91	50	20.80	B	2-3	ba	CH						21	
	22				50	0	21.60	F	5	d	D						22	
7/27	23	523.567			55	20			B-C	4-3	b-c	CM					23	
	24				97	25	23.60										24	
	25				55	18	24.50	E	4-5	c-d	D						25	
	26			Plutonic (Granitic) Schist	75	0	26.20	C-D	4	c-b	CL						26	
	27				90	0	27.00	C-B	3-4	b-c	CM						27	
7/28	28	517.817			55	24	27.40	F	5	d	D						28	
	29	28.45			100	32	28.50	C	3	b-c	CM						29	
	30	516.267		Siliceous Schist	98	30	29.60	B	2	ba	CH						30	

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-16, 2/3

Hole No: M98-16
 Ground EL: 515.267 m
 Hole length: 70.00 m

Location: Dam Axis (Left bank)
 Drilling period: Jul. 20, 1999 - Aug. 7, 1999
 Hole inclination: 90 degrees (Vertical)

Azimuth:
 Northing: 1,125,441.039
 Easting: 3,067,732.004

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugson value	Sample	Casing	Commentation	Depth (m)
7/31	31	515.467	[Pattern]	Pelitic Schist (Psammite)	97	34	33.70	B-C	3	b-c	CM	Rock type (31.0-31.6, 31.6-34.35): Dark to dark grey pelitic schist, well schistose (37-60° foliated), intercalated with thin silty clay layers, containing relatively high amount of mica and thin veins of secondary quartz.	1.10 43.0m	L=0.6 P=11	[Symbol]	7/31	31	
	32	514.667		Siliceous Schist	92	22						32						
	33			Pelitic (Psammite) Schist	98	13						33						
	34	511.917			93	32						34						
8/1	35		[Pattern]	Siliceous Schist	100	55	40.80	B	2-1	a-b	CH	Rock type (30.8-31.6, 34.35-50.0): White to light grey siliceous schist, well schistose (50°-60° foliated), composed of thin alternating rocks of white layers and grey layers. 34.35-38.0: Relatively high content of quartz. 38.0-47.5: High content of white mica, containing dots of iron mineral of about 4 mm in dia. 38.1-38.8, 39.4-40.0: micro folding (Z-shaped).	2.10 50.3m	L=2.2 P=15	[Symbol]	35		
	36				94	56						36						
	37				99	76						37						
	38				100	41						38						
	39				100	59						39						
	40				98	90						40						
	41				97	37						41						
	42				98	21						42						
	43				100	60						43						
	44				98	73						44						
8/2	45		[Pattern]	Siliceous Schist	75	0	44.20	C	3-4	b	CM	Rock condition: 41.7-46.4: Slightly weathered to fresh, fairly jointed. Rock pieces are almost fresh. Joints are mostly along schistosity (80°-60°). 44.4-45.0: Well jointed. 46.4-51.0: Slightly weathered, well jointed. Partly oxidized (47.6-48.0, 48.75-49.0, 49.9-50.0). 49.6-51.0: Slightly to moderately altered, containing irregular shaped quartz vein / black iron mineral / brown iron oxide / irregular-shaped dissolution cavities (less than 5 mm in dia).	1.10 43.0m	L=0.6 P=11	[Symbol]	45		
	46				100	62						46						
	47				82	14						47						
	48				60	40						48						
8/3	49		[Pattern]	Siliceous Schist	85	0	45.40	B-C	2-3	b	CH	1.10 43.0m	L=0.6 P=11	[Symbol]	49			
	50	53.00			80	0									50			
	51	496.267			98	10									51			
8/4	52		[Pattern]	Green Schist	100	0	51.60	C-D	4-3	e-b	CL	Rock type: Light greenish grey, medium grained green schist, well schistose (30°-50°). 50.0-56.0, 60.4-60.6: Schistosity is irregularly folded or undulated. Quartz veins exist at 50.8-50.9 (irregular), 51.7 (50°, 2.4 mm thick), 51.9 (folded, 5 mm thick), 51.95 (30°-50°), 52.5-52.9 (irregular, many, less than 3 mm thick), 53.8-53.85 (45°), 55.05 (fragmented), 55.4-55.45 (20°, 2 cm thick), 55.0-55.6 (irregular, many, less than 3 mm thick), 59.8 (30°, 1 cm thick), 60.0-60.35 (irregular), 60.7 (40°, 5 mm thick).	2.10 50.3m	L=1.1 P=11	[Symbol]	52		
	53				90	22						53						
	54				82	0						54						
	55				77	0						55						
	56				90	0						56						
8/5	57		[Pattern]	Green Schist	75	0	54.50	C	4	b-c	CL	Rock condition: 51.0-54.0: Slightly weathered, well jointed. Rock pieces are almost fresh to slightly stained. Most of joints are along schistosity (30°-80°). Joint planes are stained. 54.0-61.65: Almost fresh, well jointed. Rock pieces are fresh. Most of joints are along schistosity (30°-50°). Joint planes are fresh, partly intercalated with fine materials.	1.10 43.0m	L=0.9 P=11	[Symbol]	57		
	58				95	12						58						
	59				83	0						59						
	60				95	0						60						

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-16, 3/3

Hole No.: M98-16

Location: Dam Axis (Left bank)

Azimuth:

Ground EL: 546.267 m

Drilling period: Jul. 20, 1999 - Aug. 7, 1999

Northing: 1,125,441.039

Hole length: 70.00 m

Hole inclination: 90 degrees (Vertical)

Easting: 3,067,732.004

Date	Depth(m)	EL.(m)	Log.	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugon value	Sample	Casing	Cementation	Depth (m)
	61			Green Schist	92	11	61.65	B-C	4-3	b	CM	61.65-64.5: Almost fresh, fairly jointed. Rock pieces are fresh. Most of joints are along schistosity (30°-50°). Joint planes are fresh, partly intercalated with fine materials. 62.1-62.65: Irregular shaped quartz veins are dominant.		L=0.2 P=12				61
	62		96		43	62												
	63		98		50	63												
	64		94		36	64												
	64.50	481.767		Sillaceous Schist	100	20	B	2-3	a-b	CH	64.5-65.7: White to light grey siliceous schist, well-schistosed (60°-70°), composed of thin alternating rocks of white layers and grey layers. High content of white mica and pyrite. 65.7: Thin layer of pyrite (70°, T=2 cm). 68.45-68.9: High content of irregular shaped quartz veins of less than 2 cm thick. 64.5-65.0, 67.2-67.5: Almost fresh, partly jointed. Joint planes are along schistosity, almost fresh.	L=0.2 P=11				65		
	66		100		93	66												
	67		100		74	67												
	68		100		71	68												
	68.90	477.367		Pamatic Schist	100	78					68.9-70.0: Dark grey pamatic schist, well-schistosed (20°-70°, folded), composed of alternating rocks of thin layers of fine-grained dark portion and medium grained light portions. Rock condition: Fresh, rarely jointed.						69	
	70	476.267			100	63											70	

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-17, 1/2

Hole No.: **M98-17**
 Ground EL.: **571.869 m**
 Hole length: **60.00 m**

Location: **Dam Axis (Left bank)**
 Drilling period: **Aug. 2, 1992 - Aug. 23, 1992**
 Hole inclination: **90 degrees (Vertical)**

Azimuth: **-**
 Northing: **1,125,569.789**
 Easting: **3,067,740.659**

Date	Depth (m)	EL. (m)	Log	Rock type	Core Recovery (%)	RQD	Depth (m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugon value	Sample	Casing	Concentration	Depth (m)						
	1				32	0	0.60	F	5	d	D	Rock type: Siliceous Schist							1					
	2				32	0		C-D	4	e-b	CL	White light grey, alternate thin layers (like laminae) of 1 cm to 5 cm thick, highly schistosity dipping 60° in general							2					
	3				81	22	2.50					White layer consists of quartz and feldspar. Grey layer consists of white mica, chlorite, biotite.							3					
	4				97	55		C	3	b-c	CM	Schistosity plane is composed of white mica showing slipper nature.							4					
	5				90	23						Quartz veins in variable shapes and scales are common as follows: 4.0-4.3 (40°): 15 cm thick 4.7-4.8 (80-90°): parallel to schistosity, max. 3 cm thick, containing dissolution cavities of less than 1 cm long. 6.4-6.5 (20-40°) 10.9 (60°): 5 cm thick 11.6-11.7 (40°): irregular shaped 12.0-13.75: irregular shape & associated with irregular shaped pyrite mica clots. 15.2-15.8: high content of quartz veins of less than 5 cm thick along schistosity.						3/5	5					
	6				94	48						17.4-17.5: irregular shaped 22.9-23.0 (40°): along schistosity, less than 5 cm thick.							6					
	7				100	63		B	2-3	b	CH	Microfracturing is observed at 5.6-6.3, 9.25-9.6 (Z shape), 10.7-10.9, 23.0-24.8.							7					
	8				94	21	7.40					Rock condition: 0.0-0.6: Cutting, brownish light grey, consisting of sand- to silt-sized grains. 1.0-1.2, 1.6-1.8, 2.3-2.5: Cutting, light grey, consisting of sand sized grains. 0.6-1.0, 1.2-1.6, 1.8-2.3: Rock fragments of less than 1 cm in dia., consisting of moderately weathered siliceous schist, containing fine grained materials at 0.85-0.9 m. 2.5-2.7: Moderately to slightly weathered. Rock pieces are slightly stained and slightly softened. Joint planes are stained and mostly along schistosity (60°).								8				
	9				97	92						Major joints: 3.1 (70°): joint plane is almost fresh, stepped, slicken side of 15° plunge indicating counterclockwise rotation. 3.5-3.6 (60°): undulating, fairly smooth, stained. 4.15-4.35 (50°): fragmented, slightly stained. 5.0-5.2 (40°): fragmented, fairly rough.							9					
	10				97	48						5.2-7.4: Slightly weathered. Rock pieces are almost fresh to slightly weathered. Joint planes are mostly stained and partly softened.							10					
	11				99	73						Major joints: 5.6 (35°), 5.8 (25°): rough, slightly stained with brown/black iron oxide. 5.9 (50°): smooth, intercalated with clayey film. 6.4 (65°): fairly rough, almost fresh, along schistosity. 7.4-8.0: Slightly to moderately weathered. Slightly altered. Most of joints are along schistosity, smooth, slightly stained. Dissolution cavities of less than 1 cm long at 7.4 m. 8.0-19.0: Slightly weathered. Rock pieces are slightly stained to fresh. Most of joint planes are stained and almost tight.												11
	12				100	58						Major joints: 9.4 (60°, 40°): stained, stepped, rough. 10.7 (50°), 11.05 (40°), 11.65 (40°), 11.7 (60°), 11.9 (70°): stained, smooth.							12					
	13				100	65		B	2	b	CH	12.0-13.75: undulating joints accompanied with dissolution cavities of less than 1 cm long. 15.0 (50°), 15.2 (60°), 15.3 (50°), 15.5 (30°): fairly smooth, slightly stained. 17.4-17.6 (60-30°): closely jointed.							13					
	14				100	62						19.0-20.0: Slightly weathered. Rock pieces are fresh to slightly stained. Most of joints are along schistosity, fairly smooth, stained.							14					
	15				100	90						20.0-23.5: Slightly weathered. Rock pieces are fresh to slightly stained. Most of joints are along schistosity, stained, fairly smooth, tight.							15					
	16				99	91						23.5-24.0: Well jointed and slightly weathered. Rock pieces are slightly stained to fresh. Joints are irregular in direction, slightly stained to fresh.							16					
	17				100	73						24.0-27.6: Slightly weathered. Rock pieces are fresh to slightly stained. Most of joints are stained, fairly smooth, along schistosity except the following: 25.5 (55°): stained, smooth. 25.75 (5°): stained, fairly smooth. 26.4 (60°): stained, smooth.							17					
	18				100	45	17.20	C	4	b	CL	26.9 (50°): almost fresh, stepped, slicken side plunging 20° indicating counterclockwise rotation. 27.6-28.35: Slightly to moderately weathered and well-jointed. Rock pieces are slightly stained. Most of joints are stained, dipping 30° parallel to schistosity.							18					
	19				99	54	19.20	B	2-3	b	CH	28.35-29.65: Slightly weathered. Rock pieces are slightly stained to fresh. Most of joints are stained, partly fresh.							19					
	20				99	32	20.00	C	3-4	b	CM	29.65-30.0: Well jointed, slightly weathered. Rock pieces are slightly stained, partly intercalated with brown films along joints.							20					
	21				100	28													21					
	22				100	83		B	2	b-a	CH								22					
	23				98	95													23					
	24				97	54	23.50												24					
	25				98	83	24.00	B	4	b	CM								25					
	26				100	59		B-C	2	b	CH								26					
	27				100	39													27					
	28				96	27	27.60	B-C	4	b-c	CM								28					
	29				96	17	28.35	B	3-2	b	CH								29					
	30				99	45	29.65	C	4	b-c	CM								30					
							30.00																	

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M198-17, 2/2

Hole No.: M198-17
 Ground EL.: 571.860 m
 Hole length: 60.00 m

Location: Dam Axis (Left bank)
 Drilling period: Aug. 2, 1999 - Aug. 23, 1999
 Hole Inclination: 90 degrees (Vertical)

Altitude: -
 Northing: 1,125,569.789
 Easting: 3,067,740.659

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	GWL S.P.T.	Lagoon value	Sample	Casing	Cementation	Depth (m)
8/11	31			Siliceous Schist	100	33	34.65	B	3	b	CH CH	Rock type: Siliceous Schist • White light grey, alternate thin layers (like laminae) of 1 mm to 5 mm thick, highly schistose dipping 60° in general. • Quartz veins in variable shapes and scales are scattered as follows: 35.2-35.45: tightly folded, Z-shaped, less than 2 cm thick. 36.0-36.4: folded, less than 2 cm thick. 43.05-43.15: irregular shaped to folded, less than 1 cm thick. 48.2-49.4: high content of irregular shaped quartz veins to lens, accompanied with pyritic chlorite layers. • Microfolding is observed at 32.5-34.9 (Z-shaped), 38.5-38.8, 43.7-44.0. • 41.8-45.0: Relatively high content of white mica.	Lu=5.6 Po=13				31	
	32	98	39		32													
	33	97	66		33													
	34	98	51		34													
	35	97	55		35													
8/13	36			Siliceous Schist	100	87	41.00	B-A	I	a-b	B B	Rock condition: • 30.0-34.65: Slightly to moderately weathered. Rock pieces are slightly stained to fresh. Most of joints are along schistosity, stained, smooth, and tight as follows. 30.75-30.9 (40°, 60°), 32.3 (70°): stained, fairly rough. 32.95-33.0 (45°): well jointed, stained, intercalated with clayey materials. 33.6 (60°): slightly stained, intercalated with clayey materials of about 1 cm thick. 33.95-34.1 (40-60°): well jointed, slightly stained, intercalated with thin clayey film. 34.1-34.4 (80°): fairly rough, stained. • 34.65-41.0: Fresh to slightly weathered, rarely jointed. Rock pieces are fresh to slightly stained. Most of joints are along schistosity, slightly stained to fresh, tight, fairly smooth. • 41.0-41.45: Well jointed, fresh to slightly weathered. Rock pieces are fresh. Most of joints are along schistosity, rarely stained. • 41.45-50.45: Slightly weathered. Rock pieces are fresh to slightly stained, not sulfided. Most of joints are slightly stained, tight, along schistosity.	Lu=0.3 Po=14			36		
	37	100	74		37													
	38	99	95		38													
8/16	39			Siliceous Schist	98	79	41.45	B-C	4	b	CM		Lu=0.4 Po=14				39	
	40	96	94		40													
8/17	41			Siliceous Schist	99	84	41.00	B-C	4	b	CM		Lu=0.4 Po=14					41
	42	98	16		42													
	43	95	0		43													
8/18	44			Siliceous Schist	97	59	41.00	B-C	4	b	CM		Lu=0.4 Po=14					44
	45	100	16		45													
8/19	46			Siliceous Schist	98	70	41.00	B-C	4	b	CM		Lu=2.6 Po=15					46
	47	100	51		47													
	48	100	58		48													
8/20	49			Siliceous Schist	100	82	41.00	B-C	4	b	CM		Lu=2.6 Po=15					49
	50	99	59		50													
8/21	51	50.45	521.41	Pelite Schist	100	53	41.00	B	3-2	b-a	CH CH	Rock type: • 50.45-51.1, 51.7-55.75: Pelitic schist; black to dark grey, fine to medium grained, well schistose (70-80°). • 51.1-51.75: Siliceous schist; consists of quartz, feldspar and white mica mainly, well schistose (70-80°). • Pelitic schist is frequently intercalated with quartz veins of less than 5 cm thick as mentioned below. 50.55-50.95: quartz lens of less than 3 cm thick, elongated parallel to schistosity (70°). 52.83, 53.3, 53.5, 53.75, 54.4, 54.8, 55.25: quartz veins of less than 3 cm thick, irregularly elongated parallel to schistosity (35-60°). 55.4-55.5, 55.6-55.75, 55.8-55.9: undulated quartz veins of 2cm - 5cm thick. • Irregular microfolding: 51.7-51.9 Rock condition: 50.45-55.75: Slightly weathered, slightly sheared. Rock pieces are almost fresh to slightly stained. Most of joints are slightly stained to fresh, along schistosity.	Lu=2.0 Po=15			51		
	52	51.70	520.16	Siliceous Schist	100	71										52		
	53			Pelite Schist	100	56										53		
8/22	54			Siliceous Schist	100	82	41.00	B	3-2	b-a	CH CH		Lu=0.4 Po=16					54
	55	100	47		55													
8/22	56	55.75	516.11	Siliceous Schist	100	45	60.00					• 50.45-55.75: Slightly weathered, slightly sheared. Rock pieces are almost fresh to slightly stained. Most of joints are slightly stained to fresh, along schistosity.	No ground water					56
	57				100	60												57
	58				100	62												58
	59				100	67												59
60	60.00	511.86			100	36												60

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-18, 1/1

Hole No.: M98-18
 Ground EL.: 565.313 m
 Hole length: 30.00 m

Location: Dam Axis (Left bank)
 Drilling period: Aug. 31 - Sep. 07, 1999
 Hole inclination: 90 degrees (Vertical)

Altitude: -
 Northing: 1,124,715.167
 Easting: 3,067,955.256

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugeon value	Sample	Casing	Cementation	Depth (m)	
	1				0	0		F	5	d	D	Weathered siliceous schist Highly weathered, greyish white, fine grained, with mica and garnet.						1	
	2				33	0	1.70	D	4	b-c	CL							2	
	3				90	0	2.85					Siliceous schist, moderately to slightly weathered Light brownish white to white, fine-grained. Joints along the schistosity are frequent. Stained by iron oxide. Garnet is common. The schistosity dips at 40 to 45 degrees. The rock is dominantly composed of quartz, while quartz vein and speck are rare. A smooth schistosity joint of 38 degree dip at 3.50 m. A similar with 48 degrees of dip at 4.75 m						3	
	4				97	0	4.05	D	3	b-c	CM								4
	5				97	75													5
	6				100	71		C-D	2	b	CH								6
	7				93	73													7
	8				75	50	7.70												8
	9				33	0	8.60	E	5	d-c	D								9
	10				33	15	9.40	D	3	b	CL							10	
	11				40	0	10.10	F	5	d	D	At 9.30 m, a schistosity joint with rough surface, dipping at 42 degrees.						11	
	12				88	46	11.20	D	3-4	b-c	CL							12	
	13				94	76	12.05	C	3	b-c	CM							13	
	14			Siliceous schist	95	67		C	2	b	CH	Deeper than 12 m, quartz contents increase and the schistosity gets less prominent. At 12.70 m, a 42-degree rough schistosity joint.						14	
	15				90	33	14.70											15	
	16				100	45	15.90	C-D	3	b-c	CM	At 15 m, a vertical joint with rough surface.						16	
	17				100	52						From 15.0 m to 17.0 m, slightly weathered with strong schistosity.						17	
	18				100	50		C	2-3	b	CH							18	
	19				100	10	18.30											19	
	20				85	37	19.30	C	3	b	CM							20	
	21				100	48						At 20.0 m, a 43-degree rough joint.						21	
	22				100	67												22	
	23				100	54		C	2-3	b	CH	At 22.15 m, smooth schistosity joints of 46 degree dip are closely developed.						23	
	24				100	60												24	
	25				100	75												25	
	26				100	19	25.00	C	3-4	b	CM	At 24.90 m, a 44-degree smooth schistosity joint.						26	
	27				100	42						At 25.0 m, a 40 degree smooth schistosity joint, stained.						27	
	28				97	23	27.40	C	2-3	b	CH							28	
	29				100	26	28.00	C	3-4	b	CM	At 27.30 m, a 43 degree dipping smooth schistosity joint.						29	
	30	535.313			96	75	30.00	C-B	2	b-a	CH	At 28.70 m, a 20cm long vertical joint with rough surface. Quartz vein and specks develop.						30	

BOTTOM OF THE BOREHOLE

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-19, 1/3

Hole No.: M98-19
 Ground EL.: 488.720 m
 Hole length: 70.00 m

Location: Flint Line (left Bank)
 Drilling period: Aug. 18 - Sep. 06, 1999
 Hole Inclination: 90 degrees (Vertical)

Azimuth:
 Northing: 1,125,285.282
 Easting: 3,067,590.815

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Logon value	Sample	Casing	Cementation	Depth (m)	
	1			Psammite Schist (Pelitic)	22	0	0.0	F	5	d	D	Psammite schist Light whitish grey, fine grained, highly schistose, highly jointed, consisting of mica, amphibole and feldspar. Intensively weathered to the depth of 2 m.						1	
	2				79	0	1.40	D	4	b-c	CL	CL							2
	3				100	65							Iron oxide stain is occasionally seen.						3
8/18	4				100	62							Schistosity joints are very common, with smooth joint planes.		Lu(40)				4
	5				100	10			B-C	3-4	b	CM	At 3.70 m, a smooth joint dipping at 55 degrees. At 4.0 m, a smooth joint dipping at 40 degrees.						5
	6				100	41							Dip of schistosity is 40 to 45 degrees.						6
	7				100	52							Micro-folding at 7 m.						7
8/19	8				100	55		7.80				CM			Lu(8.9)				8
	9				97	10		8.80	CB	4	b-c	CL							9
8/20	10				95	21							At 9.50 m, a joint with rough plane and stain dips at 45 degrees.						10
	11				96	38			B-C	3	b	CM							11
8/21	12				82	10		11.85					11.25 m - 11.45 m, Quartz vein.						12
	13				90	0		12.10	C	4-3	b-c	CL			Lu(5.4)				13
8/22	14				97	12		13.90	B-C	3	b	CM							14
	15				96	0		15.00	C	4	b	CL							15
	16				96	0							16.30 m - 16.65 m, intercalation of meta-volcanic rock with mica and amphibole.						16
8/24	17	16.85	471.870		99	51						CM	At 17.0 m, a 38-degree-dipping joint with rough and stained surface.		Lu(7.8)				17
	18			97	36			B-C	3	b-c	CM	18.00 m - 18.35 m, a vertical joint, stained and rough surface.						18	
	19			100	30							18.50 m - 18.85 m, quartzite.						19	
	20			96	57		19.40					Calcareous, deeper than 19 m.						20	
8/25	21			100	89							Light whitish grey, fine-grained, fairly to moderately hard, moderately schistose and moderately jointed, with small mica flakes.						21	
	22			100	65							Dip of schistosity is 40 to 50 degrees.						22	
	23			100	86							Slightly weathered or fresh.		Lu(214)				23	
8/26	24			96	71													24	
	25			91	79			B	2	a-b	CH	CH						25	
	26			90	65							At 25.50 m, a rough joint with iron-oxide-stain, dipping at 32 degrees.						26	
8/27	27			99	80							At 25.70 m a 62-degree-dipping smooth joint.						27	
	28			97	70									Lu(14)				28	
	29			100	64							At 28.70 m, a 45-degree iron-stained, smooth joint.						29	
8/28	30			100	71													30	

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-19, 2/3

Hole No.: M98-19
 Ground EL.: 488.720 m
 Hole length: 70.00 m

Location: Plinth Line (Left bank)
 Drilling period: Aug. 18 - Sep. 06, 1999
 Hole inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,125,285.282
 Easting: 3,067,573.815

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugon value	Sample	Casing	Cementation	Depth (m)
	31			Psammitic Schist	100	64					CH	Psammitic schist, (calcareous)						31
8/28	32				98	77		B	2	a-b	CH	At 31.40 m, a 8 cm thick quartz vein.						32
	33				95	25	32.95						At 32.30 m, a 25-degree dipping smooth joint, filled with fine material.	Lu=0.9	Po=2.0			33
	34				90	0	34.05	C	4	b-c	CL							34
8/29	35				96	20						CM	At 34.35 m, a 24 degree-dipping smooth joint.					35
	35	35.30	453.620		97	0		B-C	3	b	CM	Metamorphosed Dolerite and Tuff						35
	36			Green Schist	96	52	35.35					Light greenish, fine grained, hard, fresh, sparsely jointed.						36
	37				98	37						At 37.55 m, a joint dipping at 37 degrees.	Lu=0.6	Po=1.2				37
	38				100	67		B-A	2	a	CH	At 38.15 m, a smooth and stained joint dipping at 32 degrees.						38
	39				97	92						38.55 m - 38.70 m, Highly schistose, with a 3cm thick quartz vein.						39
8/31	40				100	72						From 41.25 m, transitional to the psammitic schist.						40
	41	41.40	447.320		99	31	41.25											41
	42			Psammitic Schist (Pelitic)	100	0	42.85	B	4	b	CM	Psammitic schist (calcareous, pelitic)	Lu=0.18	Po=8.3				42
	43				98	82						White grey, fine grained, fresh, jointed, hard, moderately to highly schistose rock.						43
	44				99	27						Joint planes are often coated with fine material.						44
9/1	45				100	50						At 43.85 m, a smooth, fresh joint dipping at 60 degrees.						45
	46				100	90						At 46.1 m, a smooth joint dipping at 45 degrees with the joint plane coated by fine material.						46
	47	46.90	441.820		55	46					CH	Pelitic schist (psammitic, fine chlorite schist)	Lu=0.3	Po=15			47	
	48			Pelitic Schist (Psammitic)	100	16						Light whitish grey, fine-grained, highly schistose, frequently jointed, associated by fine calcareous veins and specks. Schistosity joints are common.						48
	49				100	20		B	3	a-b	CH	Dip of schistosity shows generally 45 to 65 degrees.						49
9/2	50				100	33						At 50.0 m, a smooth schistosity joint dipping at 55 degrees.						50
	51				100	55						At 50.3 m, a smooth schistosity joint dipping at 60 degrees. The joint plane is coated with fine material at places.						51
	52				100	14								Lu=0.1	Po=15			52
	53			Pelitic Schist (Psammitic)	100	12												53
9/3	54				98	30												54
	55				97	10												55
	56				100	10	55.60											56
	57				90	0								Lu=0.5	Po=11			57
	58			Psammitic Schist	95	0		B-C	4	b-a	CM							58
9/4	59				97	0	59.40											59
	60							B	3-4	a	CH	CH						60

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M98-19, 3/3

Hole No.: M98-19
 Ground EL.: 438.720 m
 Hole length: 70.0 m

Location: Plinth Line (Left bank)
 Drilling period: Aug. 18 - Sep. 06, 1999
 Hole inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,125,285.282
 Easting: 3,067,590.815

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugon value	Sample	Casing	Cementation	Depth (m)						
9.4	61	418.720		Pelitic Schist (Psammite)	96	10	62.15	B	3-4	a	CH	Pelitic schist The same rock type continues to the bottom of the hole.						61						
	62				100	30												62						
	63				100	0												63.00	B	4	a	CM	L=0.0 P=16	63
	64				100	12												64.00	B	3	a	CH	64	
	65				98	0												64.80	B-C	4	a	CM	65	
9.5	66				100	34												66						
	67				100	0		B	3	a	CH							67						
	68				98	0	68.20						87/95m	L=0.0 P=17				68						
	69				90	0	69.45	B-C	4	a-b	CM							69						
9.6	70	70.00	418.720		100	10	70.00	B-C	3-4	a-b	CH							70						

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

M93-20, 1/1

Hole No.: M98-20
 Ground EL.: 418.234 m
 Hole length: 30.0 m

Location: Diversion tunnel intake
 Drilling period: Sep. 14 - Sep. 25, 1999
 Hole inclination: 90 degrees (Vertical)

Azimuth:
 Northing: 1,125,104.856
 Easting: 3,067,375.848

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L S.P.T.	Logson value	Sample	Casing	Cementation	Depth (m)						
	1			Terrace deposit	0	0						Alluvial deposit Light brown loose gravel with silty sand, seeming with 35% fine and 65% sand. Pitting up to 1.75 m.						1						
	2				80	0														2				
	3				10	0								1.9x10 cm/sec						3				
	3.50	414.734			75	10	3.50					Surface of the bedrock at 3.50 m.							3.50					
	4			Pelitic schist	85	0						Pelitic schist (fine grained) Dark grey, fine grained, highly weathered, jointed and moderately schistose. Weathered garnet grains included. Joints are stained by iron oxide. Patches and veins of quartz occur. At 6.55 m, a joint with the 75 degree dip, with rough plane. Micro-foldings at 6.70m, 7.10m, 7.70m & 8.00m 11.0m - 11.5m, Amphibolite schist. 11.30 m, a joint with the 41 degree dip, with smooth and stained joint plane. 14.25m, a 45 degree dipping joint, rough and stained. 17.00m - 17.60 m, Sample is washed away. Pelitic schist (Calcareous) Light whitish grey, fine grained, hard, highly jointed, slightly weathered, with mica and amphibole and high concentration of calcite. Quartz patches. Dip of the schistosity is 40 to 50 degrees. At 25.70 m, a 44 degree dipping rough joint. Down from 26.5 m, highly calcareous (impure limestone). Fairly to moderately hard. Core is often washed in soft rock sections.												4
	5				47	0			C	4-3	b-c		CL	5.7x10 cm/sec						5				
	6				97	10	6.50													6				
	7				55	23	7.25		C	3-4	b-c		CM							7				
	8				50	10	8.60		C	4	e-b		CL	Ln=5.0 P=7.4						8				
	9				96	13	9.00		E	5	d		D							9				
	10				90	0			C	4-3	b-c		CL							10				
	11				90	0	11.00													11				
	12				77	33														12				
	13				60	12			C	3	b		CM	Ln=1.4 P=11						13				
	14			61	22	14.35		F	5	d	D							14						
	15			90	0	14.75		C	4	b	CL							15						
	15	16.00	402.234		90	0	15.00	C	4	b	CL							15						
	16			90	0	15.70		C-D	3-4	b-c	CM							16						
	17			95	50	16.20		C-D	4	b-c	CL							17						
	18			60	15	17.00		C	3-2	b	CM	Ln=1.7 P=8.4						18						
	19	19.00	399.234		85	16	17.60	D	4-5	b-c	CL							19						
	20			90	21	19.35		C	3-4	b-c	CM							20						
	21			80	0			C	4	b-c	CL							21						
	22			55	0	21.45						Ln=11 P=11						22						
	23			90	13													23						
	24			90	28			C-B	3-4	b	CM							24						
	25			91	0													25						
	26			60	0													26						
	27			60	0	26.75												27						
	28			35	28	27.00		E	5	d	D	Ln=0.3 P=13						28						
	29			30	0	27.45		C-B	3	b	CM							29						
	30	30.00	388.234		30	15	28.00	E	5	d	D							30						
	30						28.50	C	4	b	CL							30						
	30						29.70	E	5	d	D							30						
	30						30.70	C-B	3	b	CM							30						

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

Qs-1, 2/2

Hole No.: Qs-1
 Ground EL.: 528.236 m
 Hole length: 50.00 m

Location: Sappare Quarry
 Drilling period: Jan. 9, 1999 - Feb. 15, 1999
 Hole inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,126,172.176
 Easting: 3,070,357.495

Date	Depth(m)	EL.(m)	Log.	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Logon value	Sample	Casing	Cementation	Depth (m)		
2/6	31			Limestone	100	85	31.00	A-B	2	a	B	28.71 (20): rough, stained 30.3 (45): rough 30.5 (37): rough 30.85 (62), 31.3 (48), 32.15 (30), 32.6 (38), 33.7 (52), 34.13 (15): rough, stained 34.2 (20): smooth 34.7 (50), 35.4 (42): rough, along calcite vein 36.28 (60): rough, slightly stained 36.79 (46), 36.85 (29): rough, stained 37.61 (37): rough 38.2 (65), 38.35 (40), 38.45 (40): rough, stained 38.55 (42), 38.65 (35): stained 39.75 (67): rough, along calcite vein 39.9 (62), 40.55 (54), 40.85 (20), 41.0 (27), 41.12 (30), 42.0 (45), 42.6 (48), 42.8 (47): rough, stained 43.05 (46), 43.6 (46): rough, along calcite vein 44.5 (39): smooth 44.70 (53): smooth, stained 46.0 (50): rough, filled 46.5 (85): rough, stained 47.0 (38), 48.25 (45): rough 48.65 (44), 49.2 (17), 49.7 (11): rough, stained								
	32				100	74														
	33				100	82														
	34				100	94														
	35				100	55														
	36				100	81			A-B	2	b-a	CH								
	37				100	43														
	38				100	20														
	39				100	15														
	2/7	40				100	72	33.70												
2/9	41			100	42	43.60	A-B	3-4	b-a	CM										
	42			100	40						CH									
2/10	43			100	26															
	44			100	56															
	45			100	45															
2/11	46			100	74		A-B	3	a-b	CH										
	47			100	31															
	48			100	85															
2/14	49			100	45															
	50			100	36	50.00														

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

Qs-2, 2/4

Hole No.: Qs-2
 Ground EL.: 513.373 m
 Hole length: 100.00 m

Location: Sappare Quarry
 Drilling period: Feb. 24, 1999 - Jun. 3, 1999
 Hole inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,126,371.357
 Easting: 3,070,560.418

Date	Depth(m)	El.(m)	Leg	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock mass	Description	G.W.L. S.P.T.	Lugon value	Sample	Casing	Cementation	Depth (m)		
	31			Limestone	100	100						30.37 (4): rough, stained 32.4 (5): rough 32.8 (5): stepped 34.35 (3): rough, along calcite vein 36.0 (3): rough, coated 36.8 (2): stepped 37.4 (5): smooth 39.8 (4): smooth, coated 40.5 (4): smooth 41.4 (3): rough, fresh 41.9 (5), 43.23 (5): smooth, fresh 46.0 (3): rough 48.65 (5): smooth 50.55 (5), 51.9 (5), 54.75 (6): rough 55.05 (5): smooth 56.05 (6): smooth, stained 58.75 (6): smooth 59.35 (5): stepped, coated 59.7 (5): smooth, stained								
	32				100	100														31
3.5	33				100	100			A B	2-1	a b	B B								32
	34				100	68		34.40												33
	35				100	40														34
3.6	36				94	17														35
	37				94	30														36
3.8	38				95	46			A B	2-1	b	CH								37
	39				91	26														38
3.9	40				88	25		43.00				CH								39
	41				100	73														40
3.10	42				100	70			A B	2	a	B								41
	43				100	77		42.60												42
3.11	44				100	69			A B	4-3	a	CH								43
	45				100	20														44
3.12	46				100	72		45.50												45
	47				100	78														46
	48				99	69														47
3.13	49				100	61														48
	50				97	55														49
3.14	51				100	73			A B	2-1	a	B B								50
	52				98	51														51
3.17	53				98	90														52
	54				98	63														53
	55				97	75														54
3.18	56				100	94		56.00												55
	57				94	28		56.80	A B	4	b a	CM								56
	58				95	43														57
3.19	59				100	75			A B	2	b a	CH								58
	60				99	20														59

FEASIBILITY STUDY ON MUNDA DAM **GEOLOGICAL LOG OF DRILL HOLE**

Qs-2, 3/4

Hole No.: **Qs-2**
 Ground EL.: **513.373 m**
 Hole length: **100.00 m**

Location: **Sappare Quarry**
 Drilling period: **Feb. 24, 1999 - Jun. 3, 1999**
 Hole inclination: **90 degrees (Vertical)**

Azimuth: **-**
 Northing: **1,126,371.357**
 Easting: **3,070,560.418**

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugron value	Sample	Coring	Cementation	Depth (m)		
3/20	61		[Pattern]	Limestone	95	56						61.2 (40); 61.75 (50); 62.2 (40): rough						61		
	62				98	52							64.95 (50); 65.15 (30): smooth						62	
	63				94	79							67.4 (20): rough						63	
3/21	64				93	30							70.2 (45): smooth, coated							64
	65				98	51							72.7 (15): rough							65
	66				100	15	A-B	2	b-a	CH			74.6 (15): smooth		Lu=1.7	Po=11				66
3/22	67				100	45							77.35 (45); 78.0 (35); 78.6 (20); 80.10 (60); 80.75 (90); 81.68 (60): smooth							67
	68				100	72							82.05 (43): smooth, coated							68
	69				94	94							82.95 (58): rough, stepped		Lu=2.0	Po=11				69
2/23	70				95	81							83.1 (15): small crystals of pyrite on joint plane							70
	71				98	56							84.05 (33): smooth, coated with calcite							71
	72				98	25							85.7 (32): rough, stained							72
3/24	73				90	0		72.40												73
	74				80	10		74.00	B	4	b-c	CM			Lu=2.0	Po=3.2				74
	75				98	54														75
5/21	76				95	58														76
5/22	77				96	50			A-B	3	a	CH								77
5/23	78				97	33									Lu=2.7	Po=11				78
5/24	79				96	32		78.85												79
5/25	80				100	10			A-B	4	a-b	CM								80
5/27	81				92	10		80.80												81
	82				97	65														82
	83				96	38									Lu=4.5	Po=11				83
5/28	84				99	83														84
5/29	85				97	61														85
	86				97	27			A-B	3-2	a-b	CH								86
	87				98	0														87
5/30	88				95	60														88
	89				98	63									Lu=4.0	Po=11				89
	90				98	35														90

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

Qs-2, 4/4

Hole No.: Qs-2
 Ground EL.: 513.373 m
 Hole length: 100.00 m

Location: Sappare Quarry
 Drilling period: Feb. 24, 1999 - Jun. 3, 1999
 Hole Inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,126,371.357
 Easting: 3,070,560.418

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugron value	Sample	Casing	Concentration	Depth (m)
5/31	91	413.373		Limestone	96	14	100.0	A B	3-2	a b	CH	CH	91.0 (30): smooth, coated with calcite. 91.1 (53): smooth. 94.1 (45): rough, stepped. 94.8 - 95.2 (55): stained with iron oxide. 97.5 (48): smooth, pyrite on the joint plane. 97.2 - 97.3: fragmented, stained with iron oxide. 97.5-100.0: whitish, high content of calcite. All joints are coated with calcite. 98.6 (40): rough, coated, stained with iron oxide. 99.0 (55): rough, stained.					91
	92				30	92												
	93				11	93												
	94				52	94												
	95				53	95												
6/1	96				38	96												
	97				16	97												
6/2	98				76	98												
	99				33	99												
	100				66	100												

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

Qt-1, 1/2

Hole No.: Qt-1
 Ground EL.: 662.321 m
 Hole length: 50.00 m

Location: TodoBo Banda Quarry
 Drilling period: Feb. 21, 1999 - Feb. 28, 1999
 Hole inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,125,326.226
 Easting: 3,065,899.435

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugon value	Sample	Casing	Cementation	Depth (m)	
2/21	1			Quartzite (Impure)	50	0	0.50	F	5	d	D	Rock type: Impure quartzite, light grey, fine grained, slightly schistose (60-70), jointed along schistosity which consists of tiny mica flakes. Weathering: 0.0-1.0: Highly to moderately weathered to be brown and soft. 1.0-4.3: Slightly to moderately weathered. Rock pieces are fresh, stained and softened along joints. Joints: Most joints are smooth and stained with iron oxide, partly filled with clayey to sandy material.							
	2				88	0	1.00	C-B	4	e	CL								
	3				90	0		B	4-3	b	CM								
	4	4.30	658.021			85	0	4.30			CM								
	5			Green Schist	43	0		C-D	3	c	CL								
	6	6.00	656.321		95	15	6.00			CM									
	7	7.00	655.321		91	0	7.00	B	4-3	b	CM								
2/22	8	7.30	655.021	Green Schist	84	0						Rock type: Light greenish grey, medium grained, amphibole or chlorite mica schist, moderately schistose (70-90). Weathering: Moderately weathered to be brownish and slightly soft. Joints: Rough, stained and filled with sandy material. Rock type: Impure quartzite, light grey, fine grained. 7.0-7.3: Intercalation of green schist (looks intrusive). Weathering: Slightly to moderately weathered. 7.0-7.3: Moderately weathered to be brownish and soft. Joints: stained with iron oxide, partly filled with clayey material.							
	9			Quartzite (Impure)	60	0		C-D	4	e	CL								
	10	9.30	653.021		60	0	9.30												
	11	10.65	651.671	Paragneiss Schist	60	0		D-E	5	d	D								
	12				42	0	12.00												
	13				90	0													
	14				95	0													
	15				91	15													
	16				78	0		B-A	4	b-c	CM								
	17				84	10													
	18			Quartzite (Impure)	98	0													
	19				85	0													
	20				84	0	20.70												
21				70	0		B	4	c	CL									
22				70	0	21.80													
23				90	0		B-A	4	b	CM									
24	24.10	638.221		95	0	23.50													
25	24.40	637.921	Green Schist	94	0														
26	24.90	637.421	Quartz Vein	56	0		B	5-4	b-c	CL									
27	27.00	635.321	Quartzite (Pure)	90	0														
28				85	10														
29			Quartz Vein	93	24		B-A	3	b	CM									
30				97	0	30.00													

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

Q1-1, 2/2

Hole No.: Q1-1
 Ground EL.: 662.321 m
 Hole length: 50.00 m

Location: Todobo Banda Quarry
 Drilling period: Feb. 21, 1992 - Feb. 28, 1999
 Hole inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,125,326.226
 Easting: 3,065,899.435

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	Q.W.L. S.P.T.	Lugon value	Sample	Casing	Concentration	Depth (m)																													
2/23	31	613.321		Quartz Vein	70	0	31.00	B	4	e-b	CL	Rock type: Impure quartzite, light grey, fine grained, with rare occurrence of mica. 30.0-40.0: slightly schistosed (B3-90). 40.0-50.0: slightly schistosed (S0-43). 50.0-60.0: Moderately sheared, closely jointed. 60.0-70.0: Intensely sheared, closely jointed, fragmented.							31																												
	32				96	0	31.80	B-A	3	b	CM								32																												
2/24	33				80	0	33.00	B	4-5	e-b	CL															33																					
	34				99	30																					34																				
	35				90	20	35.00	A-B	3	b-a	CH																						35														
	36				95	0																												36													
2/25	37				93	10		A-B	4	b-a	CM																													37							
	38				95	0	38.00																																		CM	38					
	39				95	30	39.00	A-B	3	a-b	CH																																				39
	40				90	0																																									
2/26	41			Quartzite (Impure)	90	0																																									41
	42				93	10																																									
	43				96	14		A-B	4	b-a	CM																																				43
	44				93	10																																									
	45				90	10																																									45
	46				98	0																																									
2/27	47				90	0	46.50																																								47
	48				65	0	48.00	B	4	c	CL																																				CL
2/28	49				65	0	49.00	E	5	d	D																																				
	50				60	0	50.00	B	4	c	CL																																				50

N1

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

Qt-2, 1/4

Hole No.: Qt-2
 Ground EL.: 691.695 m
 Hole length: 100.00 m

Location: Todobo Banda Quarry
 Drilling period: Feb. 1, 1999 - Feb. 13, 1999
 Hole Inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,125,364.729
 Easting: 3,066,101.804

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugeon value	Sample	Casing	Cementation	Depth (m)		
	1				90		22					Rock type: Impure quartzite, light grey to whitish grey, fine-grained. Quartz veins, thin layers of mica/slates are common. 7.9-8.1: High content of chlorite. 13.6-15.3: Slightly pelitic, high content of mica and garnet. 19.9-20.1: Intercalation of green schist (seems to be intrusive or tectonic lens). 20.3-20.7: Intercalation of limonite. 25.0-28.0: High content of quartz (recrystallised).								
	2				40	0	1.40	BC	3	b-c	CM									
	3				65	0	3.00	BC	4	c-b	CL									
	4				93		12	B	4.3	b	CM	Schistosity: Mostly indistinct. 0.0-4.2: 60-90 degrees. 3.2-11.0: 0-10 degrees. 11.0-19.0: 10-20 degrees. 19.0-20.0: folded. 20.0-23.4: relatively distinct with mica (biotite) flakes. 23.4-30.0: 10-0 degrees.								
	5				76	24	4.20	C	5	a-b	D									
	6				90		63													
	7				95	0														
	8				90		28	A-B	2-3	b-a	CH	Weathering 0.0-4.6: Slightly to moderately weathered. Rock pieces are fresh, stained to be brown and softened along joints. 4.6-15.6: Slightly weathered to fresh. Rock pieces are fresh, stained to be brownish and slightly stained along joints. 15.6-30.0: Fresh to slightly weathered. Rock pieces are fresh, slightly stained to be dark brownish and rarely softened along joints.								
	9				100	80														
	10				95		37													
	11				94		78													
	12				100		53	A-B	2-1	a-b	B	Joints: Most of joints exist along schistosity.								
	13				100		84													
	14				100		36													
	15			Quartzite (impure)	95		16	A-B	3	a	CH									
	16				95		20													
	17				100		77													
	18				97		50	A-B	2-3	a-b	B									
	19				96		68													
	20				97		94													
	21				94		62													
	22				96		38	A-B	3	b-a	CH									
	23				96		30													
	24				97		55													
	25				98		45	A-B	2-3	a	B									
	26				100		50													
	27				93		45	A-B	4-3	a-b	CH									
	28				96		56													
	29				100		0													
	30				85		0	B-A	4	b-a	CM									

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

Qt-2, 2/4

Hole No.: Qt-2
 Ground EL.: 691.605 m
 Hole length: 100.00 m

Location: Todobo Banda Quarry
 Drilling period: Feb. 1, 1999 - Feb. 13, 1999
 Hole inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,125,364.729
 Easting: 3,066,101.804

Date	Depth(m)	EL.(m)	Log.	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugron value	Sample	Casing Cementation	Depth (m)	
	31				96		30.80	B-A	4	b-a	CM	Rock type: Impure quartzite, light grey to whitish grey, fine-grained. Quartz veins, thin layers of micaceous are common. 37.2-38.3: High content of mica and garnet.						31
	32				97	50		A-B	3	a-b	CH							
27	33				55	14					CM	Schistosity: Mostly indistinct, dipping 0 - 10 degrees. 45-60: Schistosity is poorly developed due to high content of silicate.						33
	34				90	22		A-B	4	b-a	CM	Weathering: 30.9-60.0: Fresh to slightly weathered. Rock pieces are fresh, slightly stained to be dark brownish and rarely stained along joints.						34
	35				90	10	35.00											35
	36				100	58	36.00	A-B	3	a-b	CH	Beds: Most of joints exist along schistosity. Major joints: 33.3 (80): stepped, slightly stained. 38.6 (33): stepped, stained, slightly weathered. 41.8 (70): stepped, slightly stained. 42.0 (70), 44.4 (60): rough.						36
	37				94	0		A-B	4	b-a	CM							37
	38				94	56	37.40				CH							38
	39				100	53	39.70	A-B	3	a-b	CH							39
	40				100	84	39.80	A-B	2	a-b	B							40
	41				100	43	41.00	A-B	3	a-b	CH							41
28	42				100	37												42
	43				100	77												43
	44				100	60												44
	45			Quartzite (Impure)	90	42												45
	46				97	93		A-B	2	a-b	B							46
	47				97	65					B							47
	48				96	53												48
	49				100	40												49
	50				95	60	42.60 49.90	A-B	4	b	CM							50
	51				98	65		A	2	a-b	B							51
	52				97	66	52.00											52
	53				90	35												53
	54				98	43												54
29	55				95	43												55
	56				100	88		A-B	3	a-b	CH CH							56
	57				100	38												57
	58				100	18												58
	59				100	31												59
	60				95	42												60

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

Q1-2, 3/4

Hole No.: Q1-2
 Ground EL.: 601.605 m
 Hole length: 100.00 m

Location: Todobo Banda Quarry
 Drilling period: Feb. 1, 1999 - Feb. 13, 1999
 Hole inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,125,364.729
 Easting: 3,065,101.804

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L.	S.P.T.	Lugeon value	Sample	Casing	Cementation	Depth (m)		
	61				100	10						Rock type: In pure quartzite, light grey to bluish grey, fine grained. Quartz veins, thin layers of micaceous are common. Thin intercalations of pelitic layers. 85.0-88.05: green schist, slightly weathered (seems to be intrusive or tectonic lens).								61	
	62				97	53		A-B	3	a-b	CH										62
	63				90	17	63.00					Schistosity: Relatively distinct, dipping 0 - 10 degrees, due to thin intercalations of pelitic layers.								63	
	64				93	17	63.50	B-A	4	b	CM										64
	65				95	24	65.00	A-B	3	b-a	CH	Weathering: 60.0-90.0: Fresh to slightly weathered. Rock pieces are fresh, slightly stained to be dark brownish and rarely softened along joints. Kinds: Most of joints exist along schistosity. Major joint: 64.3 (65): rough, slightly stained. 70.63 (66): rough. 72.3 (67): stained. 77.3 (80): stepped, slightly stained. 80.3 (80): along schistosity, rough, slightly stained.								65	
2/10	66				98	74															66
	67				100	55		A-B	2	a-b	B										67
	68				100	72															68
	69				100	70															69
	70				97	24	69.20	A-B	3	a-b	CH	B									70
	71				55	38	70.40														71
2/11	72				98	56															72
	73			Quartzite (impure)	99	56		A-B	2	a-b	B										73
	74				95	37															74
	75				100	43	74.40														75
	76				97	42															76
	77				96	62															77
2/12	78				99	54		A-B	4-3	a-b	CH	CH									78
	79				94	28															79
	80				100	24															80
	81				85	16	80.70														81
	82				98	0															82
	83				85	17		A-B	4-3	b-a	CM	CM									83
	84				90	10															84
	85				95	0															85
	86	65.00	515.605		96	14	85.30														86
2/13	87			Green Schist	95	58		A-B	2-3	b-a	CH	CH									87
	88	88.05	513.555		100	85															88
	89			Quartzite (impure)	94	56															89
	90				98	68	89.10	A-B	2	a-b	B										90

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

Qt-2, 4/4

Hole No.: Qt-2
 Ground EL.: 601.605 m
 Hole length: 100.00 m

Location: Todobo Banda Quarry
 Drilling period: Feb. 1, 1999 - Feb. 13, 1999
 Hole Inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,125,361.729
 Easting: 3,066,101.804

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugeon value	Sample	Casing	Cementation	Depth (m)		
2.13	91	501.605	[Vertical Lines]	Quartzite (Impure)	97	49	90.90	A-B	2	a-b	B	Rock is fine to coarse quartzite, light grey to whitish grey, fine-grained. Quartz veins, fine to coarse in character are common. Thin intercalations of pelitic layers. 90.3-90.4: small grained crystals are scattering.							91	
	92				100	20	A-B	3	b-a	CH	Schistosity: Relatively indistinct, dipping 0 - 10 degrees.								92	
	93				97	84													Weathering: 90.0-100.0: Fresh to slightly weathered. Rock pieces are fresh, slightly stained to be dark brownish and rarely softened along joints.	93
	94				95	15														Joints: Most of joints exist along schistosity. Major joints: 90.15 (0): smooth, slightly stained. 93.1 - 95.3 (10-30): rough, stained, along schistosity. 99.85 (A): stepped, stained, intercalated with clayey to sandy materials.
	95				94	32	95.20	A-B	2	a-b	B	95								
	96				95	62	95.60					A-B							3	b-a
	97				100	70	98.50	A-B	2	a-b	B									
	98				95	29						98.50							A-B	2
	99				100	33	100.00	A-B	2	a-b	B									
	100				100.00	92						59							100.00	100

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

Qt-3, 1/2

Hole No.: Qt-3
 Ground EL.: 456.615 m
 Hole length: 50.00 m

Location: Todobo Banda Quarry
 Drilling period: Dec. 12, 1998 - Jan. 14, 1999
 Hole Inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,125,425.783
 Easting: 3,066,422.702

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugon value	Sample	Casing	Comminution	Depth (m)
12/27	1		△ △	Talus deposits	50	0						Brownish, unconsolidated and non-plastic silt with little sand and angular fragments of psammitic/pelitic schists.						1
	2	454.815	△ △		60	0	1.80											2
12/28	3			Psammitic Schist	75	0	3.00	C-D	4	c-b	CL	Light grey, fine- to medium grained, well-schistosed (60), and slightly to moderately weathered, jointed with mostly rough and stained joint planes along schistosity.			S1			3
	4				100	30												4
	5	452.115		Green Schist	90	10						4.5-4.7: Green schist (inbasive?), moderately weathered.						5
12/29	6				100	21						4.7-10.7 Quartzite. Rock type: Light to whitish grey, fine grained, poorly schistosed (50). Weathering: 4.7-10.0: Slightly weathered. Rock pieces are fresh, stained and slightly softened along joints. 10.0-10.7: Moderately weathered. Rock pieces are fresh and stained and softened along joints.						6
	7			Quartzite (Impure)	100	32		B-C	3	b-c	CM							7
12/30	8				100	0												8
	9				100	17						Major joints: 7.37 (45), 7.4 (43): rough, stained. 7.65 (40), 7.92 (19), 8.4 (51): rough, coated with calcite. 8.58 (41): rough. 9.55 (60): rough along calcite veins. 9.72 (42): rough. Filled with fine material. 9.9 (56): rough, stained with iron oxide. 10.0-10.7: fragmented, no measurable joints.			S2			9
12/31	10				100	32	10.00											10
	11	445.915		Psammitic Schist	75	0	11.00	C	4	b-c	CL	Schistosed (60), fragmented, moderately weathered, stained and softened along joints.						11
1/2	12			Quartzite (Impure)	80	0		B-C	4	b	CM	Light grey, fine grained, poorly schistosed (50), jointed, slightly to moderately weathered, slightly stained along joints.						12
	13				100	17	13.50											13
	14	443.115		Psammitic (Felsic) Schist	57	0	15.40	C	4	b-c	CL	Rock type: Light grey, medium- to fine grained, well-schistosed (90) alternating rock of siliceous schist, psammitic schist and pelitic schist, highly jointed, fragmented. Weathering: Moderately weathered. Core stained to be brownish and softened along joints. Fresh portions remain partially. 14.6-15.0, 15.5-16.0: core loss.			S3			14
	15				35	0	16.00	E	5	d	D							15
	16	440.115		Green Schist	52	0		C	4	b-c	CL	Rock type: Mixed rock of psammitic schist and green schist. Weathering: Moderately weathered. Core stained to be brownish and softened along joints. Fresh portions remain partially.						16
1/3	17				70	0	18.00											17
	18	438.615			97	10						Rock type: Light grey, medium- to fine grained, well-schistosed psammitic schist, intercalated with pelitic schist, highly jointed, fragmented. 28.2-28.4: High content of amphibole.						18
	19				95	10												19
	20				94	14						Schistosity: 18.0-25.5: Highly schistosed, dipping 80-90 degrees, slightly undulated. 25.5-29.5: Highly schistosed, dipping around 60 degrees. Weathering: Slightly to moderately weathered. Rock pieces are fresh, stained to be brownish, and partly softened along joints. 25.5-26.4: Moderately weathered. Rock pieces are stained and softened along joints.			S4			20
	21				100	13												21
	22			Psammitic (Felsic) Schist	97	11		B-C	4	b-c	CM	Major joints: 18.9-19.12 (82), 21.6-21.8 (79): rough, stained. 22.0-22.2 (78): smooth, stained. 22.46 (40): rough, stained with thin filler. 23.62-23.71 (82): rough, stained. 27.0-28.0: closely jointed (30-47), stained. 28.0-29.0: closely jointed (18-50), stained with iron oxide.						22
	23				80	0												23
	24				75	0												24
	25				95	0	25.50											25
1/5	26				95	0	26.40	C-D	4	b-c	CL							26
	27				95	0												27
	28				93	0		B-C	4	b-c	CM							28
	29	427.115		Quartzite (Pure)	81	36	29.50	B-A	4-3	b-a	CM							29
	30																	30

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

Q1-3, 2/2

Hole No.: Q1-3
 Ground EL.: 456.615 m
 Hole length: 50.00 m

Location: Todobo Banda Quarry
 Drilling period: Dec.12, 1998 - Jan.14, 1999
 Hole inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,125,425.783
 Easting: 3,066,422.702

Date	Depth(m)	EL.(m)	Log.	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugeon value	Sample	Casing	Cementation	Depth (m)		
	31				85	0						Rock type: Whitish grey, fine grained, poorly schistose. Weathering: Slightly weathered to fresh. Rock pieces are fresh, stained and partly softened along joints. Joints: 29.5-41.5: Highly jointed, dipping 50-20 degrees, joint planes are generally stained, rarely softened. 36.15 (64): smooth, stained. 36.25 (50): rough, stained. 41.5-44.1: less jointed with an interval of 5-20 cm. 44.1-50.0: jointed with an interval of 2-15 cm. Most of joint planes are fresh, some are stained. Joint angles mainly between 15-30 degrees. 45.6 (80): smooth, fresh.								
	32				82	0														
	33				80	0														
	34				90	0														
	35				78	0		B-A	4-3	b-a	CM									
	36				65	0					CM									
	37				90	0														
	38				94	0														
	39				95	0														
	40			Quartzite (Pure)	94	0														
	41				66	0	40.70													
	41				41.00	0	41.00	B-A	5	b-a	CL									
	41				72	0	41.50	B-A	4	a-b	CM									
	42																			
	43				67	15		A-B	3	a-b	CH	CH								
	44				100	11	44.10													
	45				84	16														
	46				72	0														
	47				92	0		A-B	4-3	a-b	CM	CM								
	48				90	16														
	49				100	11														
	50	50.00	456.615		88	0	50.00													

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

QL-4, 1/2

Hole No.: QL-4
 Ground EL.: 501.710 m
 Hole length: 50.00 m

Location: Todofo Banda Quarry
 Drilling period: Mar.20, 1999 - Apr.23, 1999
 Hole inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,125,905.256
 Easting: 3,066,280.909

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugeon value	Sample	Casing	Cementation	Depth (m)		
	1			Fammitic (Pelitic) Schist	84	0					D	Rock type: Light brownish grey to grey, fine- to medium-grained, well schistosed (20-30) alternating rock of thin siliceous layers and thin biotite/capthobole rich layers. Weathering: 0.0-2.0: Moderately to highly weathered, fragmented. Rock pieces are stained and softened. 2.0-4.0: Moderately weathered, jointed. Rock pieces are stained and slightly softened along joints. Joints: 0.0-2.0: Fragmented, invisible. 2.0-4.0: Mainly along schistosity, low dipping, deteriorated. 2.6-2.9, 2.7-3.0: Fragmented. 2.3 (40): smooth, stained, slightly softened.						1		
	2				97	0	2.00	E	5-4	d	D									2
	3				93	0	2.60 3.00	D E	4-3 5	b-c d	CL D									3
	4	490.00	497.710			73	0	3.70	C	3-4	b-c		CM							4
	5				75	20	4.40	D	4-5	c	D								5	
	6				60	0	6.25	C-B	3-2	b-c	CM								6	
	7				83	48						Weathering: 4.0-6.25: Slightly to moderately weathered. Rock pieces are slightly stained and softened along joints. 6.25-11.00: Slightly weathered. Rock pieces are almost fresh, slightly stained along joints. 11.0-30.0: Slightly to moderately weathered. Rock pieces are fresh, stained and rarely softened along joints. 18.8-22.0: Moderately weathered.						7		
	8				88	45		B-C	3-2	a-b	CH								8	
	9				87	40	9.00				CH								9	
	10				87	63	9.40	C-B	3-4	h-c	CM								10	
	11				89	34	11.00	B	3-2	a-b	CH								11	
	12				60	0						Joints: 4.0-4.4: Closely jointed, fragmented. 4.4-11.0: Joints along schistosity are dominant. 4.5 (40): stepped. 7.1 (45): rough, slightly stained. 8.6 (60): rough, stained. 9.4 (35): rough, almost fresh. 11.0 - 25.45: well-jointed along schistosity. Most joints are stained. 25.5 (65): smooth, slightly stained.						12		
	13				85	0													13	
	14				70	20													14	
	15				75	0													15	
	16				89	0													16	
	17				80	10													17	
	18				83	10													18	
	19				60	0		B-C	4-3	b	CM								19	
	20				76	21													20	
	21				87	0													21	
	22				86	0													22	
	23				82	10													23	
	24			Fammitic Schist	55	0													24	
	25				81	0	25.45												25	
	26				75	27													26	
	27				91	33													27	
	28				85	44		B	2-3	b	CH								28	
	29				86	51													29	
	30				88	49	30.00												30	

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

QT-4, 2/2

Hole No.: QT-4
 Ground EL.: 501.710 m
 Hole length: 50.00 m

Location: Todobo Banda Quarry
 Drilling period: Mar.20, 1999 - Apr.23, 1999
 Hole inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,125,905,256
 Easting: 3,066,280,909

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugon value	Sample	Casing	Concentration	Depth (m)	
	31				77	25	30.70	B-C	4	b-c	CM	Rock type: Grey, medium- to fine grained, well schistosed (20-30), alternating rock of thin siliceous layers and pelitic layers. 44.2-44.8: Quartz vein, sandy.							31
	32				85	48	32.00	B	2-3	a-b	CH								
	33				65	0						Weathering: 30.0-40.6: Slightly to moderately weathered. Rock pieces are slightly stained and sulfured along joints. 42.4-44.0: Moderately weathered. Rock pieces are stained, sulfured. 44.0-50.0: Slightly to moderately weathered. Rock pieces are fresh, stained and rarely sulfured along joints.							33
	34				75	0													
	35				89	10						Joints: 30.0-42.5: Moderately jointed. Joints along schistosity are dominant. 42.5-44.0: Closely jointed. 42.4-43.0: Fragmented, invisible. 44.0-50.0: Jointed with an interval of 5-30cm. 30.85 (61), 34.25 (60), 35.1 (50), 36.5 (60), 39.5 (60), 39.85 (35): smooth, stained. 44.4 (60): smooth, slightly stained. 46.3 (25): smooth, fragmented along joints. 46.8 (65): stepped, slightly stained.						35	
	36				92	28													
	37				95	0						B-C							37
	38				86	13		B-C	4-3	b-c	CM		CM						
	39				98	0													39
	40			Psammite Schist	86	0													40
	41				90	20													41
	42				88	0													42
	43				90	0	42.50 43.00	E	5	d	D								43
	44				93	0	44.00	C	4	b	CL	CL							44
	45				90	52													45
	46				85	40		B	3	a-b	CH								46
	47				75	37	47.00												47
	48				75	0		B-C	4	b	CM	CH							48
	49				60	33	48.30												49
	50	50.00	451.710		58	42	50.00	B	3	a-b	CH								50

NA

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

Q1-5, 1/2

Hole No.: Q1-5
 Ground EL: 489.247 m
 Hole length: 50.00 m

Location: Todobo Banda Quarry
 Drilling period: May 18, 1999 - Jun. 15, 1999
 Hole inclination: 90 degrees (Vertical)

Azimuth:
 Northing: 1,124,946.310
 Easting: 3,066,564.495

Date	Depth(m)	EL.(m)	Log.	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.T.	Lugon value	Sample	Casing	Cementation	Depth (m)		
	1			Granitic Schist	90	0	0.40	C-D	4	c	CL	Rock type: Grey, fine- to medium grained, moderately schistose (10-40). Granitic schist with intercalations of thin pelitic layers. Weathering: 0.0-0.4: Highly weathered to be brown. Rock pieces are softened. 0.4-0.9: Moderately to slightly weathered. Rock pieces are stained and softened along joints. 0.9-10.0: Slightly weathered. Rock pieces are fresh, stained along joints, and rarely softened. 10.0-22.5: Slightly to moderately weathered. Rock pieces are fresh, stained along joints, and partly softened at well jointed portions. 22.5-30.0: Fresh to slightly weathered. Rock pieces are fresh, slightly stained along joints. Joints: 0.0-0.4: Closely jointed, fragmented. 0.4-0.9: Jointed with an interval of 5-10cm. Joint planes are stained and filled with sandy/clayey materials. 0.9-6.0: Jointed with an interval of 5-30cm. Joint planes are stained, rarely softened. Most of the joints are along schistosity, 20-40 degrees. 6.0-8.1: Relatively less jointed. Joint planes are slightly stained to fresh, rarely softened. 8.7-9.7: low dip joints (0-10) are developed closely. 8.1-10.0: Jointed with an interval of 5-30cm. 8.9-9.7: Joint planes are stained, and rock pieces are discolored. 10.0-30.0: Jointed with an interval of 5-40cm. Joint planes are slightly stained to fresh. 10.7-10.8 (10-20), 11.0-11.25 (20-50), 11.7-11.95 (20-30), 12.0-12.3, 12.7-13.25, 14.0-14.4 (10-30), 15.0-15.7, 20.0-20.6, 24.0-24.2, 25.0-25.3, 25.85-26.15, 29.65-30.0: closely jointed, fragmented. Most joint planes are stained and partly softened.								
	2				93	93		0.90	C	3-4	b-c		CM							2
	3				96	66			B	3	b-a		CH							3
	4				93	52		4.00					CH							4
	5				78	0		5.10	B-C	4	b-c		CM							5
	6				92	54		6.00	B	3	b		CH							6
	7				95	20							CM							7
	8				83	10		8.10	B	4	b-c		CM							8
	9				87	57		8.85	B-A	2	b		CH							9
	10				83	67		9.20	B	3	b-c		CM							10
	11				80	31		10.00					CH							11
	12				81	33														12
	13				72	0			B	4-3	b-c		CM							13
	14				75	0														14
	15				73	0		15.00												15
	16				80	20		15.75	C	4	c		CL							16
	17				94	51		16.40	B-C	3-4	c-b		CM							17
	18				90	20		17.00	B-A	1-3	b		CH							18
	19				87	50			B	3-4	b		CM							19
	20				90	17		20.00												20
	21				53	0		21.00	C-D	4	c		CL							21
	22				92	50		21.60	B-C	4	b-c		CM							22
	23				92	31		22.00	B	3	a-b		CH							23
	24				92	31		22.50	B-C	4	b-c		CM							24
	25				90	26		23.65	B	3-2	a-b		CH							25
	26				63	12														26
	27				86	0														27
	28				81	0			B	4	b-c		CM							28
	29				90	12														29
	30				70	0		29.60												30
				75	0		30.00	C-B	4	b	CL							30		

GEOLOGIC LOG OF DRILL HOLE

FEASIBILITY STUDY ON MUNDA DAM MULTIPURPOSE PROJECT

Q1-5, 2/2

Hole No.: Q1-5
 Ground EL.: 489.247 m
 Hole length: 50.00 m

Location: Todobo Banda Quarry
 Drilling period: May 18, 1999 - Jun. 15, 1999
 Hole inclination: 90 degrees (Vertical)

Azimuth: -
 Northing: 1,124,946.310
 Easting: 3,066,564.495

Date	Depth(m)	EL.(m)	Log	Rock type	Core Recovery (%)	RQD	Depth(m)	Hardness	Joint interval	Joint condition	Rock class	Description	G.W.L. S.P.t.	Lugeon value	Sample	Casing	Comentation	Depth (m)	
	31				70	0						Rock type: Grey, medium grained, moderately schistose (10-40). Paragneiss schist with intercalations of thin pelitic portions. 30.0-35.0: Slightly altered. No distinct softening due to the alteration. Joint planes discoloured and clay minerals of light greenish grey in colour exists along joint planes. 35.0-50.0: Partly altered and discoloured along joints.							31
	32				90	0													
	33				65	0													33
	34				83	0													34
	35				74	0	34.40												35
	36				82	42	35.80	B-A	3-2	a-b	CH	Joints: 30.0-34.4: Closely jointed with an interval of 2-10cm. Joint angles are variable (30-80). Joint planes are slightly altered without intense deterioration. 34.4-40.0: Jointed with an interval of 5-20cm. Most of the joints are rough and along schistosity (10-30). 40.0-47.5: Closely jointed, sheared, resulting in low core recovery. Few measurable joint due to fragmentation. 47.5-50.0: Jointed along schistosity (20-30) with an interval of 5-15cm. Joint planes are discoloured due to alteration.						36	
	37				30	0	37.10	B	4	a-b	CM								
	38				47	10					CH								38
	39				92	20	38.90	B	3	a-b	CH								39
	40			Paragneiss Schist	70	20	40.00	B	3-4	b-a	CM								40
	41				23	0													41
	42				30	0													42
	43				33	0													43
	44				30	0		B	4	c-b	CL								44
	45				45	10													45
	46				30	0													46
	47				36	0													47
	48				58	15	47.50												48
	49				77	15		B-A	3	a-b	CH								49
	50				86	0	50.00												50

