REPUBLIC OF LEBANON

COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION

DETAILED DESIGN OF BISRI DAM PROJECT

CONTRACT NO.17909

ROCK MATERIAL SOURCES

GEOTECHNICAL INVESTIGATION REPORT IX FACTUAL

November 2014



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MATERIAL SOURCES (RQ-1b, RQ-2a/2b & RQ-3a)

	Ref:	L1214D / 1580
	Revision:	Date: November 10 th , 2014
QC	□ Draft	☑ Final
	Signature:	

1. Introduction

<u>8 boreholes</u> were located (Appendix 1) and drilled within the areas (right abutment, RQ-1a/1b and RQ-2a/2b) proposed as potential rock material sources, to determine subsurface conditions and to obtain samples for laboratory testing and to estimate the quantity of material that is available in the potential rock material sources (surface plane area of the usable material).

RQ-1b

BHRQ1: 60m

BHRQ2: 45m

BHRQ3: 45m

RQ-2a

BHRQ4: 45m

BHRQ5: 42.5m

RQ-2b

BHRQ6: 45m

BHRQ7: 15m (field activity was physically blocked by the landowner)

BHRQ8: 45m

RQ-3a/3b

Old boreholes BHLA3, BHLA4 and EV10 (please refer to Report Volume I and VI) were used to evaluate the subsurface conditions and for laboratory testing.

2. Potential Rock Material Sources

The proposed rock material sources (RQ-1a/1b, RQ-2a/2b and RQ-3a/3b) are situated along with the right (RQ-1a/1b, at elevation above 550) and left (RQ-3a/3b, at elevation above 450) downstream abutments and at the top of the right abutment (RQ-2a/2b, at elevation above 725), as shown on related drawing (Appendix 1).



Figure 1: RQ-1a/1b



Figure 2: RQ-2a/2b

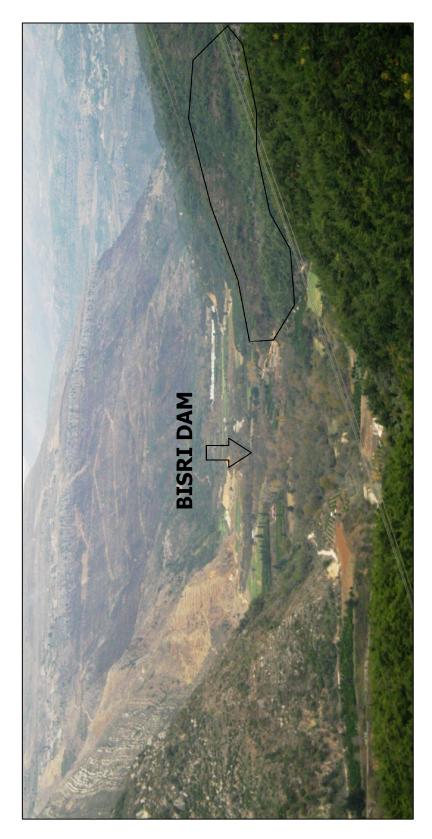


Figure 3: RQ-3a/3b

3. Field Investigation

The field investigation was performed between August 11 and September 25, 2014. Eight boreholes to a maximum depth of 60m were drilled at locations shown on Figure 4. Truck and crawler mounted rotary drill rigs (see Figure 5 & 6) were used in field investigation.

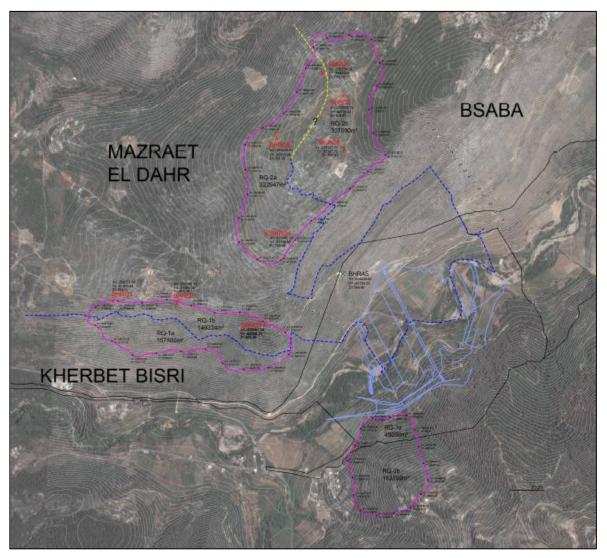


Figure 4: Locations of the boreholes drilled within the potential rock material sources

RQ-1b:

BHRQ1 / Piezometer: 60 meters deep.

0-3m: Transition zone from lower saprolite to the parent rock.

3-60m: Cenomanian dolomitic LIMESTONE (C4).

BHRQ2 / Piezometer: 45 meters deep.

0-5m: Transition zone from lower saprolite to the parent rock.

5-45m: Cenomanian dolomitic LIMESTONE (C4).

BHRQ3 / Piezometer: 45 meters deep.

0-1.5m: Transition zone from lower saprolite to the parent rock.

1.5-45m: Cenomanian dolomitic LIMESTONE (C4).

RQ-2a:

BHRQ4 / Piezometer: 45 meters deep.

0-1.5m: Transition zone from lower saprolite to the parent rock.

1.5-45m: Cenomanian dolomitic LIMESTONE (C4).

BHRQ5 / Piezometer: 42.5 meters deep.

0-0.5m: Transition zone from lower saprolite to the parent rock.

0.5-36.5m: Cenomanian dolomitic LIMESTONE (C4).

36.5-42.5m: Cavity

RQ-2b:

BHRQ6 / Piezometer: 45 meters deep.

0-45m: Cenomanian dolomitic LIMESTONE (C4).

BHRQ7: 15 meters deep, field activity was physically blocked by the landowner.

0-3.5m: Transition zone from lower saprolite to the parent rock.

3.5-15m: Cenomanian dolomitic LIMESTONE (C4).

BHRQ8 / Piezometer: 45 meters deep.

0-3m: Transition zone from lower saprolite to the parent rock.

3-45m: Cenomanian dolomitic LIMESTONE (C4).



Figure 5: BHRQ3 (RQ-1b)



Figure 6: BHRQ5 (RQ-2a)

4. Scope of Works

The scope of works of this field investigation consisted of the followings:

- Continuous core drilling in soil (Saprolite) and rock.
- Installing standpipe open piezometers into the borehole and measuring the depth and fluctuations of the groundwater table.

86mm diameter (OD) double tube core barrel (T2) equipped with tungsten carbide core bit was used in continuous core drilling with NW drill rods and HW casings (see Figure 7)

Core drilling was performed by using as minimum as possible amount of circulation water, only clean water was used during the drilling, water losses were recorded on site and indicated in logs of borings.

Cores taken from the boreholes were stored in standard wooden core boxes. All the necessary information related to the runs of coring and boreholes were clearly indicated on the boxes. Photos of core boxes are presented in Appendix 3 of this factual report.



Figure 7: Double tube core barrel (BHRQ2, RQ-1b)

Perforated (one third of the standpipe) UPVC pipes, 50mm diameter (OD) and 3.7mm thick, wrapped with geotextile (PP, 150 gr/m^2) were installed into the boreholes as open standpipe piezometers with concrete heading and steel pipe protection (see Figure 7), in a manner to measure the depth and fluctuations of the groundwater table.



Figure 8: BHRQ3 (RQ-1b)

All the field works were performed according to ASTM standards (ASTM D6640: Core drilling in soil and rock and ASTM D4750: Determining Subsurface Liquid Level in a borehole) and were supervised by an engineering geologist.

5. Subsurface Strata

According to the cores taken from the boreholes, the following subsurface soil (Saprolite) and rock stratums were encountered within the drilled boreholes. The logs of borings are presented in Appendix 2 of this factual report.

BHRQ1 (RQ-1b) / Piezometer (NGL: +665.56): 60 meters deep, dry (October 14, 2014)

0-3m: Transition zone from lower saprolite to the parent rock, (*loss of water circulation*, 100%, at 3m)

3-60m: C4 (Cenomanian)

3-31.5m: Light olive brown to cream slightly weathered mainly blocky and seamy occasionally massive and fractured/crushed strong rarely/slightly karstified and porous dolomitic LIMESTONE.

31.5-45m: Light olive brown to cream slightly and slightly - moderately weathered blocky/seamy and fractured occasionally crushed moderately strong to strong rarely karstified and porous slightly dolomitic LIMESTONE.

45-60m: Light olive brown to cream and white slightly - moderately and moderately to completely weathered mainly fractured and crushed sometimes block/seamy to fractured moderately strong occasionally karstified and slightly porous dolomitic LIMESTONE.

BHRQ2 (RQ-1b) / Piezometer (NGL: +665.29): 45 meters deep, groundwater table (GWT) at a depth of 23.1m (GWT: +642.19, October 14, 2014).

0-5m: Transition zone from lower saprolite to the parent rock, (*loss of water circulation*, 100%, at 5m)

5-45m: C4 (Cenomanian)

5-18m: Light olive brown to cream slightly and slightly - moderately sometimes highly weathered fractured and crushed weak to moderately strong and strong rarely/slightly karstified dolomitic LIMESTONE.

18-27m: Light olive brown to cream and white slightly - moderately and moderately sometimes highly weathered blocky/seamy to fractured and crushed weak and weak to moderately strong karstified and porous dolomitic LIMESTONE.

27-32m: Light olive brown to cream slightly and slightly - moderately weathered mainly blocky and seamy sometimes fractured and crushed moderately strong to strong rarely/slightly karstified and porous dolomitic LIMESTONE.

32-36m: Light olive brown to cream slightly - moderately weathered blocky/seamy to fractured and crushed moderately strong to strong rarely/slightly karstified and porous dolomitic LIMESTONE.

36-40m: Light olive brown to cream and white slightly - moderately and moderately weathered fractured and crushed weak to moderately strong karstified and porous dolomitic LIMESTONE.

40-45m: Light olive brown to cream slightly - moderately weathered blocky/seamy to fractured moderately strong to strong slightly dolomitic LIMESTONE.

BHRQ3 (RQ-1b) / Piezometer (NGL: +652.94): 45 meters deep, dry (October 14, 2014)

0-1.5m: Transition zone from lower saprolite to the parent rock, (*loss of water circulation,* 100%, at 0.5m)

1.5-45m: C4 (Cenomanian)

1.5-26m: Light olive brown to cream and white slightly weathered mainly massive to blocky/seamy sometimes fractured and crushed moderately strong to strong occasionally/slightly karstified and porous dolomitic LIMESTONE.

26-29m: Light olive brown to cream slightly - moderately weathered fractured moderately strong slightly porous dolomitic LIMESTONE.

29-35m: Light olive brown to cream slightly - moderately weathered massive to blocky and seamy weak to moderately strong and strong rarely porous dolomitic LIMESTONE.

35-39m: Light olive brown to cream slightly weathered blocky and seamy strong dolomitic LIMESTONE.

39-45m: Light olive brown to cream and white mainly slightly sometimes moderately weathered blocky/seamy to fractured and crushed moderately strong to strong sometimes weak to moderately strong occasionally karstified and slightly porous dolomitic LIMESTONE.

BHRQ4 (RQ-2a) / Piezometer (NGL: +759.08): 45 meters deep, groundwater table (GWT) at a depth of 43.55m (GWT: +715.53).

0-1.5m: Transition zone from lower saprolite to the parent rock.

1.5-45m: C4 (Cenomanian)

1.5-6m: Light olive brown to cream slightly weathered blocky/seamy to fracture strong occasionally/slightly karstified dolomitic LIMESTONE (*cavity between 4 and 4.3m*).

6-9.5m: Light olive brown to cream and white slightly - moderately weathered fractured and crushed weak to moderately strong occasionally karstified and porous dolomitic LIMESTONE.

9.5-18m: Light olive brown to cream and white slightly and slightly to moderately weathered blocky/seamy to fractured and crushed moderately strong rarely/slightly marly dolomitic LIMESTONE (*loss of water circulation*, 100%, at 10.3m)

18-32.5m: Light olive brown to cream faintly weathered mainly blocky/seamy occasionally fractured and crushed moderately strong to strong rarely/slightly karstified dolomitic LIMESTONE (*cavity between 25.5 and 26.5m*).

32.5-39.5m: Light olive brown to cream and white slightly and slightly - moderately sometimes highly weathered mainly fractured occasionally crushed weak and weak to moderately strong karstified and porous slightly dolomitic LIMESTONE.

39.5-45m: Light olive brown to cream slightly - moderately weathered blocky/seamy to fractured occasionally crushed weak to moderately strong LIMESTONE.

BHRQ5 (RQ-2a) / Piezometer (NGL: +790.86): 42.5 meters deep, dry (October 14, 2014)

0-0.5m: Transition zone from lower saprolite to the parent rock.

0.5-36.5m: C4 (Cenomanian)

0.5-9.5m: Light olive brown to cream slightly sometimes moderately weathered blocky/seamy to fractured moderately strong to strong occasionally karstified (karst voids are filled with clay) dolomitic LIMESTONE.

9.5-25.5m: Light olive brown to cream slightly to moderately and moderately weathered fractured and crushed weak and weak to moderately strong karstified (karst voids are filled with clay) dolomitic LIMESTONE (*loss of water circulation, 100%, at 10.5m*).

25.5-36.5m: Light olive brown to cream slightly weathered blocky/seamy to fractured sometimes crushed moderately strong to strong occasionally karstified (karst voids are filled with clay) slightly dolomitic LIMESTONE.

36.5-42.5m: Cavity

BHRQ6 (RQ-2b) / Piezometer (NGL: +799.10): 45 meters deep, dry (October 14, 2014)

0-1.5m: Mylonitized LIMESTONE

1.5-45m: C4 (Cenomanian)

1.5-6.5m: Light olive brown to cream slightly weathered blocky/seamy to fracture moderately strong to strong slightly dolomitic LIMESTONE.

6.5-12m: Light olive brown to cream and white faintly weathered massive to blocky/seamy moderately strong to strong slightly dolomitic LIMESTONE.

12-16.5m: Light olive brown to cream and white faintly weathered blocky/seamy to fracture moderately strong to strong slightly dolomitic LIMESTONE.

16.5-45m: Light olive brown to cream and white faintly weathered mainly massive to blocky/seamy rarely fractured moderately strong to strong occasionally/slightly karstified dolomitic LIMESTONE.

BHRQ7 (RQ-2b, NGL: +808.67): 15 meters deep, *field activity was physically blocked by the landowner*.

0-3.5m: Transition zone from lower saprolite to the parent rock (*loss of water circulation*, 100%, at 1.5m)

3.5-15m: C4 (Cenomanian)

3.5-15m: Light olive brown to cream and white slightly weathered mainly fractured sometimes crushed moderately strong to strong occasionally/slightly karstified (karst voids are filled with clay) dolomitic LIMESTONE.

BHRQ8 (RQ-2b) / Piezometer (NGL: +787.97): 45 meters deep, *groundwater table (GWT)* at a depth of 41.7m (GWT: +746.27).

0-3m: Transition zone from lower saprolite to the parent rock, (*loss of water circulation,* 100%, at 3m)

3-45m: C4 (Cenomanian)

3-6.5m: Light olive brown to cream slightly and moderately weathered mainly fractured sometimes crushed weak to moderately strong and strong rarely/slightly karstified dolomitic LIMESTONE.

6.5-16.5m: Light olive brown to cream slightly weathered blocky and seamy moderately strong to strong occasionally/slightly karstified (karst voids are filled with clay) dolomitic LIMESTONE.

16.5-45m: Light olive brown to cream and white slightly to moderately weathered blocky/seamy to fractured and crushed weak to moderately strong rarely/slightly karstified (karst voids are filled with clay) occasionally porous dolomitic LIMESTONE.

6. Sampling & Laboratory Testing

Representative rock/core samples from the boreholes (BHRQ1, BHRQ3, BHRQ4, BHRQ5, BHRQ6, BHRQ8 and EV10) at different depths were selected (see Figure 9 - 15) for laboratory testing in Lebanon and Turkey (*Petrography & Hardness, see Figure 16 - 19*). List of sampling and laboratory testing program is presented in Appendix 4 of this factual report.

The following tests were adopted for laboratory testing:

- Water Absorption.
- Dry & Soaked Density.
- LA (500 revolution).
- Soundness (Sodium Sulphate).
- Wetting Drying Loss (35 cycle)
- Dry & Soaked Uni-Axial Compressive Strength.
- AAR (Alkali Aggregate Reactions).
- Petrography & Hardness.

The following samples were selected for laboratory testing:

BHRQ1 (RQ-1b)

From 12 to 16m: Light olive brown to cream slightly weathered mainly blocky and seamy occasionally crushed moderately strong to strong rarely karstified dolomitic LIMESTONE (C4).

BHRQ3 (RQ-1b)

From 4.5 to 7.8m: Light olive brown to cream slightly weathered blocky/seamy to massive moderately strong to strong occasionally karstified and porous dolomitic LIMESTONE (C4).

BHRQ4 (RQ-2a)

From 10.5 to 14m: Light olive brown to cream and white slightly and slightly to moderately weathered blocky/seamy to fractured and crushed moderately strong slightly marly (rarely) dolomitic LIMESTONE (C4).

BHRQ5 (RQ-2a)

From 1.5 to 4.5m: Light olive brown to cream slightly sometimes moderately weathered blocky/seamy to fractured and crushed moderately strong to strong occasionally karstified (karst voids are filled with clay) dolomitic LIMESTONE (C4).

BHRQ6 (RQ-2b)

From 3 to 6m: Light olive brown to cream slightly weathered blocky/seamy to fracture moderately strong to strong slightly dolomitic LIMESTONE (C4).

From 13.5 to 16.8m: Light olive brown to cream and white faintly weathered blocky/seamy to fracture moderately strong to strong slightly dolomitic LIMESTONE (C4).

BHRQ8 (RQ-2b)

From 6 to 9.3m: Light olive brown to cream slightly weathered blocky/seamy to fracture moderately strong to strong occasionally/slightly karstified dolomitic LIMESTONE (C4).

EV10 (RQ-3a)

From 22.5 to 30m: Beige slightly weathered fractured and crushed moderately strong to strong occasionally karstified slightly sandy and dolomitic LIMESTONE (J7-J6)



Figure 9: Sampling Box No.:1



Figure 10: Sampling Box No.:2



Figure 11: Sampling Box No.:3



Figure 12: Sampling Box No.: 4



Figure 13: Sampling Box No.: 5



Figure 14: Sampling Box No.: 6



Figure 15: Sampling Boxes (No. 1 to 6)

The following samples were selected for petrographic analysis (including Hardness):

BHRQ1 (RQ-1b)

Core sample at 13m

BHRQ3 (RQ-1b)

Core sample at 5m



Figure 16: BHRQ1 & BHRQ3 (RQ-1b)

BHRQ4 (RQ-2a)

Core sample at 12m

BHRQ5 (RQ-2a)

Core sample at 2.5m

BHRQ6 (RQ-2b)

Core sample at 15.5m

BHRQ8 (RQ-2b)

Core sample at 9m



Figure 17: BHRQ4, BHRQ5, BHRQ6 & BHRQ8 (RQ-2a/2b)

EV10 (RQ-3a)

Core sample at 24m



Figure 18: EV10 (RQ-3a)



Figure 19: RQ-1b, RQ-2a/2b & RQ-3a

7. Alternative Rock Material Sources (Existing Quarries)

There are three active rock quarries (*Mazraat Ez Zaarouriye, Douaouir El Bitar and Mrah El Habas*) officially running at locations shown on Figure 20. These quarries *to be investigated* are far from BISRI DAM site around *25* kilometres.

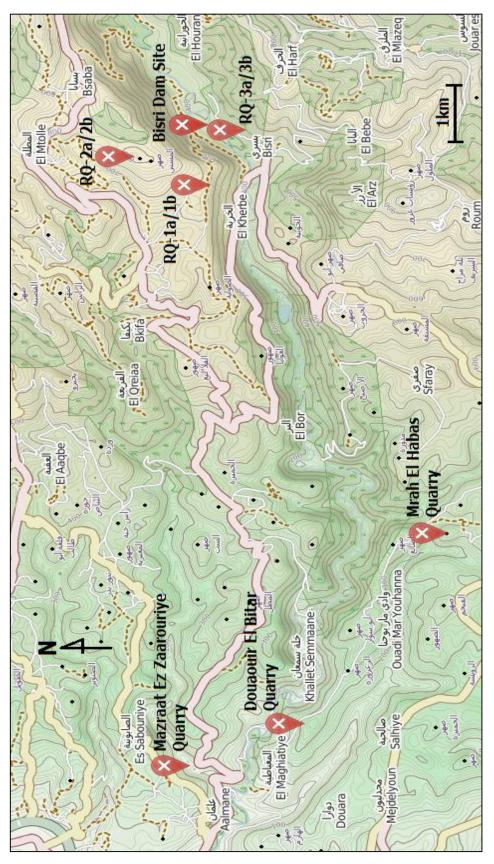


Figure 20

8. Assessment of Rock Material Sources

Please refer to Table 1 below.

Table 1: Assessment of Rock Material Sources

Rock Material Sources	Topography	Landforming	Geology	Intact rock strength (Marinos & Hoek, 2001)	Surface Area (Hectares)	Rock cut height (meters, multi-bench system)	Estimated quantity of rock can be quarried (Cubic meters, millions)	Accessibility	Environmental Impact	Nearby and/or existing Structures	Legal Situation	Additional cost of transportation (USD per cubic meters, estimated)
RQ-1a (Kherbet Bisri)	Downhill steep slope.	Difficult	Cenomanian/Albian limestone, marly limestone and marlstone (C4-C3)	Highly variable	15.8	28	> 1.5	Inaccessible	Bush type sparse vegetation / Reptiles.	No	To be expropriated (Kherbet Bisri).	
RQ-1b (<i>Mazraet El Dahr</i>)	Downhill steep slope.	Difficult	Cenomanian limestone (C4)	Strong (R4)	14.9	28	> 2	Accessible	Bush type <i>sparse</i> vegetation / Reptiles.	A small quarry (blocks of rock) and a villa (nearby).	To be expropriated (objection from Mazraet El Dahr Municipality).	
RQ-2a (Mazraet El Dahr)	Downhill moderately inclined slope.	Easy	Cenomanian limestone (C4)	Strong (R4)	32.3	30	> 4.5	Accessible	Bush type <i>sparse</i> vegetation / Reptiles.	No	To be expropriated (it may be subject to objection of Mazraet El Dahr Municipality).	
RQ-2b (<i>Bsaba</i>)	Hilly terrain with slightly to moderately inclined downhill and uphill slopes.	Easy	Cenomanian limestone (C4)	Strong to very strong (R4-R5)	33.7	24	>4	Accessible	Bush type <i>sparse</i> vegetation / Reptiles.	A small house and a chicken farm (exsist).	To be expropriated (<i>Bsaba</i>).	
RQ-3a (Bisri, under expropriation)	Downhill steep slope.	Difficult	Jurassic limestone (J7-J6)	Strong to very strong (R4-R5)	4.8	34	> 0.5	Inaccessible	Bush type dense vegetation / Reptiles, Avifauna and Mammals.	No	Under expropriation (<i>Bisri</i>)	
RQ-3b (<i>Bisri / Taaid /</i> <i>Bteddine El Liqch</i>)	Downhill steep slope.	Difficult	Jurassic limestone (J7-J6)	Strong to very strong (R4-R5)	16.3	36	> 2	Accessible	Bush type dense vegetation / Reptiles, Avifauna and Mammals.	Bisri village (nearby)	To be expropriated (Bisri / Taaid / Bteddine El Liqch).	
Mazraat Ez Zaarouriye (active quarry)	Deep valley with rocky valley walls.	Difficult		To be inve	estigated.		>1					
Douaouir El Bitar (active quarry)	Hilly terrain	Easy		To be inve	estigated.		> 2	Accessible			Working under permission (<i>private person</i>).	5
Mrah El Habas (<i>active</i> quarry)	Hilly terrain	Easy		To be inve	estigated.		>2.5					

9. Closure

The findings presented in this factual report are based on the assumption that the subsurface soil (Saprolite) and rock stratums and their conditions do not deviate appreciably from those disclosed in boreholes. There may be conditions pertaining to the site which were not disclosed by this subsurface soil (Saprolite)/rock survey, and thus could not be taken into account. Therefore, the findings are valid under this assumption only.

APPENDICES

APPENDIX 1. POTENTIAL ROCK MATERIAL SOURCES & BOREHOLE

LOCATIONS

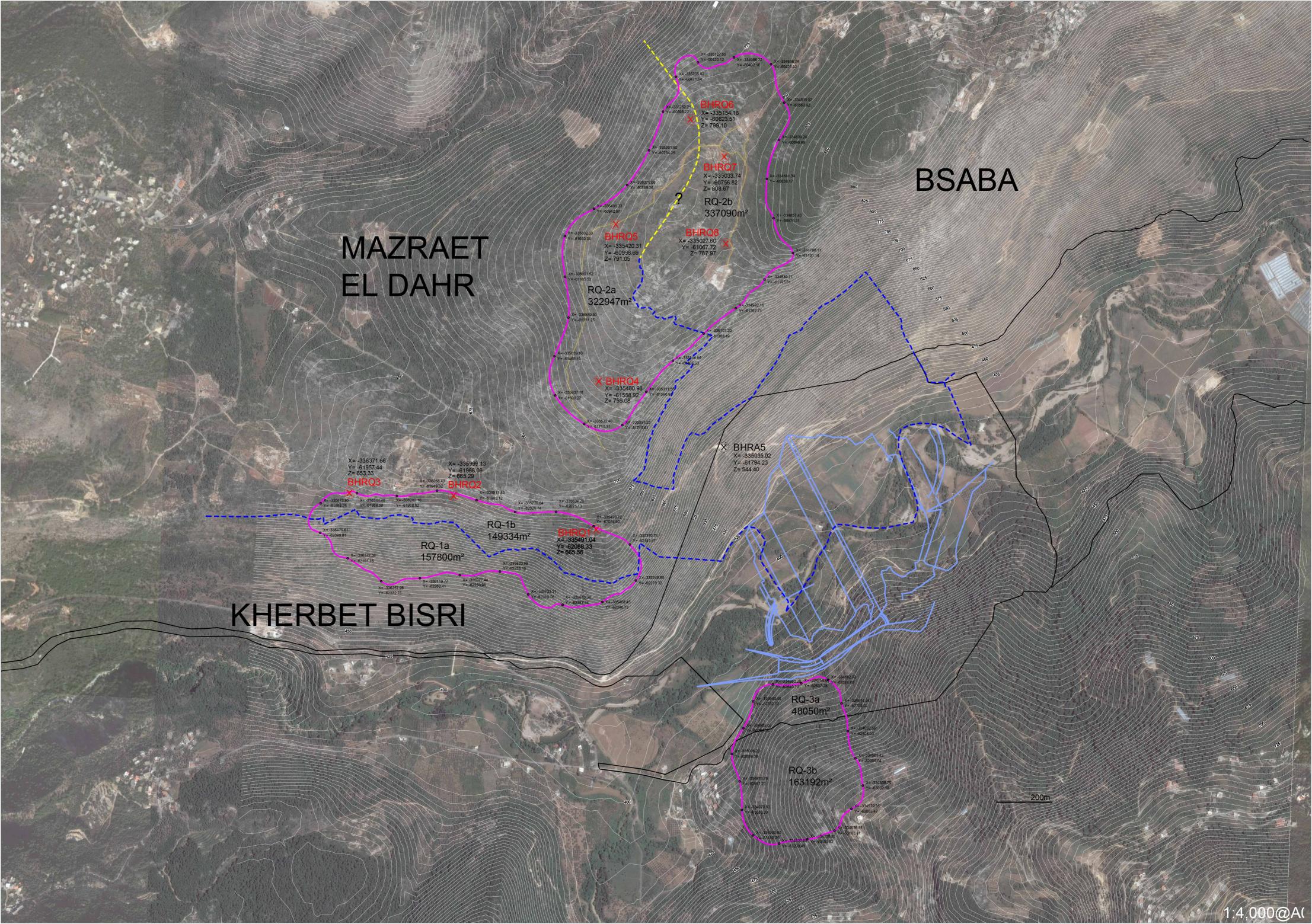
APPENDIX 2. LOGS OF BORINGS

APPENDIX 3. PHOTOS OF CORE BOXES

APPENDIX 4. LIST OF SAMPLING & LABORATORY TESTING PROGRAM –

ROCK MATERIAL SOURCES (RQ-1b, RQ-2a/2b & RQ-3a)

APPENDIX 1. POTENTIAL ROCK MATERIAL SOURCES & BOREHOLE LOCATIONS



APPENDIX 2. LOGS OF BORINGS



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TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



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TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



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	DAM.		n)·	86 to		CORE DIA	M. (mm):		10	63			ARTED:	' (''')	5/20		70111
	NEER:			K.S.		DRILLER:	().			A.A.			NISHED:		25/20		
DEРТН (m)	SYMBOL	ST	SPT N blows	רו	DES		OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		emar		
_ - - - - 21					light olive greenis fractured and frac dolomitic LIMEST	tured to bloc	to moderately weath	nered		91	91	91					
- - - 22 - -										100	100	100					
- 23 24										100	100	100					
- - - - 25										100	100	100					
- 26 27										97	93	47					
- - - 28 - -										88	75	75					
- 29 - - - - 30										87	73	69					
<u> </u>																	

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIEN	NT:			D	AR-TALEB	FI	LE NO.:	14-01	5		POP.	EUO	LE NO.:				DЦ	R01
	IECT:				I DAM / THIRD PA								LL NO				ы	NO I
	TION:				Material Sources		Elevation (m):	66	65.56		SHE			4		F : 6		20
	PMENT			CMV		METHOD:	M (m.m.)-		R				LE DEPTI	1 (m)		I F /0.0		60m
	DAM.		n):	86 to K.S.	114	CORE DIAI	w. (mm):			63 A.A.			ARTED:			5/20 25/20		
_				N.S.		DRILLER.							VISITED.		312	23/20	14	
DЕРТН (m)	SYMBOL	ST	SPT N blows	1	DES	CRIPTION	OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		Re	emar	ks	
- - - 31 -					fractured and frac dolomitic LIMEST greyish white fres	ctured to bloo ONE th to modera	tely weathered partia			80	73	67						
- 32 - - - - 33							fractured to blocky ng LIMESTONE som	ne		88	88	75						
- - - - 34 -										101	101	73						
- - 35 - - - - 36										93	93	59						
- - - 37 -										100	93	42						
- 38 - - - - 39										80	80	27						
- - - - 40										93	85	17						

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIE					AR-TALEB		LE NO.:	14-01	5		BOR	ЕНО	LE NO.:			вн	R01
	IECT:				I DAM / THIRD PA		ck Quarries) Elevation (m):	66	SE EC		SHE	CT.		5	 F : 6		
	PMENT			CMV		METHOD:	Elevation (m):	60	55.56				LE DEPTI) F : 0	_	60m
	DAM.		m)·	86 to		CORE DIA	M (mm):		IXI	63			TARTED:	1 (111)	15/20		30111
	NEER:			K.S.	114	DRILLER:	w. (11111 <i>)</i> .			A.A.			NISHED:		25/20		
DEPTH (m)	SYMBOL	ST	SPT N blows	1	DES	L	OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		emar		
<u>-</u> -					porous fractured					93	85	17					
- 41 - - - - 42					crushed mainly fra	actured and	tely weathered partia fractured to blocky ng LIMESTONE som			100	100	87					
- - - - 43 -										80	80	80					
- 44 - - - - 45										100	100	100					
- - - 46 - -							highly weathered pa	artially		65	58	7.3					
- 47 48					dolomitic LIMEST	ONE someti	mes karistied			47	47	47					
- - - 49 - -										60	36	6.7					
- 50										65	37	0					

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIEN	NT:			D	AR-TALEB	FI	LE NO.:	14-015	5_		ROD	EUO	LE NO.:			F	HR	Λ1
PROJ					I DAM / THIRD P.								LE NO				пк	UI
	TION:				Material Sources		Elevation (m):	66	5.56		SHE			6	OF	: 6		
	PMEN			CMV		METHOD:			Ro				LE DEPTI	I (m):)m
	DAM.	(mr	n):	86 to	114	CORE DIA	M. (mm):			63			ARTED:		9/15			
_	NEER:			K.S.	I	DRILLER:			-	A.A.	DA		NISHED:		9/25	/201	4	
DЕРТН (m)	SYMBOL	ST	SPT N blows	5	DES	CRIPTION (OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		Ren	nark	s	
- - - - 51						actured porc	highly weathered pa bus medium strong imes karistied	artially		65	37	0						
- - - 52 - -							nighly weathered cru arstifed LIMESTONE			71	47	25						
medium strong porous and karstifed LIMESTONE with pockets of marl 35 20 0																		
- - - 55 - -							moderately weather			50	13	0						
- 56 - - - - 57					LIMESTONE son					87	87	51						
- - - 58 -										94	94	57						
- 59 - - - - 60										100	100	93						
30		H			Er	nd of boreho	ole at 60m											
UCS LT	Uncon Layer	fined Thic		sive St	trength	TC RC SC	CR Total Core R QD Rock Quality CR Solid Core R a achieved, the numl	Designa ecovery	ation		e quo	oted p		ST SYM WT is give	Syr Wa	mple nbol	-	

SOIL STUDIES SOIL SYMBOL **ROCK SYMBOL** SAMPLERS **OTHERS** SES GP Dolomite SPT (disturbed) — Water Level ♣ GP-GM Chalky Limestone Shelby tube GM Calcarenite Tricone GC ∷∷∷ sw Weak Chalky LIMESTONE Double tube ROCK CLASSIFICATION % RQD | Classification <25 | Very Poor SP Sandy Limestone 25-50 SP - SM Poor 50-75 Fair SM-SC Basalt / volcanics 75-90 Good Excellent >90 ML ML Chert CH-MH GRANULAR SOILS N-Value Relative Density OL ₩₩₩ OH < 4 Very Loose 4 - 10 Creamy White LIMESTONE Loose $\overset{\times \times \times}{\times \times}$ PT 10 - 30 Medium Dense 30 - 50 Dense Fill Material Grainstone LIMESTONE > 50 Very Dense MARL **COHESIVE SOIL** CLAY N-Value Consistency SANDSTONE < 2 Very Soft --- CLAYwith 2 - 4 Soft Sand 4 - 8 Medium Stiff and 8 - 15 Stiff CLAYSTONE Gravel 15 - 30 Very stiff > 30 Hard Oolitic LIMESTONE Micritic LIMESTONE

Mudstone

Gypsum

Siltstone



CLIEN					AR-TALEB		LE NO.:	14-01	5		BOR	ЕНО	LE NO.:			В	HR	Q02
PROJ					I DAM / THIRD PA			1 0	05.00									-
	ATION: PMENT			CMV	Material Sources	METHOD:	Elevation (m):	Ю	65.29		SHE		LE DEPTI	1 1 (m)		F : 5	1	5m
	DAM.		n).	86 to		CORE DIAI	M. (mm):		170	63			ARTED:	· (···)		0/20		JIII
	NEER:			K.S.		DRILLER:	().			A.A.			NISHED:			5/20		
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DES	<u>I</u>	OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2			emarl		
- - - 1 -							ne residual to parent limestone with pock			57	0	0						
- 2 - - - - 3										77	4.7	0						
- - - 4 -										41	13	0						
- - 5 - - - - 6					creamish grey mo	oderately wea	athered crushed and	d		43	20	6.7			hing	wate		
- - - 7 -							mitic LIMESTONE w			55	38	33						
- 8 - - - - 9										36	36	0						
- - - - 10										31	11	6.7						

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIEN	NT:				AR-TALEB		LE NO.:	14-01	5		BOR	FHO	LE NO.:			-	RHE	RQ02
PROJ					I DAM / THIRD PA													
	TION:				Material Sources		Elevation (m):	66	55.29		SHE		I E DEDT	2)F : 5		1E r-
	PMENT		~ \.	CMV		METHOD:	M (mm):		R				LE DEPTI	1 (m		10/01		45m
	DAM.		n):	86 to K.S.	114	CORE DIAI	vi. (mm):			63 A.A.			NISHED:			10/20 15/20		
				n.ə.		DRILLER:			1				NISHED:		9/	15/20	114	
DЕРТН (m)	SYMBOL	ST	SPT N blows	5	DES	CRIPTION	OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		R	emar	ks	
			S OIG		creamish grey mo fractured medium pockets of marl	to highly we	athered crushed and mitic LIMESTONE w	shed	% F	31 42 34 40 97	10 6.7 10 27	0 6.7 0 6.7 17	N/mm2					
- - - 20										100	100	58						
																	_	
				<u> </u>														

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



	IT:				AR-TALEB		LE NO.:	14-01	5		BOR	FΗO	LE NO.:			F	HR	Q02
PROJ					I DAM / THIRD PA													
LOCA					Material Sources		Elevation (m):	66	35.29		SHE		I E DEDTI	3		F : 5		45
EQUIF			-1.	CMV		METHOD:	M (mm)		R				LE DEPTI TARTED:	1 (m)		0/20		45m
HOLE ENGIN			n):	86 to K.S.	114	CORE DIAI	w. (mm):			63 A.A.			NISHED:			5/20		
				N.S.		DRILLER.							NISHED.		31	3/20	14	
DEРТН (m)	SYMBOL	ST	SPT N blows	占	DES	CRIPTION	OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		Re	emar	ks	
- 21 - 22 - 23 - 23 - 24 - 25 - 26 - 27 - 28 - 28					mainly fractured v karstified dolomiti	sh and brownered partiall strong to str	nish cream fresh to	s and	%	777	70 67 100 89	17 40						
- 29 - - -										85	85	20						
30																		

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIEN	NT:			D	AR-TALEB	F	ILE NO.:	14-01	5									
	JECT:				I DAM / THIRD PA						BOR	ЕНО	LE NO.:			-	BHR	Q02
LOCA	ATION:			Rock	Material Sources	/ RQ-1b	Elevation (m):	66	5.29)	SHE	ET:		4	0	F : 5		
EQUII	PMEN1	Γ:		CMV	800	METHOD:			R	otary			LE DEPTH	l (m)				15m
HOLE	DAM.	(mr	n):	86 to	114	CORE DIA	M. (mm):			63	DA	TE ST	ARTED:		9/1	0/20	14	
ENGI	NEER:			K.S.		DRILLER:				A.A.	DA	ΓE FII	NISHED:		9/1	5/20	14	
DЕРТН (m)	SYMBOL	ST	SPT N blows	רז	DES	CRIPTION	OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		Re	emar	ks	
- - - 31 -					moderately weath	nered partial strong to st	rnish cream fresh to ly crushed mainly trong sometimes por			89	89	61						
- 32 - - - - 33							eathered crushed and ong porous dolomitid			67	57	37						
- - - 34 -										49	33	93						
- - 35 - - - - - 36										73	73	41						
- - - 37 -										82	82	0						
- 38 - - - - 39										83	77	17						
- - - - 40										85	79	35						

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIEN	NT:				AR-TALEB		LE NO.:	14-01	5		POD	EUO	LE NO.:			DL	IRQ	.02
PROJ					I DAM / THIRD PA								LE NO				ikų	102
	TION:				Material Sources		Elevation (m):	66	55.29		SHE			5	OF	: 5		
	PMENT		,	CMV		METHOD:			R				LE DEPTI	I (m):		/004	45	m
	DAM.		n):	86 to K.S.	114	CORE DIA	WI. (mm):			63 A.A.			ARTED:			/201 /201		
				N.S.		DRILLER:		l					NISHED:		9/10	/201	4	
DЕРТН (m)	SYMBOL	ST	SPT N blows	5	DES	CRIPTION	OF MATERIAL		% FINES	25 TCR (%)	%) SCR (%)	g R.Q.D (%)	UCS N/mm2		Rer	nark	s	
- 41 - 42 - 42 - 43 							athered fractured we E sometimes dolomit			93	93	93						
- - 44 - - - - 45										100	100	64						
- - - 46 - - - - 47																		
- - 48 - - - 49 -																		
50				<u> </u>		-1-71: 1	ala at 45 ···											
T			· <u> </u>		Er	nd of boreho	ole at 45m				_	_		_			_	

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery

SOIL STUDIES SOIL SYMBOL **ROCK SYMBOL** SAMPLERS **OTHERS** SES GP Dolomite SPT (disturbed) — Water Level ♣ GP-GM Chalky Limestone Shelby tube GM Calcarenite Tricone GC ∷∷∷ sw Weak Chalky LIMESTONE Double tube ROCK CLASSIFICATION % RQD | Classification <25 | Very Poor SP Sandy Limestone 25-50 SP - SM Poor 50-75 Fair SM-SC Basalt / volcanics 75-90 Good Excellent >90 ML ML Chert CH-MH GRANULAR SOILS N-Value Relative Density OL ₩₩₩ OH < 4 Very Loose 4 - 10 Creamy White LIMESTONE Loose $\overset{\times \times \times}{\times \times}$ PT 10 - 30 Medium Dense 30 - 50 Dense Fill Material Grainstone LIMESTONE > 50 Very Dense MARL **COHESIVE SOIL** CLAY N-Value Consistency SANDSTONE < 2 Very Soft --- CLAYwith 2 - 4 Soft Sand 4 - 8 Medium Stiff and 8 - 15 Stiff CLAYSTONE Gravel 15 - 30 Very stiff > 30 Hard Oolitic LIMESTONE Micritic LIMESTONE

Mudstone

Gypsum

Siltstone



CLIEN					AR-TALEB		LE NO.:	14-01	5		BOR	FHO	LE NO.:			F	RHE	Q03
	IECT:				I DAM / THIRD PA													. 400
	ATION: PMENT			Rock SAT	Material Sources	RQ-1b METHOD:	Elevation (m):	65	52.94		SHE		LE DEPTI	1 4 (m))F : 5		45m
	DAM.		n).	86 to		CORE DIAI	M (mm):		K	63			TARTED:	¬ (m)		11/20		45111
	NEER:		11).	K.S.	114	DRILLER:	vi. (iiiii).		Na	wraz			NISHED:			/8/20		
_				14.0.		DIVILLEIV.							NIONED.		- 10	70720		
DЕРТН (m)	SYMBOL	ST	SPT N blows	5	DES	CRIPTION (OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		R	emar	ks	
- - - 1 - - - - 2			50/0cm Refusal		light cream to whi	te and olive	residual to parent so	,		40	0	0		0.5n	n	wate		ess at
- - - - 3						to moderatel IE (c5). Time	nd crushed mainly s ly strong fresh dolon e to time porous.			57	57	47						
- - - 4 -										100	100	100						
- 5 6										100	100	100						
- - - 7 - -										100	100	100						
- 8 9										100	100	100						
- - - - 10										100	100	100						

 SPT
 Standard Penetration Test
 TCR
 Total Core Recovery

 UCS
 Unconfined Compressive Strength
 RQD
 Rock Quality Designation

 LT
 Layer Thickness
 SCR
 Solid Core Recovery



CLIE	NT:			D	AR-TALEB	FI	LE NO.:	14-015	5		POP.	EUO	LE NO.:			_	, LID	Q03
	JECT:				I DAM / THIRD PA								140					400
	ATION:				Material Sources		Elevation (m):	65	2.94		SHE			2		F : 5		
	PMENT			SAT		METHOD:			Ro				LE DEPTH	l (m)				15m
	DAM.		n):	86 to	114	CORE DIA	M. (mm):			63			ARTED:			1/20		
	NEER:			K.S.		DRILLER:				wraz	DA		NISHED:		13	/8/20	14	
DEРТН (m)	SYMBOL	ST	SPT N blows	5	DES	CRIPTION	OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		Re	mar	ks	
- -					ditto					100	100	100						
- 11 - - - - 12										100	100	99						
- - - 13 -										100	100	57						
- 14 - - - - 15										100	100	80						
- - - 16 - -										100	100	100						
- 17 - - - - 18										100	100	40						
- - - 19 - -										100	100	100						
- 20										100	100	93						
<u> </u>																		

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIE					AR-TALEB		LE NO.:	14-015	5		BOR	FHO	LE NO.:			F	RHR	Q03
	IECT:				I DAM / THIRD PA			,										400
	ATION:				Material Sources		Elevation (m):	65	2.94		SHE		I E DEDT	3		F : 5		1 <i>E</i> w-
	PMENT		٠١.	SAT		METHOD:	M (mm):		R				LE DEPTH	ı (m)		1/00		15m
	DAM.		n):	86 to K.S.	114	CORE DIAI DRILLER:	vi. (mm):		NI-	63 wraz			ARTED:			1/20 /8/20		
_				N.S.	I	DRILLER:							NISHED:		13	10/20	14	
DЕРТН (m)	SYMBOL	ST	SPT N blows	5	DES	CRIPTION C	OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		Re	emar	ks	
_ 21 _ 21 _ 22 _ 23 _ 23 _ 24 _ 24 _ 25 _ 26 _ 27 _ 27 _ 28 _ 28					ditto				1 %	100		93 98 100 27						
										100	100	90						
30								<u> </u>										

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIEN	NT:			D	AR-TALEB	FI	LE NO. : 1	14-015	5		BOB	EUO	LE NO.:				211	RQO	12
PROJ					I DAM / THIRD PA								LL NO					\ W(Ç
	ATION:				Material Sources		Elevation (m):	65	2.94		SHE			4		F : 5			
	PMENT		_	SAT		METHOD:			Ro				LE DEPTH	l (m)				45n	1
	DAM.		n):	86 to	114	CORE DIA	M. (mm):		N 1.	63			ARTED:			11/2			
H	NEER:			K.S.		DRILLER:		1	- 1	wraz	DAI		NISHED:		13	/8/2)14		
DЕРТН (m)	SYMBOL	ST	SPT N blows	5	DES	CRIPTION	OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		R	ema	rks		
- - 31 - - 32 - - - 33 - - - 33					ditto					100	100	93							
- - - 35 - - - - 36					seamy to fracture	d sometimes	aker than above blocky s crushed with interbed I marly LIMESTONE.	y Is of	-	100	100	87							
- - - 37 -									-	100	100	97							
- - 38 - - - - 39 - -									_	100	100	93							
- 40										<u>10</u> 0	100	33							H
																<u> </u>	<u> </u>		<u>—</u>
Щ				<u> </u>				J											_

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIE	NT:				AR-TALEB	FI	LE NO.:	14-01	5		1							
	JECT:				I DAM / THIRD PA						BOR	ЕНО	LE NO.:				3HF	RQ03
LOC	ATION:				Material Sources		Elevation (m):	65	52.94		SHE	ET:		5	С	F : 5		
EQU	PMEN	Γ:		SAT	2000	METHOD:			R	otary	BOR	ЕНО	LE DEPTI	1 (m)	:			45m
HOLI	E DAM.	(mn	n):	86 to	114	CORE DIA	M. (mm):			63			ARTED:		8/	11/2)14	
ENG	NEER:			K.S.		DRILLER:			Na	wraz	DA	TE FII	NISHED:		13	/8/2)14	
DEРТН (m)	SYMBOL	ST	SPT N blows	7	DES	CRIPTION	OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		R	ema	ks	
-					ditto					100	100	33						
- 41 - - - - 42										80	80	33						
- - - - 43 -										100	100	59						
- 44 - - - - 45										80	80	17						
- - - 46 - -																		
- 47 48																		
- - - - 49																		
_																	П	
50																		
					Eı	nd of boreho	ole at 45m										-	
				I														

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery

SOIL STUDIES SOIL SYMBOL **ROCK SYMBOL** SAMPLERS **OTHERS** SES GP Dolomite SPT (disturbed) — Water Level ♣ GP-GM Chalky Limestone Shelby tube GM Calcarenite Tricone GC ∷∷∷ sw Weak Chalky LIMESTONE Double tube ROCK CLASSIFICATION % RQD | Classification <25 | Very Poor SP Sandy Limestone 25-50 SP - SM Poor 50-75 Fair SM-SC Basalt / volcanics 75-90 Good Excellent >90 ML ML Chert CH-MH GRANULAR SOILS N-Value Relative Density OL ₩₩₩ OH < 4 Very Loose 4 - 10 Creamy White LIMESTONE Loose $\overset{\times \times \times}{\times \times}$ PT 10 - 30 Medium Dense 30 - 50 Dense Fill Material Grainstone LIMESTONE > 50 Very Dense MARL **COHESIVE SOIL** CLAY N-Value Consistency SANDSTONE < 2 Very Soft --- CLAYwith 2 - 4 Soft Sand 4 - 8 Medium Stiff and 8 - 15 Stiff CLAYSTONE Gravel 15 - 30 Very stiff > 30 Hard Oolitic LIMESTONE Micritic LIMESTONE

Mudstone

Gypsum

Siltstone



EQUIPMENT: CMV 800 METHOD: Rotary BOREHOLE DEPTH (n HOLE DAM. (mm)): 86 to 114 CORE DIAM. (mm): 63 DATE STARTED: ENGINEER: K.S. DRILLER: A.A. DATE FINISHED: (E) TO BY SO	9/5/2014 Remarks
EQUIPMENT: CMV 800 METHOD: Rotary BOREHOLE DEPTH (n HOLE DAM. (mm): 86 to 114 CORE DIAM. (mm): 63 DATE STARTED: A.A. DATE FINISHED: ENGINEER: K.S. DRILLER: A.A. DATE FINISHED: (E) H G G G G G G G G G G G G G G G G G G	9/5/2014 9/9/2014
HOLE DAM. (mm): 86 to 114 CORE DIAM. (mm): 63 DATE STARTED: ENGINEER: K.S. DRILLER: A.A. DATE FINISHED: (E) TO BY SO G CONTROLLER: A.A. DATE FINISHED: SAPROLITE (transition from the residual to the parent soil) SAPROLITE (transition from the residual to the parent soil) Ight grey fresh to moderately weathered fractured to blocky seamy strong dolomitic LIMESTONE 91 91 88 Ca	9/5/2014 9/9/2014
ENGINEER: K.S. DRILLER: A.A. DATE FINISHED: (b) TO DESCRIPTION OF MATERIAL SAPROLITE (transition from the residual to the parent soil) SAPROLITE (transition from the residual to the parent soil) Ilight grey fresh to moderately weathered fractured to blocky seamy strong dolomitic LIMESTONE 91 91 88 Ca	9/9/2014
DESCRIPTION OF MATERIAL SAPROLITE (transition from the residual to the parent soil) Saprolite (transition from the residual to the parent soil) light grey fresh to moderately weathered fractured to blocky seamy strong dolomitic LIMESTONE 91 91 88 Carry Strong C	
SAPROLITE (transition from the residual to the parent soil) 1	Remarks
soil) light grey fresh to moderately weathered fractured to blocky seamy strong dolomitic LIMESTONE 91 91 88 Ca	
blocky seamy strong dolomitic LIMESTONE 91 91 88 Ca Ca	
	using down to 3m
57 50 10 -	
CAVITY light to whitish grey and white moderately weathered fractured weak to medium strong porous and karstified dolomitic LIMESTONE 90 90 40	
- 8 - 72 72 8 -	

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIE					AR-TALEB		LE NO.:	14-01	5		BOR	EHO	LE NO.:				RHI	R04
	JECT:				I DAM / THIRD PA													
	ATION:				Material Sources		Elevation (m):	75	59.08		SHE		I E DEDT	2		F: 5		15
	PMENT		n).	CMV 86 to		METHOD: CORE DIAI	M (mm):		R	otary 63			LE DEPTI	1 (M)		5/201		15m
	DAM. NEER:		ny:	86 to K.S.	114	DRILLER:	vi. (111111 <i>)</i> .			A.A.			NISHED:			9/201		
_				14.0.		DIVILLEIV.							NIOTIED.	l	31	3120	_	
DЕРТН (m)	SYMBOL	ST	SPT N blows	5	DES	CRIPTION (OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		Re	emar	ks	
- - - 11 - - - - 12					mainly fractured a	and fractured	resh partially crushe I to blocky seamy mo prous and/ or dolomi	edium		95	95	60			hing 0.3m	wate	r lo	SS
- - - 13 - - -										94	80	27						
14 - - - - 15										57	51	0						
_ _ _ _ _ _ _ _ _ _										73	55	25						
- 17 - - - - 18										76	76	0						
- - - 19 - -										76	76	76						
_ 20										83	83	35						

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



BISHI DAM / THIRD PACKAGE (Rock Quarries) 750.08 SHEET: 3 0F:5	CLIEN				AR-TALEB		LE NO.:	14-01	5		BOR	FHO	LE NO.:					R04
EQUIPMENT: CMV 890 METHOD: Rotary BOREHOLE DATE (m): 48 to 114 CORE DIAM (mm): 63 to 114 CORE DIAM (mm): 6																		
HOLE DAM. (mm):							Elevation (m):	7					LEDEDT			F : 5		1E
ENGINEER: K.S. DRILLER: A.A. DATE PINISHED: 9/9/2014			n).				M (mm):		K					1 (111)		5/20		HOIII
DESCRIPTION OF MATERIAL SA SE SE O O O O O O O O O					114	1	м. (ппп).											
light grey and greyish cream fresh partially crushed mainly fractured and fractured to blocky seamy medium strong to strong sometimes porous and/ or dolomitic LIMESTONE 100 100 59 100 100 59 89 89 89 89 89 89 89 89 CAVITY (25.5-26.5m) CAVITY (25.5-26.5m) Ight grey and greyish cream fresh partially crushed mainly fractured and fractured to blocky seamy medium strong sometimes porous and/ or dolomitic LIMESTONE 110 100 100 59 110 100 1	_		SPT N blows		DES	•	OF MATERIAL		% FINES				UCS					
mainly fractured and fractured to blocky seamy medium strong to strong sometimes porous and/ or dolomitic LIMESTONE 51 51 0	- 21 - 21 - 22 - 22 - 23 - 24 - 25 - 26 - 26		S III		light grey and gre mainly fractured a strong to strong s LIMESTONE	yish cream f and fractured ometimes po	resh partially crushed to blocky seamy morous and/ or dolomi	edium	% E	83	83	59 89	N/mm2					
	_ _ _ _ _ _ _ _ _				mainly fractured a strong to strong s	and fractured	to blocky seamy me	edium										
	Ħ			1									1		<u> </u>	<u> </u>	_	<u> </u>

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIEN	NT:			D	AR-TALEB	FI	LE NO.:	14-015	5									
PROJ				BISR	I DAM / THIRD PA	ACKAGE (R	ock Quarries)				BOR	ЕНО	LE NO.:				ВН	R04
LOCA	ATION:			Rock	Material Sources	/ RQ-2a	Elevation (m):	75	9.08		SHE	ET:		4	0	F : 5		
EQUI	PMENT	Γ:		CMV		METHOD:			Ro				LE DEPTH	l (m)				45m
	DAM.	(mr	n):	86 to	114	CORE DIA	M. (mm):			63			ARTED:			5/20		
ENGI	NEER:			K.S.		DRILLER:				A.A.	DAT	ΓE FII	NISHED:		9/	9/20	14	
DЕРТН (m)	SYMBOL	ST	SPT N blows	11	DES	CRIPTION (OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		Re	emai	ks	
- - - 31 - -					mainly fractured a	and fractured	resh partially crushed d to blocky seamy med prous and/ or dolomitio	dium	-	96	89	61						
32 - - - - 33							nighly weathered partia	ally		90	90	49						
- - - 34 -							k to medium strong ONE sometimes dolon	mitic	Ē	91	91	32						
- 35 - - - - 36									-	69	69	17						
- - - 37 -									_	80	60	7.3						
- 38 - - - - 39									-	57	57	23						
- - - - 40					please refer to ne	ext page				100	80	80						

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIENT: PROJECT: LOCATION EQUIPMEN HOLE DAM ENGINEE - 41 - 41 - 42 - 42 - 43 - 44 - 44 - 44 - 46 - 45 - 46 - 46 - 46 - 46 - 47 - 46 - 47 - 48 - 48 - 48 - 48 - 48 - 48 - 48 - 48	N: NT: M. (m R:	. v	Rock CMV 86 to K.S.	DESC	ACKAGE (Ro / RQ-2a METHOD: CORE DIAM DRILLER: CRIPTION C	Elevation (m): M. (mm): PF MATERIAL Prately weathered partial ractured to blocky seam	% FINES	Rotary	SHEI BOR DAT	ET: EHOI TE ST	LE NO.: LE DEPTH ARTED: NISHED: UCS N/mm2	5 H (m)	9/ 9/	9F: 5	14 14	45m
EQUIPMEN HOLE DAM ENGINEER TOOMAS TOO	NT: M. (m R:		CMV 86 to K.S.	800 114 DESo greyish to whitish crushed mainly fra	METHOD: CORE DIAM DRILLER: CRIPTION C	II. (mm): PF MATERIAL Prately weathered partial ractured to blocky seam	FINES %	63 A.A. (%) 100	SCR (%)	80 R.Q.D (%) E E E E E E E E E E E E E E E E E E E	UCS		9/ 9/	/5/20 ⁻ /9/20	14	45m
HOLE DAM ENGINEE TORWAS - 41 - 42 - 42 - 43 - 44 - 44 - 45 - 45 - 45 - 45 - 45 - 45	M. (m R:		86 to K.S.	DESC greyish to whitish crushed mainly fra	CRIPTION C	oF MATERIAL crately weathered partial cractured to blocky seam	% FINES	63 A.A. 100	SCR (%)	8 R.Q.D (%)	UCS	1 (m)	9/	9/20 ⁻	14	45m
ENGINEE (w) H L DE PARTIE (W) P L DE PARTIE (W)	R:		K.S.	DESo	CRIPTION C	oF MATERIAL crately weathered partial cractured to blocky seam	у	A.A. 100	08 SCR (%)	8 R.Q.D (%) ⊒	UCS		9/	9/20 ⁻	14	
TOBWAS - 41 - 42 - 43 - 44 - 45 - 45 - 45 - 45 - 45 - 45		PT N N N N N N N N N N N N N N N N N N N	LT	DESo	cream mode	rately weathered partial	у	100 TCR (%)	⊗ SCR (%)	8 R.Q.D (%)	ucs					
- 41 - 41 - 42 - 42 - 43 - 44 - 44 - 45 - 45 - 45 - 45 - 45 - 47 - 47 - 48 - 48 - 48 - 48 - 48 - 48 - 48 - 48		SPT N N N N N N N N N N N N N N N N N N N		greyish to whitish crushed mainly fra	cream mode	rately weathered partial	у	100	80	80			Re	emar	ks	
- 42 - 42 - 43 - 43 - 44 45 - 45 45 45 				crushed mainly fra	actured and t	ractured to blocky seam	у									
- - -	-							91	91	88						
- 47 48 49 50																
50				Fn	nd of boreho	le at 45m	_	1	<u> </u>			_	<u> </u>	<u> </u>		
				E11	10 01 DOLETTO	io at Tolli										

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery

SOIL STUDIES SOIL SYMBOL **ROCK SYMBOL** SAMPLERS **OTHERS** SES GP Dolomite SPT (disturbed) — Water Level ♣ GP-GM Chalky Limestone Shelby tube GM Calcarenite Tricone GC ∷∷∷ sw Weak Chalky LIMESTONE Double tube ROCK CLASSIFICATION % RQD | Classification <25 | Very Poor SP Sandy Limestone 25-50 SP - SM Poor 50-75 Fair SM-SC Basalt / volcanics 75-90 Good Excellent >90 ML ML Chert CH-MH GRANULAR SOILS N-Value Relative Density OL ₩₩₩ OH < 4 Very Loose 4 - 10 Creamy White LIMESTONE Loose $\overset{\times \times \times}{\times \times}$ PT 10 - 30 Medium Dense 30 - 50 Dense Fill Material Grainstone LIMESTONE > 50 Very Dense MARL **COHESIVE SOIL** CLAY N-Value Consistency SANDSTONE < 2 Very Soft --- CLAYwith 2 - 4 Soft Sand 4 - 8 Medium Stiff and 8 - 15 Stiff CLAYSTONE Gravel 15 - 30 Very stiff > 30 Hard Oolitic LIMESTONE Micritic LIMESTONE

Mudstone

Gypsum

Siltstone



BISRI DAM/ THIRD PACKAGE (Rock Duarries)	CLIEN.	T:			C	AR-TALEB	FI	ILE NO.:	14-01	5				. =			_		
EQUIPMENT:	PROJE	ECT:			BISR	I DAM / THIRD PA						BOR	EHO	LE NO.:			E	SHK	(Q05
HOLE DAM. (mm): S6 to 114									: 7								F: 5		
ENGINEER: K.S. DRILLER: A.A. DATE FINISHED: 9/4/2014									- 	R					l (m):				42.5
Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium strong dolomitic LIMESTONE Sea Compared to blocky seamy medium st			(mn	n):		114	CORE DIA	M. (mm):			63								
SAPROLITE: transition from the residual to parent soil light grey to greyish and brownish cream fresh to moderately weathered parisilly crushed mainly fractured to blocky seamy medium strong dolomitic LIMESTONE 100 87 44	ENGIN	IEER:			K.S.		DRILLER:				A.A.	DAT	ΓE FII	NISHED:		9/4	4/20 ⁻	14	
Section Sect	DEРТН (m)	SYMBOL	ST	SPT N blows	5	DES	CRIPTION	OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.a.D (%)			Re	mar	ks	
4						light grey to greyi	sh and brow	rnish cream fresh t	to fractured						Casi	ng do	nwcown	to 1	1.5m
											100	100	35						
97 97 97 97 — — — — — — — — — — — — — —	600										100	100	81						
	- 7000 -										100	100	100						
	- 8 9										97	97	97						
	- - - 10										88	88	48						

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIEN					AR-TALEB		LE NO.:	14-015	5		BOR	FHO	LE NO.:			F		Q05	5
PROJ					I DAM / THIRD PA														
	TION:				Material Sources		Elevation (m):	79	0.86		SHE		LEBERT	2		F : 5		10.5	_
	PMENT			CMV		METHOD:			R				LE DEPT	H (m)		0 /00		42.5	4
	DAM.	-	n):	86 to	114	CORE DIA	W. (mm):			63			ARTED:			9/20			4
-	NEER:			K.S.		DRILLER:		1		A.A.	DA		NISHED:	ı	9/	4/20 ⁻	4		4
DЕРТН (m)	SYMBOL	ST	SPT N blows	占	DES	CRIPTION	OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		Re	mar	ks		
- -					moderately weath	ered partiall	nish cream fresh to y crushed mainly fra			88	88	48		Flusi	hina	wate	er lo	220	_
_					to blocky seamy r	nedium stroi	ng dolomitic LIMEST	ONE						at 10			iΤ	T	7
- 11	777														,		\vdash	\pm	-
-										53	47	0							
- -										00		Ü					 	\pm	_
- 12									-								+	\ddagger	1
- -																	+	#	1
- - 10										77	77	25					 	$\frac{1}{1}$	
- 13 -																	\downarrow	$\downarrow \downarrow$	
- -																	 	\pm	
- 14																	 	\pm	
- -										93	73	0					\perp	$\frac{1}{1}$	
- - 15																	 	\pm	
15 									•								_ 	\pm	
-																	H		_
- 16										100	80	8						$\frac{1}{1}$	_
- -														Ħ				$\frac{1}{1}$	1
- - 17					brownish cream n	moderately to	o highly weathered											$\frac{+}{1}$	1
_					partially crushed r strong porous dol	mainly fractu	ired weak to mediun	m		100	80	63						+	
_																			
18 -									ŀ								J	\blacksquare	
- -																		\prod	
- 19										100	100	100							
- -																			
- -																	\downarrow	\perp	
20				<u> </u>	1					80	63	0					丄	Ш	4

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIE					AR-TALEB		LE NO.:	14-01	5		BOR	EHO	LE NO.:				3HF	RQ05
	IECT:				I DAM / THIRD PA			1 7	20.00		CLIE	-т.				F . c		
	ATION: PMEN			CMV	Material Sources	METHOD:	Elevation (m):	73	90.86		SHE		LE DEPTI	3		F : 5		42.5
	DAM.		n).	86 to		CORE DIA	M (mm):		К	63			ARTED:	1 (111)		29/20		
	NEER:		11).	K.S.	114	DRILLER:	vi. (iiiii).			A.A.			NISHED:			4/20		
_				14.0.		DIVILLEN.							THORIED.			7,20		
DЕРТН (m)	SYMBOL	ST	SPT N blows	5	DES	CRIPTION (OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		R	emai	ks	
- 21 - 21 - 22 - 23 - 23 - 24 - 25 - 25 - 26 - 26 - 27 - 27 - 28 - 29		ST	N N N N N N N N N N N N N N N N N N N	17	ditto light grey fresh to mainly fractured to	moderately o blocky sea	weathered partiall ci	rushed	% FINE	80	100 97	0			R	emai	rks	
- - - 30										95	95	95						
- 55				<u> </u>						<u> </u>	1		<u> </u>		<u> </u>	<u> </u>	<u> </u>	

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIEN	IT:				AR-TALEB		ILE NO.: 14-0	15		POP	EUO	LE NO.:					Q05
PROJ					I DAM / THIRD PA							140					. 400
LOCA					Material Sources		Elevation (m):	790.86		SHE		I E DEDTI	4		F : 5		10.5
EQUII HOLE			-1.	CMV 86 to		METHOD: CORE DIA	M (mm):	K	otary 63			LE DEPTI	1 (m)		29/20		42.5
ENGI			ii).	K.S.	114	DRILLER:			A.A.			NISHED:			4/20		
_								m						-	.,	÷	
DЕРТН (m)	SYMBOL	ST	SPT N blows	5	DES	CRIPTION	OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		Re	emai	ks	
- 31 - 32 - 32 - 33 - 34 - 35 - 36 - 36							weathered partiall crushed amy LIMESTONE with thin		76	76	35						
				<u>. </u>												_	

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIEN	IT:			D	AR-TALEB	FII	LE NO.:	14-01	5		BOD	EHO:	I E NO :				, Lin	005
PROJ	ECT:			BISR	I DAM / THIRD P	ACKAGE (R	ock Quarries)						LE NO.:				энк	Q05
LOCA EQUII				Rock	Material Sources	/ RQ-2a METHOD:	Elevation (m):	79	90.86		SHE		LE DEPTI	5 1 (m)		F : 5		12.5
HOLE			n):	86 to		CORE DIA	M. (mm):		IX	63			ARTED:	1 (111)		29/20		12.0
ENGI			·	K.S.		DRILLER:	,			A.A.			NISHED:			4/20°		
DЕРТН (m)	SYMBOL	ĭ	SPT N blows	1	DES	CRIPTION (OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS		Re	mar	ks	
DEP.	SYN	0,	s ja						% Е	TC	SCI	R.Q.	N/mm2					
_					CAVITY													
_																		
41																		
_																		
_																		
42																		
-																	\perp	
_																		
_																		
43																	+	+
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44																		
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45								-										
_																		
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- 46																		
46																		
_																		
- 47																	+	+
_ +/																	+	+
_																		
-																	\perp	+
- 48																	+	+
																	\dagger	
_																		
-														\perp			+	+
- 49																	+	+
_																		
_														_			1	
-																	+	+
- 50																	+	+
					E	nd of boreh	ole at 42.5m											
SPT	Standa	ard F	Penetration	Test		TC	CR Total Core Ro	ecoverv						ST	S	ampl	e Tv	vne

SPTStandard Penetration TestTCRTotal Core RecoverySTSample TypeUCSUnconfined Compressive StrengthRQDRock Quality DesignationSYMSymbolLTLayer ThicknessSCRSolid Core RecoveryWTWater Table

N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

SOIL STUDIES SOIL SYMBOL **ROCK SYMBOL** SAMPLERS **OTHERS** SES GP Dolomite SPT (disturbed) — Water Level ♣ GP-GM Chalky Limestone Shelby tube GM Calcarenite Tricone GC ∷∷∷ sw Weak Chalky LIMESTONE Double tube ROCK CLASSIFICATION % RQD | Classification <25 | Very Poor SP Sandy Limestone 25-50 SP - SM Poor 50-75 Fair SM-SC Basalt / volcanics 75-90 Good Excellent >90 ML ML Chert CH-MH GRANULAR SOILS N-Value Relative Density OL ₩₩₩ OH < 4 Very Loose 4 - 10 Creamy White LIMESTONE Loose $\overset{\times \times \times}{\times \times}$ PT 10 - 30 Medium Dense 30 - 50 Dense Fill Material Grainstone LIMESTONE > 50 Very Dense MARL **COHESIVE SOIL** CLAY N-Value Consistency SANDSTONE < 2 Very Soft --- CLAYwith 2 - 4 Soft Sand 4 - 8 Medium Stiff and 8 - 15 Stiff CLAYSTONE Gravel 15 - 30 Very stiff > 30 Hard Oolitic LIMESTONE Micritic LIMESTONE

Mudstone

Gypsum

Siltstone



CLIE	NT:			D	AR-TALEB	FI	LE NO.:	14-0	15		200							2000
PROJ	JECT:			BISR	I DAM / THIRD PA	CKAGE (R	ock Quarries)				BOK	EHO	LE NO.:			t	3HF	RQ06
LOCA	ATION:			Rock	Material Sources	/ RQ-2b	Elevation (m):	799.1		SHE	ET:		1	0	F : 5		
EQUI	PMENT	Γ:		CMV	800	METHOD:	•	•	R	otary	BOR	ЕНО	LE DEPTI	1 (m)	:			45m
HOLE	DAM.	(mn	n):	86 to	114	CORE DIA	M. (mm):			63	DA	TE ST	ARTED:		24	/8/20	14	
ENGI	NEER:			K.S.		DRILLER:				A.A.	DA	ΓE FII	NISHED:		28	/8/20	14	
DЕРТН (m)	SYMBOL	ST	SPT N blows	LT	DES	CRIPTION	OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		Re	emar	ks	
-					SAPROLITE (tran	sition from r	esidual to parent	t soil)						No f	lushi	ing w	ate	r loss
_ _ _ 1 _ _					light to whitish gre					48	28	0						
- - 2 - -					fractured mainly b massive medium times dolomitic					90	90	33						
- - 3 -														Cas	ing d	lown	to 3	3.0m
- - 4 -										97	97	70						
5 6										100	100	76						
- - - - 7 -										87	73	67						
- 8 - - - 9										81	81	81						
- - - - 10										100	100	95						

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



BISRI DAM / THIRD PACKAGE (Tock Quarries)	CLIEN	NT:			D	AR-TALEB	FI	LE NO .: 14	-015								_	
EQUIPMENT:											BOR	ЕНО	LE NO.:			Е	ЗHR	Q06
MOLEDAM. (mm): 85 to 114	LOCA	TION:			Rock	Material Sources	/ RQ-2b	Elevation (m):	799.	1	SHE	ET:		2	О	F : 5		
Second Property	EQUI	PMENT	Γ: <u> </u>						F	Rotary				l (m)	:		4	15m
Description of Material 10 10 10 10 10 10 10 1				n):		114	CORE DIA	M. (mm):		63	DA	TE ST	TARTED:					
Section Sect	ENGI	NEER:			K.S.	-	DRILLER:			A.A.	DA	TE FI	NISHED:		28	/8/20	14	
Second Control of Markinsh gray fresh to slightly weathered partially fractured mainly blocky seamy and blocky seamy to massive medium strong to strong LIMESTONE some times dolomitic 10 10 10 10 10 10 10 1	DEPTH (m)	SYMBOL	ST	SPT N blows	5	DES	CRIPTION	OF MATERIAL	% FINES						Re	emar	ks	
93 93 80 93 93 80 93 93 80 93 93 80 93 93 80 93 93 80 93 93 80 93 93 80 93 93 93 80 93 93 93 93 80 93 93 93 93 93 93 93 93 93 93 93 93 93	- 11 - 12 - 12 - 13 - 14 15 - 16 		ST	S N N N N N N N N N N N N N N N N N N N	5	light to whitish gra fractured mainly b massive medium	ey fresh to si	ightly weathered partially y and blocky seamy to		100 83 100 97	100 83 100 97	95 83 75 43			Re		ks	
										93	93	80						
	- - 20									89	89	71						

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



BRIST DAM THIRDY PACKAGE (Rock Quarries) 799.1 SHEET: 3 0.7 5	CLIE			AR-TALEB		LE NO.:	14-01	5		BOR	EHO	LE NO.:		E	 Q06
EQUIPMENT:							_	200.4							
## HOLE DAM. (mm): ## 85 0 114						Elevation (m):						I E NEDTL		F: 5	 15m
ENGINEER: K.S. DRILLER: A.A. DATE FINISHED: 28/8/2014			n)·			M (mm)·		IX					1 (111)	/8/20	+3111
Column C				114		···· (······/·									
light to whitsin grey fresh to slightly weathered partially fractured mainly blocky seamy and blocky seamy and solocky seamy to massive medium strong to strong LIMESTONE some times dolomitic 22 23 24 25 26 27 28 80 80 80 80 80 80 80 80 80			SPT N blows	DES	•	OF MATERIAL		% FINES				ucs			
whitish cream fresh partially fractured mainly blocky seamy and blocky seamy to massive medium strong to strong dolomitic LIMESTONE 100 100 100 95 95 95	- 21 - 21 - 22 - 22 - 23 - 24 24			fractured mainly be massive medium	olocky seamy	y and blocky seamy	to		89	80	43				
95 95 95	- - - 27 - -			seamy and blocky	seamy to m	nassive medium stro	ky ang to								
									95	95	95				

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery

Sample Type



CLIEN	NT:				AR-TALEB		LE NO.:	14-01	5		BOB	EHO	LE NO.:				SHE	Q06
	JECT:				I DAM / THIRD PA								LL 140					
	ATION: PMEN			Rock	Material Sources	/ RQ-2b METHOD:	Elevation (m):	7	99.1		SHE		I E DEST	4 (m)		F : 5		45m
	DAM.		n):	86 to		CORE DIA	M (mm):		K	otary 63			LE DEPTI	1 (M)		/8/20		45m
	NEER:			K.S.	114	DRILLER:	w. (11111).			A.A.			NISHED:			/8/20		
-									'n			ī						
DЕРТН (m)	SYMBOL	ST	SPT N blows	ב	DES	CRIPTION (OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		R	emar	ks	
- - - 31 -						y seamy to n	ractured mainly block nassive medium stro			100	100	100						
- - 32 - - - - 33										100	100	95						
- - - - 34 -										100	100	93						
- - 35 - - - - 36					light to whitish gre weathered partial blocky seamy to r dolomitic LIMEST	lly fractured i massive med	n fresh to slightly mainly blocky seamy dium strong to strong	/ and		100	100	100						
- - - 37 -										100	100	89						
- 38 - - - - 39										93	93	89						
- - - - 40										100	100	100						

SPT Standard Penetration Test TCR Total Core Recovery ST UCS Unconfined Compressive Strength RQD Rock Quality Designation

SYM Symbol SCR Water Table LT Layer Thickness Solid Core Recovery



CLIENT:	D	AR-TALEB	FI	LE NO.:	14-01	5											
PROJECT:		I DAM / THIRD PAC						BOR	EHO	LE NO.:	BHRG						
LOCATION:		Material Sources / F	Elevation (m):	7	99.1		SHE	ET:		5	С	F: 5					
EQUIPMENT:	CMV	800	METHOD:			R	otary	BOR	ЕНО	LE DEPTH	l (m)):		4	15m		
HOLE DAM. (mm):	86 to	114 C	CORE DIA	E DIAM. (mm):			63	DATE STARTED			D: 24/8/20)14			
ENGINEER:	K.S.	K.S. DRILLER:						DAT	DATE FINISHED:			28/8/2014					
SYMBOL ST SPT	blows	DESC	RIPTION (OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		R	emai	rks			
- 41 - 41 - 41 - 42 - 42 - 43 - 43 - 43 - 44 - 44			fractured rassive med	n fresh to slightly mainly blocky seamy lium strong to strong			76	76	48 88 78								
- 45 - 45 - 46 - 46 47 - 47 - 48 48 49																	
50														Ш	Ш		
		End	of boreho	ole at 45m													
	l .	<u>I</u>				<u> </u>											

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery

SOIL STUDIES SOIL SYMBOL **ROCK SYMBOL** SAMPLERS **OTHERS** SES GP Dolomite SPT (disturbed) — Water Level ♣ GP-GM Chalky Limestone Shelby tube GM Calcarenite Tricone GC ∷∷∷ sw Weak Chalky LIMESTONE Double tube ROCK CLASSIFICATION % RQD | Classification <25 | Very Poor SP Sandy Limestone 25-50 SP - SM Poor 50-75 Fair SM-SC Basalt / volcanics 75-90 Good Excellent >90 ML ML Chert CH-MH GRANULAR SOILS N-Value Relative Density OL ₩₩₩ OH < 4 Very Loose 4 - 10 Creamy White LIMESTONE Loose $\overset{\times \times \times}{\times \times}$ PT 10 - 30 Medium Dense 30 - 50 Dense Fill Material Grainstone LIMESTONE > 50 Very Dense MARL **COHESIVE SOIL** CLAY N-Value Consistency SANDSTONE < 2 Very Soft --- CLAYwith 2 - 4 Soft Sand 4 - 8 Medium Stiff and 8 - 15 Stiff CLAYSTONE Gravel 15 - 30 Very stiff > 30 Hard Oolitic LIMESTONE Micritic LIMESTONE

Mudstone

Gypsum

Siltstone



CLIE					AR-TALEB		LE NO.:	14-01	5		BOR	FHO	LE NO.:			F	RHF	RQ07	
	JECT:				I DAM / THIRD PA														
	ATION: PMENT			Rock	Material Sources	/ RQ-2b METHOD:	Elevation (m):	80	08.67		SHE		LE DEPTI	1 (m)		F : 2		15m	
	E DAM.		ما،	86 to		CORE DIAI	M (mm):		K	63			ARTED:	1 (III)		20/20		10111	
	NEER:		ii).	K.S.	114	DRILLER:	vi. (iiiiii).			A.A.			NISHED:			22/20			
				14.0.		DIVILLEN.							TIOTILD.						
DEPTH (m)	SYMBOL	ST	SPT N blows	5	DES	CRIPTION (OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		R	emar	ks		
- - - - 1					SAPROLITE (tran	nsition from tl	he residual to paren		57	37	0								
- -																wate	r Ic)SS	
- <u>2</u> 3						aret mainly fr	ihtly weathered parti actured to blocky se nitic LIMESTONE			52	52	27		at 1	.5m				
- - - - 4 -					ditto with pockets	of clay				67	40	18							
- - 5 - - - - 6										73	73	73		Cas	ing o	lown	to 4	4.5m	
- - - 7 -										80	80	80							
- 8 - 9										60	60	23							
- - - - 10										40	21	0							

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



PROJECT: BUSRI DAM THIRD PACKAGE (Rock Quarries) BOREHOLE NO.: BHRODY	CLIENT:	<u> </u>			D	AR-TALEB	FII	.E NO. : 14	1-015		T										
CAM 900 METHOD: Roday BOREHOLE DEPTH (m): 15											ВО	REHO	LE NO.:								
## ## ## ## ## ## ## ## ## ## ## ## ##	LOCATION	ON:			Rock	Material Sources	/ RQ-2b	Elevation (m):	808	.67	SH	EET:		2							
No. No.	EQUIPM	IENT	:					•						l (m							
Section Sect	HOLE D	AM.	(mn	n):	86 to	114		/l. (mm):		6	3 D /	ATE ST	TARTED:	ARTED: 8/							
whitish to brownish cream slightly weathered partially crushed and scharer mainly fractured to blocky seamy medium strong to strong dolomitic LIMESTONE 77 71 33 76 76 76 76 76 76 76 76 76 76 76 76 76	ENGINE	ER:			K.S.		DRILLER:			Α.,	۱. D	ATE FI	NISHED:	8/22/2014							
whitsh to brownish craam sightly weathered parially crushed and schared mish fractured to blocky seamy medium strong to strong dolomitic LIMESTONE 77 71 33 77 71 71 71 71 71 71 71 71 71 71 71 71	DEPTH (m)	SYMBOL	ST	SPT N blows	7	DES	CRIPTION C	F MATERIAL	6 1 1 1 1						R	ema	ks				
16	- 12 12 13 13 14 14 14 14 14 14 14 14 14 14 14 14 14					crushed and scha	aret mainly fra	actured to blocky seamy		7	77 71	33 76									
20																					
Litt of borefiole at 13111	- - -						End of borok	iole at 15m													
<u> </u>						L L	Liiu ot borer	iole at 13M													

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery

SOIL STUDIES SOIL SYMBOL **ROCK SYMBOL** SAMPLERS **OTHERS** SES GP Dolomite SPT (disturbed) — Water Level ♣ GP-GM Chalky Limestone Shelby tube GM Calcarenite Tricone GC ∷∷∷ sw Weak Chalky LIMESTONE Double tube ROCK CLASSIFICATION % RQD | Classification <25 | Very Poor SP Sandy Limestone 25-50 SP - SM Poor 50-75 Fair SM-SC Basalt / volcanics 75-90 Good Excellent >90 ML ML Chert CH-MH GRANULAR SOILS N-Value Relative Density OL ₩₩₩ OH < 4 Very Loose 4 - 10 Creamy White LIMESTONE Loose $\overset{\times \times \times}{\times \times}$ PT 10 - 30 Medium Dense 30 - 50 Dense Fill Material Grainstone LIMESTONE > 50 Very Dense MARL **COHESIVE SOIL** CLAY N-Value Consistency SANDSTONE < 2 Very Soft --- CLAYwith 2 - 4 Soft Sand 4 - 8 Medium Stiff and 8 - 15 Stiff CLAYSTONE Gravel 15 - 30 Very stiff > 30 Hard Oolitic LIMESTONE Micritic LIMESTONE

Mudstone

Gypsum

Siltstone



CLIEN	NT:			D	AR-TALEB	F	ILE NO.:	14-0	15		200					_				
PROJ	IECT:			BISR	I DAM / THIRD PA	ACKAGE (R	ock Quarries)						LE NO.:			6	нк	Q08		
LOCA	ATION:			Rock	Material Sources		Elevation (m)): 7	787.97		SHE			1		F : 5				
	PMEN1			SAT		METHOD:			R				LE DEPTI	1 (m)				15m		
	DAM.		n):	86 to	114	CORE DIA				63		DATE STARTED:				14/8/2014				
ENGI	NEER:			K.S.		DRILLER:			Na	wraz	DA	ΓE FII	NISHED:	16/8/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	נז	DES	CRIPTION	OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		Re	emar	ks				
- - - 1 -					dark brown clayed	brown fresh	and fresh to mod		88	33	6.7									
- - 2 - - - - 3					weathered blocky sometimes crushe strong and strong time to time porou	ed weak to r	moderately andy LIMESTONE			71	50	30		Cas	ing d	own	to 3	Bm		
- - - 4 -										75	75	28		Flus		wate	r lo	SS		
- - 5 - - - - 6										67	67	20								
- - - 7 -										100	100	57								
- 8 - 9										57	57	51								
- - - - 10										57	57	33								

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIEN	NT:			D	AR-TALEB	FII	LE NO.:	14-015	5		BOB	EUO	LE NO.:					Q08
	IECT:				I DAM / THIRD PA								LL NO					. 400
	TION:				Material Sources		Elevation (m):	78	7.97		SHE			2		F : 5		
	PMENT			SAT		METHOD:			Ro				LE DEPTI	l (m)				45m
	DAM.		n):	86 to	114	CORE DIA	VI. (mm):			63			ARTED:			/8/20		
_	NEER:			K.S.		DRILLER:				wraz	DAT		NISHED:		16	/8/20	14	
DЕРТН (m)	SYMBOL	ST	SPT N blows	5	DES	CRIPTION C	OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		Re	emar	ks	
		S	og Og		ditto				₩ F	57 70 57 57	57 70 57 27	53 50 44 40	N/mm2					
_ _ _ _ 19 _ _ _										89	89	53						
_ _ 20										89	89	13						
				<u> </u>	1													

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery



CLIE					AR-TALEB		LE NO.:	14-015	5		BOR	EHO	LE NO.:			-	RHE	Q08
	JECT:				I DAM / THIRD PA													
	ATION:				Material Sources		Elevation (m):	78	7.97		SHE		LE DEDTI	3		F : 5		45
	PMEN		- \	SAT		METHOD:	M. (manua)-		R				LE DEPTH	1 (m)		/8/20		45m
	DAM.		n):	86 to K.S.	114	CORE DIAI	vi. (mm):		Na	63			ARTED:			/8/20 /8/20		
_				N.S.	I	DRILLER:				wraz			NISHED:		10	10120	14	
DЕРТН (m)	SYMBOL	ST	SPT N blows	5	DES	CRIPTION C	OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		Re	emar	ks	
- 21 - 21 - 22 - 22 - 23 - 24 - 25 - 26 - 27 - 27 - 27 - 28 - 27					ditto				%	89 89 57 67	89 89 57 67	13 23 53 13 28						
29 - - - -										100	100	40						
30														<u> </u>				

SPT Standard Penetration Test UCS Unconfined Compressive Strength Layer Thickness

LT

TCR Total Core Recovery RQD Rock Quality Designation SCR Solid Core Recovery

ST Sample Type SYM Symbol Water Table



SINCH DAM THIND DECK CRUST METHOD M	CLIEN					AR-TALEB		LE NO.:	14-015	5		BOR	FHO	LE NO.:			-	RHE	Q08	
SAT 2000 METHOD: SOME POME SOME PO									1										. 400	
MOLE DAM. (mm): 88 to 114 OORE DAM. (mm): 100								Elevation (m):	78											
Second S								M (R					I (m		10.10.0		45m	
Section Sect				n):		114		vi. (mm):		Na										
33					N.S.		DRILLER:							NISHED:		10	10120	114		
100 100 10 10 10 10 10 10 10 10 10 10 10	DEPTH (m	SYMBOL	ST	SPT N blows	5	DES	CRIPTION C	OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)		Remarks						
38 53 10 53 53 10 53 53 10 54 55 55 55 55 55 55 55 55 55 55 55 55	- 31 - 31 - 32 - 32 - 33 					ditto					100	100	47							
37											47	47	0							
39	- - - 37 -										53	53	10							
73 73 20											100	100	27							
	- 40								Ī		73	73	20							

SPT Standard Penetration Test UCS Unconfined Compressive Strength Layer Thickness

LT

TCR Total Core Recovery RQD Rock Quality Designation SCR Solid Core Recovery

ST Sample Type SYM Symbol Water Table



CLIE	NT:			D	AR-TALEB	FI	LE NO.:	14-015	5		DOD	FUO	LENO:			_		000	
PROJ	JECT:			BISR	I DAM / THIRD PA	CKAGE (R	ock Quarries)						LE NO.:		BHRQ08				
	ATION:				Material Sources		Elevation (m):	78	7.97		SHE		5						
	PMEN			SAT		METHOD:			Ro				LE DEPTI	l (m):				5m	
	DAM.		n):	86 to	114	CORE DIA	M. (mm):			63			ARTED:			8/20			
_	NEER:			K.S.		DRILLER:				wraz	DA		NISHED:		16/	8/20	14		
DЕРТН (m)	SYMBOL	ST	SPT N blows	5	DES	CRIPTION (OF MATERIAL		% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm2		Re	mar	ks		
- - -					ditto				-	73	73	20							
- 41 - - - - 42										67	67	17							
- - - - 43 -										67	67	20							
- 44 - - - - 45									•	73	73	0							
- - - - 46 - -																			
- 47 - - - - 48																			
- - - - 49																			
- - - 50					Er	nd of boreho	ole at 45m		-										

SPT Standard Penetration TestUCS Unconfined Compressive StrengthLT Layer Thickness

TCR Total Core Recovery

RQD Rock Quality Designation

SCR Solid Core Recovery

ST Sample Type
SYM Symbol
WT Water Table

SOIL STUDIES SOIL SYMBOL **ROCK SYMBOL** SAMPLERS **OTHERS** SES GP Dolomite SPT (disturbed) — Water Level ♣ GP-GM Chalky Limestone Shelby tube GM Calcarenite Tricone GC ∷∷∷ sw Weak Chalky LIMESTONE Double tube ROCK CLASSIFICATION % RQD | Classification <25 | Very Poor SP Sandy Limestone 25-50 SP - SM Poor 50-75 Fair SM-SC Basalt / volcanics 75-90 Good Excellent >90 ML ML Chert CH-MH GRANULAR SOILS N-Value Relative Density OL ₩₩₩ OH < 4 Very Loose 4 - 10 Creamy White LIMESTONE Loose $\overset{\times \times \times}{\times \times}$ PT 10 - 30 Medium Dense 30 - 50 Dense Fill Material Grainstone LIMESTONE > 50 Very Dense MARL **COHESIVE SOIL** CLAY N-Value Consistency SANDSTONE < 2 Very Soft --- CLAYwith 2 - 4 Soft Sand 4 - 8 Medium Stiff and 8 - 15 Stiff CLAYSTONE Gravel 15 - 30 Very stiff > 30 Hard Oolitic LIMESTONE Micritic LIMESTONE

Mudstone

Gypsum

Siltstone

APPENDIX 3. PHOTOS OF CORE BOXES













































































































































APPENDIX 4. LIST OF SAMPLING & LABORATORY TESTING PROGRAM – ROCK MATERIAL SOURCES (RQ-1b, RQ-2a/2b & RQ-3a)

BISRI	BISRI DAM LABORATORY TESING - BOREHOLES (BHRQ) / ROCK MATERIAL SOURCES / RQ-1b Sampling									Tes	ting					
									Ī	Ī			┙			
	Œ		5	D	Unit (U)	2	2	2	2	2	1	7	7	1	2	16
No. of Test Pit	Depth of Sampling (m)	Type of Sample	Sample Description	Date of Sampling		Crushing (Sample Preparation)	Water Absorption	Dry & Soaked Density	LA (500 revolutions)	Soundness (Sodium Sulphate)	Wetting – Drying Loss (35 cycles)	Dry Uni-Axial Compressive Strength	Soaked Uni-Axial Compressive Strength	AAR (Alkali aggregate reactions)	Petrography (including Hardness)	General Total
BHRQ3	from 4.5 to 7.8m	Core	Light olive brown to cream slightly weathered blocky/seamy to massive strong occasionally karstified and porous dolomitic LIMESTONE	0.2014		1	1	1	1	1		1	1	1	1	
BHRQ1	from 12 to 16m	Core	Light olive brown to cream slightly weathered mainly blocky and seamy occasionally crushed strong rarely karstified dolomitic LIMESTONE	15.10.		1	1	1	1	1	1	1	1		1	
			Page 1	of 3												

BISRI	ISRI DAM LABORATORY TESING - BOREHOLES (BHRQ) / ROCK MATERIAL SOURCES / RQ-2a/2b									Tes	ting										
	Sampling																				
	(m)	6	(Site)	g	Unit (U)	5	2	5	2	5	2	2	5	3	4	40					
No. of Test Pit	Depth of Sampling (m)	Type of Sample	Sample Description (Site)	Date of Sampling		Crushing (Sample Preparation)	Water Absorption	Dry & Soaked Density	LA (500 revolutions)	Soundness (Sodium Sulphate)	Wetting – Drying Loss (35 cycles)	Dry Uni-Axial Compressive Strength	Soaked Uni-Axial Compressive Strength	AAR (Alkali aggregate reactions)	Petrography (including Hardness)	General Total					
BHRQ8	from 6 to 9.3m	Core	Light olive brown to cream slightly weathered blocky/seamy to fractured moderately strong to strong occasionally/slightly karstified dolomitic LIMESTONE.			1	1	1	1	1		1	1	1	1						
BHRQ6	from 3 to 6m	Core	Light olive brown to cream slightly weathered blocky/seamy to fracture moderately strong to strong slightly dolomitic LIMESTONE.	_		1	1	1	1	1	1	1	1								
БПКО	from 13.5 to 16.8m	Core	Light olive brown to cream and white faintly weathered blocky/seamy to fracture moderately strong to strong slightly dolomitic LIMESTONE.	5.10.2014		1	1	1	1	1		1	1	1	1						
BHRQ5	from 1.5 to 4.5m		Light olive brown to cream slightly sometimes moderately weathered blocky/seamy to fractured and crushed strong occasionally karstified (karst voids are filled with clay) dolomitic LIMESTONE.	15.		1	1	1	1	1		1	1	1	1						
BHRQ4	from 10.5 to 14m		Light olive brown to cream and white slightly and slightly to moderately weathered blocky/seamy to fractured and crushed strong slightly marly (rarely) dolomitic LIMESTONE			1	1	1	1	1	1	1	1		1						
			Page 2	of 3					Page 2 of 3												

BISR	BISRI DAM LABORATORY TESING - BOREHOLES (BHRQ) / ROCK MATERIAL SOURCES / RQ-3a									Too	4:					
	Sampling									res	ting					
	(m)		C	D	Unit (U)	1	٢	1	~	~	-	-	٢	٢	٢	6
No. of Test Pit	Depth of Sampling (m)	Type of Sample	Sample Description	Date of Sampling		Crushing (Sample Preparation)	Water Absorption	Dry & Soaked Density	LA (500 revolutions)	Soundness (Sodium Sulphate)	Wetting – Drying Loss (35 cycles)	Dry Uni-Axial Compressive Strength	Soaked Uni-Axial Compressive Strength	AAR (Alkali aggregate reactions)	Petrography (including Hardness)	General Total
EV10	from 22.5 to 30m	Core	Beige slightly weathered fractured and crushed strong to very strong occasionally karstified slightly sandy and dolomitic LIMESTONE	15.10.2014		1	1	1	1	1	1	1	1	1	1	
			Page 3	of 3												