

REPUBLIC OF LEBANON
COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION

DETAILED DESIGN OF BISRI DAM PROJECT

CONTRACT NO.17909

DAM FOOTPRINT

GEOTECHNICAL INVESTIGATION REPORT V

FACTUAL

June 2014



DAR AL HANDASAH NAZIH TALEB & PARTNERS
دار الهندسة نزيه طالب وشركاه

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	Signature:	

1. Introduction

One borehole (BHRA2) was located (Appendix 1) and drilled within the axe of the dam (right side abutment) in a manner to determine the depth of groundwater table (Appendix 5), subsurface rock strata and their average hydraulic conductivities (Appendix 4) within the concerned grout curtain (depth and extension of the grout curtain).

BHRA2: 147m

One borehole (BHRA4) was located (Appendix 1) and drilled within the right side valley wall (upstream) in a manner to determine the depth of groundwater table (Appendix 5), subsurface rock strata and their average hydraulic conductivities (Appendix 4) within the area where it will be inundated (water leakage from the lake).

BHRA4: 76.5m

One borehole (BHVR2) was located (Appendix 1) and drilled within the valley (right side of the dam) in a manner to determine the subsurface soil strata and the depth of underlying bedrocks.

BHVR2: 111m

New test pits (8 nos. of NTP, see Figure 1 to 8) were excavated (see Figure 9 to 11) within the areas (S1-A/B/C, N-1, N-3 and S-3, see Figure 12) previously recommended as clay-core material sources, to a maximum depth of 5.8m from the natural ground level.

In-situ Field Density (Sand-Cone Method, see Figure 13) and Moisture Content (Speedy Moisture Testing Kit, see Figure 14) tests were carried out during the execution of the test pits.

Representative bulk soil samples (see Figure 15) were taken from the test pits and sent to the laboratory for testing. List of sampling and laboratory testing is presented in Appendix 6 of this factual report.





Figure 1: NTP1, clay-core material source of S1-A/B/C

NTP1 (X: -334204.15, Y: -62028.56, Z: + 415.33, Date: 29.05.2014): 5.5m deep, groundwater table is deeper than 5.5m.

As per site description;

0 - 0.35m: Agricultural top soil.

0.35 – 1.5m: Yellowish brown fine to medium SAND.

1.5 – 3.6m: Brown slightly sandy SILT and CLAY (in-situ testing and bulk sampling at 2.5m).

3.6 – 4m: Light brown fine to medium SAND.

4 – 5.5m: Alluvial soil deposits (Gravely SAND).



Figure 2: NTP2, clay-core material source of N-1

NTP2 (X: -333852.51, Y: -61528.41, Z: + 412.71, Date: 28.05.2014): 5m deep, groundwater table is deeper than 5m.

As per site description;

- 0 - 1.5m: Alluvial soil deposits (Sand with rounded Gravel).
- 1.5 – 4.6m: Brown clayey silty SAND (in-situ testing and bulk sampling at 3m).
- 4.6 – 5m: Bluish grey sandy silty CLAY (in-situ testing and bulk sampling at 5m).

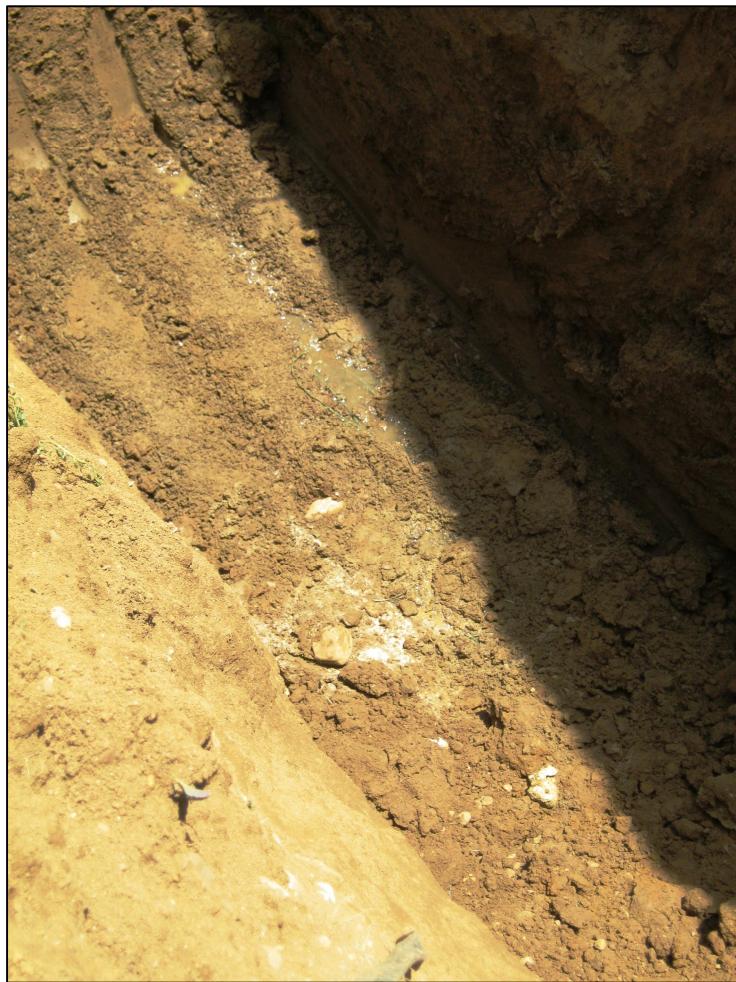


Figure 3: NTP3, clay-core material source of S-3

NTP3 (X: -333589.95, Y: -61404.50, Z: + 407.65, Date: 28.05.2014): 5.5m deep, groundwater table at a depth of 3m.

As per site description:

- 0 - 0.35m: Agricultural top soil.
- 0.35 – 1.5m: Olive brown sandy clayey SILT.
- 1.5 – 3.2m: Brown silty CLAY (in-situ testing and bulk sampling at 2.5m).
- 3.2 – 4m: Bluish grey clayey SILT and silty CLAY (bulk sampling at 3.4 and 3.8m).
- 4 – 5.5m: Alluvial soil deposits (Sand with rounded Gravel).



Figure 4: NTP4, clay-core material source of N-3

NTP4 (X: -333292.35, Y: -61187.57, Z: + 411.73, Date: 29.05.2014): 5m deep, groundwater table is deeper than 5m.

As per site description:

- 0 - 0.3m: Agricultural top soil.
- 0.3 – 1m: Alluvial soil deposits (Sand with rounded Gravel).
- 1 – 2m: Yellowish brown fine to medium SAND.
- 2 – 3m: Brown silty sandy CLAY (in-situ testing and bulk sampling at 2.5m).
- 3 – 5m: Bluish grey silty CLAY (in-situ testing and bulk sampling at 4.5m).



Figure 5: NTP5, clay-core material source of N-3

NTP5 (X: -333271.52, Y: -61148.82, Z: + 413.02, Date: 28.05.2014): 5.2m deep, groundwater table is deeper than 5.2m.

As per site description:

- 0 - 0.5m: Agricultural top soil.
- 0.5 – 2m: Alluvial soil deposits (Sand with rounded Gravel).
- 2 – 4.2m: Brown silty CLAY (in-situ testing and bulk sampling at 2.7m).
- 4.2 – 5.2m: Bluish grey silty CLAY (in-situ testing and bulk sampling at 5m).



Figure 6: NTP6, clay-core material source of N-3

NTP6 (X: -333233.27, Y: -61143.39, Z: + 413.36, Date: 28.05.2014): 5.8m deep, groundwater table is deeper than 5.8m.

As per site description:

- 0 - 0.5m: Agricultural top soil.
- 0.5 – 1.5m: Alluvial soil deposits (Sand with rounded Gravel).
- 1.5 – 4.9m: Brown silty CLAY (in-situ testing and bulk sampling at 2.8m).
- 4.9 – 5.8m: Bluish grey silty CLAY (in-situ testing and bulk sampling at 5.8m).



Figure 7: NTP7, clay-core material source of N-3

NTP7 (X: -333228.91, Y: -61103.93, Z: + 414.04, Date: 28.05.2014): 5.1m deep, groundwater table is deeper than 5.1m.

As per site description:

- 0 - 0.5m: Agricultural top soil.
- 0.5 – 0.75m: Alluvial soil deposits (Sand with rounded Gravel).
- 0.75 – 4.7m: Brown silty CLAY (in-situ testing and bulk sampling at 2.7m).
- 4.7 – 5.1m: Bluish grey silty CLAY (in-situ testing and bulk sampling at 5.1m).



Figure 8: NTP8 (stepped pit), clay-core material source of S1-A/B/C

NTP8 (X: -334208.48, Y: -62113.25, Z: + 414.78, Date: 29.05.2014): 4.5m deep, groundwater table is deeper than 4.5m.

As per site description:

0 - 0.3m: Agricultural top soil.

0.3 – 1m: Yellowish brown fine to medium SAND.

1 – 1.5m: Grey silty CLAY (in-situ testing and bulk sampling at 1.2m).

1.5 – 3.5m: Brown slightly silty fine to medium SAND.

3.5 – 4.5m: Alluvial soil deposits (Sand with rounded Gravel).



Figure 9: NTP1



Figure 10: NTP6

TP	width (m)	length (m)	depth (m)	volume (m ³)
NTP1	2.5	5.0	5.5	68.8
NTP2	2.5	5.0	5.0	62.5
NTP3	2.5	5.0	5.5	68.8
NTP4	3.0	5.0	5.0	75.0
NTP5	2.5	5.0	5.2	65.0
NTP6	2.5	5.0	5.8	72.5
NTP7	2.5	5.0	5.1	63.8
NTP8	2.4	5.0	4.5	54.0
	2.0	4.0	1.5	12.0
Total Volume				542.3

Figure 11: Test pit dimensions.

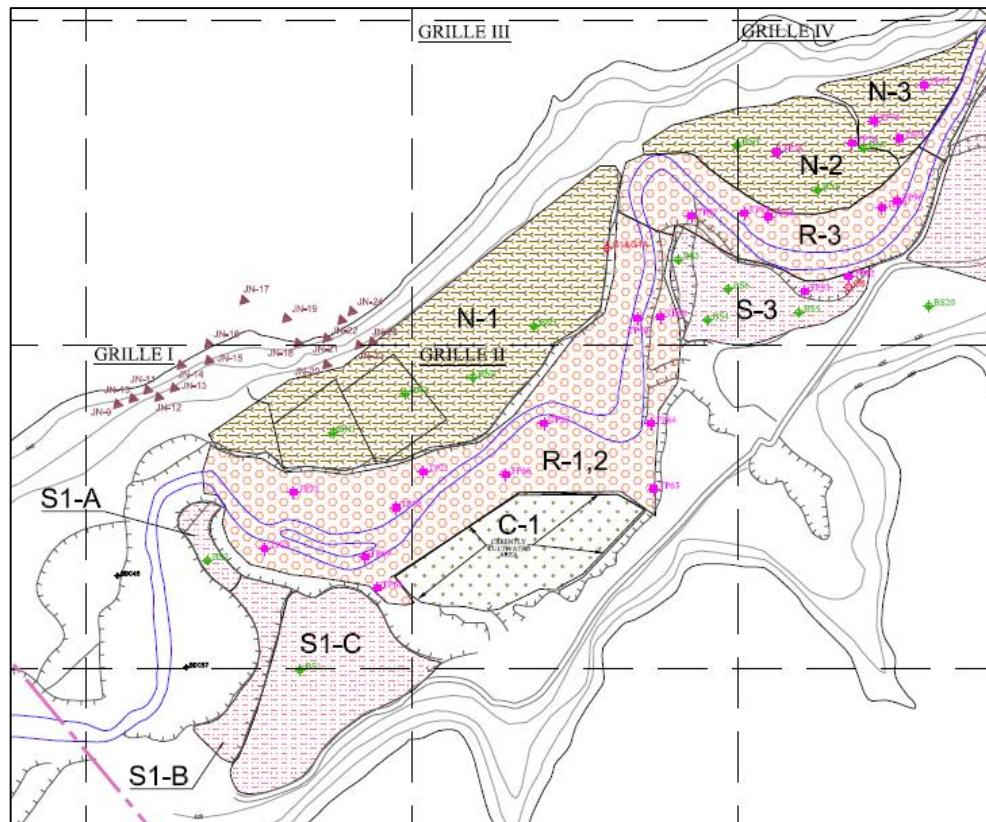


Figure 12: Previously recommended clay-core material sources.



Figure 13: Sand-cone method (NTP4)



Figure 14: Speedy moisture test kit (NTP2).



Figure 15: Bulk samples taken from the new test pits.

2. Field Investigation (Boreholes)

The field investigation was performed between April 08 and May 28, 2014. Three boreholes (BHVR2, BHRA2 and BHRA4) to a maximum depth 147m were drilled at locations shown on Figure 16. Crawler and truck mounted rotary drill rigs as shown on Figure 17 and 18 were used in field investigation.

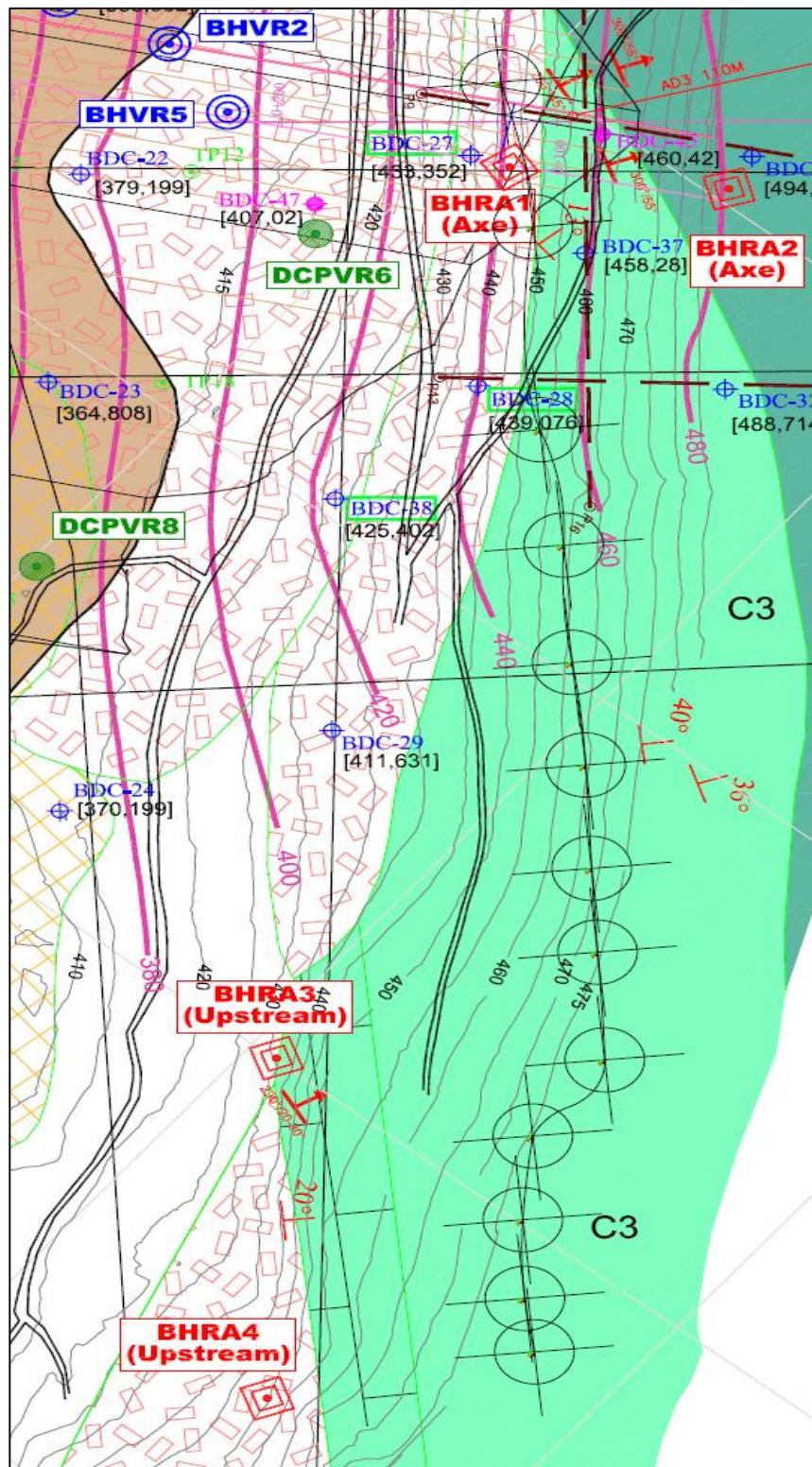


Figure 16: Locations of the boreholes.

BHVR2 / Piezometer (+414.09 NGL): 111 meters deep.

0-26m: Flood-plain and lacustrine soil deposits (loss of water circulation at 6m).

26-31.5m: Old colluvial soil deposits.

31.5-111m: C2b

BHRA2 / Piezometer (+490.25 NGL): 147 meters deep.

0-61.5m: C3-C4 (loss of water circulation, 100% and continuously, between 7 and 29m / loss of water circulation, 100%, at 34m)

61.5-147m: C3

BHRA4 (+449.85 NGL): 76.5 meters deep.

0-64.5m: C3 (loss of water circulation at 1m)

64.5-76.5m: C2b

Groundwater table was detected in boreholes at below given depths (May 2014) from the natural ground level (NGL).

BHVR2 / Piezometer (+414.09 NGL):

Groundwater table at a depth of 9.24m in average (+404.85)

BHRA2 / Piezometer (+490.25 NGL):

Groundwater table at a depth of 94.13m in average (+396.12)

BHRA4 (+449.85 NGL):

Groundwater table at a depth of 36.62m (+413.23)





Figure 17

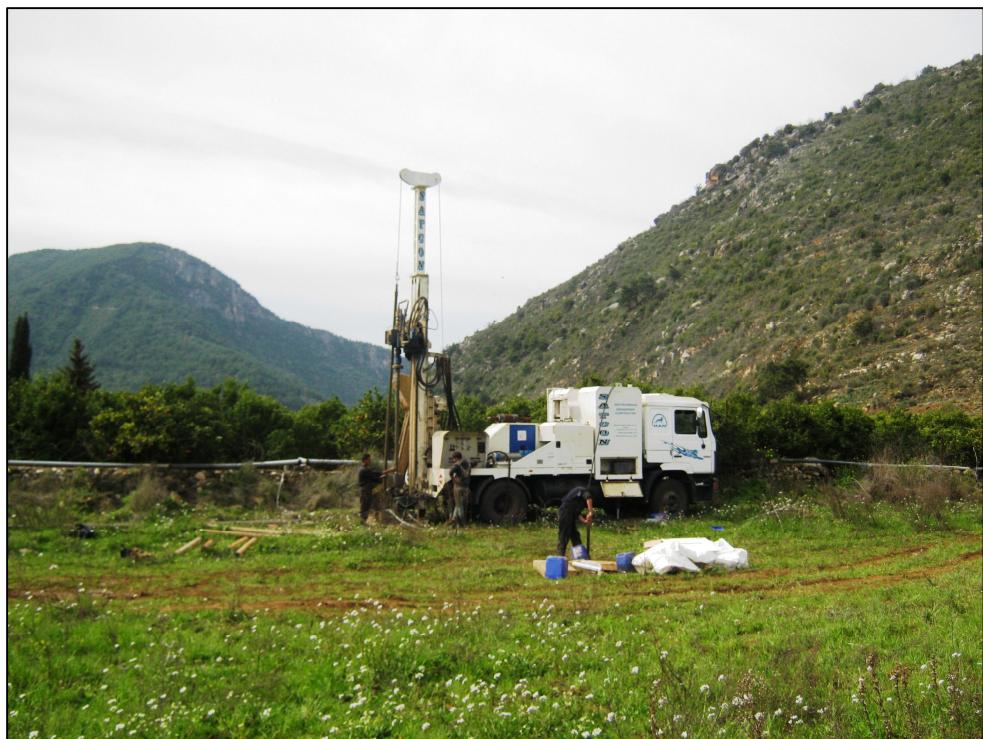


Figure 18

3. Scope of Works

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

- Continuous core drilling in soil and rock.
- Performing Standard Penetration Test in soil and obtaining disturbed (D) samples.
- Undisturbed (UD) soil sampling by using thin wall Shelby tubes.
- Performing borehole water permeability (Falling Head Test) and Lugeon tests in soil and rock strata respectively.
- Installing standpipe open piezometers into the boreholes and measuring the depth and fluctuations of the groundwater table.

86mm diameter (OD) double tube ("T" type) core barrels equipped with tungsten carbide core bits were used in continuous core drilling with BW drill rods and HW casings (see Figure 19).

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 sealed with waterproof plastic tapes and stored in standard wooden core boxes (see Figure 20). 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.

In soil strata, Standard Penetration Test (SPT) was performed at 1.5m intervals by using Split-Spoon SPT sampler in 2 inches outside diameter (see Figure 21) and disturbed samples were obtained, labelled and kept in moisture-proof containers.



Figure 19: Double tube core barrel



Figure 20: Standard wooden core boxes



Figure 21: SPT sampler

Standard Penetration Tests (SPT) was performed by using automatic trip SPT hammer as shown on Figure 22, to estimate the relative densities and consistencies of the subsurface soil strata.



Figure 22: Automatic trip SPT hammer.

Multistage Lugeon test was performed in rock strata as shown on Figure 23 at different depths. The test was conducted in portions (3 meters long) of the boreholes isolated by the single pneumatic packer having a diameter of 66mm. The test results are presented in Appendix 4 of this factual report.



Figure 23: Lugeon Test

In soil and mylonitized rock strata, Falling Head borehole water permeability test was performed at 3m intervals. The test results are presented in Appendix 4 of this factual report.

Perforated (one third of the standpipe) UPVC pipes, 60mm diameter (OD) and 2mm thick, wrapped with geotextile (PP, 150 gr/m²) were installed into the boreholes (except BHRA4, it is destroyed by the landowner) as open standpipe piezometers with concrete heading and steel pipe protection, in a manner to measure the depth and fluctuations of the groundwater table (Appendix 5).

All the field works were performed according to ASTM standards (ASTM D6640: Core drilling in soil and rock, ASTM D1586: Standard Penetration Test, ASTM D4630: Standard Test Method for Constant Head Injection Test, Lambe & Whitman: Falling Head Test, ASTM D4750: Determining Subsurface Liquid Levels in a boreholes and ASTM D1587: Undisturbed soil sampling) and were supervised by an engineering geologist.



4. Subsurface Strata

According to the core boxes, the following subsurface soil and rock strata were encountered within the boreholes BHVR2, BHRA2 and BHRA4. The logs of borings are presented in Appendix 2 of this factual report.

BHVR2 / Piezometer (+414.09 NGL): 111 meters deep.

0-26m: Flood-plain and lacustrine soil deposits.

0-4.5m: Dark to light brown medium stiff to stiff very clayey SILT.

4.5-16m: Olive green soft to medium stiff sometimes hard very silty CLAY (loss of water circulation at 6m).

16-26m: Olive green soft to medium stiff very sandy and clayey SILT.

26-31.5m: Old colluvial soil deposits.

Beige to olive gravelly argillaceous MARL with cobbles of LIMESTONE.

31.5-111m: C2b

Olive to beige argillaceous MARL / Beige to bluish grey slightly weathered fractured and crushed medium strong sometimes sandy slightly dolomitic marly LIMESTONE / Bluish grey slightly-moderately sometimes moderately-highly weathered fractured and crushed weak to medium strong sometimes very sandy and clayey calcareous MARLSTONE.

BHRA2 / Piezometer (+490.25 NGL): 147 meters deep.

0-61.5m: C3-C4

Beige and light cream to white slightly weathered fractured and crushed sometimes blocky moderately strong slightly dolomitic sandy sometimes marly LIMESTONE and sandy gravelly MARL (loss of water circulation, 100% and continuously, between 7 and 29m / loss of water circulation, 100%, at 34m)

61.5-147m: C3

61.5-111m: Beige sometimes bluish grey slightly weathered fractured and crushed moderately strong sometimes oolitic and fossiliferous sandy marly LIMESTONE.

111-147m: Bluish grey and beige slightly weathered fractured sometimes crushed weak to moderately strong calcareous sometimes clayey MARLSTONE and slightly dolomitic sometimes karstified and fossiliferous marly LIMESTONE.

BHRA4 (+449.85 NGL): 76.5 meters deep.

0-64.5m: C3

0-30m: Beige slightly-moderately sometimes highly to completely weathered fractured and crushed weak to medium strong slightly dolomitic sometimes fossiliferous sandy marly LIMESTONE and gravelly MARL.

30-45m: Olive green slightly-moderately sometimes completely weathered fractured and crushed weak calcareous MARLSTONE / marly CLAYSTONE and sandy marly LIMESTONE.



45-64.5m: Bluish grey to grey and beige slightly sometimes slightly-moderately weathered mainly fractured sometimes blocky and crushed weak to moderately strong calcareous MARLSTONE and slightly dolomitic sometimes karstified and fossiliferous marly LIMESTONE.

64.5-76.5m: C2b

Bluish grey to dark green moderately sometimes moderately-highly and completely weathered mainly crushed weak very sandy MARLSTONE.



5. Undisturbed Soil Sampling & Laboratory Testing

Undisturbed (UD) soil samples were taken from the cohesive flood-plain and lacustrine soil deposits within the boreholes BHVR2, BHVR1 (under execution) and BHVR6 (under execution) by using thin wall Shelby tubes, 3 inches in outside diameter and 50cm long with a check valve at the head of the tube.

Shelby tubes were driven into the soil by pushing them only. After the sampling, head and bottom end of the tubes were coated with wax and sealed with waterproof plastic tape.

Representative UD soil samples (30 nos.) as shown on Figure 24 to 26 were selected for laboratory testing (first package) and sent to Morocco (LABORATOIRE PUBLIC D'ESAIS ET D'ETUDES) to accelerate the testing (Triaxial: CU+U and Odometer) process. List of sampling and laboratory testing is presented in Appendix 6 of this factual report.



Figure 24: Selected UD samples (BHVR2)



Figure 25: Selected UD samples (BHVR1)



Figure 26: Selected UD samples (BHVR6)

6. Closure

The findings presented in this factual report are based on the assumption that the subsurface soil and rock strata 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/rock survey, and thus could not be taken into account. Therefore, the findings are valid under this assumption only.



APPENDICES

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APPENDIX 6. LIST OF SAMPLING & LABORATORY TESTING (BH & NTP)



APPENDIX 1. GEOLOGIE DU SITE (PLAN G-02 / APRIL 17, 2014)

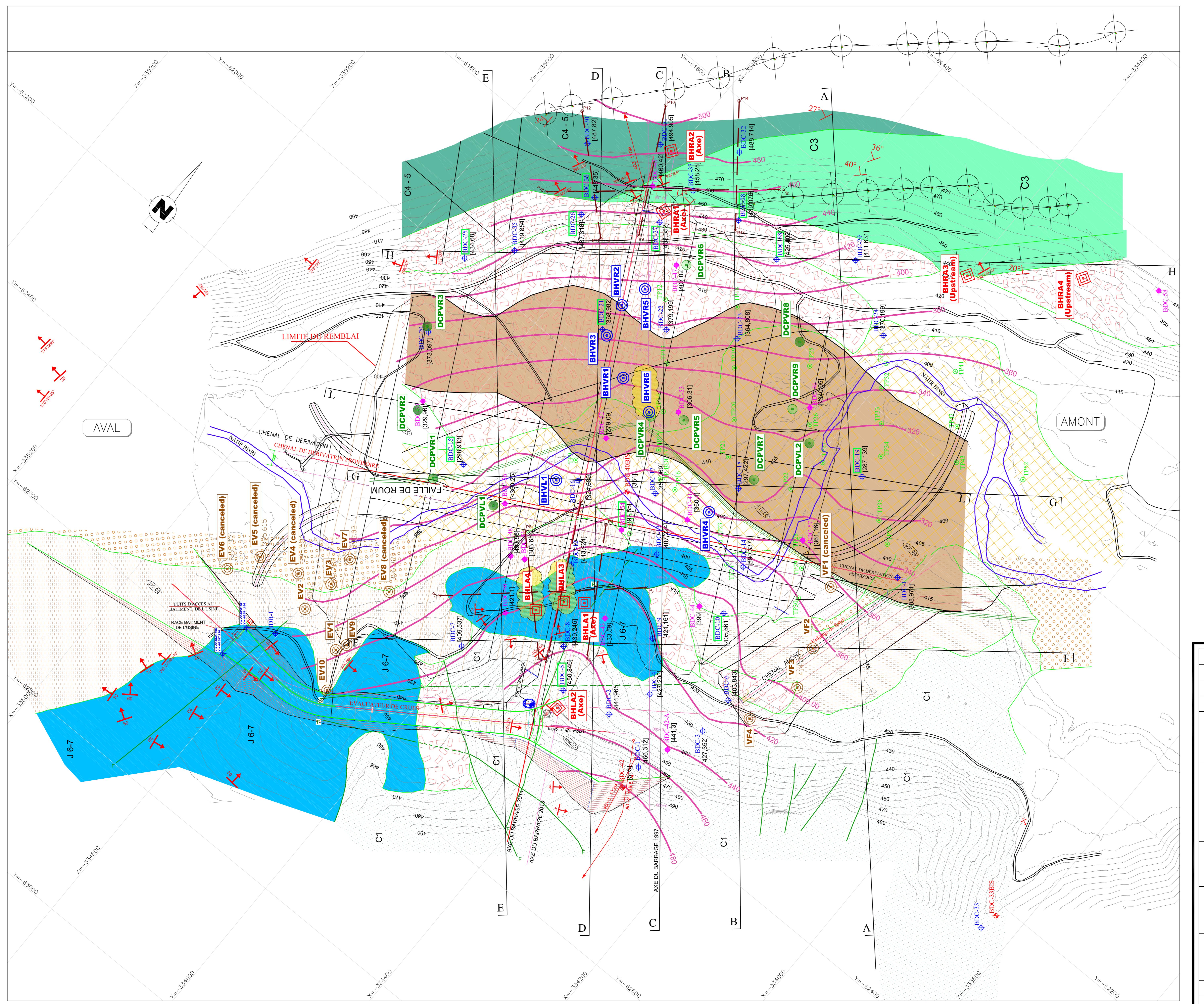


DAR AL HANDASAH NAZIH TALEB & PARTNERS
دار الهندسة نزيح طالب وشريك

Detailed Design Of Bisri Dam: Geo. Inv. Rep.II: (Factual) / Spillway & Bottom Outlet - June 2014

AS BUILT				
Name	X	Y	Z	Estimated Depth of Drilling or Probing from the Existing Ground Surface
BHLA1	-334,515.23	-62,242.74	431.50	105
BHLA2	-334,454.79	-62,371.82	459.40	95
BHLA3	-334,536.79	-62,259.09	425.27	50
BHLA4	-334,558.72	-62,290.58	424.18	50
BHRA1	-334,763.01	-61,778.38	441.98	125
BHRA2	-334,806.09	-61,710.80	490.25	145
BHRA3	-334,400.64	-61,589.18	430.25	100
BHRA4	-334,280.82	-61,494.60	449.85	100
BHVL1	-334,647.00	-62,141.55	396.57	100
BHVR1	-334,664.47	-61,981.54	413.97	115
BHVR2	-334,726.90	-61,908.90	414.09	140
BHVR3	-334,716.87	-61,952.20	413.80	70
BHVR4	-334,464.87	-62,045.87	398.14	75
BHVR5	-334,716.83	-61,873.08	414.37	65
BHVR6	-334,609.49	-61,994.66	414.49	115
DCPVL1	-334,689.40	-62,220.00	396.30	40
DCPVL2	-334,420.65	-61,891.76	399.00	45
DCPVR1	-334,773.47	-62,243.00	395.59	70 or as deep as possible
DCPVR2	-334,846.38	-62,186.19	397.75	70
DCPVR3	-334,906.75	-62,093.42	405.09	30
DCPVR4	-334,604.01	-61,997.65	414.40	70 or as deep as possible
DCPVR5	-334,567.60	-61,973.70	Canceled	70 or as deep as possible
DCPVR6	-334,695.07	-61,813.80	415.64	20
DCPVR7	-334,446.51	-61,975.32	397.88	70 or as deep as possible
DCPVR8	-334,515.48	-61,796.85	414.70	50
DCPVR9	-334,466.56	-61,871.24	411.33	70
EV1	-334,728.32	-62,498.94	415.61	30
EV2	-334,794.08	-62,483.06	401.70	30
EV3	-334,788.25	-62,435.79	398.29	50
EV4	-334,830.50	-62,452.70	395.60	Canceled
EV5	-334,883.00	-62,467.70	395.60	Canceled
EV6	-334,906.60	-62,507.40	395.00	Canceled
EV7	-334,790.02	-62,395.20	396.04	60
EV8	-334,722.90	-62,395.00	396.30	Canceled
EV9	-334,721.66	-62,484.86	414.85	30
EV10	-334,703.22	-62,547.08	420.20	30
VF1	-334,278.50	-62,019.70	398.60	Canceled
VF2	-334,245.19	-62,097.10	414.92	40
VF3	-334,228.11	-62,150.17	414.45	40
VF4	-334,250.50	-62,221.66	419.19	40

Profils	Extrémités	X	Y	Profondeur em (m)	Observations	
P1-2	P1	-334,465	-62,175	273	La profondeur des investigations est de 60m minimum	
	P2	-334,669	-62,357			
P3-4	P3	-334,468	-62,294	175		
	P4	-334,559	-62,145			
P5-6	P5	-334,514	-62,338	202		
	P6	-334,636	-62,219			
P7-8	P7	-334,511	-62,321	170		
	P8	-334,604	-62,142			
P9-10	P9	-334,768	-61,824	175		
	P10	-334,850	-61,669			
P11-12	P11	-334,804	-61,859	170		
	P12	-334,930	-61,745			
P13-14	P13	-334,674	-61,738	171		
	P14	-334,779	-61,603			
P15-16	P15	-334,899	-61,857	307		
	P16	-334,664	-61,659			
Total en (m)				Total en (m) 1,643		



GENDE:

LITHOLOGIE		2. SYMBOLS	
QUATERNNAIRE	EBOLIS,BRECHE, COUVERTURE: D'EBOLIS DE GRES, D'ARGILE ET DE BLOCS DE CALCAIRE		SONDAGES REALISES EN 1982
	SILT. SABLE. GRES DESINTEGRE		SONDAGES REALISES EN 1983
	SABLE		SONDAGES REALISES EN 1996
	LIMON		SONDAGES REALISES EN 2014 (DCPT Probing, see note 4)
	LIMON ET GALETS		SONDAGES REALISES EN 2013 (Core Drilling, see note 1)
	CENOMNIEN - TURONIEN CALCAIRE BLANCHATRE. PEU DUR. A DES NIVEAUX CALCAIRES CRAYEUX ET CALCAIRE BEIGE-BLANCHATRE PARFOIS DOLOMITIQUE. PARFOIS A POINTS ROUGES TANTOT CRISTALLINS DUR A TRES DUR. TRES KARSTIFIE. GENERALEMENT FISSURE ET FRACTURE		SONDAGES REALISES EN 2014 (Core Drilling, see note 2)
	C3		SONDAGES REALISES EN 2014 (Core Drilling, see note 3)
	ALBIEN (BARRE A CARDIUM) : CALCAIRE ORANGE-JAUNATRE. DUR. CRISTALLIN. KARSTIFIE MARNES ET MARNO-CALCAIRE VERT-JAUNATRE A ABONDANTES COQUELLES		NEW BOREHOLES
	C1		GALERIE DE RECONNAISSANCE REALISEE ENTRE 1981 ET 1984
	J 7		COURBE D'EGALE ELEVATION DU TOIT DU SUBSTRATUM
J 6	KIMMERIDGIEN: CALCAIRE GRIS. OOLITHIQUE. CRISTALLIN, DUR. KARSTIFIE. A NIVEAUX MARNEUX		CHUTES D'OUTILS RELEVEES DANS LES SONDAGES
	PORTLANDIEN: CALCAIRE FIN.MASSIF. RAREMENT OOLITHIQUE. OCRE TANTOT A POINTS ROUGES. A SILEX. CRISTALLIN. DURE PEU KARSTIFIE.		[329,96] COTE TOIT DU SUBSTRATUM
			FAILLE IMPORTANTE
			DIRECTION ET PENDAGE
			PROFILS SISMIQUES A REALISER

NOTA:

- Continuous core drilling in soil and rock to a depth of reaching the bedrock and penetrating it 5m with SPT and/or DCPT (if needed) in soil at 1.5m intervals by carrying out water permeability and Lugeon tests at 3m intervals in soil and rock respectively.

- Continuous core drilling in soil and rock to a depth of reaching the bedrock and penetrating it 10m with SPT and/or DCPT (if needed) in soil at 1.5m intervals by carrying out water permeability and Lugeon tests at 3m intervals in soil and rock respectively.
 - Continuous core drilling in rock to a depth of reaching the bottom level of the grout curtain and/or groundwater table and penetrating it

HRA1 shall be drilled to a depth of reaching the C2b and penetrating 10m

BHLA3 and BHLA4 shall be drilled in a manner to determine the thickness and distribution of the mylonitized limestone.

- Continuous Dynamic Cone Penetration (DCPT probing) to a depth reaching the bedrock or as deep as possible with full casing down 63m maximum by using a solid cone having an apex angle of 60 degrees and an end diameter of 62.5mm with AW drill rods and

LE TRACE DE LA FAILLE DE ROOM A ETE ETABLI SUR LA BASE
DES COUPES GEOLOGIQUES INTERPRETATIVES TENANT
COMPTE DES LOGS DE SONDAGES DE RECONNAISSANCES

DATE	REV	TOP	GEO	CIV	ARCH	STRUCT	MECH	ELEC				
LEBANESE REPUBLIC COUNCIL FOR DEVELOPMENT & RECONSTRUCTION												
BARRAGE BISRI												
 DAR AL HANDASAH NAZIH TALEB & PARTNERS دارالهندسة نزيح طالب وشركاه NOVEC <small>CDG DEVELOPPEMENT</small> 												
GEOLOGIE DU SITE				DRAWN								
				CHECKED								
				APPROVED								
				SCALE	1/2 000							
								DATE	April 17 2014			
												FILENAME
PROJECT		DIVISION		SHEET			REVISION					

APPENDIX 2. LOGS OF BORINGS



CLIENT: DAR-TALEB				FILE NO.:	14-001	BOREHOLE NO.:		BHVR02			
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)				Elevation (m):	414.09	SHEET:		1 OF: 12			
LOCATION: BISI				METHOD:	Rotary	BOREHOLE DEPTH (m):		111m			
EQUIPMENT: MAN				CORE DIAM. (mm):	63 to 68	DATE STARTED:		21/4/2014			
HOLE DAM. (mm): 86 to 114				DRILLER:	NAWRAS	DATE FINISHED:		13/5/2014			
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
1					Dark to light brown very clayey SILT		16	0	0		
2											Shelby tube (1.5-2m)
3											Shelby tube (2-2.5m)
4											
5					medium stiff olive green very silty CLAY		35	0	0		Shelby tube(4.5-5m)
6											Shelby tube(5-5.5m)
7											flushing water loss
8											at 6.0m
9											
10											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHVR02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISI	Elevation (m):	414.09	SHEET:	2 OF: 12						
EQUIPMENT:	MAN	METHOD:	Rotary	BOREHOLE DEPTH (m):	111m						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	21/4/2014						
ENGINEER:	K.S.	DRILLER:	NAWRAS	DATE FINISHED:	13/5/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
11					medium stiff olive green very silty CLAY		55	0	0		Shelby tube(10.5-11m)
12											Shelby tube(11-11.5m)
13											
14											
15											
16											
17											
18											
19											
20											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

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SCR Solid Core Recovery

WT Water 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

CLIENT: DAR-TALEB				FILE NO.:	14-001	BOREHOLE NO.:				BHVR02	
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)				Elevation (m):	414.09	SHEET:				3 OF: 12	
LOCATION: BISI				METHOD:	Rotary	BOREHOLE DEPTH (m):				111m	
EQUIPMENT: MAN				CORE DIAM. (mm):	63 to 68	DATE STARTED:				21/4/2014	
HOLE DAM. (mm): 86 to 114				DRILLER:	NAWRAS	DATE FINISHED:				13/5/2014	
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
21			6,4,5 N=9		ditto						Shelby tube(20-20.5m)
22					Soft to medium stiff olive green sandy very clayey SILT	110	0	0			
23			2,3,2 N=5								Shelby tube(22.5-23m)
24											Shelby tube(23-23.5m)
25						110	0	0			
26	Refusal				OLD COLLUVIAL soil deposits: MARL with sub rounded gravels	31	0	0			
27	50/0cm Refusal					52	0	0			
28						47	0	0			
29											
30	50/0cm Refusal										

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WT Water 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

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHVR02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISI	Elevation (m):	414.09	SHEET:	4	OF: 12					
EQUIPMENT:	MAN	METHOD:	Rotary	BOREHOLE DEPTH (m):	111m						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	21/4/2014						
ENGINEER:	K.S.	DRILLER:	NAWRAS	DATE FINISHED:	13/5/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
31					ditto		38	0	0		
32					beige some times grey slightly to moderately weathered and moderately weathered very slightly dolomitic small gravelly LIMESTONE with marl, the LIMESTONE is sometimes sandy and with sand. (the marl is completely weathered sandy marlstone).		87	0	0		
33							37	0	0		
34											
35							70	24	7		
36							48	29	0		
37											
38							43	0	0		
39											
40							35	0	0		

SPT Standard Penetration Test

TCR Total Core Recovery

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SCR Solid Core Recovery

WT Water 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

CLIENT: DAR-TALEB				FILE NO.:	14-001	BOREHOLE NO.:		BHVR02			
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)				Elevation (m):	414.09						
LOCATION: BISI						SHEET:	5	OF:	12		
EQUIPMENT: MAN				METHOD:	Rotary	BOREHOLE DEPTH (m):		111m			
HOLE DAM. (mm): 86 to 114				CORE DIAM. (mm):	63 to 68	DATE STARTED:		21/4/2014			
ENGINEER: K.S.				DRILLER:	NAWRAS	DATE FINISHED:		13/5/2014			
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
41	50/5cm Refusal				ditto		35	0	0		
42	50/7cm Refusal						36	36	0		
43	50/6cm Refusal						35	0	0		
44	50/5cm Refusal						52	0	0		
45	50/5cm Refusal						40	17	7		
46	50/0cm Refusal						60	0	0		
47							78	0	0		
48											
49											
50					please refer to next page		45	0	0		

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

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHVR02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISI	Elevation (m):	414.09	SHEET:	6 OF: 12						
EQUIPMENT:	MAN	METHOD:	Rotary	BOREHOLE DEPTH (m):	111m						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	21/4/2014						
ENGINEER:	K.S.	DRILLER:	NAWRAS	DATE FINISHED:	13/5/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
51					combination of creamish to some times bluish grey fossilious sandy LIMESTONE with interbeds of olive green MARLSTONE (some times completely weathered and became marl)	45	0	0			
52						90	0	0			
53						85	0	0			
54						44	0	0			
55						50	9	0			
56						62	0	0			
57						37	27	7			
58											
59											
60											

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CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHVR02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISI	Elevation (m):	414.09	SHEET:	7 OF: 12						
EQUIPMENT:	MAN	METHOD:	Rotary	BOREHOLE DEPTH (m):	111m						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	21/4/2014						
ENGINEER:	K.S.	DRILLER:	NAWRAS	DATE FINISHED:	13/5/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
61	Brickwork				ditto		38	3.3	0		
62	Brickwork		50/2cm Refusal				57	28	6.8		
63	Brickwork						32	13	0		
64	Brickwork						80	67	6.7		
65	Brickwork						51	15	7.3		
66	Brickwork						47	0	0		
67	Brickwork										
68	Brickwork										
69	Brickwork										
70	Brickwork						70	21	0		

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TCR Total Core Recovery

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

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHVR02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISI	Elevation (m):	414.09	SHEET:	8 OF: 12						
EQUIPMENT:	MAN	METHOD:	Rotary	BOREHOLE DEPTH (m):	111m						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	21/4/2014						
ENGINEER:	K.S.	DRILLER:	NAWRAS	DATE FINISHED:	13/5/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
71	50/0cm Refusal				ditto		70	21	0		
72							68	24	0		
73							39	0	0		
74	50/3cm Refusal						39	20	0		
75							41	25	0		
76							52	27	6.7		
77							41	13	0		
78	50/0cm Refusal						54	0	0		
79											
80											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT: DAR-TALEB				FILE NO.:	14-001	BOREHOLE NO.:		BHVR02			
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)				Elevation (m):	414.09	SHEET:		9	OF: 12		
LOCATION: BISI				METHOD:	Rotary	BOREHOLE DEPTH (m):		111m			
EQUIPMENT: MAN				CORE DIAM. (mm):	63 to 68	DATE STARTED:		21/4/2014			
HOLE DAM. (mm): 86 to 114				DRILLER:	NAWRAS	DATE FINISHED:		13/5/2014			
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
81	50/4cm Refusal				ditto	54	0	0			
82						41	18	0			
83						43	0	0			
84					from 49.5 to 84m C3 ????						
85					from 84 to 111 c2b olive green highly to completely weathered MARLSTONE (disintegrated to soil like marl)						
86	50/2cm Refusal					65	0	0			
87						70	0	0			
88						57	0	0			
89	50/4cm Refusal					71	65	0			
90											

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TCR Total Core Recovery

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WT Water 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

CLIENT: DAR-TALEB				FILE NO.:	14-001	BOREHOLE NO.:		BHVR02			
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)				Elevation (m):	414.09	SHEET:		10 OF: 12			
LOCATION: BISI				METHOD:	Rotary	BOREHOLE DEPTH (m):		111m			
EQUIPMENT: MAN				CORE DIAM. (mm):	63 to 68	DATE STARTED:		21/4/2014			
HOLE DAM. (mm): 86 to 114				DRILLER:	NAWRAS	DATE FINISHED:		13/5/2014			
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
91					ditto		63	0	0		
92							64	0	0		
93											
94					bluish grey fractured and crushed calcareous MARLSTONE/ marly LIMSTONE		57	6.7	0		
95							39	0	0		
96							28	17	0		
97							39	13	0		
98											
99							43	9.3	0		
100											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

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LT Layer Thickness

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WT Water Table

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CLIENT: DAR-TALEB				FILE NO.:	14-001	BOREHOLE NO.:		BHVR02			
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)				Elevation (m):	414.09	SHEET:		11 OF: 12			
LOCATION: BISI				METHOD:	Rotary	BOREHOLE DEPTH (m):		111m			
EQUIPMENT: MAN				CORE DIAM. (mm):	63 to 68	DATE STARTED:		21/4/2014			
HOLE DAM. (mm): 86 to 114				DRILLER:	NAWRAS	DATE FINISHED:		13/5/2014			
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
101	ditto						43	9	0		
102							30	20	0		casing down to 102m
103							39	9	0		
104							27	17	0		
105							39	28	0		
106							30	19	7		
107							37	16	0		
108							40	27	0		
109											
110											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

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RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHVR02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISI	Elevation (m):	414.09	SHEET:	12 OF: 12						
EQUIPMENT:	MAN	METHOD:	Rotary	BOREHOLE DEPTH (m):	111m						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	21/4/2014						
ENGINEER:	K.S.	DRILLER:	NAWRAS	DATE FINISHED:	13/5/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
111					ditto		40	27	0		
112											
113											
114											
115											
116											
117											
118											
119											
120											
					End of borehole at 111m						

SPT Standard Penetration Test

TCR Total Core Recovery

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SATCON

LEGEND

SOIL STUDIES

SOIL SYMBOL	ROCK SYMBOL	SAMPLERS	OTHERS
 GP	 Dolomite		 Water Level
 GP-GM	 Chalky Limestone		Shelby tube
 GM	 Calcarenite		Tricone
 GC	 Weak Chalky LIMESTONE		Double tube
 SW	 Sandy Limestone		
 SP			
 SP - SM			
 SM-SC	 Basalt / volcanics		
 ML			
 CH-MH	 Chert		
 OL	 CL		
 OH			
 PT	 Creamy White LIMESTONE		
 Fill Material	 Grainstone LIMESTONE		
	 MARL		
 CLAY	 SANDSTONE		
 CLAYwith Sand and Gravel	 CLAYSTONE		
	 Oolitic LIMESTONE		
	 Micritic LIMESTONE		
	 Mudstone		
	 Gypsum		
	 Siltstone		

ROCK CLASSIFICATION

% RQD	Classification
<25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
>90	Excellent

GRANULAR SOILS

N-Value	Relative Density
< 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
> 50	Very Dense

COHESIVE SOIL

N-Value	Consistency
< 2	Very Soft
2 - 4	Soft
4 - 8	Medium Stiff
8 - 15	Stiff
15 - 30	Very stiff
> 30	Hard

CLIENT: DAR-TALEB				FILE NO.:	14-001	BOREHOLE NO.:		BHRA02				
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)				Elevation (m):	490.25	SHEET:		1 OF: 15				
LOCATION: BISRI				METHOD:	Rotary	BOREHOLE DEPTH (m):		147.0				
EQUIPMENT: CMV 1000				CORE DIAM. (mm):	63 to 68	DATE STARTED:		4/11/2014				
HOLE DIA. (mm): 86 to 114				DRILLER:	A.A.	DATE FINISHED:		5/10/2014				
ENGINEER: K.S.	DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
1						creamish white crushed and fractured dolomitic LIMESTONE		57	21	21		
2								51	51	7		
3								57	57	0		
4						light beige sometimes reddish beige mainly crushed sometimes fractured marly LIMESTONE with sandy marl and marl					flushing water loss 100%, 7 - 29m	
5								47	47	20		
6								65	45	0		
7								23	23	0		
8												
9												
10								45	0	0		

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LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHRA02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISRI	Elevation (m):	490.25	SHEET:	2	OF: 15					
EQUIPMENT:	CMV 1000	METHOD:	Rotary	BOREHOLE DEPTH (m):	147.0						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	4/11/2014						
ENGINEER:	K.S.	DRILLER:	A.A.	DATE FINISHED:	5/10/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
11	50/6cm Refusal				ditto		45	0	0		
12							40	0	0		
13							33	17	0		
14	33,50/4cm Refusal						27	3	0		
15							28	0	0		
16							43	10	0		
17							40	0	0		
18							39	0	0		
19											
20											

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CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHRA02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISRI	Elevation (m):	490.25	SHEET:	3	OF: 15					
EQUIPMENT:	CMV 1000	METHOD:	Rotary	BOREHOLE DEPTH (m):	147.0						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	4/11/2014						
ENGINEER:	K.S.	DRILLER:	A.A.	DATE FINISHED:	5/10/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
21	ditto					39	0	0			
22						33	0	0			
23						39	0	0			
24						29	0	0			
25						29	0	0			
26						29	0	0			
27						27	0	0			
28						27	0	0			
29						27	0	0			
30											

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CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHRA02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISRI	Elevation (m):	490.25	SHEET:	4	OF: 15					
EQUIPMENT:	CMV 1000	METHOD:	Rotary	BOREHOLE DEPTH (m):	147.0						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	4/11/2014						
ENGINEER:	K.S.	DRILLER:	A.A.	DATE FINISHED:	5/10/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
31					ditto		53	0	0		
32							31	0	0		
33							37	0	0		
34											Flushing water loss 100%, at 34m
35					beige blocky seamy to fractured and crushed dolomitic sometimes marly LIMESTONE		33	25	0		
36							40	23	61		
37											
38							75	75	61		
39											
40							63	47	17		

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CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHRA02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISRI	Elevation (m):	490.25	SHEET:	5	OF: 15					
EQUIPMENT:	CMV 1000	METHOD:	Rotary	BOREHOLE DEPTH (m):	147.0						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	4/11/2014						
ENGINEER:	K.S.	DRILLER:	A.A.	DATE FINISHED:	5/10/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
41					ditto		63	47	17		
42					very stiff to hard light brown some times white gravely MARL		30	17	0		
43							81	0	0		
44							37	0	0		
45							48	0	0		
46							57	0	0		
47							24	0	0		
48							27	0	0		
49											
50											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHRA02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)			SHEET:	6 OF: 15						
LOCATION:	BISRI			Elevation (m):	490.25						
EQUIPMENT:	CMV 1000			METHOD:	Rotary						
HOLE DAM. (mm):	86 to 114			CORE DIAM. (mm):	63 to 68						
ENGINEER:	K.S.			DRILLER:	A.A.						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
51					ditto		27	0	0		
52							49	0	0		
53							21	0	0		
54							28	0	0		
55							38	0	0		
56							43	29	0		
57					beige fractured and crushed slightly dolomitic sandy LIMESTONE with marl		50	35	9		
58											
59											
60											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT: DAR-TALEB				FILE NO.:	14-001	BOREHOLE NO.:				BHRA02	
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)				Elevation (m):	490.25	SHEET:				7 OF: 15	
LOCATION: BISRI				METHOD:	Rotary	BOREHOLE DEPTH (m):				147.0	
EQUIPMENT: CMV 1000				CORE DIAM. (mm):	63 to 68	DATE STARTED:				4/11/2014	
HOLE DIA. (mm): 86 to 114				DRILLER:	A.A.	DATE FINISHED:				5/10/2014	
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
61					ditto		51	33	13		
62					same as above with MARL		49	0	0		
63							43	29	0		
64							57	23	0		
65					beige sometimes bluish grey fractured to crushed and crushed marly sandy LIMESTONE, some times fossilious, some times oolitic, some times cherty (not sandy not marly when cherty)		67	47	11		
66							43	17	0		
67							50	50	8		
68											
69											
70											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHRA02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISRI	Elevation (m):	490.25	SHEET:	8	OF: 15					
EQUIPMENT:	CMV 1000	METHOD:	Rotary	BOREHOLE DEPTH (m):	147.0						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	4/11/2014						
ENGINEER:	K.S.	DRILLER:	A.A.	DATE FINISHED:	5/10/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
71					ditto		50	50	8		
72							69	51	20		
73							83	83	49		
74							33	23	11		
75							33	27	0		
76							23	0	0		
77											
78											casing down to 78.0m
79							47	0	0		
80							57	57	0		

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHRA02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISRI	Elevation (m):	490.25	SHEET:	9	OF: 15					
EQUIPMENT:	CMV 1000	METHOD:	Rotary	BOREHOLE DEPTH (m):	147.0						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	4/11/2014						
ENGINEER:	K.S.	DRILLER:	A.A.	DATE FINISHED:	5/10/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
81	Brickwork				ditto		57	57	0		
82							67	67	28		
83							75	75	43		
84							40	0	0		
85							38	0	0		
86							45	20	0		
87							57	51	30		
88											
89											
90											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHRA02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISRI	Elevation (m):	490.25	SHEET:	10 OF: 15						
EQUIPMENT:	CMV 1000	METHOD:	Rotary	BOREHOLE DEPTH (m):	147.0						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	4/11/2014						
ENGINEER:	K.S.	DRILLER:	A.A.	DATE FINISHED:	5/10/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
91	ditto						57	31	6		
92							65	60	17		
93							85	85	50		
94							57	57	0		
95							58	58	11		
96							49	0	0		
97							38	16	0		
98											
99											
100											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHRA02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISRI	Elevation (m):	490.25	SHEET:	11 OF: 15						
EQUIPMENT:	CMV 1000	METHOD:	Rotary	BOREHOLE DEPTH (m):	147.0						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	4/11/2014						
ENGINEER:	K.S.	DRILLER:	A.A.	DATE FINISHED:	5/10/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
101	ditto					38	16	0			
102						60	60	0			
103						45	45	17			
104						44	23	0			
105						35	28	0			
106						45	12	0			
107						65	65	21			
108						37	13	0			
109											
110											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHRA02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISRI	Elevation (m):	490.25	SHEET:	12 OF: 15						
EQUIPMENT:	CMV 1000	METHOD:	Rotary	BOREHOLE DEPTH (m):	147.0						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	4/11/2014						
ENGINEER:	K.S.	DRILLER:	A.A.	DATE FINISHED:	5/10/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
111					ditto		37	13	0		
112							31	0	0		
113					combination of bluish grey (mainly) and beige slightly to moderately weathered mainly fractured and some times crushed weak to moderately strong and strong fossilious calcareous MARLSTONE some times clayey some times oolitic		48	48	20		
114											
115							38	38	19		
116											
117											
118							49	22	0		
119											
120							45	34	0		

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHRA02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISRI	Elevation (m):	490.25	SHEET:	13 OF: 15						
EQUIPMENT:	CMV 1000	METHOD:	Rotary	BOREHOLE DEPTH (m):	147.0						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	4/11/2014						
ENGINEER:	K.S.	DRILLER:	A.A.	DATE FINISHED:	5/10/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
121	ditto						57	57	13		
122							84	84	17		
123							93	93	24		
124							89	89	32		
125							71	52	0		
126							80	80	15		
127											
128											
129											
130							49	49	0		

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHRA02						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISRI	Elevation (m):	490.25	SHEET:	14 OF: 15						
EQUIPMENT:	CMV 1000	METHOD:	Rotary	BOREHOLE DEPTH (m):	147.0						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	4/11/2014						
ENGINEER:	K.S.	DRILLER:	A.A.	DATE FINISHED:	5/10/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
131	ditto					49	49	0			
132						47	47	0			
133						33	9	0			
134						89	89	32			
135						51	51	13			
136						67	67	40			
137						93	93	30			
138						89	89	47			
139											
140											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT: DAR-TALEB				FILE NO.:	14-001	BOREHOLE NO.:		BHRA02			
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)				Elevation (m):	490.25	SHEET:		15 OF: 15			
LOCATION: BISRI				METHOD:	Rotary	BOREHOLE DEPTH (m):		147.0			
EQUIPMENT: CMV 1000				CORE DIAM. (mm):	63 to 68	DATE STARTED:		4/11/2014			
HOLE DAM. (mm): 86 to 114				DRILLER:	A.A.	DATE FINISHED:		5/10/2014			
ENGINEER: K.S.											
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
141					ditto		89	89	47		
142							79	79	15		
143							85	85	32		
144							95	95	20		
145							92	92	13		
146											
147											
148											
149											
150											
					End of borehole at 147m						

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

SATCON

LEGEND

SOIL STUDIES

SOIL SYMBOL	ROCK SYMBOL	SAMPLERS	OTHERS
 GP	 Dolomite		 Water Level
 GP-GM	 Chalky Limestone		Shelby tube
 GM	 Calcarenite		Tricone
 GC	 Weak Chalky LIMESTONE		
 SW	 Sandy Limestone		
 SP	 SP - SM		
 SP - SM	 Basalt / volcanics		
 SM-SC	 ML		
 CH-MH	 Chert		
 OL	 CL		
 OH	 Creamy White LIMESTONE		
 PT	 Fill Material		
	 MARL		
 CLAY	 SANDSTONE		
 CLAYwith Sand and Gravel	 CLAYSTONE		
	 Oolitic LIMESTONE		
	 Micritic LIMESTONE		
	 Mudstone		
	 Gypsum		
	 Siltstone		
ROCK CLASSIFICATION			
% RQD	Classification		
<25	Very Poor		
25-50	Poor		
50-75	Fair		
75-90	Good		
>90	Excellent		
GRANULAR SOILS			
N-Value	Relative Density		
< 4	Very Loose		
4 - 10	Loose		
10 - 30	Medium Dense		
30 - 50	Dense		
> 50	Very Dense		
COHESIVE SOIL			
N-Value	Consistency		
< 2	Very Soft		
2 - 4	Soft		
4 - 8	Medium Stiff		
8 - 15	Stiff		
15 - 30	Very stiff		
> 30	Hard		

CLIENT: DAR-TALEB				FILE NO.:	14-001	BOREHOLE NO.:				BHRA04	
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)				Elevation (m):	449.85	SHEET:				1 OF: 8	
LOCATION: BISRI				METHOD:	Rotary	BOREHOLE DEPTH (m):				76.5m	
EQUIPMENT: CMV 1000				CORE DIAM. (mm):	63 to 68	DATE STARTED:				20/5/2014	
HOLE DAM. (mm): 86 to 114				DRILLER:	A.A.	DATE FINISHED:				28/5/2014	
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
1	50/4cm refusal				beige gravelly MARL	26	0	0			flushing water loss at 1m
2						40	0	0			
3						45	0	0			
4						33	0	0			
5					light olive green gravelly MARL	52	0	0			
6						51	39	13			
7						37	37	0			
8					combination of yellowish beige slightly weathered crushed and fractured sandy marly LIMESTONE (sometimes fossiliferous) and grey sometimes light olive green moderately to highly weathered crushed and fractured to blocky seamy calcareous MARLSTONE. The MARLSTONE is sometimes highly weathered (disintegrated into soil like marl)						
9											
10											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHRA04						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISRI	Elevation (m):	449.85	SHEET:	2 OF: 8						
EQUIPMENT:	CMV 1000	METHOD:	Rotary	BOREHOLE DEPTH (m):	76.5m						
HOLE DAM. (mm):	86 to 114	CORE DIAM. (mm):	63 to 68	DATE STARTED:	20/5/2014						
ENGINEER:	K.S.	DRILLER:	A.A.	DATE FINISHED:	28/5/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
11					combination of yellowish beige slightly weathered crushed and fractured sandy marly LIMESTONE (sometimes fossilous) and grey some times light olive green moderately to highly weathered crushed and fractured to blocky seamy calcareous MARLSTONE. The MARLSTONE is sometimes highly weathered (disintegrated into soil like marl)		37	37	0		
12							23	17	15		
13							44	44	11		
14											casing down to 13.5m
15							49	33	16		
16							57	45	10		
17							51	41	16		
18											
19							51	4.7	0		
20							58	24	0		

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT: DAR-TALEB				FILE NO.:	14-001	BOREHOLE NO.:		BHRA04			
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)				Elevation (m):	449.85	SHEET:		3	OF: 8		
LOCATION: BISRI		Elevation (m):		449.85		BOREHOLE DEPTH (m):		76.5m			
EQUIPMENT: CMV 1000		METHOD:		Rotary		DATE STARTED:		20/5/2014			
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm):		63 to 68		DATE FINISHED:		28/5/2014			
ENGINEER: K.S.		DRILLER: A.A.									
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
21					combination of yellowish beige slightly weathered crushed and fractured sandy marly LIMESTONE (sometimes fossilous) and grey some times light olive green moderately to highly weathered crushed and fractured to blocky缝状 calcareous MARLSTONE. The MARLSTONE is sometimes highly weathered (disintegrated into soil like marl)		58	24	0		
22							35	27	0		
23							19	11	0		
24							24	17	0		
25							55	17	0		
26							40	24	17		
27							36	36	0		
28											
29											
30											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT: DAR-TALEB				FILE NO.:	14-001	BOREHOLE NO.:				BHRA04			
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)				Elevation (m):	449.85	SHEET:				4 OF: 8			
LOCATION: BISRI				METHOD:	Rotary	BOREHOLE DEPTH (m):				76.5m			
EQUIPMENT: CMV 1000				CORE DIAM. (mm):	63 to 68	DATE STARTED:				20/5/2014			
HOLE DAM. (mm): 86 to 114				DRILLER:	A.A.	DATE FINISHED:				28/5/2014			
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL			% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
31					combination of yellowish beige slightly weathered crushed and fractured sandy marly LIMESTONE (sometimes fossilious) and grey some times light olive green moderately to highly weathered crushed and fractured to blocky缝状 calcareous MARLSTONE. The MARLSTONE is sometimes highly weathered (disintegrated into soil like marl)			43	0	0			
32								73	50	0			
33								55	36	0			
34								31	0	0			
35								43	27	0			
36								27	23	0			
37													
38													
39													
40								61	49	8			

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT: DAR-TALEB				FILE NO.:	14-001	BOREHOLE NO.:		BHRA04			
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)				Elevation (m):	449.85	SHEET:		5	OF: 8		
LOCATION: BISRI		Elevation (m):		449.85		BOREHOLE DEPTH (m):		76.5m			
EQUIPMENT: CMV 1000		METHOD:		Rotary		DATE STARTED:		20/5/2014			
HOLE DAM. (mm): 86 to 114		CORE DIAM. (mm):		63 to 68		DATE FINISHED:		28/5/2014			
ENGINEER: K.S.		DRILLER: A.A.									
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
41					combination of yellowish beige slightly weathered crushed and fractured sandy marly LIMESTONE (sometimes fossilous) and grey some times light olive green moderately to highly weathered crushed and fractured to blocky seamy calcareous MARLSTONE. The MARLSTONE is sometimes highly weathered (disintegrated into soil like marl)		61	49	8		
42							96	18	0		
43							68	68	10		
44							92	122	25		
45							100	93	51		
46							99	99	16		
47							97	97	49		
48							86	86	55		
49											
50											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT:	DAR-TALEB	FILE NO.:	14-001	BOREHOLE NO.:	BHRA04						
PROJECT:	BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)										
LOCATION:	BISRI		Elevation (m):	449.85	SHEET:	6 OF: 8					
EQUIPMENT:	CMV 1000		METHOD:	Rotary	BOREHOLE DEPTH (m):						
HOLE DAM. (mm):	86 to 114		CORE DIAM. (mm):	63 to 68	DATE STARTED: 20/5/2014						
ENGINEER:	K.S.		DRILLER:	A.A.	DATE FINISHED: 28/5/2014						
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
51					combination of yellowish beige slightly weathered crushed and fractured sandy marly LIMESTONE (sometimes fossilous) and grey some times light olive green moderately to highly weathered crushed and fractured to blocky seamy calcareous MARLSTONE. The MARLSTONE is some times highly weathered (disintegrated into soil like marl)		86	86	0		
52							83	83	35		
53							70	47	27		
54							96	96	43		
55							67	67	10		
56							84	74	20		
57							56	29	0		
58											
59											
60											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

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SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT: DAR-TALEB				FILE NO.:	14-001	BOREHOLE NO.:				BHRA04			
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)				Elevation (m):	449.85	SHEET:				7 OF: 8			
LOCATION: BISRI				METHOD:	Rotary	BOREHOLE DEPTH (m):				76.5m			
EQUIPMENT: CMV 1000				CORE DIAM. (mm):	63 to 68	DATE STARTED:				20/5/2014			
HOLE DAM. (mm): 86 to 114				DRILLER:	A.A.	DATE FINISHED:				28/5/2014			
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL			% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
61					combination of yellowish beige slightly weathered crushed and fractured sandy marly LIMESTONE (sometimes fossilous) and grey some times light olive green moderately to highly weathered crushed and fractured to blocky seamy calcareous MARLSTONE. The MARLSTONE is sometimes highly weathered (disintegrated into soil like marl)			30	30	0			
62								67	30	0			
63								53	22	0			
64					bluish to light olive green and light grey and sometimes green moderately to highly weathered crushed and fractured highly sandy MARLSTONE with interbeds of marly SANDSTONE			21	13	0			
65								22	13	0			
66								23	0	0			
67								33	0	0			
68													
69													
70													

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

CLIENT: DAR-TALEB				FILE NO.:	14-001	BOREHOLE NO.:		BHRA04			
PROJECT: BISRI DAM / SECOND PACKAGE (DAM FOOTPRINT)				Elevation (m):	449.85	SHEET:		8	OF: 8		
LOCATION: BISRI				METHOD:	Rotary	BOREHOLE DEPTH (m):		76.5m			
EQUIPMENT: CMV 1000				CORE DIAM. (mm):	63 to 68	DATE STARTED:		20/5/2014			
HOLE DAM. (mm): 86 to 114				DRILLER:	A.A.	DATE FINISHED:		28/5/2014			
ENGINEER: K.S.											
DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	UCS N/mm ²	Remarks
71					bluish to light olive green and light grey and sometimes green moderately to highly weathered crushed and fractured highly sandy MARLSTONE with interbeds of marly SANDSTONE	33	0	0			
72							43	0	0		
73							36	6.7	0		
74							40	0	0		
75							63	0	0		
76											
77											
78											
79											
80											
End of borehole at 76.5m											

SPT Standard Penetration Test

TCR Total Core Recovery

ST Sample Type

UCS Unconfined Compressive Strength

RQD Rock Quality Designation

SYM Symbol

LT Layer Thickness

SCR Solid Core Recovery

WT Water 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

SATCON

LEGEND

SOIL STUDIES

SOIL SYMBOL	ROCK SYMBOL	SAMPLERS	OTHERS															
		Dolomite		SPT (disturbed)														
		Chalky Limestone		Shelby tube														
		Calcarenite		Tricone														
		Weak Chalky LIMESTONE		Double tube														
		Sandy Limestone																
		SP - SM																
		SM-SC																
		Basalt / volcanics																
		ML																
		CH-MH																
		OL																
		OH																
		PT																
		Fill Material																
		CL																
		Creamy White LIMESTONE																
		Grainstone LIMESTONE																
		MARL																
		CLAY																
		CLAYwith Sand and Gravel																
		Oolitic LIMESTONE																
		Micritic LIMESTONE																
		Mudstone																
		Gypsum																
		Siltstone																
				ROCK CLASSIFICATION														
				<table border="1"> <thead> <tr> <th>% RQD</th> <th>Classification</th> </tr> </thead> <tbody> <tr> <td><25</td> <td>Very Poor</td> </tr> <tr> <td>25-50</td> <td>Poor</td> </tr> <tr> <td>50-75</td> <td>Fair</td> </tr> <tr> <td>75-90</td> <td>Good</td> </tr> <tr> <td>>90</td> <td>Excellent</td> </tr> </tbody> </table>	% RQD	Classification	<25	Very Poor	25-50	Poor	50-75	Fair	75-90	Good	>90	Excellent		
% RQD	Classification																	
<25	Very Poor																	
25-50	Poor																	
50-75	Fair																	
75-90	Good																	
>90	Excellent																	
				GRANULAR SOILS														
				<table border="1"> <thead> <tr> <th>N-Value</th> <th>Relative Density</th> </tr> </thead> <tbody> <tr> <td>< 4</td> <td>Very Loose</td> </tr> <tr> <td>4 - 10</td> <td>Loose</td> </tr> <tr> <td>10 - 30</td> <td>Medium Dense</td> </tr> <tr> <td>30 - 50</td> <td>Dense</td> </tr> <tr> <td>> 50</td> <td>Very Dense</td> </tr> </tbody> </table>	N-Value	Relative Density	< 4	Very Loose	4 - 10	Loose	10 - 30	Medium Dense	30 - 50	Dense	> 50	Very Dense		
N-Value	Relative Density																	
< 4	Very Loose																	
4 - 10	Loose																	
10 - 30	Medium Dense																	
30 - 50	Dense																	
> 50	Very Dense																	
				COHESIVE SOIL														
				<table border="1"> <thead> <tr> <th>N-Value</th> <th>Consistency</th> </tr> </thead> <tbody> <tr> <td>< 2</td> <td>Very Soft</td> </tr> <tr> <td>2 - 4</td> <td>Soft</td> </tr> <tr> <td>4 - 8</td> <td>Medium Stiff</td> </tr> <tr> <td>8 - 15</td> <td>Stiff</td> </tr> <tr> <td>15 - 30</td> <td>Very stiff</td> </tr> <tr> <td>> 30</td> <td>Hard</td> </tr> </tbody> </table>	N-Value	Consistency	< 2	Very Soft	2 - 4	Soft	4 - 8	Medium Stiff	8 - 15	Stiff	15 - 30	Very stiff	> 30	Hard
N-Value	Consistency																	
< 2	Very Soft																	
2 - 4	Soft																	
4 - 8	Medium Stiff																	
8 - 15	Stiff																	
15 - 30	Very stiff																	
> 30	Hard																	

APPENDIX 3. PHOTOS OF CORE BOXES



DAR AL HANDASAH NAZIH TALEB & PARTNERS
دار الهندسة نزيه طالب وشريك

Detailed Design Of Bisri Dam: Geo. Inv. Rep.II: (Factual) / Spillway & Bottom Outlet - June 2014











































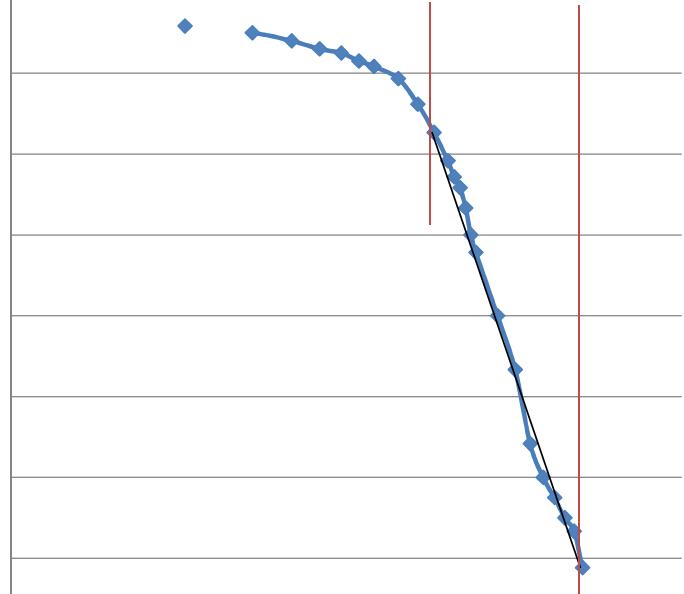






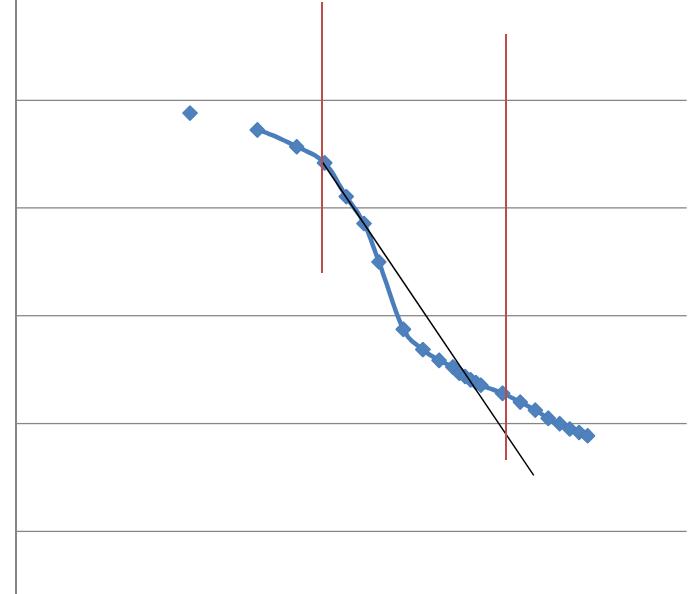
APPENDIX 4. BOREHOLE WATER PERMEABILITY & LUGEON TEST RESULTS



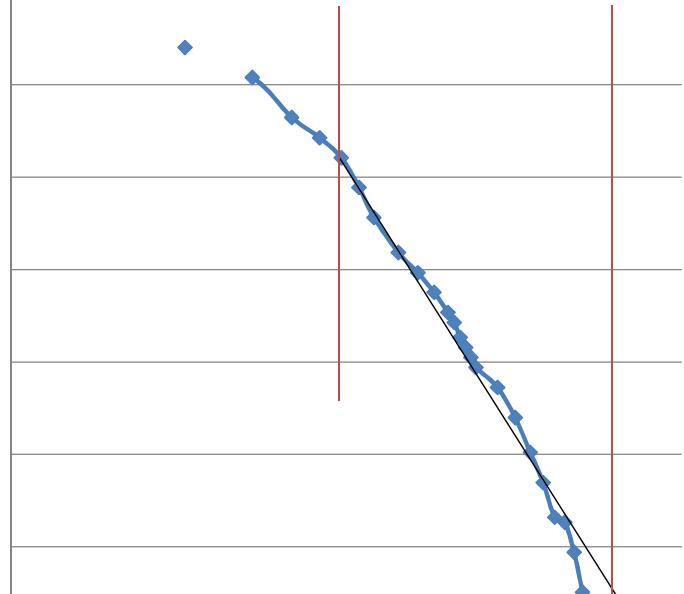
BHVR2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	0	to	3	K(m/sec, FHM):	4.7946E-08
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	3	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	0.09
Falling Head Method (FHM)				2	0.09
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.10
H1	2.84	m	7	0.12	420 0.96 2.89
H2	2.51	m	9	0.12	540 0.96 2.88
t1 (as per graph)	780	sec.	11	0.14	660 0.95 2.86
t2	3600	sec.	13	0.16	780 0.95 2.84
Log Time (sec)				15	0.19
				16	0.20
				17	0.21
				18	0.22
				19	0.24
				20	0.25
				25	0.30
				30	0.34
				35	0.40
				40	0.42
				45	0.44
				50	0.45
				55	0.46
				60	0.49
Water Permeability (m/sec)		Relative Permeability		Semi-Pervious to Impervious	
1.00E-03	1.00E-05	Pervious		Semi-Pervious to Impervious	
1.00E-05	1.00E-08	Semi-Pervious		Semi-Pervious to Impervious	
1.00E-08	1.00E-12	Impervious		Semi-Pervious to Impervious	

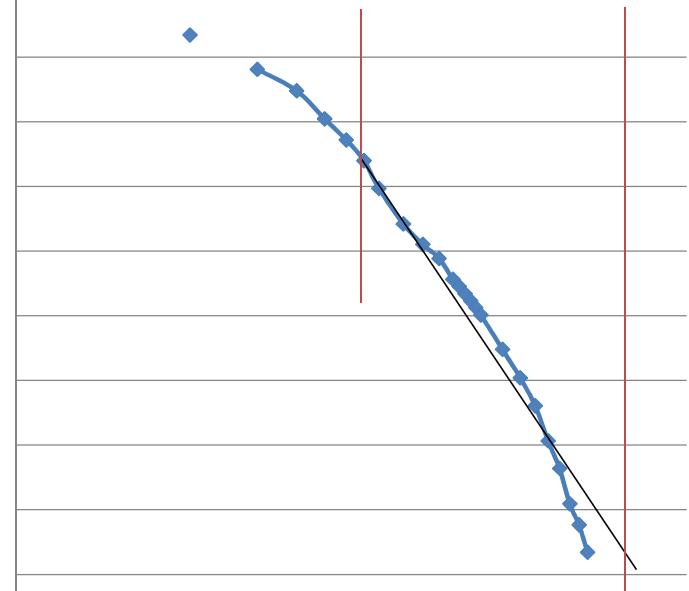
BHVR2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
		DAM FOOTPRINT					
Test Interval	3	to	6	K(m/sec, FHM):	4.5845E-06		
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)		
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	5	m	0	0.00		
Length of uncased test interval below the pre-test water level	L	1	m	1	0.95		
Falling Head Method (FHM)				2	1.42		
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	1.89		
				4	2.60		
				5	2.85		
				6	3.05		
H1	3.58	m	7	3.18	420 0.36 1.82		
H2	0.12	m	9	3.53	540 0.29 1.47		
t1 (as per graph)	120	sec.	11	3.65	660 0.27 1.35		
t2	1800	sec.	13	3.80	780 0.24 1.20		
Log Time (sec)				15	3.92		
				16	3.98		
				17	4.02		
				18	4.08		
				19	4.11		
				20	4.16		
				25	4.29		
				30	4.59		
				35	4.88		
ht/h ₀							
Water Permeability (m/sec)				Relative Permeability			
1.00E-03	1.00E-05	Pervious					
1.00E-05	1.00E-08	Semi-Pervious					
1.00E-08	1.00E-12	Impervious					
Semi-Pervious to Pervious							

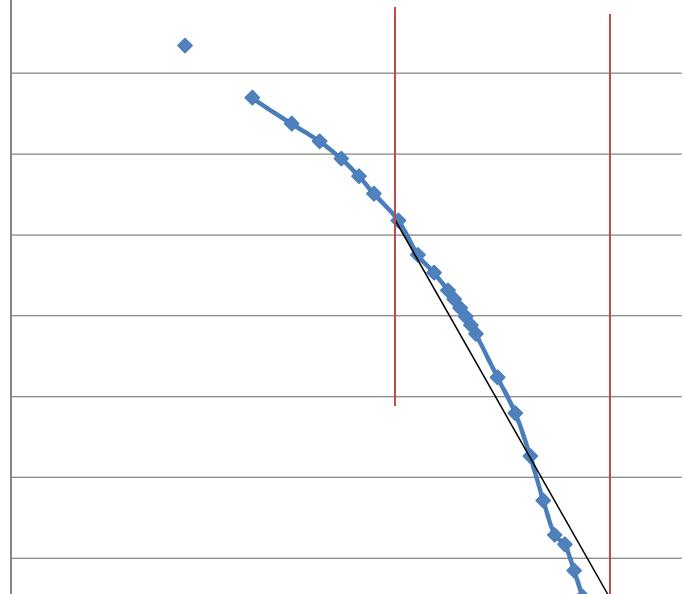
BHVR2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
		DAM FOOTPRINT					
Test Interval	6	to	9	K(m/sec, FHM):	2.2149E-07		
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)		
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	6.65	m	0	0.00		
Length of uncased test interval below the pre-test water level	L	2.35	m	1	0.93		
Falling Head Method (FHM)				2	1.21		
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	1.43		
				4	1.65		
				5	1.77		
				6	1.80		
H1	4.56	m	7	1.88	420 0.72 4.78		
H2	3	m	9	2.09	540 0.69 4.56		
t1 (as per graph)	540	sec.	11	2.29	660 0.66 4.36		
t2	3000	sec.	13	2.41	780 0.64 4.24		
Log Time (sec)				15	2.52		
				16	2.63		
				17	2.68		
				18	2.73		
				19	2.79		
				20	2.82		
				25	2.97		
				30	3.08		
				35	3.23		
				40	3.40		
				45	3.53		
				50	3.65		
				55	3.80		
				60	3.95		
Water Permeability (m/sec)		Relative Permeability		Semi-Pervious			
1.00E-03	1.00E-05	Pervious					
1.00E-05	1.00E-08	Semi-Pervious					
1.00E-08	1.00E-12	Impervious					

BHVR2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
		DAM FOOTPRINT					
Test Interval	9	to	12	K(m/sec, FHM):	5.9685E-07		
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)		
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	8	m	0	0.00		
Length of uncased test interval below the pre-test water level	L	3	m	1	0.19		
Falling Head Method (FHM)				2	0.44		
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.69		
				4	0.93		
				5	1.43		
				6	1.83		
H1	7.07	m	7	2.40	420 0.70 5.60		
H2	3.02	m	9	3.40	540 0.58 4.60		
t1 (as per graph)	240	sec.	11	3.70	660 0.54 4.30		
t2	1800	sec.	13	3.86	780 0.52 4.14		
Log Time (sec)				15	3.96		
				16	4.05		
				17	4.10		
				18	4.15		
				19	4.19		
				20	4.23		
				25	4.35		
				30	4.48		
				35	4.60		
				40	4.72		
				45	4.80		
				50	4.88		
				55	4.93		
				60	4.98		
Water Permeability (m/sec)		Relative Permeability		Semi-Pervious			
1.00E-03	1.00E-05	Pervious					
1.00E-05	1.00E-08	Semi-Pervious					
1.00E-08	1.00E-12	Impervious					

BHVR2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	12	to	15	K(m/sec, FHM):	2.3848E-08
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	9.24	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	0.03
Falling Head Method (FHM)				2	0.05
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.06
H1	9.21	m	4	0.07	120 0.995 9.19
H2	9.15	m	5	0.08	180 0.993 9.18
t1 (as per graph)	60	sec.	6	0.09	240 0.992 9.17
t2	360	sec.			300 0.991 9.16
					360 0.990 9.15
Log Time (sec)					
Water Permeability (m/sec)	Relative Permeability		<p>Semi-Pervious to Impervious</p>		
1.00E-03	1.00E-05	Pervious			
1.00E-05	1.00E-08	Semi-Pervious			
1.00E-08	1.00E-12	Impervious			

BHVR2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	15	to	18	K(m/sec, FHM):	2.3929E-08
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	9.24	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	0.11
Falling Head Method (FHM)				2	0.17
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.25
				4	0.29
				5	0.33
				6	0.39
H1	8.91	m	7	0.45	420 0.95 8.79
H2	8.04	m	9	0.52	540 0.94 8.72
t1 (as per graph)	300	sec.	11	0.56	660 0.94 8.68
t2	5000	sec.	13	0.60	780 0.94 8.64
Log Time (sec)				15	0.64
				16	0.66
				17	0.69
				18	0.71
				19	0.73
				20	0.75
				25	0.79
				30	0.85
				35	0.92
				40	0.98
				45	1.05
				50	1.06
				55	1.12
				60	1.20
Water Permeability (m/sec)		Relative Permeability			
1.00E-03	1.00E-05	Pervious			
1.00E-05	1.00E-08	Semi-Pervious			
1.00E-08	1.00E-12	Impervious			
Semi-Pervious to Impervious					

BHVR2		DAM FOOTPRINT		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
Test Interval	18	to	21	K(m/sec, FHM):	1.3952E-08
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	9.24	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	0.06
Falling Head Method (FHM)				2	0.11
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.14
				4	0.18
				5	0.21
				6	0.24
H1	9	m	7	0.28	420 0.97 8.96
H2	8.44	m	9	0.33	540 0.96 8.91
t1 (as per graph)	360	sec.	11	0.36	660 0.96 8.88
t2	5400	sec.	13	0.38	780 0.96 8.86
Log Time (sec)				15	0.41
				16	0.42
				17	0.43
				18	0.44
				19	0.45
				20	0.46
				25	0.51
				30	0.55
				35	0.59
				40	0.64
				45	0.68
				50	0.73
				55	0.76
				60	0.80
Water Permeability (m/sec)		Relative Permeability		Semi-Pervious to Impervious	
1.00E-03	1.00E-05	Pervious		Semi-Pervious to Impervious	
1.00E-05	1.00E-08	Semi-Pervious		Semi-Pervious to Impervious	
1.00E-08	1.00E-12	Impervious		Semi-Pervious to Impervious	

BHVR2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	Pre-T.W.D (m):	18	G.W.D (m):	9.24	Date: 22.04.2014
Diameter of test interval	21	to	24	K(m/sec, FHM):	1.2043E-08
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	9.24	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	0.06
Falling Head Method (FHM)				2	0.12
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.15
				4	0.17
				5	0.19
				6	0.21
H1	8.98	m	7	0.23	420 0.98 9.01
H2	8.55	m	9	0.26	540 0.97 8.98
t1 (as per graph)	540	sec.	11	0.30	660 0.97 8.94
t2	5000	sec.	13	0.32	780 0.97 8.92
Log Time (sec)				15	0.34
				16	0.35
				17	0.36
				18	0.37
				19	0.38
				20	0.39
				25	0.44
				30	0.48
				35	0.53
				40	0.58
				45	0.62
				50	0.63
				55	0.66
				60	0.69
Water Permeability (m/sec)		Relative Permeability		Semi-Pervious to Impervious	
1.00E-03	1.00E-05	Pervious		Semi-Pervious to Impervious	
1.00E-05	1.00E-08	Semi-Pervious		Semi-Pervious to Impervious	
1.00E-08	1.00E-12	Impervious		Semi-Pervious to Impervious	

BHVR2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
		DAM FOOTPRINT					
Test Interval	24	to	27	K(m/sec, FHM):	9.7523E-08		
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)		
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	9.24	m	0	0.00		
Length of uncased test interval below the pre-test water level	L	3	m	1	0.08		
Falling Head Method (FHM)				2	0.17		
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.30		
				4	0.45		
				5	0.59		
				6	0.76		
H1	8.79	m	7	0.92	420 0.90 8.32		
H2	7.06	m	9	1.23	540 0.87 8.01		
t1 (as per graph)	240	sec.	11	1.32	660 0.86 7.92		
t2	2700	sec.	13	1.39	780 0.85 7.85		
Log Time (sec)				15	1.44		
				16	1.46		
				17	1.49		
				18	1.52		
				19	1.54		
				20	1.58		
				25	1.68		
				30	1.77		
				35	1.86		
				40	1.95		
				45	2.03		
				50	2.10		
				55	2.13		
				60	2.18		
Water Permeability (m/sec)		Relative Permeability		Semi-Pervious			
1.00E-03	1.00E-05	Pervious					
1.00E-05	1.00E-08	Semi-Pervious					
1.00E-08	1.00E-12	Impervious					

BHVR2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	27	to	30	K(m/sec, FHM):	2.1521E-05
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	9.24	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	6.70
Falling Head Method (FHM)				2	8.68
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	9.00
H1	2.54	m			
H2	0.24	m			
t1 (as per graph)	60	sec.			
t2	180	sec.			
Log Time (sec)					
Water Permeability (m/sec)	Relative Permeability		Pervious 1.00E-03 1.00E-05 Pervious 1.00E-05 1.00E-08 Semi-Pervious 1.00E-08 1.00E-12 Impervious		

BHVR2			BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST						
			DAM FOOTPRINT									
Test Interval	Pre-T.W.D (m):	9.8	9.24			Date:	30.04.2014					
Diameter of test interval	30	to	33			K(m/sec, FHM):	7.1065E-06					
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t				
Length of uncased test interval below the pre-test water level	L	3	m	0	0.00	0	1.00	9.24				
Falling Head Method (FHM)						1	9.05	60 0.02 0.19				
$K_{(m/sec)} = \frac{D^2}{8L(t_2 - t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						2	9.10	120 0.02 0.14				
						3	9.14	180 0.01 0.10				
						4	9.17	240 0.01 0.07				
						5	9.20	300 0.00 0.04				
H1	0.19		m									
H2	0.04		m									
t1 (as per graph)	60		sec.									
t2	300		sec.									
Log Time (sec)												
Water Permeability (m/sec)			Relative Permeability									
1.00E-03	1.00E-05	Pervious										
1.00E-05	1.00E-08	Semi-Pervious										
1.00E-08	1.00E-12	Impervious										
						Semi-Pervious to Pervious						

BHVR2			BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST						
			DAM FOOTPRINT									
Test Interval	Pre-T.W.D (m):	9.9	9.24			Date:	30.04.2014					
Diameter of test interval	33	to	36			K(m/sec, FHM):	3.8489E-05					
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t				
Length of uncased test interval below the pre-test water level	L	3	m	0	0.00	0	1.00	9.24				
Falling Head Method (FHM)						1	6.52	60 0.29 2.72				
$K_{(m/sec)} = \frac{D^2}{8L(t_2 - t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						2	8.43	120 0.09 0.81				
						3	9.20	180 0.004 0.04				
H1	2.72		m									
H2	0.04		m									
t1 (as per graph)	60		sec.									
t2	180		sec.									
Log Time (sec)												
Water Permeability (m/sec)			Relative Permeability									
1.00E-03	1.00E-05		Pervious									
1.00E-05	1.00E-08		Semi-Pervious									
1.00E-08	1.00E-12		Impervious									

BHVR2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	36	to	39	K(m/sec, FHM):	6.1251E-05
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	9.24	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	7.23
Falling Head Method (FHM)				2	9.17
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$					
H1	2.01	m			
H2	0.07	m			
t1 (as per graph)	60	sec.			
t2	120	sec.			
Log Time (sec)					
Water Permeability (m/sec)	Relative Permeability		Pervious 1.00E-03 1.00E-05 Pervious 1.00E-05 1.00E-08 Semi-Pervious 1.00E-08 1.00E-12 Impervious		

BHVR2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	39	to	42	K(m/sec, FHM):	4.0544E-06
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	9.24	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	1.00
Falling Head Method (FHM)				2	2.03
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	2.80
				4	3.30
				5	3.60
				6	3.86
H1	5.04	m	7	4.20	420 0.55 5.04
H2	0.01	m	9	4.96	540 0.46 4.28
t1 (as per graph)	420	sec.	11	5.62	660 0.39 3.62
t2	2100	sec.	13	6.25	780 0.32 2.99
Log Time (sec)				15	6.72
				16	6.92
				17	7.10
				18	7.35
				19	7.60
				20	7.77
				25	8.30
				30	8.79
				35	9.23
				40	9.23
Water Permeability (m/sec)		Relative Permeability		Semi-Pervious to Pervious	
1.00E-03	1.00E-05	Pervious		Semi-Pervious to Pervious	
1.00E-05	1.00E-08	Semi-Pervious		Semi-Pervious to Pervious	
1.00E-08	1.00E-12	Impervious		Semi-Pervious to Pervious	

BHVR2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST												
		DAM FOOTPRINT														
Test Interval	45	to	48	K(m/sec, FHM):	1.9420E-07											
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)											
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	9.24	m	0	0.00											
Length of uncased test interval below the pre-test water level	L	3	m	1	0.22											
Falling Head Method (FHM)				2	0.36											
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.41											
				4	0.41											
H1		9.02	m													
H2		8.83	m													
t1 (as per graph)		60	sec.													
t2		180	sec.													
Log Time (sec)																
<table border="1"> <thead> <tr> <th>Water Permeability (m/sec)</th> <th>Relative Permeability</th> </tr> </thead> <tbody> <tr> <td>1.00E-03</td> <td>1.00E-05</td> <td>Pervious</td> </tr> <tr> <td>1.00E-05</td> <td>1.00E-08</td> <td>Semi-Pervious</td> </tr> <tr> <td>1.00E-08</td> <td>1.00E-12</td> <td>Impervious</td> </tr> </tbody> </table>						Water Permeability (m/sec)	Relative Permeability	1.00E-03	1.00E-05	Pervious	1.00E-05	1.00E-08	Semi-Pervious	1.00E-08	1.00E-12	Impervious
Water Permeability (m/sec)	Relative Permeability															
1.00E-03	1.00E-05	Pervious														
1.00E-05	1.00E-08	Semi-Pervious														
1.00E-08	1.00E-12	Impervious														
Semi-Pervious																

BHVR2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	51	to	54	K(m/sec, FHM):	1.9606E-07
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	9.24	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	0.80
Falling Head Method (FHM)				2	1.30
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	1.42
				4	1.55
				5	1.61
				6	1.63
H1	8.44	m	7	1.64	420 0.822 7.60
H2	7.58	m	9	1.65	540 0.821 7.59
t1 (as per graph)	60	sec.	11	1.66	660 0.820 7.58
t2	660	sec.	13	1.66	780 0.820 7.58
Log Time (sec)					
Water Permeability (m/sec)		Relative Permeability			
1.00E-03	1.00E-05	Pervious			
1.00E-05	1.00E-08	Semi-Pervious			
1.00E-08	1.00E-12	Impervious			
Semi-Pervious to Impervious					

BHVR2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	54	to	57	K(m/sec, FHM):	4.8699E-07
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	9.24	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	0.69
Falling Head Method (FHM)				2	0.99
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	1.28
				4	1.56
				5	1.80
				6	1.89
H1	7.96	m	7	1.94	420 0.79 7.30
H2	7.25	m	9	1.97	540 0.79 7.27
t1 (as per graph)	180	sec.	11	1.99	660 0.78 7.25
t2	390	sec.	13	1.99	780 0.78 7.25
Log Time (sec)					
Water Permeability (m/sec)		Relative Permeability			
1.00E-03	1.00E-05	Pervious			
1.00E-05	1.00E-08	Semi-Pervious			
1.00E-08	1.00E-12	Impervious			
Semi-Pervious					

BHVR2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	78	to	81	K(m/sec, FHM):	1.8316E-05
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	9.24	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	7.93
Falling Head Method (FHM)				2	8.76
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$					
H1	1.31	m			
H2	0.48	m			
t1 (as per graph)	60	sec.			
t2	120	sec.			
Log Time (sec)					
Water Permeability (m/sec)	Relative Permeability		Semi-Pervious to Pervious		
1.00E-03	1.00E-05	Pervious			
1.00E-05	1.00E-08	Semi-Pervious			
1.00E-08	1.00E-12	Impervious			

DAR AL HADASAH NAZIH TALEB & PARTNERS consulting engineers			BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST										
			DAM FOOTPRINT												
BHVR2	Pre-T.W.D (m):	15	G.W.D (m):	9.24	Date:	07.05.2014									
Test Interval	81		to		84										
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0	h_t						
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	9.24	m	0	0.00	0	1.00	9.24						
Length of uncased test interval below the pre-test water level		L	3	m	1	6.82	60	0.26	2.42						
Falling Head Method (FHM)						2	8.43	120	0.09	0.81					
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	8.92	180	0.03	0.32					
H1	2.42		m												
H2	0.32		m												
t1 (as per graph)	60		sec.												
t2	180		sec.												
Log Time (sec)															
Water Permeability (m/sec)	Relative Permeability														
1.00E-03	1.00E-05	Pervious													
1.00E-05	1.00E-08	Semi-Pervious													
1.00E-08	1.00E-12	Impervious													
						Semi-Pervious to Pervious									

DAR AL-HANDASAH NAZIH TALEB & PARTNERS consulting engineers		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST				
		DAM FOOTPRINT						
BHVR2	Pre-T.W.D (m):	19.9	G.W.D (m):	9.24	Date:	09.05.2014		
Test Interval	84	to	87		K(m/sec, FHM):	2.0737E-07		
Diameter of test interval		D	86	mm	Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)		h_0	9.24	m	0	0.00	0	1.00
Length of uncased test interval below the pre-test water level		L	3	m	1	0.29	60	0.97
Falling Head Method (FHM)						2	0.48	120 0.95 8.76
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$						3	0.68	180 0.93 8.56
						4	0.87	240 0.91 8.37
						5	0.98	300 0.894 8.26
						6	1.04	360 0.887 8.20
H1		8.76	m		7	1.08	420	0.883 8.16
H2		8.09	m		9	1.15	540	0.875 8.09
t1 (as per graph)		120	sec.		11	1.18	660	0.872 8.06
t2		540	sec.		13	1.20	780	0.870 8.04
Log Time (sec)						15	1.20	900 0.870 8.04
Water Permeability (m/sec)		Relative Permeability						
1.00E-03	1.00E-05	Pervious						
1.00E-05	1.00E-08	Semi-Pervious						
1.00E-08	1.00E-12	Impervious						
						Semi-Pervious to Impervious		

BHVR2		DAM FOOTPRINT		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
Test Interval	90	to	93	K(m/sec, FHM):	2.1948E-07
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	9.24	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	0.19
Falling Head Method (FHM)				2	0.39
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.56
				4	0.72
				5	0.86
				6	0.92
H1	8.85	m	7	0.93	420 0.90 8.31
H2	8.3	m	9	0.94	540 0.90 8.30
t1 (as per graph)	120	sec.	11	0.94	660 0.90 8.30
t2	440	sec.			
Log Time (sec)					
Water Permeability (m/sec)		Relative Permeability		Semi-Pervious to Impervious	
1.00E-03	1.00E-05	Pervious			
1.00E-05	1.00E-08	Semi-Pervious			
1.00E-08	1.00E-12	Impervious			

BHVR2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	93	to	96	K(m/sec, FHM):	2.4894E-05
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	9.24	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	5.87
Falling Head Method (FHM)				2	7.42
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	9.02
H1	3.37	m			
H2	0.22	m			
t1 (as per graph)	60	sec.			
t2	180	sec.			
Log Time (sec)					
Water Permeability (m/sec)	Relative Permeability		Pervious		
1.00E-03	1.00E-05	Pervious			
1.00E-05	1.00E-08	Semi-Pervious			
1.00E-08	1.00E-12	Impervious			

BHVR2	Pre-T.W.D (m):	31.5	G.W.D (m):	9.24	Date:	10.05.2014				
Test Interval	96	to	99		K(m/sec, FHM):	1.1750E-05				
Diameter of test interval	D	86	mm		Time (min)	Drawdown from R.L (m)	Time (sec)	h_t / h_0		
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	9.24	m	0	0.00	0	1.00	9.24		
Length of uncased test interval below the pre-test water level	L	3	m	1	7.79	60	0.16	1.45		
Falling Head Method (FHM)					2	8.23	120	0.11		
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$					3	8.71	180	0.06		
					4	9.03	240	0.02		
H1	1.45		m							
H2	0.21		m							
t1 (as per graph)	60		sec.							
t2	240		sec.							
Log Time (sec)										
Water Permeability (m/sec)	Relative Permeability			Semi-Pervious to Pervious						
1.00E-03	1.00E-05	Pervious			Semi-Pervious to Pervious					
1.00E-05	1.00E-08	Semi-Pervious			Semi-Pervious to Pervious					
1.00E-08	1.00E-12	Impervious			Semi-Pervious to Pervious					

BHVR2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	99	to	102	K(m/sec, FHM):	4.1467E-05
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	9.24	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	5.47
Falling Head Method (FHM)				2	7.87
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	9.20
H1	3.77	m			
H2	0.04	m			
t1 (as per graph)	60	sec.			
t2	180	sec.			
Log Time (sec)					
Water Permeability (m/sec)	Relative Permeability		Pervious 1.00E-03 1.00E-05 Pervious 1.00E-05 1.00E-08 Semi-Pervious 1.00E-08 1.00E-12 Impervious		



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 02**
TRANCHE ESSAYEE **57.00 m à 60.00 m**

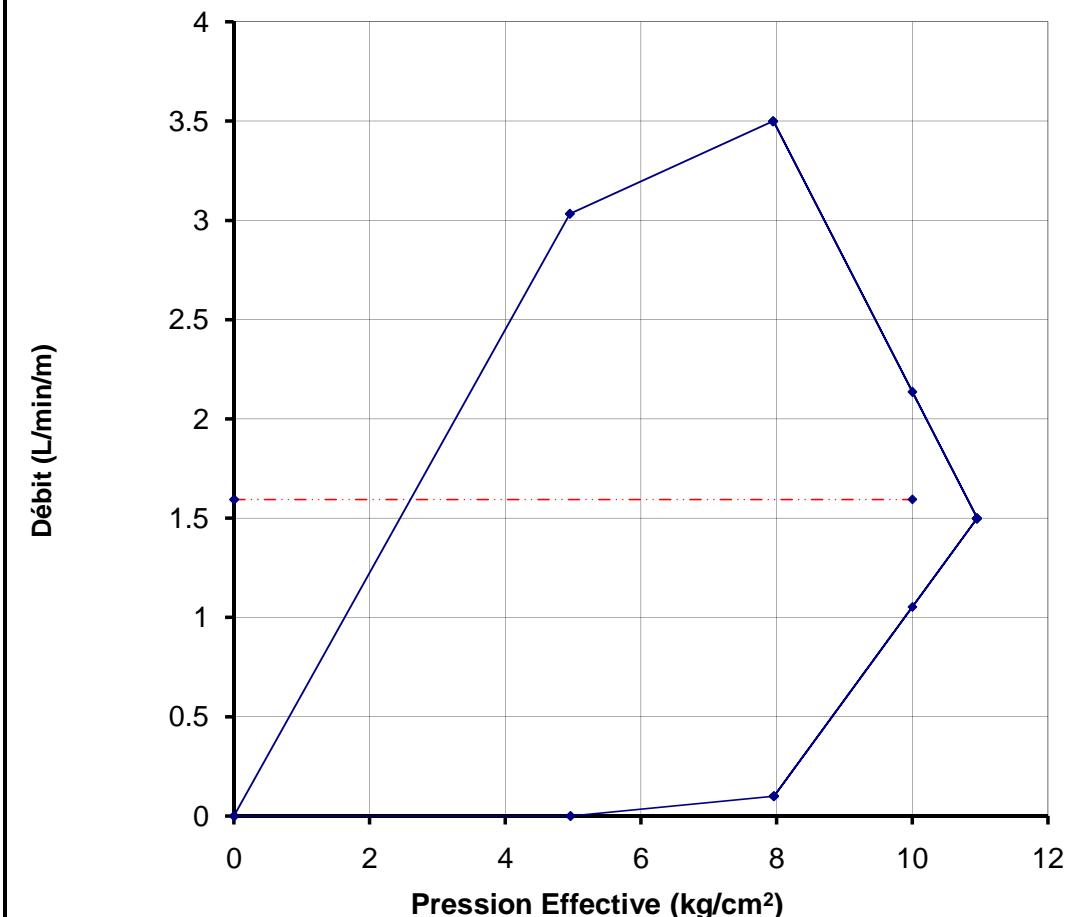
Date: **5/3/2014**

Manomètre **0.50 m**

depth to water: **9.10 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	91	10	3	9.1	3.03	0.96	9.01E-03	4.951
7	105	10	3	10.5	3.50	0.96	1.04E-02	7.950
10	45	10	3	4.5	1.50	0.96	4.46E-03	10.956
7	3	10	3	0.3	0.10	0.96	2.97E-04	7.960
4	0	10	3	0	0.00	0.96	0.00E+00	4.960



Lugeon = 1.59 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 02**
TRANCHE ESSAYEE **60.00 m à 63.00 m**

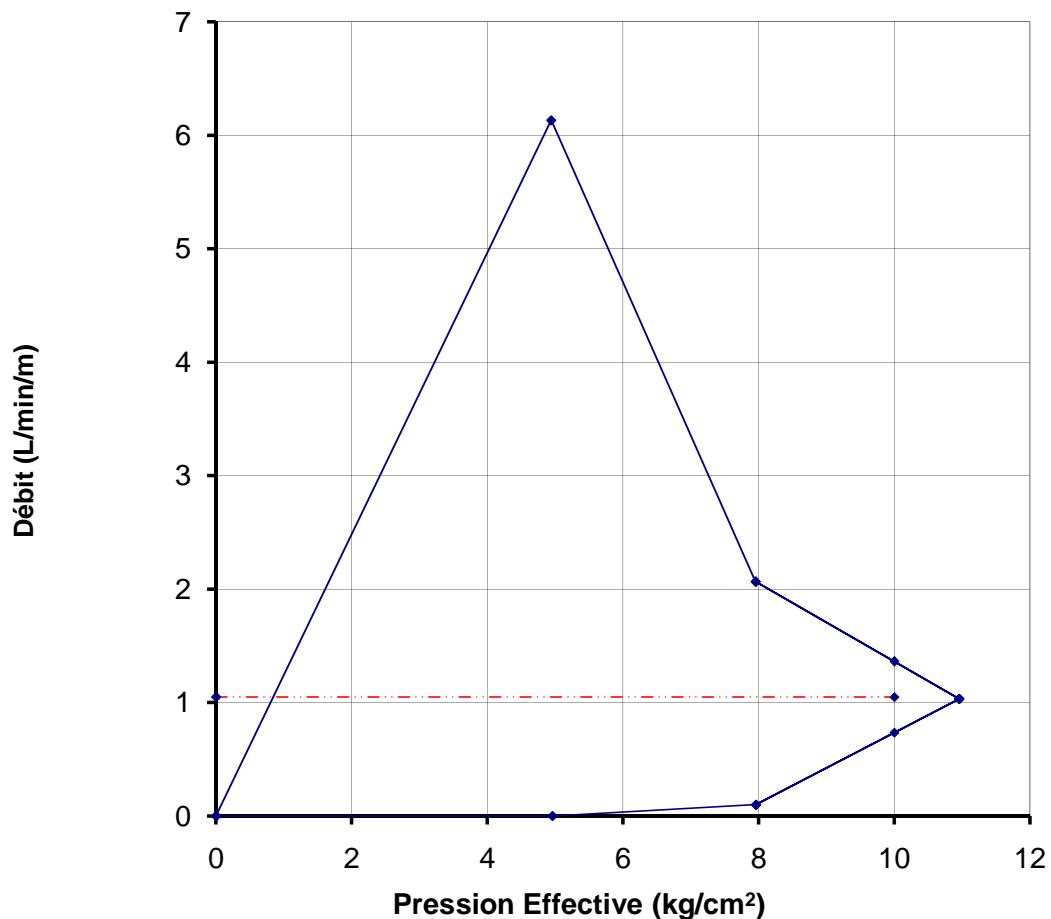
Date: **5/3/2014**

Manomètre **0.50 m**

depth to water: **9.10 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	184	10	3	18.4	6.13	0.96	1.82E-02	4.942
7	62	10	3	6.2	2.07	0.96	6.14E-03	7.954
10	31	10	3	3.1	1.03	0.96	3.07E-03	10.957
7	3	10	3	0.3	0.10	0.96	2.97E-04	7.960
4	0	10	3	0	0.00	0.96	0.00E+00	4.960



Lugeon = **1.05 L/min/m**



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 02**
TRANCHE ESSAYEE **63.00 m à 66.00 m**

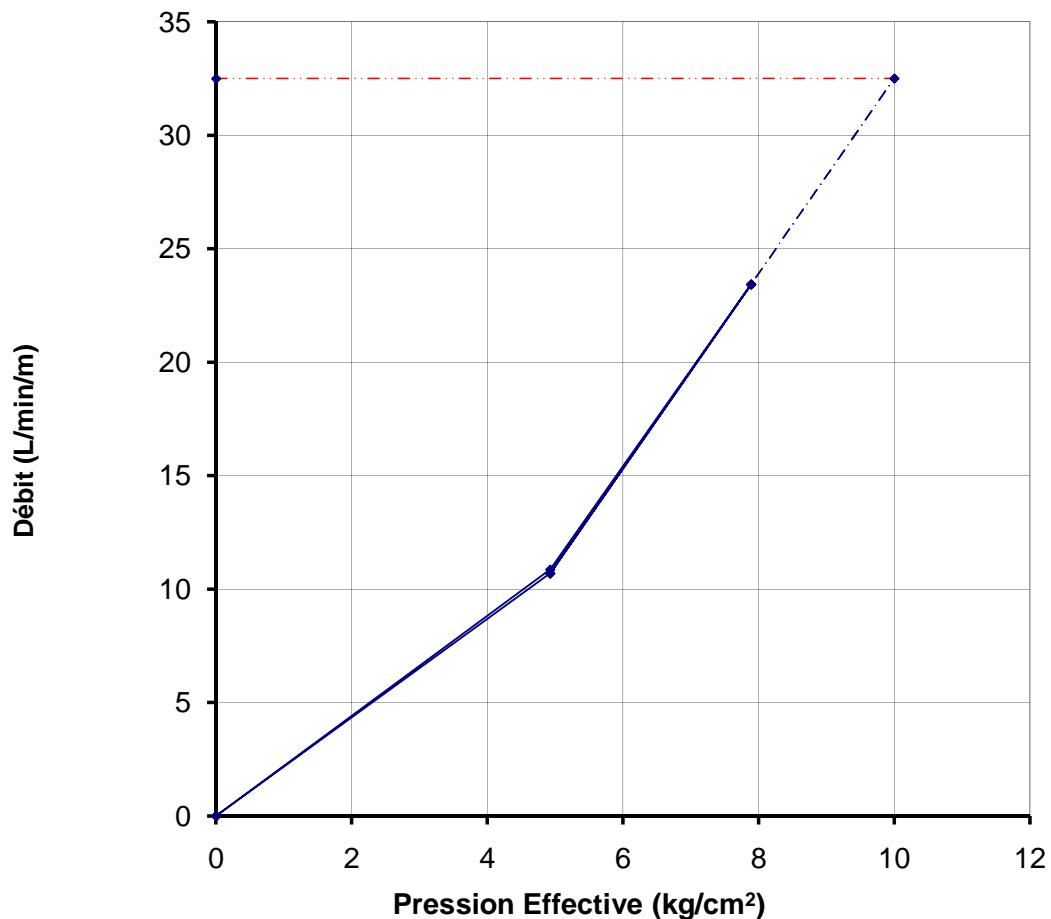
Date: **5/3/2014**

Manomètre **0.50 m**

depth to water: **9.10 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	321	10	3	32.1	10.70	0.96	3.18E-02	4.928
7	703	10	3	70.3	23.43	0.96	6.96E-02	7.890
4	326	10	3	32.6	10.87	0.96	3.23E-02	4.928



Lugeon = 32.50 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 02**
TRANCHE ESSAYEE **66.00 m à 69.00 m**

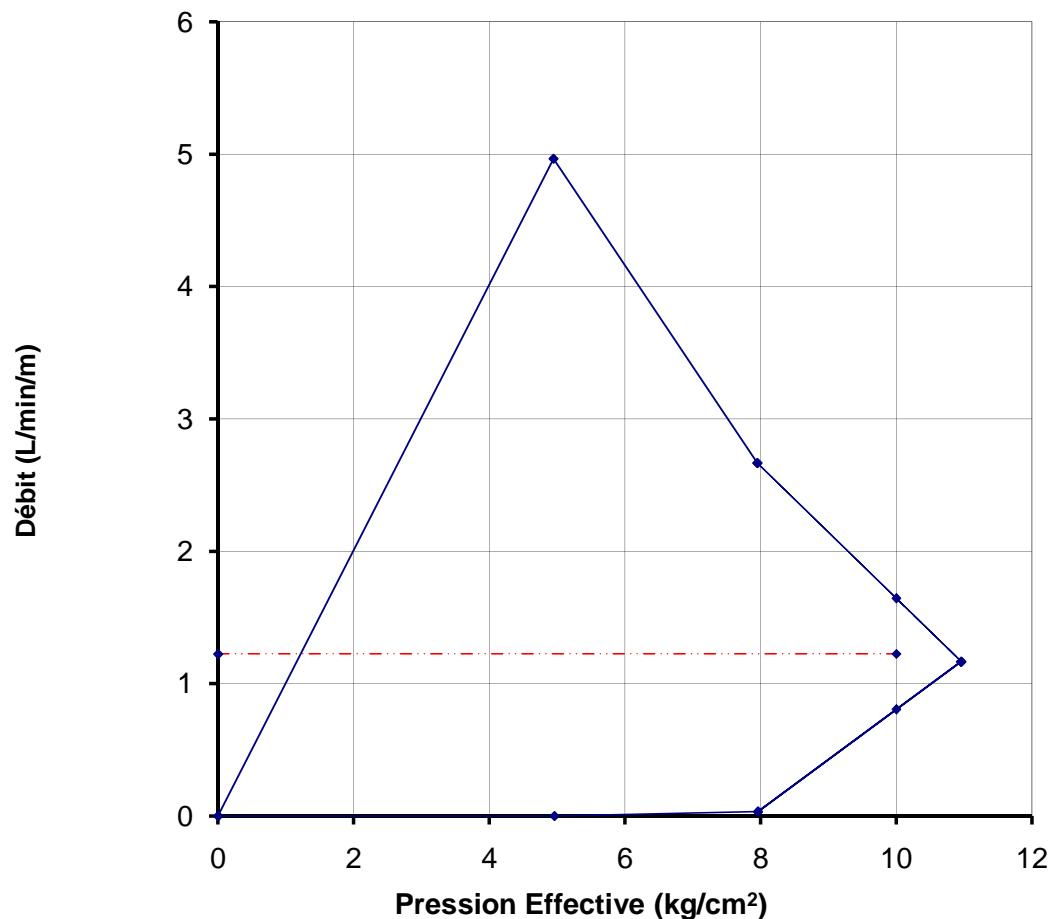
Date: **5/5/2014**

Manomètre **0.50 m**

depth to water: **9.10 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	149	10	3	14.9	4.97	0.96	1.48E-02	4.945
7	80	10	3	8	2.67	0.96	7.92E-03	7.952
10	35	10	3	3.5	1.17	0.96	3.47E-03	10.957
7	1	10	3	0.1	0.03	0.96	9.90E-05	7.960
4	0	10	3	0	0.00	0.96	0.00E+00	4.960



Lugeon = 1.22 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 02**
TRANCHE ESSAYEE **69.00 m à 72.00 m**

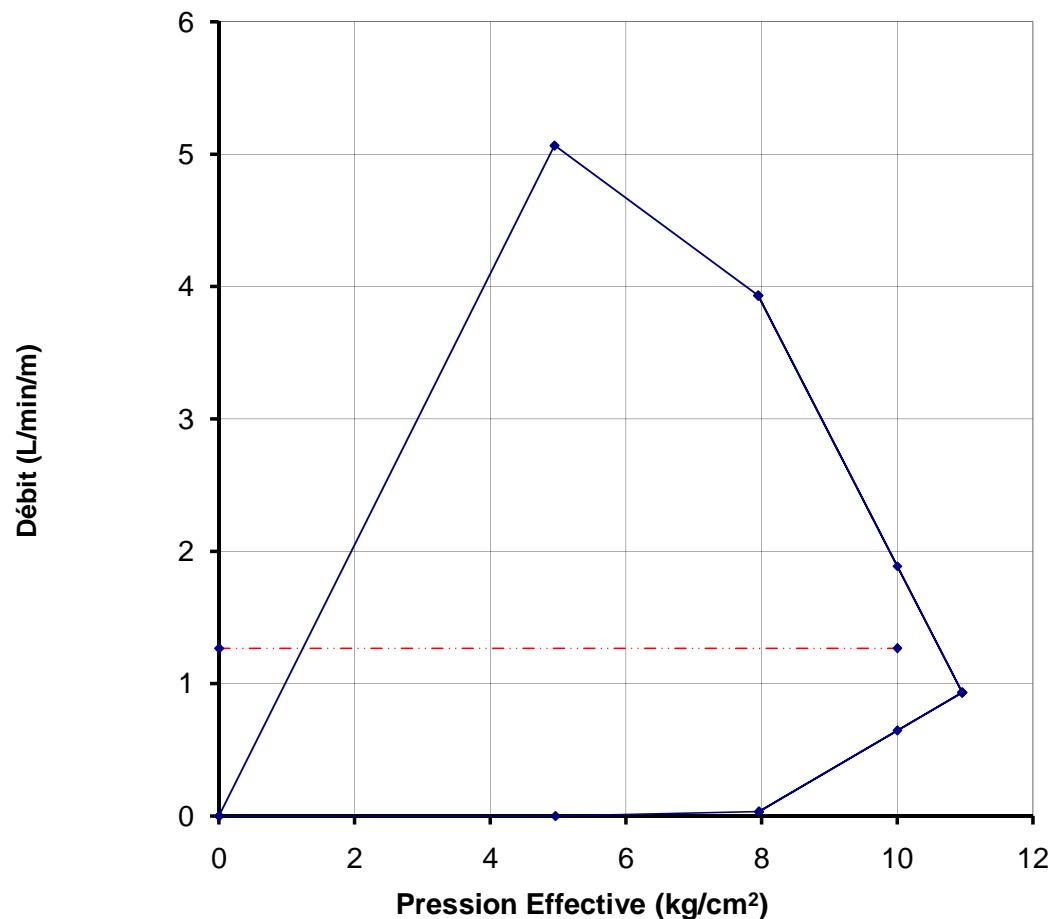
Date: **5/5/2014**

Manomètre **0.50 m**

depth to water: **9.10 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	152	10	3	15.2	5.07	0.96	1.50E-02	4.945
7	118	10	3	11.8	3.93	0.96	1.17E-02	7.948
10	28	10	3	2.8	0.93	0.96	2.77E-03	10.957
7	1	10	3	0.1	0.03	0.96	9.90E-05	7.960
4	0	10	3	0	0.00	0.96	0.00E+00	4.960



Lugeon = 1.27 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 02**
TRANCHE ESSAYEE **72.00 m à 75.00 m**

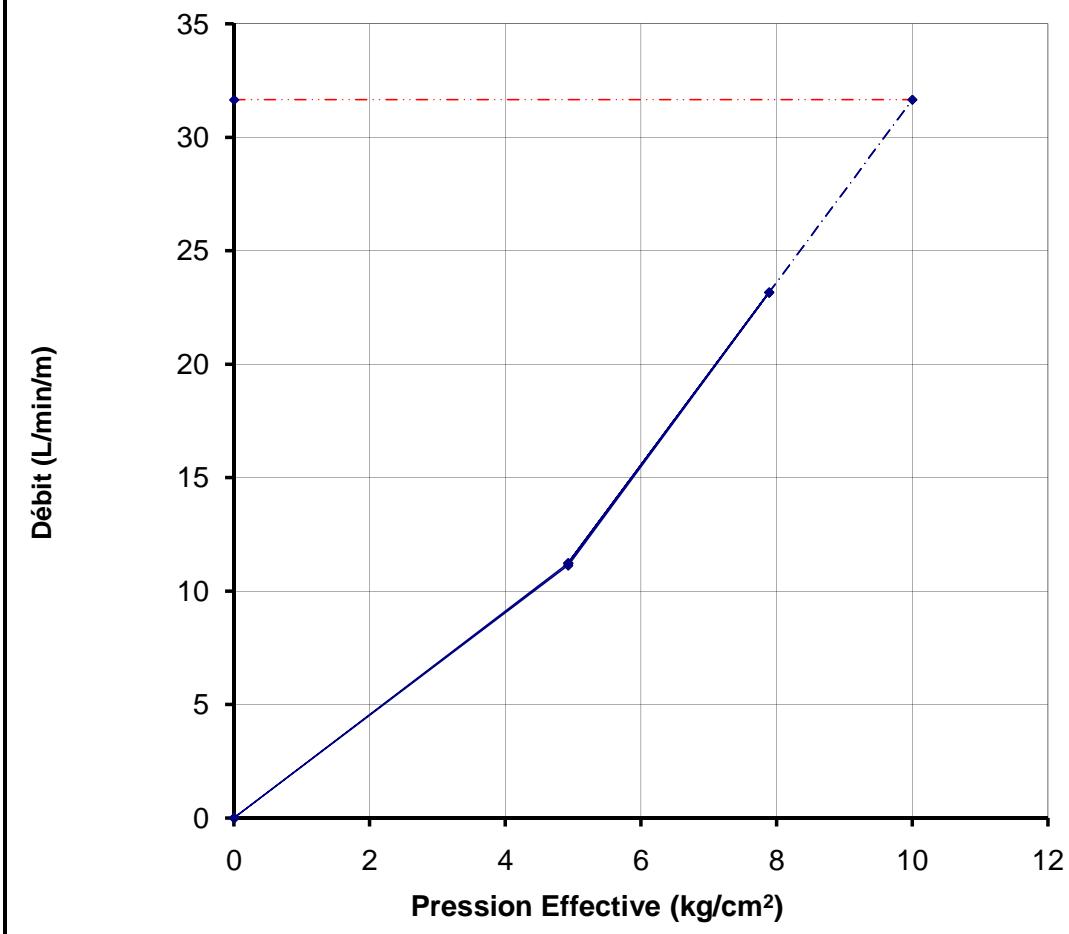
Date: **5/5/2014**

Manomètre **0.50 m**

depth to water: **9.10 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	337	10	3	33.7	11.23	0.96	3.34E-02	4.927
7	695	10	3	69.5	23.17	0.96	6.88E-02	7.891
4	334	10	3	33.4	11.13	0.96	3.31E-02	4.927



Lugeon = 31.66 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 02**
TRANCHE ESSAYEE **75.00 m à 78.00 m**

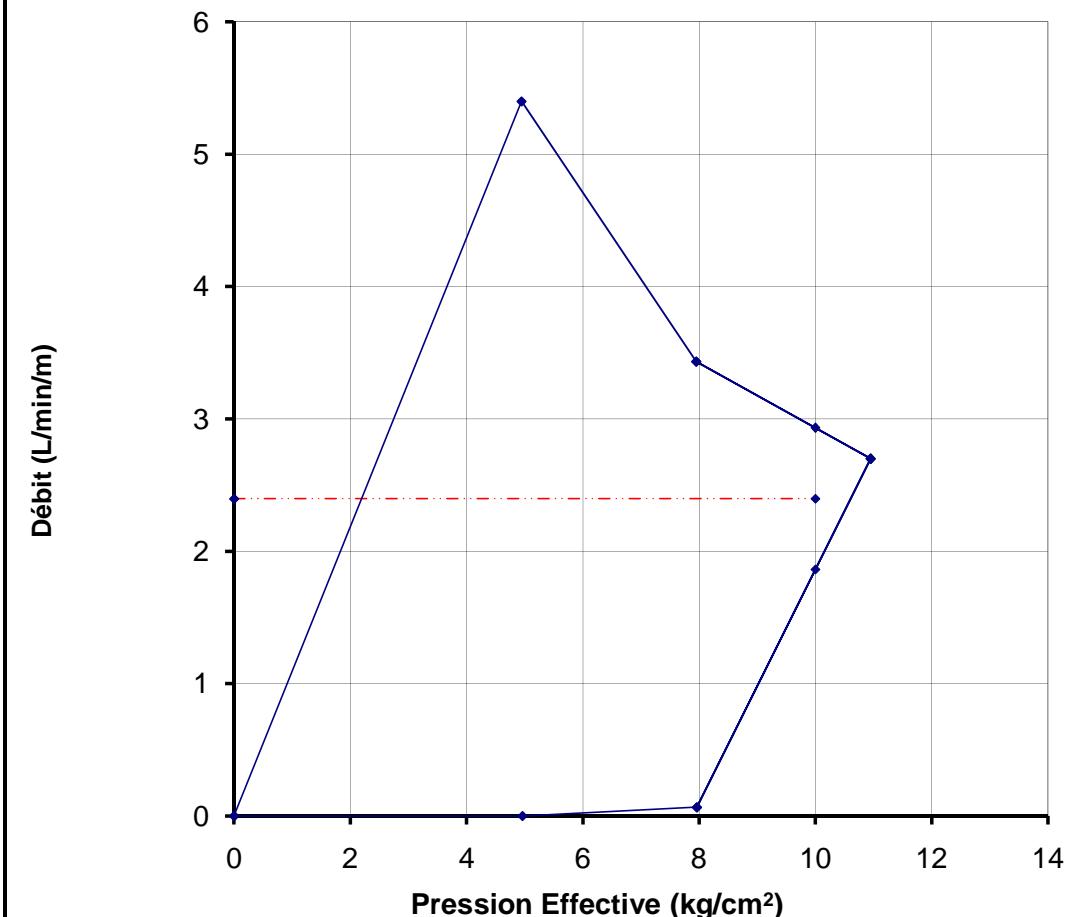
Date: **5/7/2014**

Manomètre **0.50 m**

depth to water: **9.10 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	162	10	3	16.2	5.40	0.96	1.60E-02	4.944
7	103	10	3	10.3	3.43	0.96	1.02E-02	7.950
10	81	10	3	8.1	2.70	0.96	8.02E-03	10.952
7	2	10	3	0.2	0.07	0.96	1.98E-04	7.960
4	0	10	3	0	0.00	0.96	0.00E+00	4.960



Lugeon = 2.40 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHVR 02**
TRANCHE ESSAYEE **87.00 m à 90.00 m**

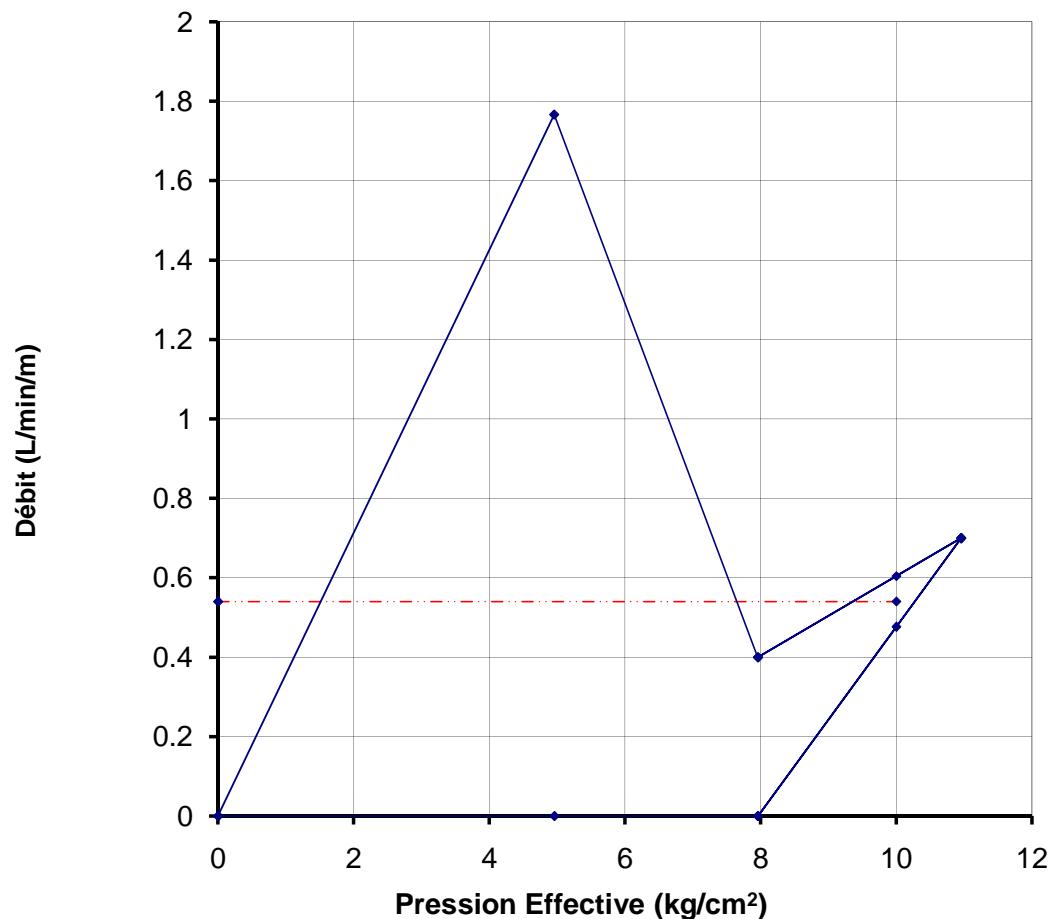
Date: **5/9/2014**

Manomètre **0.50 m**

depth to water: **9.10 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	53	10	3	5.3	1.77	0.96	5.25E-03	4.955
7	12	10	3	1.2	0.40	0.96	1.19E-03	7.959
10	21	10	3	2.1	0.70	0.96	2.08E-03	10.958
7	0	10	3	0	0.00	0.96	0.00E+00	7.960
4	0	10	3	0	0.00	0.96	0.00E+00	4.960



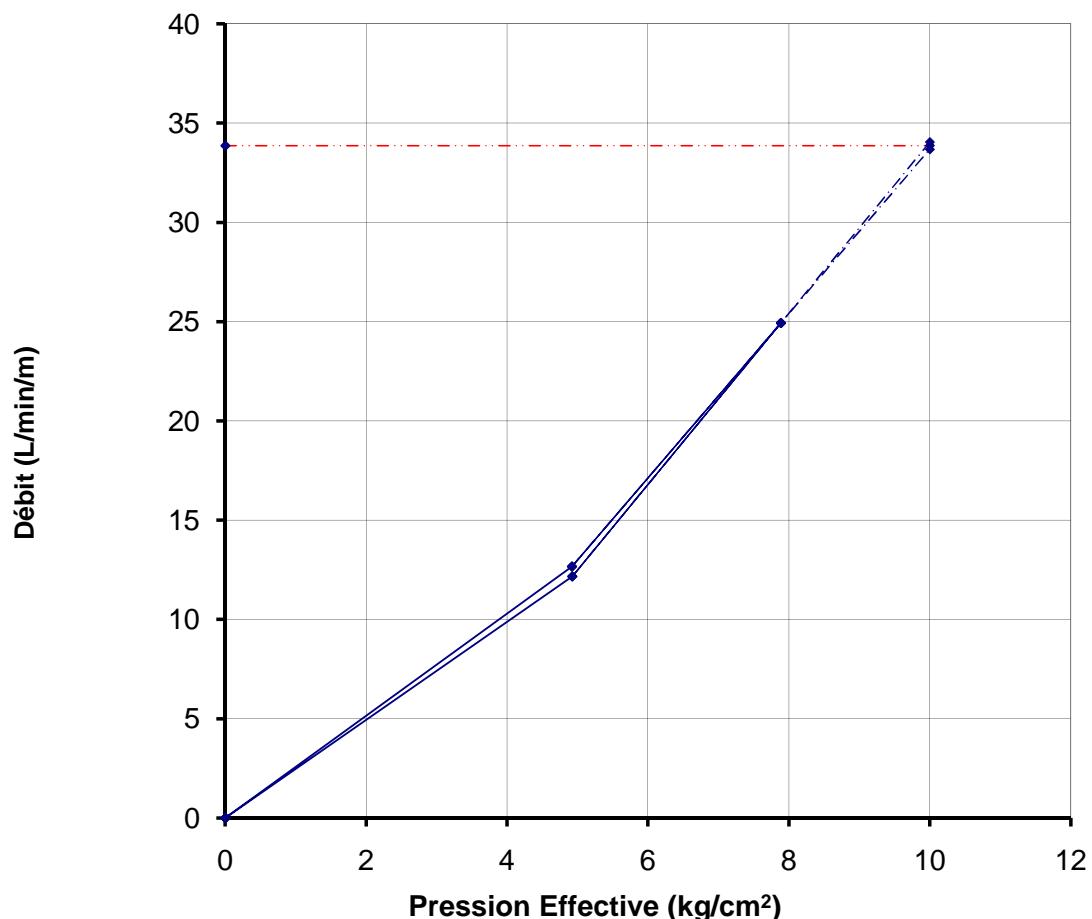
Lugeon = 0.54 L/min/m



PROJECT: SONDAGE No.: TRANCHE ESSAYEE	BISRI DAM / SECOND PACKAGE BHVR 02 102.00 m à 105.00 m	Date: 5/12/2014
		Manomètre 0.50 m
depth to water: 9.10 m		

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	380	10	3	38	12.67	0.96	3.76E-02	4.922
7	748	10	3	74.8	24.93	0.96	7.41E-02	7.886
4	365	10	3	36.5	12.17	0.96	3.61E-02	4.924



Lugeon = 33.86 L/min/m

 DAR AL HANDASAH NAZIH TALEB & PARTNERS consulting engineers دارالهندسة نزيح طالب وشركاه للمهندسين والتصميمات الفنية		BISRI DAM DAM FOOTPRINT		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
BHRA2	Pre-T.W.D (m):	22	G.W.D (m):	94.13	Date:
Test Interval	30	to	33	K(m/sec, FHM):	7.5889E-08
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	22	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	0.10
Falling Head Method (FHM)				2	0.21
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.25
H1	21.33	m	4	0.30	120 0.99 21.79
H2	18.44	m	5	0.40	180 0.99 21.75
t1 (as per graph)	1500	sec.	6	0.48	240 0.99 21.70
t2	3600	sec.	7	0.55	300 0.98 21.60
			8	0.62	360 0.98 21.52
			9	0.67	420 0.98 21.46
			10	0.72	480 0.97 21.33
			11	0.85	540 0.97 21.15
			12	1.00	600 0.96 21.00
			13	1.12	660 0.96 20.88
			14	1.20	720 0.95 20.81
			15	1.26	780 0.95 20.74
			16	1.32	840 0.94 20.68
			17	1.39	900 0.94 20.61
			18	1.45	960 0.93 20.55
			19	1.76	1020 0.92 20.24
			20	2.04	1080 0.91 19.96
			25	2.40	1140 0.91 19.60
			30	2.57	1200 0.91 19.43
			35	2.84	1500 0.92 20.24
			40	3.17	1800 0.91 19.96
			45	3.42	2100 0.89 19.60
			50	3.56	2400 0.88 19.43
			55	3.56	2700 0.87 19.17
			60	3.56	3000 0.86 18.83
					3300 0.84 18.58
					3600 0.84 18.44
Water Permeability (m/sec)		Relative Permeability			
1.00E-03	1.00E-05	Pervious			
1.00E-05	1.00E-08	Semi-Pervious			
1.00E-08	1.00E-12	Impervious			
Semi-Pervious					

BHRA2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	42	to	45	K(m/sec, FHM):	4.8133E-08
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	19.5	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	0.32
Falling Head Method (FHM)				2	0.45
$K_{(m/sec)} = \frac{D^2}{8L(t_2 - t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.54
$H_1 = 17.74$				4	0.62
$H_2 = 16.39$				5	0.68
$t_1 \text{ (as per graph)} = 1800 \text{ sec.}$				6	0.73
$t_2 = 3600 \text{ sec.}$				7	0.78
Log Time (sec)				9	0.88
				11	0.98
				13	1.07
				15	1.15
				16	1.18
				17	1.22
				18	1.25
				19	1.29
				20	1.34
				25	1.54
				30	1.76
				35	1.99
				40	2.23
				45	2.49
				50	2.68
				55	2.88
				60	3.12
Water Permeability (m/sec)		Relative Permeability		Semi-Pervious to Impervious	
1.00E-03	1.00E-05	Pervious		Semi-Pervious to Impervious	
1.00E-05	1.00E-08	Semi-Pervious		Semi-Pervious to Impervious	
1.00E-08	1.00E-12	Impervious		Semi-Pervious to Impervious	

BHRA2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	45	to	48	K(m/sec, FHM):	6.3990E-09
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	23	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	0.20
Falling Head Method (FHM)				2	0.28
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	0.33
$H_1 = 22.35$				4	0.36
$H_2 = 22$				5	0.38
$t_1 \text{ (as per graph)} = 1200$				6	0.41
$t_2 = 3900$				7	0.43
Log Time (sec)				9	0.47
				11	0.51
				13	0.54
				15	0.57
				16	0.59
				17	0.60
				18	0.62
				19	0.64
				20	0.65
				25	0.70
				30	0.75
				35	0.79
				40	0.84
				45	0.89
				50	0.94
				55	0.97
				60	1.00
Water Permeability (m/sec)		Relative Permeability		Impervious	
1.00E-03	1.00E-05	Pervious		Impervious	
1.00E-05	1.00E-08	Semi-Pervious		Impervious	
1.00E-08	1.00E-12	Impervious		Impervious	

BHRA2		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	54	to	57	K(m/sec, FHM):	1.6252E-07
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h_0	27.3	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	0.46
Falling Head Method (FHM)				2	0.86
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	1.13
H1	25.88	m	4	1.42	120 0.97 26.44
H2	24.9	m	5	1.76	180 0.96 26.17
t1 (as per graph)	240	sec.	6	1.99	240 0.95 25.88
t2	500	sec.	7	2.13	300 0.94 25.54
Log Time (sec)				8	2.34
				9	2.35
				10	900 0.91 25.17
				11	2.25
				12	540 0.92 25.05
				13	660 0.92 24.99
				14	780 0.91 24.96
				15	900 0.91 24.95
				16	960 0.91 24.94
				17	1020 0.91 24.94
				18	1080 0.91 24.94
				19	1140 0.91 24.93
				20	1200 0.91 24.93
				21	1500 0.91 24.92
				22	1800 0.91 24.92
				23	2100 0.91 24.91
				24	2400 0.91 24.90
				25	2700 0.91 24.90
				26	3000 0.91 24.90
				27	3300 0.91 24.90
				28	3600 0.91 24.90
Water Permeability (m/sec)		Relative Permeability		Semi-Pervious	
1.00E-03	1.00E-05	Pervious		Semi-Pervious	
1.00E-05	1.00E-08	Semi-Pervious		Semi-Pervious	
1.00E-08	1.00E-12	Impervious		Semi-Pervious	



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **3.00 m à 6.00 m**

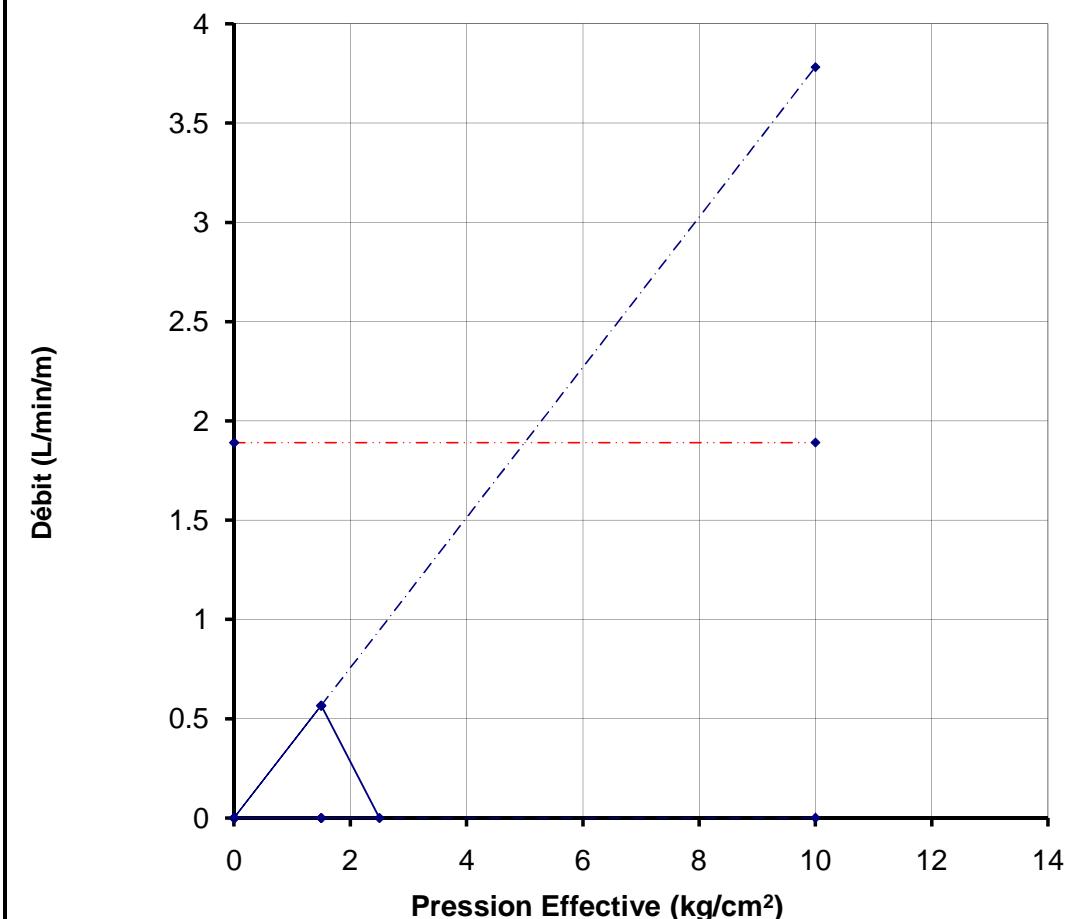
Date: **4/11/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
1	17	10	3	1.7	0.57	0.5	1.68E-03	1.498
2	0	10	3	0	0.00	0.5	0.00E+00	2.500
1	0	10	3	0	0.00	0.5	0.00E+00	1.500



Lugeon = 1.89 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **15.00 m à 18.00 m**

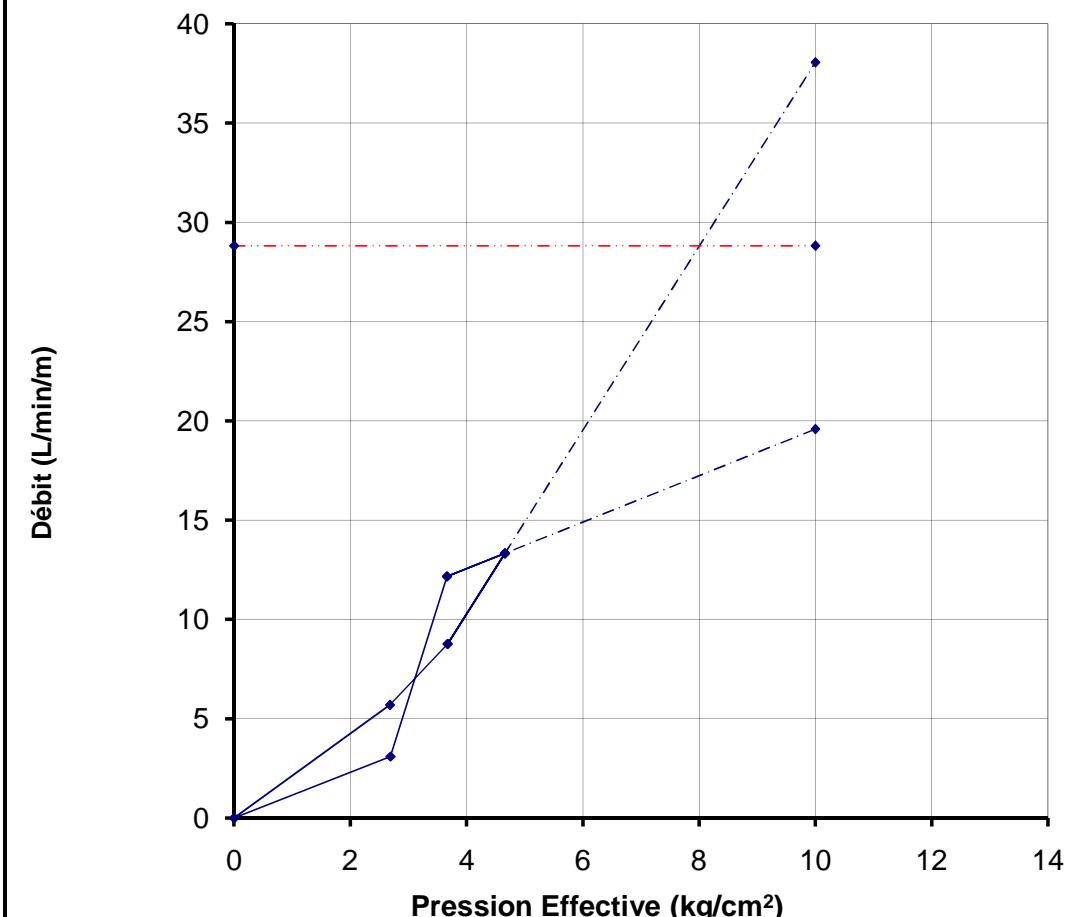
Date: **4/11/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
1	171	10	3	17.1	5.70	1.7	1.69E-02	2.683
2	263	10	3	26.3	8.77	1.7	2.60E-02	3.674
3	400	10	3	40	13.33	1.7	3.96E-02	4.660
2	365	10	3	36.5	12.17	1.7	3.61E-02	3.664
1	93	10	3	9.3	3.10	1.7	9.21E-03	2.691



Lugeon = **28.82 L/min/m**



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **36.00 m à 39.00 m**

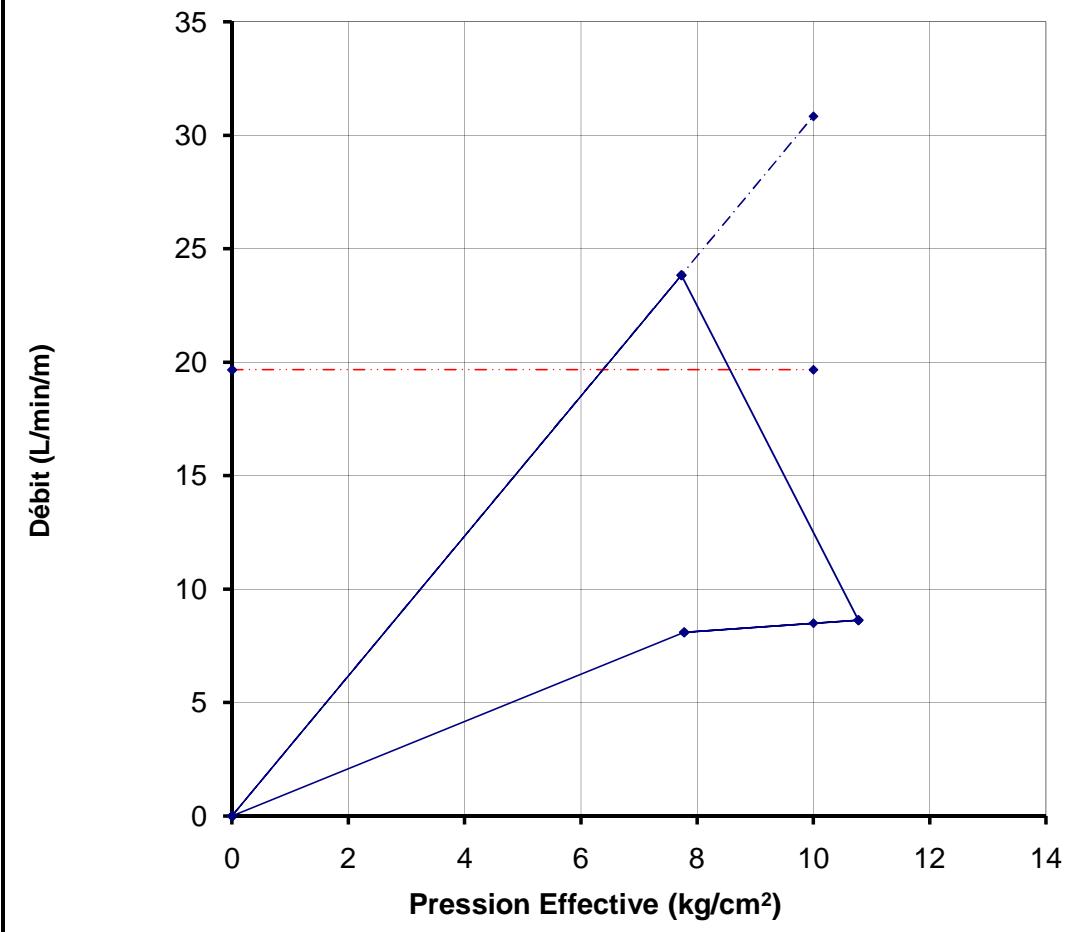
Date: **4/14/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	243	10	3	24.3	8.10	3.8	2.41E-02	7.776
7	259	10	3	25.9	8.63	3.8	2.56E-02	10.774
4	715	10	3	71.5	23.83	3.8	7.08E-02	7.729



Lugeon = 19.67 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **39.00 m à 42.00 m**

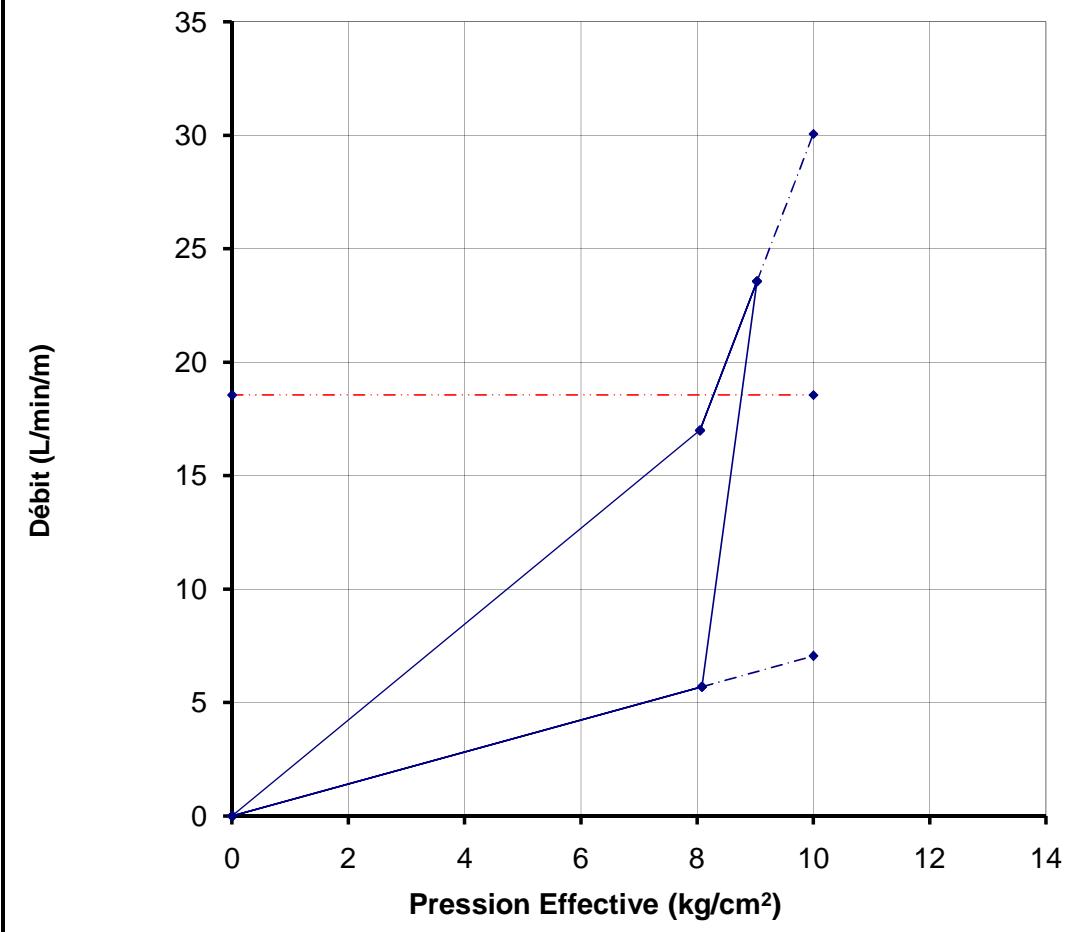
Date: **4/14/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	171	10	3	17.1	5.70	4.1	1.69E-02	8.083
5	707	10	3	70.7	23.57	4.1	7.00E-02	9.030
4	510	10	3	51	17.00	4.1	5.05E-02	8.050



Lugeon = 18.56 L/min/m



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **48.00 m à 51.00 m**

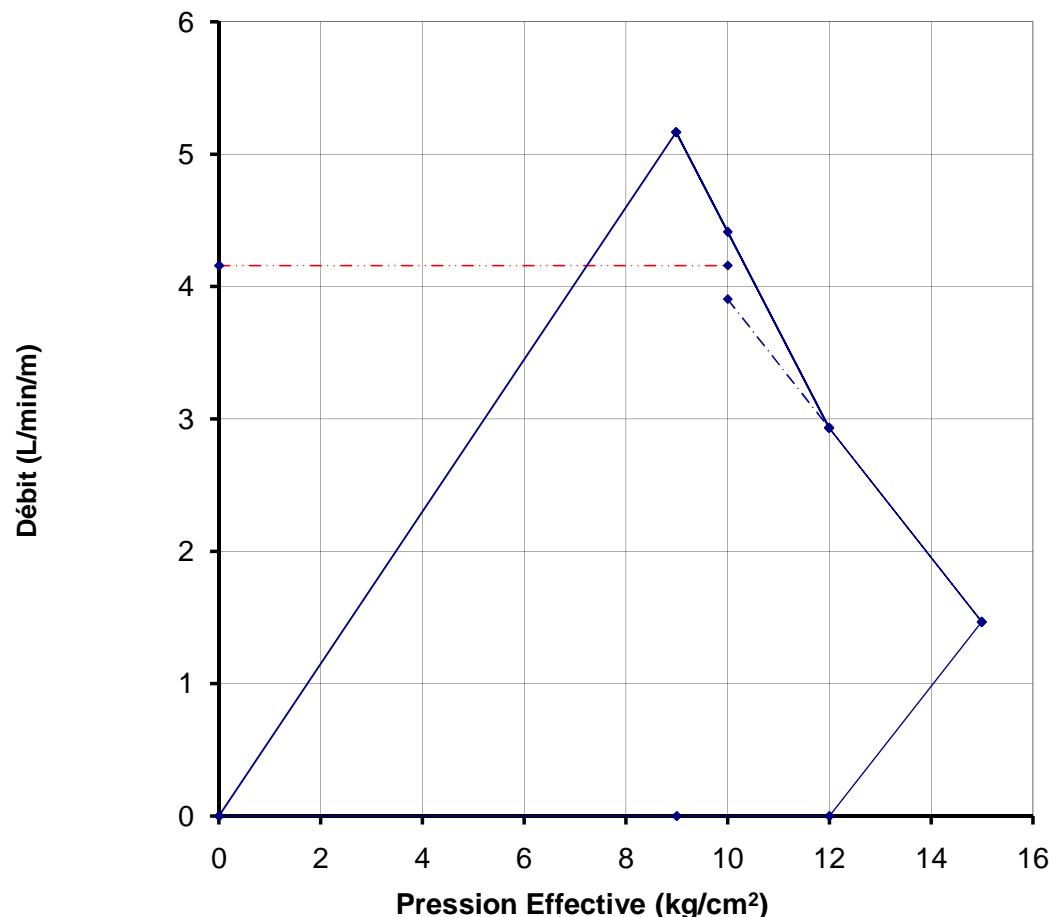
Date: **4/18/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	155	10	3	15.5	5.17	5	1.53E-02	8.985
7	88	10	3	8.8	2.93	5	8.71E-03	11.991
10	44	10	3	4.4	1.47	5	4.36E-03	14.996
7	0	10	3	0	0.00	5	0.00E+00	12.000
4	0	10	3	0	0.00	5	0.00E+00	9.000



Lugeon = **4.16 L/min/m**



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **51.00 m à 54.00 m**

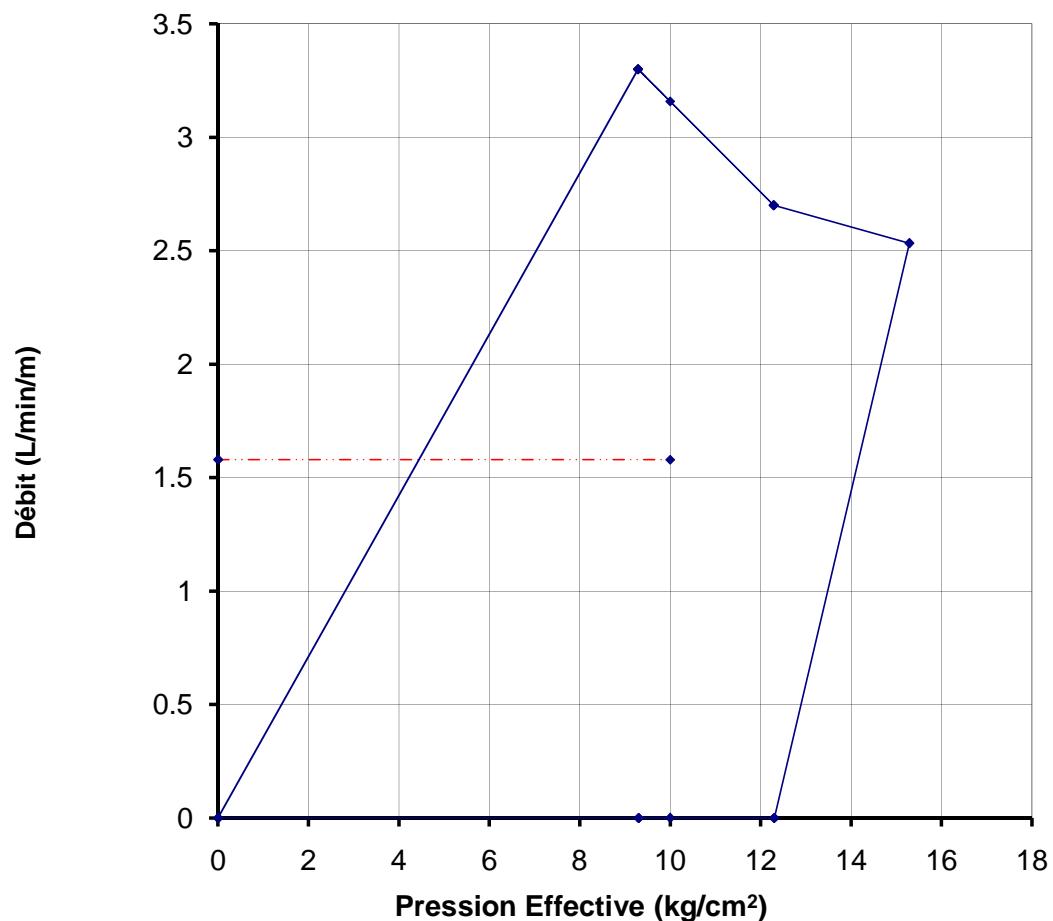
Date: **4/18/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	99	10	3	9.9	3.30	5.3	9.80E-03	9.290
7	81	10	3	8.1	2.70	5.3	8.02E-03	12.292
10	76	10	3	7.6	2.53	5.3	7.52E-03	15.292
7	0	10	3	0	0.00	5.3	0.00E+00	12.300
4	0	10	3	0	0.00	5.3	0.00E+00	9.300



Lugeon = 1.58 L/min/m



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **57.00 m à 60.00 m**

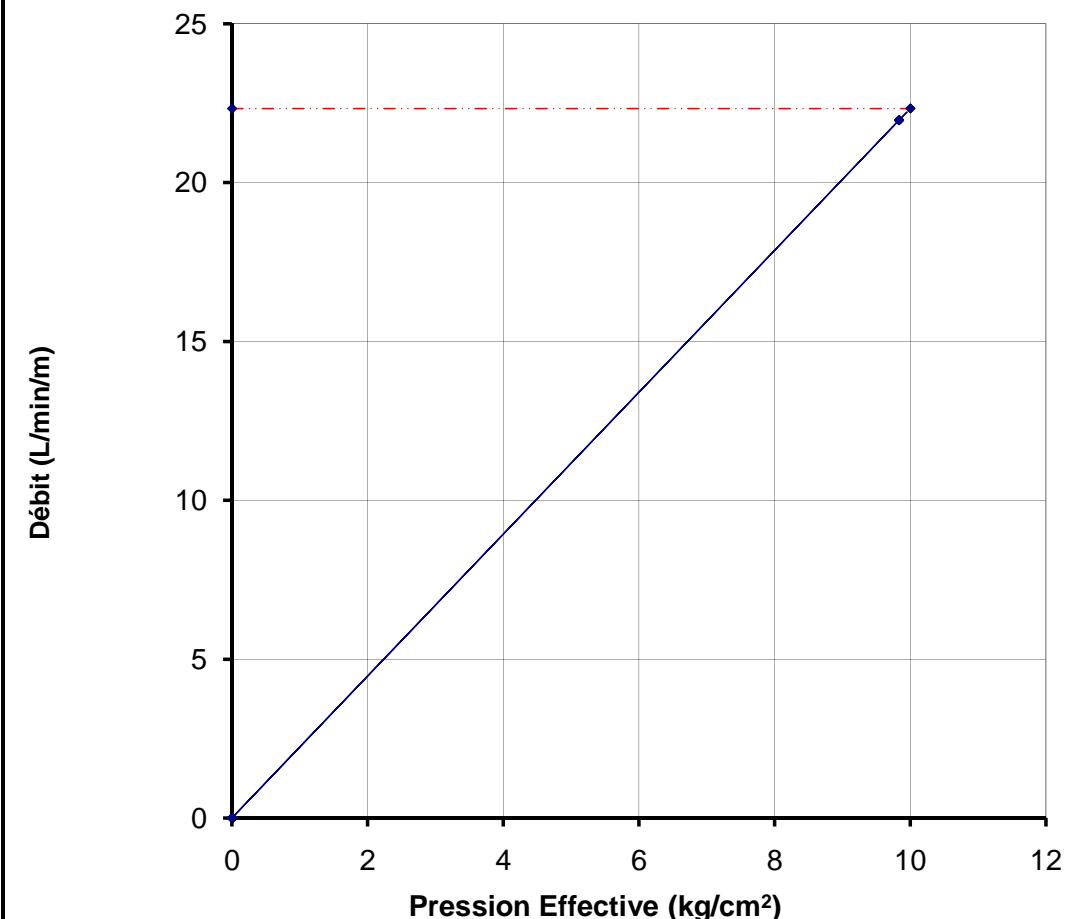
Date: **4/22/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	659	10	3	65.9	21.97	5.9	6.52E-02	9.835



Lugeon = 22.34 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **60.00 m à 63.00 m**

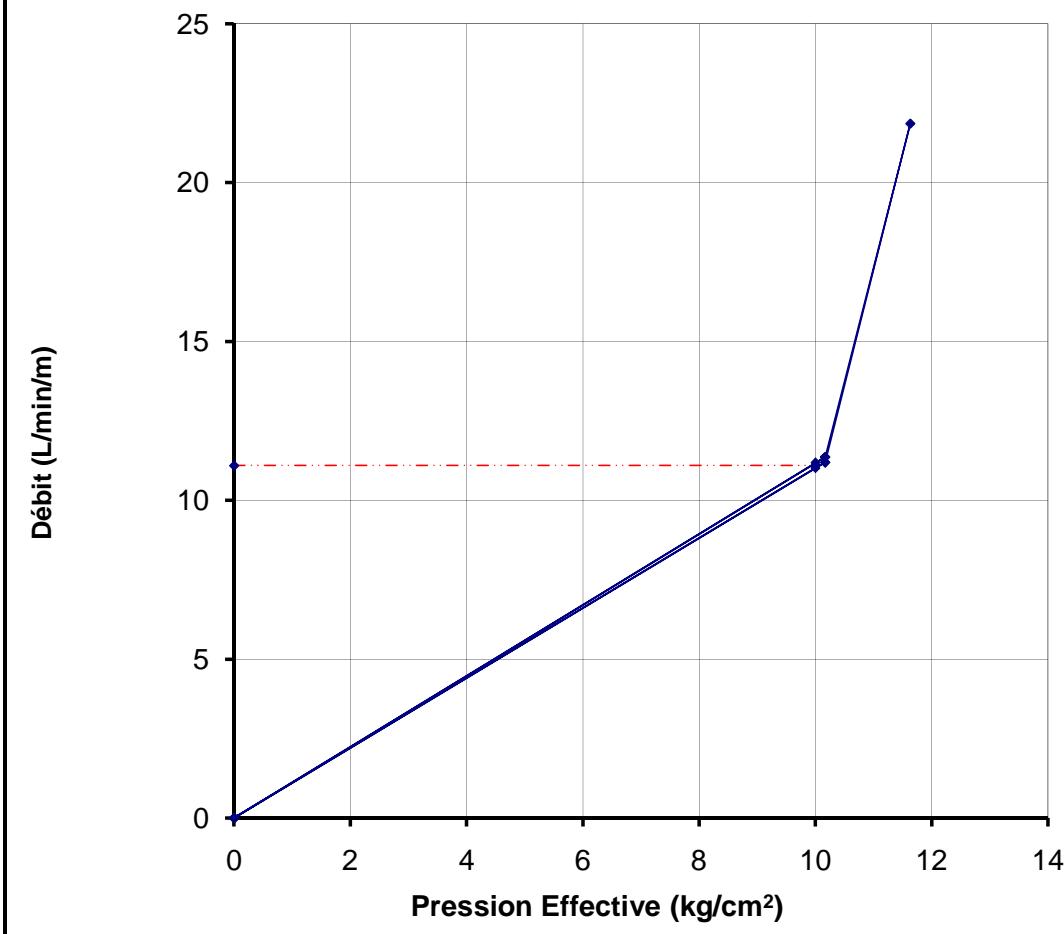
Date: **4/22/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	336	10	3	33.6	11.20	6.2	3.33E-02	10.167
5.5	656	10	3	65.6	21.87	6.2	6.49E-02	11.635
4	341	10	3	34.1	11.37	6.2	3.38E-02	10.166



Lugeon = 11.10 L/min/m



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **63.00 m à 66.00 m**

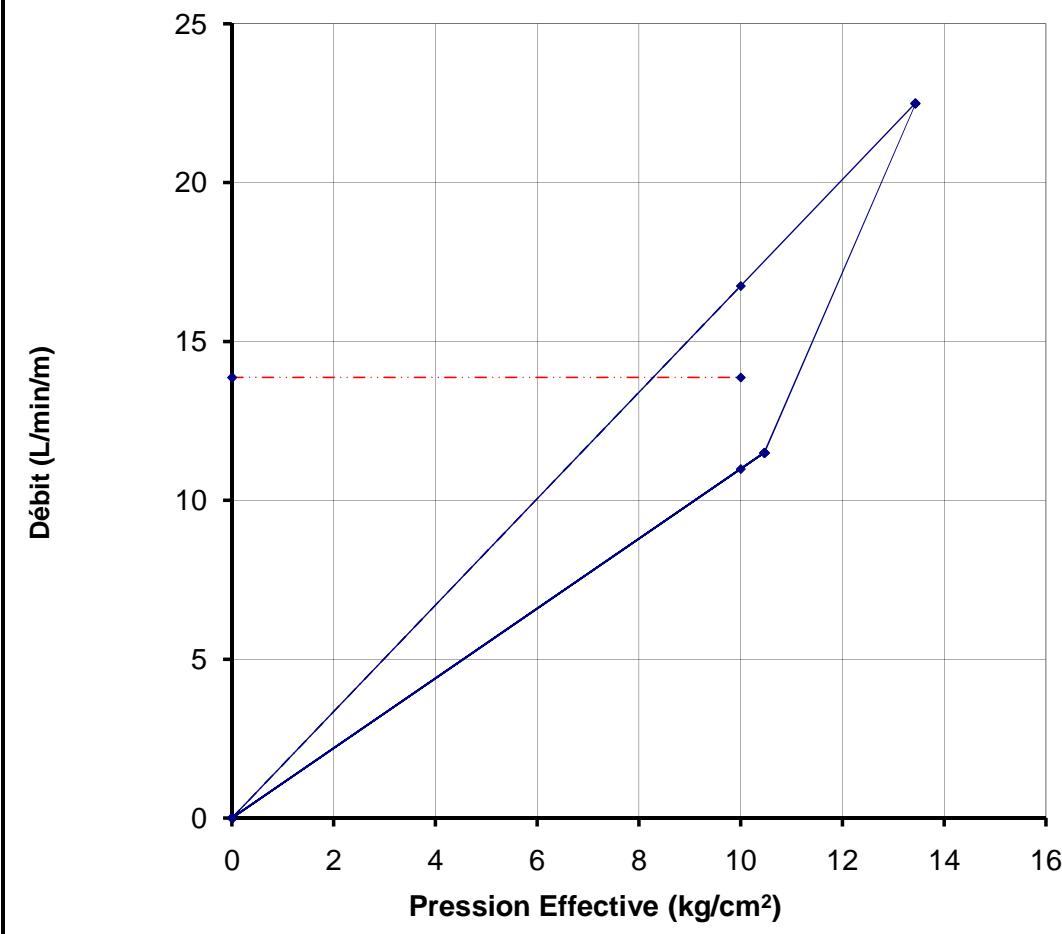
Date: **4/23/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	345	10	3	34.5	11.50	6.5	3.42E-02	10.466
7	675	10	3	67.5	22.50	6.5	6.68E-02	13.433
4	345	10	3	34.5	11.50	6.5	3.42E-02	10.466



Lugeon = 13.87 L/min/m



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **66.00 m à 69.00 m**

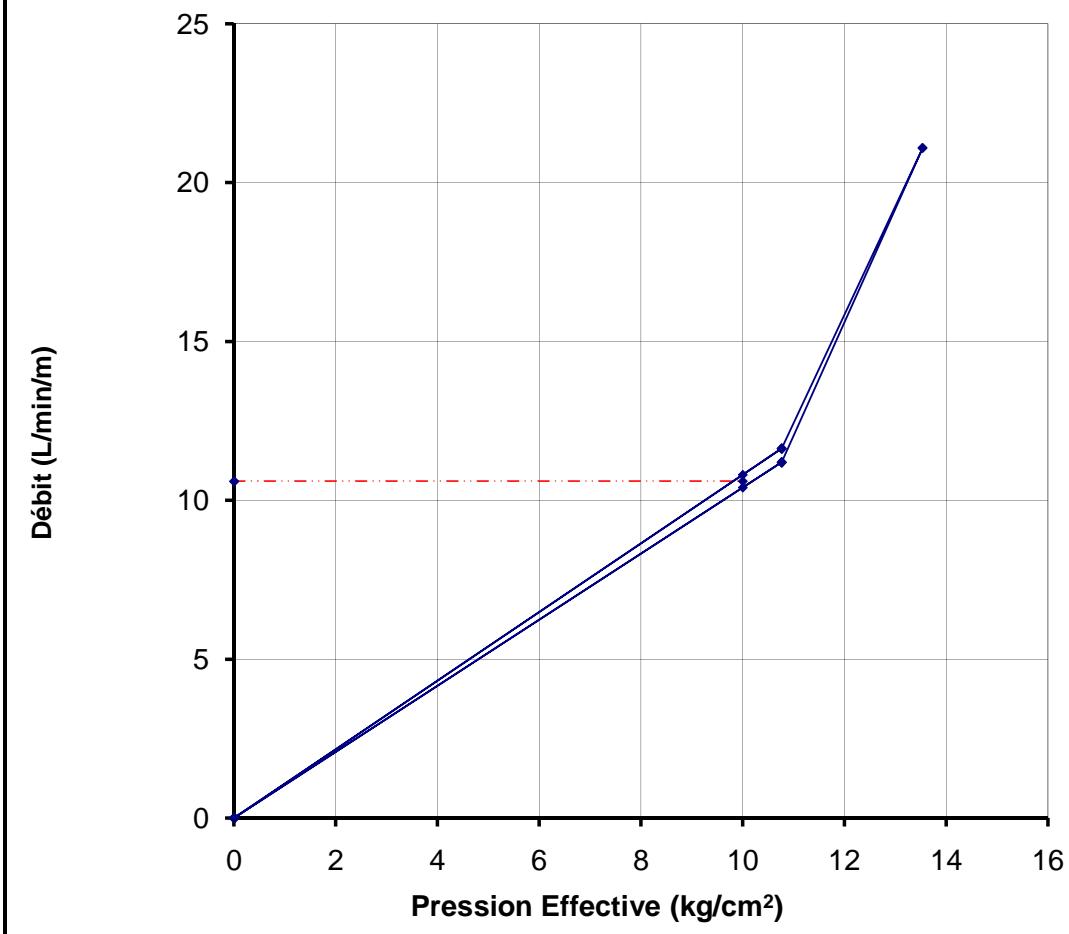
Date: **4/23/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	349	10	3	34.9	11.63	6.8	3.46E-02	10.765
6.8	633	10	3	63.3	21.10	6.8	6.27E-02	13.537
4	336	10	3	33.6	11.20	6.8	3.33E-02	10.767



Lugeon = 10.60 L/min/m



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **69.00 m à 72.00 m**

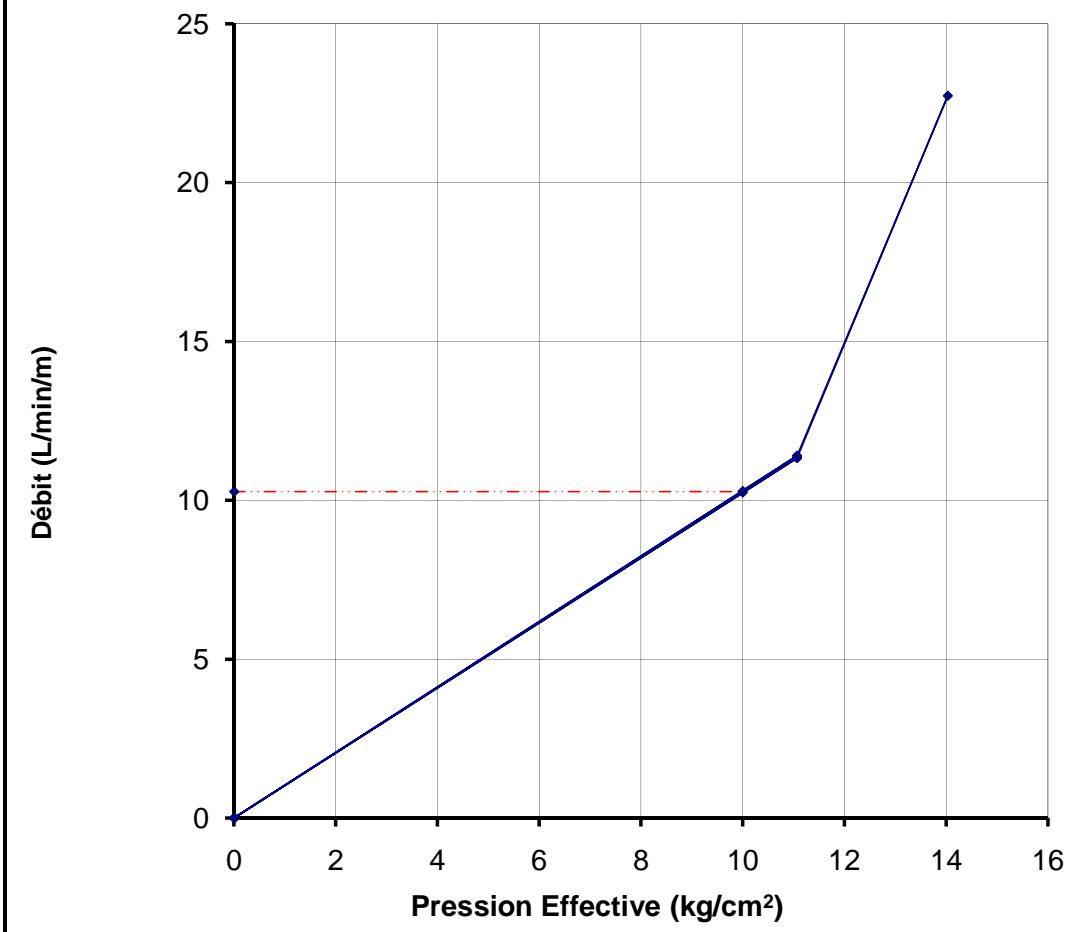
Date: **4/23/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	340	10	3	34	11.33	7.1	3.37E-02	11.066
7	682	10	3	68.2	22.73	7.1	6.75E-02	14.032
4	342	10	3	34.2	11.40	7.1	3.39E-02	11.066



Lugeon = 10.27 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **72.00 m à 75.00 m**

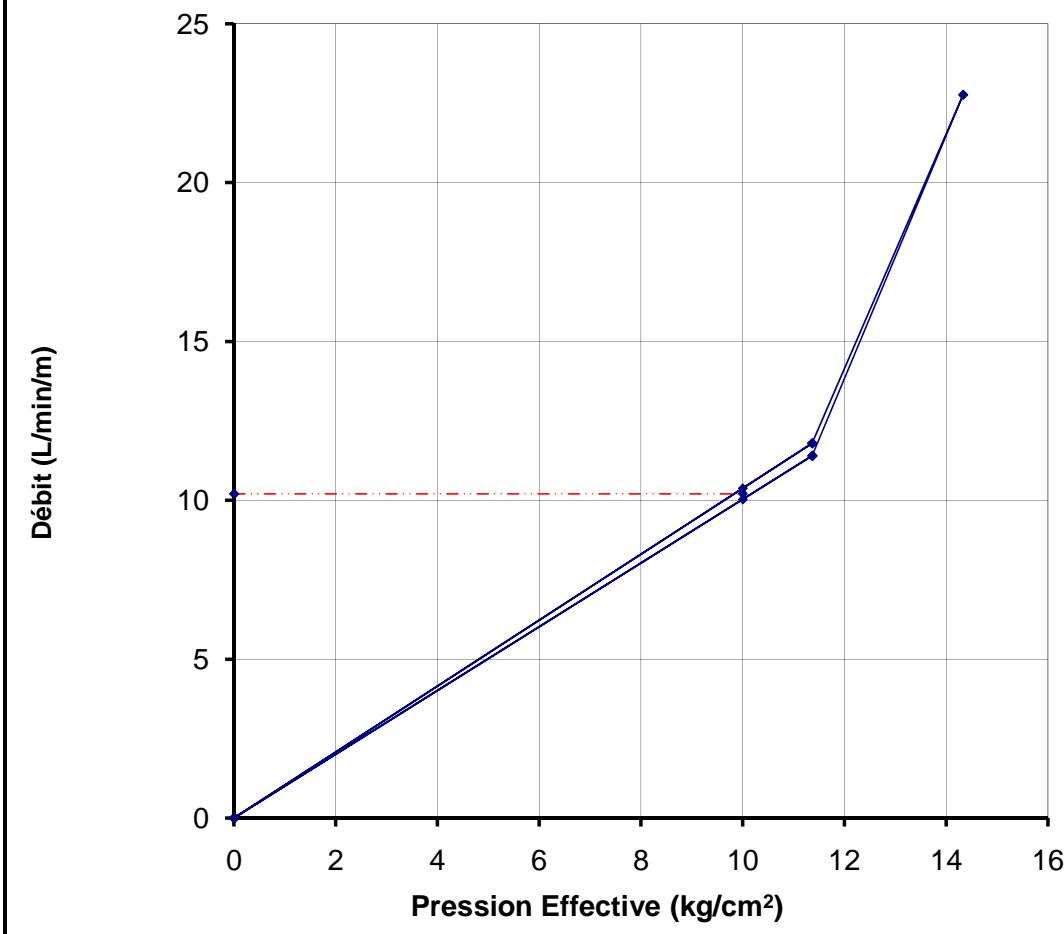
Date: **4/24/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	354	10	3	35.4	11.80	7.4	3.50E-02	11.365
7	683	10	3	68.3	22.77	7.4	6.76E-02	14.332
4	342	10	3	34.2	11.40	7.4	3.39E-02	11.366



Lugeon = 10.21 L/min/m



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **75.00 m à 78.00 m**

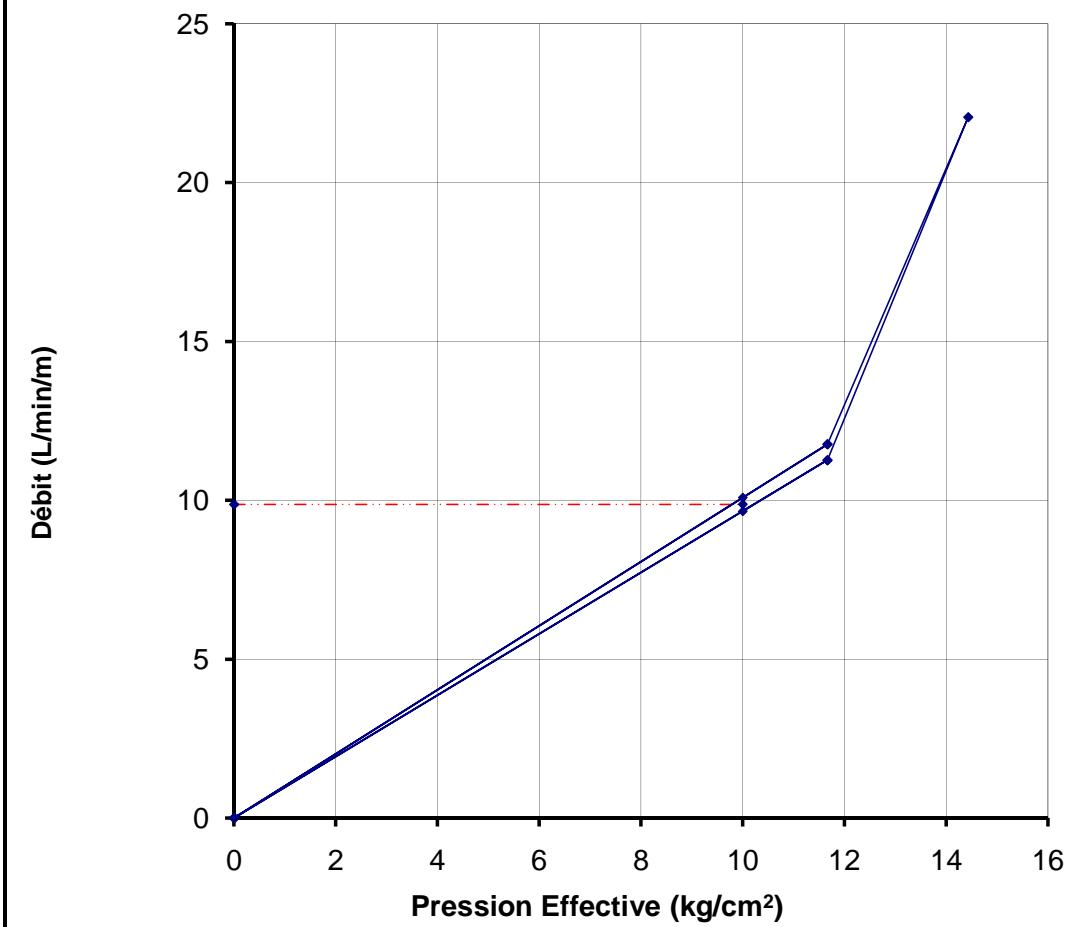
Date: **4/24/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	338	10	3	33.8	11.27	7.7	3.35E-02	11.667
6.8	662	10	3	66.2	22.07	7.7	6.55E-02	14.434
4	353	10	3	35.3	11.77	7.7	3.49E-02	11.665



Lugeon = **9.87 L/min/m**



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **78.00 m à 81.00 m**

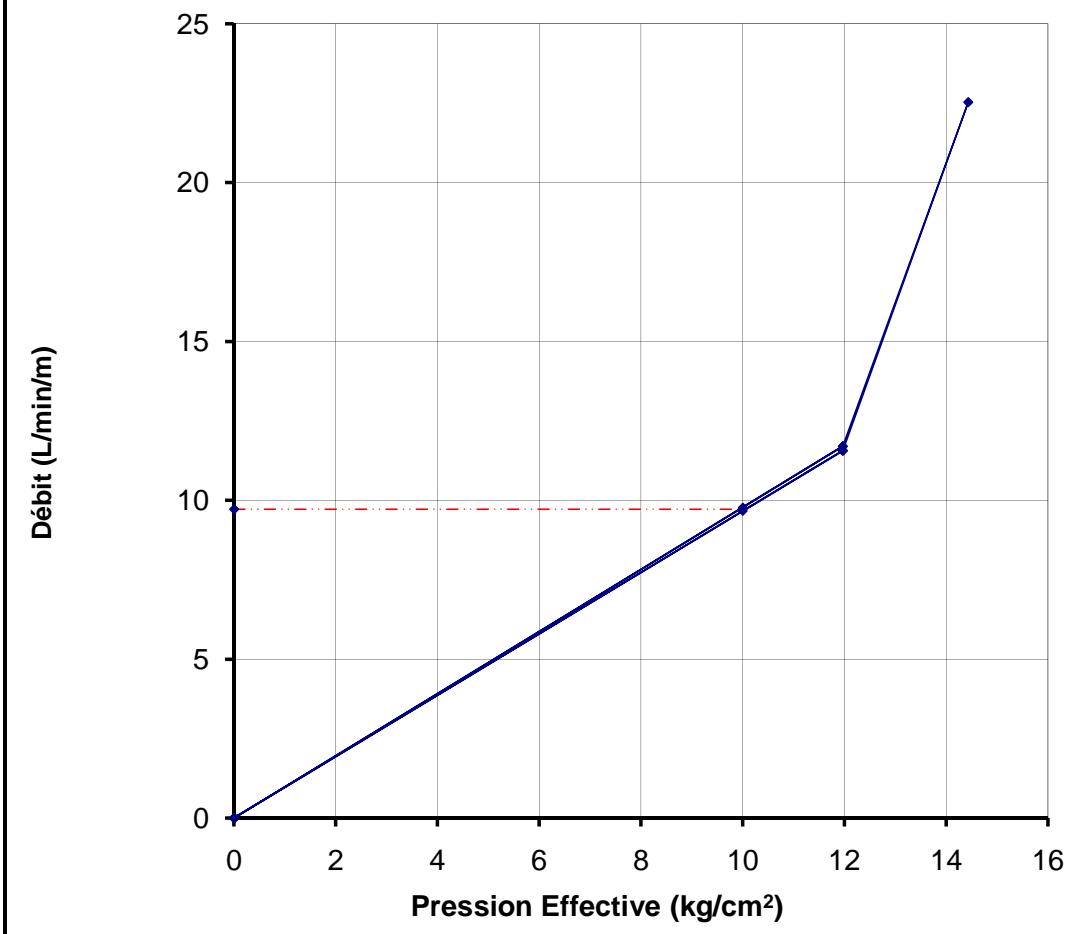
Date: **4/24/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	347	10	3	34.7	11.57	8	3.44E-02	11.966
6.5	676	10	3	67.6	22.53	8	6.69E-02	14.433
4	351	10	3	35.1	11.70	8	3.47E-02	11.965



Lugeon = **9.72 L/min/m**



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **81.00 m à 84.00 m**

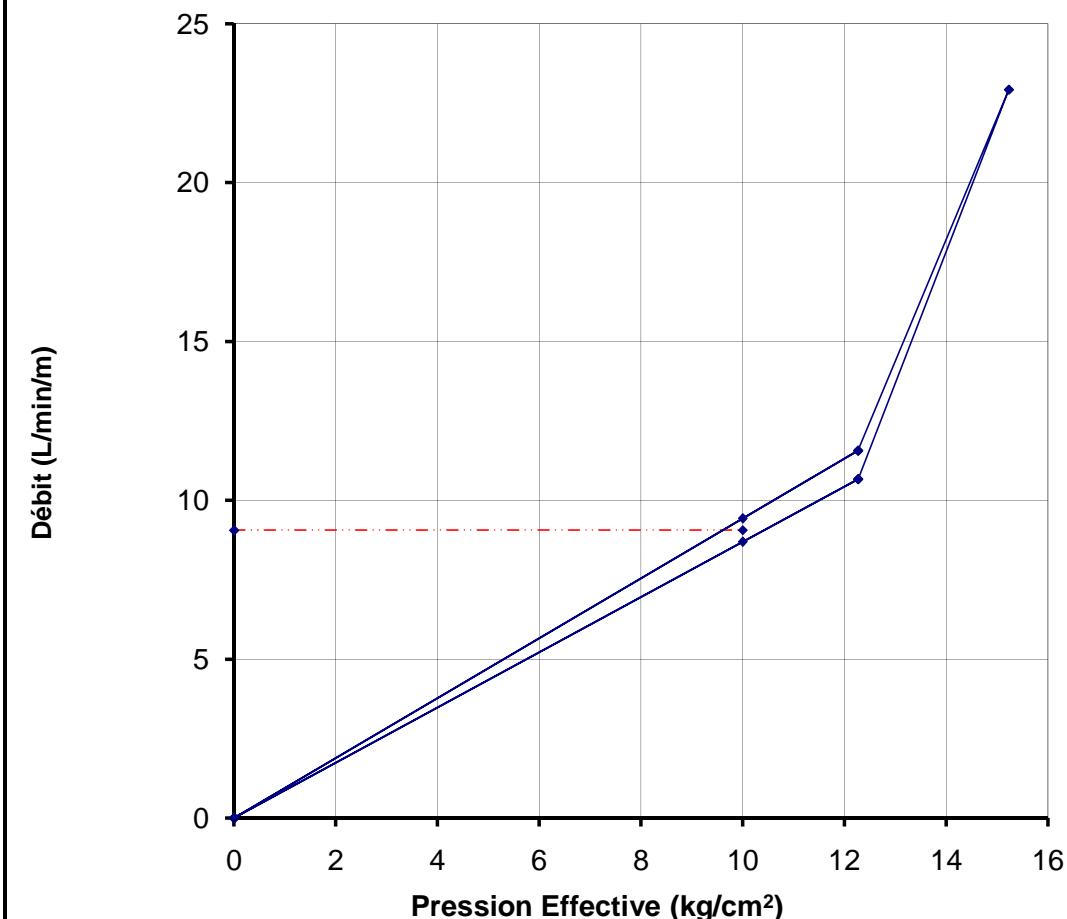
Date: **4/25/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	347	10	3	34.7	11.57	8.3	3.44E-02	12.266
7	688	10	3	68.8	22.93	8.3	6.81E-02	15.232
4	320	10	3	32	10.67	8.3	3.17E-02	12.268



Lugeon = **9.06 L/min/m**



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **84.00 m à 87.00 m**

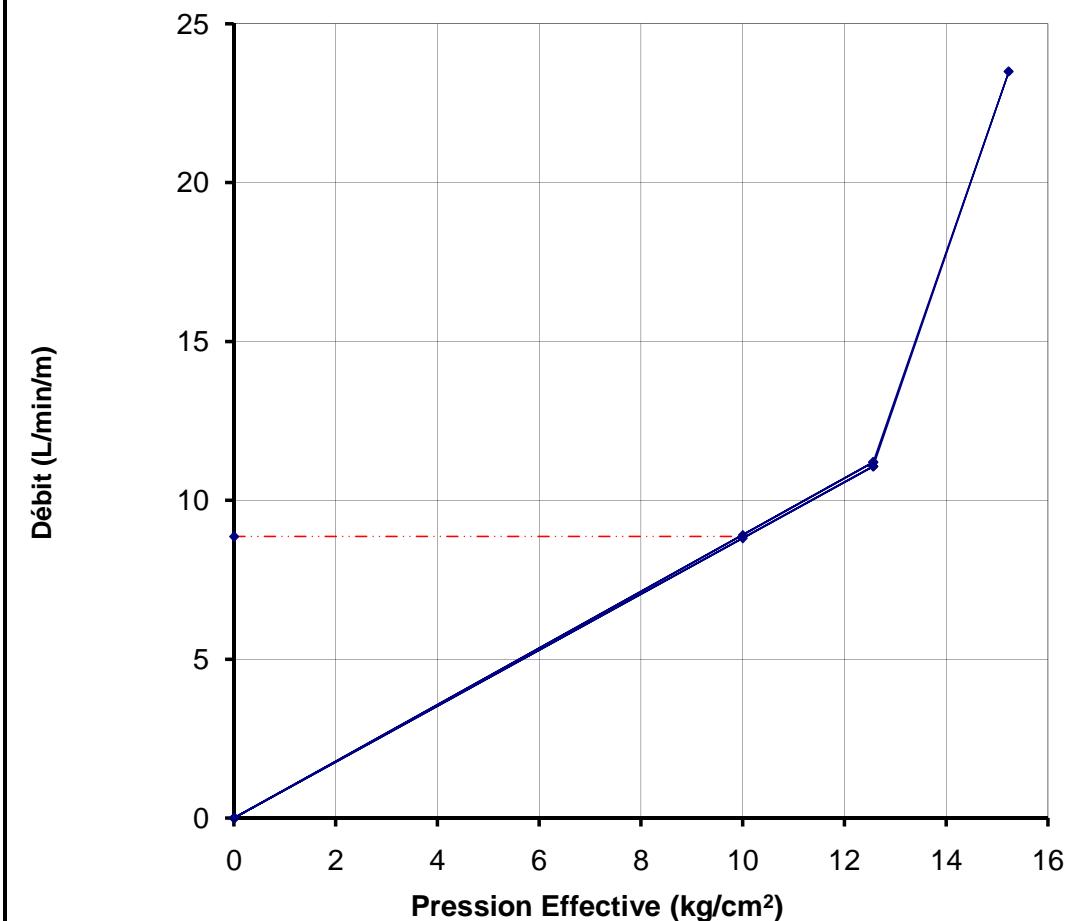
Date: **4/25/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	336	10	3	33.6	11.20	8.6	3.33E-02	12.567
6.7	705	10	3	70.5	23.50	8.6	6.98E-02	15.230
4	332	10	3	33.2	11.07	8.6	3.29E-02	12.567



Lugeon = **8.86 L/min/m**



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **87.00 m à 90.00 m**

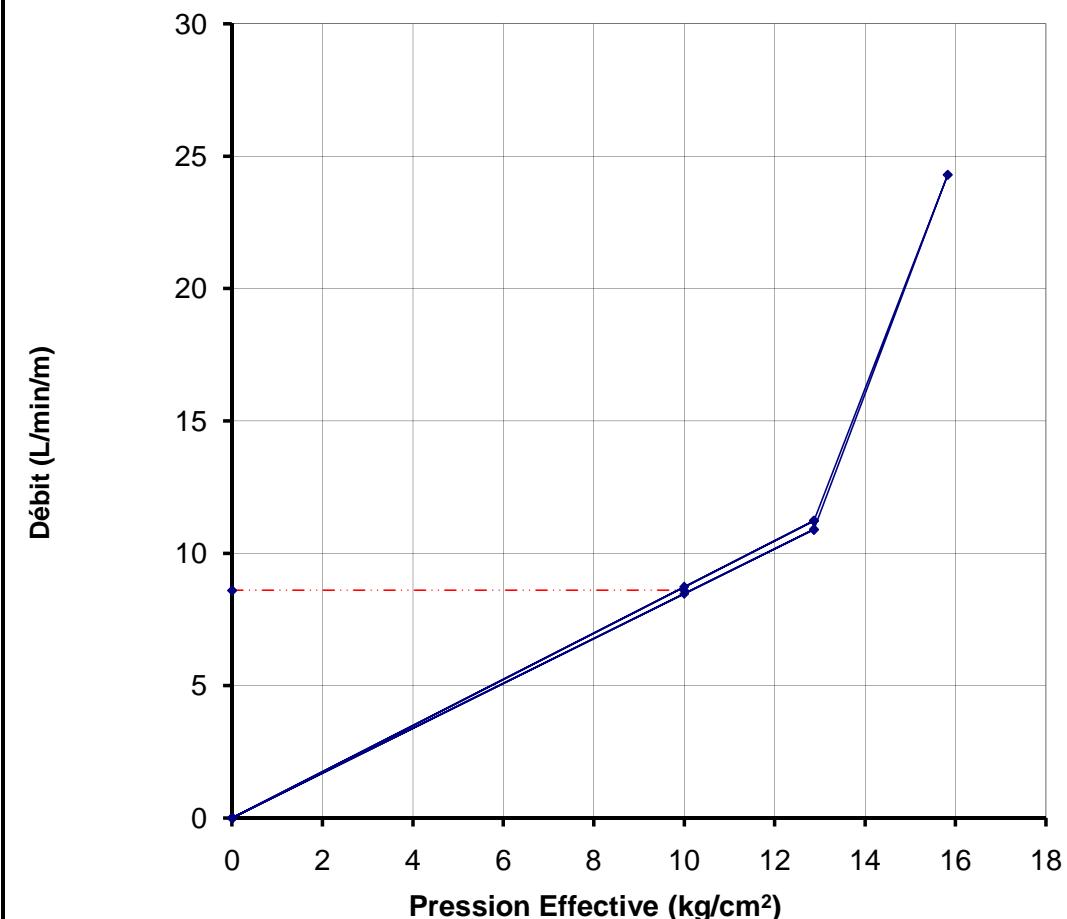
Date: **4/25/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	337	10	3	33.7	11.23	8.9	3.34E-02	12.867
7	729	10	3	72.9	24.30	8.9	7.22E-02	15.828
4	327	10	3	32.7	10.90	8.9	3.24E-02	12.868



Lugeon = 8.60 L/min/m



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **90.00 m à 93.00 m**

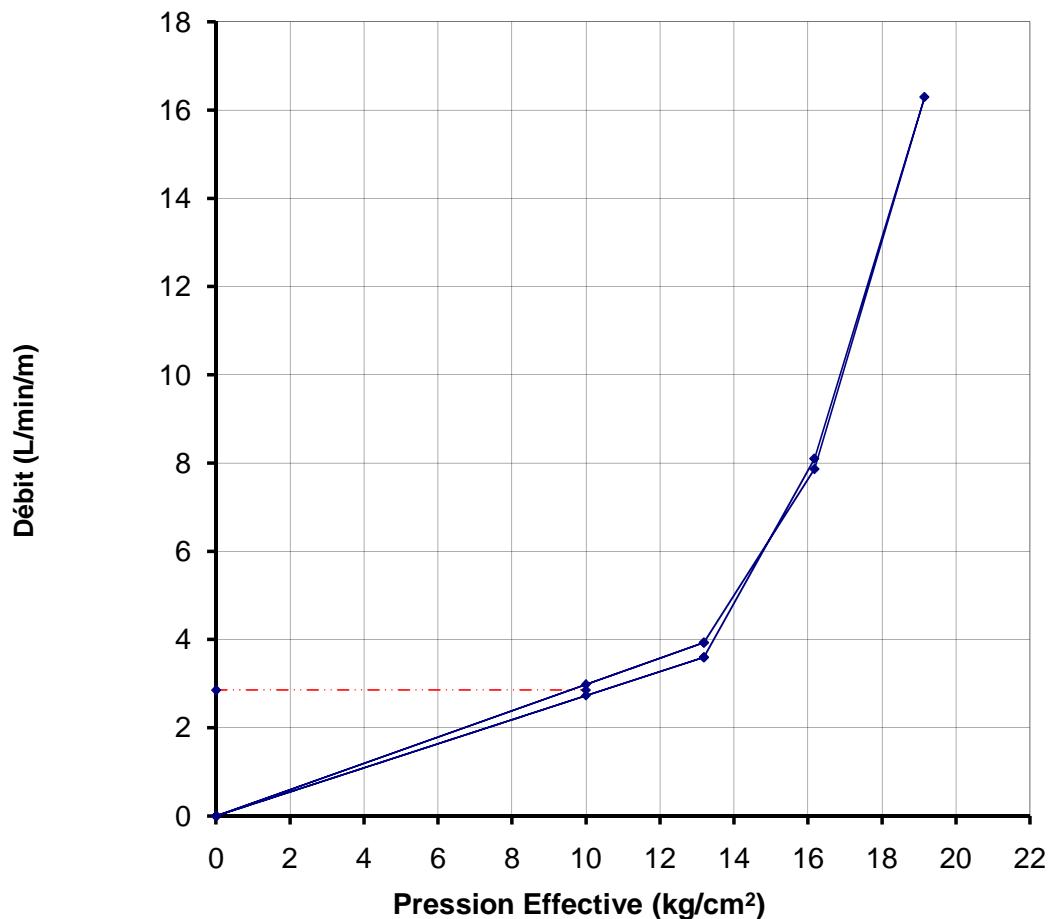
Date: **4/25/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	118	10	3	11.8	3.93	9.2	1.17E-02	13.188
7	236	10	3	23.6	7.87	9.2	2.34E-02	16.177
10	489	10	3	48.9	16.30	9.2	4.84E-02	19.152
7	243	10	3	24.3	8.10	9.2	2.41E-02	16.176
4	108	10	3	10.8	3.60	9.2	1.07E-02	13.189



Lugeon = 2.86 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **93.00 m à 96.00 m**

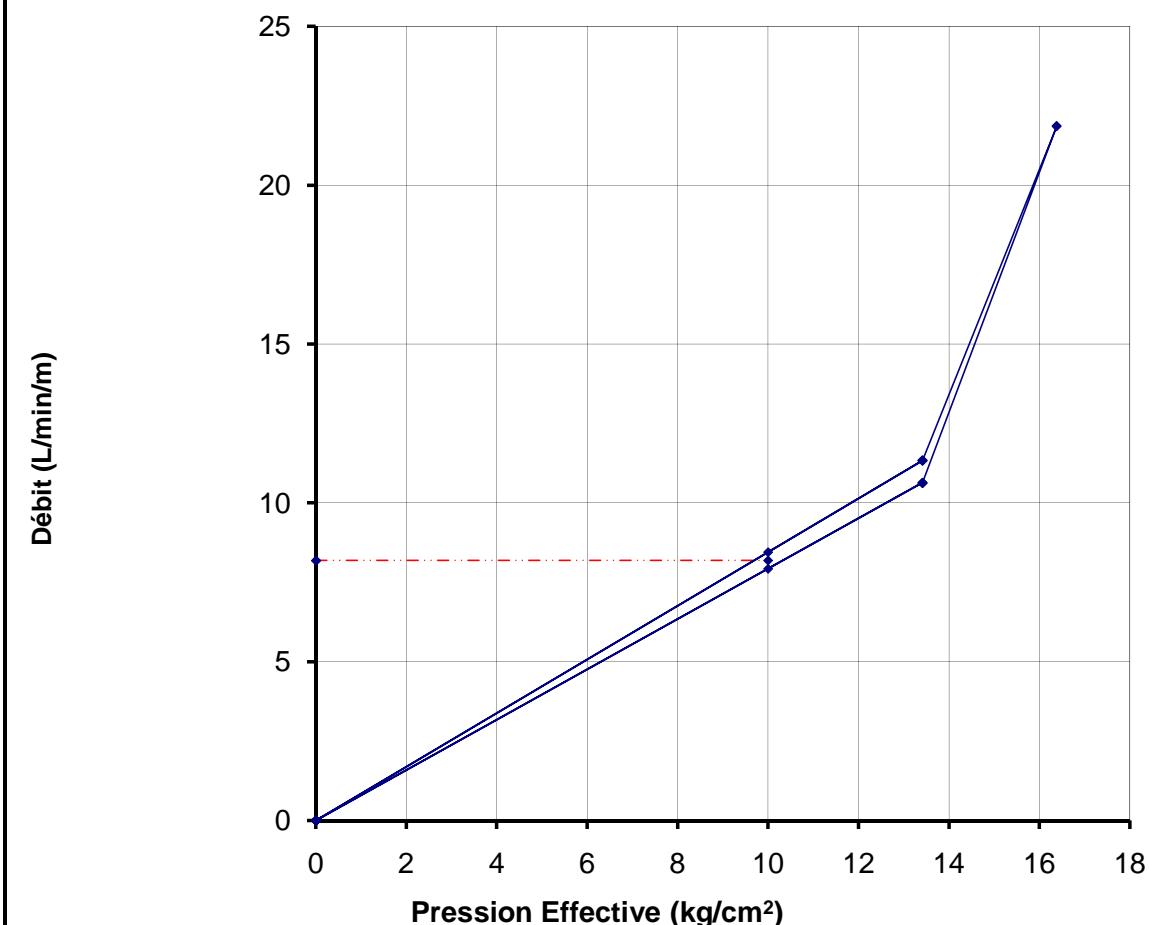
Date: **4/26/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	340	10	3	34	11.33	9.45	3.37E-02	13.416
7	656	10	3	65.6	21.87	9.45	6.49E-02	16.385
4	319	10	3	31.9	10.63	9.45	3.16E-02	13.418



Lugeon = 8.19 L/min/m



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **96.00 m à 99.00 m**

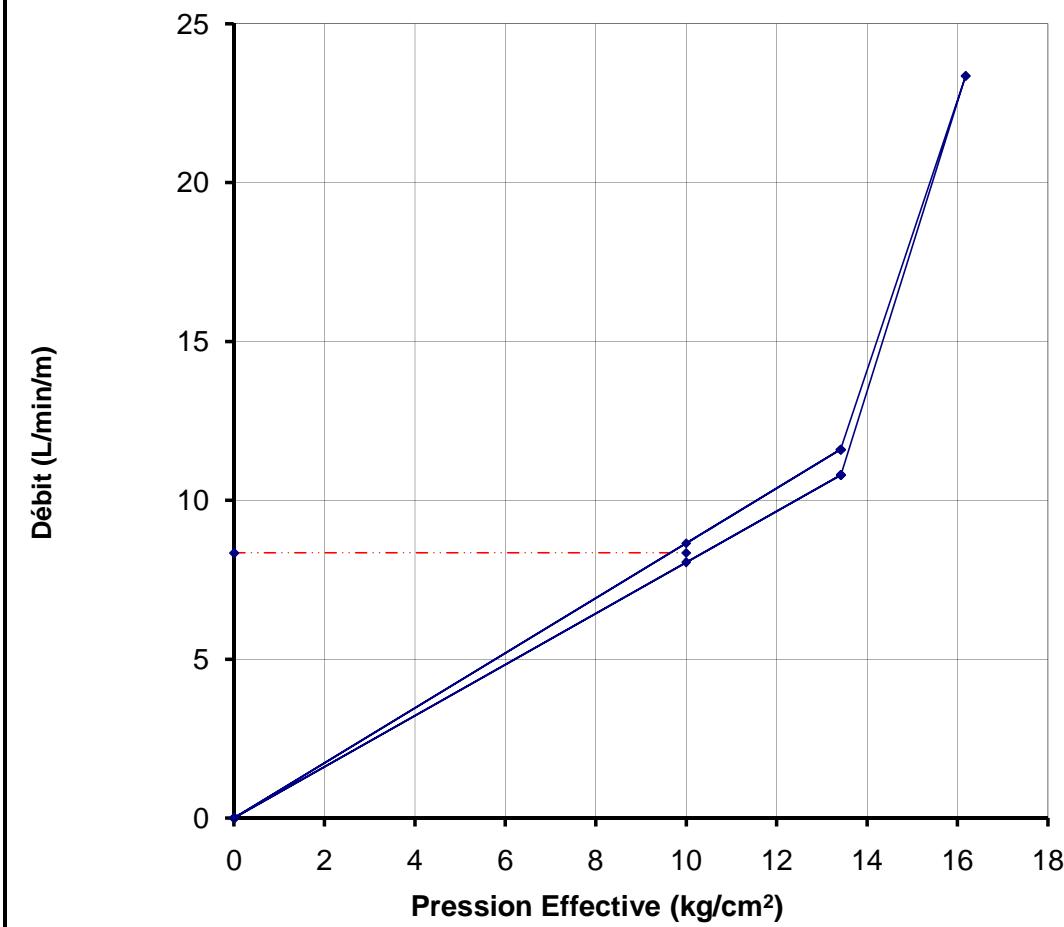
Date: **4/28/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	348	10	3	34.8	11.60	9.45	3.45E-02	13.416
6.8	701	10	3	70.1	23.37	9.45	6.94E-02	16.181
4	324	10	3	32.4	10.80	9.45	3.21E-02	13.418



Lugeon = 8.35 L/min/m



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **99.00 m à 102.00 m**

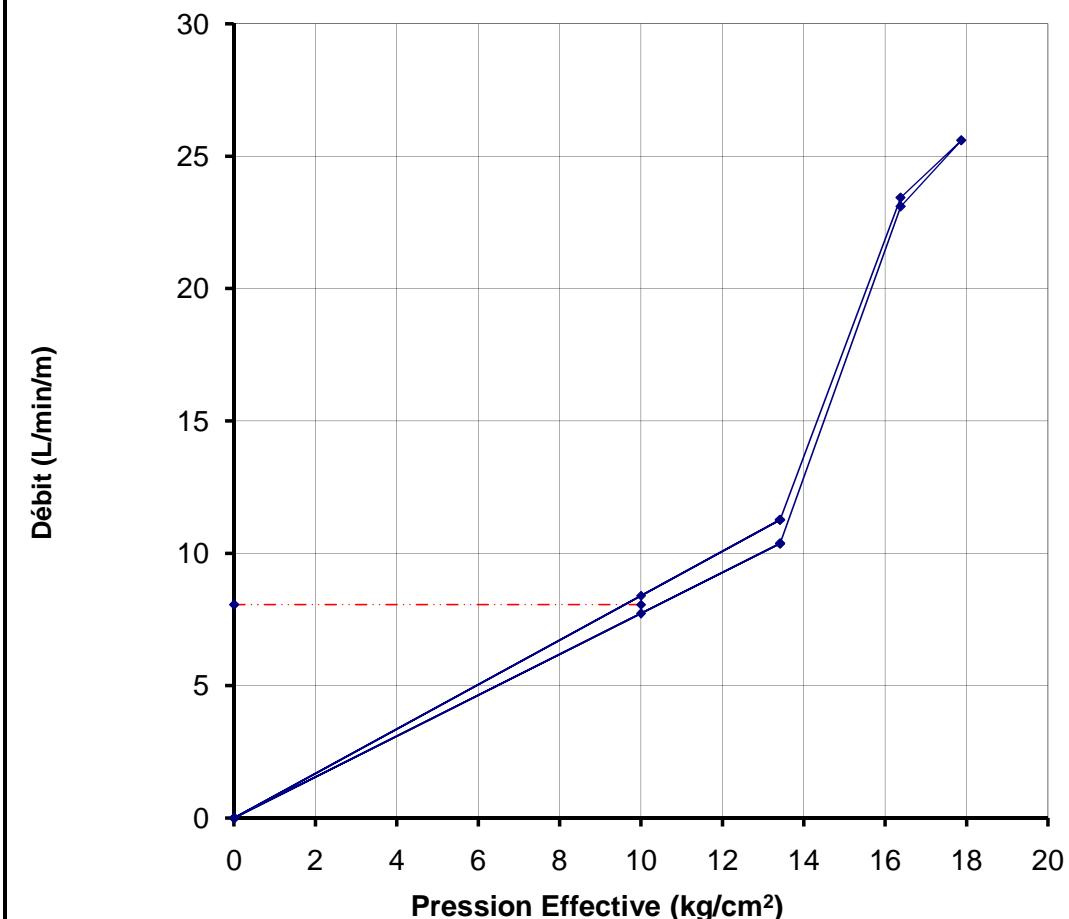
Date: **4/28/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	338	10	3	33.8	11.27	9.45	3.35E-02	13.417
7	703	10	3	70.3	23.43	9.45	6.96E-02	16.380
8.5	768	10	3	76.8	25.60	9.45	7.60E-02	17.874
7	693	10	3	69.3	23.10	9.45	6.86E-02	16.381
4	311	10	3	31.1	10.37	9.45	3.08E-02	13.419



Lugeon = 8.06 L/min/m



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **102.00 m** à **105.00 m**

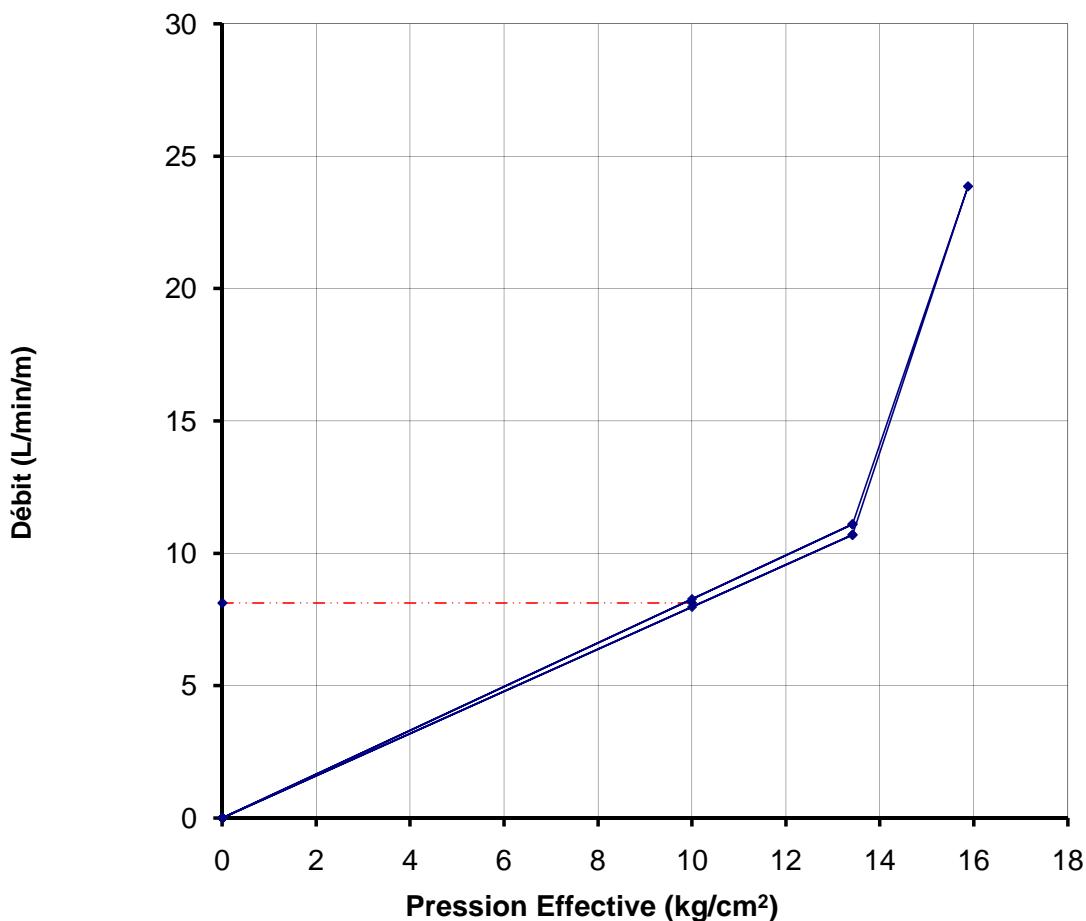
Date: **4/29/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	333	10	3	33.3	11.10	9.45	3.30E-02	13.417
6.5	716	10	3	71.6	23.87	9.45	7.09E-02	15.879
4	321	10	3	32.1	10.70	9.45	3.18E-02	13.418



Lugeon = **8.12 L/min/m**



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **105.00 m** à **108.00 m**

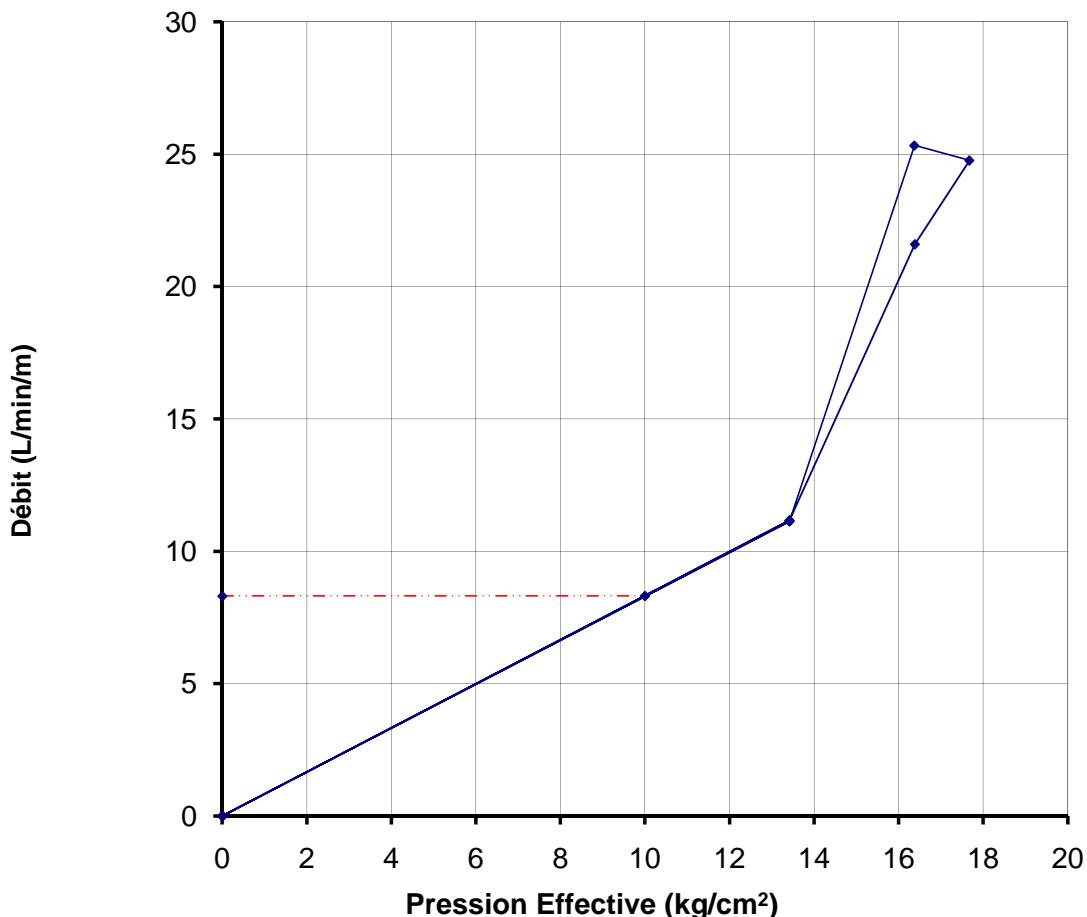
Date: **4/29/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	334	10	3	33.4	11.13	9.45	3.31E-02	13.417
7	760	10	3	76	25.33	9.45	7.52E-02	16.375
8.3	743	10	3	74.3	24.77	9.45	7.36E-02	17.676
7	648	10	3	64.8	21.60	9.45	6.42E-02	16.386
4	335	10	3	33.5	11.17	9.45	3.32E-02	13.417



Lugeon = **8.31 L/min/m**



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **108.00 m** à **111.00 m**

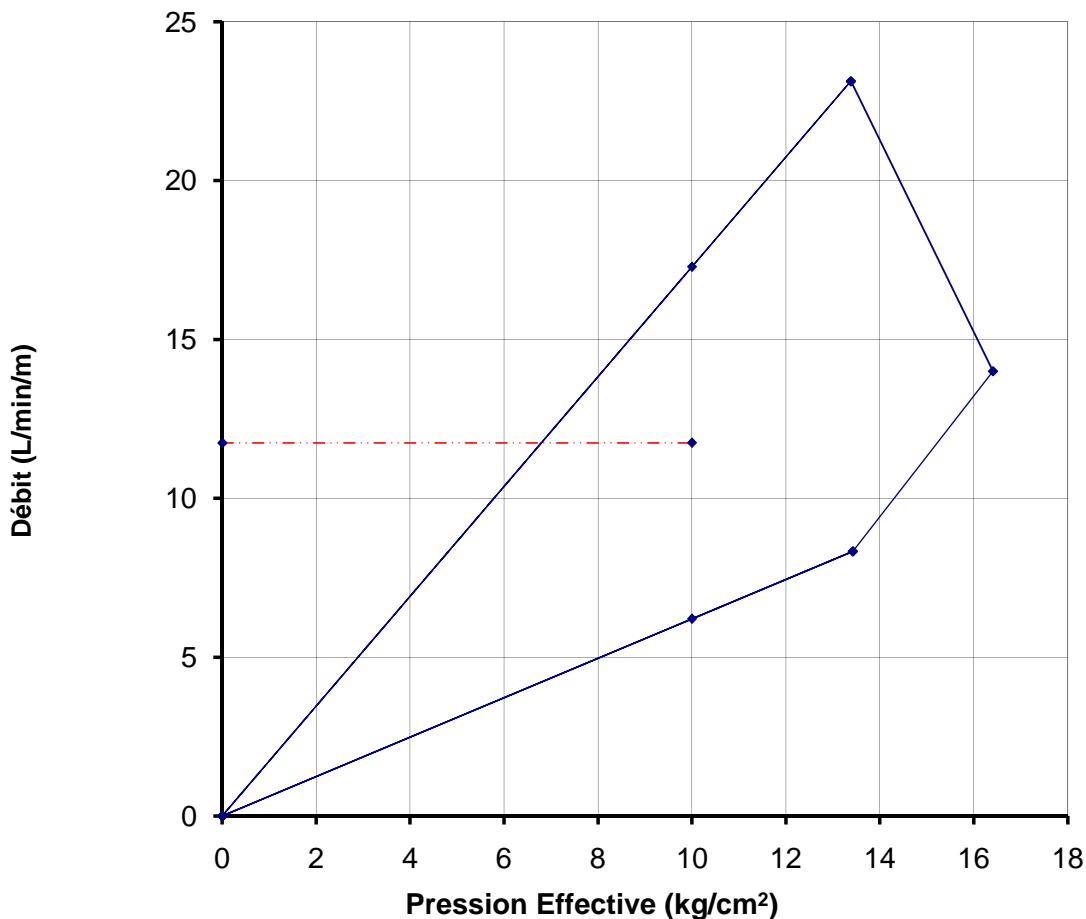
Date: **4/30/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	250	10	3	25	8.33	9.45	2.48E-02	13.425
7	420	10	3	42	14.00	9.45	4.16E-02	16.408
4	694	10	3	69.4	23.13	9.45	6.87E-02	13.381



Lugeon = 11.75 L/min/m



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **111.00 m** à **114.00 m**

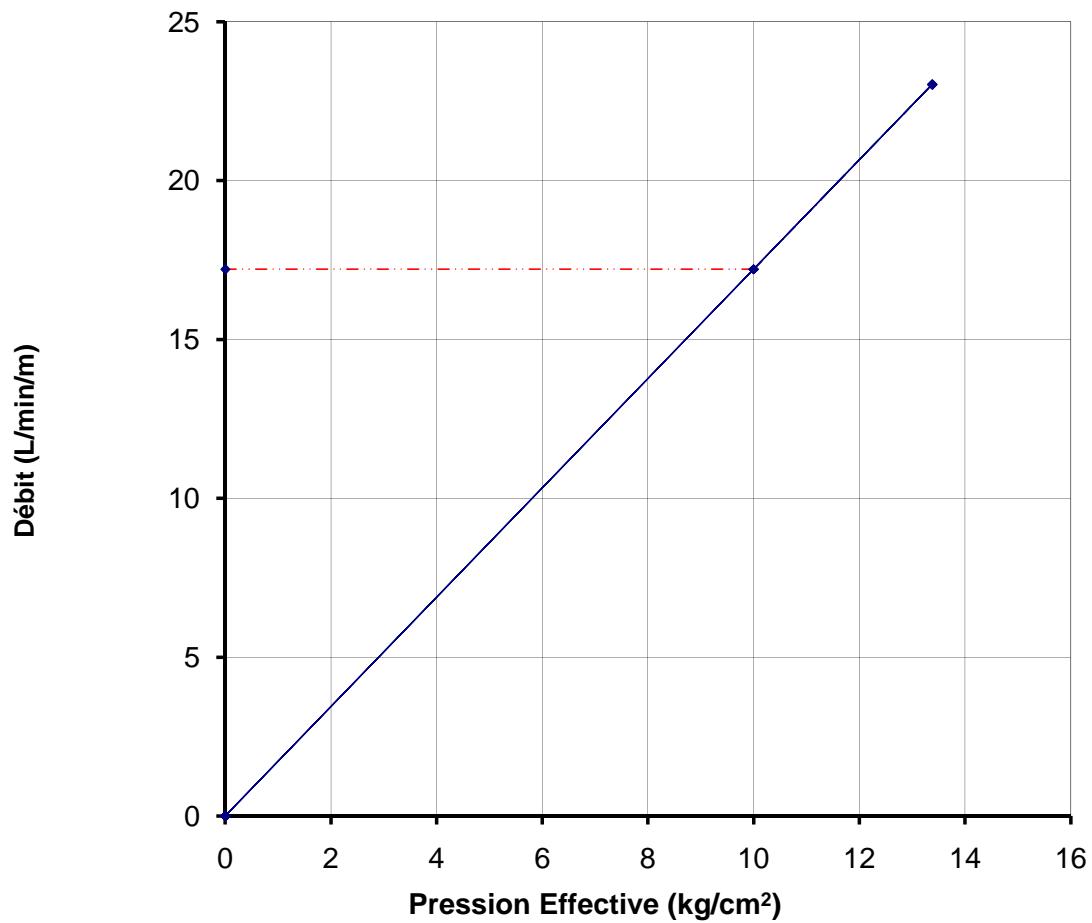
Date: **4/30/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	691	10	3	69.1	23.03	9.45	6.84E-02	13.382



Lugeon = 17.21 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **114.00 m** à **117.00 m**

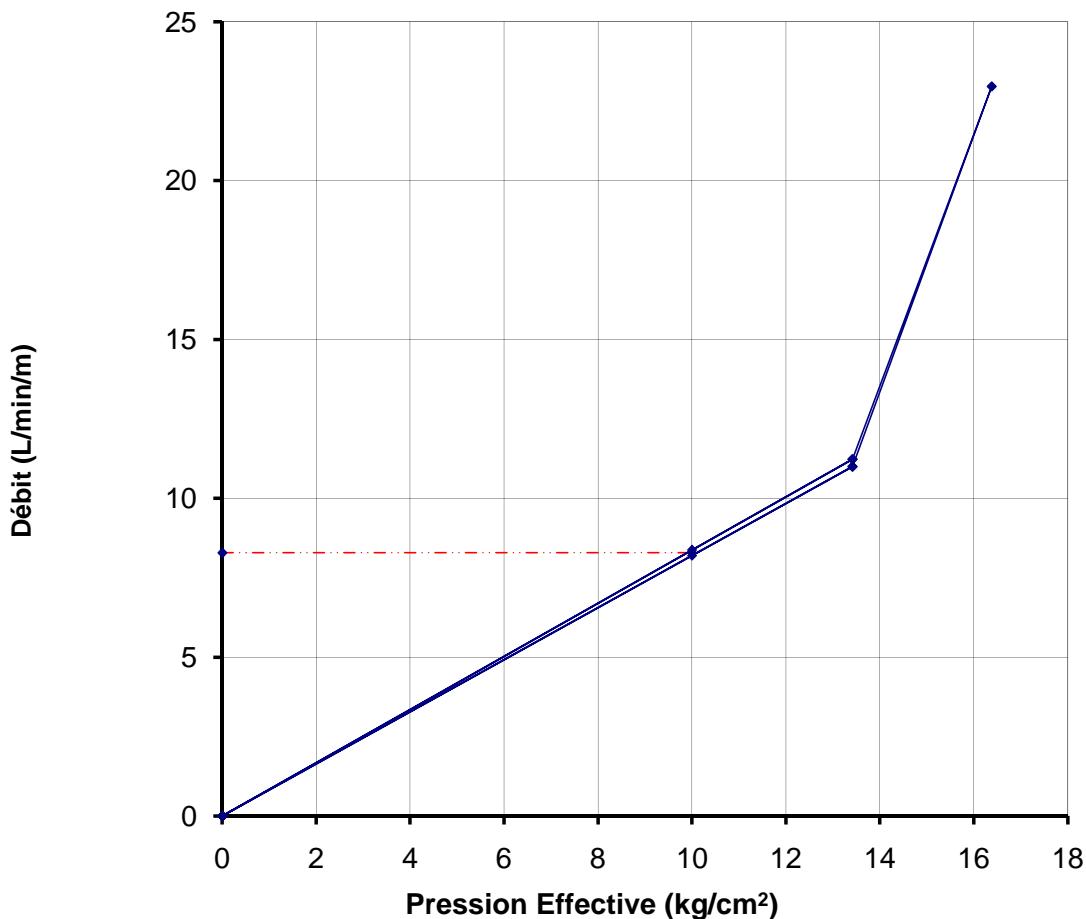
Date: **5/1/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	330	10	3	33	11.00	9.45	3.27E-02	13.417
7	689	10	3	68.9	22.97	9.45	6.82E-02	16.382
4	337	10	3	33.7	11.23	9.45	3.34E-02	13.417



Lugeon = 8.29 L/min/m



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **117.00 m** à **120.00 m**

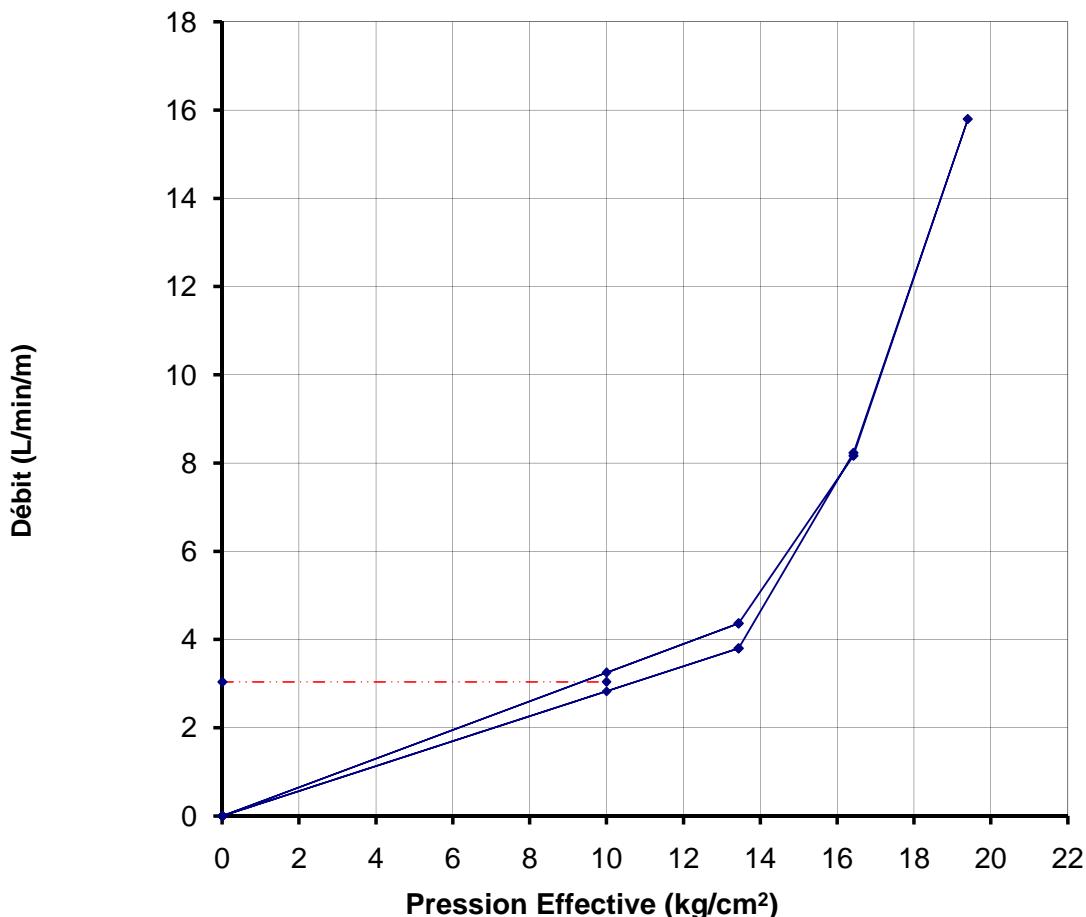
Date: **5/1/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	131	10	3	13.1	4.37	9.45	1.30E-02	13.437
7	245	10	3	24.5	8.17	9.45	2.43E-02	16.426
10	474	10	3	47.4	15.80	9.45	4.69E-02	19.403
7	247	10	3	24.7	8.23	9.45	2.45E-02	16.426
4	114	10	3	11.4	3.80	9.45	1.13E-02	13.439



Lugeon = **3.04 L/min/m**



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **120.00 m** à **123.00 m**

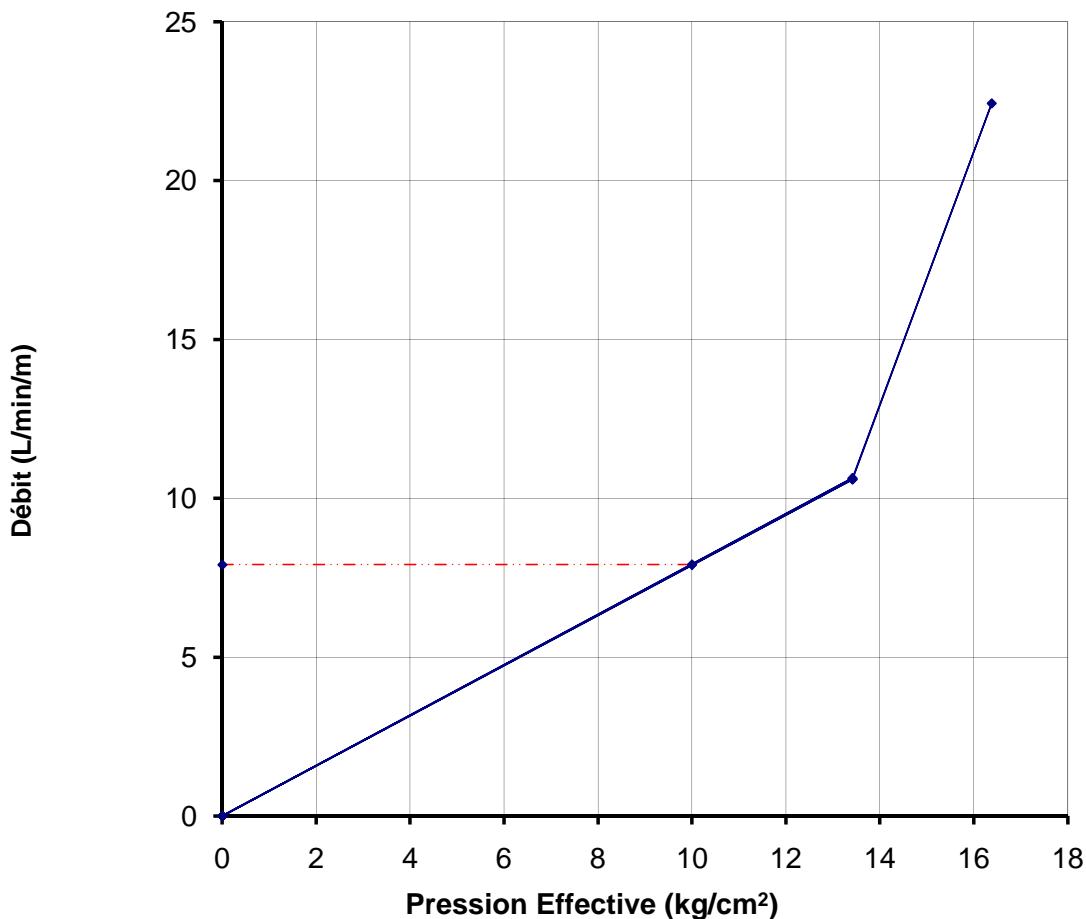
Date: **5/2/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	318	10	3	31.8	10.60	9.45	3.15E-02	13.419
7	673	10	3	67.3	22.43	9.45	6.66E-02	16.383
4	319	10	3	31.9	10.63	9.45	3.16E-02	13.418



Lugeon = 7.91 L/min/m



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **123.00 m** à **126.00 m**

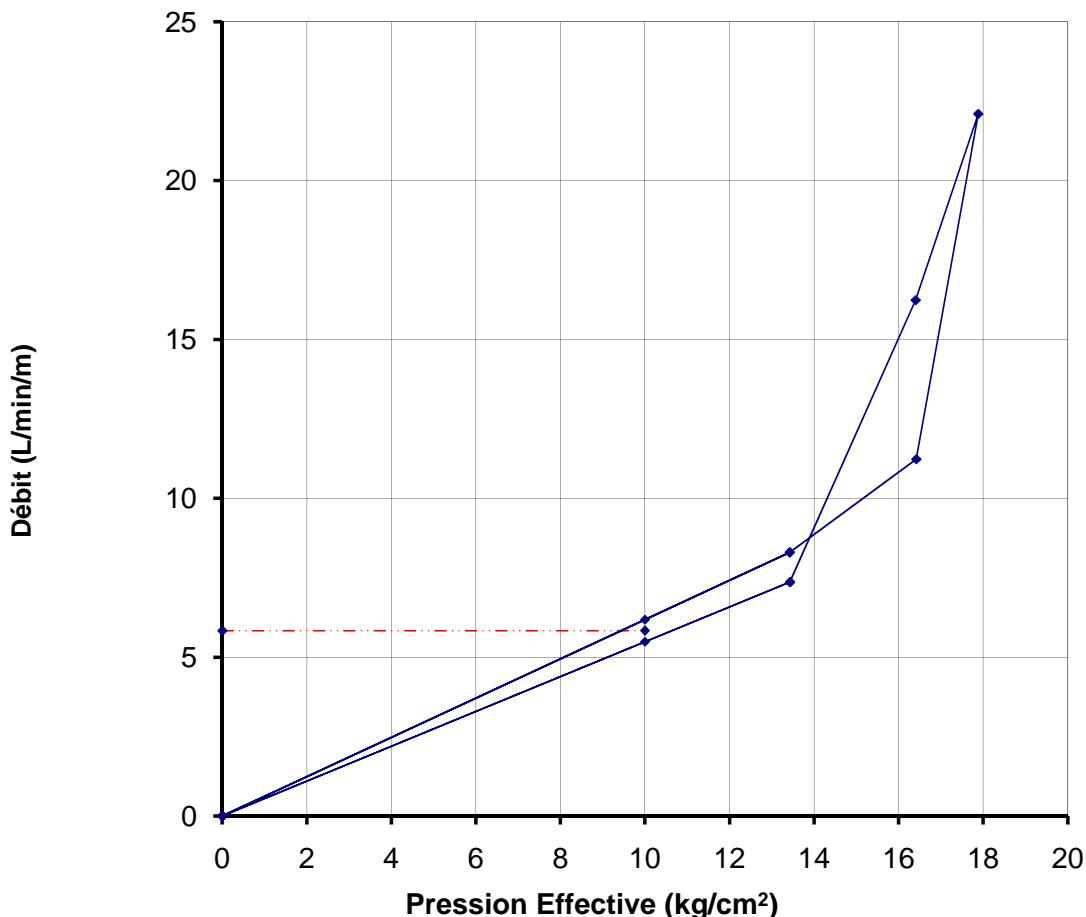
Date: **5/3/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	249	10	3	24.9	8.30	9.45	2.47E-02	13.425
7	337	10	3	33.7	11.23	9.45	3.34E-02	16.417
8.5	663	10	3	66.3	22.10	9.45	6.56E-02	17.884
7	487	10	3	48.7	16.23	9.45	4.82E-02	16.402
4	221	10	3	22.1	7.37	9.45	2.19E-02	13.428



Lugeon = 5.83 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **126.00 m** à **129.00 m**

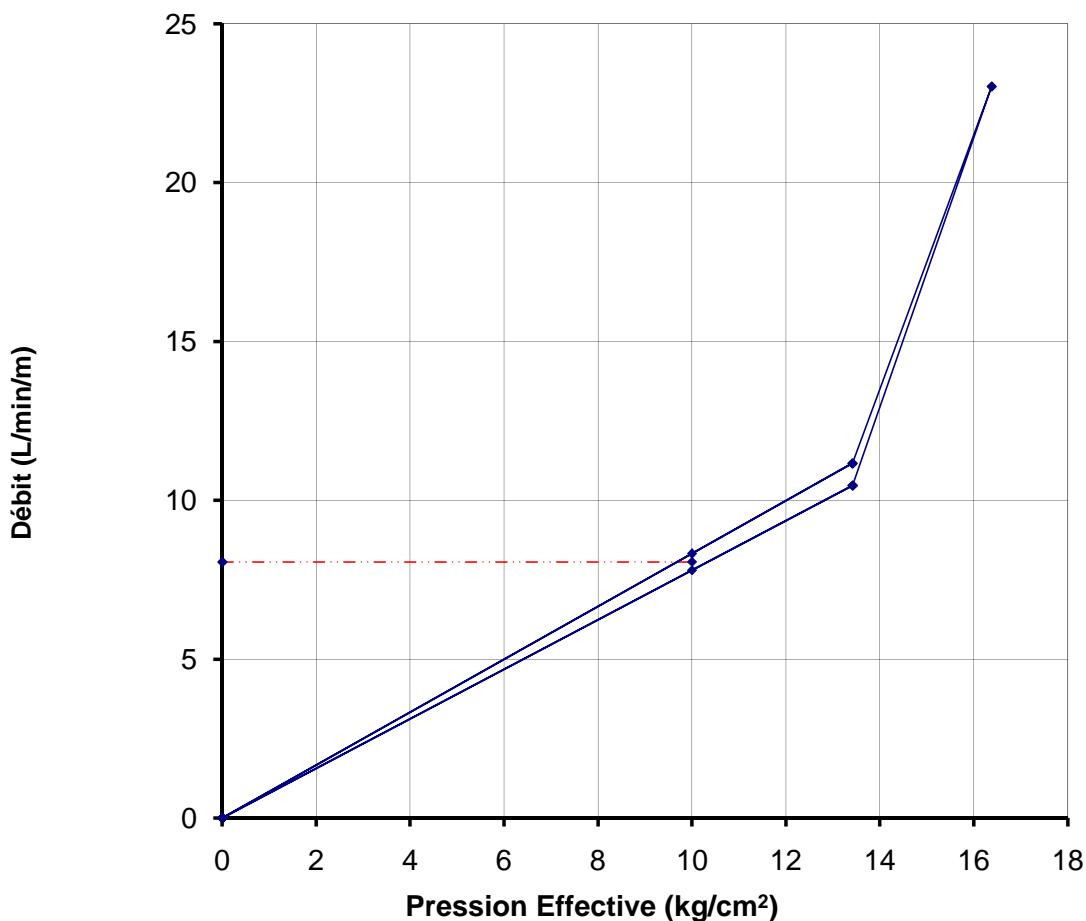
Date: **5/5/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	335	10	3	33.5	11.17	9.45	3.32E-02	13.417
7	691	10	3	69.1	23.03	9.45	6.84E-02	16.382
4	314	10	3	31.4	10.47	9.45	3.11E-02	13.419



Lugeon = **8.06 L/min/m**



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **129.00 m** à **132.00 m**

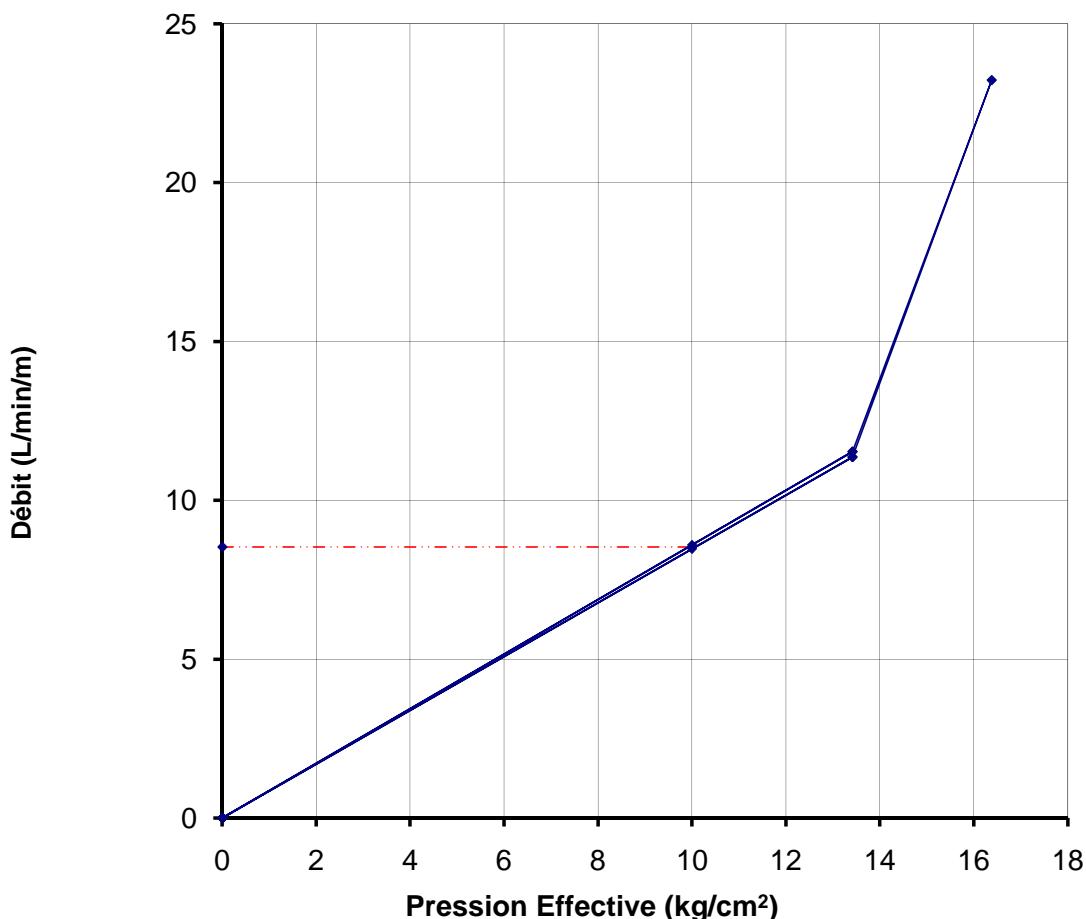
Date: **5/5/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	346	10	3	34.6	11.53	9.45	3.43E-02	13.416
7	697	10	3	69.7	23.23	9.45	6.90E-02	16.381
4	341	10	3	34.1	11.37	9.45	3.38E-02	13.416



Lugeon = 8.53 L/min/m



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **132.00 m** à **135.00 m**

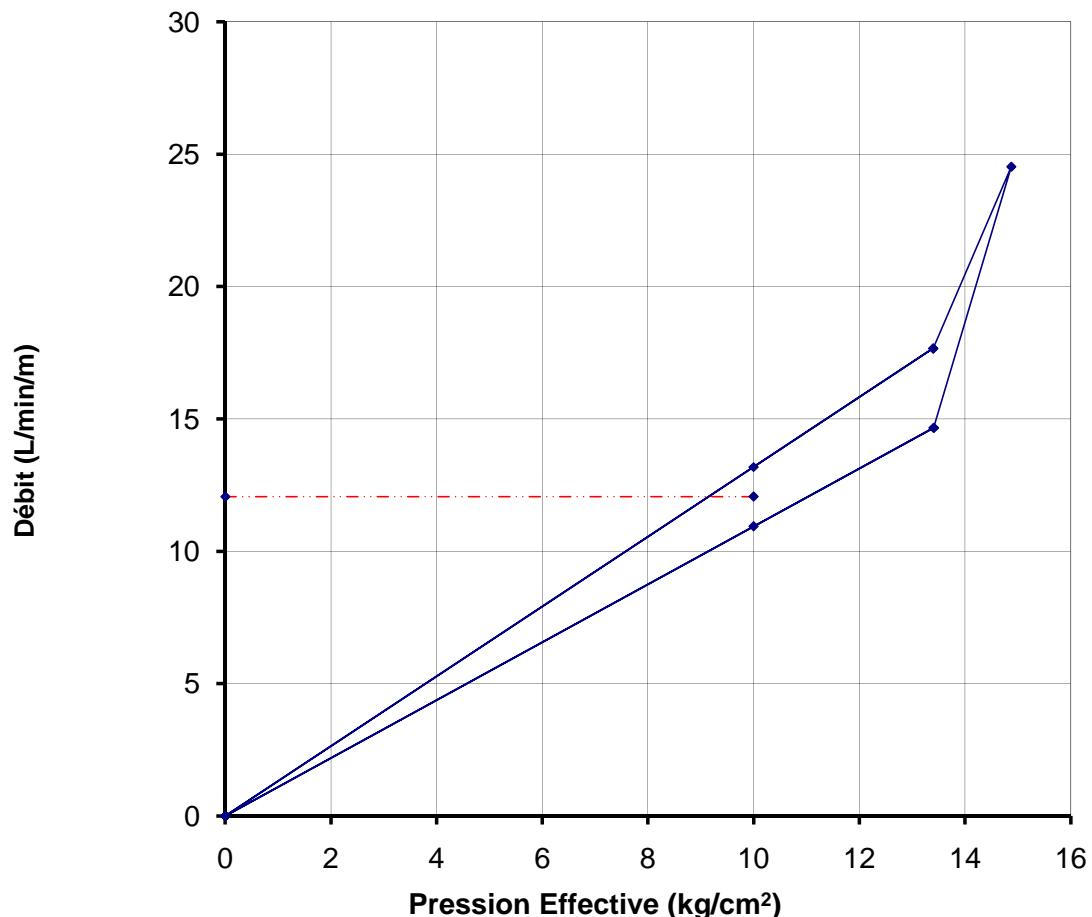
Date: **5/6/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	440	10	3	44	14.67	9.45	4.36E-02	13.406
5.5	368	5	3	73.6	24.53	9.45	7.29E-02	14.877
4	530	10	3	53	17.67	9.45	5.25E-02	13.398



Lugeon = 12.06 L/min/m



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **135.00 m** à **138.00 m**

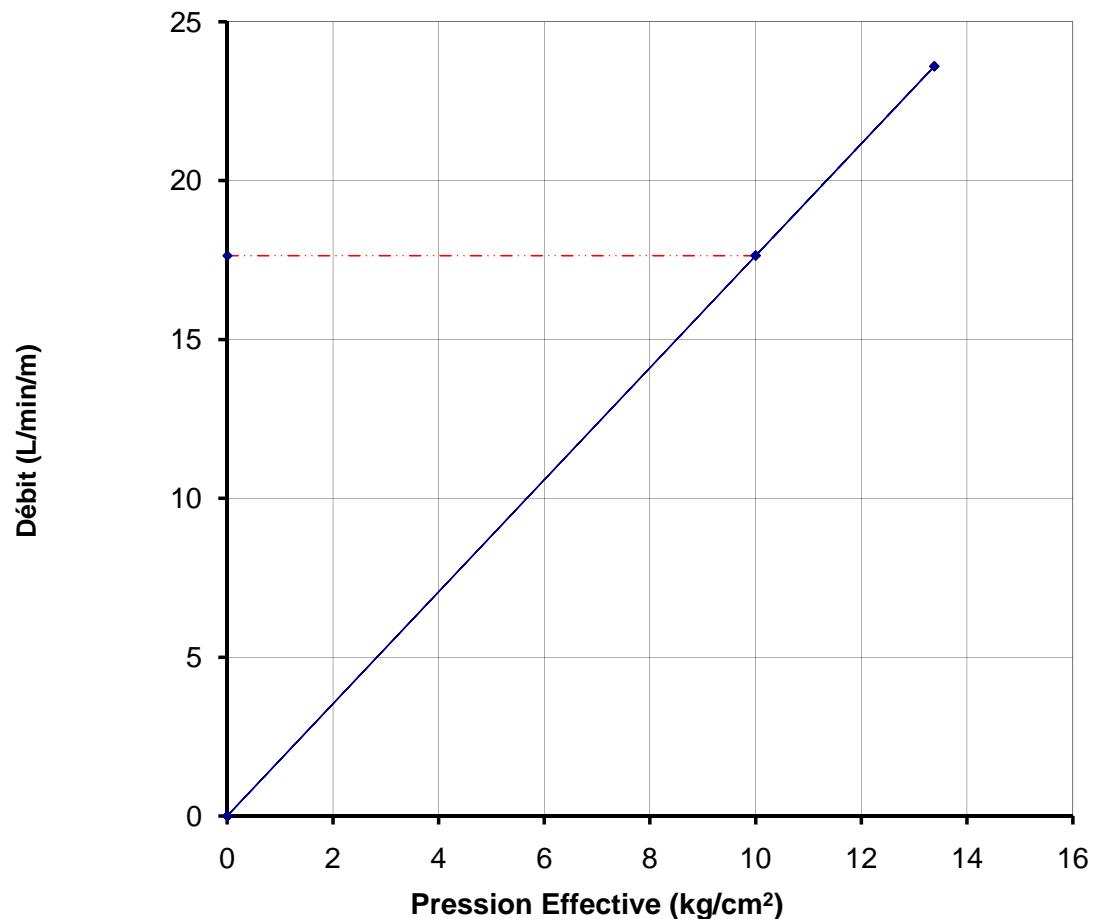
Date: **5/6/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	708	10	3	70.8	23.60	9.45	7.01E-02	13.380



Lugeon = 17.64 L/min/m



PROJECT: **BISRI DAM / SECOND PACKGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **138.00 m** à **141.00 m**

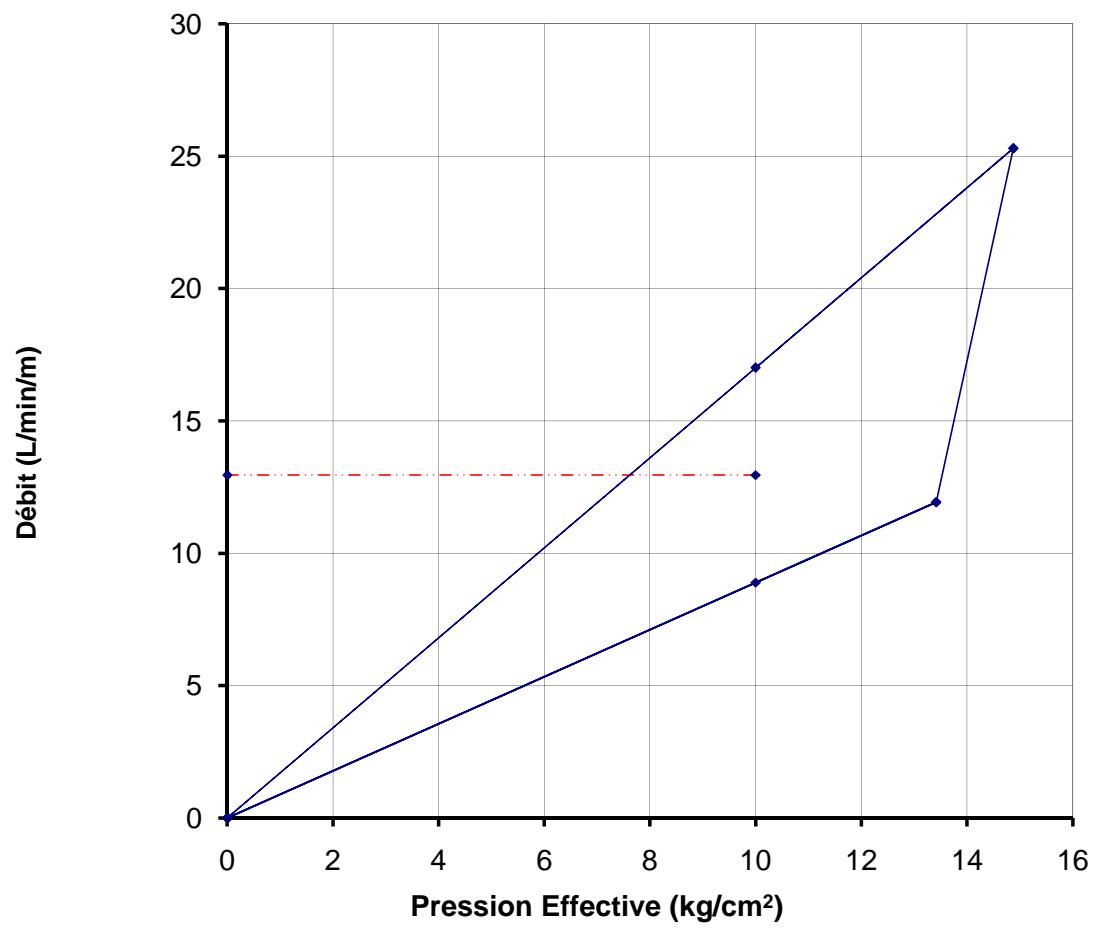
Date: **5/7/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	358	10	3	35.8	11.93	9.45	3.54E-02	13.415
5.5	759	10	3	75.9	25.30	9.45	7.51E-02	14.875



Lugeon = 12.95 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **141.00 m** à **144.00 m**

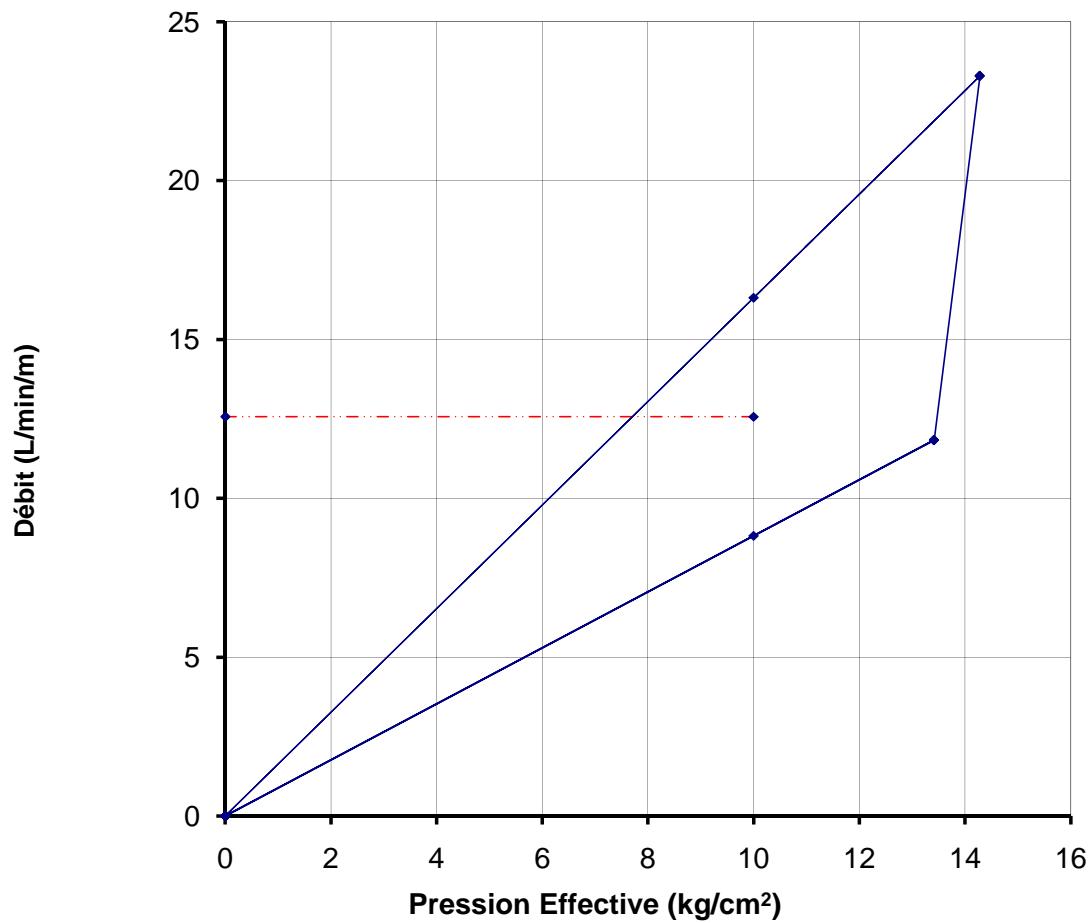
Date: **5/7/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	355	10	3	35.5	11.83	9.45	3.51E-02	13.415
4.9	699	10	3	69.9	23.30	9.45	6.92E-02	14.281



Lugeon = 12.57 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 02**
TRANCHE ESSAYEE **144.00 m** à **147.00 m**

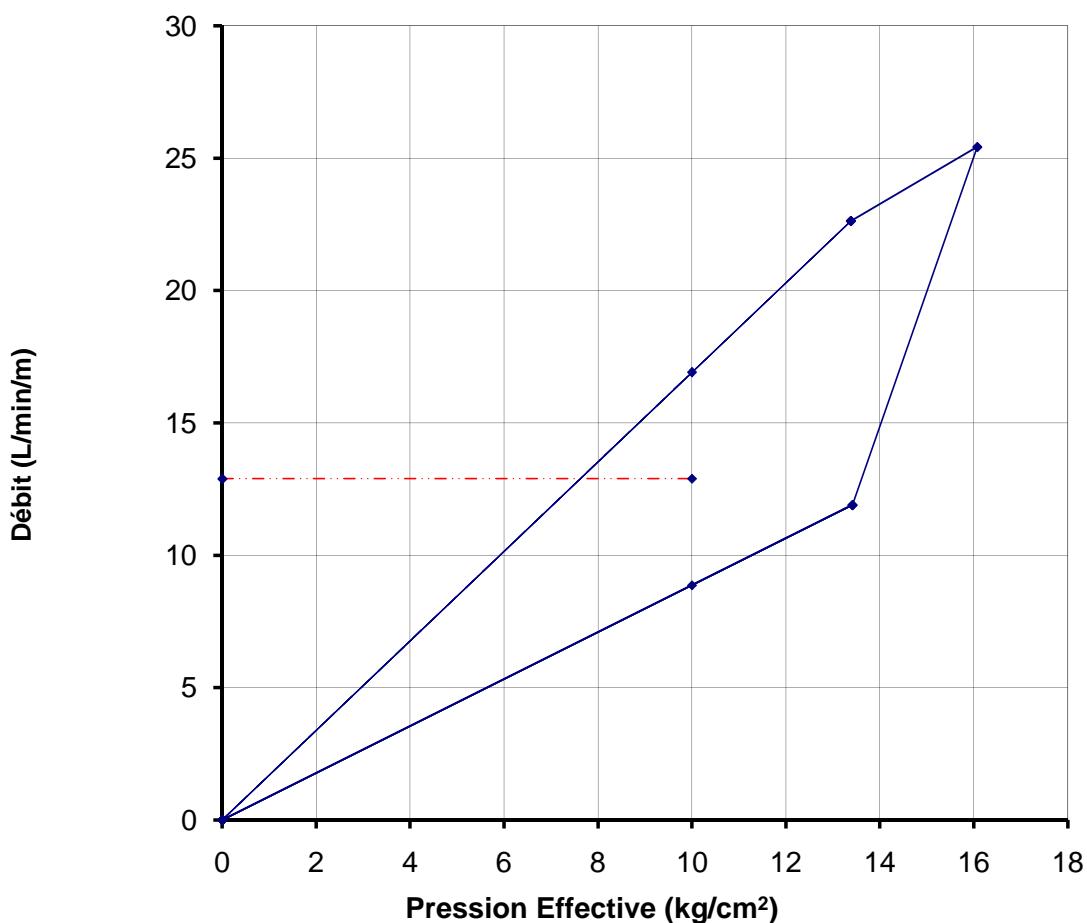
Date: **5/9/2014**

Manomètre **0.50 m**

depth to water: **94.00 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	357	10	3	35.7	11.90	9.45	3.53E-02	13.415
6.7	534	7	3	76.28571	25.43	9.45	7.55E-02	16.074
4	679	10	3	67.9	22.63	9.45	6.72E-02	13.383



Lugeon = 12.89 L/min/m

BHRA4		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST	
		DAM FOOTPRINT			
Test Interval	1.5	to	4.5	K(m/sec, FHM):	2.8196E-05
Diameter of test interval	D	86	mm	Time (min)	Drawdown from R.L (m)
Pre-test water depth (Pre-T.W.D) / Groundwater depth (GWD)	h ₀	4.5	m	0	0.00
Length of uncased test interval below the pre-test water level	L	3	m	1	2.08
Falling Head Method (FHM)				2	3.61
$K_{(m/sec)} = \frac{D^2}{8L(t_2-t_1)} \ln\left(\frac{L}{D}\right) \ln\left(\frac{H_1}{H_2}\right)$				3	4.39
H1	2.42	m			
H2	0.11	m			
t1 (as per graph)	60	sec.			
t2	180	sec.			
Log Time (sec)					
Water Permeability (m/sec)	Relative Permeability		Pervious		
1.00E-03	1.00E-05	Pervious			
1.00E-05	1.00E-08	Semi-Pervious			
1.00E-08	1.00E-12	Impervious			



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **10.50 m à 13.50 m**

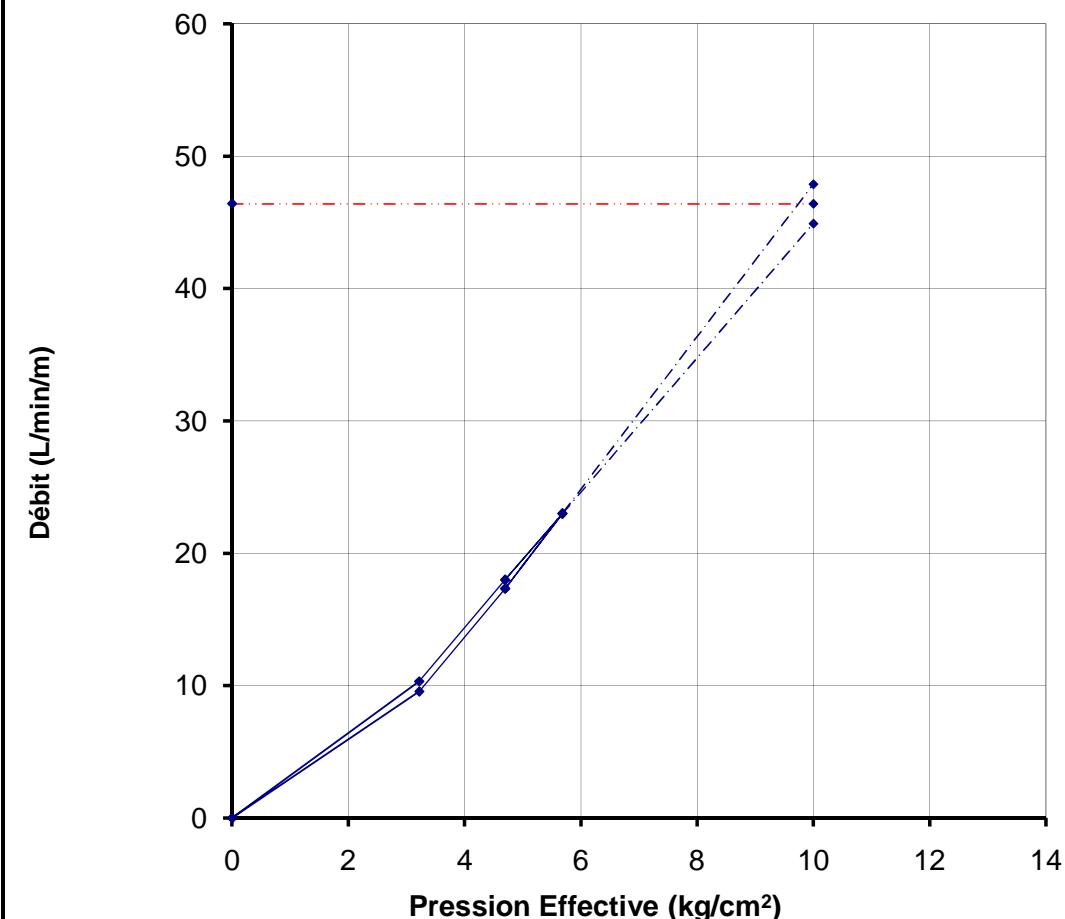
Date: **5/20/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
2	287	10	3	28.7	9.57	1.25	2.84E-02	3.222
3.5	520	10	3	52	17.33	1.25	5.15E-02	4.699
4.5	690	10	3	69	23.00	1.25	6.83E-02	5.682
3.5	540	10	3	54	18.00	1.25	5.35E-02	4.697
2	310	10	3	31	10.33	1.25	3.07E-02	3.219



Lugeon = 46.40 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **15.00 m à 18.00 m**

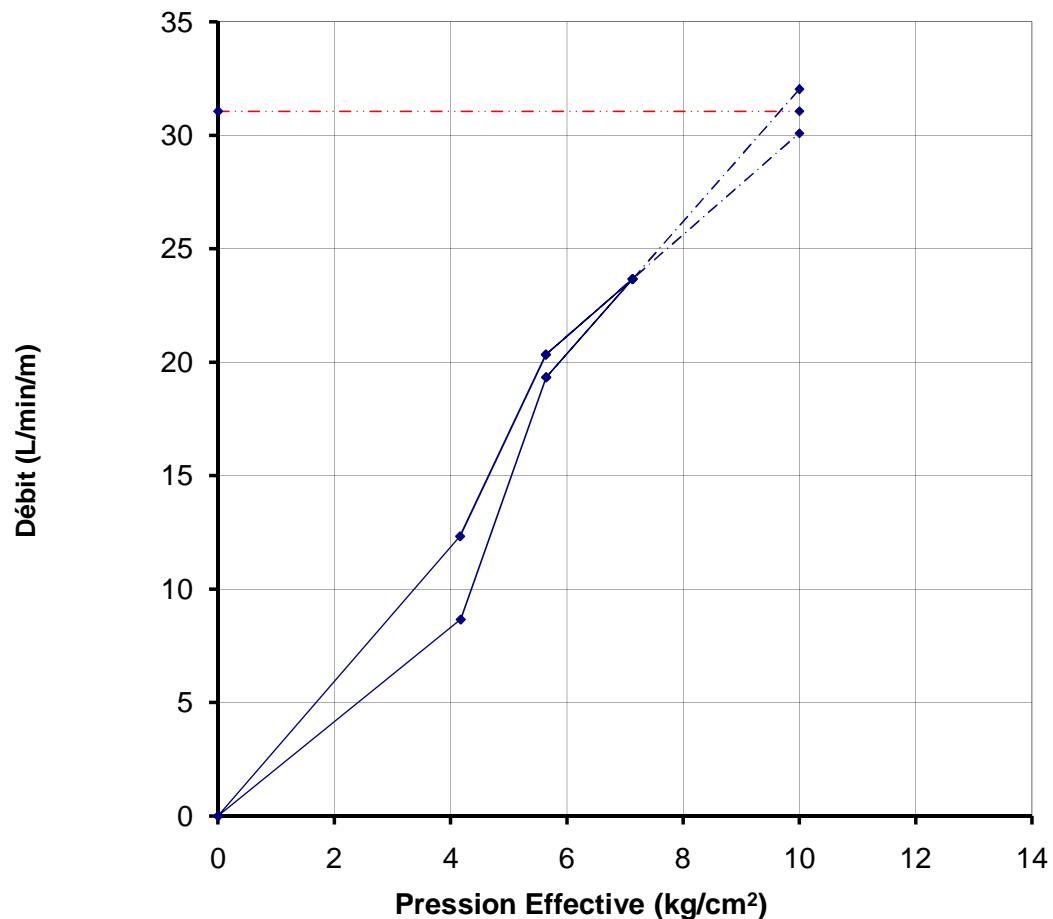
Date: **5/20/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
2.5	260	10	3	26	8.67	1.7	2.57E-02	4.174
4	580	10	3	58	19.33	1.7	5.74E-02	5.643
5.5	710	10	3	71	23.67	1.7	7.03E-02	7.130
4	610	10	3	61	20.33	1.7	6.04E-02	5.640
2.5	370	10	3	37	12.33	1.7	3.66E-02	4.163



Lugeon = **31.06 L/min/m**



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **18.00 m à 21.00 m**

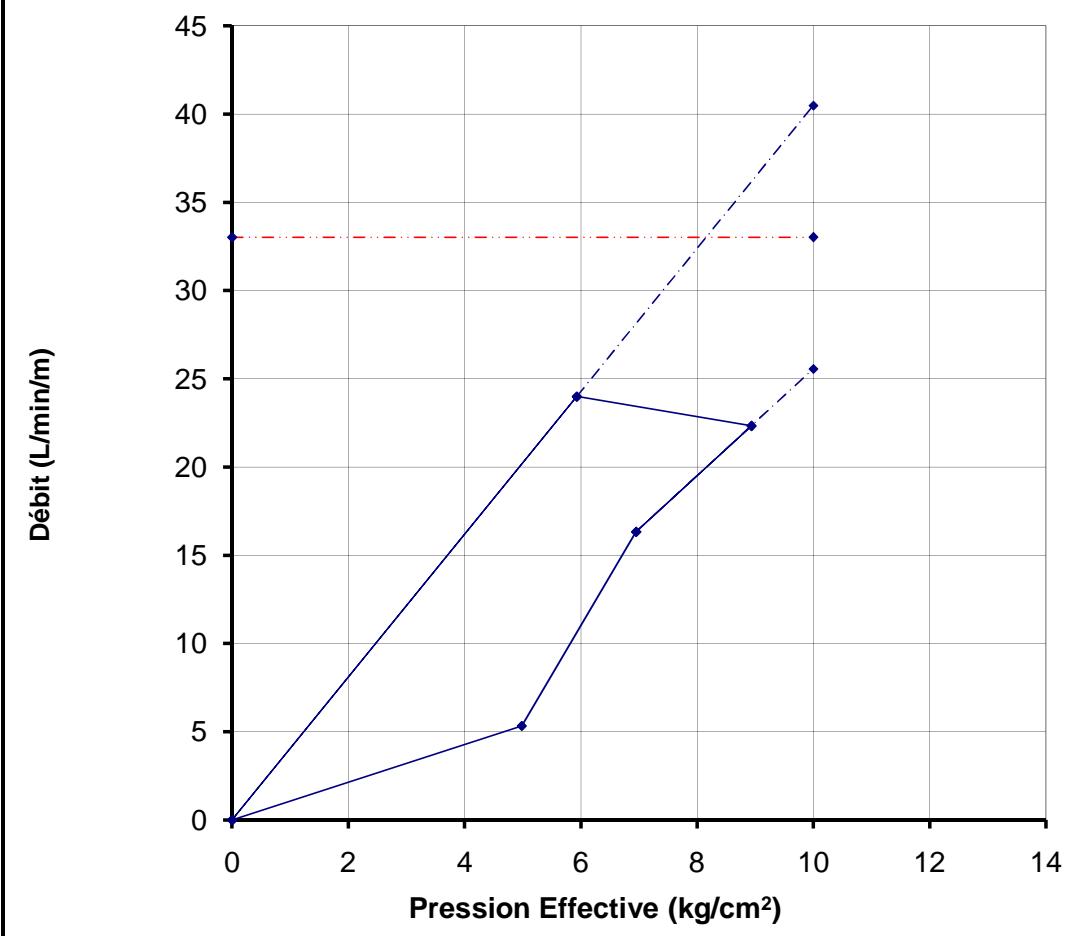
Date: **5/21/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
3	160	10	3	16	5.33	2	1.58E-02	4.984
5	490	10	3	49	16.33	2	4.85E-02	6.951
7	201	3	3	67	22.33	2	6.63E-02	8.934
4	720	10	3	72	24.00	2	7.13E-02	5.929



Lugeon = 33.02 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **21.00 m à 24.00 m**

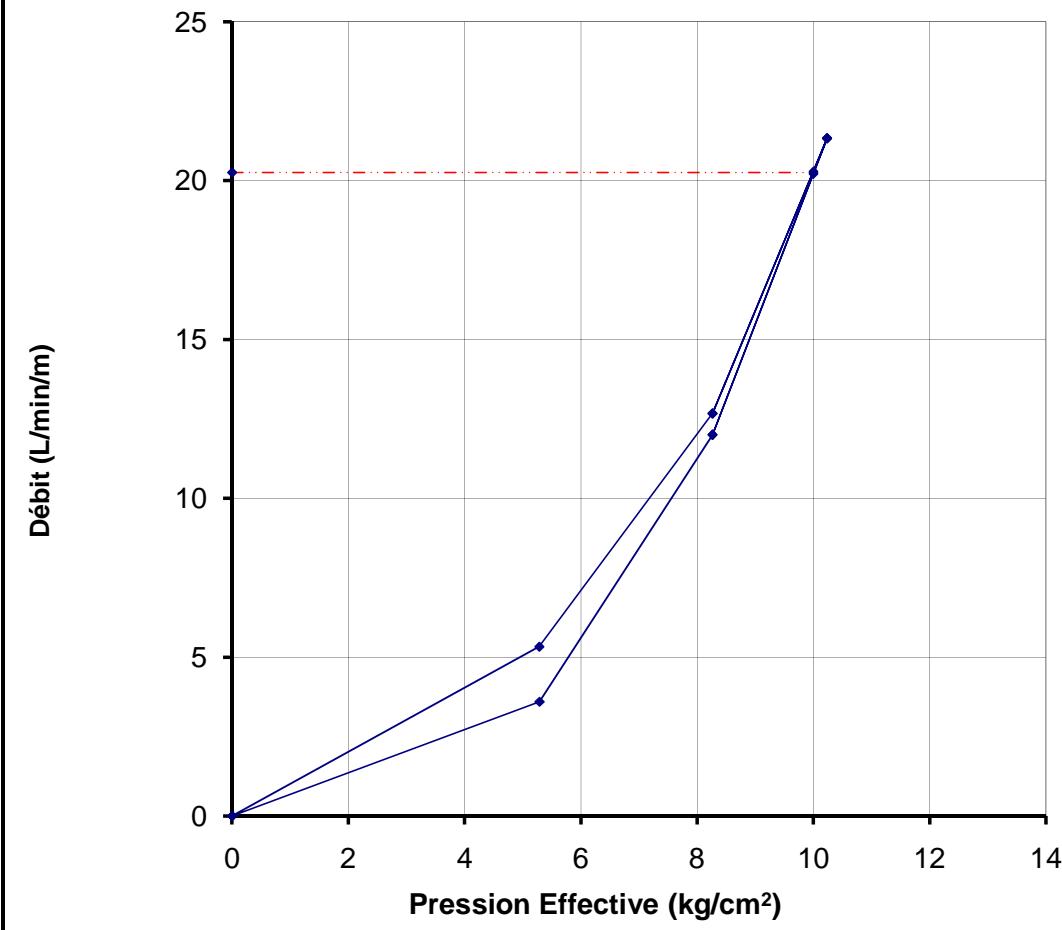
Date: **5/21/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
3	108	10	3	10.8	3.60	2.3	1.07E-02	5.289
6	360	10	3	36	12.00	2.3	3.56E-02	8.264
8	640	10	3	64	21.33	2.3	6.34E-02	10.237
6	380	10	3	38	12.67	2.3	3.76E-02	8.262
3	160	10	3	16	5.33	2.3	1.58E-02	5.284



Lugeon = 20.25 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **24.00 m à 27.00 m**

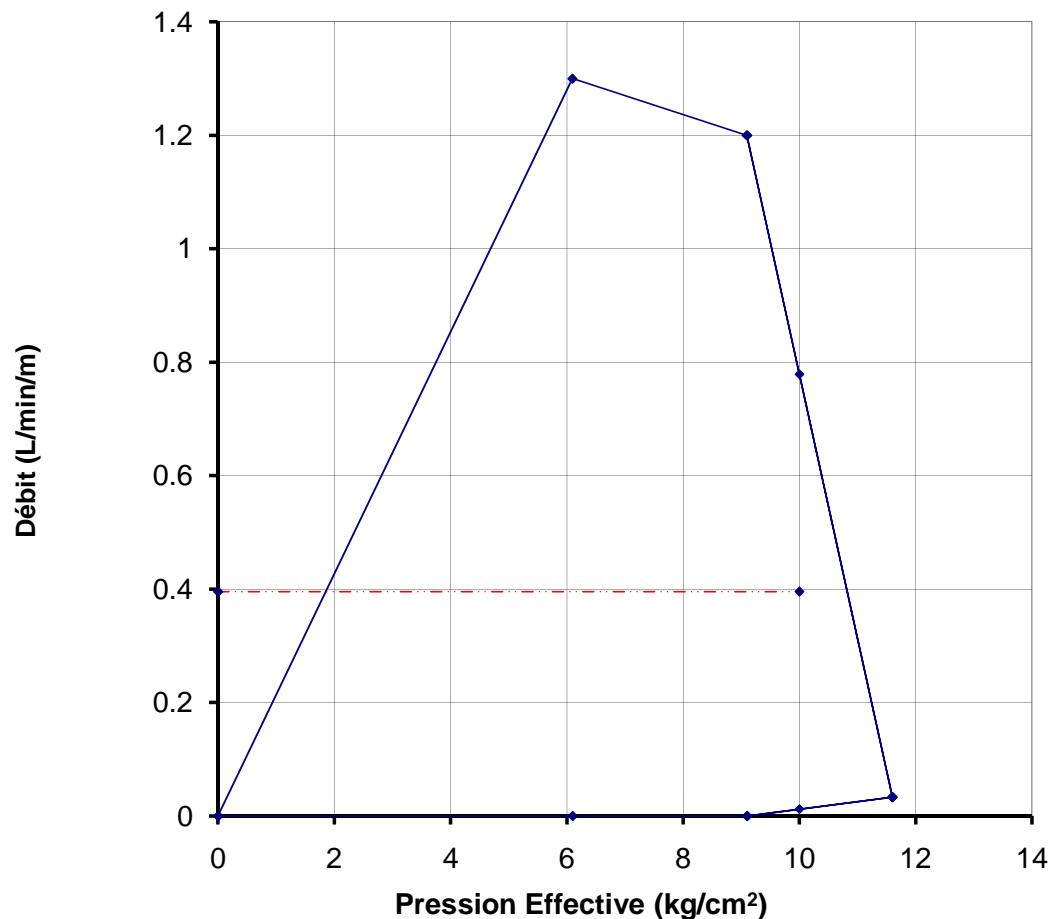
Date: **5/21/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
3.5	39	10	3	3.9	1.30	2.6	3.86E-03	6.096
6.5	36	10	3	3.6	1.20	2.6	3.56E-03	9.096
9	1	10	3	0.1	0.03	2.6	9.90E-05	11.600
6.5	0	10	3	0	0.00	2.6	0.00E+00	9.100
3.5	0	10	3	0	0.00	2.6	0.00E+00	6.100



Lugeon = 0.40 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **27.00 m à 30.00 m**

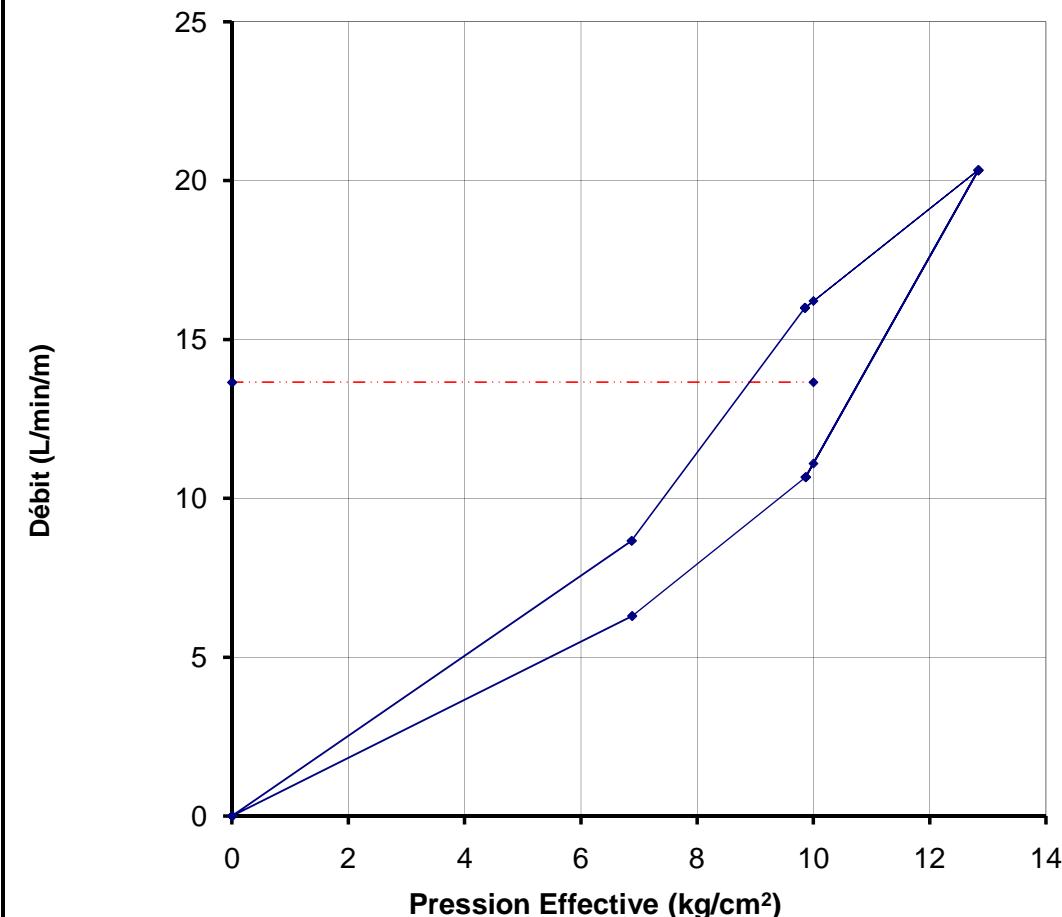
Date: **5/22/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	189	10	3	18.9	6.30	2.9	1.87E-02	6.881
7	320	10	3	32	10.67	2.9	3.17E-02	9.868
10	610	10	3	61	20.33	2.9	6.04E-02	12.840
7	480	10	3	48	16.00	2.9	4.75E-02	9.852
4	260	10	3	26	8.67	2.9	2.57E-02	6.874



Lugeon = 13.65 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **30.00 m à 33.00 m**

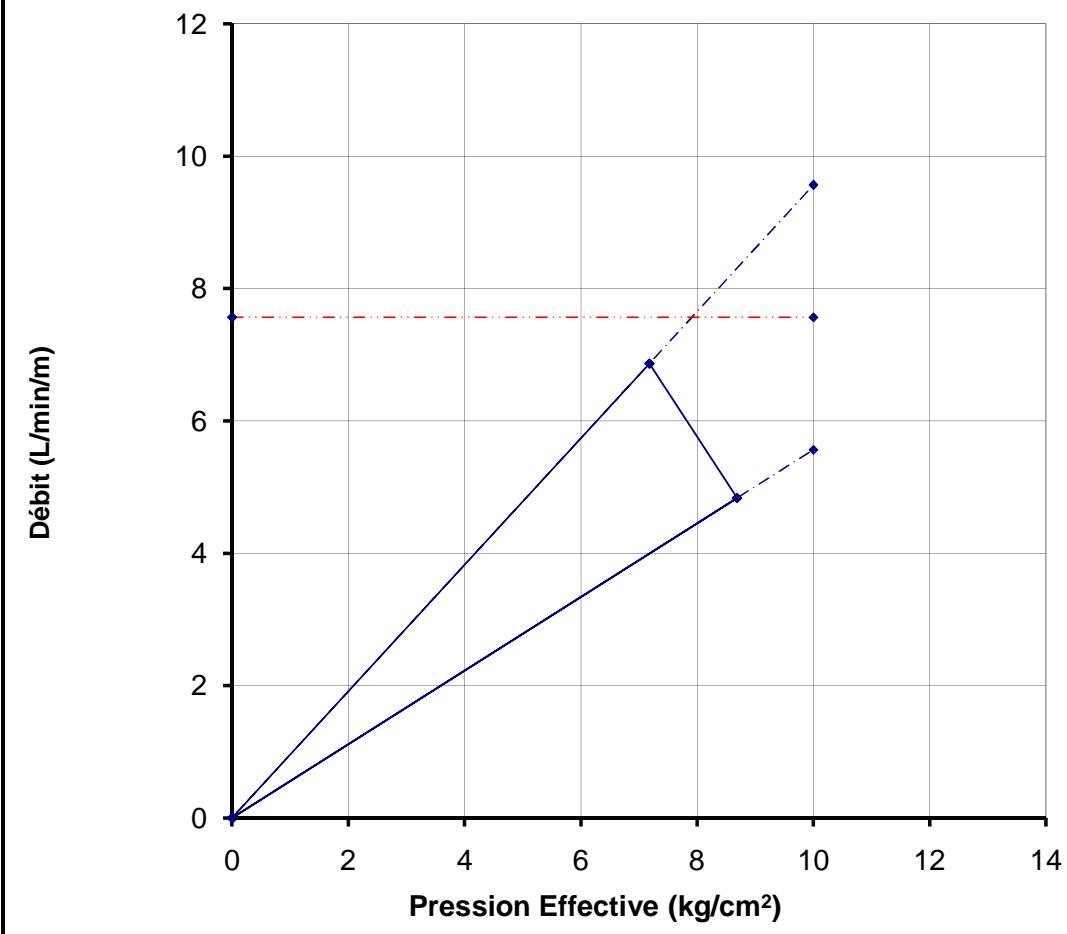
Date: **5/22/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	206	10	3	20.6	6.87	3.2	2.04E-02	7.180
5.5	145	10	3	14.5	4.83	3.2	1.44E-02	8.686



Lugeon = 7.56 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **33.00 m à 36.00 m**

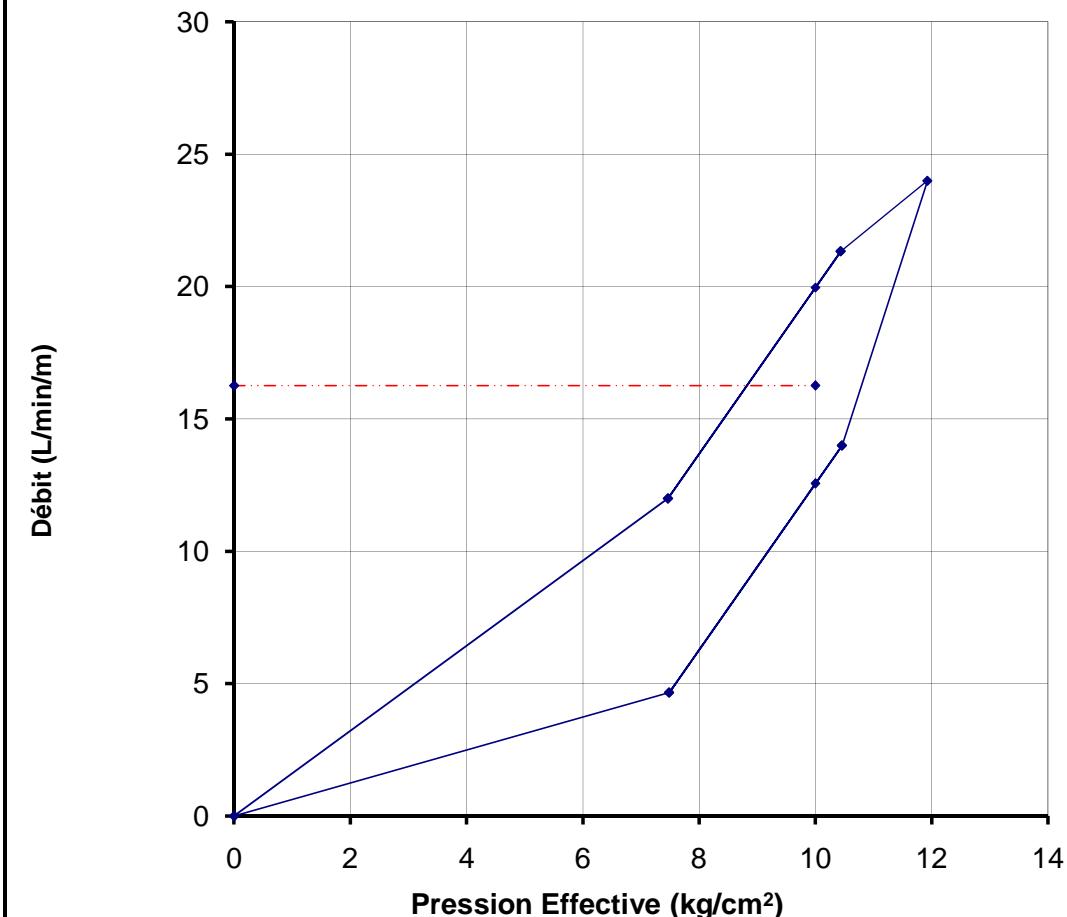
Date: **5/23/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	140	10	3	14	4.67	3.5	1.39E-02	7.486
7	420	10	3	42	14.00	3.5	4.16E-02	10.458
8.5	720	10	3	72	24.00	3.5	7.13E-02	11.929
7	640	10	3	64	21.33	3.5	6.34E-02	10.437
4	360	10	3	36	12.00	3.5	3.56E-02	7.464



Lugeon = **16.26 L/min/m**



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **36.00 m à 39.00 m**

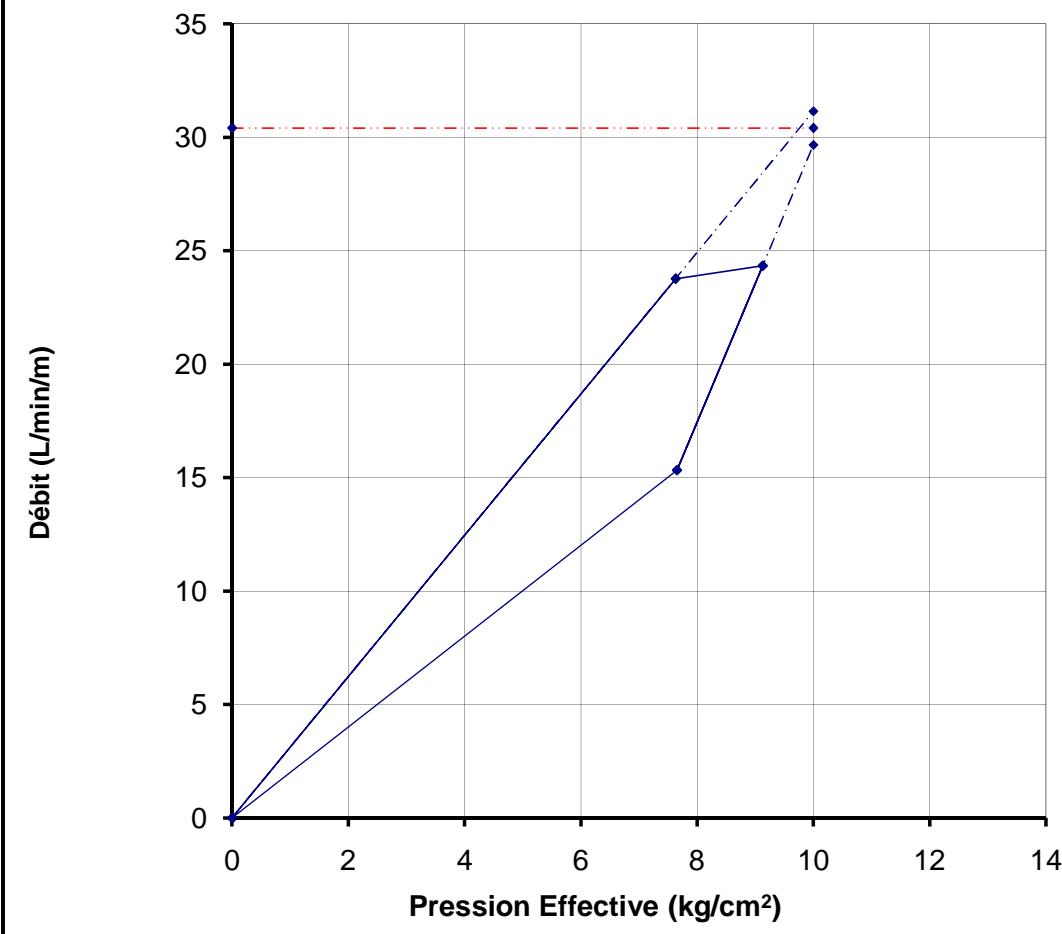
Date: **5/23/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	460	10	3	46	15.33	3.7	4.55E-02	7.654
5.5	730	10	3	73	24.33	3.7	7.23E-02	9.128
4	713	10	3	71.3	23.77	3.7	7.06E-02	7.629



Lugeon = 30.41 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **39.00 m à 42.00 m**

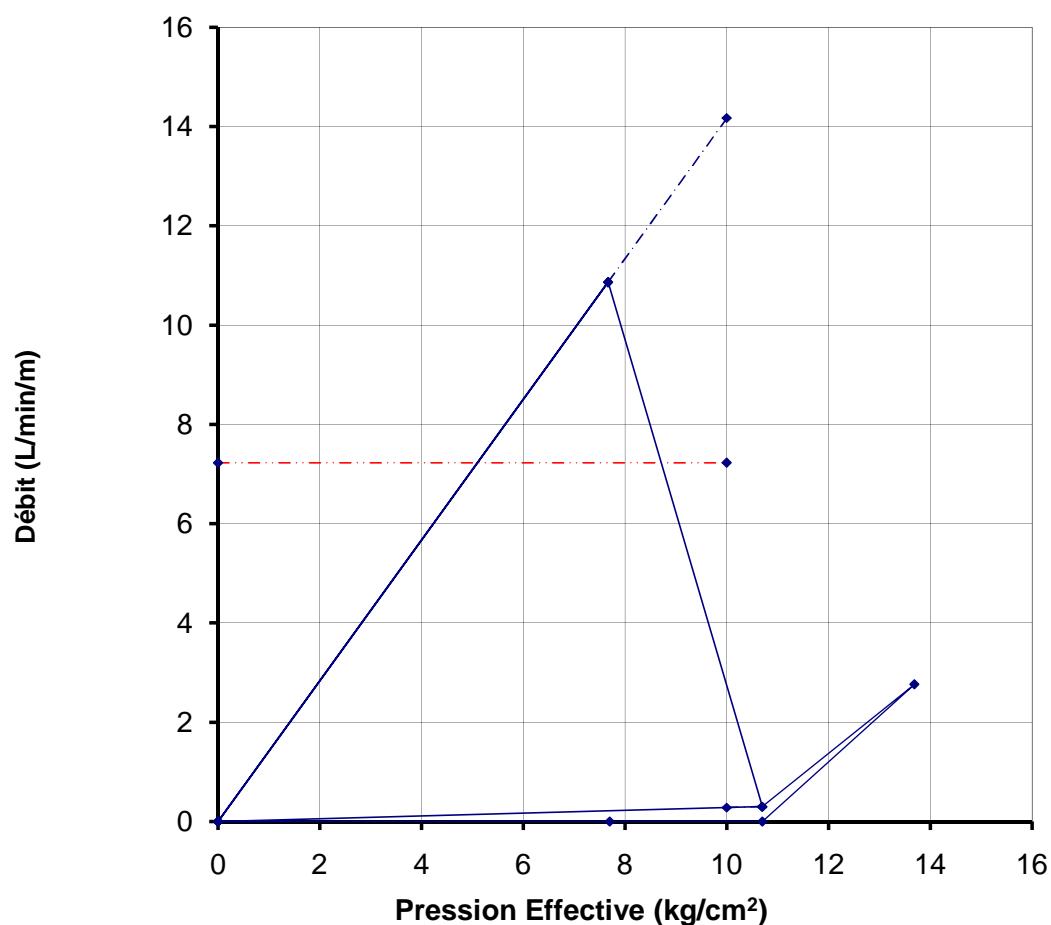
Date: **5/24/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	326	10	3	32.6	10.87	3.7	3.23E-02	7.668
7	9	10	3	0.9	0.30	3.7	8.91E-04	10.699
10	83	10	3	8.3	2.77	3.7	8.22E-03	13.692
7	0	10	3	0	0.00	3.7	0.00E+00	10.700
4	0	10	3	0	0.00	3.7	0.00E+00	7.700



Lugeon = 7.23 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **42.00 m à 45.00 m**

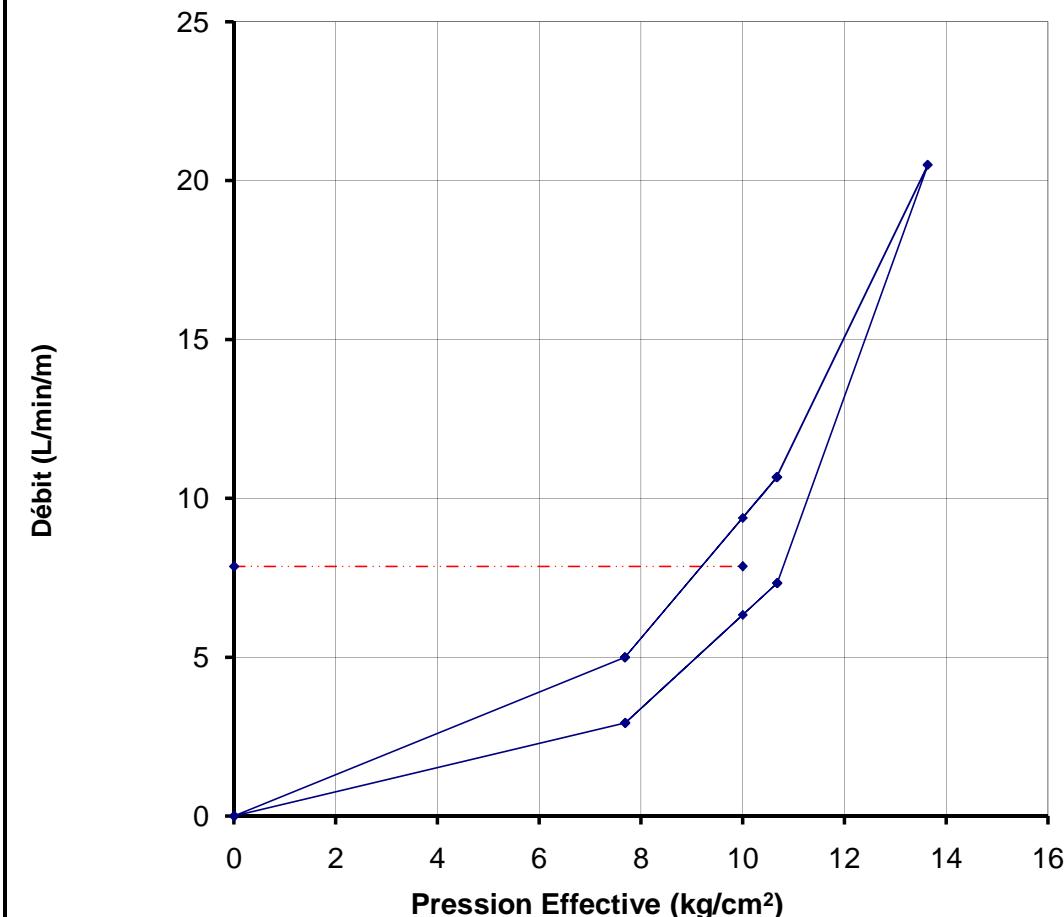
Date: **5/24/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	88	10	3	8.8	2.93	3.7	8.71E-03	7.691
7	220	10	3	22	7.33	3.7	2.18E-02	10.678
10	615	10	3	61.5	20.50	3.7	6.09E-02	13.639
7	320	10	3	32	10.67	3.7	3.17E-02	10.668
4	150	10	3	15	5.00	3.7	1.49E-02	7.685



Lugeon = **7.86 L/min/m**



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **45.00 m à 48.00 m**

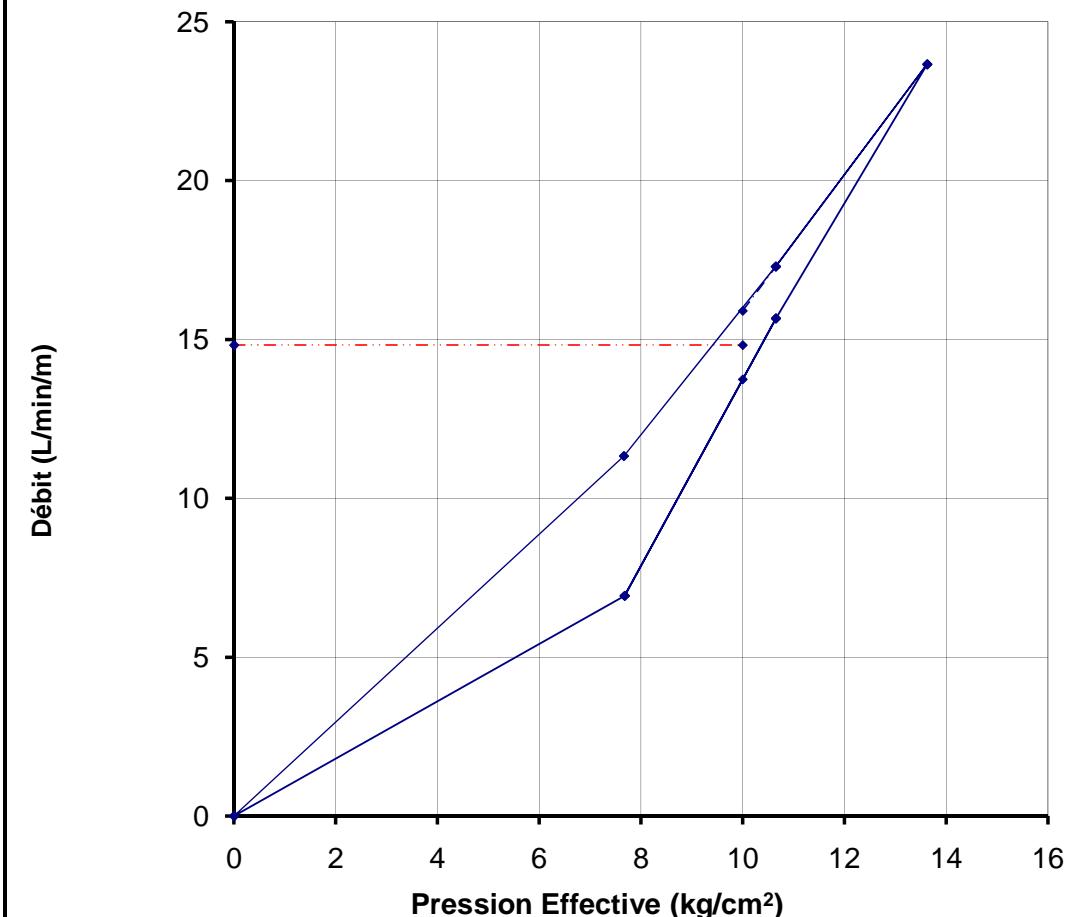
Date: **5/23/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	208	10	3	20.8	6.93	3.7	2.06E-02	7.679
7	470	10	3	47	15.67	3.7	4.65E-02	10.653
10	710	10	3	71	23.67	3.7	7.03E-02	13.630
7	519	10	3	51.9	17.30	3.7	5.14E-02	10.649
4	340	10	3	34	11.33	3.7	3.37E-02	7.666



Lugeon = **14.82 L/min/m**



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **48.00 m à 51.00 m**

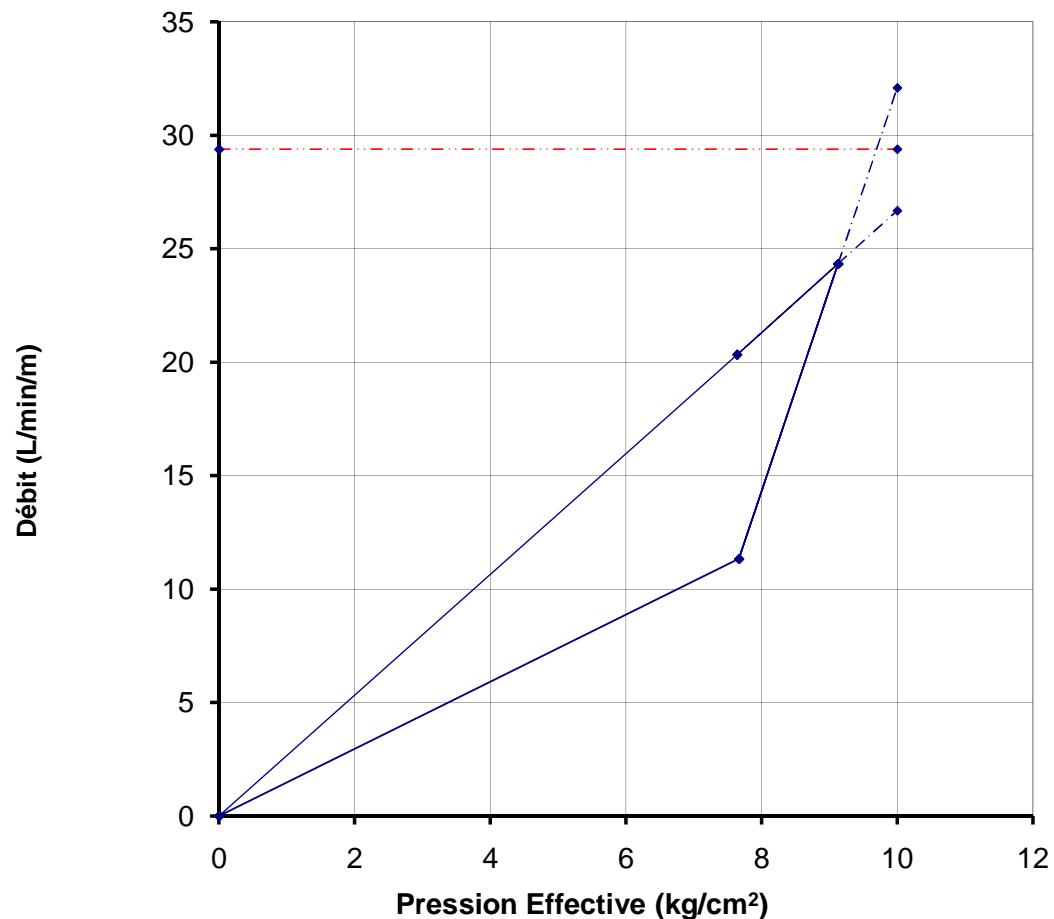
Date: **5/23/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	340	10	3	34	11.33	3.7	3.37E-02	7.666
5.5	730	10	3	73	24.33	3.7	7.23E-02	9.128
4	610	10	3	61	20.33	3.7	6.04E-02	7.640



Lugeon = 29.39 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **51.00 m à 54.00 m**

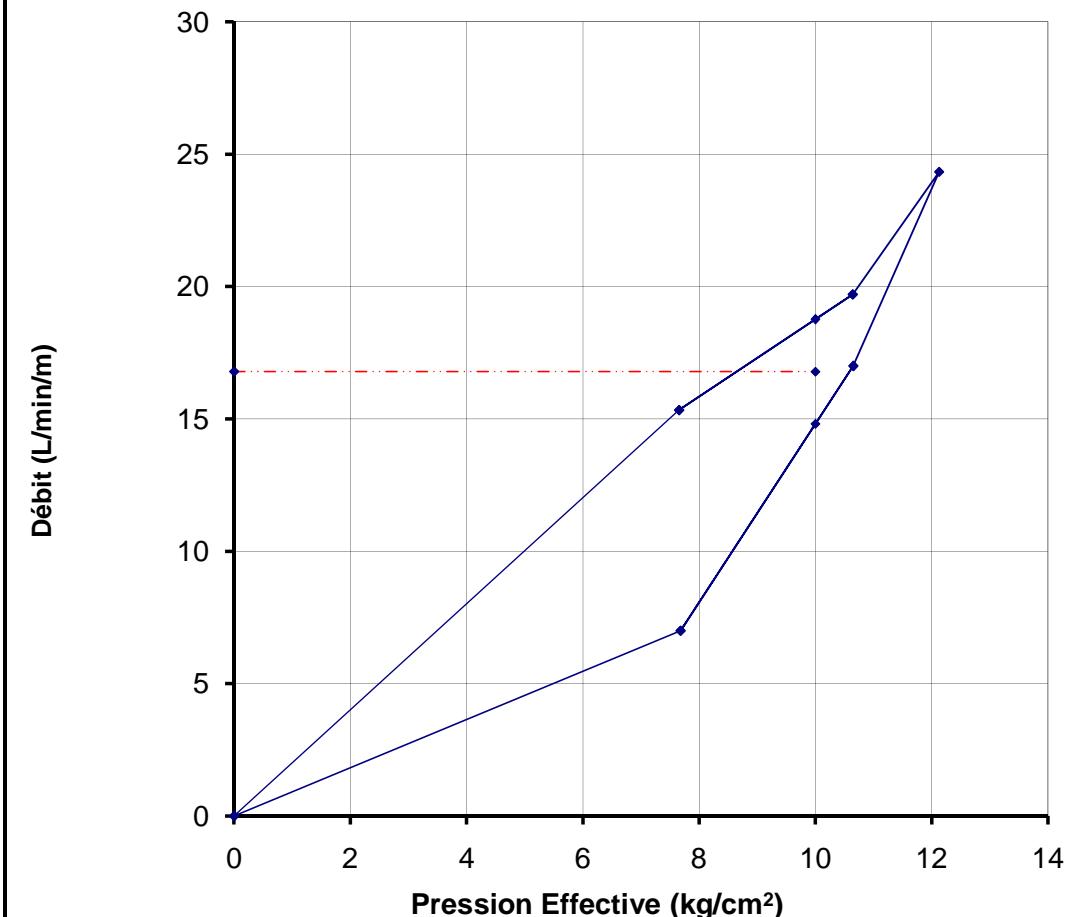
Date: **5/23/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	210	10	3	21	7.00	3.7	2.08E-02	7.679
7	510	10	3	51	17.00	3.7	5.05E-02	10.650
8.5	730	10	3	73	24.33	3.7	7.23E-02	12.128
7	591	10	3	59.1	19.70	3.7	5.85E-02	10.641
4	460	10	3	46	15.33	3.7	4.55E-02	7.654



Lugeon = 16.79 L/min/m



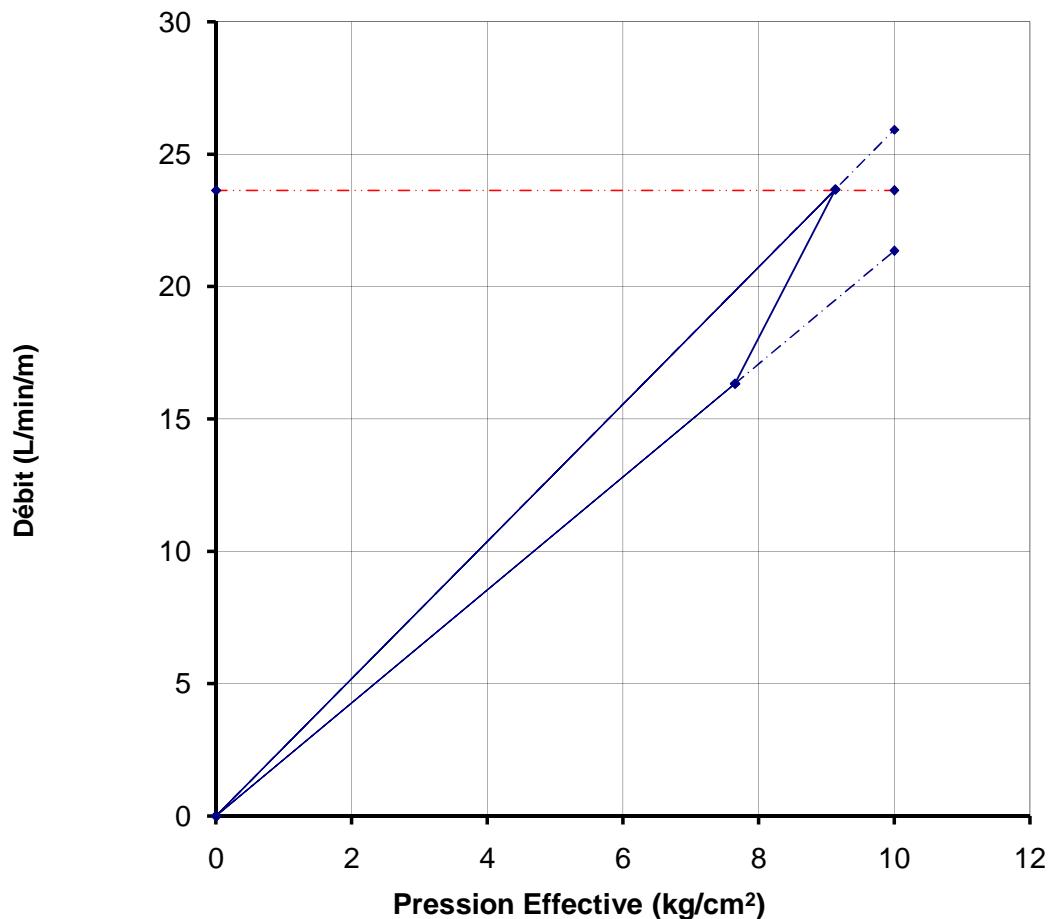
PROJECT: BISRI DAM / SECOND PACKAGE
SONDAGE No.: BHRA 04
TRANCHE ESSAYEE 54.00 m à 57.00 m

Date: **5/26/2014**

Manomètre 0.50 m

depth to water: 36.50 m

ESSAI DE PERMEABILITE LUGEON



Lugeon = 23.63 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **57.00 m à 60.00 m**

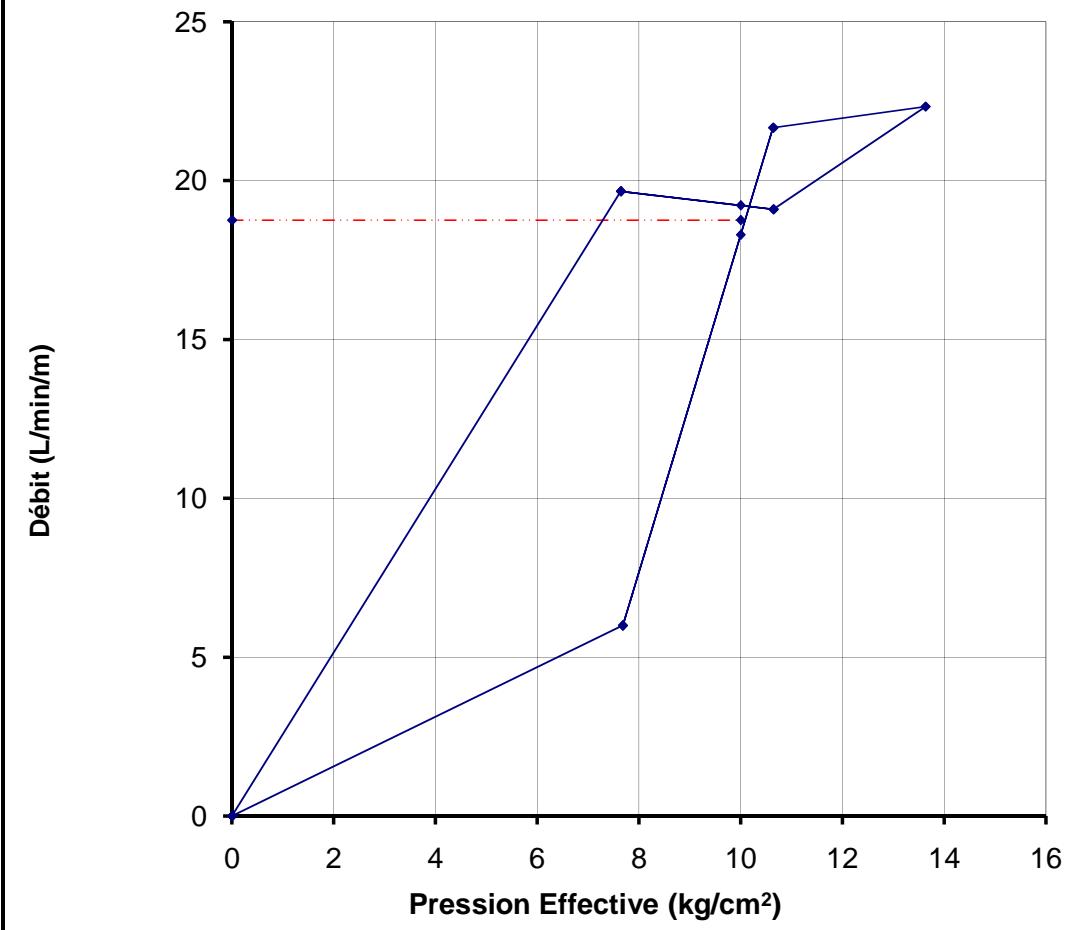
Date: **5/26/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	180	10	3	18	6.00	3.7	1.78E-02	7.682
7	650	10	3	65	21.67	3.7	6.44E-02	10.636
10	134	2	3	67	22.33	3.7	6.63E-02	13.634
7	573	10	3	57.3	19.10	3.7	5.67E-02	10.643
4	590	10	3	59	19.67	3.7	5.84E-02	7.642



Lugeon = 18.76 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **60.00 m à 63.00 m**

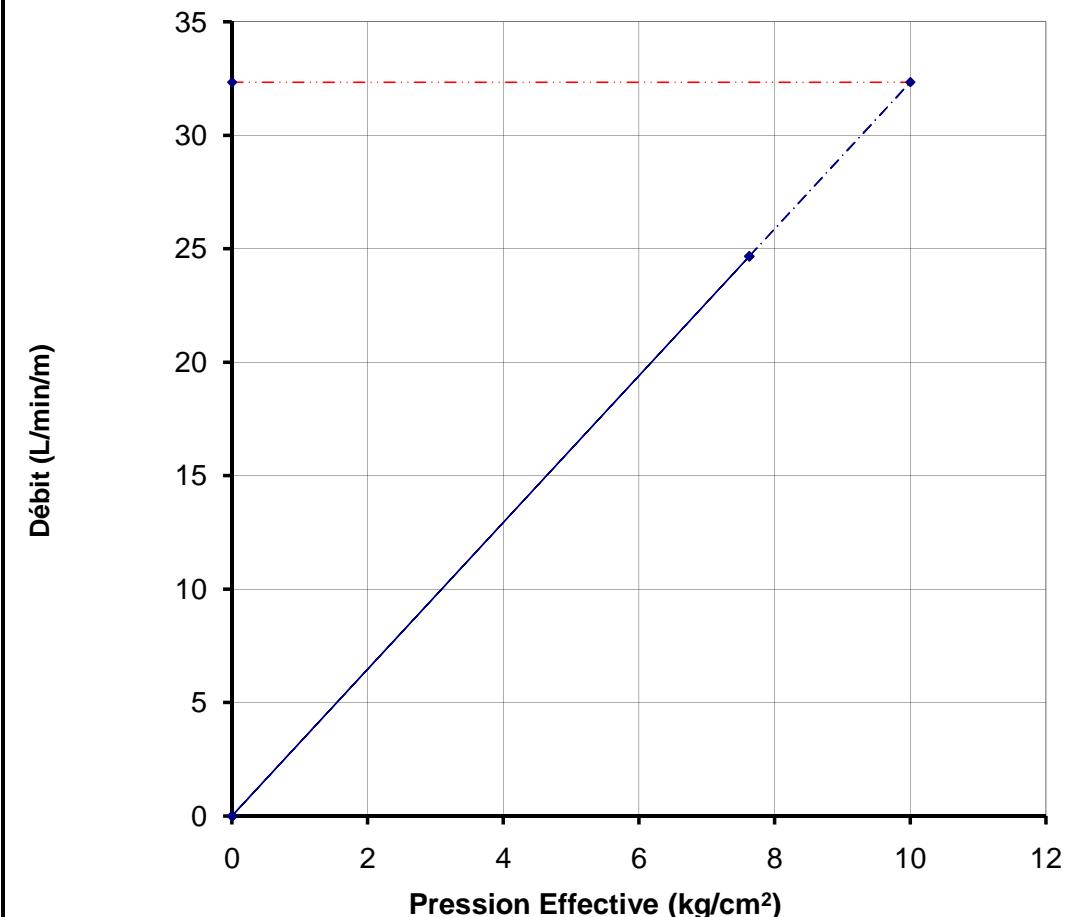
Date: **5/27/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	740	10	3	74	24.67	3.7	7.33E-02	7.627



Lugeon = 32.34 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **63.00 m à 66.00 m**

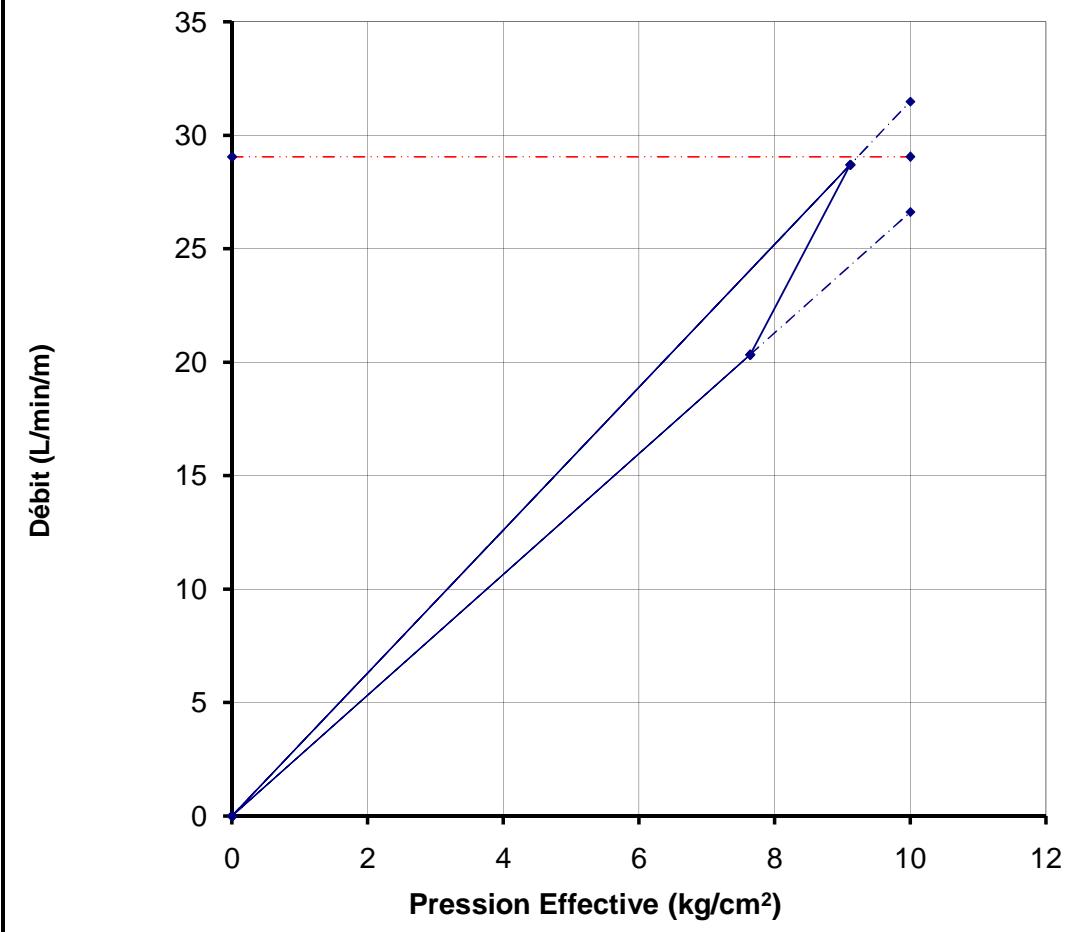
Date: **5/27/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	610	10	3	61	20.33	3.7	6.04E-02	7.640
5.5	861	10	3	86.1	28.70	3.7	8.52E-02	9.115



Lugeon = 29.05 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **66.00 m à 69.00 m**

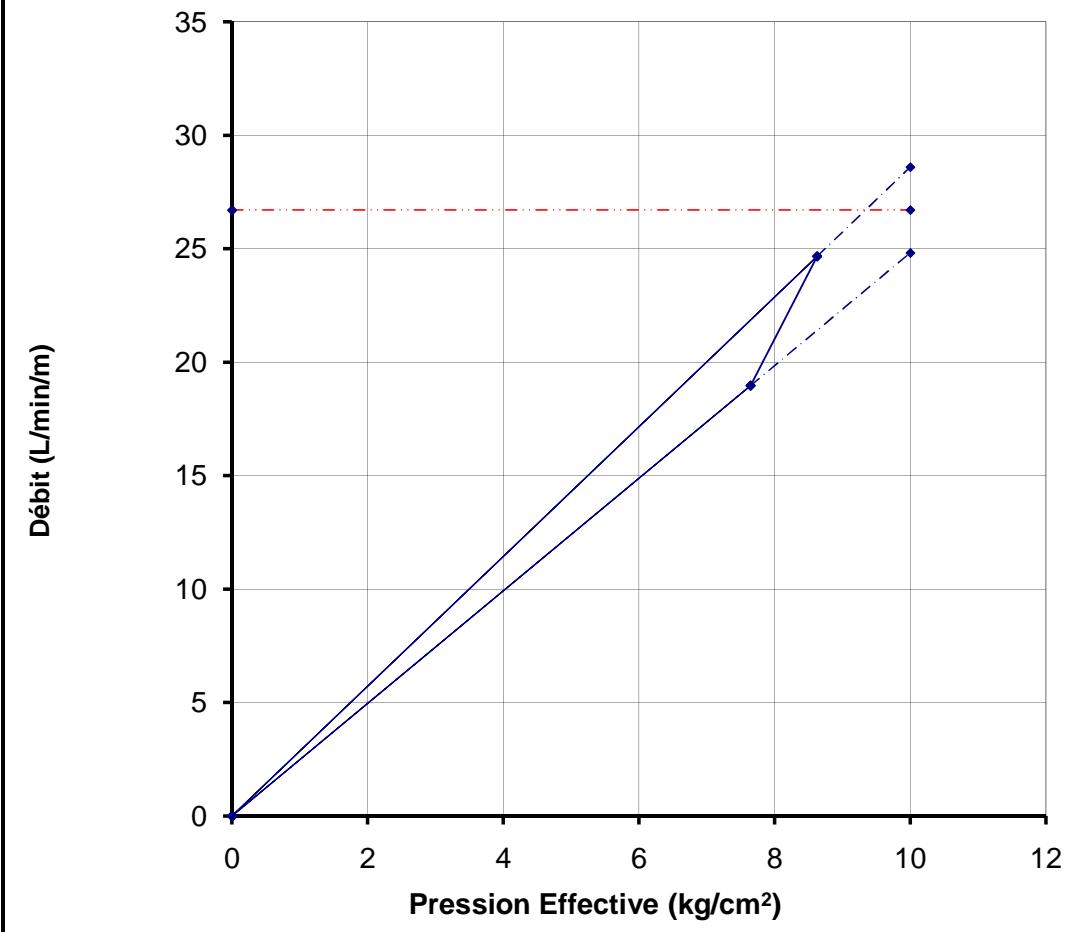
Date: **5/27/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	569	10	3	56.9	18.97	3.7	5.63E-02	7.644
5	740	10	3	74	24.67	3.7	7.33E-02	8.627



Lugeon = 26.70 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **69.00 m à 72.00 m**

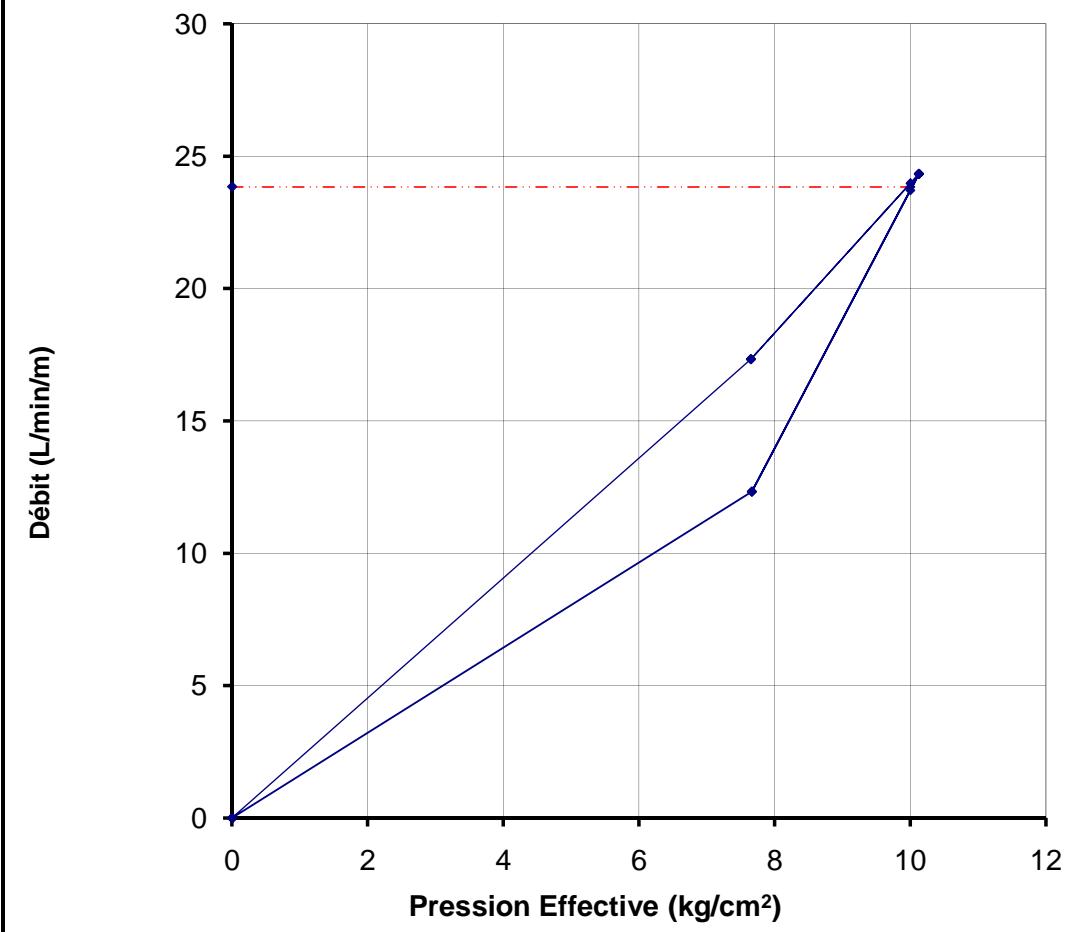
Date: **5/28/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P - J + ΔH
4	370	10	3	37	12.33	3.7	3.66E-02	7.663
6.5	730	10	3	73	24.33	3.7	7.23E-02	10.128
4	520	10	3	52	17.33	3.7	5.15E-02	7.649



Lugeon = 23.84 L/min/m



PROJECT: **BISRI DAM / SECOND PACKAGE**
SONDAGE No.: **BHRA 04**
TRANCHE ESSAYEE **72.00 m à 75.00 m**

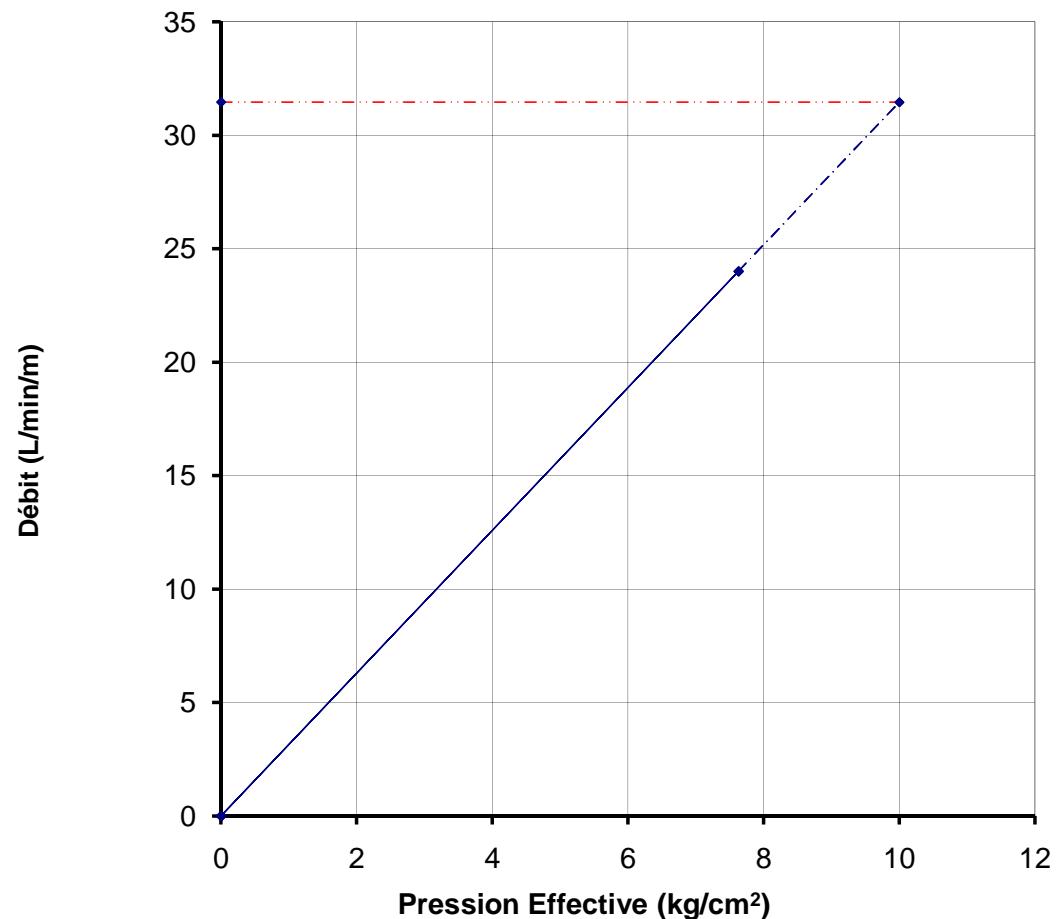
Date: **5/28/2014**

Manomètre **0.50 m**

depth to water: **36.50 m**

ESSAI DE PERMEABILITE LUGEON

Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ ΔH
4	720	10	3	72	24.00	3.7	7.13E-02	7.629



Lugeon = 31.46 L/min/m

APPENDIX 5. GROUNDWATER MEASUREMENTS INCLUDING DAILY MEASUREMENTS



DAR AL HANDASAH NAZIH TALEB & PARTNERS
دار الهندسة نزيح طالب وشريك

Detailed Design Of Bisri Dam: Geo. Inv. Rep.II: (Factual) / Spillway & Bottom Outlet - June 2014

BISRI DAM & LAKE (PIEZOMETERS)

Piezometer	Depth of groundwater table (m) from the NGL (May 7, 2014)	Depth of groundwater table (m) from the NGL (May 19, 2014)	Depth of groundwater table (m) from the NGL (May 30, 2014)	NGL (Updated on December 2013)	Depth of groundwater table as project level (May 7, 2014)	Depth of groundwater table as project level (May 19, 2014)	Depth of groundwater table as project level (Maay 30, 2014)
BDC-2	26.65	26.62	26.67	443.16	416.5	416.5	416.5
BDC-3	12.18	12.13	12.11	428.353	416.2	416.2	416.2
BDC-4	16.4	16.42	16.36	428.585	412.2	412.2	412.2
BDC-5	45.44	45.51	45.5	454.435	409.0	408.9	408.9
BDC-6	21.65	21.73	21.75	417.86	396.2	396.1	396.1
BDC-7	7.13	7.24	7.2	416.33	409.2	409.1	409.1
BDC-8	41.6	41.5	41.56	440.584	399.0	399.1	399.0
BDC-9	26.5	26.38	26.42	422.417	395.9	396.0	396.0
BCD-10	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged
BCD-11	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged
BCD-12	18.04	17.93	17.91	413.74	395.7	395.8	395.8
BCD-13	15.21	15.26	15.32	410.7	395.5	395.4	395.4
BCD-14	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged
BCD-15	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged
BCD-16	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged
BCD-17	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged
BCD-18	2.41	2.38	2.33	398.35	395.9	396.0	396.0
BCD-19	Damaged	Damaged	Damaged	399.13	Damaged	Damaged	Damaged
BCD-20	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged
BCD-21	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged
BCD-22	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged
BCD-23	Damaged	Damaged	Damaged	414.46	Damaged	Damaged	Damaged
BCD-24	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged
BCD-25	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged
BCD-26	73.22	73.34	73.42	437.8	364.6	364.5	364.4
BCD-27	49.28	49.29	49.42	433.202	383.9	383.9	383.8
BCD-28	35.79	35.77	35.73	439.6	403.8	403.8	403.9
BCD-29	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged
BCD-30	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged
BCD-31	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged
BCD-32	59.22	59.31	59.29	490.22	431.0	430.9	430.9
BCD-38					Damaged	Damaged	Damaged
BDC-42A	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged
BDC-43	Damaged	Damaged	Damaged	435.71	Damaged	Damaged	Damaged
BDC-50	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged
BDC-57	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged
BDB-1	Damaged	Damaged	Damaged	416.32	Damaged	Damaged	Damaged
EV2	2.75	3.67	4.65	401.7	398.95	398.03	397.05
EV3	Artesian flow	Artesian flow	Artesian flow	398.29	Artesian flow	Artesian flow	Artesian flow
EV7	Artesian flow	Artesian flow	Artesian flow	396	Artesian flow	Artesian flow	Artesian flow
EV10	20.35	20.32	20.41	420.2	399.85	399.88	399.79
VF2	6.75	6.97	7.23	414.92	408.17	407.95	407.69
VF3	5.83	5.81	5.84	414.45	408.62	408.64	408.61
VF4	5.93	6.02	5.97	419.19	413.26	413.17	413.22
BHVL1	0.75	0.72	0.77	396.57	395.82	395.85	395.8
BHLA1	35.91	35.94	35.88	431.5	395.59	395.56	395.62
BHLA2	55.18	55.22	54.92	459.4	404.22	404.18	404.48
BHVR3	8.88	8.91	8.97	413.8	404.92	404.89	404.83
BHVR5	10.38	10.44	10.51	414.37	403.99	403.93	403.86
BHRA3	24.57	25.23	26.32	430.25	405.68	405.02	403.93
BHRA1	37.21	38.74	38.63	441.98	404.77	403.24	403.35
BHVR2		9.23	9.21	414.09		404.86	404.88
BHRA2		93.84	97.57	490.25		396.41	392.68
BHRA4			36.5	449.85			413.35

BISRI DAM & LAKE (PIEZOMETERS)

Piezometer	Depth of groundwater table (m) from the NGL (updated on December 2013)	Depth of groundwater table (m) from the NGL (updated on January 2014)	Depth of groundwater table (m) from the NGL (updated on February 2014)	Depth of groundwater table (m) from the NGL (updated on March 2014)	Depth of groundwater table (m) from the NGL (updated on April 5, 2014)	Depth of groundwater table (m) from the NGL (updated on April 21, 2014)	Depth of groundwater table (m) from the NGL (updated on April 30, 2014)	NGL (Updated on December 2013)	Depth of groundwater table as project level (December 2013)	Depth of groundwater table as project level (January 2014)	Depth of groundwater table as project level (February 2014)	Depth of groundwater table as project level (March 2014)	Depth of groundwater table as project level (April 5, 2014)	Depth of groundwater table as project level (April 21, 2014)	Depth of groundwater table as project level (April 30, 2014)	Depth of groundwater table as project level (January 2013)	Depth of groundwater table as project level (April 1983)
BDC-2	35	26.2	26.49	26.48	26.5	26.68	26.49	443.16	408.2	417.0	416.7	416.7	416.7	416.5	416.7	417.6	407.4
BDC-3	5	5.75	12.24	12.2	12.05	12.11	12.06	428.353	423.4	422.6	416.1	416.2	416.3	416.2	416.3	421.4	414.5
BDC-4	12	16.8	16.25	16.23	16.32	16.38	16.53	428.585	416.6	411.8	412.3	412.4	412.3	412.2	412.1	423.1	403.1
BDC-5	33	46.28	46.65	44.4	44.53	44.82	44.91	454.435	421.4	408.2	407.8	410.0	409.9	409.6	409.5	408.8	407.8
BDC-6	16	21.6	21.96	21.3	21.7	21.77	21.58	417.86	401.9	396.3	395.9	396.6	396.2	396.1	396.3	396.7	391.5
BDC-7	7.4	8.25	7.54	7	7.24	7.35	7.21	416.33	408.9	408.1	408.8	409.3	409.1	409.0	409.1	409.2	409.1
BDC-8	12.5	17.9	18.25	42.46	42.62	42.33	41.78	440.584	428.1	422.7	422.3	398.1	398.0	398.3	398.8	397.1	397.6
BDC-9	28.6	27.27	26.95	25.93	26.53	26.61	26.42	422.417	393.8	395.1	395.5	396.5	395.9	395.8	396.0	396.1	396.6
BDC-10	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	396.4
BDC-11	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	400.3	401.5
BDC-12	17.57	26.3	17.82	17.2	17.95	17.95	17.82	413.74	396.2	387.4	395.9	396.5	395.8	395.8	395.9	396.4	396.6
BDC-13	15.22	16.4	15.24	No Access	No Access	No Access	No Access	410.7	395.5	394.3	395.5	No Access	No Access	No Access	No Access	394.4	396.5
BDC-14	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	397.7
BDC-15	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged
BDC-16	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	395.7
BDC-17	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	397
BDC-18	2.46	3.1	2.32	1.78	2.28	2.41	2.33	398.35	395.9	395.3	396.0	396.6	396.1	395.9	396.0	396.6	396.3
BDC-19	13	2.7	8.6	Damaged	Damaged	Damaged	Damaged	399.13	386.1	396.4	390.5	Damaged	Damaged	Damaged	Damaged	391.8	392.4
BDC-20	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	398.6
BDC-21	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	406.1
BDC-22	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	404.9
BDC-23	9.67	8.9	9.42	Damaged	Damaged	Damaged	Damaged	414.46	404.8	405.6	405.0	Damaged	Damaged	Damaged	Damaged	405.9	405.0
BDC-24	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	406.4
BDC-25	74.1	74.75	74.22	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	364.1
BDC-26	74.67	75.23	74.82	73.1	72.58	72.86	73.09	437.8	363.1	362.6	363.0	364.7	365.2	364.9	364.7	365.3	
BDC-27	51.5	51.22	51.1	51.83	44.85	46.77	48.52	433.202	381.7	382.0	382.1	381.4	388.4	386.4	384.7	>358.4	387.9
BDC-28	35.8	36.3	36.9	36.6	34.6	34.23	35.18	439.6	403.8	403.3	402.7	403.0	405.0	405.4	404.4	386.4	404.5
BDC-29	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	406
BDC-30	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	>344.4
BDC-31	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	>366.9
BDC-32	60.15	60.85	59.63	59.25	59.3	59.81	59.44	490.22	430.1	429.4	430.6	431.0	430.9	430.4	430.8	>370.2	
BDC-38	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	408.7
BDC-42A	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	414
BDC43	28.22	28.1	28.36	Damaged	Damaged	Damaged	Damaged	435.71	407.5	407.6	407.4	Damaged	Damaged	Damaged	Damaged	408.6	
BDC-50	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged
BDC-57	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged		Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged
BDB-1	19.2	26.8	20.18	Damaged	Damaged	Damaged	Damaged	416.32	397.1	389.5	396.1	Damaged	Damaged	Damaged	Damaged		
EV2		4.6	5.3	4.05	3.55	3.96	3.18	401.7	397.1	396.4	397.65	398.15	397.74	398.52			
EV3		Artesian flow	Artesian flow	Artesian flow	Artesian flow	Artesian flow	Artesian flow	398.29	Artesian flow	Artesian flow	Artesian flow	Artesian flow	Artesian flow	Artesian flow	Artesian flow		
EV7		Artesian flow	Artesian flow	Artesian flow	Artesian flow	Artesian flow	Artesian flow	396	Artesian flow	Artesian flow	Artesian flow	Artesian flow	Artesian flow	Artesian flow	Artesian flow		
EV10		20.35	21.35	15.8	20.2	20.34	20.27	420.2	399.85	398.85	404.4	400	399.86	399.93			
VF2		6.4	6.1	7.2	6.48	6.51	6.69	414.92	408.52	408.82	407.72	408.44	408.41	408.23			
VF3		5.3	5.65	6	5.49	5.63	5.72	414.45	409.15	408.8	408.45	408.96	408.82	408.73			
VF4		5.9	6.83	6	5.78	5.89	5.89	419.19	413.29	412.36	413.19	413.41	413.3	413.3			
BHVL1		0.4	0.4	0.68	0.75	0.71	0.71	396.57		396.17	396.17	395.89	395.82	395.86			
BHLA1		35	35	35.6	35.7	35.8	431.5		396.5	396.5	395.9	395.8	395.7				
BHLA2			54.12	54.6	54												

BISRI DAM - Daily Water Level Measurements / During Execution

BHRA2	DATE	Morning	Evening
	4/11/2014		13.1
	4/12/2014	16.5	23.1
	4/14/2014	31.5	26.7
	4/15/2014	37.8	
	4/17/2014		28.4
	4/18/2014	42.8	27.2
	4/19/2014	52.1	29.6
	4/21/2014	54.2	28.5
	4/22/2014	57.5	28.5
	4/23/2014	59	30.9
	4/24/2014		42.5
	4/25/2014	52.3	48.2
	4/26/2014	57.7	62.3
	4/28/2014	73.4	58.5
	4/29/2014	72.8	63.5
	4/30/2014	77.6	65
	5/1/2014	81.5	61.5
	5/2/2014	80.5	60
	5/3/2014	81.1	68.15
	5/5/2014	82.9	70.9
	5/6/2014	83.7	78.2
	5/7/2014	84.9	70.15
	5/9/2014	84.5	71.5

BISRI DAM - Daily Water Level Measurements / During Execution

BHRA4	DATE	Morning	Evening
	5/20/2014		12.2
	5/21/2014	Dry	15.4
	5/22/2014	23.55	24.8
	5/23/2014	23.9	23.8
	5/24/2014	23.5	28.9
	5/26/2014	31.5	38.5
	5/27/2014	36.5	35.2
	5/28/2014	37.9	

APPENDIX 6. LIST OF SAMPLING & LABORATORY TESTING (BH & NTP).



BISRI DAM LABORATORY TESING - NEW TEST PITS (NTP)					Testing																																		
Sampling																																							
No. of Test Pit	Depth of Sampling (m)	Type of Sample	Sample Description	Date of Sampling	Unit (U)	Remolding	15	Void Ratio	15	Sieve	15	Hydrometer	15	Field Density	13	Triaxial (CU+U)	5	In-situ Moisture	13	Consolidation	5	Atterberg	15	Organic Content	14	Bulk and Saturated Density	15	Proctor	5	Permeability	5	Free Swelling Index	5	Double Hydrometer	5	Sulfate, Chloride, PH	8	General Total	168
NTP1	2.5	Bulk	Clay core material (Area: S1-A/B/C)	29.05.2014		3		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1						
NTP2	3	Bulk	Clay core material (Area: N-1)	28.05.2014		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
NTP3	5					3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
NTP3	2.5	Bulk	Clay core material (Area: S-3)	28.05.2014		3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
NTP3	3.4					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
NTP3	3.8					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
NTP4	2.5	Bulk	Clay core material (Area: N-3)	29.05.2014		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
NTP4	4					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
NTP5	2.7	Bulk	Clay core material (Area: N-3)	28.05.2014		3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
NTP5	5					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
NTP6	2.8	Bulk	Clay core material (Area: N-3)	28.05.2014		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
NTP6	5.8					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
NTP7	2.7	Bulk	Clay core material (Area: N-3)	28.05.2014		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
NTP7	5.1					3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1						
NTP8	1.2	Bulk	Clay core material (Area: S1-A/B/C)	29.05.2014		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							

Test will be done on compacted/re-molded (98%, Wopt + 2%) soil samples.

Bisri Dam Laboratory Testing (Morocco) - Undisturbed Soil Samples (First Package)

Bisri Dam Laboratory Testing (Morocco) - Undisturbed Soil Samples (First Package)																	Testing																												
Sampling						Testing																																							
No. of BH	Depth of Sampling (m)	Type of Sampling	Sample Description	Date of Sampling	Unit (U)	Moisture Content	16	Void Ratio	0	Sieve	16	Hydrometer	16	UCS	0	Triaxial (CU+U)	8	Triaxial (CD)	0	Consolidation	8	Atterberg	16	Organic Content	9	Bulk and Saturated Density	0	Uni-axial CS	0	PLI	0	Water Absorption	0	Unit Weight	0	Soundness	0	Stake Durability	0	Calcium Carbonate	0	Sulfate, Chloride, PH	0	General Total	89
BHVR2	7.5-8.0m	Shelby	Undisturbed	As per ID card		1	1	1	1								1	1																											
	8.0-8.5m					1	1	1										1	1																										
	13.5-14.0m					1	1	1	1																																				
	14.0-14.5m					1	1	1											1	1																									
	19.5-20.0m					1	1	1	1																																				
	20.0-20.5m					1	1	1											1	1																									
BHVR6	4.5-5.0m	Shelby	Undisturbed	As per ID card		1	1	1	1																																				
	5.0-5.5m					1	1	1											1	1																									
	13.5-14.0m					1	1	1	1																																				
	16.5-17.0m					1	1	1											1	1																									
	32.0-32.5m					1	1	1	1											1	1																								
	37.5-38.0m					1	1	1											1	1																									
	43.5-44.0m					1	1	1	1											1	1																								
	44.0-44.5m					1	1	1											1	1																									
	47.0-47.5m					1	1	1	1											1																									
	49.5-50.0m					1	1	1											1	1																									

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Note: Regarding the Triaxial Test (CU+U), the maximum consolidation pressure: 1600 kN/m², the intermediate one: 800 kN/m² and the minimum: 400 kN/m². A counter-pressure of 500 kN/m² during shearing, to be sure that the samples will remain totally saturated for more accuracy in the pore pressure (u) monitoring.

Bisri Dam Laboratory Testing (Morocco) - Undisturbed Soil Samples (First Package)