REPUBLIC OF LEBANON

COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION

DETAILED DESIGN OF BISRI DAM PROJECT

CONTRACT NO.17909

SPILLWAY & BOTTOM OUTLET STRUCTURES

GEOTECHNICAL INVESTIGATION REPORT I

FACTUAL

January 2014

Founded 1956

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دار الهندسة نزيه طالب وشركاه

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	☐ Draft	☑ Final
	Signature:	

1. Introduction

Nine boreholes were located and drilled in a manner to determine the depth of subsurface rock stratums within the entrance and exit of the bottom outlet structure and within the flip bucket of the spillway (Appendix 1).

2. Field Investigation

The field investigation was performed between November 16 and December 24, 2013. Nine boreholes were drilled to a maximum depth of 65m at locations shown on Figure 1. A crawler mounted rotary drill rig as shown on Figure 2 was used in field investigation.

EV1 (+415.70 NGL):

30 meters deep, crushed sandy limestone at a depth of 21m (+394.70).

EV2/Piezometer (+402.20 NGL):

30 meters deep, no subsurface rock stratum was encountered.

VF3/Piezometer (+414.40 NGL):

39 meters deep, intensely jointed and crushed claystone at a depth of 33m (+381.40).

VF2/Piezometer (+414 NGL):

39 meters deep, moderately weathered sandstone at a depth of 32.5m (+381.50), highly weathered marlstone at a depth of 33.5m (+380.50) and intensely jointed marly limestone at a depth of 36m (+378.00).

EV7/Piezometer (+396 NGL):

65 meters deep, crushed marly limestone at a depth of 56m (+340.00) and moderately to highly weathered marlstone at a depth of 62.5m (+333.50).

EV3/Piezomete (+395.80 NGL):

45.5 meters deep, crushed marly limestone at a depth of 41.5m (+354.30).

EV9 (+414.90 NGL):

18 meters deep, blocky/seamy and crushed limestone at a depth of 9m (+405.90)

EV10/Piezometer (+420.10 NGL):

30 meters deep, intensely jointed and crushed limestone at a depth of 2.5m (+417.60)

VF4/Piezometer (+419.10 NGL):

40 meters deep, highly to completely weathered sandstone (mainly decomposed and/or disintegrated to soil) at a depth of 2m, moderately to highly weathered poorly cemented sandstone at a depth of 12m (+407.10), moderately weathered crushed sandstone at a depth of 27m (+392.10) and slightly to moderately weathered intensely jointed well cemented sandstone at a depth of 38m (+381.10).

Groundwater table and artesian flow were detected in boreholes at below given depths (November and December 2013) from the natural ground level (NGL)

EV1/No Piezometer (+415.70 NGL):

Groundwater table at a depth of 15m (+400.70) during the execution.

EV2/Piezometer (+402.20 NGL):

Groundwater table at a depth of 4.4m (+397.80) in average.

VF3/Piezometer (+414.40 NGL):

Groundwater table at a depth of 5.7m (+408.70) in average.

VF2/Piezometer (+414 NGL):

Groundwater table at a depth of 6m (+408.00) in average.

EV7/Piezometer (+396 NGL):

Artesian flow at a depth of 21m (+375.00), groundwater table at a depth of 1m (+395.00) before having the artesian flow.

EV3/Piezomete (+395.80 NGL):

Artesian flow at a depth of 12m (+383.80) and 42m (+353.80), groundwater table at a depth of 0.3m (+395.50) before having the artesian flow.

EV9/ No piezometer (+414.90 NGL):

Groundwater table at a depth of 15.5m (+399.40) during the execution

EV10/Piezometer (+420.10 NGL):

Groundwater table at a depth of 19.5m (+400.60) in average.

VF4/Piezometer (+419.10 NGL):

Groundwater at a depth of 6m (+413.00) in average.

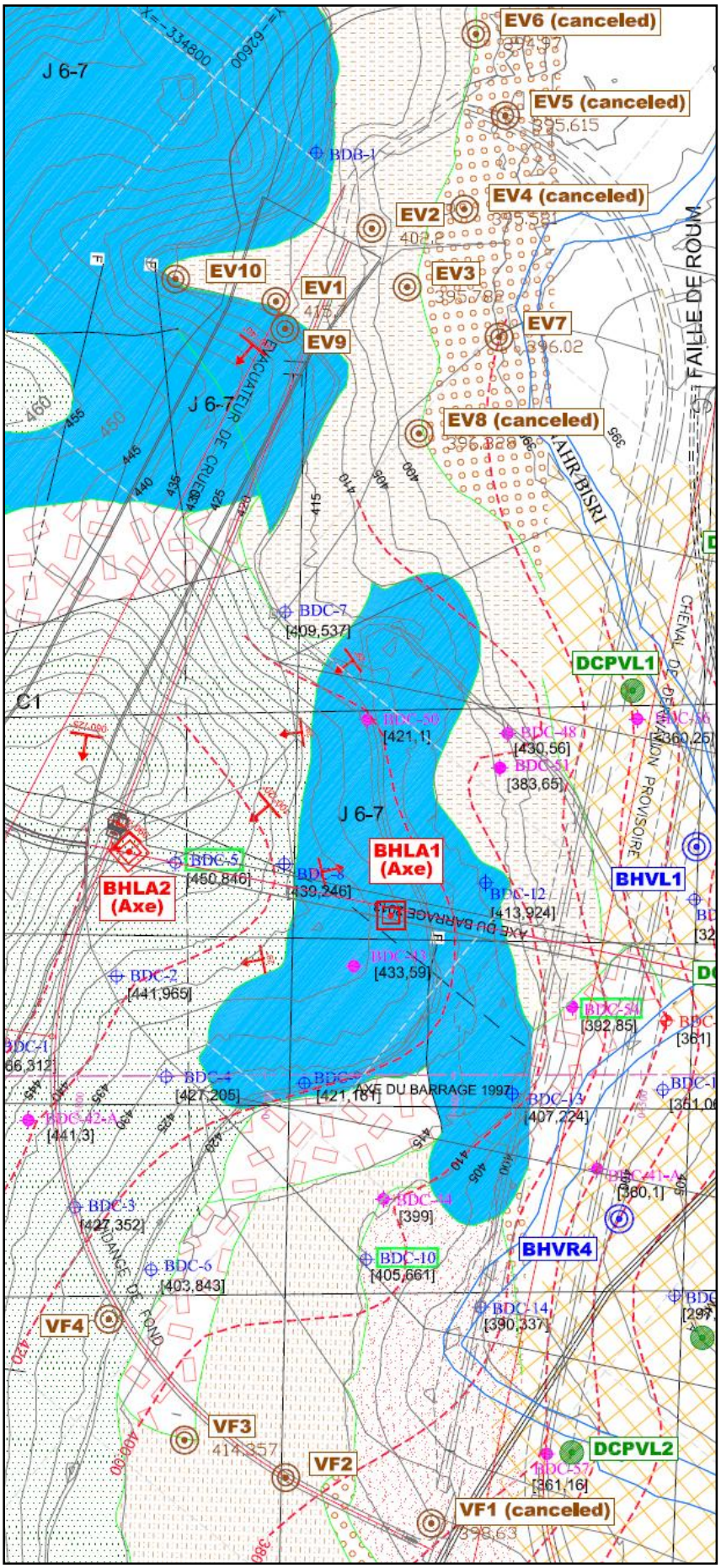


Figure 1: Borehole locations

Cavities were detected in boreholes at below given depths from the natural ground level (NGL)

EV1/No Piezometer (+415.70 NGL):

Cavity was detected between 24.5 (+391.20) and 25.5m (+390.20).

EV3/Piezomete (+395.80 NGL):

Cavity (confined karstic aquifer) was detected between 42 (+353.80) and 44m (+351.80) with artesian flow.

Figure 2: Crawler mounted rotary drill rig (EV1)

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 samples.
- Performing Dynamic Cone Penetration Test in soils contain coarse gravels and cobbles.
- Performing borehole water permeability (Falling Head Test) and Lugeon tests in soil and rock stratums respectively.
- Installing standpipe open piezometers into the boreholes and measuring the depth and fluctuations of the groundwater table.

86mm diameter double tube core barrel ("T" type), equipped with tungsten carbide core bit was used in continuous core drilling with BW drill rods and HW casings.

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 during the drilling 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 3). 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 stratums, Standard Penetration Test (SPT) was performed at 1.5m intervals by using Split-Spoon SPT sampler in 2 inches outside diameter (see Figure 3) and disturbed samples were obtained, labeled and kept in moisture-proof containers.

Figure 3: Wooden core box and SPT sampler

Dynamic Cone Penetration Test (DCPT) was carried out in soils contain coarse gravels and cobbles to estimate their relative density. A solid cone (see Figure 4) having an apex angle of 60^{o} and an end diameter of 62.5mm was used in DCPT with AW drill rods and automatic trip SPT hammer (see Figure 5).

Figure 4: Solid cone

Figure 5: SPT hammer

Multistage Lugeon test was performed in rock stratums as shown on Figure 6 at different depths. The test was conducted in portions (5 meters long) of the boreholes isolated by the single pneumatic packer having a diameter of 76mm. The test results are presented in Appendix 4 of this factual report.

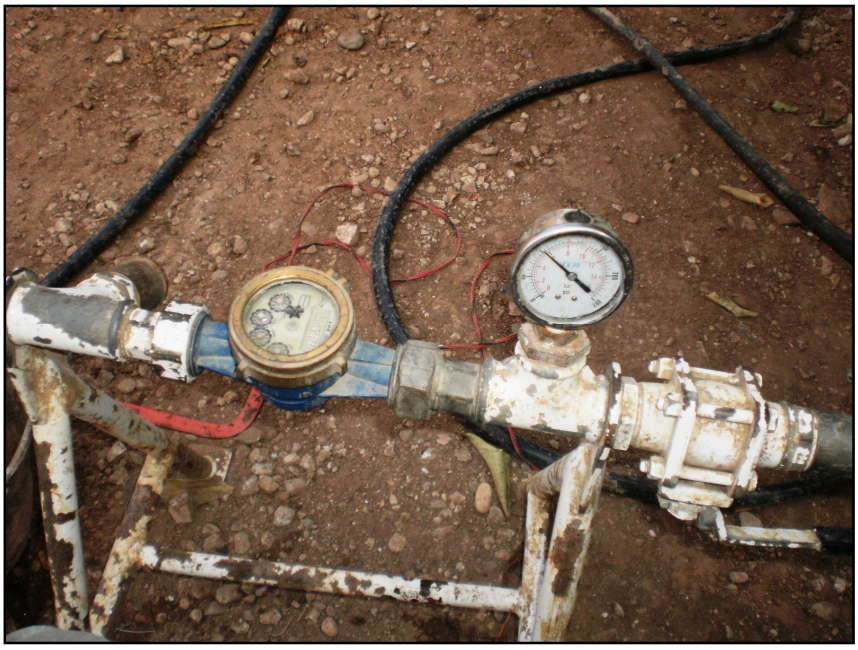


Figure 6: Lugeon Test

In soil stratums, Falling Head borehole water permeability test was carried out as shown on Figure 7 at 3m intervals. The test results are presented in Appendix 4 of this factual report.

Figure 7: Falling Head Test

All the field works were performed according to ASTM and IS standards (ASTM D6640: Core drilling in soil and rock, ASTM D1586: Standard Penetration Test, IS 4968: Dynamic Cone Penetration Test, ASTM D4630: Standard Test Method for Constant Head Injection Test, Lambe & Whitman: Falling Head Test and ASTM D4750: Determining Subsurface Liquid Levels in a borehole) and were supervised by an engineering geologist who also kept the logs of borings.

4. Subsurface Strata

According to the logs of borings, the following subsurface soil and rock stratums were encountered within the boreholes. The logs of borings are presented in Appendix 2 of this factual report.

EV1 (+415.70 NGL):

0-21m: Loose to medium dense (in general) and dense silty clayey SAND with gravels.

21-30m: Crushed sandy LIMESTONE

EV2/Piezometer (+402.20 NGL):

0-30m: Loose to medium dense (in general) and dense silty clayey SAND with gravels / soft (in general) to medium stiff slightly sandy and silty CLAY

VF3/Piezometer (+414.40 NGL):

0-16.5m: Loose to medium dense (in general) and dense silty clayey SAND with gravels / soft (in general) to medium stiff slightly silty and sandy CLAY.

16.5-33m: Highly weathered CLAYSTONE (mainly decomposed and/or disintegrated to soil).

33-39m: Slightly to moderately weathered intensely jointed and crushed CLAYSTONE.

VF2/Piezometer (+414 NGL):

0-32.5m: Medium dense (in general) and dense silty clayey SAND with gravels / soft (in general) to medium stiff slightly silty and sandy CLAY.

32.5-33.5m: Moderately weathered crushed SANDSTONE.

33.5-36m: Highly weathered (mainly decomposed and/or disintegrated to soil) MARLSTONE.

36-39m: Slightly weathered intensely jointed marly LIMESTONE.

EV7/Piezometer (+396 NGL):

0-10.5m: Loose to medium dense silty clayey SAND with gravels.

10.5-19m: Soft to medium stiff slightly silty and sandy CLAY.
19-37.5m: Firm slightly silty and sandy CLAY.
37.5-56m: Firm to very stiff (in general) and hard slightly silty and sandy CLAY.
56-62.5m: Slightly weathered crushed marly LIMESTONE.
62.5-65m: Moderately to highly weathered MARLSTONE.

EV3/Piezomete (+395.80 NGL):

0-6m: Medium dense silty clayey SAND with gravels.

6-19m: Soft to medium stiff slightly silty and sandy CLAY.

19-25m: Medium stiff to firm slightly silty and sandy CLAY.

25-30m: Soft slightly silty and sandy CLAY.

30-41.5m: Loose to medium dense silty clayey SAND with gravels.

41.5-45.5m: Slightly weathered crushed marly LIMESTONE.

EV9 (+414.90 NGL):

0-5m: Loose to medium dense silty clayey SAND with gravels and cobbles.

5-9m: Highly weathered SANDSTONE (decomposed and/or disintegrated to soil).

9-18m: Slightly weathered blocky/seamy and crushed LIMESTONE.

EV10/Piezometer (+420.10 NGL):

0-2.5m: Medium dense silty clayey SAND with gravels.

2.5-30m: Slightly weathered intensely jointed and crushed LIMESTONE.

VF4/Piezometer (+419.10 NGL):

0-2m: Loose clayey SILT.

2-12m: Highly to completely weathered SANDSTONE (mainly decomposed and/or disintegrated to soil).

12-27m: Moderately to highly weathered poorly cemented SANDSTONE.

27-38m: Moderately weathered crushed SANDSTONE.

38-40m: Slightly to moderately weathered intensely jointed well cemented SANDSTONE.

5. Closure

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

APPENDICES

APPENDIX 1. GEOLOGIE DU SITE (PLAN G-02 / December 2013)

APPENDIX 2. LOGS OF BORINGS

APPENDIX 3. PHOTOS OF CORE BOXES

APPENDIX 4. BOREHOLE WATER PERMEABILITY & LUGEON TEST RESULTS

APPENDIX 1. GEOLOGIE DU SITE (PLAN G-02 / December 2013)

	x	y	z	Estimated depth of Drilling or probing from the existing ground surface (m)
BHLA1	−334,515.0	−62,242.8	431.5	105
BHLA2	−334,452.5	−62,371.9	459.2	95
BHRA1	−334,761.7	−61,782.4	440.1	125
BHRA2	−334,799.7	−61,708.1	489.9	145
BHRA3	−334,399.6	−61,586.5	430.8	100
BHRA4	−334,281.1	−61,494.7	449.9	100
BHVL1	−334,646.8	−62,140.6	396.6	100
BHVR1	−334,786.8	−62,057.4	No Access	95
BHVR2	−334,844.8	−61,965.6	No Access	50
BHVR3	−334,716.2	−61,952.7	413.8	70
BHVR4	−334,467.5	−62,046.0	398.0	75
BHVR5	−334,650.3	−61,876.5	414.2	65
DCPVL1	−334,689.4	−62,220.0	396.3	40
DCPVL2	−334,355.3	−61,986.1	No Access	45
DCPVR1	−334,772.9	−62,210.1	397.1	70 or as deeper as possible
DCPVR2	−334,848.2	−62,181.8	397.8	70
DCPVR3	−334,910.9	−62,086.5	405.6	30
DCPVR4	−334,620.5	−62,050.7	398.0	70 or as deeper as possible
DCPVR5	−334,567.6	−61,973.7	414.7	70 or as deeper as possible
DCPVR6	−334,695.1	−61,813.6	415.6	20
DCPVR7	−334,446.7	−61,971.5	398.1	70 or as deeper as possible
DCPVR8	−334,574.3	−61,848.1	414.5	50
DCPVR9	−334,467.6	−61,866.5	411.3	70
EV1	−334,728.7	−62,498.6	415.7	30
EV2	−334,791.3	−62,484.1	402.2	30
EV3	−334,779.2	−62,449.7	395.8	50
EV4	−334,830.5	−62,452.7	395.6	Cancelled
EV5	−334,883.0	−62,467.7	395.6	Cancelled
EV6	−334,906.6	−62,507.4	395.0	Cancelled
EV7	−334,789.7	−62,395.0	396.0	60
EV8	−334,722.9	−62,395.0	396.3	Cancelled
EV9	−334,720.5	−62,485.6	414.9	30
EV10	−334,703.9	−62,547.4	420.1	30
VF1	−334,278.5	−62,019.7	398.6	Cancelled
VF2	−334,248.0	−62,095.0	414.0	40
VF3	−334,229.1	−62,149.3	414.4	40
VF4	−334,253.3	−62,221.5	419.1	40

LEGENDE:

1. LITHOLOGIE

QUATERNAIRE		EBOULIS,BRECHE, COUVERTURE: D'EBOULIS DE GRES, D'ARGILE ET DE BLOCS DE CALCAIRE
		SILT. SABLE. GRES DESINTEGRE
		SABLE
		LIMON
		LIMON ET GALETS
C4-5		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
C3		ALBIEN (BARRE A CARDIUM) : CALCAIRE ORANGE-JAUNÂTRE. DUR. CRISTALLIN. KARSTIFIE MARNES ET MARNO-CALCAIRE VERT-JAUNÂTRE A ABONDANTES COQUILLES.
C1		GRES DE BASE ; ALTERNANACE DE SABLE , D'ARGILE, DE MARNE,DE SABLE FERRUGINEUX CIMENTE, PARFOIS TRES DUR. DE TUF PARFOIS CIMENTE ET DE CINERITES
J 7		KIMMERIDGIEN: CALCAIRE GRIS. OOLITHIQUE. CRISTALLIN, DUR. KARSTIFIE. A NIVEAUX MARNEUX
J 6		PORTLANDIEN: CALCAIRE FIN MASSIF. RAREMENT OOLITHIQUE. OCRE TANTOT A POINTS ROUGES. A SILEX. CRISTALLIN. DURE PEU KARSTIFIE.

2. SYMBOLS

- BDC1 — SONDAGES REALISES EN 1982
- BDC45 — SONDAGES REALISES EN 1983
- BDC47 — SONDAGES REALISES EN 1996
- SONDAGES REALISES EN 2014 (DCPT Probing, see note 4)
- SONDAGES REALISES EN 2013 (Core Drilling, see note 1)
- SONDAGES REALISES EN 2014 (Core Drilling, see note 2)
- SONDAGES REALISES EN 2014 (Core Drilling, see note 3)
- AD−1 — GALERIE DE RECONNAISSANCE REALISEE ENTRE 1981 ET 1984
- COURBE D'EGALE ELEVATION DU TOIT DU SUBSTRATUM
- CHUTES D'OUTILS RELEVEES DANS LES SONDAGES
- [329,96] — COTE TOIT DU SUBSTRATUM
- FAILLE IMPORTANTE
- DIRECTION ET PENDAGE

NOTA:

1 - 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.

2 - Continuous core drilling in soil and rock to a depth of reaching the bedrock and penetrating it 30m 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.

3 - Continuous core drilling in rock to a depth of reaching the bottom level of the grout curtain for the bore-holes located within the axe of the dam and reaching the ground water table and penetrating it for the bore-holes located within the lake of the dam by carrying out Lugeon test at 3m intervals.

4 - Continuous Dynamic Cone Penetration (DCPT probing) to a depth of reaching the bedrock or as deep as possible with full casing down to 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 automatic trip standard SPT hammer.

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

Echelle : 0 20 100m

No	DATE	REV	TOP	GEO	CIV	ARCH	STRUCT	MECH	ELEC

LEBANESE REPUBLIC

COUNCIL FOR DEVELOPMENT & RECONSTRUCTION

BARRAGE BISRI

DAR AL HANDASAH NAZIH TALEB & PARTNERS — دار الهندسة نزيه طالب وشركاه (Founded 1956)

NOVEC — CDR DEVELOPMENT

	DRAWN	
	CHECKED	
	APPROVED	
GEOLOGIE DU SITE	SCALE	1/2 000 on A1
	DATE	December 2013
	FILENAME	PLAN G-02

PROJECT	DIVISION	SHEET	REVISION
			12/12/2013

APPENDIX 2. LOGS OF BORINGS

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV1
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	415.7	**SHEET:** 1	**OF:** 3
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	30.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	11/16/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	11/19/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
1					medium dense light brown silty SAND		100	0	0		No piezometer was installed
2			11,9,7 16		medium dense light brown clayey SAND		52	0	0		
3			7,7,9 16								
4					medium dense light brown fine to coarse grained clayey SAND with sharp gravels		29	0	0		
5			9,10,12 22				40	0	0		
6			7,9,10 19								
7					medium dense light olive green clayey SAND with little small gravels		83	0	0		
8			5,7,7 14				74	0	0		
9			8,13,18 31								
10							58	0	0		

SPT S... Penetration Test
UCS U... d Compressive Strength
LT L... kness
N N... blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV1
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	415.7	**SHEET:** 2	**OF:** 3
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	30.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	11/16/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	11/19/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
11			1,2,1 3		ditto		58	0	0		
12			1,2,2 4		soft light olive green CLAY		50	0	0		
13							65	0	0		
14			2,1,2 3								
15			8,8,11 29		medium dense light olive green clayey SAND with little gravels		92	0	0		WT at 15m
16							59	0	0		
17			6,7,6 13				45	0	0		
18			7,9,9 18								
19							59	0	0		
20			8,9,10 19				49	0	0		

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV1
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	415.7	**SHEET:** 3	**OF:** 3
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	30.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	11/16/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	11/19/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
21			50/5cm Refusal		ditto		49	0	0		
22					whitish grey very closely fractured marly LIMESTONE		55	0	0		Flushing water loss at 21m
23			50/5cm Refusal		grey very closely fractured LIMESTONE		62	6	0		Casing down to 22.5m
24											
25					24.5 CAVITY 25.5		43	13	0		
26					strong whitish grey very closely to closely fractured moderately weathered LIMESTONE		40	20	0		
27											
28							33	12	0		
29							32	17	0		
30											
					End of borehole at 30m						

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON

SOIL STUDIES

LEGEND

SOIL SYMBOL


GP


GP-GM


GM


GC


SW


SP


SP - SM


SM-SC


ML


CH-MH


OL


OH


PT


Fill Material


CLAY


CLAYwith Sand and Gravel

ROCK SYMBOL


Dolomite


Chalky Limestone


Calcarenite


Weak Chalky LIMESTONE


Sandy Limestone


Basalt / volcanics


Chert


CL


Creamy White LIMESTONE


Grainstone LIMESTONE


MARL


SANDSTONE


CLAYSTONE


Oolitic LIMESTONE


Micritic LIMESTONE


Mudstone


Gypsum


Siltstone

SAMPLERS


SPT (disturbed)


Shelby tube


Tricone


Double tube

OTHERS


Water Level

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

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV2
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	402.2	**SHEET:**	1 **OF:** 3
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	30.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	11/20/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	11/22/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
1					medium dense light brown clayey SAND		38	0	0		No flushing water loss
2			9,11,14 25				48	0	0		
3			9,13,15 28				52	0	0		
4											
5			13,17,21 38		dense light brown SAND		63	0	0		WT at 4.6m
6			8,13,13 26								
7					ditto, medium dense		67	0	0		
8			1,2,2 4		soft brown CLAY		80	0	0		
9			1,1,2 3								
10							62	0	0		

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV2
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	402.2	**SHEET:** 2	**OF:** 3
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	30.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	11/20/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	11/22/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
11			1,1,1 2		very soft brown CLAY		62	0	0		
12			0/45cm				48	0	0		
13							61	0	0		
14			3,5,5 10		medium dense light brown clayey SAND		74	0	0		
15			6,7,8 15								
16							73	0	0		
17			2,2,2 4		soft brown CLAY		86	0	0		
18			6,8,12 20								
19					very stiff brown slightly sandy CLAY		76	0	0		
20			1,1,1 2		ditto, very soft		69	0	0		

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV2
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	402.2	**SHEET:** 3	**OF:** 3
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	30.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	11/20/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	11/22/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
21			1,1,1 2		ditto, very soft		69	0	0		Casing down to 21m (broken)
22					medium dense brown clayey SAND with occasional gravels		57	0	0		
23			8,8,11 19				57	0	0		
24			8,9,12 21								
25					soft brown CLAY		76	0	0		
26			1,1,2 3								
27			2,2,3 5				67	0	0		
28							80	0	0		
29			1,1,1 2		very soft grey CLAY						
30			1,1,1 2				80	0	0		
					End of borehole at 30m						

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON

SOIL STUDIES

LEGEND

SOIL SYMBOL


GP


GP-GM


GM


GC


SW


SP


SP - SM


SM-SC


ML


CH-MH


OL


OH


PT


Fill Material


CLAY


CLAYwith Sand and Gravel

ROCK SYMBOL


Dolomite


Chalky Limestone


Calcarenite


Weak Chalky LIMESTONE


Sandy Limestone


Basalt / volcanics


Chert


CL


Creamy White LIMESTONE


Grainstone LIMESTONE


MARL


SANDSTONE


CLAYSTONE


Oolitic LIMESTONE


Micritic LIMESTONE


Mudstone


Gypsum


Siltstone

SAMPLERS


SPT (disturbed)


Shelby tube


Tricone


Double tube

OTHERS


Water Level

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

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV3
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	395.8	**SHEET:**	1 **OF:** 5
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	45.5
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	12/9/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	12/11/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
1					medium dense dark grey SAND		63	0	0		WT at 0.3m No flushing water loss
2			3,4,18 22		medium dense brown and grey fine to coarse grained SAND with rounded and sharp gravels		69	0	0		
3											
4							40	0	0		
5											
6			1,2,3 5				55	0	0		
7					medium stiff greyish brown sandy CLAY and CLAY		72	0	0		
8			2,2,3 5								
9							81	0	0		
10			3,3,4 7				90	0	0		

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV3
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	395.8	**SHEET:** 2	**OF:** 5
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	45.5
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	12/9/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	12/11/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
11			2,4,3 7		medium stiff greyish brown sandy CLAY and CLAY		90	0	0		
12			2,4,4 8				86	0	0		Artesian water flow at 12m
13							71	0	0		
14			2,3,3 6				81	0	0		
15			2,2,3 5								
16							80	0	0		
17			2,3,4 7				72	0	0		
18											
19			3,3,4 7				67	0	0		
20			3,5,7 12		ditto, stiff		70	0	0		

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV3
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	395.8	**SHEET:** 3	**OF:** 5
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	45.5
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	12/9/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	12/11/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
21			5,7,9		ditto, very stiff		70	0	0		
22			16				81	0	0		
23			3,5,6		ditto, stiff		70	0	0		
24			11								
25			4,6,6				90	0	0		
26			12		ditto, medium stiff		70	0	0		
27			2,2,2								
28			4				73	0	0		
29			2,3,2								
30			5		refer to next page		55	0	0		
			2,3,3								
			6								

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV3
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	395.8	**SHEET:** 4	**OF:** 5
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	45.5
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	12/9/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	12/11/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
31			15,18,24 42		dense creamish to brown clayey SAND with occasional sharp gravels		61	0	0		
32			11,50/3cm Refusal				62	0	0		
33			9,12,19 31				59	0	0		
34											
35			4,6,7 13		ditto, medium dense		50	0	0		
36			2,3,3 6		ditto, loose		62	0	0		
37											
38			13,17,23 40		ditto, dense		56	0	0		
39			13,15,19 34				64	0	0		
40											

SPT Standard Penetration Test — TCR Total Core Recovery — ST Sample Type
UCS Unconfined Compressive Strength — RQD Rock Quality Designation — SYM Symbol
LT Laboratory — 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
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV3
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	395.8	**SHEET:** 5	**OF:** 5
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	45.5
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	12/9/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	12/11/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
41			5,6,6 12		ditto, medium dense		64	0	0		
42					grey very closely fractured moderately weathered very closely fractured LIMESTONE						Artesian flow at 42.0m
43					CAVITY		0	0	0		
44											
45					grey very closely fractured moderately weathered LIMESTONE interbedded with layers of marl.		21	0	0		Casing down to 44.5m
46											
47											
48											
49											
50											
					End of borehole at 45.5m						

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

SOIL STUDIES

LEGEND

SOIL SYMBOL


GP


GP-GM


GM


GC


SW


SP


SP - SM


SM-SC


ML


CH-MH


OL


OH


PT


Fill Material


CLAY


CLAYwith Sand and Gravel

ROCK SYMBOL


Dolomite


Chalky Limestone


Calcarenite


Weak Chalky LIMESTONE


Sandy Limestone


Basalt / volcanics


Chert


CL


Creamy White LIMESTONE


Grainstone LIMESTONE


MARL


SANDSTONE


CLAYSTONE


Oolitic LIMESTONE


Micritic LIMESTONE


Mudstone


Gypsum


Siltstone

SAMPLERS


SPT (disturbed)


Shelby tube


Tricone


Double tube

OTHERS


Water Level

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

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV7
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	396	**SHEET:** 1	**OF:** 7
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	65.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	12/2/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	12/7/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
1					medium dense dark grey SAND		47	0	0		No Flushing water loss WT at 1m
2			6,8,32 40		dense brown and grey fine to coarse grained SAND with rounded and sharp gravels		51	0	0		
3			37,50/4cm Refusal								
4							37	0	0		
5											CPT (15,9,7,7,10)
6			7,5,5 10				31	0	0		
7					medium dense greyish brown clayey SAND		89	0	0		
8			6,7,8 15								
9			7,9,11 20				100	0	0		
10							80	0	0		

SPT S... Penetration Test
UCS U... d Compressive Strength
LT L... kness
N N... blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV7
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	396	**SHEET:** 2	**OF:** 7
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	65.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	12/2/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	12/7/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
11			1,2,3 5		ditto		80	0	0		
12			1,1,2 3		soft greyish brown sandy CLAY and CLAY		100	0	0		
13							81	0	0		
14			2,4,4 8		ditto, stiff		86	0	0		
15			3,4,5 9								
16							79	0	0		
17			2,3,3 6		ditto, medium stiff		92	0	0		
18			3,3,4 7								
19							79	0	0		
20			5,5,8 13		ditto, stiff		89	0	0		

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV7
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	396	**SHEET:** 3	**OF:** 7
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	65.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	12/2/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	12/7/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
21			5,7,9 16		ditto, very stiff		89	0	0		Atersian water flow at 21.0m
22							100	0	0		
23			6,8,8 16				95	0	0		
24			5,7,9 16								
25							68	0	0		
26			4,6,7 13		ditto, stiff		79	0	0		
27			5,5,9 14								
28							89	0	0		
29			6,8,8 16		ditto, very stiff		89	0	0		
30											

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV7
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	396	**SHEET:** 4	**OF:** 7
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	65.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	12/2/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	12/7/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
31					ditto, very stiff		68	0	0		
32			7,7,9 16				81	0	0		
33			6,7,8 15				80	0	0		
34											
35			6,8,9 17				91	0	0		
36			7,9,9 18				79	0	0		
37											
38			5,7,8 15				70	0	0		
39			6,9,10 19				75	0	0		
40											

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	**DAR-TALEB**	**FILE NO.:**	13-046	**BOREHOLE NO.:**	**EV7**
PROJECT:	**BISRI DAM**				
LOCATION:	BISRI	**Elevation (m):**	396	**SHEET:** 5	**OF:** 7
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	65.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	**12/2/2013**
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	**12/7/2013**

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
41			7,11,13		ditto, very stiff		75	0	0		
			24								
42			8,15,17				95	0	0		
			32		ditto, hard						
43							69	0	0		
44			9,12,15		ditto, very stiff		67	0	0		
			27								
45			8,14,14				92	0	0		
			28								
46											
47			10,12,13				95	0	0		
			25								
48			7,10,13				91	0	0		
			23								
49											
50			6,8,11				86	0	0		
			19								

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	**DAR-TALEB**	**FILE NO.:**	13-046	**BOREHOLE NO.:**	**EV7**
PROJECT:	**BISRI DAM**				
LOCATION:	BISRI	**Elevation (m):**	396	**SHEET:** 6	**OF:** 7
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	65.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	**12/2/2013**
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	**12/7/2013**

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
51			9,9,13		ditto, very stiff		86	0	0		
52			22				88	0	0		
53			5,5,7		ditto, stiff		67	0	0		
54			12								
55			5,5,8		greyish brown CLAY with cobbles of limestone		43	0	0		
56			13								
57							45	9	7		casing down to 57m
58							27	20	0		Flushing water loss between 56 & 62m
59											
60							25	13	0		

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV7
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	396	**SHEET:** 7	**OF:** 7
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	65.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	12/2/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	12/7/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
61					greyish brown CLAY with cobbles of limestone		23	23	0		
62											
63					creamish blue highly weathered MARLSTONE		47	0	0		
64											
65							65	0	0		
66											
67											
68											
69											
70											
					End of borehole at 65m						

SPT Standard Penetration Test
UCS Unconfined Compressive Strength
LT Layer Thickness
N Number of blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given
TCR Total Core Recovery
RQD Rock Quality Designation
SCR Solid Core Recovery
ST Sample Type
SYM Symbol
WT Water Table

SATCON

SOIL STUDIES

LEGEND

SOIL SYMBOL


GP


GP-GM


GM


GC


SW


SP


SP - SM


SM-SC


ML


CH-MH


OL


OH


PT


Fill Material


CLAY


CLAYwith Sand and Gravel

ROCK SYMBOL


Dolomite


Chalky Limestone


Calcarenite


Weak Chalky LIMESTONE


Sandy Limestone


Basalt / volcanics


Chert


CL


Creamy White LIMESTONE


Grainstone LIMESTONE


MARL


SANDSTONE


CLAYSTONE


Oolitic LIMESTONE


Micritic LIMESTONE


Mudstone


Gypsum


Siltstone

SAMPLERS


SPT (disturbed)


Shelby tube


Tricone


Double tube

OTHERS


Water Level

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

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV9
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	414.9	**SHEET:** 1	**OF:** 2
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	18.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	12/12/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	12/15/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
1					light brown clayey SAND with gravels and cobbles of limestone		47	3	0		
2			50/0cm Refusal				31	3	0		
3			50/7cm Refusal				42	5	0		
4											
5							47	0	0		
6			6,19,36 55		very dense brown clayey SAND		76	0	0		
7											
8			17,50/11cm Refusal		very dense brown clayey cemented SAND		28	0	0		Flushing water loss at 7.5m
9											Casing down to 9.0m
10					light to brownish grey very closely fractured LIMESTONE with pockets of sandy clay		37	0	0		

SPT S…enetration Test
UCS U…d Compressive Strength
LT L…kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	**DAR-TALEB**	**FILE NO.:**	13-046	**BOREHOLE NO.:**	**EV9**
PROJECT:	**BISRI DAM**				
LOCATION:	BISRI	**Elevation (m):**	414.9	**SHEET:** 2	**OF:** 2
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	18.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	**12/12/2013**
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	**12/15/2013**

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
11					ditto		37	0	0		
12					whitish grey closely to moderately fractured LIMESTONE interbedded with occasional thin layers of marl		63	63	38		
13							57	43	31		
14					grey very closely to closely fractured LIMESTONE with pockets of marl and sand (in some places).		43	37	8.7		
15											Ground water table at a depth of 15.5m
16							51	37	10		
17							43	43	0		
18											
19											
20											
					End of borehole at 18m						

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON

SOIL STUDIES

LEGEND

SOIL SYMBOL


GP


GP-GM


GM


GC


SW


SP


SP - SM


SM-SC


ML


CH-MH


OL


OH


PT


Fill Material


CLAY


CLAYwith Sand and Gravel

ROCK SYMBOL


Dolomite


Chalky Limestone


Calcarenite


Weak Chalky LIMESTONE


Sandy Limestone


Basalt / volcanics


Chert


CL


Creamy White LIMESTONE


Grainstone LIMESTONE


MARL


SANDSTONE


CLAYSTONE


Oolitic LIMESTONE


Micritic LIMESTONE


Mudstone


Gypsum


Siltstone

SAMPLERS


SPT (disturbed)


Shelby tube


Tricone


Double tube

OTHERS


Water Level

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

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	**DAR-TALEB**	**FILE NO.:**	13-046	**BOREHOLE NO.:**	**EV10**
PROJECT:	**BISRI DAM**				
LOCATION:	BISRI	**Elevation (m):**	420.1	**SHEET:** 1	**OF:** 3
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	30.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	**12/15/2013**
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	**12/18/2013**

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
1			6,8,9 17		medium dense dark brown clayey SAND with gravels and occasional small cobbles of limestone		37	0	0		
2					ditto, yellowish brown		52	19	0		
3					light grey very closely fractured LIMESTONE inter-bedded with layers of clay		53	7	0		casing down to 3m
4											
5					light brown clayey gravely SAND		50	40	8		
6					whitish grey very closely to closely fractured LIMESTONE with pockets of sandy clay						
7							47	30	8		
8							31	7	0		
9											
10							37	6	0		

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	**DAR-TALEB**	**FILE NO.:**	13-046	**BOREHOLE NO.:**	**EV10**
PROJECT:	**BISRI DAM**				
LOCATION:	BISRI	**Elevation (m):**	420.1	**SHEET:** 2	**OF:** 3
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	30.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	**12/15/2013**
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	**12/18/2013**

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
11					ditto		37	6	0		
12					ditto, with small cobbles of silex		49	32	8		flushing water loss at 11.5m
13					whitish grey very closely to closely fractured LIMESTONE with pockets of sandy clay		46	43	0		
14											
15							60	50	22		
16					whitish grey very closely to closely fractured LIMESTONE with pockets of sand		55	55	0		
17											
18							53	47	15		
19							53	47	0		
20							53	40	15		

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAHNT	**FILE NO.:**	13-046	**BOREHOLE NO.:**	EV 10
PROJECT:	BESRI DAM				
LOCATION:	BESRI	**Elevation (m):**	420.1	**SHEET:**	3 **OF:** 3
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	30.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	12/15/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	12/18/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
21					ditto		53	40	15		Ground water table at 20.12m
22					ditto, vuggy and with vertical fractures		53	47	0		
23					whitish grey very closely to closely fractured LIMESTONE with pockets of sand		53	53	11		
24											
25							51	43	7		
26											
27							42	20	0		
28							43	43	0		
29											
30							53	53	0		
					End of borehole at 30m						

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON

SOIL STUDIES

LEGEND

SOIL SYMBOL


GP


GP-GM


GM


GC


SW


SP


SP - SM


SM-SC


ML


CH-MH


OL


OH


PT


Fill Material


CLAY


CLAYwith Sand and Gravel

ROCK SYMBOL


Dolomite


Chalky Limestone


Calcarenite


Weak Chalky LIMESTONE


Sandy Limestone


Basalt / volcanics


Chert


CL


Creamy White LIMESTONE


Grainstone LIMESTONE


MARL


SANDSTONE


CLAYSTONE


Oolitic LIMESTONE


Micritic LIMESTONE


Mudstone


Gypsum


Siltstone

SAMPLERS


SPT (disturbed)


Shelby tube


Tricone


Double tube

OTHERS


Water Level

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

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	VF2
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	414	**SHEET:** 1	**OF:** 4
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	39.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	11/27/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	11/29/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
1					light brown SAND		49	0	0		No flushing water loss
2			8,5,7 12		medium dense light brown clayey SAND		70	0	0		
3			7,11,13 24								
4							48	0	0		
5			11,15,21 36		dense light brown clayey SAND with rounded gravels		60	0	0		
6			12,17,27 44								Ground water table at 5.90m
7							55	0	0		
8			7,7,10 17		very stiff dark brown CLAY with rounded gravels and cobbles		13	0	0		
9			1,2,2 4								
10					ditto, soft		43	0	0		

SPT S... Penetration Test
UCS U... d Compressive Strength
LT La... kness
N N... blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	VF2
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	414	**SHEET:** 2	**OF:** 4
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	39.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	11/27/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	11/29/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
					ditto, soft		43	0	0		
			7,16,17 33								
11					dense brownish grey clayey SAND						
							65	0	0		
12			11,16,21 37								
13					stiff brownish grey slightly sandy CLAY		81	0	0		
			2,8,2 10								
14											
					medium dense brownish grey clayey SAND		86	0	0		
15			8,9,12 21								
16							70	0	0		
			7,9,10 19								
17											
							67	0	0		
18			5,5,7 12								
19							59	0	0		
			4,3,3 6								
20					refer to next page		67	0	0		

SPT S... Penetration Test
UCS U... d Compressive Strength
LT L... kness
N N... blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	VF2
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	414	**SHEET:** 3	**OF:** 4
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	39.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	11/27/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	11/29/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
21			3,3,4 7		medium stiff brownish grey slightly sandy to sandy CLAY		67	0	0		
22							71	0	0		
23			4,4,4 8				79	0	0		
24			3,4,4 8				100	0	0		
25											
26			3,3,3 6				100	0	0		
27			3,4,5 9				100	0	0		
28											
29			2,2,3 5				67	0	0		
30											

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	VF2
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	414	**SHEET:** 4	**OF:** 4
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	39.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	11/27/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	11/29/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
31			3,15,18 33		ditto, hard		90	0	0		
32			9,16,21 37		dense brownish grey clayey SAND		80	20	0		
33					dark brown highly weathered very closely fractured SANDSTONE						Casing down 33m
34					bluish grey clayey MARL		47	0	0		
35			50/5cm Refusal				100	0	0		
36											
37					grey moderately weathered very closely to closely fractured LIMESTONE interbedded with layers of marl		63	63	8		
38							53	47	20		
39											
40											
					End of borehole at 39m						

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON

SOIL STUDIES

LEGEND

SOIL SYMBOL


GP


GP-GM


GM


GC


SW


SP


SP - SM


SM-SC


ML


CH-MH


OL


OH


PT


Fill Material


CLAY


CLAYwith Sand and Gravel

ROCK SYMBOL


Dolomite


Chalky Limestone


Calcarenite


Weak Chalky LIMESTONE


Sandy Limestone


Basalt / volcanics


Chert


CL


Creamy White LIMESTONE


Grainstone LIMESTONE


MARL


SANDSTONE


CLAYSTONE


Oolitic LIMESTONE


Micritic LIMESTONE


Mudstone


Gypsum


Siltstone

SAMPLERS


SPT (disturbed)


Shelby tube


Tricone


Double tube

OTHERS


Water Level

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

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	VF3
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	414.4	**SHEET:** 1	**OF:** 4
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	39.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	11/23/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	11/26/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
1					medium dense light brown clayey SAND with occasional gravels		51	0	0		No flushing water loss
2			12,17,6 23				68	0	0		
3			5,7,7 14				64	0	0		
4											
5			8,11,15 26				73	0	0		
6			10,15,18 33								Ground water table at 5.80m
7					ditto, dense		54	0	0		
8			2,2,2 4		soft light olive green CLAY		57	0	0		
9			3,3,2 5								
10							57	0	0		

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	VF3
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	414.4	**SHEET:** 2	**OF:** 4
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	39.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	11/23/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	11/26/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
11			1,1,1 2		ditto		57	0	0		
12			1/45cm				67	0	0		
13					very loose light olive green clayey SAND		67	0	0		
14			3,9,9 18		ditto, medium dense						
15			8,18,22 40		medium dense light olive green clayey SAND with cobbles of sandstone dense light olive green clayey SAND		70	0	0		
16					dense light brown clayey SAND with gravels and cobbles of sandstone		67	0	0		
17			50/0cm Refusal				49	0	0		
18			8,14,19 33								
19							67	0	0		
20			12,17,25 42				54	0	0		

SPT	S[illegible]enetration Test	TCR	Total Core Recovery	ST	Sample Type
UCS	U[illegible]d Compressive Strength	RQD	Rock Quality Designation	SYM	Symbol
LT	L[illegible]kness	SCR	Solid Core Recovery	WT	Water Table

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

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	VF3
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	414.4	**SHEET:** 3	**OF:** 4
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	39.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	11/23/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	11/26/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
21			10,13,17 30		ditto		54	0	0		
22					light brown CLAY with cobbles of marlstone		71	0	0		
23			50/0cm Refusal		light brown CLAY with cobbles of claystone		45	6	0		
24			50/6cm Refusal				53	0	0		
25											
26			50/5cm Refusal				59	0	0		
27											
28							52	0	0		
29											
30							56	0	0		

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	VF3
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	414.4	**SHEET:** 4	**OF:** 4
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	39.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	11/23/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	11/26/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
31					ditto		42	0	0		
32			50/5cm Refusal				59	0	0		
33											Casing down to 33m
34					light brown very closely to closely fractured highly weathered CLAYSTONE		57	30	0		
35											
36							73	60	0		
37							71	40	0		
38							74	20	0		
39											
40											
					End of borehole at 39m						

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON

SOIL STUDIES

LEGEND

SOIL SYMBOL


GP


GP-GM


GM


GC


SW


SP


SP - SM


SM-SC


ML


CH-MH


OL


OH


PT


Fill Material


CLAY


CLAYwith Sand and Gravel

ROCK SYMBOL


Dolomite


Chalky Limestone


Calcarenite


Weak Chalky LIMESTONE


Sandy Limestone


Basalt / volcanics


Chert


CL


Creamy White LIMESTONE


Grainstone LIMESTONE


MARL


SANDSTONE


CLAYSTONE


Oolitic LIMESTONE


Micritic LIMESTONE


Mudstone


Gypsum


Siltstone

SAMPLERS


SPT (disturbed)


Shelby tube


Tricone


Double tube

OTHERS


Water Level

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

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	VF4
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	419.1	**SHEET:** 1	**OF:** 4
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	40.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	12/20/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	12/24/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
1					loose dark brown slightly clayey SILT with tree roots		47	0	0		No flushing water loss
2			2,4,4 8		loose light brown clayey SAND with gravels and occasional cobbles of sandstone		38	5	0		
3			4,7,7 14								
4					medium dense light brown clayey SAND with gravels and traces of marl		100	0	0		
5					?? weak bluish grey closely fractured SANDSTONE with traces of marl						
6			50/4cm Refusal		very dense light brown clayey SAND with gravels and occasional cobbles of sandstone		34	0	0		WT at 5.85m
7					grey slightly clayey SAND		47	0	0		
8					medium dense light greyish brown clayey SAND		67	0	0		
9			7,9,14 23								
10					refer to next page		44	7	0		

SPT S…enetration Test
UCS U…d Compressive Strength
LT L…kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	VF4
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	419.1	**SHEET:** 2	**OF:** 4
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	40.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	12/20/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	12/24/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
11					light brown poorly cemented SANDSTONE		44	7	0		
12			50/0cm Refusal		ditto, bluish grey		34	0	0		
13					light brown poorly cemented SANDSTONE		13	0	0		
14			50/3cm Refusal				17	0	0		
15			50/5cm Refusal				0	0	0		
16							0	0	0		
17			50/4cm Refusal				0	0	0		
18			50/2cm Refusal				0	0	0		
19							0	0	0		
20			50/5cm Refusal				0	0	0		

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	VF4
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	419.1	**SHEET:** 3	**OF:** 4
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	40.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	12/20/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	12/24/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
21			50/1cm Refusal		ditto		0	0	0		casing down to 21m
22							0	0	0		
23			50/3cm Refusal				0	0	0		
24			50/2cm Refusal				0	0	0		
25							0	0	0		
26			50/5cm Refusal				0	0	0		
27			50/10cm Refusal		dark grey very closely fractured SANDSTONE		33	0	0		
28											
29							51	0	0		
30											

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON
SOIL STUDIES

BORING LOG

CLIENT:	DAR-TALEB	**FILE NO.:**	13-046	**BOREHOLE NO.:**	VF4
PROJECT:	BISRI DAM				
LOCATION:	BISRI	**Elevation (m):**	419.1	**SHEET:** 4	**OF:** 4
EQUIPMENT:	CMV 1000	**METHOD:**	ROTARY	**BOREHOLE DEPTH (m):**	40.0
HOLE DAM. (mm):	101mm	**CORE DIAM. (mm):**	86	**DATE STARTED:**	12/20/2013
ENGINEER:	K.S.	**DRILLER:**	M.O.	**DATE FINISHED:**	12/24/2013

DEPTH (m)	SYMBOL	ST	SPT N blows	LT	DESCRIPTION OF MATERIAL	% FINES	TCR (%)	SCR (%)	R.Q.D (%)	Fracture Frequency (m-1)	Remarks
31					dark grey very closely fractured SANDSTONE		53	10	0		
32							43	3	0		
33							58	8	0		
34							33	13	0		
35							37	0	0		
36							67	30	0		
37					dark grey very closely to closely fractured SANDSTONE		57	50	0		
38											
39											
40											
					End of borehole at 40m						

SPT S… Penetration Test
UCS U… d Compressive Strength
LT L… kness
N N… blows from SPT. Where full 0.3m has not been achieved, the number of blows for the quoted penetration is given

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

ST Sample Type
SYM Symbol
WT Water Table

SATCON

SOIL STUDIES

LEGEND

SOIL SYMBOL


GP


GP-GM


GM


GC


SW


SP


SP - SM


SM-SC


ML


CH-MH


OL


OH


PT


Fill Material


CLAY


CLAYwith Sand and Gravel

ROCK SYMBOL


Dolomite


Chalky Limestone


Calcarenite


Weak Chalky LIMESTONE


Sandy Limestone


Basalt / volcanics


Chert


CL


Creamy White LIMESTONE


Grainstone LIMESTONE


MARL


SANDSTONE


CLAYSTONE


Oolitic LIMESTONE


Micritic LIMESTONE


Mudstone


Gypsum


Siltstone

SAMPLERS


SPT (disturbed)


Shelby tube


Tricone


Double tube

OTHERS


Water Level

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

APPENDIX 3. PHOTOS OF CORE BOXES


Besri Dam
EV:01 Box:01
0.00 → 7.00
0,00→
1,5→
3,00→
4,5→
6,00→


Besri Dam
EV:01 Box:02
7.00 → 14.00
7,5→
9,00→
10,5→
12,00→
13,5→
BH. EV.1 Box. 2


BH-EV.1
Besri Dam
EV:01 Box:03
14.00 → 21.00
16.5 →
18.00 →
19.5 →
21.00 →
SATCON


Besri Dam
EV:01 Box:04
21.00 → 30.00
22.5 →
24.00 →
24.5 m → 25.30 m
25.5 →
27.00 →
28.5 →
30.00.
BH-EV.1 Box.4
SATCON


Besri Dam
EV:02 Box:01
0.00 → 9.00
3,00 →
4,5→
6,00→
7,5→
9,00→


Besri Dam
EV:02 Box:02
9.00 → 16.50
10,5→
12,00
13,5 →
9.00
15,00→
12.00
16,5→


Besri Dam
EV:02 Box:03
16.50 → 24.00
18,00→
19,5→
21,00→
22,5→
24,00→


Besri Dam
EV:02 Box:04
24.00 → 30.00
27,5→
27,00→
28,5→
30,00→


Besri Dam
Ev:03 Box:01
0.00 → 7.00
0.0→
1.5→
3.0→
4.5→
6.0→


Besri Dam
Ev:03 Box:02
7.00 → 13.50
7.5→
9.0→
10.5→
12.0→
13.5→


Besri Dam
Ev:03 Box:03
13.50→19.50
15,0→
16,5→
18,0→
19,5→


Besri Dam
Ev:03 Box:04
19.50→28.00
21,0→
22,5→
24,0→
25,5→
27,0→


Besri Dam
Ev:03 Box:05
2800 → 34.50


Besri Dam
Ev:03 Box:06
34.50 → 45.50
37.5→
39.0→
40.5→
41.5→ 43.5 Cavity
45.50


Besri Dam
Ev:07 Box:01
0.00 — 8.50
0,0→
1,5→
3,0→
4,5→
6,0→
7,5→


Besri Dam
Ev:07 Box:02
8.50 — 13.50
9,0→
10,5→
12,0→
13,5→


Besri Dam
Ev:07 Box:03
13.50 → 19.50


Besri Dam
Ev:07 Box:04
19.50 → 25.50


Besri Dam
Ev:07 Box:05
25.50 → 31.50
30.0
31.5


Besri Dam
Ev:07 Box:06
31.50 → 37.50
33.0
34.5
36.00
37.5


Besri Dam
Ev:07 Box:07
37.50 → 43.50
39.00 →
40.5 →
42.0 →
43.5 →


Besri Dam
Ev:07 Box:08
43.50 → 49.00
46.5 →
48.0 →


Besri Dam
Ev:07 Box:09
49.00 → 57.00
49.5→
51.0→
52.5→
54.0→
55.5→
57.0→


Besri Dam
Ev:07 Box:10
57.00 → 65.00
60.0→
62.5→
63.0→
65.0


Besri Dam
EV:09 Box:01
0.00 → 8.50
1,5→
3,0→
4,5→
6,0→
7,5→


Besri Dam
EV:09 Box:02
8.50 → 16.50
9,0→
10,5→
12,0→
13,5→
15,0→
16,5→


Ev.9 Box_3
Besri Dam
EV:09 Box:03
16.50 → 18.00


Besri Dam
EV:10 Box:01
0.00 → 9.00
3,0→
4,5→
6,0→
7,5→
9,0→


Besri Dam
EV:10 Box:02
9.00 → 17.50
12,0→
13,5→
15,0→
16,5→


Besri Dam
EV:10 Box:03
17.50 →24.50
19.5→
21.0→
22.5→
24.0→


Besri Dam
EV:10 Box:04
24.50 →30.00
27.0→
28.5→
30.0→


Besri Dam
VF:02 Box:01
0.00→9.00
1,5→
3,00→
4,5→
6,00→
7,5→
9,00→


Besri Dam
VF:02 Box:02
9.00→16.50
12,00→
13,5→
15,00→
16,5→


Besri Dam
VF:02 Box:03
16.50→24.00
18,00→
19,5→
21,00→
22,5→
24,00→


Besri Dam
VF:02 Box:04
24.00→29.50
25,5→
27,00→
28,5→


BH-V F-
Besri Dam
VF:02 Box:05
29.50→35.50
31,5→
33,00→
34,5→


BH-V
Besri Dam
VF:02 Box:06
35.50→39.00
36,00→
37,5→
39,00.


Besri Dam
VF:03 Box:01
0.00 → 7.50
1,5→
3,00→
4,5→
6,00→
7,5→
BH-VF:3 Box.1


Besri Dam
VF:03 Box:02
7.50 → 15.00
1.00→
10,5→
12,00→
13,5→
15,00→
BH-VF:3


Besri Dam
VF:03 Box:03
15.00 → 22.5
16,5→
18,00→
19,5→
21,00→
22,5→


Besri Dam
VF:03 Box:04
22.5 → 30.00
24,0→
25,5→
27,0→
28,5→
30,00→


Besri Dam
VF:03 Box:05
30.00 → 37.00
31,5
33,0
34,5
36,00


Besri Dam
VF:03 Box:06
37.00 → 39.00
24.00
39,00


Besri Dam
VF:04 Box:01
0.00 → 7.50


Besri Dam
VF:04 Box:02
7.50 → 28.50

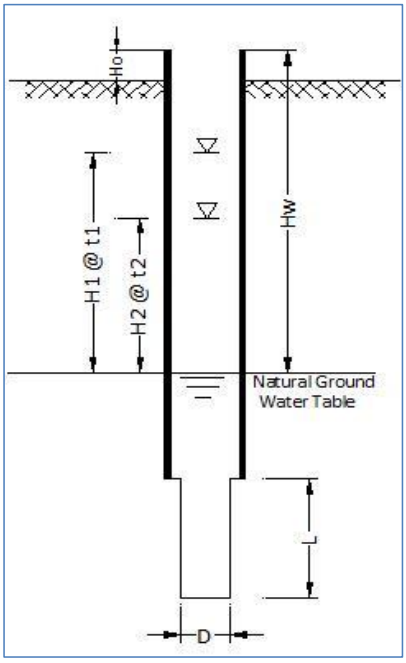

Besri Dam
VF:04 Box:03
28.50 → 36.00
30,0→
31,5→
33,0→
34,5→
36,0→

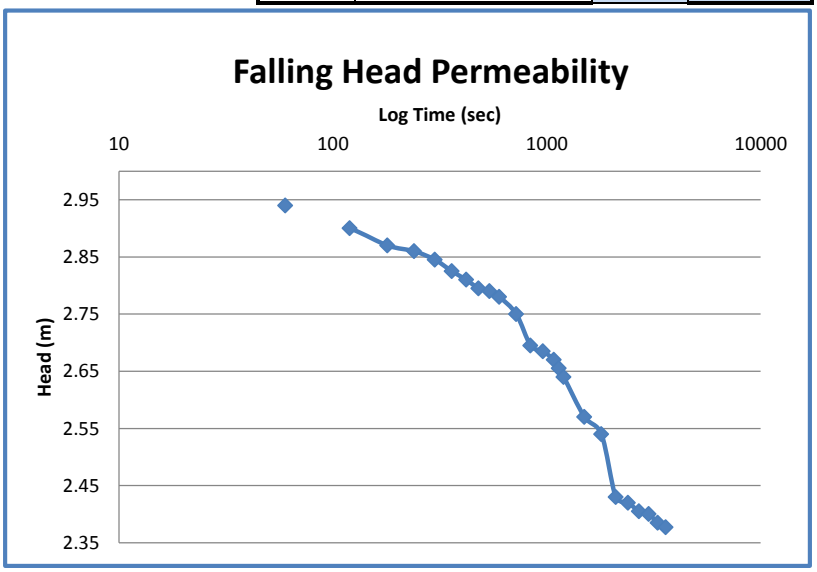

Besri Dam
VF:04 Box:04
36.00 → 40.00
39,0→
40,0

APPENDIX 4. BOREHOLE WATER PERMEABILITY & LUGEON TEST RESULTS

PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 01	X			Date:		11/16/2013	
Test Location	0 to 3m	Y			K(m/sec):		1.6092E-08	
Inclination	0	Z						
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	3.00
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.06	60	2.94
WATER LEVEL BEFORE TEST		W.L	Dry	mAD	2	0.10	120	2.90
HEIGHT OF CASING ABOVE NGL		Ho	0	m	3	0.13	180	2.87
CASING TOP LEVEL			0	mAD	4	0.14	240	2.86
CASING LENGTH			0	m	5	0.16	300	2.85
CASING BOTTOM LEVEL			0	mAD	6	0.18	360	2.83
BOREHOLE DEPTH			3	m	7	0.19	420	2.81
BOREHOLE BOTTOM LEVEL			-3	mAD	8	0.21	480	2.80
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	9	0.21	540	2.79
WATER HEAD		Hw	3	m	10	0.22	600	2.78
					12	0.25	720	2.75
					14	0.31	840	2.70
					16	0.32	960	2.69
					18	0.33	1080	2.67
					19	0.35	1140	2.66
					20	0.36	1200	2.64
					25	0.43	1500	2.57
					30	0.46	1800	2.54
					35	0.57	2100	2.43
					40	0.58	2400	2.42
					45	0.60	2700	2.41
					50	0.60	3000	2.40
					55	0.62	3300	2.39
					60	0.62	3600	2.38

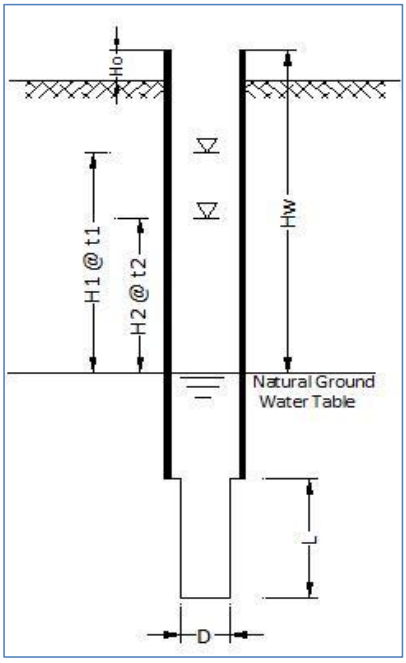
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

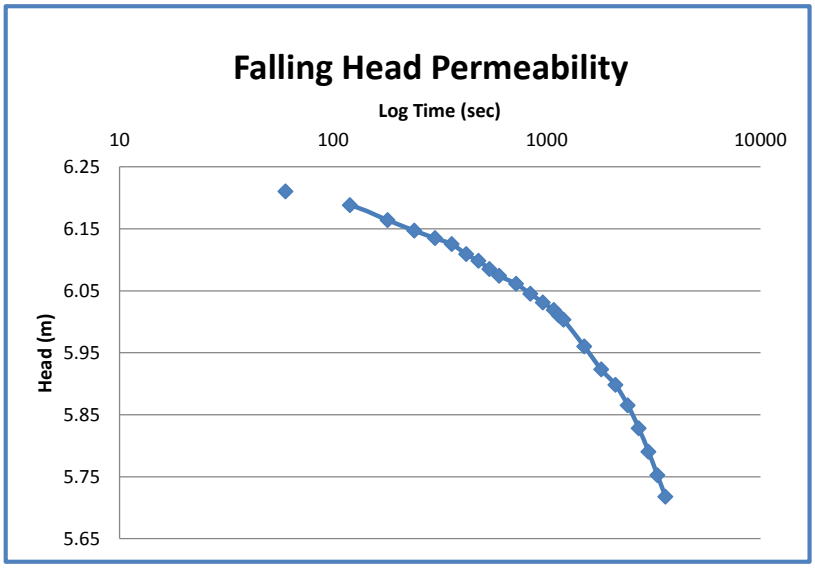




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 01	X			Date:		11/16/2013	
Test Location	3 to 6m	Y			K(m/sec):		2.1652E-08	
Inclination	0	Z						
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	6.30
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.09	60	6.21
WATER LEVEL BEFORE TEST		W.L	-5	mAD	2	0.11	120	6.19
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	0.14	180	6.16
CASING TOP LEVEL			0.3	mAD	4	0.15	240	6.15
CASING LENGTH			3.3	m	5	0.17	300	6.14
CASING BOTTOM LEVEL			-3	mAD	6	0.18	360	6.13
BOREHOLE DEPTH			6	m	7	0.19	420	6.11
BOREHOLE BOTTOM LEVEL			-6	mAD	8	0.20	480	6.10
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	9	0.22	540	6.09
WATER HEAD		Hw	6.3	m	10	0.23	600	6.07
					12	0.24	720	6.06
					14	0.26	840	6.05
					16	0.27	960	6.03
					18	0.28	1080	6.02
					19	0.29	1140	6.01
					20	0.30	1200	6.00
					25	0.34	1500	5.96
					30	0.38	1800	5.92
					35	0.40	2100	5.90
					40	0.44	2400	5.87
					45	0.47	2700	5.83
					50	0.51	3000	5.79
					55	0.55	3300	5.75
					60	0.58	3600	5.72

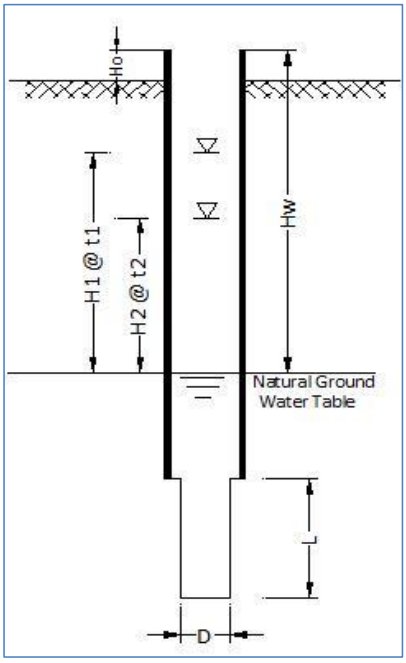
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

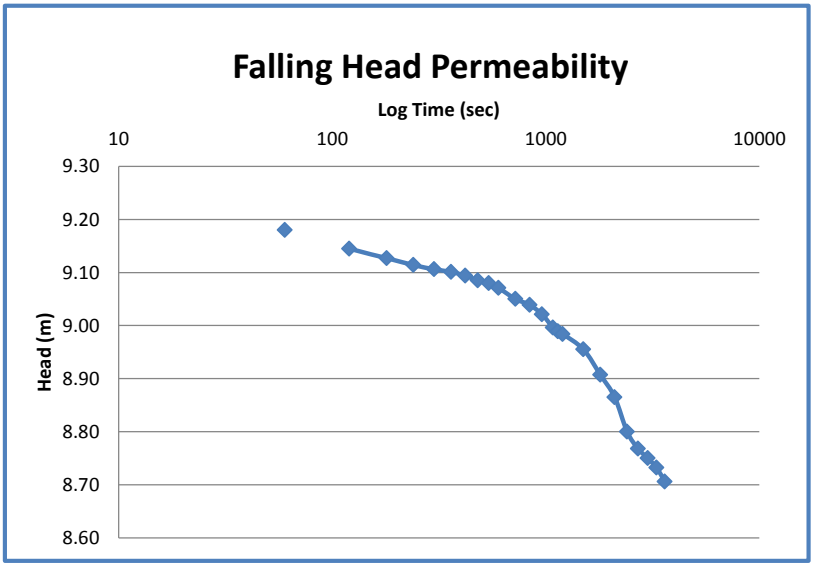




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 01	X			Date:		11/16/2013	
Test Location	6 to 9m	Y			K(m/sec):		8.6308E-09	
Inclination	0	Z						
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	9.30
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.12	60	9.18
WATER LEVEL BEFORE TEST		W.L	-5.5	mAD	2	0.16	120	9.15
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	0.17	180	9.13
CASING TOP LEVEL			0.3	mAD	4	0.19	240	9.11
CASING LENGTH			6.3	m	5	0.19	300	9.11
CASING BOTTOM LEVEL			-6	mAD	6	0.20	360	9.10
BOREHOLE DEPTH			9	m	7	0.21	420	9.09
BOREHOLE BOTTOM LEVEL			-9	mAD	8	0.22	480	9.09
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	9	0.22	540	9.08
WATER HEAD		Hw	9.3	m	10	0.23	600	9.07
					12	0.25	720	9.05
					14	0.26	840	9.04
					16	0.28	960	9.02
					18	0.30	1080	9.00
					19	0.31	1140	8.99
					20	0.32	1200	8.98
					25	0.35	1500	8.96
					30	0.39	1800	8.91
					35	0.44	2100	8.87
					40	0.50	2400	8.80
					45	0.53	2700	8.77
					50	0.55	3000	8.75
					55	0.57	3300	8.73
					60	0.59	3600	8.71

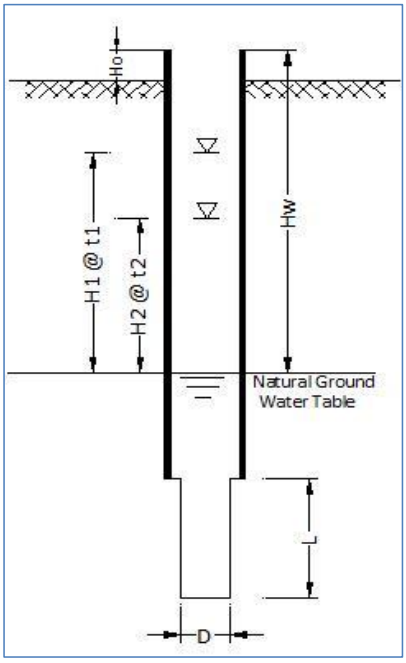
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

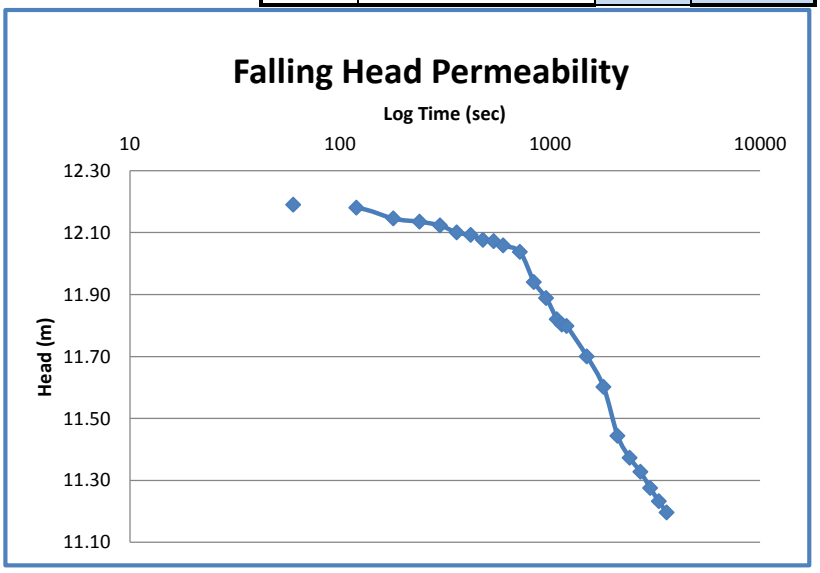




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 01	X			Date:		11/20/2013	
Test Location	9 to 12m	Y			K(m/sec):		1.5924E-08	
Inclination	0	Z						
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	12.30
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.11	60	12.19
WATER LEVEL BEFORE TEST		W.L	-3.5	mAD	2	0.12	120	12.18
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	0.16	180	12.15
CASING TOP LEVEL			0.3	mAD	4	0.17	240	12.14
CASING LENGTH			9.3	m	5	0.18	300	12.12
CASING BOTTOM LEVEL			-9	mAD	6	0.20	360	12.10
BOREHOLE DEPTH			12	m	7	0.21	420	12.09
BOREHOLE BOTTOM LEVEL			-12	mAD	8	0.22	480	12.08
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	9	0.23	540	12.07
WATER HEAD		Hw	12.3	m	10	0.24	600	12.06
					12	0.26	720	12.04
					14	0.36	840	11.94
					16	0.41	960	11.89
					18	0.48	1080	11.82
					19	0.50	1140	11.80
					20	0.50	1200	11.80
					25	0.60	1500	11.70
					30	0.70	1800	11.60
					35	0.86	2100	11.44
					40	0.93	2400	11.37
					45	0.97	2700	11.33
					50	1.03	3000	11.28
					55	1.07	3300	11.23
					60	1.10	3600	11.20

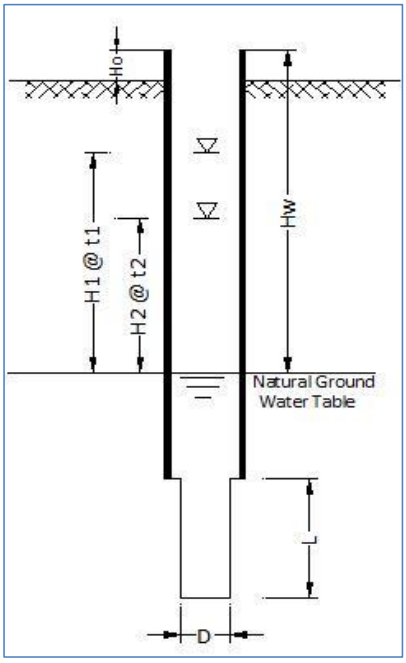
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

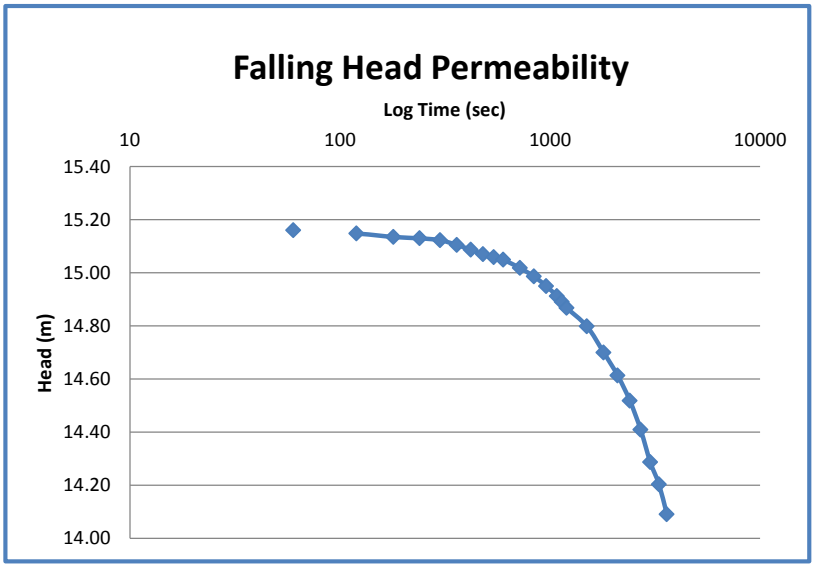




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 01	X			Date:		11/18/2013	
Test Location	12 to 15m	Y			K(m/sec):		2.5555E-08	
Inclination	0	Z						
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	15.30
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.14	60	15.16
WATER LEVEL BEFORE TEST		W.L	-11.3	mAD	2	0.15	120	15.15
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	0.17	180	15.14
CASING TOP LEVEL			0.3	mAD	4	0.17	240	15.13
CASING LENGTH			12.3	m	5	0.18	300	15.12
CASING BOTTOM LEVEL			-12	mAD	6	0.20	360	15.11
BOREHOLE DEPTH			15	m	7	0.21	420	15.09
BOREHOLE BOTTOM LEVEL			-15	mAD	8	0.23	480	15.07
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	9	0.24	540	15.06
WATER HEAD		Hw	15.3	m	10	0.25	600	15.05
					12	0.28	720	15.02
					14	0.31	840	14.99
					16	0.35	960	14.95
					18	0.39	1080	14.91
					19	0.41	1140	14.89
					20	0.43	1200	14.87
					25	0.50	1500	14.80
					30	0.60	1800	14.70
					35	0.69	2100	14.61
					40	0.78	2400	14.52
					45	0.89	2700	14.41
					50	1.01	3000	14.29
					55	1.10	3300	14.20
					60	1.21	3600	14.09

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

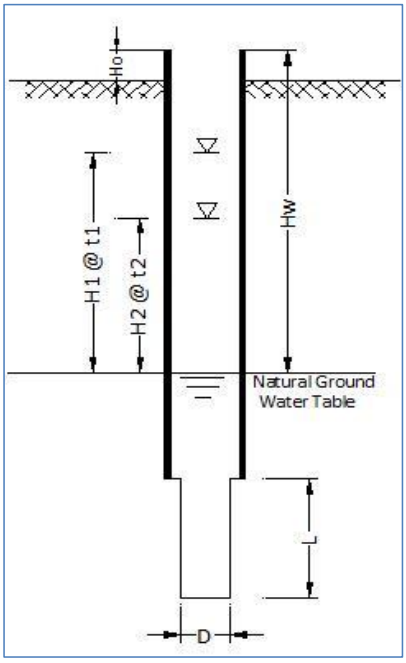


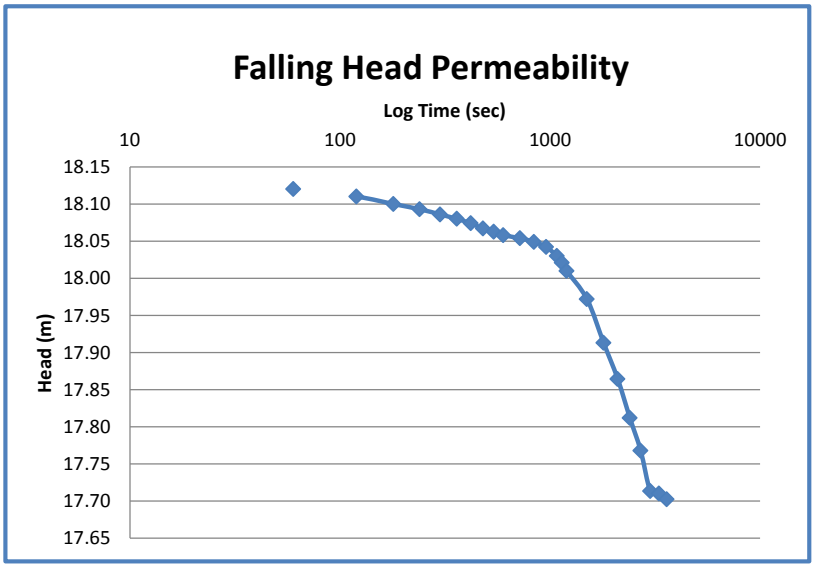


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 01	X			Date:		11/18/2013	
Test Location	15 to 18m	Y			K(m/sec):		1.0572E-08	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	18.30
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.18	60	18.12
WATER LEVEL BEFORE TEST	W.L	-16.5	mAD	2	0.19	120	18.11
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	0.20	180	18.10
CASING TOP LEVEL		0.3	mAD	4	0.21	240	18.09
CASING LENGTH		15.3	m	5	0.21	300	18.09
CASING BOTTOM LEVEL		-15	mAD	6	0.22	360	18.08
BOREHOLE DEPTH		18	m	7	0.23	420	18.07
BOREHOLE BOTTOM LEVEL		-18	mAD	8	0.23	480	18.07
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	0.24	540	18.06
WATER HEAD	Hw	18.3	m	10	0.24	600	18.06
				12	0.25	720	18.05
				14	0.25	840	18.05
				16	0.26	960	18.04
				18	0.27	1080	18.03
				19	0.28	1140	18.02
				20	0.29	1200	18.01
				25	0.33	1500	17.97
				30	0.39	1800	17.91
				35	0.44	2100	17.86
				40	0.49	2400	17.81
				45	0.53	2700	17.77
				50	0.59	3000	17.71
				55	0.59	3300	17.71
				60	0.60	3600	17.70

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

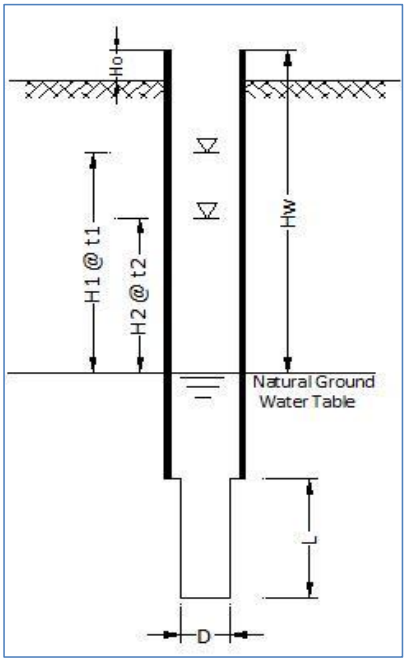


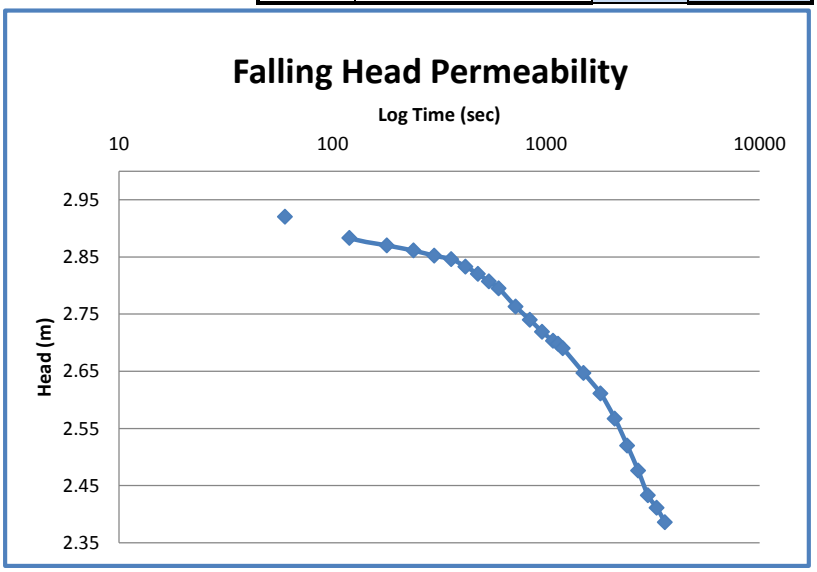


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST		
CLIENT		DAR-TALEB					
Borehole	EV 02	X		Date:		11/20/2013	
Test Location	0 to 3m	Y		K(m/sec):		5.4110E-08	
Inclination	0	Z					

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1		mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	3.00
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.08	60	2.92
WATER LEVEL BEFORE TEST	W.L	Dry	mAD	2	0.12	120	2.88
HEIGHT OF CASING ABOVE NGL	Ho	0	m	3	0.13	180	2.87
CASING TOP LEVEL		0	mAD	4	0.14	240	2.86
CASING LENGTH		0	m	5	0.15	300	2.85
CASING BOTTOM LEVEL		0	mAD	6	0.15	360	2.85
BOREHOLE DEPTH		3	m	7	0.17	420	2.83
BOREHOLE BOTTOM LEVEL		-3	mAD	8	0.18	480	2.82
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	0.19	540	2.81
WATER HEAD	Hw	3	m	10	0.21	600	2.80
				12	0.24	720	2.76
				14	0.26	840	2.74
				16	0.28	960	2.72
				18	0.30	1080	2.70
				19	0.30	1140	2.70
				20	0.31	1200	2.69
				25	0.35	1500	2.65
				30	0.39	1800	2.61
				35	0.43	2100	2.57
				40	0.48	2400	2.52
				45	0.52	2700	2.48
				50	0.57	3000	2.43
				55	0.59	3300	2.41
				60	0.61	3600	2.39

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

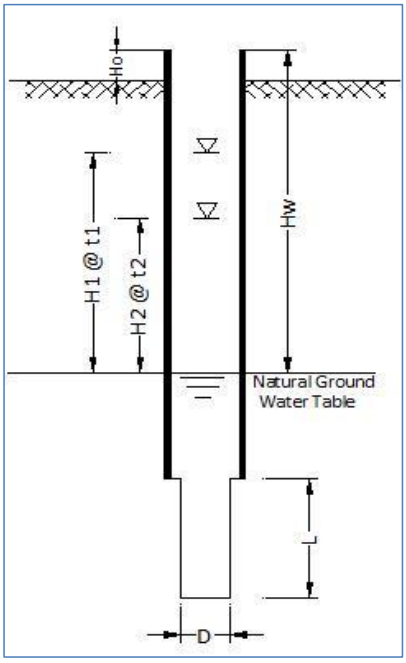


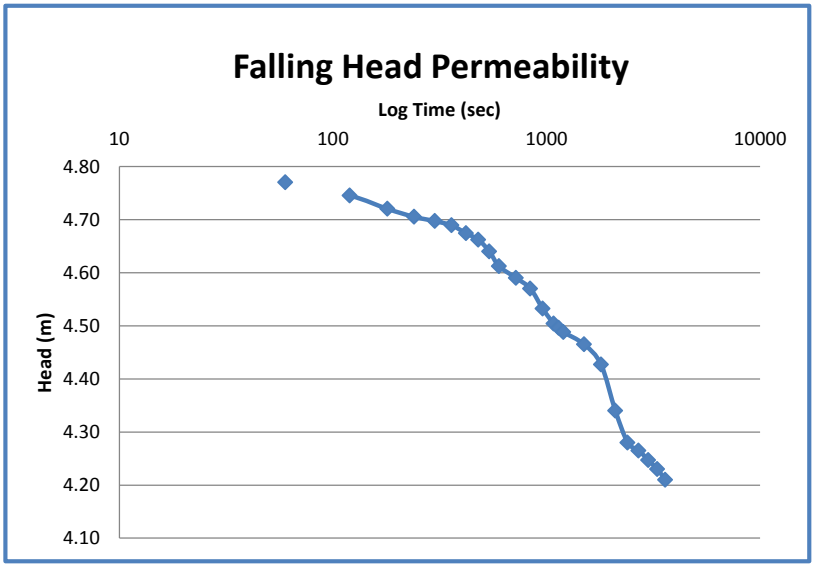


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST		
CLIENT		DAR-TALEB					
Borehole	EV 02	X		Date:		11/20/2013	
Test Location	3 to 6m	Y		K(m/sec):		1.5042E-08	
Inclination	0	Z					

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	4.90
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.13	60	4.77
WATER LEVEL BEFORE TEST	W.L	-4.5	mAD	2	0.16	120	4.75
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	0.18	180	4.72
CASING TOP LEVEL		0.3	mAD	4	0.20	240	4.71
CASING LENGTH		3.3	m	5	0.20	300	4.70
CASING BOTTOM LEVEL		-3	mAD	6	0.21	360	4.69
BOREHOLE DEPTH		6	m	7	0.23	420	4.67
BOREHOLE BOTTOM LEVEL		-6	mAD	8	0.24	480	4.66
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	0.26	540	4.64
WATER HEAD	Hw	4.9	m	10	0.29	600	4.61
				12	0.31	720	4.59
				14	0.33	840	4.57
				16	0.37	960	4.53
				18	0.40	1080	4.50
				19	0.40	1140	4.50
				20	0.41	1200	4.49
				25	0.44	1500	4.47
				30	0.47	1800	4.43
				35	0.56	2100	4.34
				40	0.62	2400	4.28
				45	0.64	2700	4.27
				50	0.65	3000	4.25
				55	0.67	3300	4.23
				60	0.69	3600	4.21

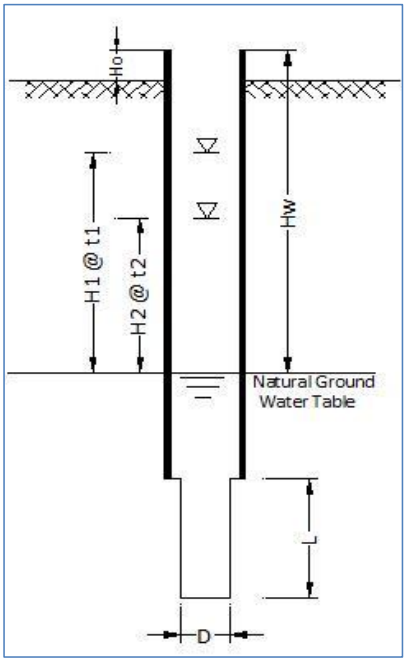
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

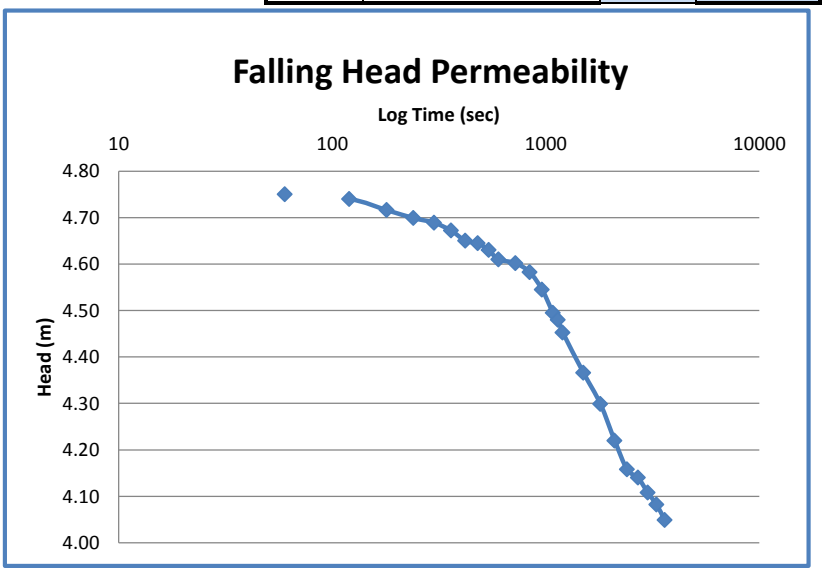




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 02	X			Date:		11/20/2013	
Test Location	6 to 9m	Y			K(m/sec):		2.4231E-08	
Inclination	0	Z						
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	4.90
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.15	60	4.75
WATER LEVEL BEFORE TEST		W.L	-4.3	mAD	2	0.16	120	4.74
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	0.18	180	4.72
CASING TOP LEVEL			0.3	mAD	4	0.20	240	4.70
CASING LENGTH			6.3	m	5	0.21	300	4.69
CASING BOTTOM LEVEL			-6	mAD	6	0.23	360	4.67
BOREHOLE DEPTH			9	m	7	0.25	420	4.65
BOREHOLE BOTTOM LEVEL			-9	mAD	8	0.26	480	4.65
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	9	0.27	540	4.63
WATER HEAD		Hw	4.9	m	10	0.29	600	4.61
					12	0.30	720	4.60
					14	0.32	840	4.58
					16	0.36	960	4.55
					18	0.41	1080	4.50
					19	0.42	1140	4.48
					20	0.45	1200	4.45
					25	0.53	1500	4.37
					30	0.60	1800	4.30
					35	0.68	2100	4.22
					40	0.74	2400	4.16
					45	0.76	2700	4.14
					50	0.79	3000	4.11
					55	0.82	3300	4.08
					60	0.85	3600	4.05

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

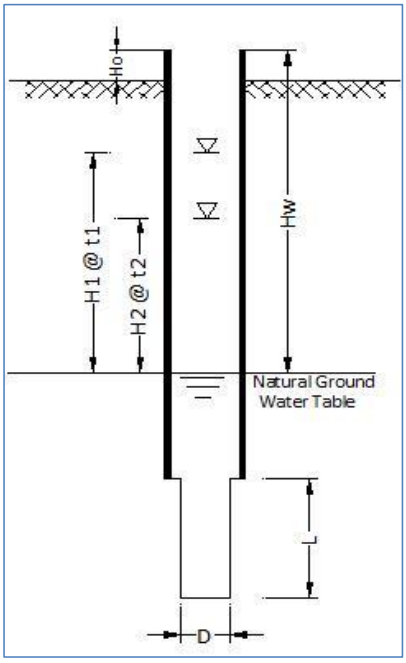


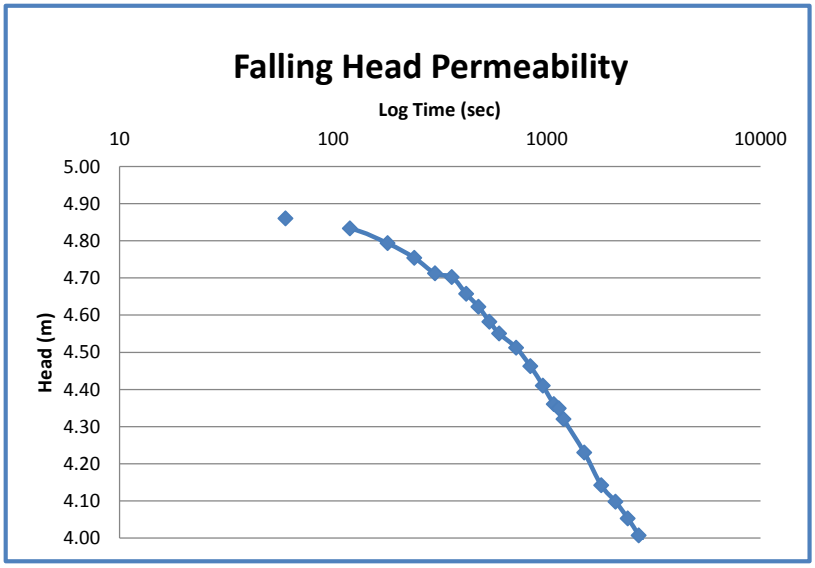


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST		
CLIENT		DAR-TALEB					
Borehole	EV 02	X		Date:		11/20/2013	
Test Location	9 to 12m	Y		K(m/sec):		6.5877E-08	
Inclination	0	Z					

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	4.90
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.04	60	4.86
WATER LEVEL BEFORE TEST	W.L	-11	mAD	2	0.07	120	4.83
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	0.11	180	4.79
CASING TOP LEVEL		0.3	mAD	4	0.15	240	4.75
CASING LENGTH		9.3	m	5	0.19	300	4.71
CASING BOTTOM LEVEL		-9	mAD	6	0.20	360	4.70
BOREHOLE DEPTH		12	m	7	0.24	420	4.66
BOREHOLE BOTTOM LEVEL		-12	mAD	8	0.28	480	4.62
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	0.32	540	4.58
WATER HEAD	Hw	4.9	m	10	0.35	600	4.55
				12	0.39	720	4.51
				14	0.44	840	4.46
				16	0.49	960	4.41
				18	0.54	1080	4.36
				19	0.55	1140	4.35
				20	0.58	1200	4.32
				25	0.67	1500	4.23
				30	0.76	1800	4.14
				35	0.80	2100	4.10
				40	0.85	2400	4.05
				45	0.89	2700	4.01
				50	0.94	3000	3.96
				55	0.99	3300	3.91
				60	1.03	3600	3.87

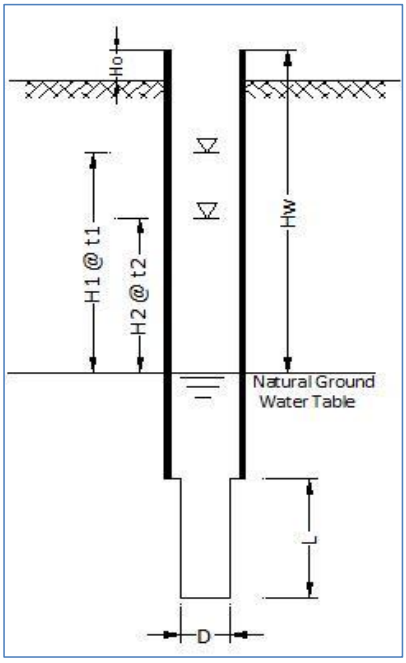
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

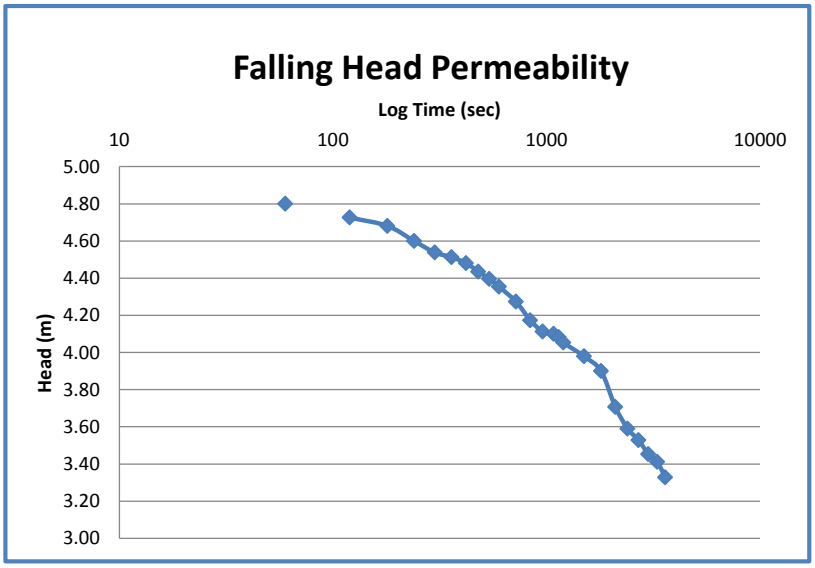




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 02	X			Date:		11/21/2013	
Test Location	12 to 15m	Y			K(m/sec):		6.9126E-08	
Inclination	0	Z						
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	4.90
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.10	60	4.80
WATER LEVEL BEFORE TEST		W.L	-10.5	mAD	2	0.17	120	4.73
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	0.22	180	4.68
CASING TOP LEVEL			0.3	mAD	4	0.30	240	4.60
CASING LENGTH			12.3	m	5	0.36	300	4.54
CASING BOTTOM LEVEL			-12	mAD	6	0.39	360	4.51
BOREHOLE DEPTH			15	m	7	0.42	420	4.48
BOREHOLE BOTTOM LEVEL			-15	mAD	8	0.47	480	4.44
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	9	0.50	540	4.40
WATER HEAD		Hw	4.9	m	10	0.55	600	4.35
					12	0.63	720	4.27
					14	0.73	840	4.17
					16	0.79	960	4.11
					18	0.80	1080	4.10
					19	0.82	1140	4.08
					20	0.85	1200	4.05
					25	0.92	1500	3.98
					30	1.00	1800	3.90
					35	1.19	2100	3.71
					40	1.31	2400	3.59
					45	1.37	2700	3.53
					50	1.45	3000	3.45
					55	1.49	3300	3.41
					60	1.57	3600	3.33

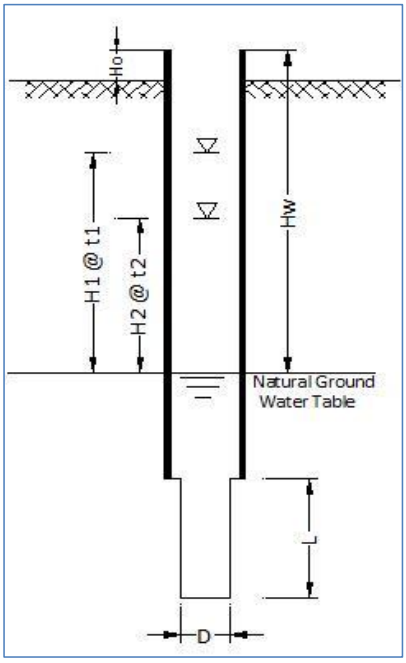
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

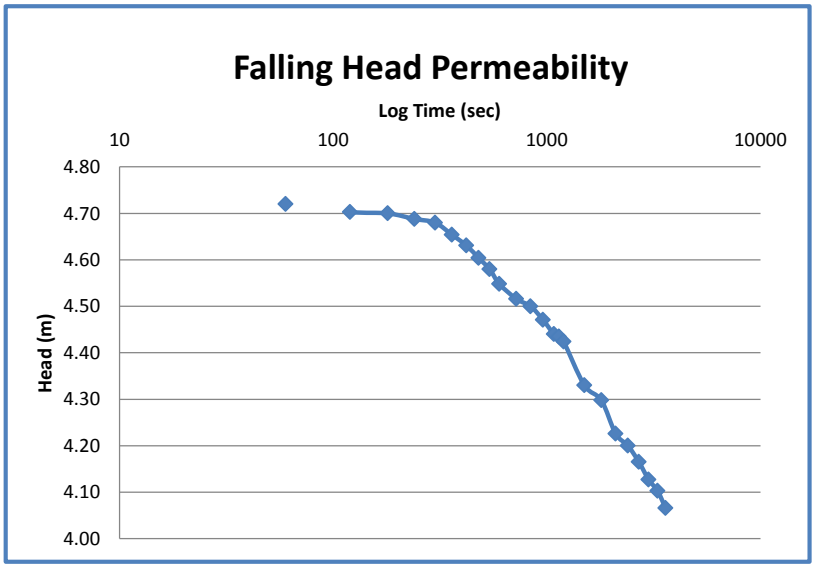




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 02	X			Date:		11/21/2013	
Test Location	15 to 18m	Y			K(m/sec):		4.5632E-08	
Inclination	0	Z						
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	4.90
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.18	60	4.72
WATER LEVEL BEFORE TEST		W.L	-11.2	mAD	2	0.20	120	4.70
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	0.20	180	4.70
CASING TOP LEVEL			0.3	mAD	4	0.21	240	4.69
CASING LENGTH			15.3	m	5	0.22	300	4.68
CASING BOTTOM LEVEL			-15	mAD	6	0.25	360	4.65
BOREHOLE DEPTH			18	m	7	0.27	420	4.63
BOREHOLE BOTTOM LEVEL			-18	mAD	8	0.30	480	4.60
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	9	0.32	540	4.58
WATER HEAD		Hw	4.9	m	10	0.35	600	4.55
					12	0.38	720	4.52
					14	0.40	840	4.50
					16	0.43	960	4.47
					18	0.46	1080	4.44
					19	0.47	1140	4.44
					20	0.48	1200	4.42
					25	0.57	1500	4.33
					30	0.60	1800	4.30
					35	0.67	2100	4.23
					40	0.70	2400	4.20
					45	0.74	2700	4.17
					50	0.77	3000	4.13
					55	0.80	3300	4.10
					60	0.83	3600	4.07

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

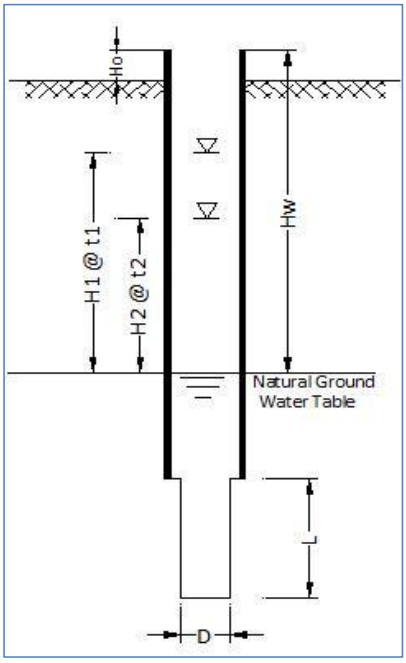


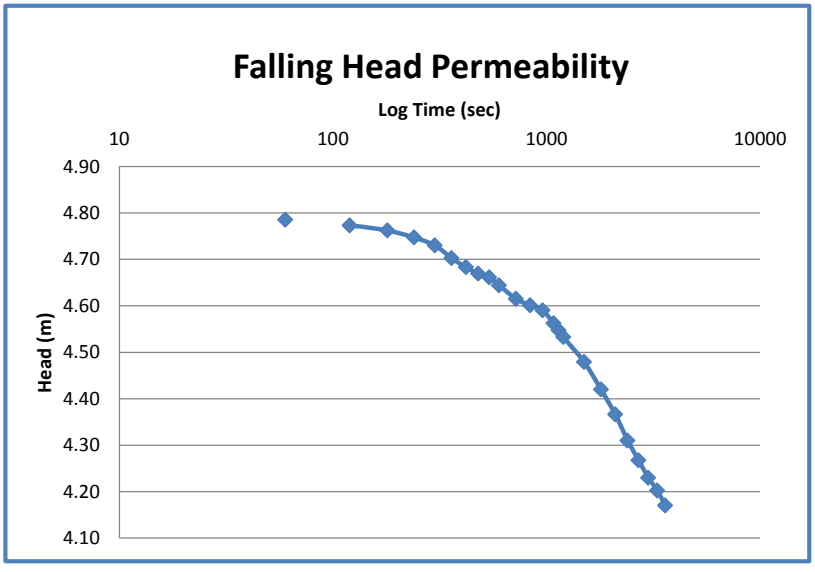


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST		
CLIENT		DAR-TALEB					
Borehole	EV 02	X		Date:		11/21/2013	
Test Location	18 to 21m	Y		K(m/sec):		3.9026E-08	
Inclination	0	Z					

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	4.90
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.12	60	4.79
WATER LEVEL BEFORE TEST	W.L	-4	mAD	2	0.13	120	4.77
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	0.14	180	4.76
CASING TOP LEVEL		0.3	mAD	4	0.15	240	4.75
CASING LENGTH		18.3	m	5	0.17	300	4.73
CASING BOTTOM LEVEL		-18	mAD	6	0.20	360	4.70
BOREHOLE DEPTH		21	m	7	0.22	420	4.68
BOREHOLE BOTTOM LEVEL		-21	mAD	8	0.23	480	4.67
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	0.24	540	4.66
WATER HEAD	Hw	4.9	m	10	0.26	600	4.64
				12	0.29	720	4.62
				14	0.30	840	4.60
				16	0.31	960	4.59
				18	0.34	1080	4.56
				19	0.35	1140	4.55
				20	0.37	1200	4.53
				25	0.42	1500	4.48
				30	0.48	1800	4.42
				35	0.53	2100	4.37
				40	0.59	2400	4.31
				45	0.63	2700	4.27
				50	0.67	3000	4.23
				55	0.70	3300	4.20
				60	0.73	3600	4.17

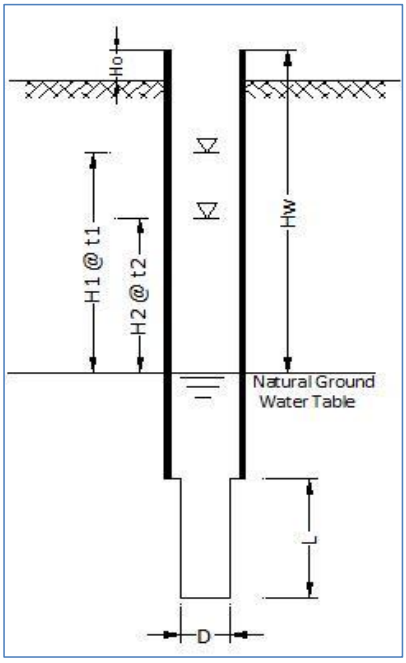
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

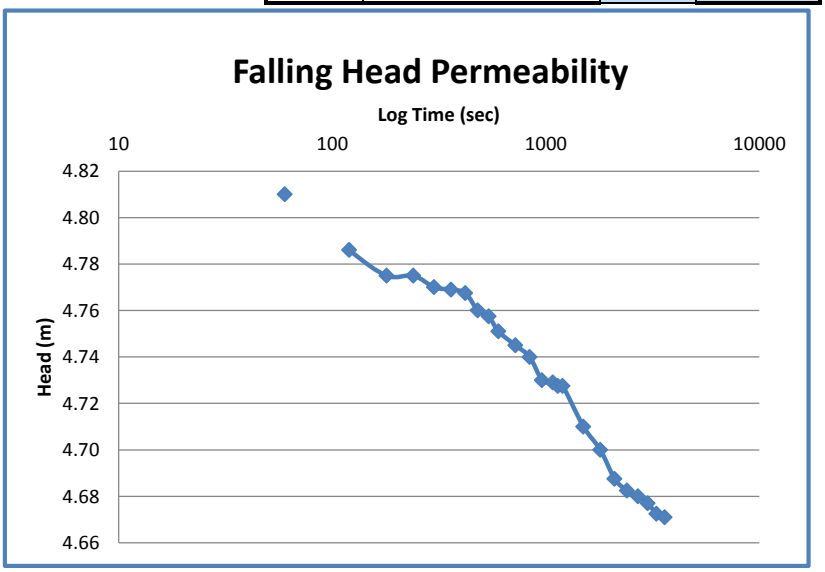




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 02	X			Date:		11/21/2013	
Test Location	21 to 24m	Y			K(m/sec):		7.0389E-09	
Inclination	0	Z						
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	4.90
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.09	60	4.81
WATER LEVEL BEFORE TEST		W.L	-8.3	mAD	2	0.11	120	4.79
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	0.13	180	4.78
CASING TOP LEVEL			0.3	mAD	4	0.13	240	4.78
CASING LENGTH			21.3	m	5	0.13	300	4.77
CASING BOTTOM LEVEL			-21	mAD	6	0.13	360	4.77
BOREHOLE DEPTH			24	m	7	0.13	420	4.77
BOREHOLE BOTTOM LEVEL			-24	mAD	8	0.14	480	4.76
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	9	0.14	540	4.76
WATER HEAD		Hw	4.9	m	10	0.15	600	4.75
					12	0.16	720	4.75
					14	0.16	840	4.74
					16	0.17	960	4.73
					18	0.17	1080	4.73
					19	0.17	1140	4.73
					20	0.17	1200	4.73
					25	0.19	1500	4.71
					30	0.20	1800	4.70
					35	0.21	2100	4.69
					40	0.22	2400	4.68
					45	0.22	2700	4.68
					50	0.22	3000	4.68
					55	0.23	3300	4.67
					60	0.23	3600	4.67

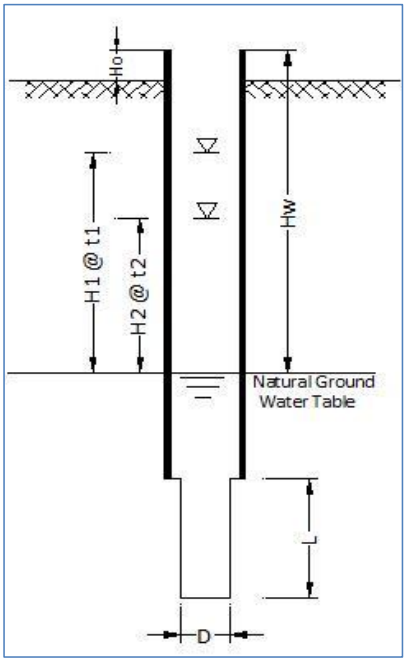
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

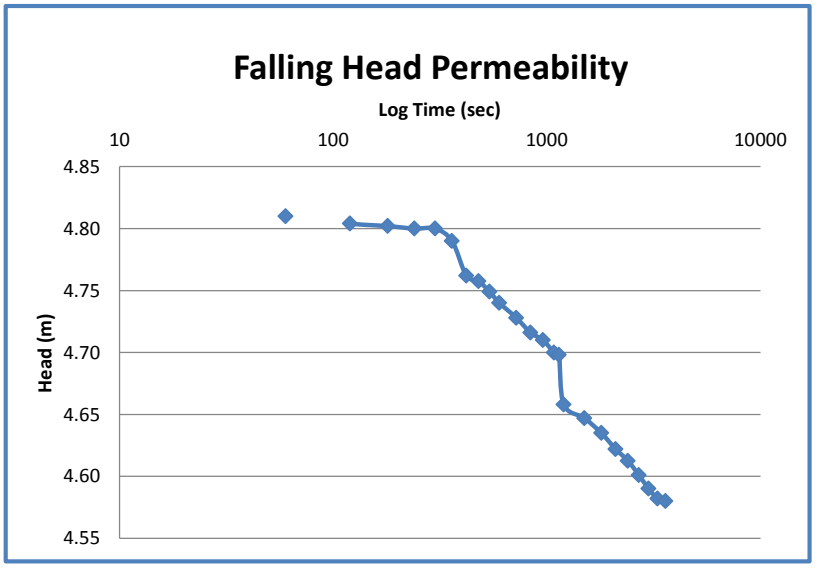




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 02	X			Date:		11/22/2013	
Test Location	24 to 27m	Y			K(m/sec):		7.5700E-09	
Inclination	0	Z						
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	4.90
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.09	60	4.81
WATER LEVEL BEFORE TEST		W.L	-11.7	mAD	2	0.10	120	4.80
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	0.10	180	4.80
CASING TOP LEVEL			0.3	mAD	4	0.10	240	4.80
CASING LENGTH			24.3	m	5	0.10	300	4.80
CASING BOTTOM LEVEL			-24	mAD	6	0.11	360	4.79
BOREHOLE DEPTH			27	m	7	0.14	420	4.76
BOREHOLE BOTTOM LEVEL			-27	mAD	8	0.14	480	4.76
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	9	0.15	540	4.75
WATER HEAD		Hw	4.9	m	10	0.16	600	4.74
					12	0.17	720	4.73
					14	0.18	840	4.72
					16	0.19	960	4.71
					18	0.20	1080	4.70
					19	0.20	1140	4.70
					20	0.24	1200	4.66
					25	0.25	1500	4.65
					30	0.27	1800	4.64
					35	0.28	2100	4.62
					40	0.29	2400	4.61
					45	0.30	2700	4.60
					50	0.31	3000	4.59
					55	0.32	3300	4.58
					60	0.32	3600	4.58

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

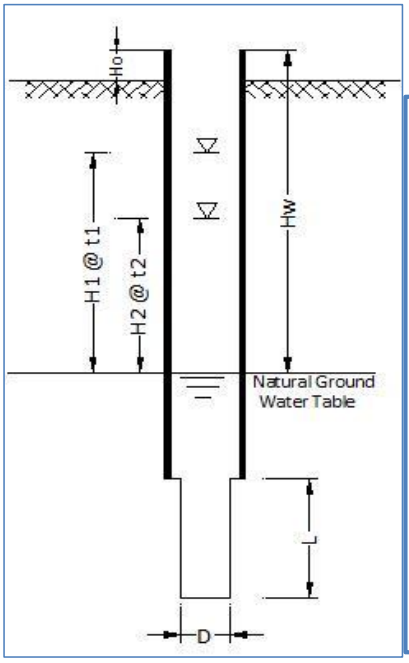


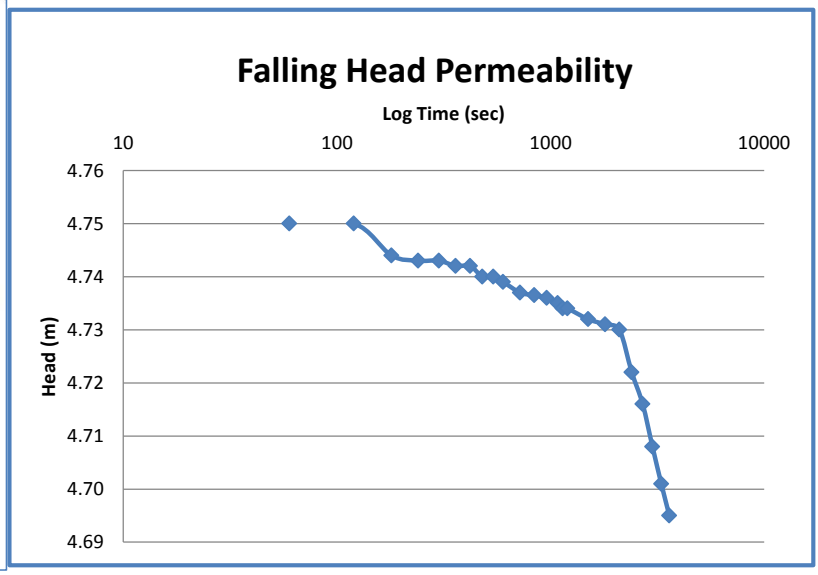


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST		
CLIENT		DAR-TALEB					
Borehole	EV 02	X		Date:		11/22/2013	
Test Location	27 to 30m	Y		K(m/sec):		5.2307E-09	
Inclination	0	Z					

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	4.90
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.15	60	4.75
WATER LEVEL BEFORE TEST	W.L	-18	mAD	2	0.15	120	4.75
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	0.16	180	4.74
CASING TOP LEVEL		0.3	mAD	4	0.16	240	4.74
CASING LENGTH		27.3	m	5	0.16	300	4.74
CASING BOTTOM LEVEL		-27	mAD	6	0.16	360	4.74
BOREHOLE DEPTH		30	m	7	0.16	420	4.74
BOREHOLE BOTTOM LEVEL		-30	mAD	8	0.16	480	4.74
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	0.16	540	4.74
WATER HEAD	Hw	4.9	m	10	0.16	600	4.74
				12	0.16	720	4.74
				14	0.16	840	4.74
				16	0.16	960	4.74
				18	0.17	1080	4.74
				19	0.17	1140	4.73
				20	0.17	1200	4.73
				25	0.17	1500	4.73
				30	0.17	1800	4.73
				35	0.17	2100	4.73
				40	0.18	2400	4.72
				45	0.18	2700	4.72
				50	0.19	3000	4.71
				55	0.20	3300	4.70
				60	0.21	3600	4.70

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

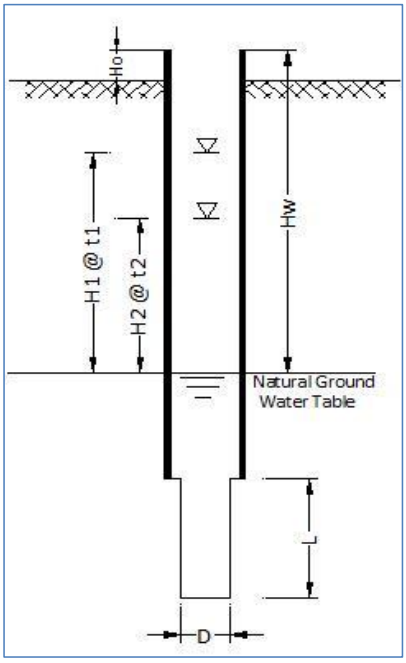


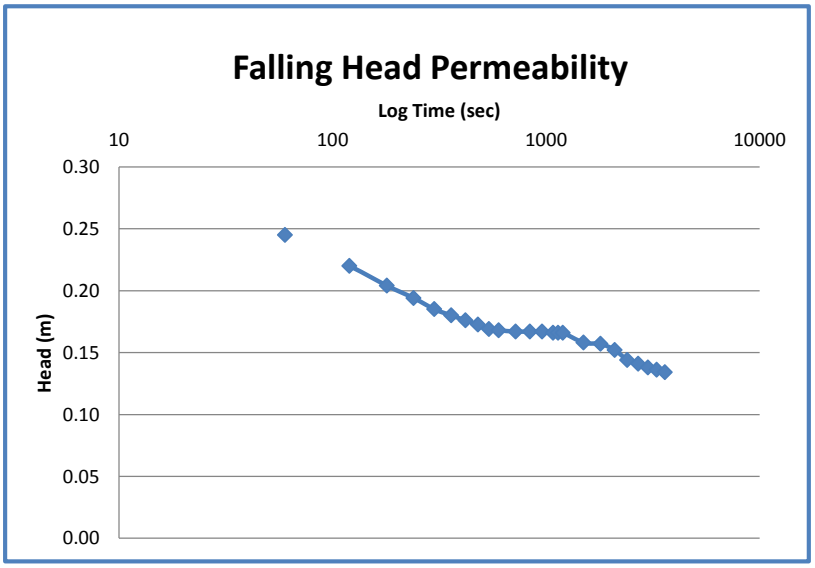


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV03	X			Date:		12/9/2013	
Test Location	0 to 3m	Y			K(m/sec):		9.6330E-08	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	0.30
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.06	60	0.25
WATER LEVEL BEFORE TEST	W.L	-0.3	mAD	2	0.08	120	0.22
HEIGHT OF CASING ABOVE NGL	Ho	0	m	3	0.10	180	0.20
CASING TOP LEVEL		0	mAD	4	0.11	240	0.19
CASING LENGTH		0	m	5	0.12	300	0.19
CASING BOTTOM LEVEL		0	mAD	6	0.12	360	0.18
BOREHOLE DEPTH		3	m	7	0.12	420	0.18
BOREHOLE BOTTOM LEVEL		-3	mAD	8	0.13	480	0.17
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	0.13	540	0.17
WATER HEAD	Hw	0.3	m	10	0.13	600	0.17
				12	0.13	720	0.17
				14	0.13	840	0.17
				16	0.13	960	0.17
				18	0.13	1080	0.17
				19	0.13	1140	0.17
				20	0.13	1200	0.17
				25	0.14	1500	0.16
				30	0.14	1800	0.16
				35	0.15	2100	0.15
				40	0.16	2400	0.14
				45	0.16	2700	0.14
				50	0.16	3000	0.14
				55	0.16	3300	0.14
				60	0.17	3600	0.13

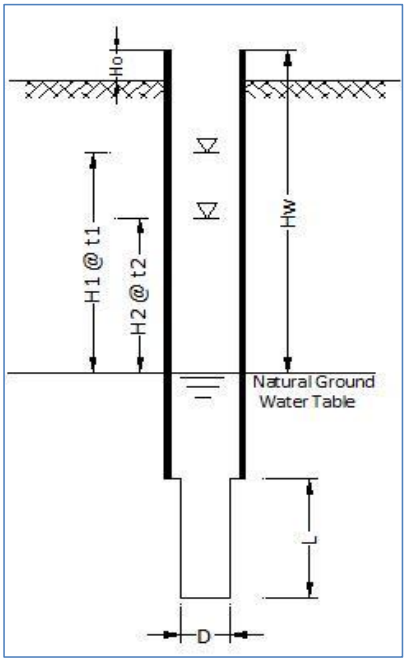
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

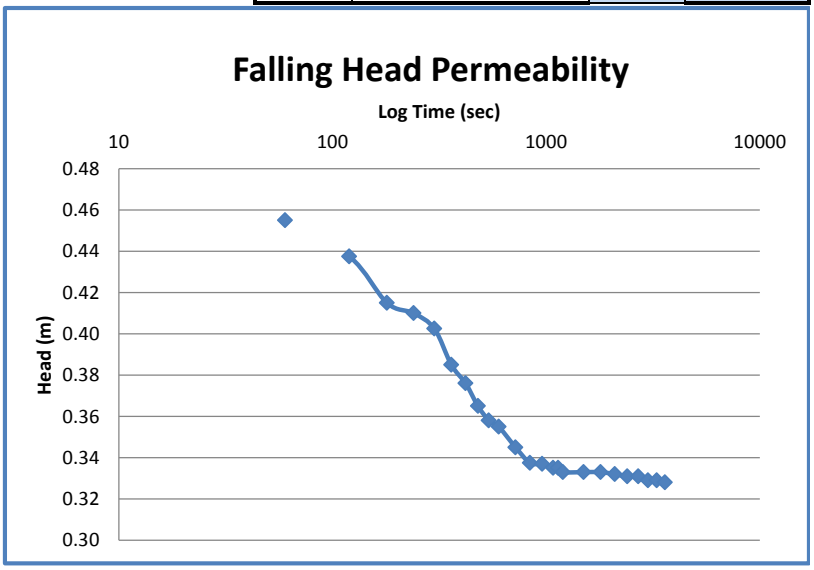




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV03	X			Date:		12/9/2013	
Test Location	3 to 6m	Y			K(m/sec):		1.1224E-08	
Inclination	0	Z						
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	0.60
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.15	60	0.46
WATER LEVEL BEFORE TEST		W.L	-0.85	mAD	2	0.16	120	0.44
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	0.19	180	0.42
CASING TOP LEVEL			0.3	mAD	4	0.19	240	0.41
CASING LENGTH			3.3	m	5	0.20	300	0.40
CASING BOTTOM LEVEL			-3	mAD	6	0.22	360	0.39
BOREHOLE DEPTH			6	m	7	0.22	420	0.38
BOREHOLE BOTTOM LEVEL			-6	mAD	8	0.24	480	0.37
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	9	0.24	540	0.36
WATER HEAD		Hw	0.6	m	10	0.25	600	0.36
					12	0.26	720	0.35
					14	0.26	840	0.34
					16	0.26	960	0.34
					18	0.27	1080	0.34
					19	0.27	1140	0.34
					20	0.27	1200	0.33
					25	0.27	1500	0.33
					30	0.27	1800	0.33
					35	0.27	2100	0.33
					40	0.27	2400	0.33
					45	0.27	2700	0.33
					50	0.27	3000	0.33
					55	0.27	3300	0.33
					60	0.27	3600	0.33

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

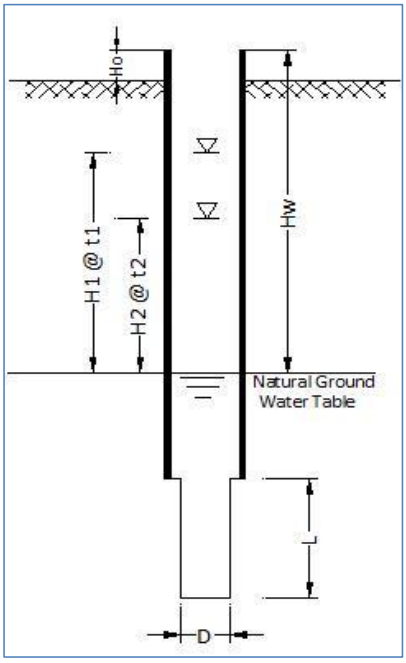


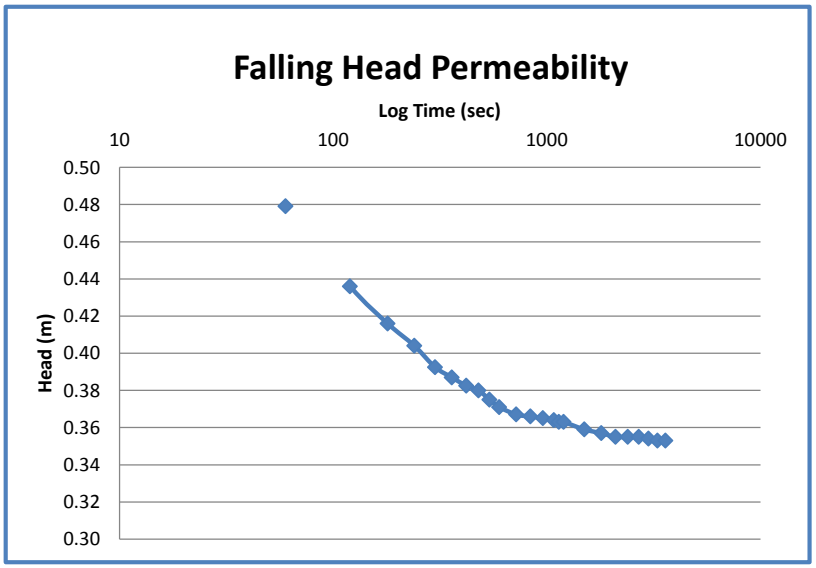


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV03	X			Date:		12/9/2013	
Test Location	6 to 9m	Y			K(m/sec):		1.4783E-08	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	0.60
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.12	60	0.48
WATER LEVEL BEFORE TEST	W.L	-1.3	mAD	2	0.16	120	0.44
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	0.18	180	0.42
CASING TOP LEVEL		0.3	mAD	4	0.20	240	0.40
CASING LENGTH		6.3	m	5	0.21	300	0.39
CASING BOTTOM LEVEL		-6	mAD	6	0.21	360	0.39
BOREHOLE DEPTH		9	m	7	0.22	420	0.38
BOREHOLE BOTTOM LEVEL		-9	mAD	8	0.22	480	0.38
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	0.23	540	0.38
WATER HEAD	Hw	0.6	m	10	0.23	600	0.37
				12	0.23	720	0.37
				14	0.23	840	0.37
				16	0.24	960	0.37
				18	0.24	1080	0.36
				19	0.24	1140	0.36
				20	0.24	1200	0.36
				25	0.24	1500	0.36
				30	0.24	1800	0.36
				35	0.25	2100	0.36
				40	0.25	2400	0.36
				45	0.25	2700	0.36
				50	0.25	3000	0.35
				55	0.25	3300	0.35
				60	0.25	3600	0.35

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

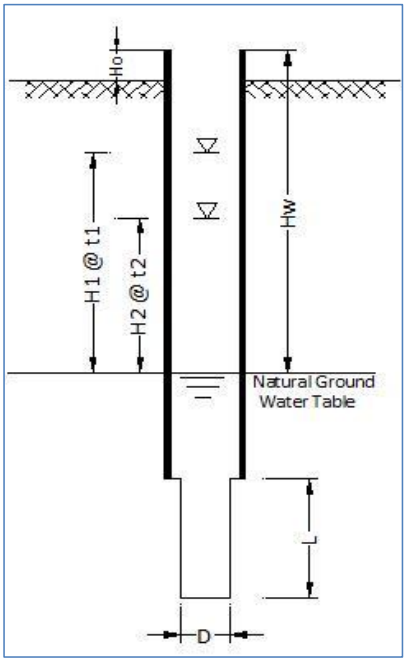


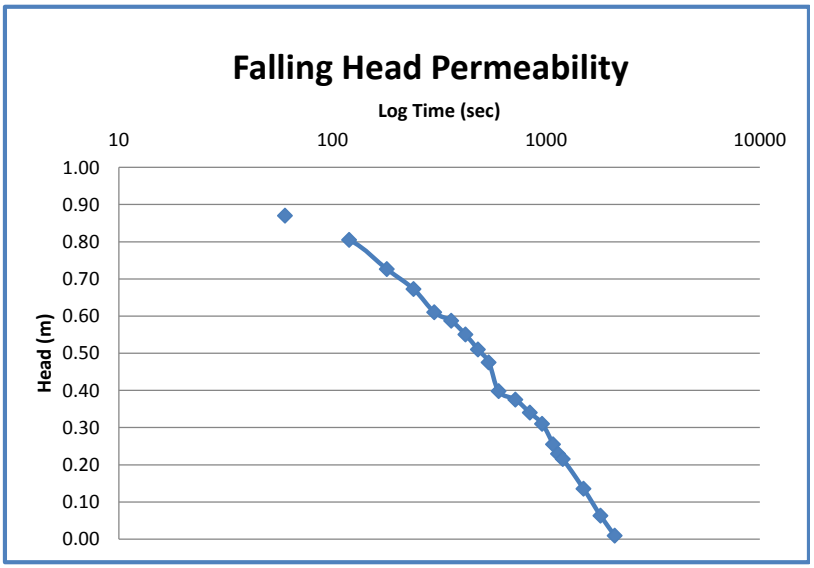


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 07	X			Date:		12/2/2013	
Test Location	0 to 3m	Y			K(m/sec):		2.5030E-06	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1		mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	1.00
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.13	60	0.87
WATER LEVEL BEFORE TEST	W.L	-1.3	mAD	2	0.20	120	0.81
HEIGHT OF CASING ABOVE NGL	Ho	0	m	3	0.27	180	0.73
CASING TOP LEVEL		0	mAD	4	0.33	240	0.67
CASING LENGTH		0	m	5	0.39	300	0.61
CASING BOTTOM LEVEL		0	mAD	6	0.41	360	0.59
BOREHOLE DEPTH		3	m	7	0.45	420	0.55
BOREHOLE BOTTOM LEVEL		-3	mAD	8	0.49	480	0.51
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	0.53	540	0.48
WATER HEAD	Hw	1	m	10	0.60	600	0.40
				12	0.63	720	0.38
				14	0.66	840	0.34
				16	0.69	960	0.31
				18	0.75	1080	0.26
				19	0.77	1140	0.23
				20	0.79	1200	0.22
				25	0.87	1500	0.14
				30	0.94	1800	0.06
				35	0.99	2100	0.01

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

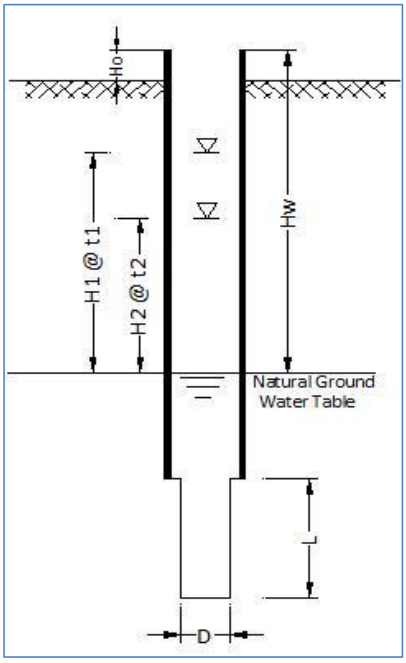


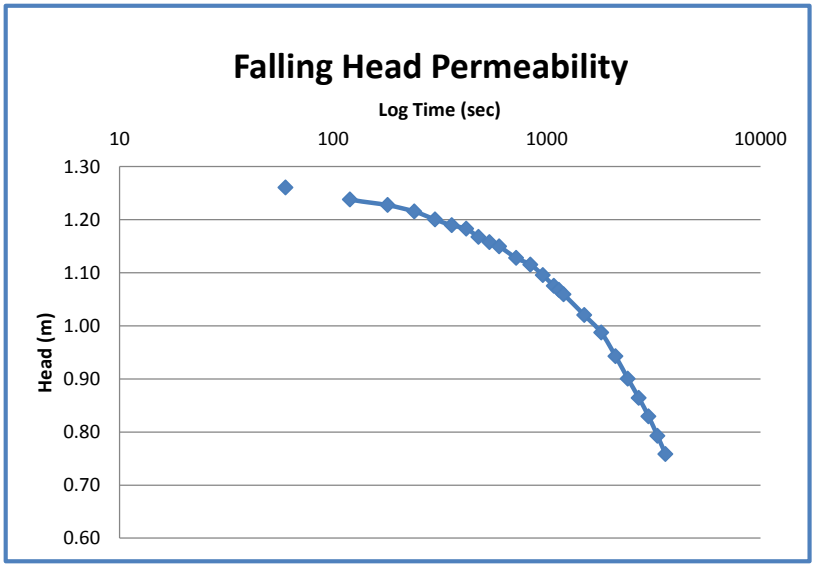


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 07	X			Date:		12/2/2013	
Test Location	3 to 6m	Y			K(m/sec):		1.5864E-07	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	1.35
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.09	60	1.26
WATER LEVEL BEFORE TEST	W.L	-4	mAD	2	0.11	120	1.24
HEIGHT OF CASING ABOVE NGL	Ho	0.35	m	3	0.12	180	1.23
CASING TOP LEVEL		0.35	mAD	4	0.14	240	1.22
CASING LENGTH		3.3	m	5	0.15	300	1.20
CASING BOTTOM LEVEL		-2.95	mAD	6	0.16	360	1.19
BOREHOLE DEPTH		6	m	7	0.17	420	1.18
BOREHOLE BOTTOM LEVEL		-6	mAD	8	0.18	480	1.17
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3.05	m	9	0.19	540	1.16
WATER HEAD	Hw	1.35	m	10	0.20	600	1.15
				12	0.22	720	1.13
				14	0.24	840	1.12
				16	0.26	960	1.10
				18	0.28	1080	1.08
				19	0.28	1140	1.07
				20	0.29	1200	1.06
				25	0.33	1500	1.02
				30	0.36	1800	0.99
				35	0.41	2100	0.94
				40	0.45	2400	0.90
				45	0.49	2700	0.86
				50	0.52	3000	0.83
				55	0.56	3300	0.79
				60	0.59	3600	0.76

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

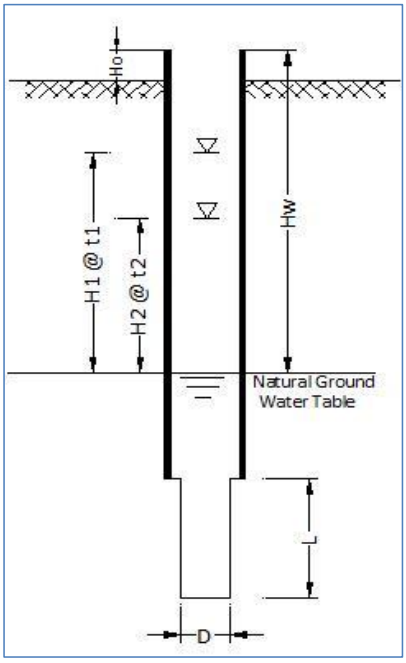


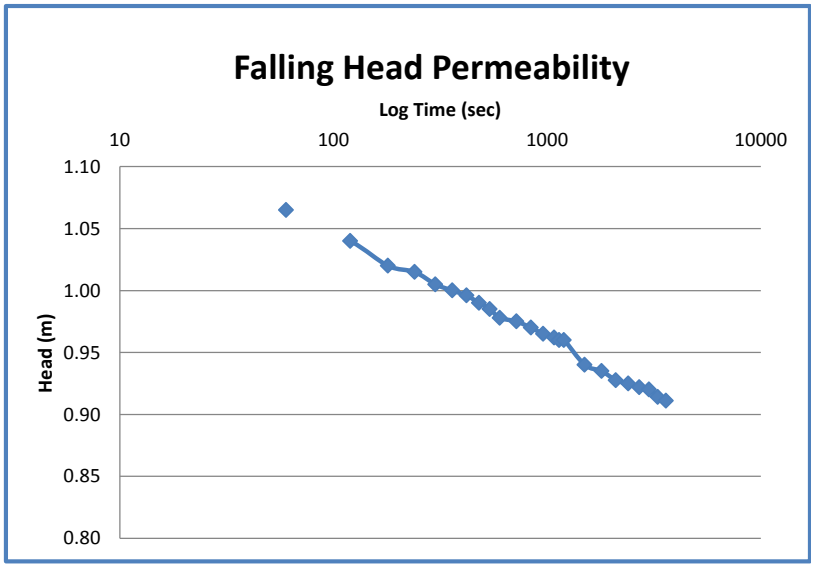


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 07	X			Date:		12/2/2013	
Test Location	6 to 9m	Y			K(m/sec):		3.5217E-08	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	1.30
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.24	60	1.07
WATER LEVEL BEFORE TEST	W.L	-3.8	mAD	2	0.26	120	1.04
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	0.28	180	1.02
CASING TOP LEVEL		0.3	mAD	4	0.29	240	1.02
CASING LENGTH		6.3	m	5	0.30	300	1.01
CASING BOTTOM LEVEL		-6	mAD	6	0.30	360	1.00
BOREHOLE DEPTH		9	m	7	0.30	420	1.00
BOREHOLE BOTTOM LEVEL		-9	mAD	8	0.31	480	0.99
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	0.32	540	0.99
WATER HEAD	Hw	1.3	m	10	0.32	600	0.98
				12	0.33	720	0.98
				14	0.33	840	0.97
				16	0.34	960	0.97
				18	0.34	1080	0.96
				19	0.34	1140	0.96
				20	0.34	1200	0.96
				25	0.36	1500	0.94
				30	0.37	1800	0.94
				35	0.37	2100	0.93
				40	0.38	2400	0.93
				45	0.38	2700	0.92
				50	0.38	3000	0.92
				55	0.39	3300	0.91
				60	0.39	3600	0.91

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

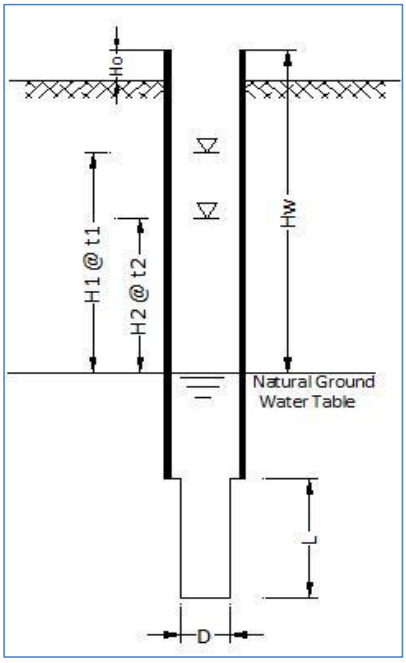


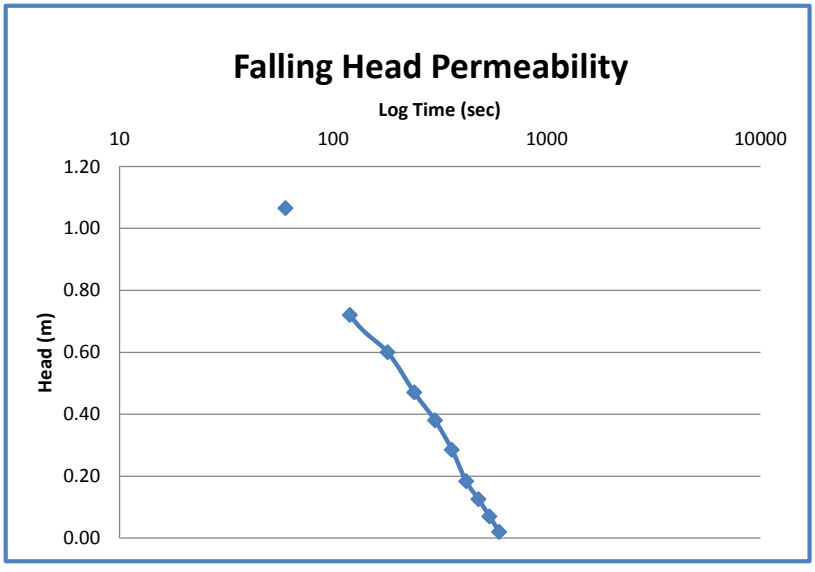


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 07	X			Date:		12/2/2013	
Test Location	9 to 12m	Y			K(m/sec):		8.8643E-06	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	1.30
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.24	60	1.07
WATER LEVEL BEFORE TEST	W.L	-5.6	mAD	2	0.58	120	0.72
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	0.70	180	0.60
CASING TOP LEVEL		0.3	mAD	4	0.83	240	0.47
CASING LENGTH		9.3	m	5	0.92	300	0.38
CASING BOTTOM LEVEL		-9	mAD	6	1.02	360	0.29
BOREHOLE DEPTH		12	m	7	1.12	420	0.18
BOREHOLE BOTTOM LEVEL		-12	mAD	8	1.18	480	0.13
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	1.23	540	0.07
WATER HEAD	Hw	1.3	m	10	1.28	600	0.02

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

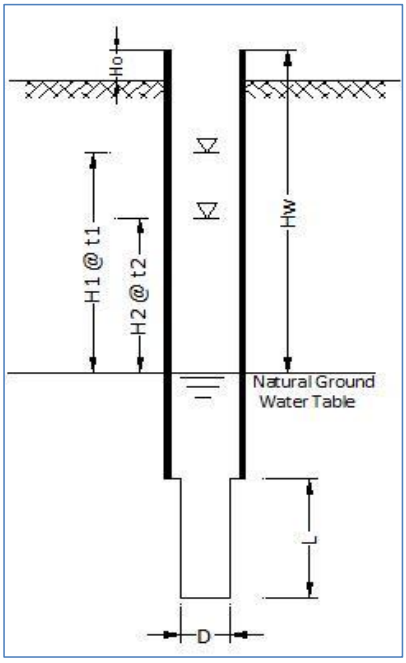


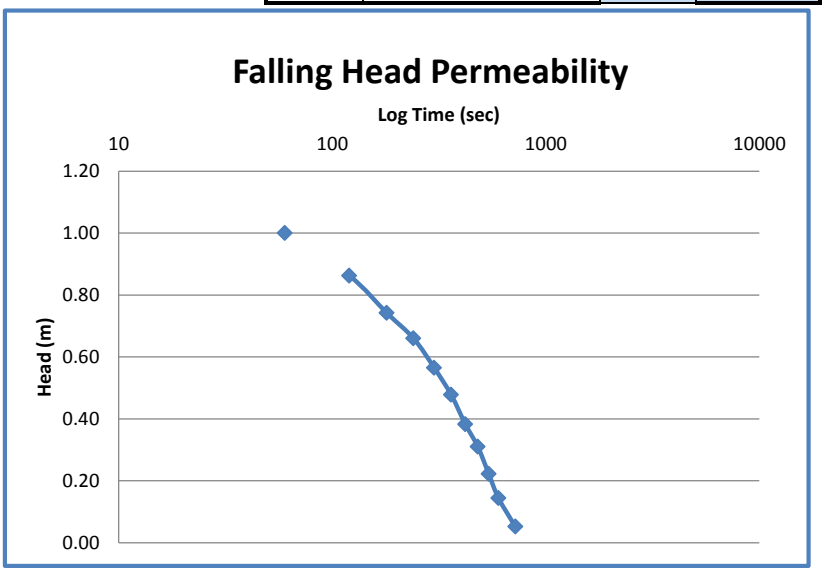


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 07	X			Date:		12/3/2013	
Test Location	12 to 15m	Y			K(m/sec):		6.7452E-06	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	1.30
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.30	60	1.00
WATER LEVEL BEFORE TEST	W.L	-7	mAD	2	0.44	120	0.86
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	0.56	180	0.74
CASING TOP LEVEL		0.3	mAD	4	0.64	240	0.66
CASING LENGTH		12.3	m	5	0.74	300	0.57
CASING BOTTOM LEVEL		-12	mAD	6	0.82	360	0.48
BOREHOLE DEPTH		15	m	7	0.92	420	0.38
BOREHOLE BOTTOM LEVEL		-15	mAD	8	0.99	480	0.31
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	1.08	540	0.22
WATER HEAD	Hw	1.3	m	10	1.16	600	0.14
				12	1.25	720	0.05

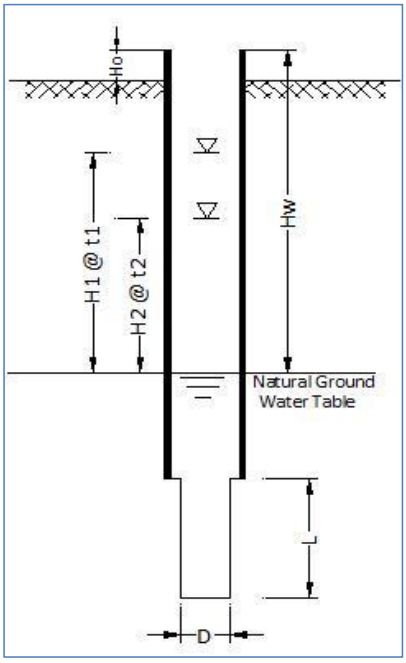
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

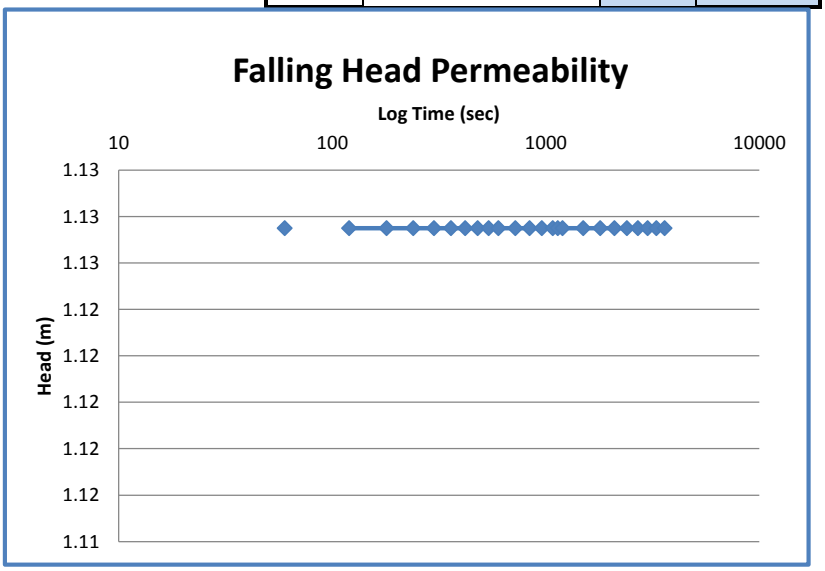




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 07	X			Date:		12/3/2013	
Test Location	15 to 18m	Y			K(m/sec):		0.0000E+00	
Inclination	0	Z			Test is failed due to the artesian flow.			
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	1.30
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.17	60	1.13
WATER LEVEL BEFORE TEST		W.L	-12.7	mAD	2	0.17	120	1.13
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	0.17	180	1.13
CASING TOP LEVEL			0.3	mAD	4	0.17	240	1.13
CASING LENGTH			15.3	m	5	0.17	300	1.13
CASING BOTTOM LEVEL			-15	mAD	6	0.17	360	1.13
BOREHOLE DEPTH			18	m	7	0.17	420	1.13
BOREHOLE BOTTOM LEVEL			-18	mAD	8	0.17	480	1.13
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	9	0.17	540	1.13
WATER HEAD		Hw	1.3	m	10	0.17	600	1.13
					12	0.17	720	1.13
					14	0.17	840	1.13
					16	0.17	960	1.13
					18	0.17	1080	1.13
					19	0.17	1140	1.13
					20	0.17	1200	1.13
					25	0.17	1500	1.13
					30	0.17	1800	1.13
					35	0.17	2100	1.13
					40	0.17	2400	1.13
					45	0.17	2700	1.13
					50	0.17	3000	1.13
					55	0.17	3300	1.13
					60	0.17	3600	1.13

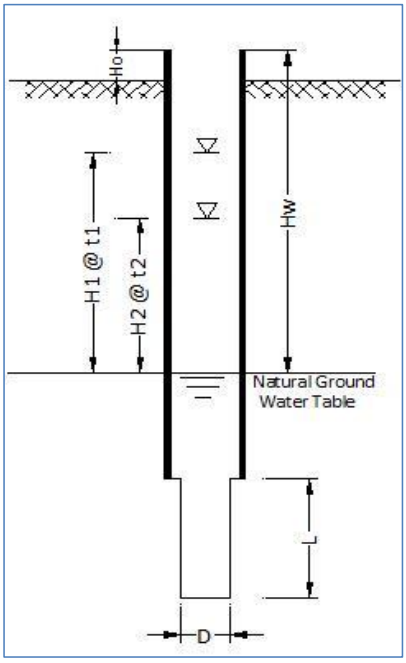
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

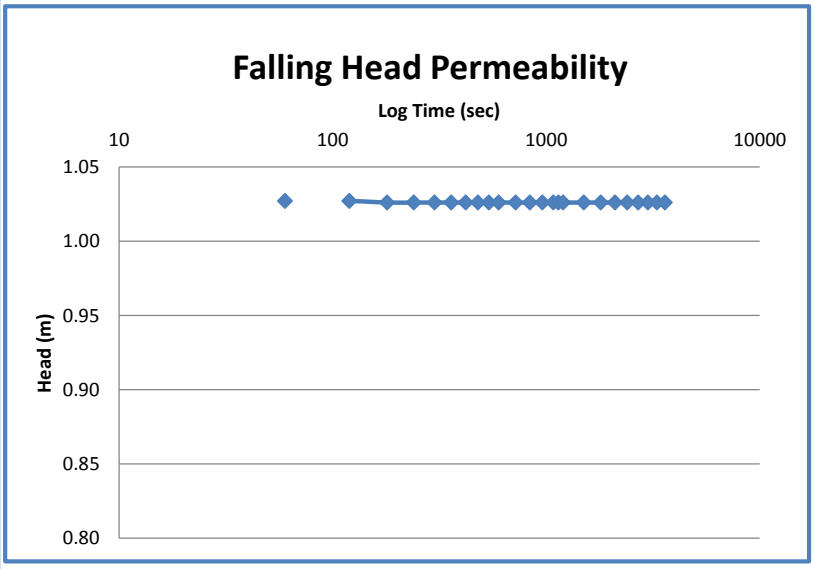




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 07	X			Date:		12/3/2013	
Test Location	18 to 21m	Y			K(m/sec):		0.0000E+00	
Inclination	0	Z			Test is failed due to the artesian flow.			
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	1.30
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.27	60	1.03
WATER LEVEL BEFORE TEST		W.L	-14.5	mAD	2	0.27	120	1.03
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	0.27	180	1.03
CASING TOP LEVEL			0.3	mAD	4	0.27	240	1.03
CASING LENGTH			18.3	m	5	0.27	300	1.03
CASING BOTTOM LEVEL			-18	mAD	6	0.27	360	1.03
BOREHOLE DEPTH			21	m	7	0.27	420	1.03
BOREHOLE BOTTOM LEVEL			-21	mAD	8	0.27	480	1.03
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	9	0.27	540	1.03
WATER HEAD		Hw	1.3	m	10	0.27	600	1.03
					12	0.27	720	1.03
					14	0.27	840	1.03
					16	0.27	960	1.03
					18	0.27	1080	1.03
					19	0.27	1140	1.03
					20	0.27	1200	1.03
					25	0.27	1500	1.03
					30	0.27	1800	1.03
					35	0.27	2100	1.03
					40	0.27	2400	1.03
					45	0.27	2700	1.03
					50	0.27	3000	1.03
					55	0.27	3300	1.03
					60	0.27	3600	1.03

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

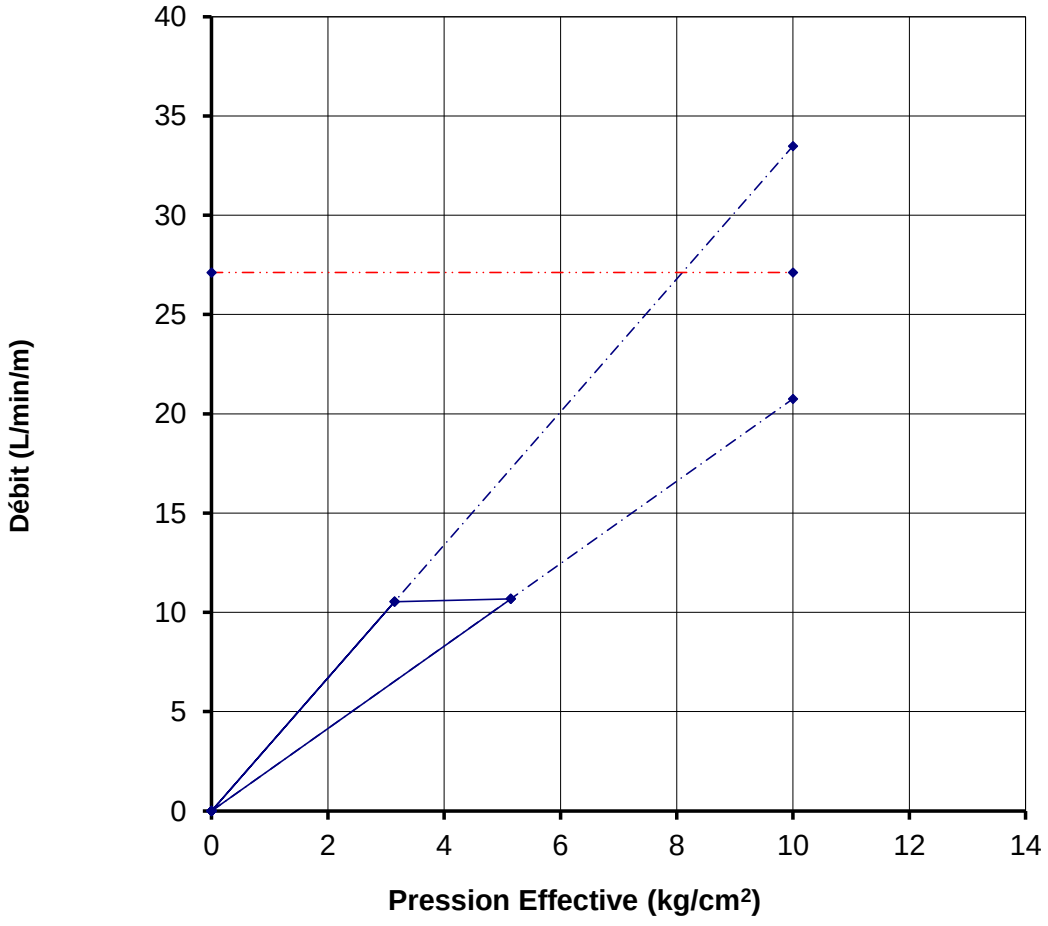




SATCON	PROJECT: **BISRI DAM**		Date: **12/16/2013**
	SONDAGE No.: **EV 09**		
	TRANCHE ESSAYEE **9.00 m** à **14.00 m**		Manomètre **0.50 m**
			GWT: **15.5m**

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	527	10	5	52.7	10.54	1.2	5.22E-02	3.148
4	534	10	5	53.4	10.68	1.2	5.29E-02	5.147

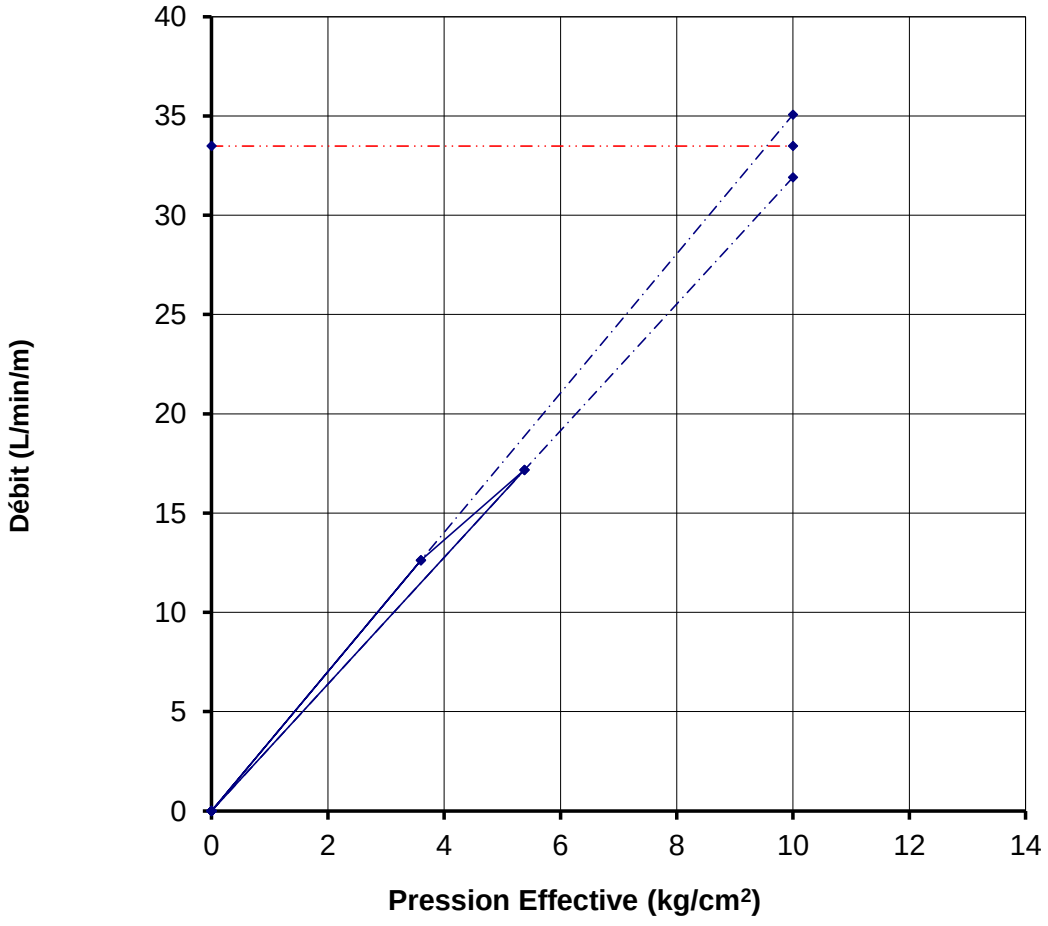


Lugeon = 27.12 L/min/m

PROJECT:	**BISRI DAM**	Date: **12/16/2013**
SONDAGE No.:	**EV 09**	
TRANCHE ESSAYEE	**14.00 m** à **18.00 m**	Manomètre **0.50 m**
		GWT: **15.5m**

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	505	10	4	50.5	12.63	1.65	5.00E-02	3.600
3.8	687	10	4	68.7	17.18	1.65	6.80E-02	5.382

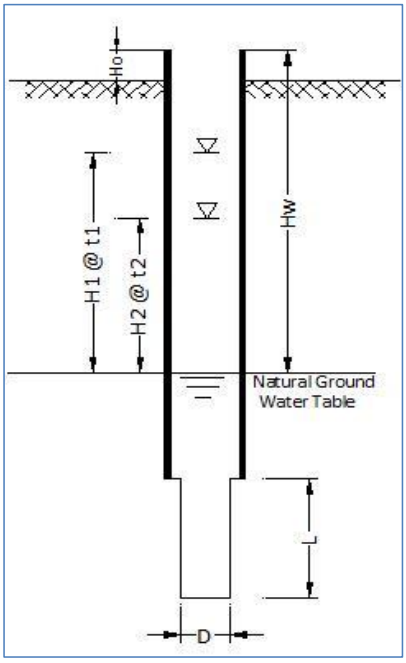


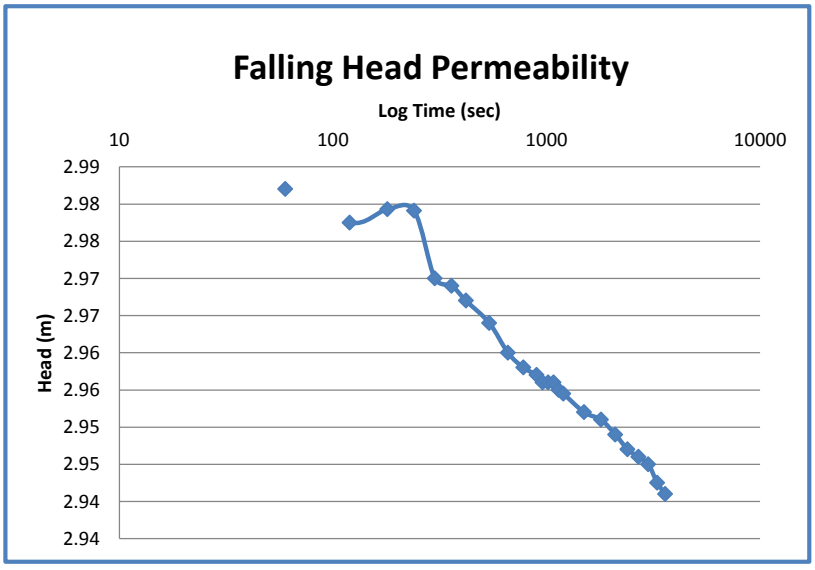
Lugeon = 33.5 L/min/m

PROJECT		BISRI DAM				FALLING HEAD BOREHOLE WATER PERMEABILITY TEST		
CLIENT		DAR-TALEB						
Borehole	EV 09	X			Date:		12/12/2013	
Test Location	0 to 3	Y			K(m/sec):		3.2013E-09	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1		mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	3.00
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.02	60	2.98
WATER LEVEL BEFORE TEST	W.L	-0.4	mAD	2	0.02	120	2.98
HEIGHT OF CASING ABOVE NGL	Ho	0	m	3	0.02	180	2.98
CASING TOP LEVEL		0	mAD	4	0.02	240	2.98
CASING LENGTH		0	m	5	0.03	300	2.97
CASING BOTTOM LEVEL		0	mAD	6	0.03	360	2.97
BOREHOLE DEPTH		3	m	7	0.03	420	2.97
BOREHOLE BOTTOM LEVEL		-3	mAD	9	0.04	540	2.96
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	11	0.04	660	2.96
WATER HEAD	Hw	3	m	13	0.04	780	2.96
				15	0.04	900	2.96
				16	0.04	960	2.96
				17	0.04	1020	2.96
				18	0.04	1080	2.96
				19	0.05	1140	2.96
				20	0.05	1200	2.95
				25	0.05	1500	2.95
				30	0.05	1800	2.95
				35	0.05	2100	2.95
				40	0.05	2400	2.95
				45	0.05	2700	2.95
				50	0.06	3000	2.95
				55	0.06	3300	2.94
				60	0.06	3600	2.94

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

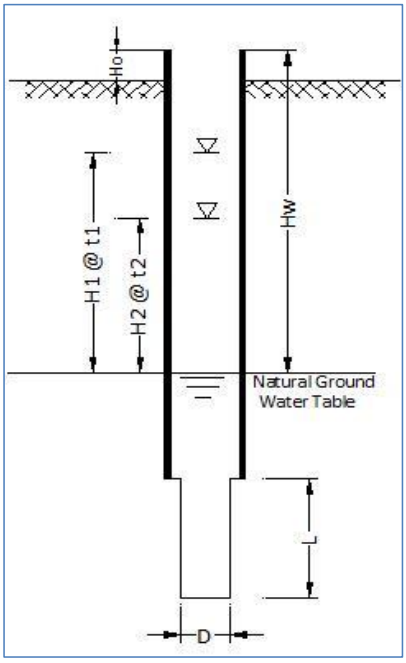


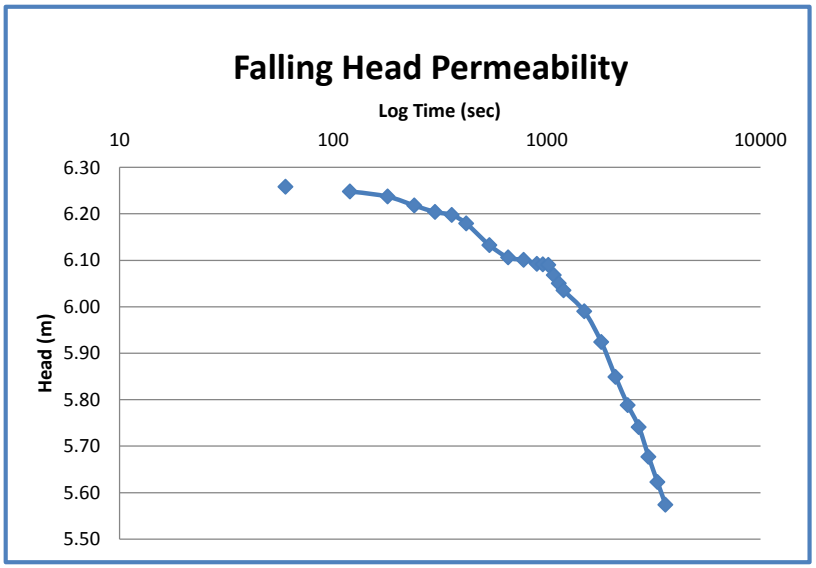


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	EV 09	X			Date:		12/12/2013	
Test Location	3 to 6	Y			K(m/sec):		3.7518E-08	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	127	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	6.30
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.04	60	6.26
WATER LEVEL BEFORE TEST	W.L	-2	mAD	2	0.05	120	6.25
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	0.06	180	6.24
CASING TOP LEVEL		0.3	mAD	4	0.08	240	6.22
CASING LENGTH		3.3	m	5	0.10	300	6.20
CASING BOTTOM LEVEL		-3	mAD	6	0.10	360	6.20
BOREHOLE DEPTH		6	m	7	0.12	420	6.18
BOREHOLE BOTTOM LEVEL		-6	mAD	9	0.17	540	6.13
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	11	0.19	660	6.11
WATER HEAD	Hw	6.3	m	13	0.20	780	6.10
				15	0.21	900	6.09
				16	0.21	960	6.09
				17	0.21	1020	6.09
				18	0.23	1080	6.07
				19	0.25	1140	6.05
				20	0.27	1200	6.04
				25	0.31	1500	5.99
				30	0.38	1800	5.92
				35	0.45	2100	5.85
				40	0.51	2400	5.79
				45	0.56	2700	5.74
				50	0.62	3000	5.68
				55	0.68	3300	5.62
				60	0.73	3600	5.57

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

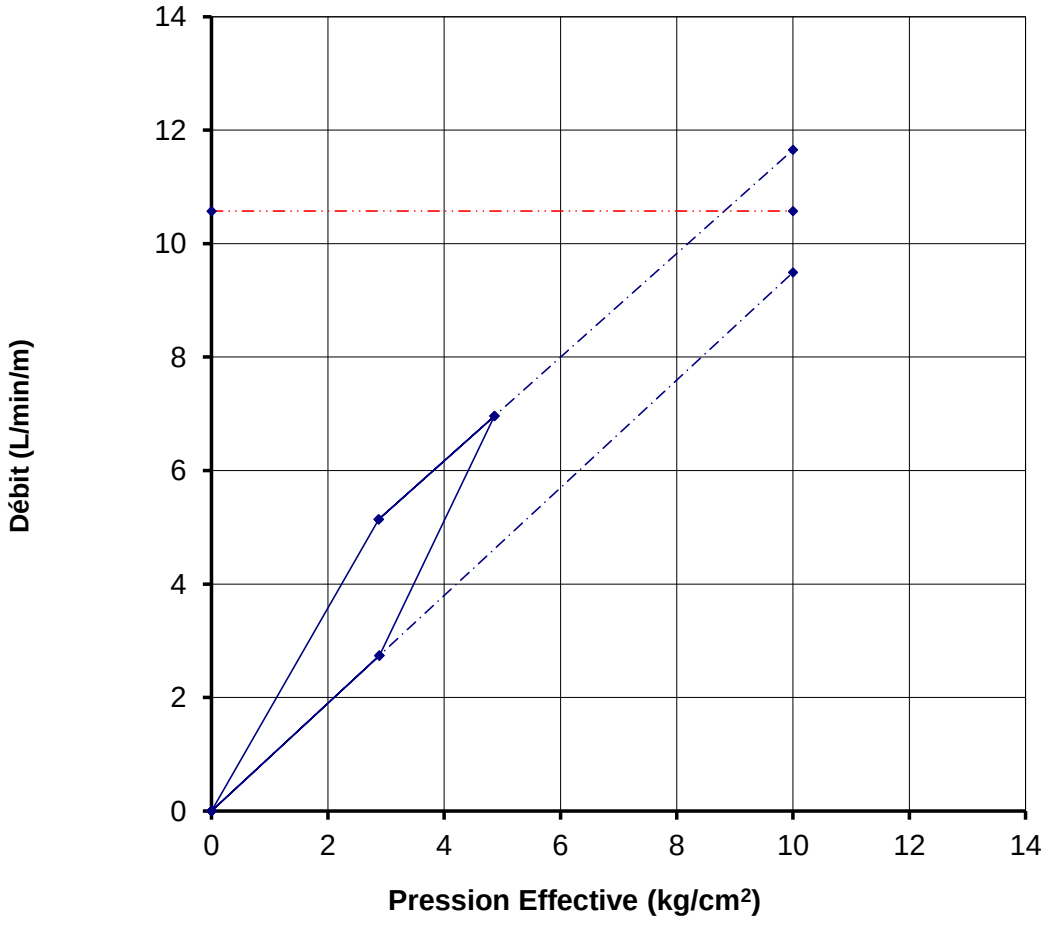




SATCON	PROJECT: **BISRI DAM**		Date: **12/17/2013**
	SONDAGE No.: **EV 10**		
	TRANCHE ESSAYEE **6.00 m** à **11.00 m**		Manomètre **0.50 m**
			GWT: **20.12 m**

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	257	10	5	25.7	5.14	0.9	2.54E-02	2.875
4	348	10	5	34.8	6.96	0.9	3.45E-02	4.866
2	137	10	5	13.7	2.74	0.9	1.36E-02	2.886

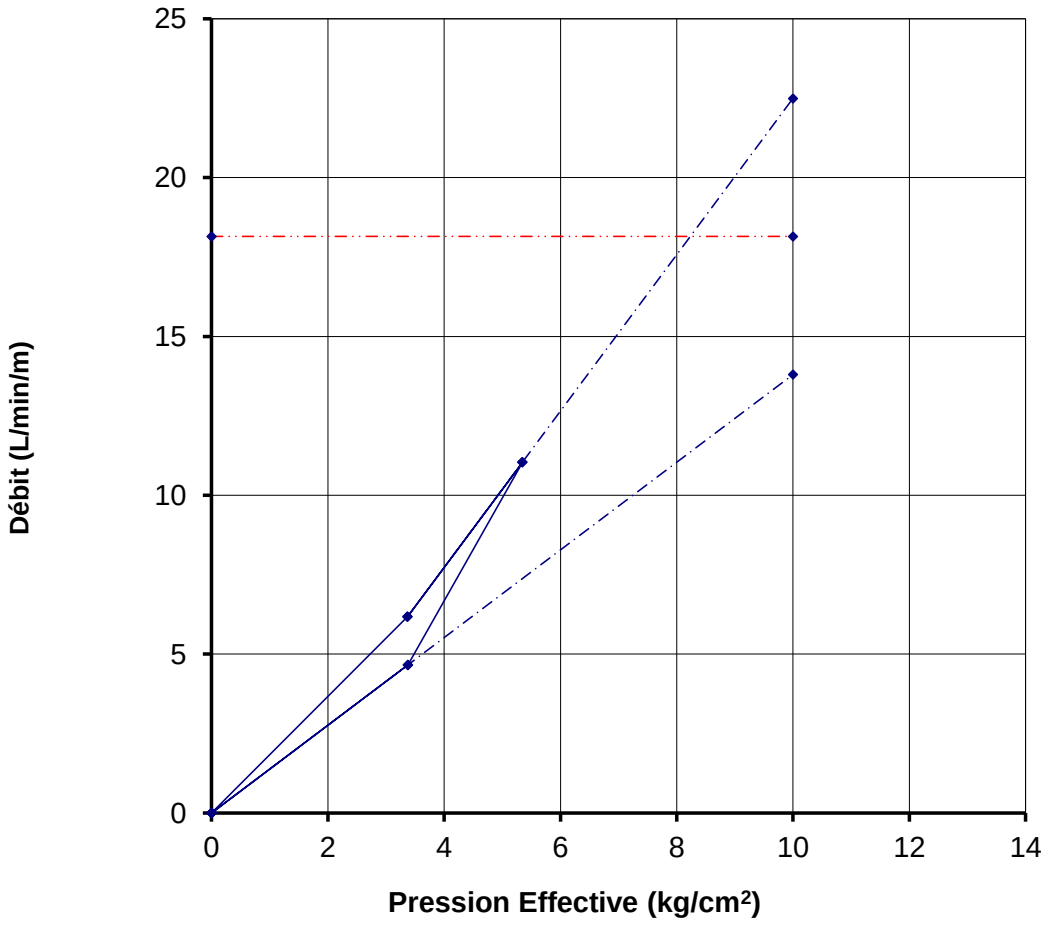


Lugeon = 10.57 L/min/m

PROJECT: **BISRI DAM**		Date: **12/18/2013**
SONDAGE No.: **EV 10**		
TRANCHE ESSAYEE **11.00 m** à **16.00 m**		Manomètre **0.50 m**
		GWT: **20.12 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	233	10	5	23.3	4.66	1.4	2.31E-02	3.377
4	552	10	5	55.2	11.04	1.4	5.46E-02	5.345
2	309	10	5	30.9	6.18	1.4	3.06E-02	3.369

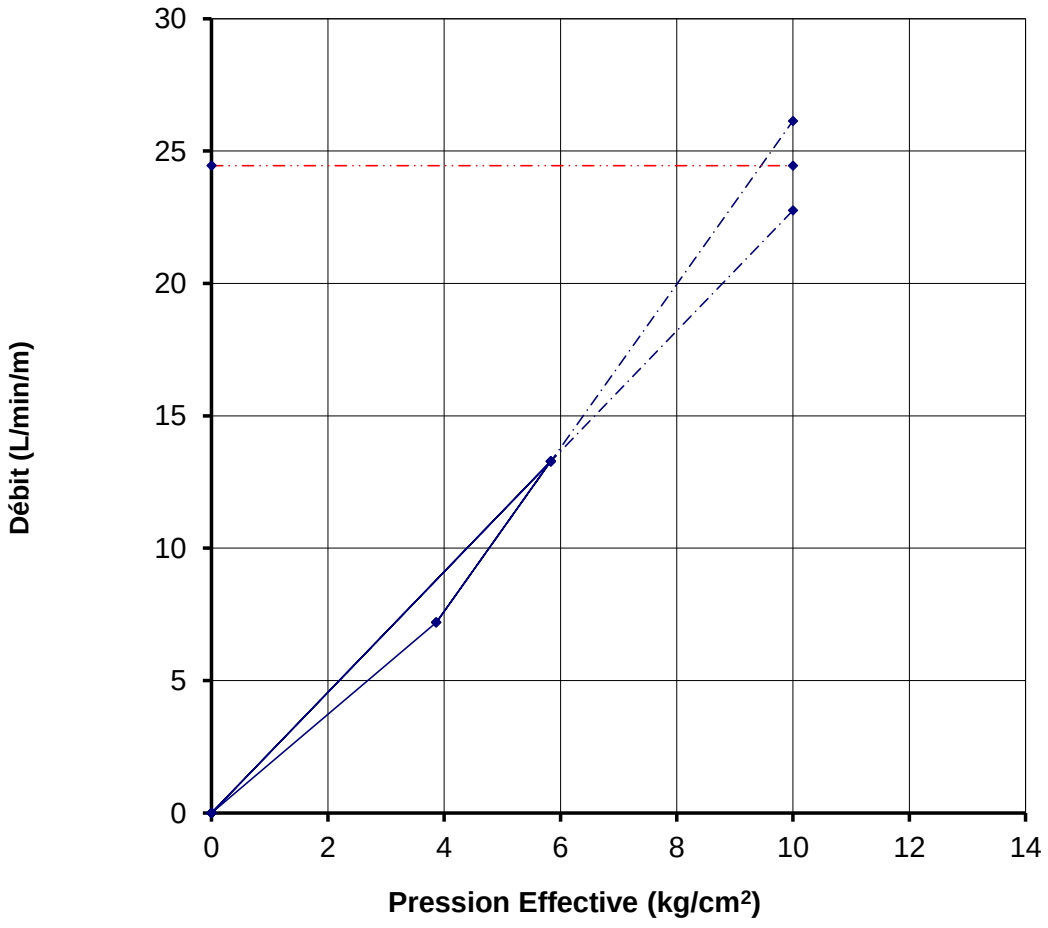


Lugeon = 18.1 L/min/m

PROJECT: **BISRI DAM**		Date: **12/18/2013**
SONDAGE No.: **EV 10**		
TRANCHE ESSAYEE **16.00 m** à **21.00 m**		Manomètre **0.50 m**
		GWT: **20.12 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	360	10	5	36	7.20	1.9	3.56E-02	3.864
4	664	10	5	66.4	13.28	1.9	6.57E-02	5.834

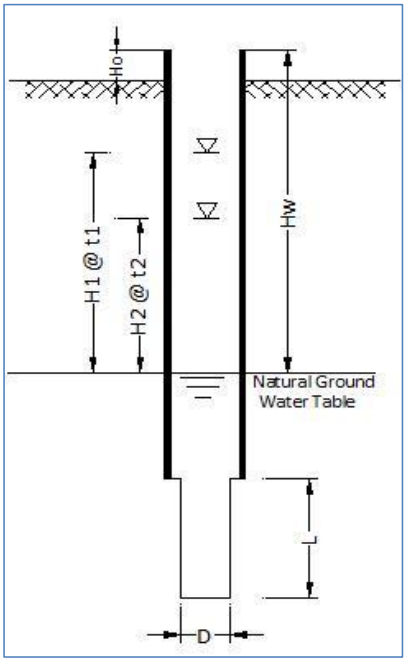


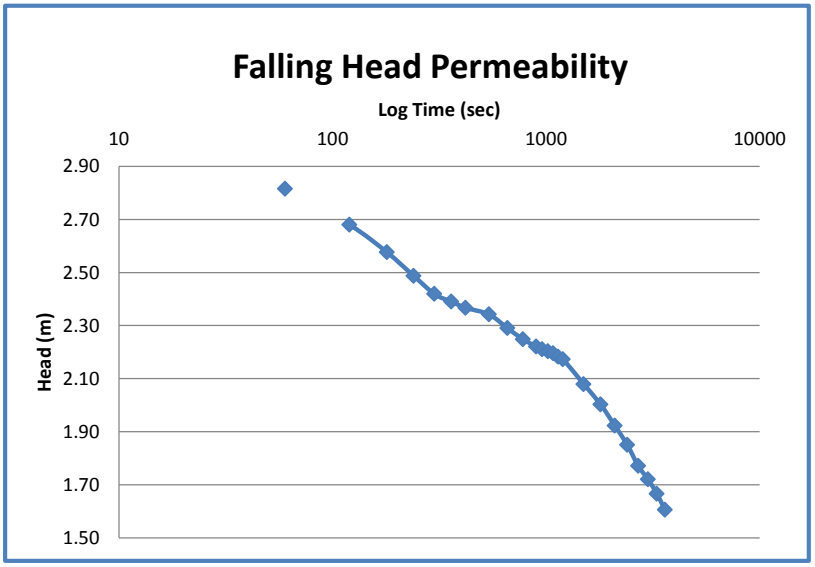
Lugeon = 24.45 L/min/m

PROJECT		BISRI DAM		FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB					
Borehole	EV 10	X		Date:		12/12/2013	
Test Location	0 to 3	Y		K(m/sec):		1.3488E-07	
Inclination	0	Z					

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1		mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	3.00
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.19	60	2.82
WATER LEVEL BEFORE TEST	W.L	-1.85	mAD	2	0.32	120	2.68
HEIGHT OF CASING ABOVE NGL	Ho	0	m	3	0.42	180	2.58
CASING TOP LEVEL		0	mAD	4	0.51	240	2.49
CASING LENGTH		0	m	5	0.58	300	2.42
CASING BOTTOM LEVEL		0	mAD	6	0.61	360	2.39
BOREHOLE DEPTH		3	m	7	0.63	420	2.37
BOREHOLE BOTTOM LEVEL		-3	mAD	9	0.66	540	2.34
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	11	0.71	660	2.29
WATER HEAD	Hw	3	m	13	0.75	780	2.25
				15	0.78	900	2.22
				16	0.79	960	2.21
				17	0.80	1020	2.20
				18	0.81	1080	2.20
				19	0.82	1140	2.18
				20	0.83	1200	2.17
				25	0.92	1500	2.08
				30	1.00	1800	2.00
				35	1.08	2100	1.92
				40	1.15	2400	1.85
				45	1.23	2700	1.77
				50	1.28	3000	1.72
				55	1.33	3300	1.67
				60	1.40	3600	1.61

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$



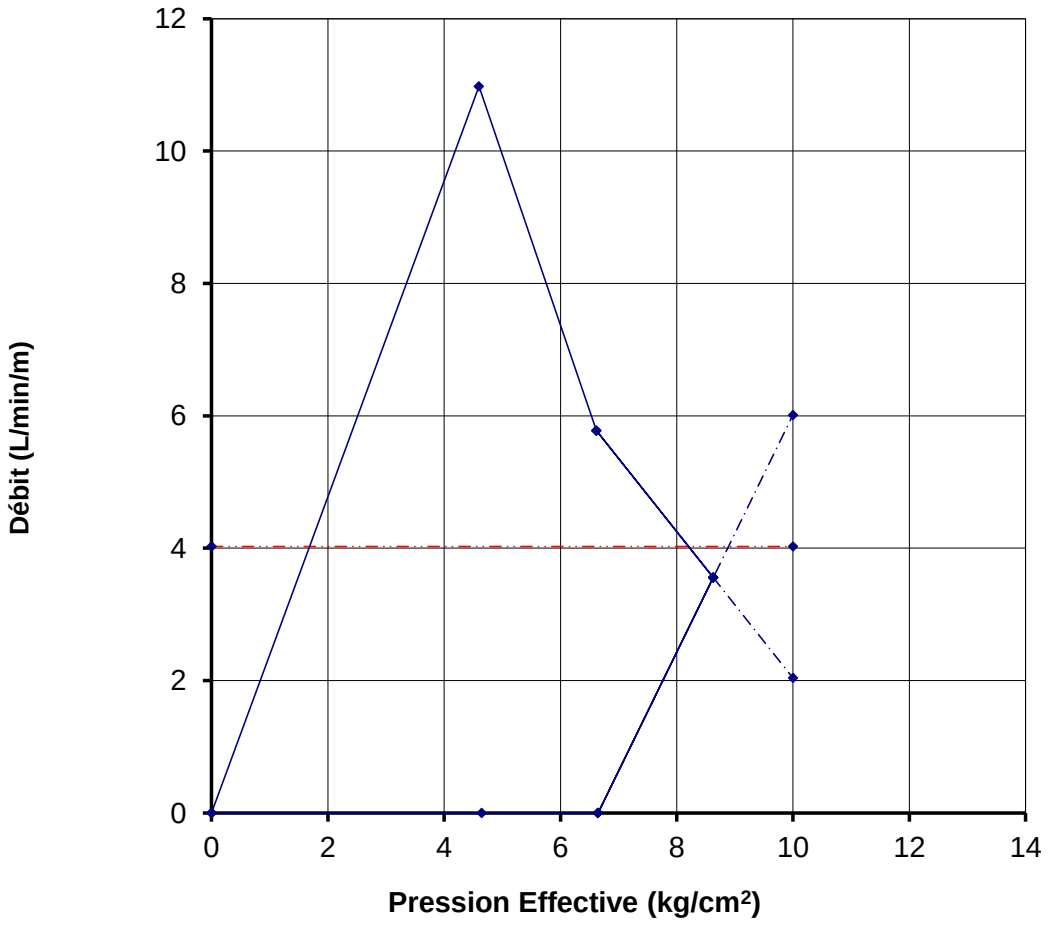


SATCON	PROJECT: **BISRI DAM**		Date: **11/29/2013**
	SONDAGE No.: **VF 02**		
	TRANCHE ESSAYEE **34.50 m** à **39.00 m**		Manomètre **0.50 m**

depth to water: **5.95 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	494	10	4.5	49.4	10.98	0.645	4.89E-02	4.596
6	260	10	4.5	26	5.78	0.645	2.57E-02	6.619
8	160	10	4.5	16	3.56	0.645	1.58E-02	8.629
6	0	10	4.5	0	0.00	0.645	0.00E+00	6.645
4	0	10	4.5	0	0.00	0.645	0.00E+00	4.645

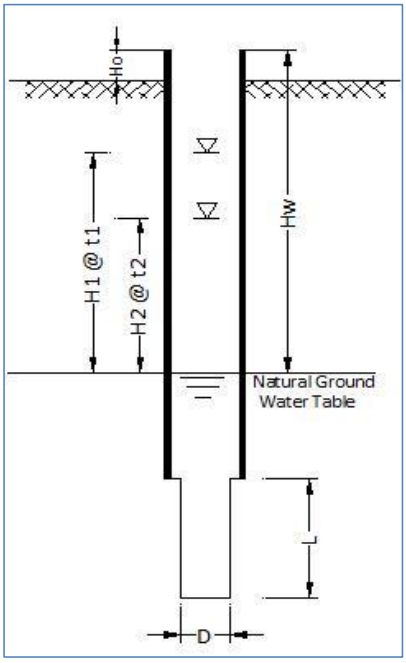


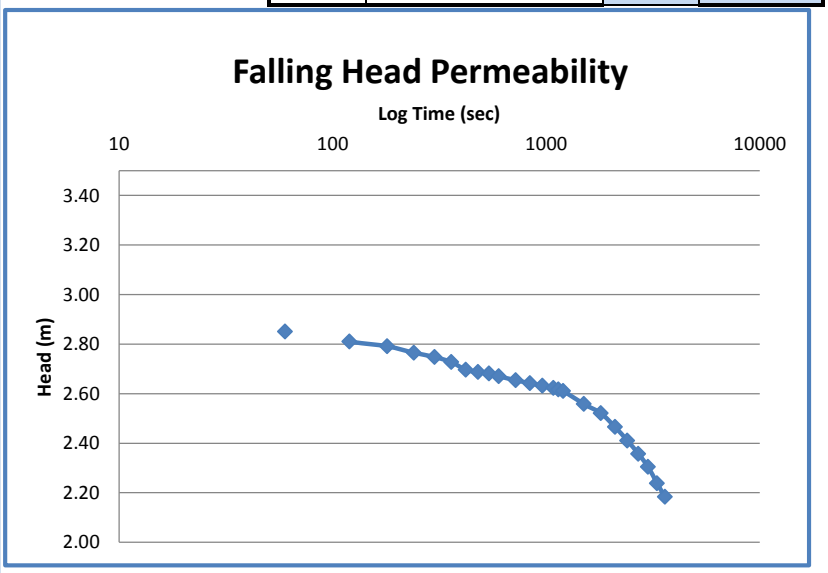
Lugeon = 4.03 L/min/m

PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF02	X			Date:		11/27/2013	
Test Location	0 to 3m	Y			K(m/sec):		8.7542E-08	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	3.00
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.15	60	2.85
WATER LEVEL BEFORE TEST	W.L	-2.5	mAD	2	0.19	120	2.81
HEIGHT OF CASING ABOVE NGL	Ho	0	m	3	0.209	180	2.79
CASING TOP LEVEL		0	mAD	4	0.235	240	2.77
CASING LENGTH		0	m	5	0.252	300	2.75
CASING BOTTOM LEVEL		0	mAD	6	0.273	360	2.73
BOREHOLE DEPTH		3	m	7	0.304	420	2.70
BOREHOLE BOTTOM LEVEL		-3	mAD	8	0.313	480	2.69
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	0.319	540	2.68
DEPTH FROM TOP OF CASING TO ORIGINAL GROUND WATER	Hw	3	m	10	0.33	600	2.67
				12	0.346	720	2.65
				14	0.358	840	2.64
				16	0.368	960	2.63
				18	0.378	1080	2.62
				19	0.383	1140	2.62
				20	0.389	1200	2.61
				25	0.442	1500	2.56
				30	0.479	1800	2.52
				35	0.535	2100	2.47
				40	0.59	2400	2.41
				45	0.64	2700	2.36
				50	0.70	3000	2.30
				55	0.76	3300	2.24
				60	0.82	3600	2.18

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

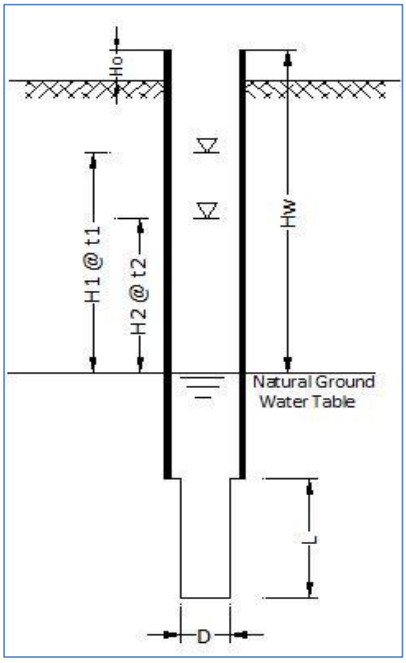


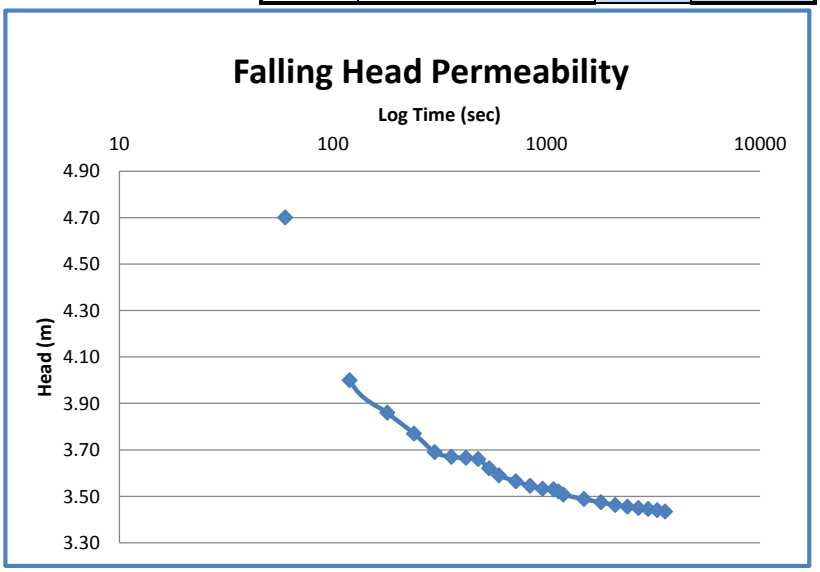


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF02	X			Date:		11/27/2013	
Test Location	3 to 6m	Y			K(m/sec):		2.2361E-08	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	6.30
NATURAL GROUND LEVEL	NGL	0	mAD	1	1.60	60	4.70
WATER LEVEL BEFORE TEST	W.L	-5.5	mAD	2	2.30	120	4.00
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	2.440	180	3.86
CASING TOP LEVEL		0.3	mAD	4	2.530	240	3.77
CASING LENGTH		3.3	m	5	2.610	300	3.69
CASING BOTTOM LEVEL		-3	mAD	6	2.630	360	3.67
BOREHOLE DEPTH		6	m	7	2.635	420	3.67
BOREHOLE BOTTOM LEVEL		-6	mAD	8	2.640	480	3.66
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	2.680	540	3.62
DEPTH FROM TOP OF CASING TO ORIGINAL GROUND WATER	Hw	6.3	m	10	2.71	600	3.59
				12	2.736	720	3.56
				14	2.755	840	3.55
				16	2.768	960	3.53
				18	2.770	1080	3.53
				19	2.780	1140	3.52
				20	2.793	1200	3.51
				25	2.812	1500	3.49
				30	2.826	1800	3.47
				35	2.838	2100	3.46
				40	2.85	2400	3.46
				45	2.85	2700	3.45
				50	2.86	3000	3.45
				55	2.86	3300	3.44
				60	2.87	3600	3.43

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

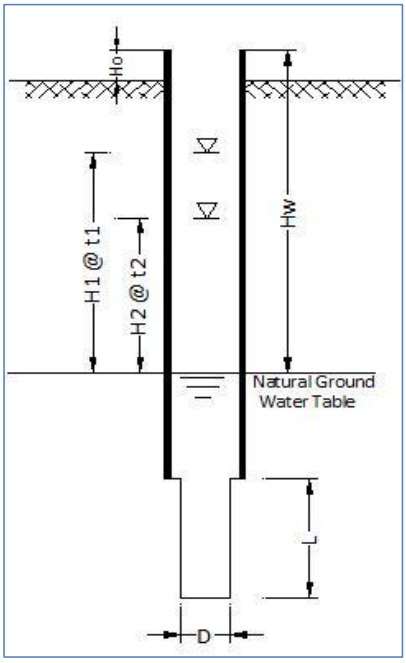


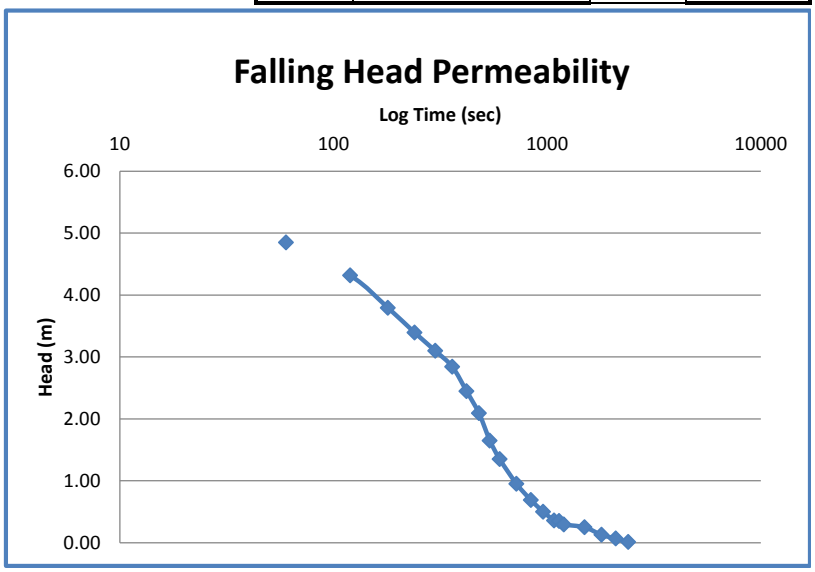


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF02	X			Date:		11/27/2013	
Test Location	6 to 9m	Y			K(m/sec):		2.8526E-06	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	6.25
NATURAL GROUND LEVEL	NGL	0	mAD	1	1.40	60	4.85
WATER LEVEL BEFORE TEST	W.L	-6	mAD	2	1.94	120	4.32
HEIGHT OF CASING ABOVE NGL	Ho	0.35	m	3	2.46	180	3.79
CASING TOP LEVEL		0.35	mAD	4	2.86	240	3.39
CASING LENGTH		6.3	m	5	3.15	300	3.10
CASING BOTTOM LEVEL		-5.95	mAD	6	3.41	360	2.84
BOREHOLE DEPTH		9	m	7	3.80	420	2.45
BOREHOLE BOTTOM LEVEL		-9	mAD	8	4.16	480	2.09
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3.05	m	9	4.60	540	1.65
DEPTH FROM TOP OF CASING TO ORIGINAL GROUND WATER	Hw	6.25	m	10	4.90	600	1.35
				12	5.300	720	0.95
				14	5.560	840	0.69
				16	5.750	960	0.50
				18	5.890	1080	0.36
				19	5.900	1140	0.35
				20	5.954	1200	0.30
				25	6.000	1500	0.25
				30	6.123	1800	0.13
				35	6.181	2100	0.07
				40	6.24	2400	0.01

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

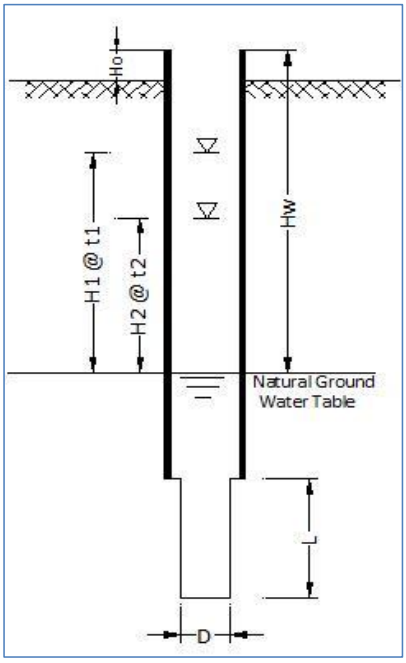


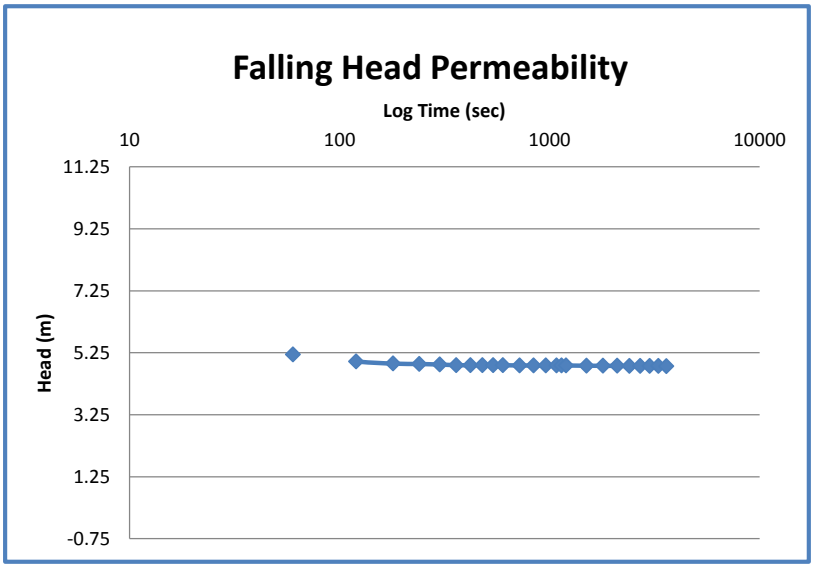


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF02	X			Date:		11/27/2013	
Test Location	9 to 12m	Y			K(m/sec):		9.8353E-09	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	6.25
NATURAL GROUND LEVEL	NGL	0	mAD	1	1.06	60	5.19
WATER LEVEL BEFORE TEST	W.L	-10.5	mAD	2	1.28	120	4.97
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	1.35	180	4.90
CASING TOP LEVEL		0.3	mAD	4	1.36	240	4.89
CASING LENGTH		9.3	m	5	1.38	300	4.87
CASING BOTTOM LEVEL		-9	mAD	6	1.40	360	4.85
BOREHOLE DEPTH		12	m	7	1.40	420	4.85
BOREHOLE BOTTOM LEVEL		-12	mAD	8	1.40	480	4.85
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	1.40	540	4.85
DEPTH FROM TOP OF CASING TO ORIGINAL GROUND WATER	Hw	6.25	m	10	1.40	600	4.85
				12	1.409	720	4.84
				14	1.410	840	4.84
				16	1.410	960	4.84
				18	1.410	1080	4.84
				19	1.410	1140	4.84
				20	1.410	1200	4.84
				25	1.418	1500	4.83
				30	1.420	1800	4.83
				35	1.424	2100	4.83
				40	1.43	2400	4.82
				45	1.43	2700	4.82
				50	1.43	3000	4.82
				55	1.43	3300	4.82
				60	1.43	3600	4.82

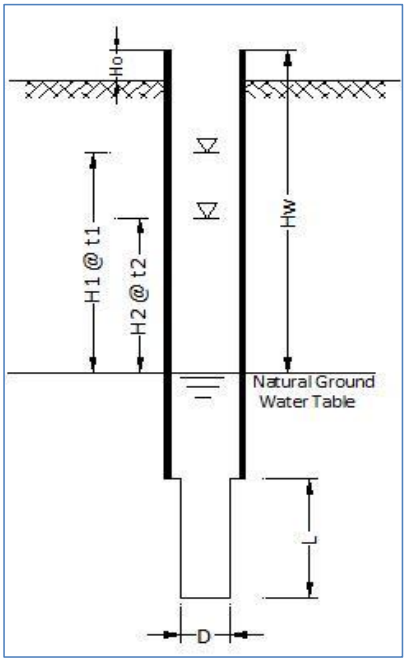
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

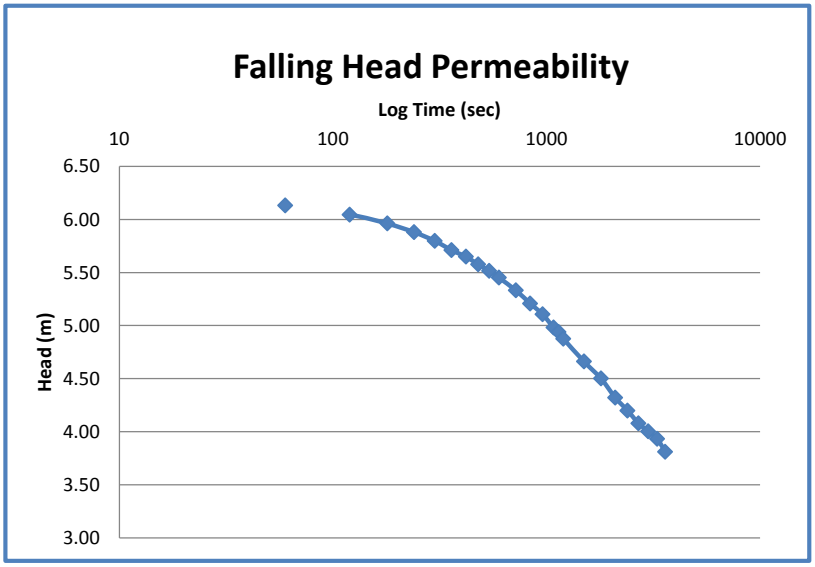




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF02	X			Date:		11/28/2013	
Test Location	12 to 15m	Y			K(m/sec):		1.2389E-07	
Inclination	0	Z						
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	6.25
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.12	60	6.13
WATER LEVEL BEFORE TEST		W.L	-13.8	mAD	2	0.21	120	6.05
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	0.29	180	5.96
CASING TOP LEVEL			0.3	mAD	4	0.37	240	5.88
CASING LENGTH			12.3	m	5	0.45	300	5.80
CASING BOTTOM LEVEL			-12	mAD	6	0.54	360	5.71
BOREHOLE DEPTH			15	m	7	0.60	420	5.65
BOREHOLE BOTTOM LEVEL			-15	mAD	8	0.68	480	5.58
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	9	0.74	540	5.51
DEPTH FROM TOP OF CASING TO ORIGINAL GROUND WATER		Hw	6.25	m	10	0.80	600	5.45
					12	0.92	720	5.33
					14	1.04	840	5.21
					16	1.15	960	5.11
					18	1.27	1080	4.98
					19	1.31	1140	4.94
					20	1.38	1200	4.88
					25	1.59	1500	4.66
					30	1.75	1800	4.50
					35	1.93	2100	4.32
					40	2.05	2400	4.20
					45	2.17	2700	4.08
					50	2.25	3000	4.00
					55	2.32	3300	3.93
					60	2.44	3600	3.81

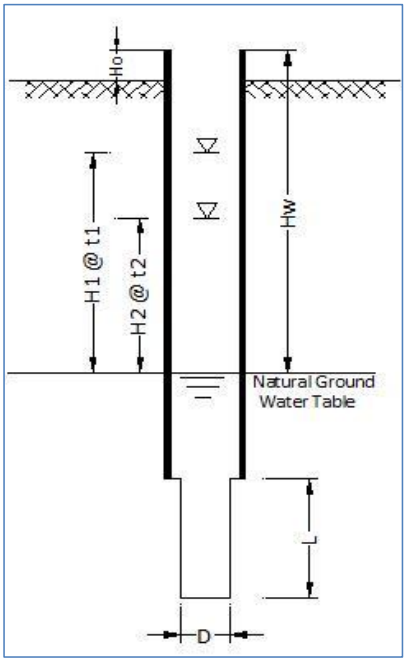
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

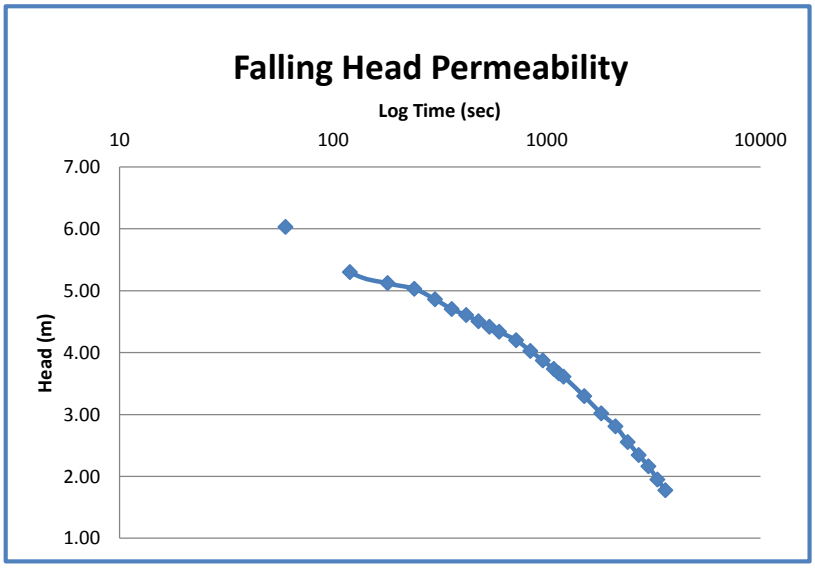




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF02	X			Date:		11/28/2013	
Test Location	15 to 18m	Y			K(m/sec):		3.2278E-07	
Inclination	0	Z						
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	6.25
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.22	60	6.03
WATER LEVEL BEFORE TEST		W.L	-14.2	mAD	2	0.95	120	5.30
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	1.13	180	5.12
CASING TOP LEVEL			0.3	mAD	4	1.22	240	5.03
CASING LENGTH			15.3	m	5	1.39	300	4.86
CASING BOTTOM LEVEL			-15	mAD	6	1.55	360	4.70
BOREHOLE DEPTH			18	m	7	1.65	420	4.61
BOREHOLE BOTTOM LEVEL			-18	mAD	8	1.75	480	4.50
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	9	1.84	540	4.41
DEPTH FROM TOP OF CASING TO ORIGINAL GROUND WATER		Hw	6.25	m	10	1.92	600	4.34
					12	2.05	720	4.20
					14	2.23	840	4.02
					16	2.38	960	3.87
					18	2.52	1080	3.74
					19	2.59	1140	3.66
					20	2.64	1200	3.61
					25	2.96	1500	3.29
					30	3.24	1800	3.02
					35	3.44	2100	2.81
					40	3.70	2400	2.55
					45	3.91	2700	2.34
					50	4.09	3000	2.16
					55	4.30	3300	1.95
					60	4.48	3600	1.77

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

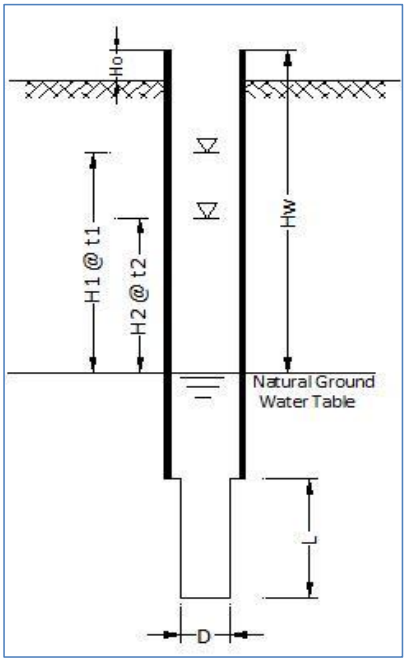


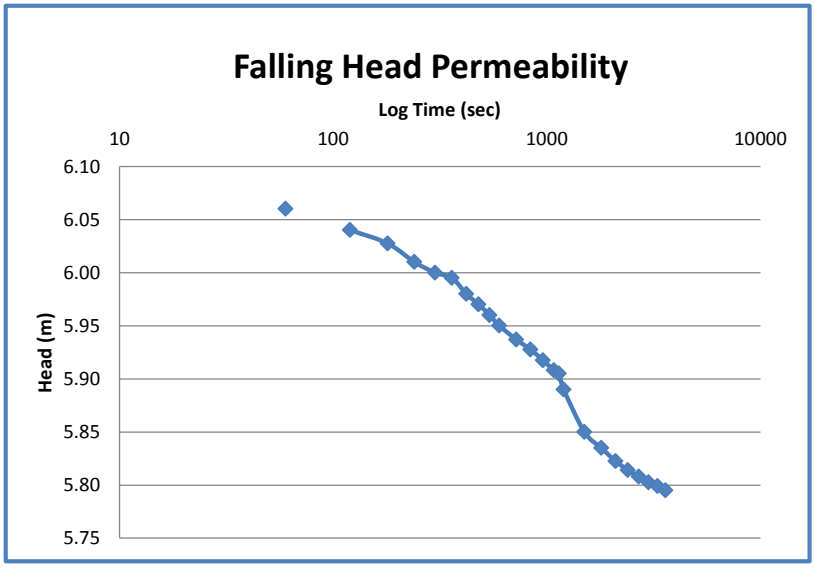


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF02	X			Date:		11/28/2013	
Test Location	18 to 21m	Y			K(m/sec):		4.9238E-09	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	6.25
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.19	60	6.06
WATER LEVEL BEFORE TEST	W.L	-15.25	mAD	2	0.21	120	6.04
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	0.22	180	6.03
CASING TOP LEVEL		0.3	mAD	4	0.24	240	6.01
CASING LENGTH		18.3	m	5	0.25	300	6.00
CASING BOTTOM LEVEL		-18	mAD	6	0.26	360	6.00
BOREHOLE DEPTH		21	m	7	0.27	420	5.98
BOREHOLE BOTTOM LEVEL		-21	mAD	8	0.28	480	5.97
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	0.29	540	5.96
DEPTH FROM TOP OF CASING TO ORIGINAL GROUND WATER	Hw	6.25	m	10	0.30	600	5.95
				12	0.31	720	5.94
				14	0.32	840	5.93
				16	0.33	960	5.92
				18	0.34	1080	5.91
				19	0.35	1140	5.91
				20	0.36	1200	5.89
				25	0.40	1500	5.85
				30	0.42	1800	5.84
				35	0.43	2100	5.82
				40	0.44	2400	5.81
				45	0.44	2700	5.81
				50	0.45	3000	5.80
				55	0.45	3300	5.80
				60	0.46	3600	5.80

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

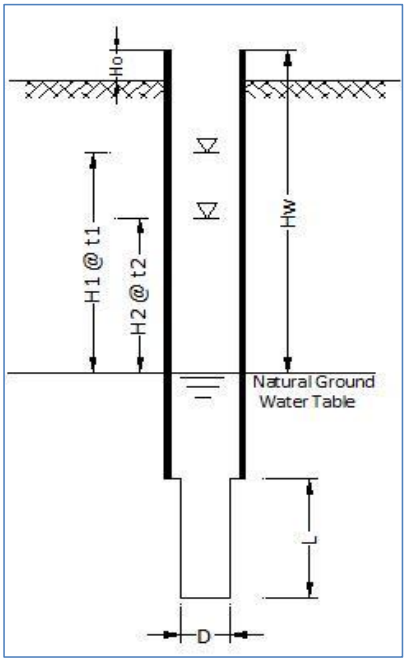


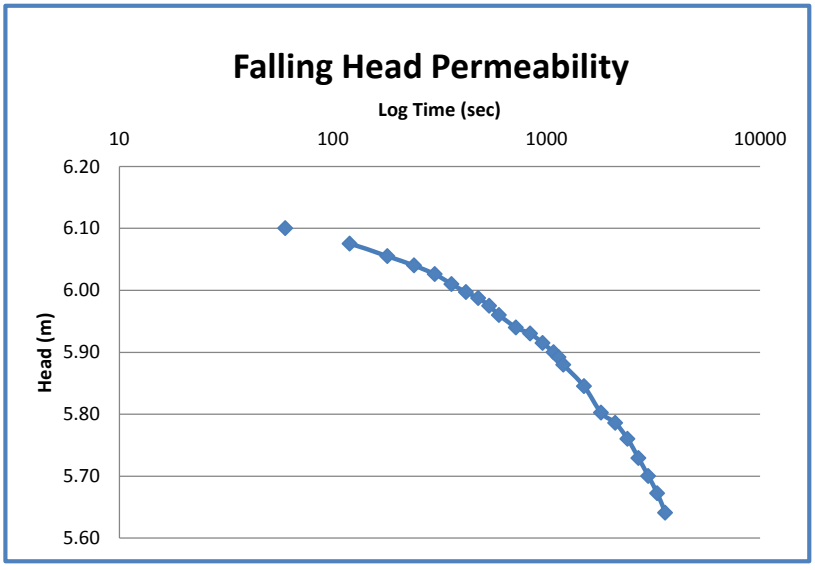


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF02	X			Date:		11/28/2013	
Test Location	21 to 24m	Y			K(m/sec):		1.9815E-08	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	6.25
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.15	60	6.10
WATER LEVEL BEFORE TEST	W.L	-11.9	mAD	2	0.18	120	6.08
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	0.20	180	6.06
CASING TOP LEVEL		0.3	mAD	4	0.21	240	6.04
CASING LENGTH		21.3	m	5	0.22	300	6.03
CASING BOTTOM LEVEL		-21	mAD	6	0.24	360	6.01
BOREHOLE DEPTH		24	m	7	0.25	420	6.00
BOREHOLE BOTTOM LEVEL		-24	mAD	8	0.26	480	5.99
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	0.28	540	5.98
DEPTH FROM TOP OF CASING TO ORIGINAL GROUND WATER	Hw	6.25	m	10	0.29	600	5.96
				12	0.31	720	5.94
				14	0.32	840	5.93
				16	0.34	960	5.92
				18	0.35	1080	5.90
				19	0.36	1140	5.89
				20	0.37	1200	5.88
				25	0.41	1500	5.85
				30	0.45	1800	5.80
				35	0.46	2100	5.79
				40	0.49	2400	5.76
				45	0.52	2700	5.73
				50	0.55	3000	5.70
				55	0.58	3300	5.67
				60	0.61	3600	5.64

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$





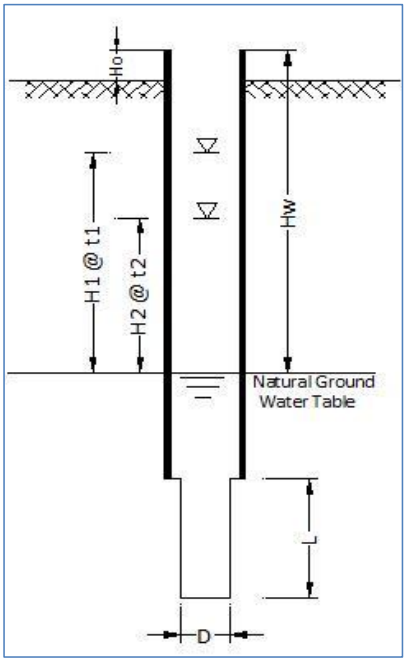
PROJECT	BISRI DAM	FALLING HEAD BOREHOLE WATER PERMEABILITY TEST
CLIENT	DAR-TALEB	

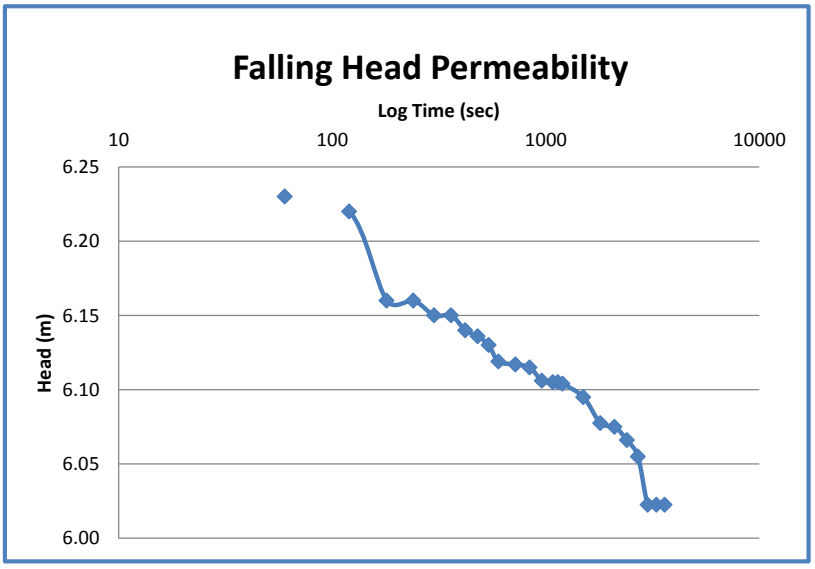
Borehole	VF02	X		Date:	11/28/2013
Test Location	24 to 27m	Y		K(m/sec):	5.8001E-09
Inclination	0	Z			

DIAMETER OF CASING	D1	110	mm
DIAMETER OF TEST SECTION	D	86	mm
NATURAL GROUND LEVEL	NGL	0	mAD
WATER LEVEL BEFORE TEST	W.L	-13.2	mAD
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m
CASING TOP LEVEL		0.3	mAD
CASING LENGTH		24.3	m
CASING BOTTOM LEVEL		-24	mAD
BOREHOLE DEPTH		27	m
BOREHOLE BOTTOM LEVEL		-27	mAD
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m
DEPTH FROM TOP OF CASING TO ORIGINAL GROUND WATER	Hw	6.25	m

Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
0	0.00	0	6.25
1	0.02	60	6.23
2	0.03	120	6.22
3	0.09	180	6.16
4	0.09	240	6.16
5	0.10	300	6.15
6	0.10	360	6.15
7	0.11	420	6.14
8	0.11	480	6.14
9	0.12	540	6.13
10	0.13	600	6.12
12	0.13	720	6.12
14	0.14	840	6.12
16	0.14	960	6.11
18	0.15	1080	6.11
19	0.15	1140	6.11
20	0.15	1200	6.10
25	0.16	1500	6.10
30	0.17	1800	6.08
35	0.18	2100	6.08
40	0.18	2400	6.07
45	0.20	2700	6.06
50	0.23	3000	6.02
55	0.23	3300	6.02
60	0.23	3600	6.02

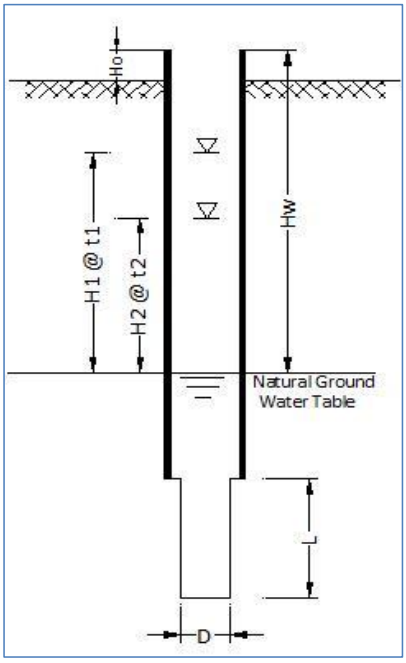
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

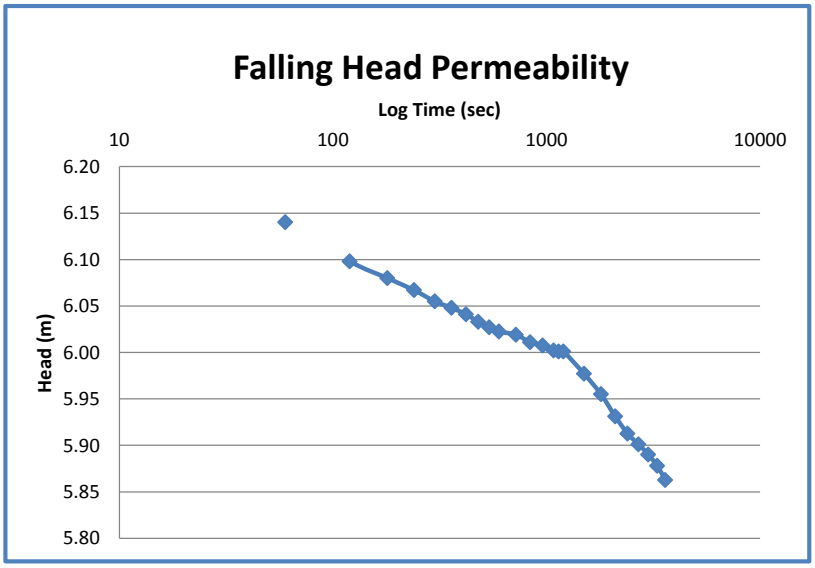




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF02	X			Date:		11/29/2013	
Test Location	27 to 30m	Y			K(m/sec):		1.0650E-08	
Inclination	0	Z						
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	6.25
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.11	60	6.14
WATER LEVEL BEFORE TEST		W.L	-16.7	mAD	2	0.15	120	6.10
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	0.17	180	6.08
CASING TOP LEVEL			0.3	mAD	4	0.18	240	6.07
CASING LENGTH			27.3	m	5	0.20	300	6.06
CASING BOTTOM LEVEL			-27	mAD	6	0.20	360	6.05
BOREHOLE DEPTH			30	m	7	0.21	420	6.04
BOREHOLE BOTTOM LEVEL			-30	mAD	8	0.22	480	6.03
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	9	0.22	540	6.03
DEPTH FROM TOP OF CASING TO ORIGINAL GROUND WATER		Hw	6.25	m	10	0.23	600	6.02
					12	0.23	720	6.02
					14	0.24	840	6.01
					16	0.24	960	6.01
					18	0.25	1080	6.00
					19	0.25	1140	6.00
					20	0.25	1200	6.00
					25	0.27	1500	5.98
					30	0.30	1800	5.96
					35	0.32	2100	5.93
					40	0.34	2400	5.91
					45	0.35	2700	5.90
					50	0.36	3000	5.89
					55	0.37	3300	5.88
					60	0.39	3600	5.86

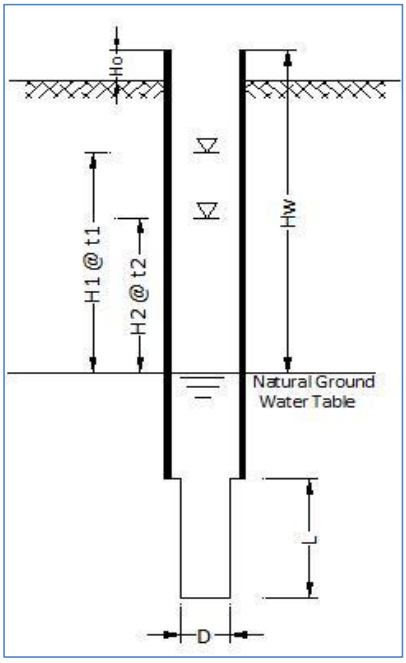
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

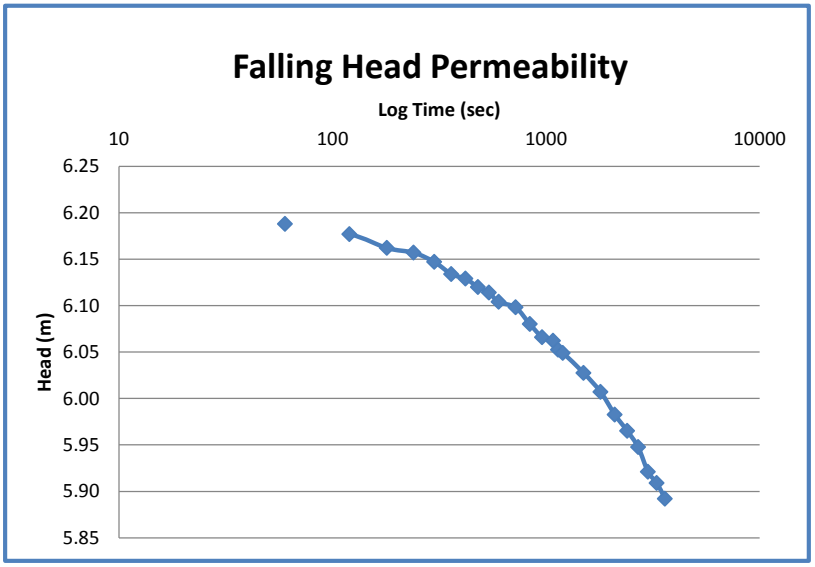




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF02	X			Date:		11/29/2013	
Test Location	30 to 33m	Y			K(m/sec):		1.1711E-08	
Inclination	0	Z						
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	6.25
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.06	60	6.19
WATER LEVEL BEFORE TEST		W.L	-13.9	mAD	2	0.07	120	6.18
HEIGHT OF CASING ABOVE NGL		Ho	0.35	m	3	0.09	180	6.16
CASING TOP LEVEL			0.35	mAD	4	0.09	240	6.16
CASING LENGTH			30.3	m	5	0.10	300	6.15
CASING BOTTOM LEVEL			-29.95	mAD	6	0.12	360	6.13
BOREHOLE DEPTH			33	m	7	0.12	420	6.13
BOREHOLE BOTTOM LEVEL			-33	mAD	8	0.13	480	6.12
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3.05	m	9	0.14	540	6.11
DEPTH FROM TOP OF CASING TO ORIGINAL GROUND WATER		Hw	6.25	m	10	0.15	600	6.10
					12	0.15	720	6.10
					14	0.17	840	6.08
					16	0.18	960	6.07
					18	0.19	1080	6.06
					19	0.20	1140	6.05
					20	0.20	1200	6.05
					25	0.22	1500	6.03
					30	0.24	1800	6.01
					35	0.27	2100	5.98
					40	0.29	2400	5.97
					45	0.30	2700	5.95
					50	0.33	3000	5.92
					55	0.34	3300	5.91
					60	0.36	3600	5.89

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

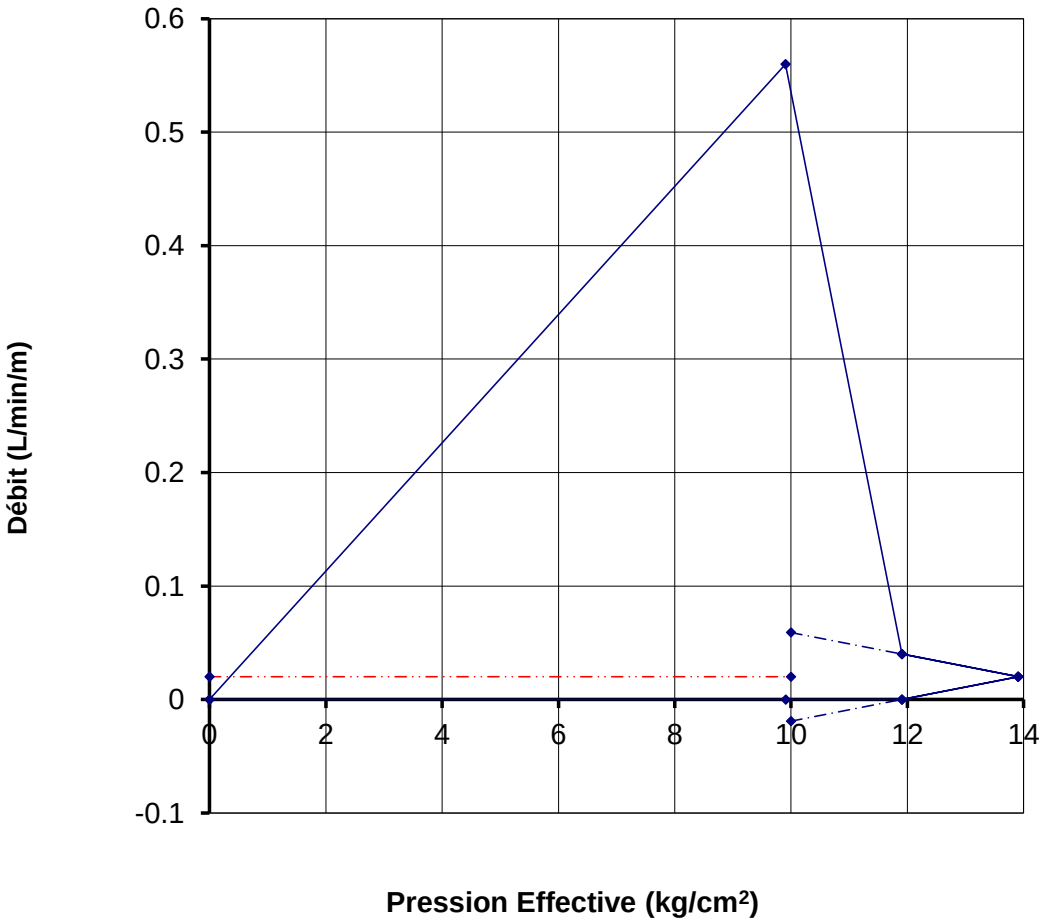




PROJECT:	**BISRI DAM**	Date:	**11/26/2013**
SONDAGE No.:	**VF 03**		
TRANCHE ESSAYEE	**24.00 m** à **29.00 m**	Manomètre	**0.50 m**
		depth to water:	**5.86 m**

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	28	10	5	2.8	0.56	5.91	2.77E-03	9.907
6	2	10	5	0.2	0.04	5.91	1.98E-04	11.910
8	1	10	5	0.1	0.02	5.91	9.90E-05	13.910
6	0	10	5	0	0.00	5.91	0.00E+00	11.910
4	0	10	5	0	0.00	5.91	0.00E+00	9.910



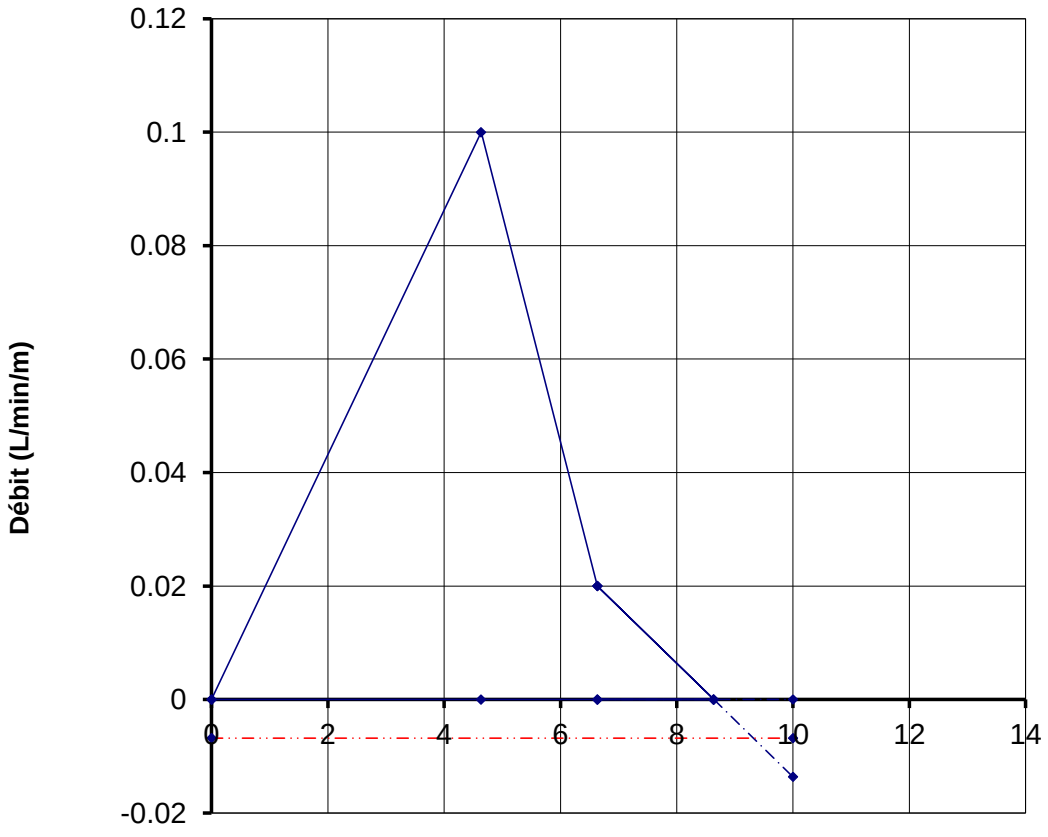
Lugeon = 0.02 L/min/m

SATCON	PROJECT:	**BISRI DAM**		Date:	**11/26/2013**
	SONDAGE No.:	**VF 03**			
	TRANCHE ESSAYEE	**29.00 m**	à **34.00 m**	Manomètre	**0.50 m**

depth to water: **5.86 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	5	10	5	0.5	0.10	0.636	4.95E-04	4.636
6	1	10	5	0.1	0.02	0.636	9.90E-05	6.636
8	0	10	5	0	0.00	0.636	0.00E+00	8.636
6	0	10	5	0	0.00	0.636	0.00E+00	6.636
4	0	10	5	0	0.00	0.636	0.00E+00	4.636

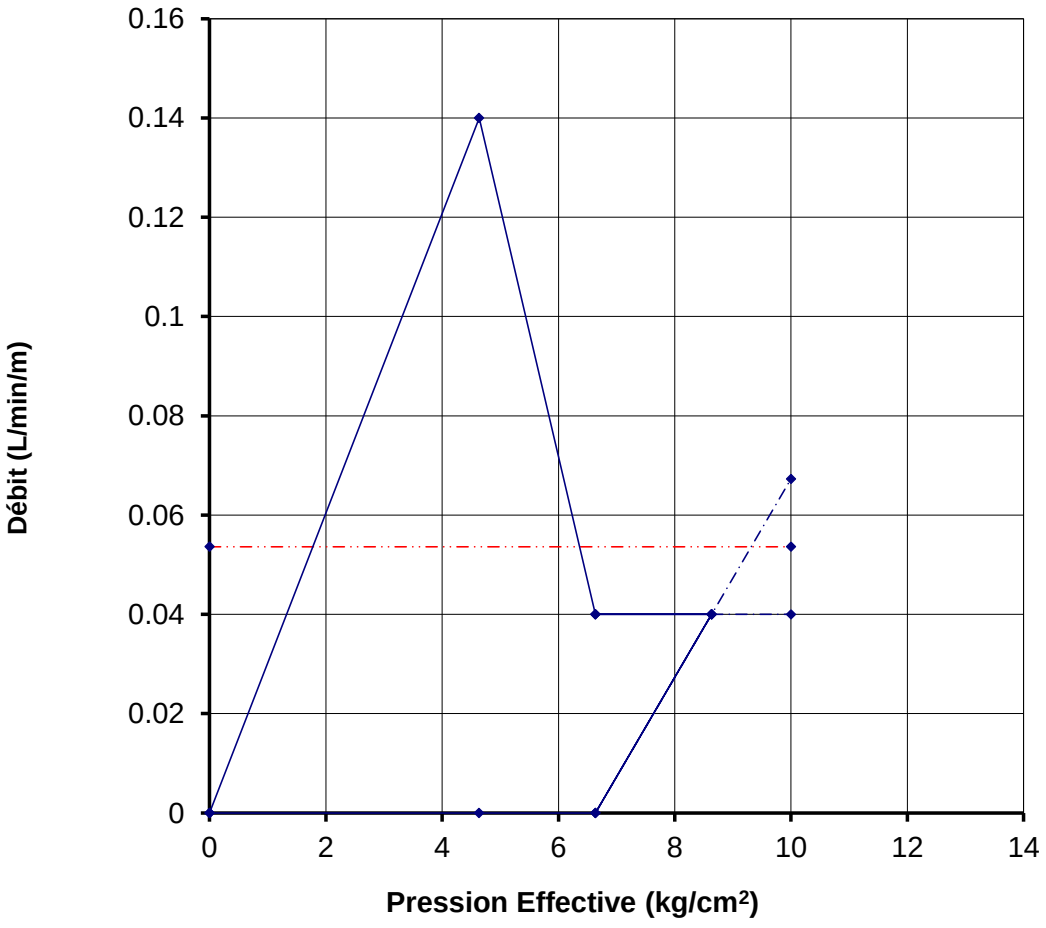


Lugeon = 0.0 L/min/m

SATCON	PROJECT: **BISRI DAM**		Date: **11/26/2013**
	SONDAGE No.: **VF 03**		
	TRANCHE ESSAYEE **34.00 m** à **39.00 m**		Manomètre **0.50 m**
			depth to water: **5.86 m**

ESSAI DE PERMEABILITE LUGEON

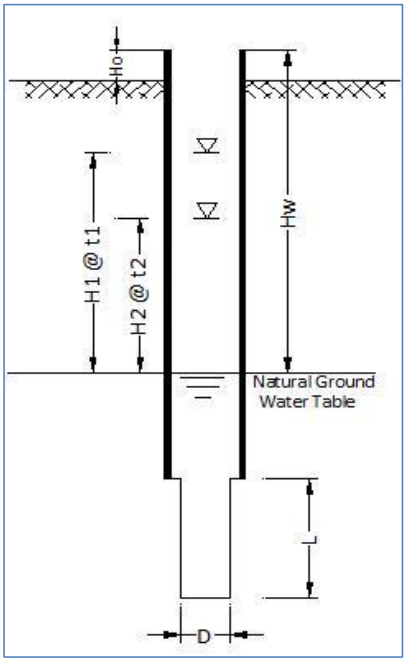
Pression de Lecture P (bars)	Eau absorbée en (L)	Durée en (min)	Longueur de Passe en (m)	Débit (L/min)	Débit (L/min/m)	ΔH (bars)	Perte de charge (Bars) J	Pression Effective (bar) P -J+ΔH
4	7	10	5	0.7	0.14	0.636	6.93E-04	4.635
6	2	10	5	0.2	0.04	0.636	1.98E-04	6.636
8	2	10	5	0.2	0.04	0.636	1.98E-04	8.636
6	0	10	5	0	0.00	0.636	0.00E+00	6.636
4	0	10	5	0	0.00	0.636	0.00E+00	4.636

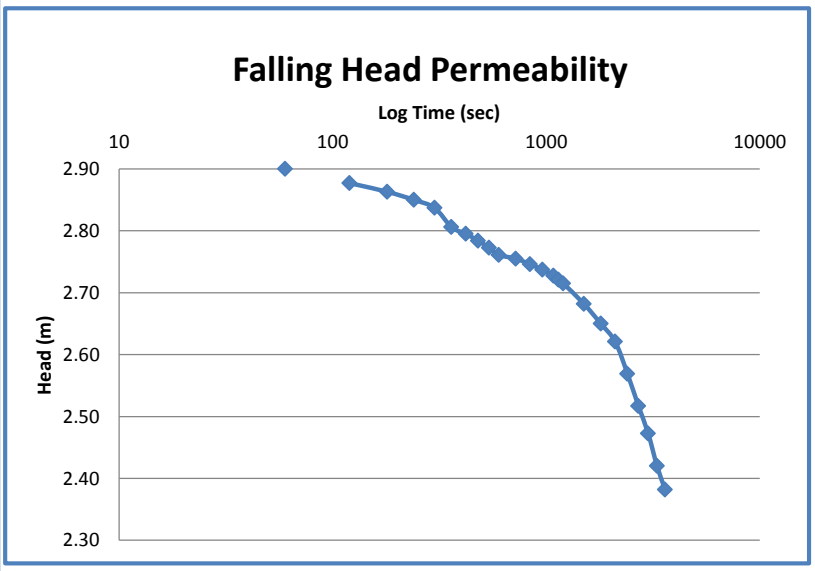


Lugeon = 0.05 L/min/m

PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF02	X			Date:		11/23/2013	
Test Location	0 to 3m	Y			K(m/sec):		6.9775E-08	
Inclination	0	Z						
DIAMETER OF CASING		D1	110	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	3.00
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.10	60	2.90
WATER LEVEL BEFORE TEST		W.L	-2.5	mAD	2	0.12	120	2.88
HEIGHT OF CASING ABOVE NGL		Ho	0	m	3	0.14	180	2.86
CASING TOP LEVEL			0	mAD	4	0.15	240	2.85
CASING LENGTH			0	m	5	0.16	300	2.84
CASING BOTTOM LEVEL			0	mAD	6	0.19	360	2.81
BOREHOLE DEPTH			3	m	7	0.21	420	2.80
BOREHOLE BOTTOM LEVEL			-3	mAD	8	0.22	480	2.78
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	9	0.23	540	2.77
DEPTH FROM TOP OF CASING TO ORIGINAL GROUND WATER		Hw	3	m	10	0.24	600	2.76
					12	0.25	720	2.76
					14	0.25	840	2.75
					16	0.26	960	2.74
					18	0.27	1080	2.73
					19	0.28	1140	2.72
					20	0.29	1200	2.72
					25	0.32	1500	2.68
					30	0.35	1800	2.65
					35	0.38	2100	2.62
					40	0.43	2400	2.57
					45	0.48	2700	2.52
					50	0.53	3000	2.47
					55	0.58	3300	2.42
					60	0.62	3600	2.38

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

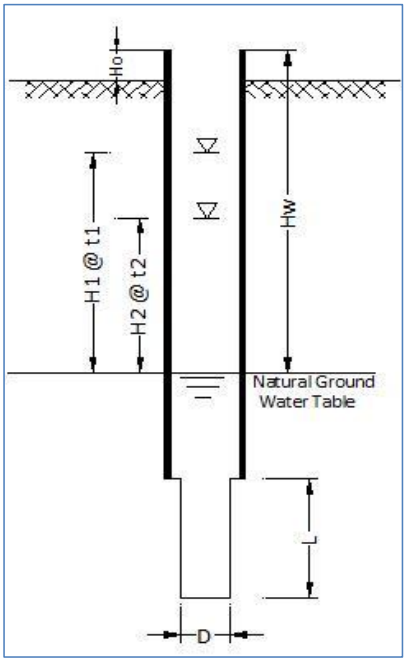


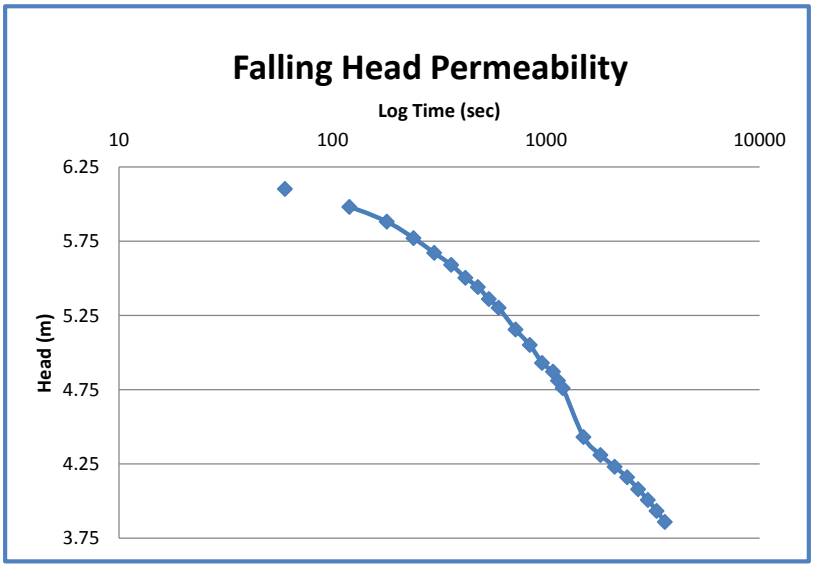


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF02	X			Date:		11/23/2013	
Test Location	3 to 6m	Y			K(m/sec):		7.1792E-08	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	6.30
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.20	60	6.10
WATER LEVEL BEFORE TEST	W.L	-3.5	mAD	2	0.32	120	5.98
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	0.42	180	5.88
CASING TOP LEVEL		0.3	mAD	4	0.53	240	5.77
CASING LENGTH		3.3	m	5	0.63	300	5.67
CASING BOTTOM LEVEL		-3	mAD	6	0.71	360	5.59
BOREHOLE DEPTH		6	m	7	0.80	420	5.50
BOREHOLE BOTTOM LEVEL		-6	mAD	8	0.86	480	5.44
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	0.94	540	5.36
DEPTH FROM TOP OF CASING TO ORIGINAL GROUND WATER	Hw	6.3	m	10	1.00	600	5.30
				12	1.15	720	5.16
				14	1.25	840	5.05
				16	1.37	960	4.93
				18	1.43	1080	4.87
				19	1.49	1140	4.81
				20	1.54	1200	4.76
				25	1.87	1500	4.43
				30	1.99	1800	4.31
				35	2.07	2100	4.23
				40	2.14	2400	4.16
				45	2.22	2700	4.08
				50	2.29	3000	4.01
				55	2.37	3300	3.93
				60	2.44	3600	3.86

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

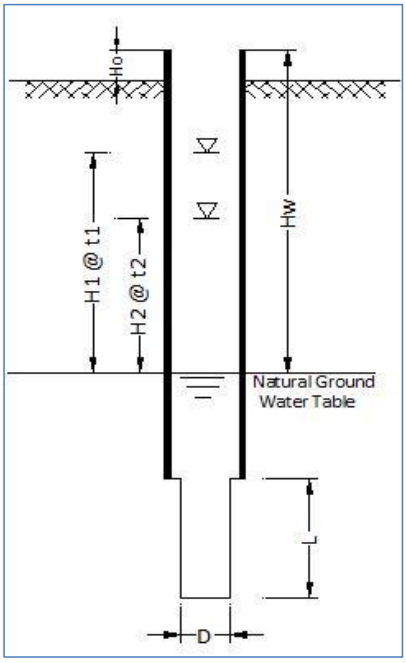


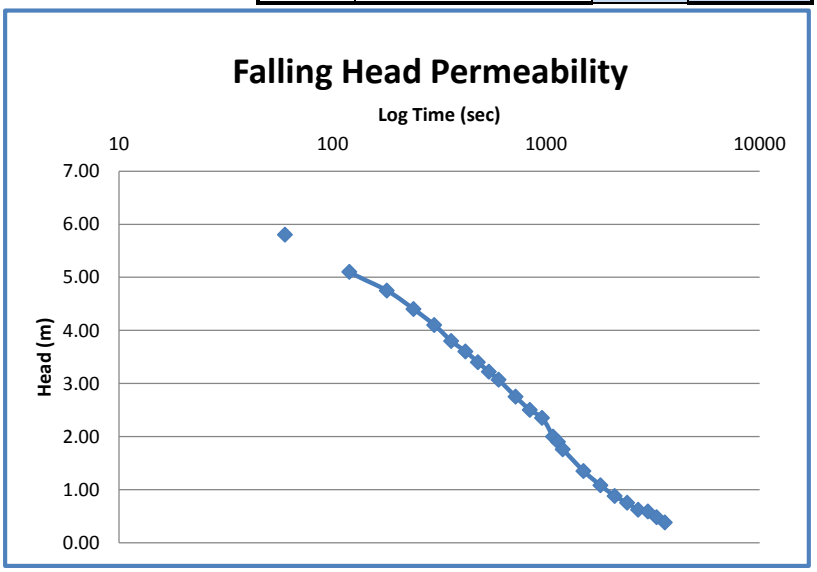


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF02	X			Date:		11/23/2013	
Test Location	6 to 9m	Y			K(m/sec):		6.6921E-07	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	6.10
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.30	60	5.80
WATER LEVEL BEFORE TEST	W.L	-5.3	mAD	2	1.00	120	5.10
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	1.35	180	4.75
CASING TOP LEVEL		0.3	mAD	4	1.70	240	4.40
CASING LENGTH		6.3	m	5	2.00	300	4.10
CASING BOTTOM LEVEL		-6	mAD	6	2.30	360	3.80
BOREHOLE DEPTH		9	m	7	2.50	420	3.60
BOREHOLE BOTTOM LEVEL		-9	mAD	8	2.70	480	3.40
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	2.88	540	3.22
DEPTH FROM TOP OF CASING TO ORIGINAL GROUND WATER	Hw	6.1	m	10	3.03	600	3.07
				12	3.350	720	2.75
				14	3.600	840	2.50
				16	3.750	960	2.35
				18	4.100	1080	2.00
				19	4.200	1140	1.90
				20	4.340	1200	1.76
				25	4.750	1500	1.35
				30	5.020	1800	1.08
				35	5.220	2100	0.88
				40	5.35	2400	0.75
				45	5.48	2700	0.62
				50	5.51	3000	0.59
				55	5.62	3300	0.48
				60	5.72	3600	0.38

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

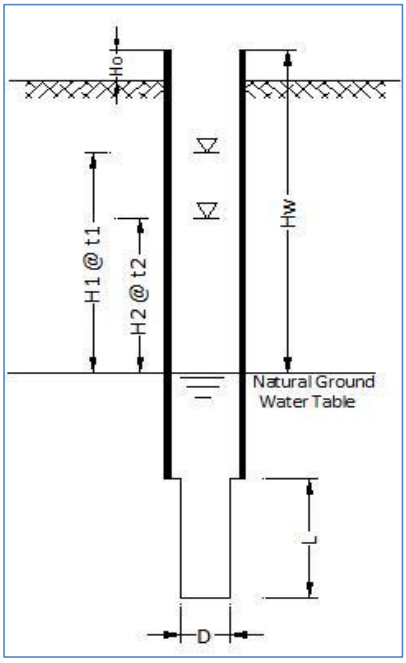


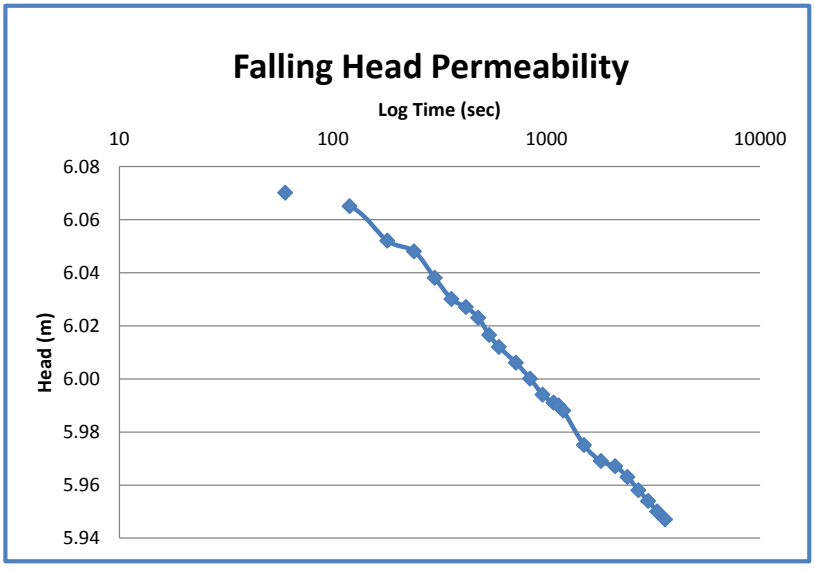


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF02	X			Date:		11/25/2013	
Test Location	9 to 12m	Y			K(m/sec):		3.9664E-09	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	6.10
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.03	60	6.07
WATER LEVEL BEFORE TEST	W.L	-9.5	mAD	2	0.04	120	6.07
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	0.05	180	6.05
CASING TOP LEVEL		0.3	mAD	4	0.05	240	6.05
CASING LENGTH		9.3	m	5	0.06	300	6.04
CASING BOTTOM LEVEL		-9	mAD	6	0.07	360	6.03
BOREHOLE DEPTH		12	m	7	0.07	420	6.03
BOREHOLE BOTTOM LEVEL		-12	mAD	8	0.08	480	6.02
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	0.08	540	6.02
DEPTH FROM TOP OF CASING TO ORIGINAL GROUND WATER	Hw	6.1	m	10	0.09	600	6.01
				12	0.09	720	6.01
				14	0.10	840	6.00
				16	0.11	960	5.99
				18	0.11	1080	5.99
				19	0.11	1140	5.99
				20	0.11	1200	5.99
				25	0.13	1500	5.98
				30	0.13	1800	5.97
				35	0.13	2100	5.97
				40	0.14	2400	5.96
				45	0.14	2700	5.96
				50	0.15	3000	5.95
				55	0.15	3300	5.95
				60	0.15	3600	5.95

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

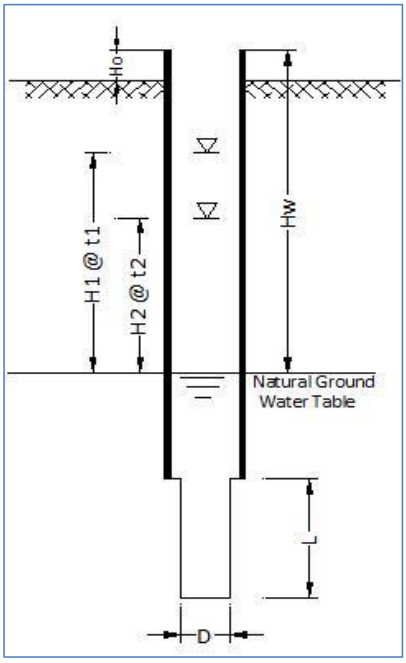


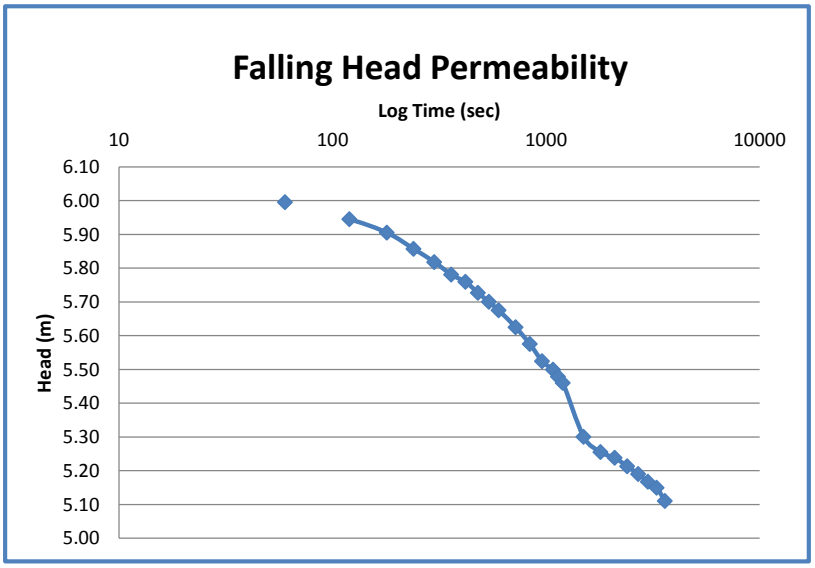


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF02	X			Date:		11/25/2013	
Test Location	12 to 15m	Y			K(m/sec):		1.7577E-08	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	6.10
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.11	60	6.00
WATER LEVEL BEFORE TEST	W.L	-11	mAD	2	0.16	120	5.95
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	0.20	180	5.91
CASING TOP LEVEL		0.3	mAD	4	0.24	240	5.86
CASING LENGTH		12.3	m	5	0.28	300	5.82
CASING BOTTOM LEVEL		-12	mAD	6	0.32	360	5.78
BOREHOLE DEPTH		15	m	7	0.34	420	5.76
BOREHOLE BOTTOM LEVEL		-15	mAD	8	0.37	480	5.73
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	0.40	540	5.70
DEPTH FROM TOP OF CASING TO ORIGINAL GROUND WATER	Hw	6.1	m	10	0.43	600	5.68
				12	0.48	720	5.63
				14	0.53	840	5.58
				16	0.58	960	5.52
				18	0.60	1080	5.50
				19	0.62	1140	5.48
				20	0.64	1200	5.46
				25	0.80	1500	5.30
				30	0.85	1800	5.26
				35	0.86	2100	5.24
				40	0.89	2400	5.21
				45	0.91	2700	5.19
				50	0.93	3000	5.17
				55	0.95	3300	5.15
				60	0.99	3600	5.11

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

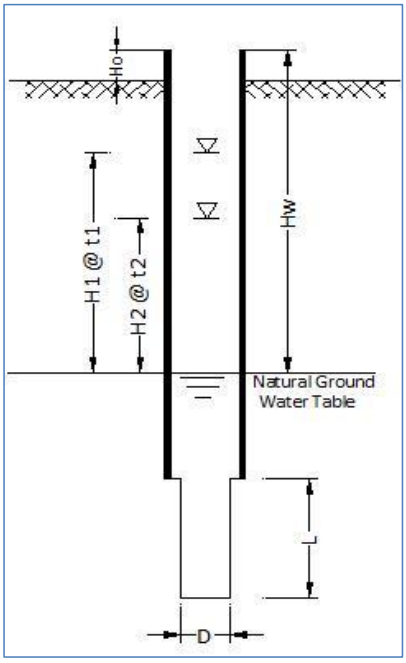


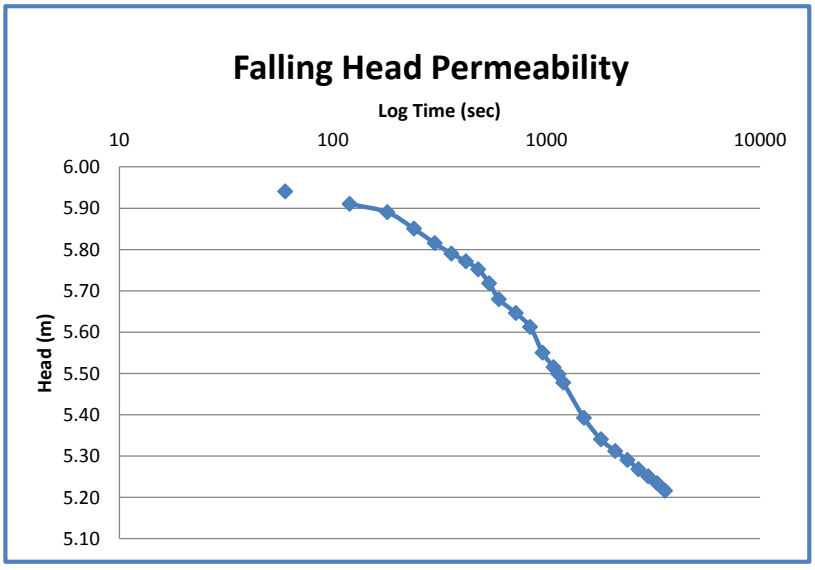


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF02	X			Date:		11/25/2013	
Test Location	15 to 18m	Y			K(m/sec):		1.4288E-08	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	110	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	6.10
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.16	60	5.94
WATER LEVEL BEFORE TEST	W.L	-14.5	mAD	2	0.19	120	5.91
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	0.21	180	5.89
CASING TOP LEVEL		0.3	mAD	4	0.25	240	5.85
CASING LENGTH		15.3	m	5	0.29	300	5.82
CASING BOTTOM LEVEL		-15	mAD	6	0.31	360	5.79
BOREHOLE DEPTH		18	m	7	0.33	420	5.77
BOREHOLE BOTTOM LEVEL		-18	mAD	8	0.35	480	5.75
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	9	0.38	540	5.72
DEPTH FROM TOP OF CASING TO ORIGINAL GROUND WATER	Hw	6.1	m	10	0.42	600	5.68
				12	0.45	720	5.65
				14	0.49	840	5.61
				16	0.55	960	5.55
				18	0.59	1080	5.52
				19	0.60	1140	5.50
				20	0.62	1200	5.48
				25	0.71	1500	5.39
				30	0.76	1800	5.34
				35	0.79	2100	5.31
				40	0.81	2400	5.29
				45	0.83	2700	5.27
				50	0.85	3000	5.25
				55	0.87	3300	5.23
				60	0.88	3600	5.22

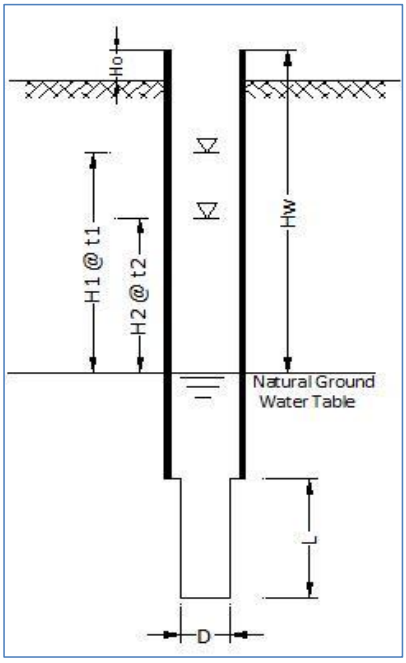
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

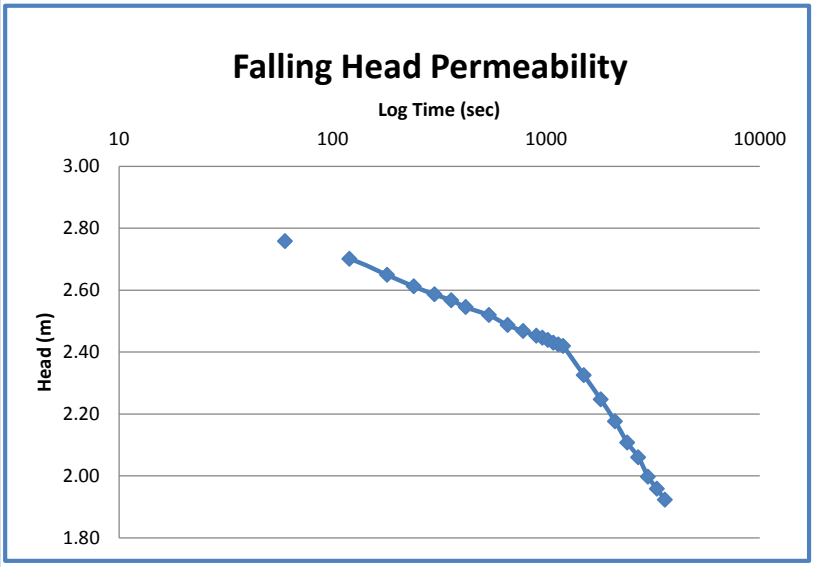




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF 04	X			Date:		12/19/2013	
Test Location	0 to 3	Y			K(m/sec):		9.9085E-08	
Inclination	0	Z						
DIAMETER OF CASING		D1		mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	3.00
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.24	60	2.76
WATER LEVEL BEFORE TEST		W.L	-2.3	mAD	2	0.30	120	2.70
HEIGHT OF CASING ABOVE NGL		Ho	0	m	3	0.35	180	2.65
CASING TOP LEVEL			0	mAD	4	0.39	240	2.61
CASING LENGTH			0	m	5	0.41	300	2.59
CASING BOTTOM LEVEL			0	mAD	6	0.43	360	2.57
BOREHOLE DEPTH			3	m	7	0.46	420	2.55
BOREHOLE BOTTOM LEVEL			-3	mAD	9	0.48	540	2.52
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	11	0.51	660	2.49
WATER HEAD		Hw	3	m	13	0.53	780	2.47
					15	0.55	900	2.45
					16	0.55	960	2.45
					17	0.56	1020	2.44
					18	0.57	1080	2.43
					19	0.58	1140	2.42
					20	0.58	1200	2.42
					25	0.68	1500	2.33
					30	0.75	1800	2.25
					35	0.82	2100	2.18
					40	0.89	2400	2.11
					45	0.94	2700	2.06
					50	1.00	3000	2.00
					55	1.04	3300	1.96
					60	1.08	3600	1.92

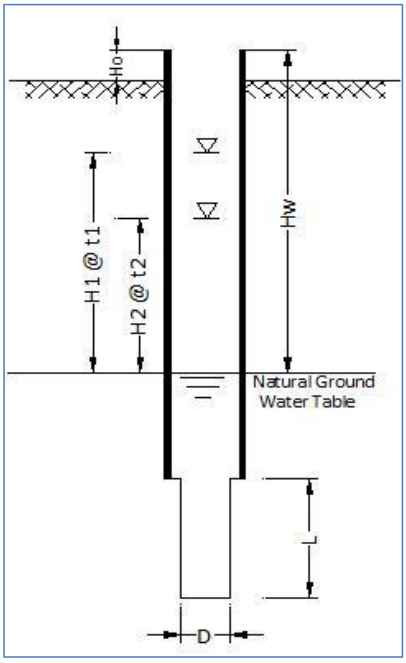
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

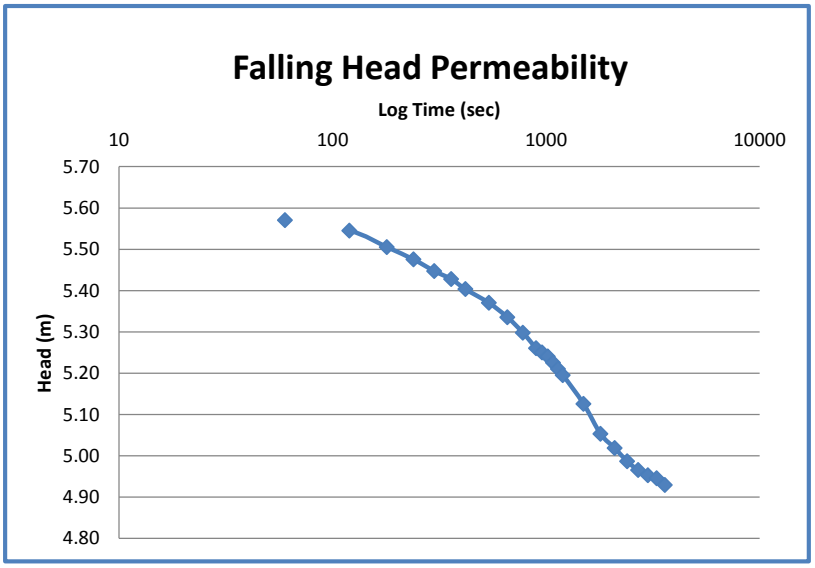




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF 04	X			Date:		12/19/2013	
Test Location	3 to 6	Y			K(m/sec):		1.5049E-08	
Inclination	0	Z						
DIAMETER OF CASING		D1	127	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	5.75
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.18	60	5.57
WATER LEVEL BEFORE TEST		W.L	-3.2	mAD	2	0.21	120	5.55
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	0.25	180	5.51
CASING TOP LEVEL			0.3	mAD	4	0.28	240	5.48
CASING LENGTH			3.3	m	5	0.30	300	5.45
CASING BOTTOM LEVEL			-3	mAD	6	0.32	360	5.43
BOREHOLE DEPTH			6	m	7	0.35	420	5.40
BOREHOLE BOTTOM LEVEL			-6	mAD	9	0.38	540	5.37
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	11	0.42	660	5.34
WATER HEAD		Hw	5.75	m	13	0.45	780	5.30
					15	0.49	900	5.26
					16	0.50	960	5.25
					17	0.51	1020	5.24
					18	0.53	1080	5.23
					19	0.54	1140	5.21
					20	0.56	1200	5.20
					25	0.63	1500	5.13
					30	0.70	1800	5.05
					35	0.73	2100	5.02
					40	0.76	2400	4.99
					45	0.79	2700	4.97
					50	0.80	3000	4.95
					55	0.81	3300	4.95
					60	0.82	3600	4.93

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

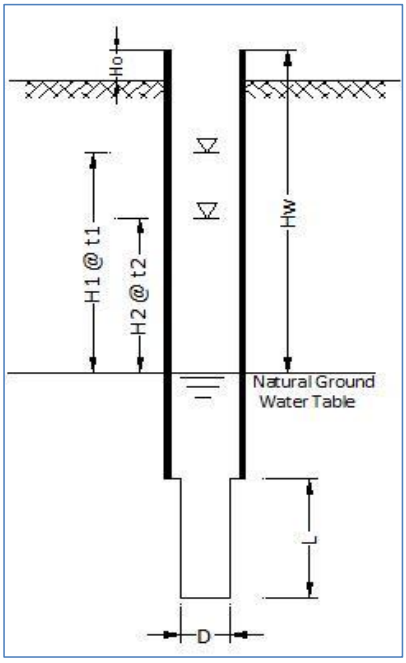


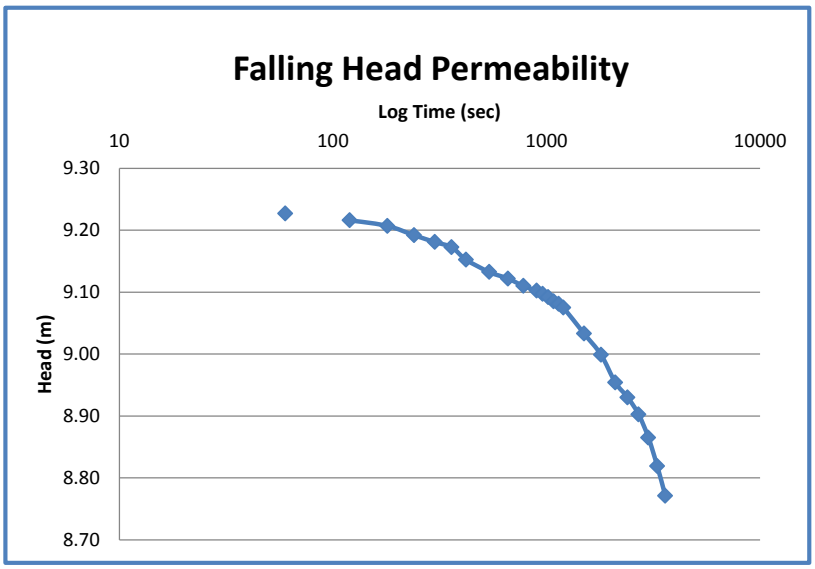


PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF 04	X			Date:		12/19/2013	
Test Location	6 to 9	Y			K(m/sec):		1.5342E-08	
Inclination	0	Z						

				Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF CASING	D1	127	mm				
DIAMETER OF TEST SECTION	D	86	mm	0	0.00	0	9.30
NATURAL GROUND LEVEL	NGL	0	mAD	1	0.07	60	9.23
WATER LEVEL BEFORE TEST	W.L	-4.7	mAD	2	0.08	120	9.22
HEIGHT OF CASING ABOVE NGL	Ho	0.3	m	3	0.09	180	9.21
CASING TOP LEVEL		0.3	mAD	4	0.11	240	9.19
CASING LENGTH		6.3	m	5	0.12	300	9.18
CASING BOTTOM LEVEL		-6	mAD	6	0.13	360	9.17
BOREHOLE DEPTH		9	m	7	0.15	420	9.15
BOREHOLE BOTTOM LEVEL		-9	mAD	9	0.17	540	9.13
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE	L	3	m	11	0.18	660	9.12
WATER HEAD	Hw	9.3	m	13	0.19	780	9.11
				15	0.20	900	9.10
				16	0.20	960	9.10
				17	0.21	1020	9.09
				18	0.22	1080	9.09
				19	0.22	1140	9.08
				20	0.23	1200	9.08
				25	0.27	1500	9.03
				30	0.30	1800	9.00
				35	0.35	2100	8.95
				40	0.37	2400	8.93
				45	0.40	2700	8.90
				50	0.44	3000	8.87
				55	0.48	3300	8.82
				60	0.53	3600	8.77

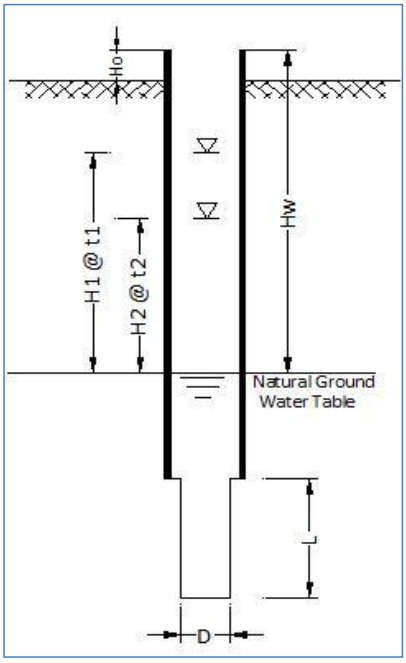
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

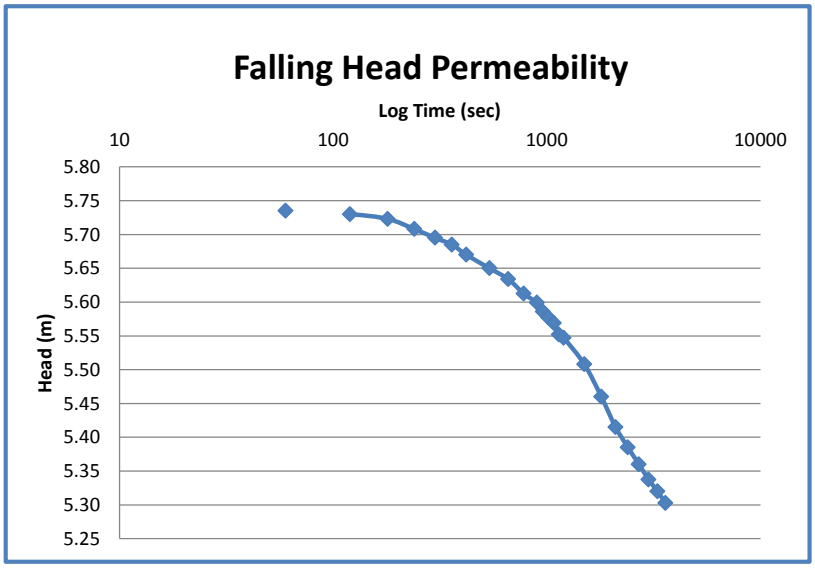




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF 04	X			Date:		12/20/2013	
Test Location	9 to 12	Y			K(m/sec):		2.2058E-08	
Inclination	0	Z						
DIAMETER OF CASING		D1	127	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	5.75
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.02	60	5.74
WATER LEVEL BEFORE TEST		W.L	-7.3	mAD	2	0.02	120	5.73
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	0.03	180	5.72
CASING TOP LEVEL			0.3	mAD	4	0.04	240	5.71
CASING LENGTH			9.3	m	5	0.06	300	5.70
CASING BOTTOM LEVEL			-9	mAD	6	0.07	360	5.69
BOREHOLE DEPTH			12	m	7	0.08	420	5.67
BOREHOLE BOTTOM LEVEL			-12	mAD	9	0.10	540	5.65
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	11	0.12	660	5.63
WATER HEAD		Hw	5.75	m	13	0.14	780	5.61
					15	0.15	900	5.60
					16	0.16	960	5.59
					17	0.17	1020	5.58
					18	0.18	1080	5.57
					19	0.20	1140	5.55
					20	0.20	1200	5.55
					25	0.24	1500	5.51
					30	0.29	1800	5.46
					35	0.34	2100	5.42
					40	0.37	2400	5.39
					45	0.39	2700	5.36
					50	0.41	3000	5.34
					55	0.43	3300	5.32
					60	0.45	3600	5.30

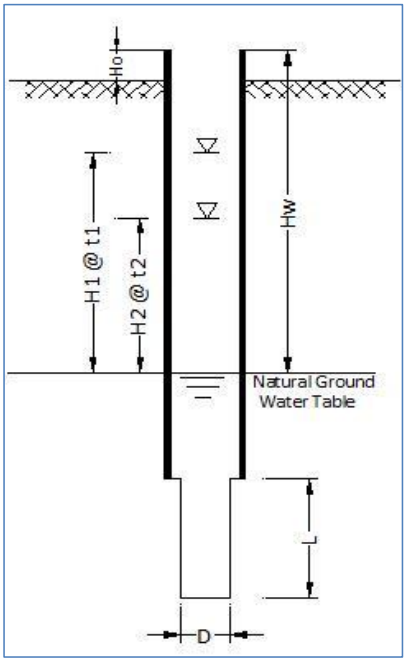
$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

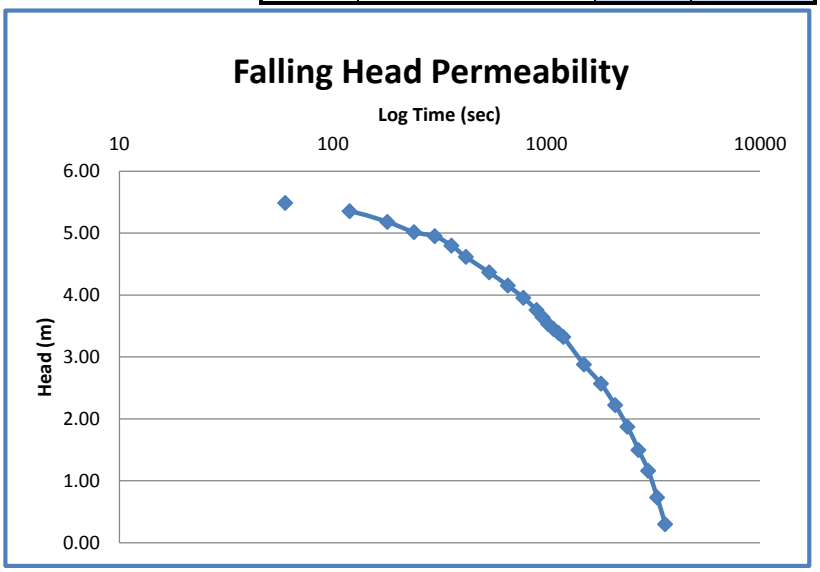




PROJECT		BISRI DAM			FALLING HEAD BOREHOLE WATER PERMEABILITY TEST			
CLIENT		DAR-TALEB						
Borehole	VF 04	X			Date:		12/20/2013	
Test Location	12 to 15	Y			K(m/sec):		1.1819E-06	
Inclination	0	Z						
DIAMETER OF CASING		D1	127	mm	Time (min)	Drop Down Below Casing Top Level (m)	Time (sec)	Head (m)
DIAMETER OF TEST SECTION		D	86	mm	0	0.00	0	5.75
NATURAL GROUND LEVEL		NGL	0	mAD	1	0.27	60	5.49
WATER LEVEL BEFORE TEST		W.L	-8.6	mAD	2	0.40	120	5.35
HEIGHT OF CASING ABOVE NGL		Ho	0.3	m	3	0.57	180	5.18
CASING TOP LEVEL			0.3	mAD	4	0.74	240	5.02
CASING LENGTH			12.3	m	5	0.80	300	4.95
CASING BOTTOM LEVEL			-12	mAD	6	0.95	360	4.80
BOREHOLE DEPTH			15	m	7	1.14	420	4.61
BOREHOLE BOTTOM LEVEL			-15	mAD	9	1.39	540	4.36
LENGTH OF THE UNCASED SECTION IN THE BOREHOLE		L	3	m	11	1.60	660	4.15
WATER HEAD		Hw	5.75	m	13	1.80	780	3.95
					15	1.99	900	3.76
					16	2.11	960	3.64
					17	2.22	1020	3.53
					18	2.30	1080	3.45
					19	2.37	1140	3.38
					20	2.43	1200	3.32
					25	2.87	1500	2.88
					30	3.19	1800	2.57
					35	3.53	2100	2.22
					40	3.88	2400	1.87
					45	4.25	2700	1.50
					50	4.59	3000	1.16
					55	5.02	3300	0.73
					60	5.45	3600	0.30

$$K_{(m/sec)} = \frac{D^2}{8L(t2-t1)} Ln\left(\frac{L}{D}\right) Ln\left(\frac{H1}{H2}\right)$$

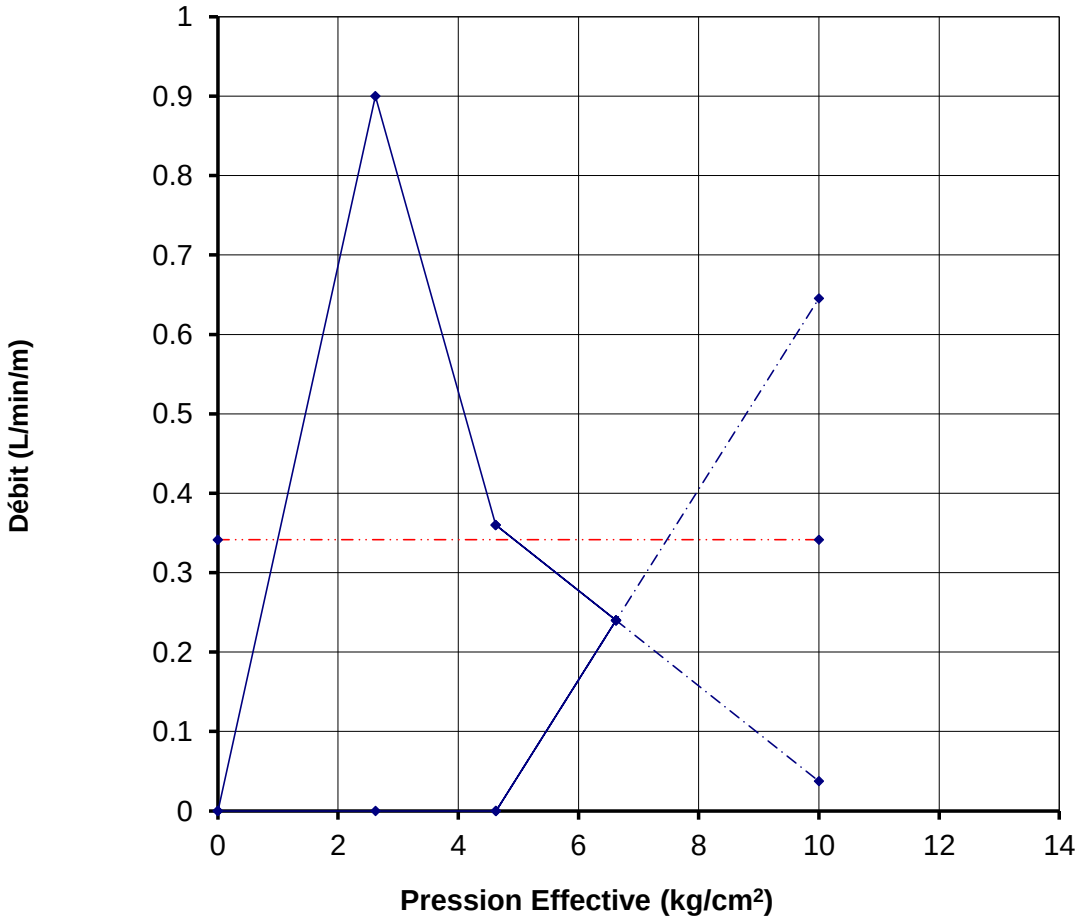




SATCON	PROJECT:	**BISRI DAM**		Date:	**12/22/2013**
	SONDAGE No.:	**VF 04**			
	TRANCHE ESSAYEE	**21.00 m**	à **26.00 m**	Manomètre	**0.50 m**
				depth to water:	**5.75 m**

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	45	10	5	4.5	0.90	0.625	4.46E-03	2.621
4	18	10	5	1.8	0.36	0.625	1.78E-03	4.623
6	12	10	5	1.2	0.24	0.625	1.19E-03	6.624
4	0	10	5	0	0.00	0.625	0.00E+00	4.625
2	0	10	5	0	0.00	0.625	0.00E+00	2.625



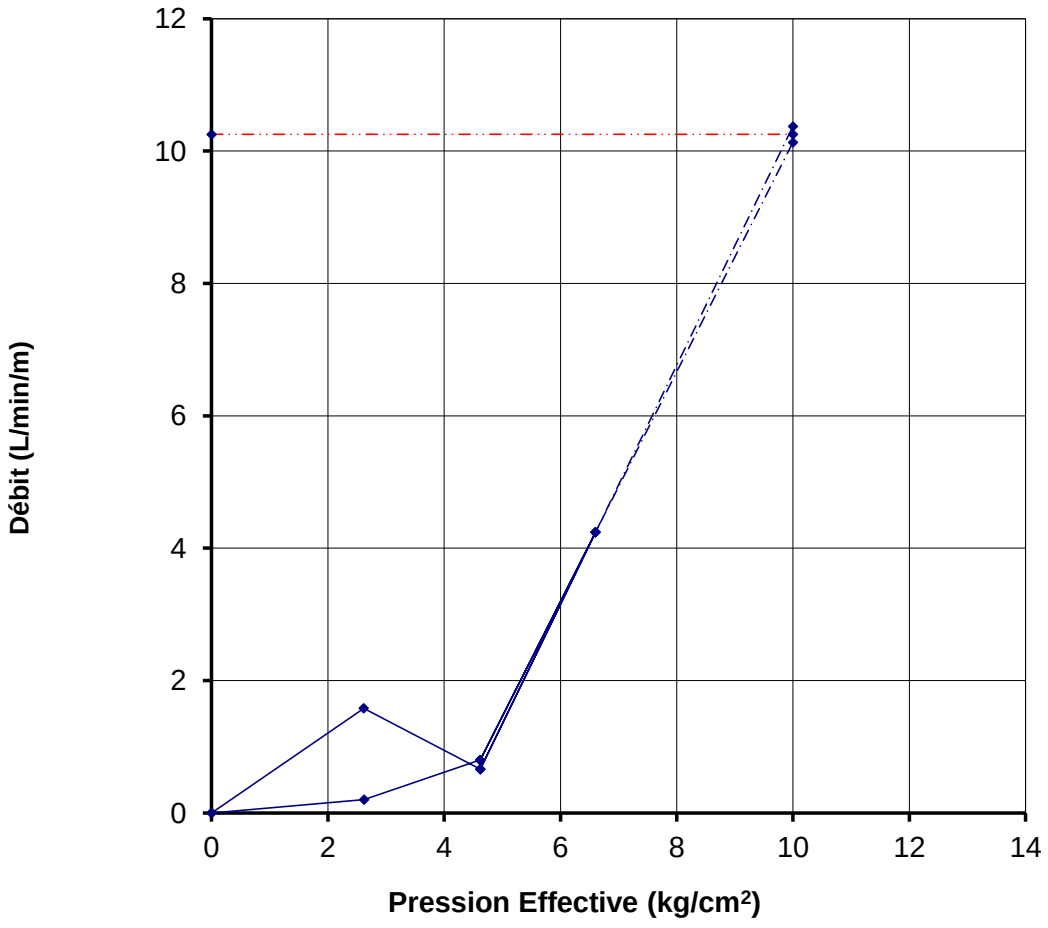
Lugeon = 0.34 L/min/m

SATCON	PROJECT: **BISRI DAM**		Date: **12/22/2013**
	SONDAGE No.: **VF 04**		
	TRANCHE ESSAYEE **26.00 m** à **31.00 m**		Manomètre **0.50 m**

depth to water: **5.75 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	79	10	5	7.9	1.58	0.625	7.82E-03	2.617
4	33	10	5	3.3	0.66	0.625	3.27E-03	4.622
6	212	10	5	21.2	4.24	0.625	2.10E-02	6.604
4	40	10	5	4	0.80	0.625	3.96E-03	4.621
2	10	10	5	1	0.20	0.625	9.90E-04	2.624



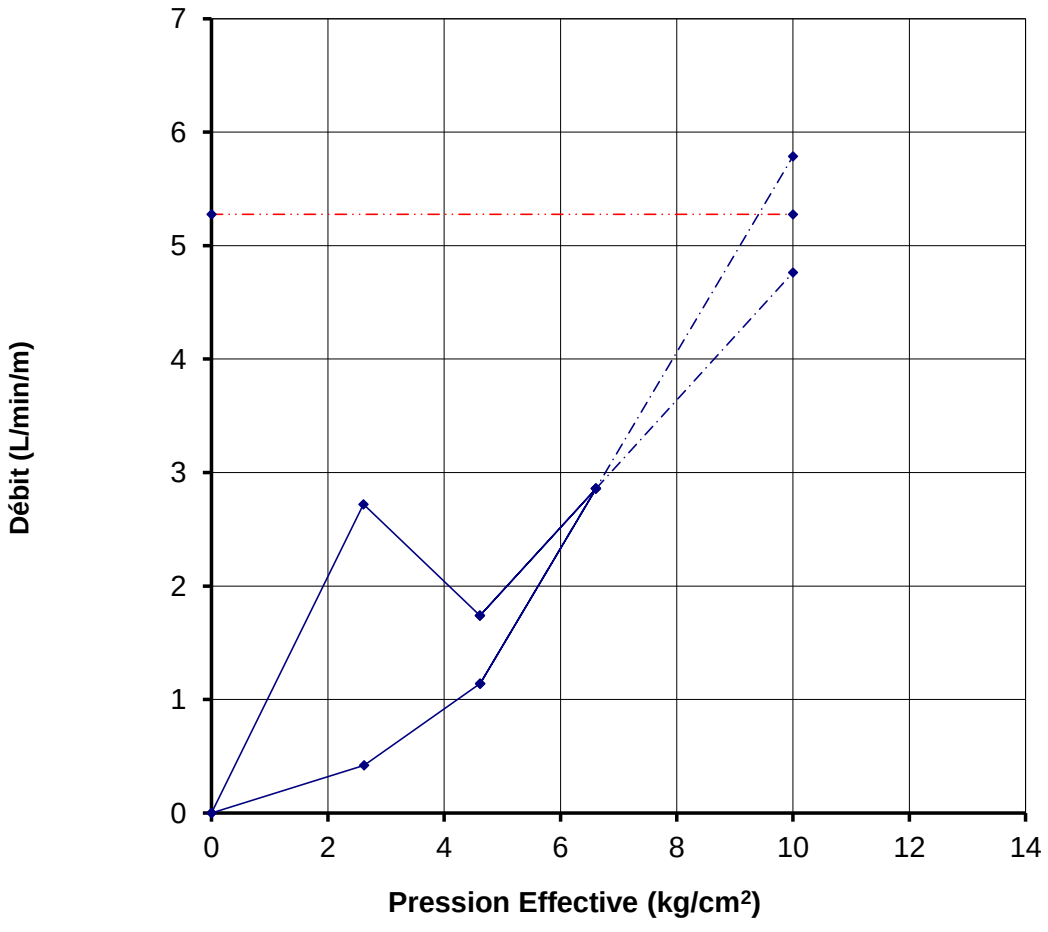
Lugeon = 10.3 L/min/m

SATCON	PROJECT:	**BISRI DAM**		Date:	**12/24/2013**
	SONDAGE No.:	**VF 04**			
	TRANCHE ESSAYEE	**31.00 m**	à **36.00 m**	Manomètre	**0.50 m**

depth to water: **5.75 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	136	10	5	13.6	2.72	0.625	1.35E-02	2.612
4	87	10	5	8.7	1.74	0.625	8.61E-03	4.616
6	143	10	5	14.3	2.86	0.625	1.42E-02	6.611
4	57	10	5	5.7	1.14	0.625	5.64E-03	4.619
2	21	10	5	2.1	0.42	0.625	2.08E-03	2.623



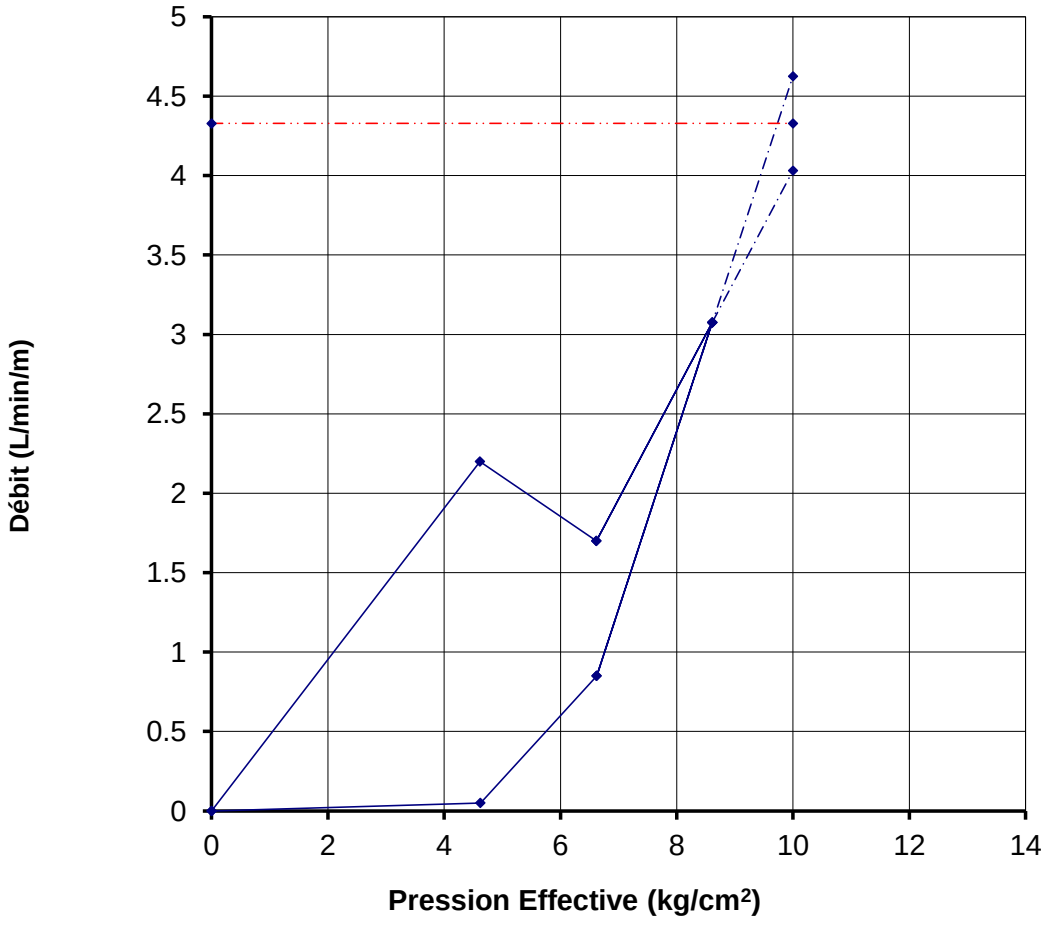
Lugeon = 5.28 L/min/m

SATCON	PROJECT: **BISRI DAM**		Date: **12/24/2013**
	SONDAGE No.: **VF 04**		
	TRANCHE ESSAYEE **36.00 m** à **40.00 m**		Manomètre **0.50 m**

depth to water: **5.75 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	4	8.8	2.20	0.625	8.71E-03	4.616
6	68	10	4	6.8	1.70	0.625	6.73E-03	6.618
8	123	10	4	12.3	3.08	0.625	1.22E-02	8.613
6	34	10	4	3.4	0.85	0.625	3.37E-03	6.622
4	2	10	4	0.2	0.05	0.625	1.98E-04	4.625



Lugeon = 4.33 L/min/m