### MALAYSIA

# ON SMALL SCALE HYDROELECTRIC POWER DEVELOPMENT PROJECT AT UPPER LIWAGU RIVER BASIN IN SABAH

FINAL REPORT

APPENDIX VOL. I

OCTOBER, 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

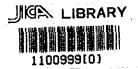
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### **MALAYSIA**

# FEASIBILITY STUDY ON SMALL SCALE HYDROELECTRIC POWER DEVELOPMENT PROJECT AT UPPER LIWAGU RIVER BASIN IN SABAH

FINAL REPORT
APPENDIX VOL. I



2433/

OCTOBER, 1992

JAPAN INTERNATIONAL COOPERATION AGENCY



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### Appendix 1

### **TOPOGRAPHIC SURVEY DATA**

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L.	Traverse Line for Upper Liwagu River Basin	AP1-1
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### SURCOM SERVICES SDN. BHD.

Land Surveyors: Land Title, Engineering, Topographic Hydrographic Surveyors

2nd Floor, No. 126 Jalan Gaya, Kota Kinabalu,

P. O. BOX No. 11125, 86812 KOTA KNABALU,

7th Jenniew 1921

TEL: \$1000 \$17907 FAX: 211013

P. O. BOX No. 276, 81007 Taweu.

TELEFAX: 778978

Our Fall UBS/OUS.57

Pengurus Besar, Lembaga Latrik Sabah. Wisma LLS. Kota Kinabalu.

Tuan.

SURVEY WORKS AT UPPER LIMAGU FIVES EASIE

TENDER NO. T. 2155

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CHUA THIAM HUAT, ASD. B. Sury. (Q'lu), MIS (Aust) Jurukur Beriesen (Licensed Surveyor)

CTH/el

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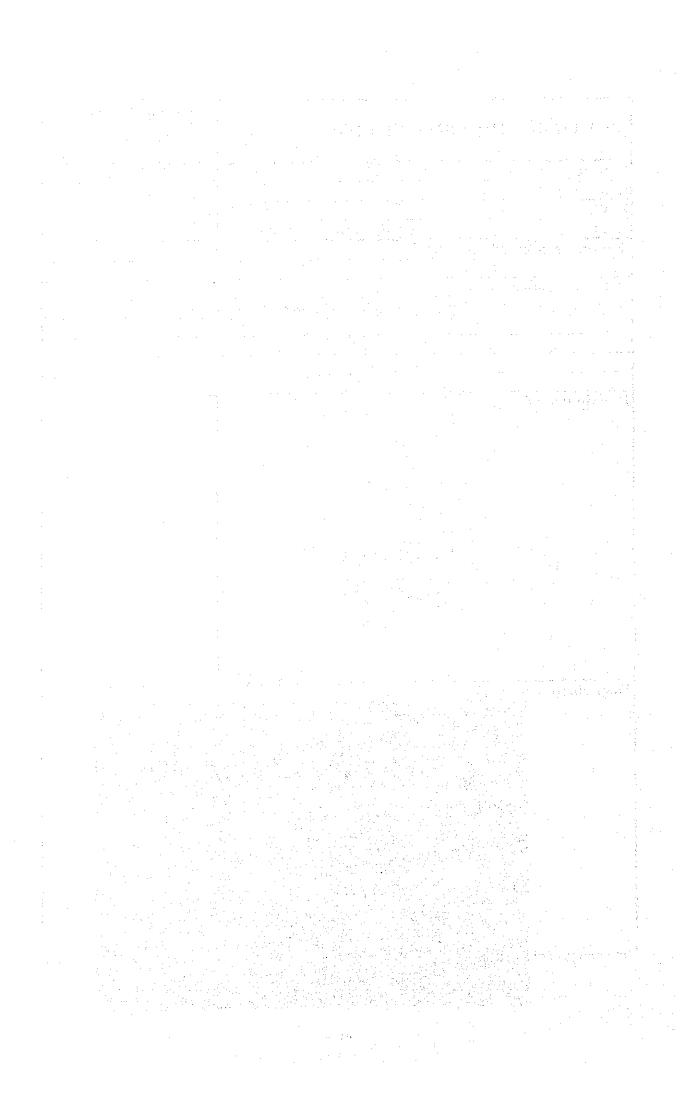
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# SURVEY WORKS AT UPPER LIWAGU RIVER BASIN

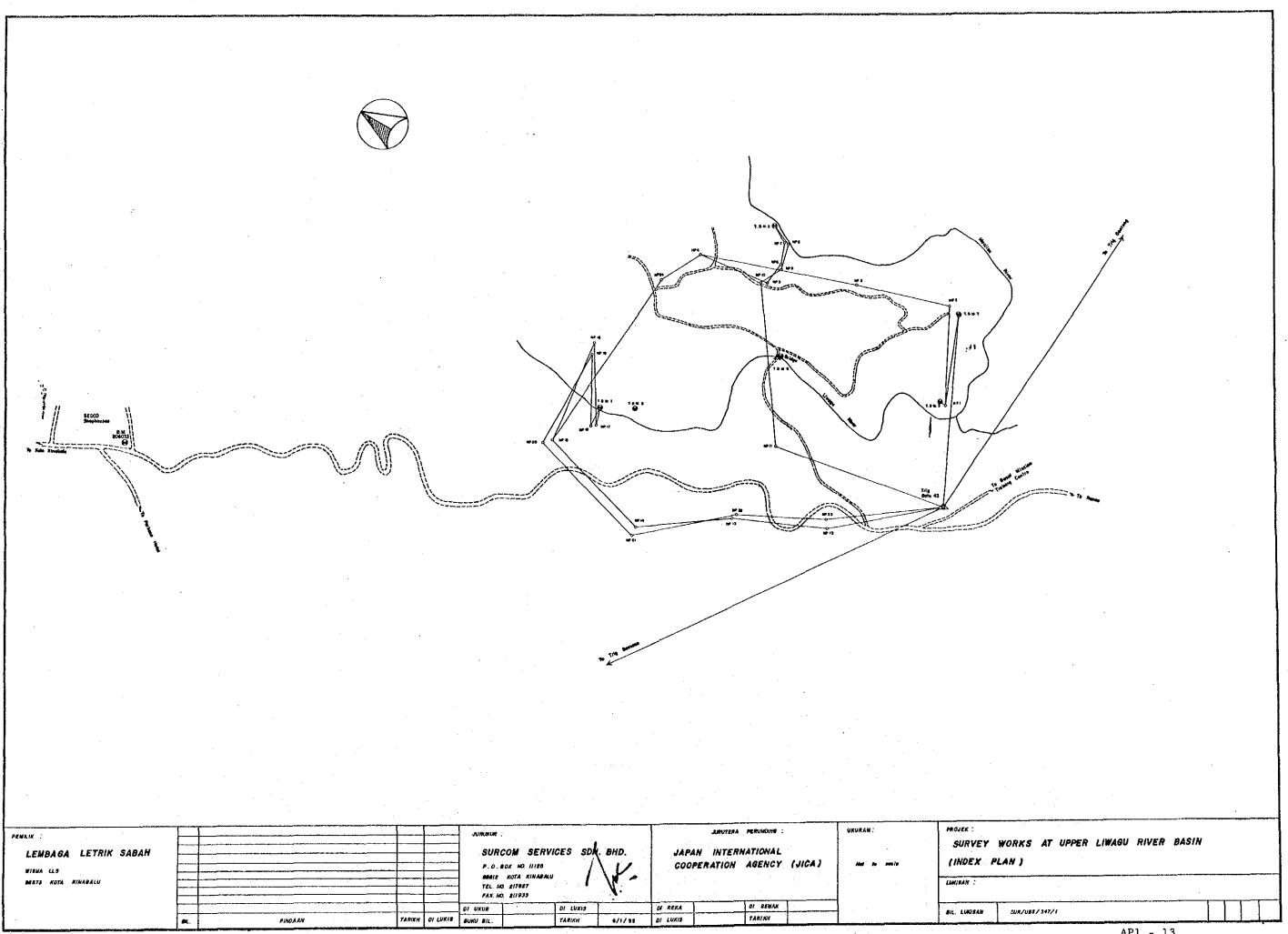
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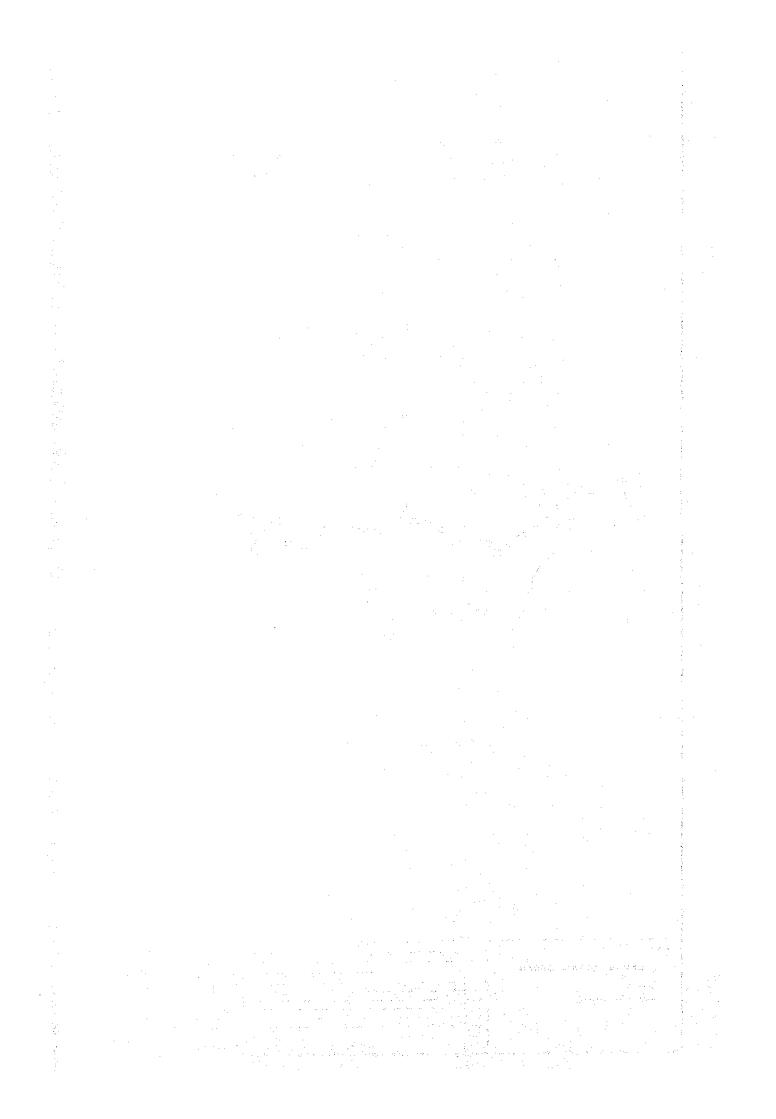
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TOPOGRAPHIC	SURVEY	OF	INTAKE	DAM	AT	LIWAGU	RIVER	SUR/UBS/34	7/2 - 3
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### SURCOM SERVICES SDN. BHD.

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# Appendix 2 GEOLOGICAL INVESTIGATION DATA

### Appendix 2

### GEOLOGY

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DEPTH	30CK	ိ	CORE	8	3,	CASING CASING	COLOR	WEATHER ING	HARD. NESS	CUTTING	DESCRIPTION	N:SPT Na:CPT	K (cm/sec)	. 5	.EV
	8			∴.∝	١		ō	ΜE	3	8		NO.CP1			
0m			0=	100%					* v *			s	o _ 0.097m	Om	1049,91
1	7 .	000	Ш		1		Brown				Medium SAND with		1-1-1992		
111	-1	0.0	Ш				В				0.92 rounded peoble			Ē.	,
1	AVE	1/ 1	Ш		<b>i</b> i		ght				BOULDER; fine- to		<u> </u>	۱-۱ [	1
4	RA		Ш				978				2.00 medium grained sandstone	Nd > 50		F	
2-3	9	1	Ш				1	, .			PEBBLE; rounded to			-2	
4		80	Ш	Щ	]						300 angular gravel	Nrl > 50	€ 1.05 x 10 <sup>-2</sup>	F	
3-3	<u></u>	00	Ш	W		100	χ.	-			3.00 dilguidi graver			<u>-</u> 3	1046.9
1	ģ	.	Ш		_		re				Slightly weathered			Ē	ŀ
. 1	S		Ш	<u> </u>	ة	<u>ج</u>	Ð	2	2	4	4.11 medium grained SAND-	Nd > 50	48.96 x t0 <sup>-2</sup>	_4	1
4-1	SANDSTON	`	Ш	Ш	core	grey				3	STONE; mainly fragments	1	- 10.90XIU	<b>F</b> *	
		Δ (	Ш		Ω̈	rs.		4	4	4	5.00 FAULT BRECCIA with	Nd >50-	· ·	F	
5-	- <u> </u>		Н	หหล	ı. ı	Reddish		1			5.60 clay infill cracks		ļ	<u>-</u> 5	1
-1	Ö	•	₩	Ш	Series	ď		1	ı	<u> </u>		Nd > 50		Ē	1
6-1	BRECCIA		Ж	17(1	ဖိ					2	0.00			6	
		.	Ш		ĕ				3	4	medium grained		48.41×10 <sup>-3</sup>	Ē.	
- 1	FAULT		Ш		9,5	: .			2	3	7.00 SANUSTONE,	Nd >50		-7	
2 1	FΑ	۱ ٔ ا	Ш		Longyear		Grey				strongly brecciated,				
4		•	Ш	W	1 1		ပ်				with vein of calcite,	Nd > 50	1	Ē	٠.
8-	-	•	Ш	1	×i†.	11	25.5		3	4	mainly sandstone		<b>4</b> 1.61 x10 <sup>-2</sup>	-8	
			Ш		1 1						fragments		1	<u>-</u>	
9-1	STONE		Щ		Corebarrei					1		Nd > 50		9	
-	10		41		ä			2	<u> </u>		9.55	-		Ē	
10	Ω		41		ંદુ	101	انا	٠	2	3			7.50 x 10 <sup>-3</sup>	10	
'' ‡	Z	•	П				g rey		<u> </u>	<del> </del>	10.28	Nd >50 ==		-	
7	SA	•	Ш		NMLC				3	4				E	1
1-		•	Ш		Σ		Light			Í	11.45		14	-1	
=		•	Ш	111					-2-	-3-	(11.55	Nd >50	11	-	
2			Ш	W		•			ŀ	:			0.00 .0-4	-2	
- =		.			1.2				,				8.98 x 10	Ē.	ŀ
3 1		١. ا		政		>	e,	٠.	3	:			11		
~ <u>.</u>	'				]	5	Grey			4	13.65			E	
1						-		- 3 -	4	1	13.80			E	
4=		•				Greenish Grey		2	3	-	14.31 GALLET BRECCIA with			-4	
=		4			[ ]	ž-	L "	3	4	1	FAULT BRECCIA with			E	1034.9
5- <del>5</del>	1		₩	₩	┝	Ü	$\vdash$	<u> </u>	<del>                                     </del>	<u> </u>			<del>                                     </del>	-5	1004.5
-						±					End of borehole			E	
6.4	CIA					:								E_6	
- 1	ECC		Ш			4.			i	!				Ē.	
]	BR									!				Ē.	
7 🖥	ш,				1	:	1		1				1	E'	
- 1	<u> </u>					17								Ē	
8-	FAU		Ш											-8	
-	-					. *				ļ	<b>[</b> .			E	
9_			Ш											£_9	
1			Ш											E	
20 =									1	!				20	
		I	 [//	 (1				+	+	1	► doller's note 4		4 Once F		
	1.1	.		4		t.				1,4	inck), Z(substick), 3(piece), 4(frequent), 5 grain	•	● Open End	ı iest	
													Packer T		

GEOLOGIC LOG OF DRILL HOLE SMALL SCALE HYDROELECTRIC POWER DEVELOPMENT PROJECT AT UPPER LIMAGU RIVER HOLE No. LI-2 (SHEET 1 OF 15.00 m COMMENCED Liwagu River Intake DEPTH OF HOLE LOCATION 0.75 m COMPLETED 9 - 1 - 1992 1049.81 m DEPTH OF OVERBURDEN **ELEVATION** 14.25 m DRILLED BY Wil , M. Liew LENGTH OF ROCK DRILLING COORDINATE E765,732.5 N662,777.5 T. Hatano 15.00 m LOGGED BY TOTAL LENGTH OF CORE ANGLE FROM HOLIZONTAL 90' 85-100 % X: APPLIED GEOTECHNICS CORE RECOVERY BEARING OF ANGLE HOLE \_\_\_ OBSERVATION OF CORE N-VALUE PERMEABILITY RECOVERY N: SPT DESCRIPTION K (cm/sec) Nd : CPT 1049.81 🖫 GRAVEL with sond : Brow 0.75 approx. 60% gravel 1049.06 Nd > 50 -Moderately to 1.60 slightly weathered 2 2.00 Nd > 50medium grained 2 2.63 2 4 1.72×10-2 Nd >50 -3 3.00 SANDSTONE; 3 partially strongly 4.00 fractured, with 42.11x10<sup>-3</sup>. Nd > 50 -3 4 4.25 coatings of brown 9-1-1992 silty clay along Nd > 50joints, with vein of 3 6.50 calcite -6 Nd > 504.23x 10<sup>-3</sup> Grey 4 7.00 Nd > 50-**4**2,27x10<sup>−3</sup> Brownish Nd > 50 SAND 2 2 9.10 Nd > 50Moderately weathered €6.47 x10<sup>-3</sup> medium grained Nd >50-3 3 SANDSTONE: mainly III.19 sandstone fragments Slightly weathered medium grained 5.80x10<sup>-4</sup> SANDSTONE: with 2 2 vein of calcite Slightly weathered SANDSTONE: mainly 5.00 sandstone, long core 1034.81 End of borehole ◀ Open- End Test

Water Table

Packer Test

ELECTRIC POWER DEVELOPMENT CO., LTD.

# SMALL SCALE HYDROELECTRIC GEOLOGIC LOG OF DRILL HOLE

S٨					ELECTRI		eer.	7 I I	PPER LIWAGU RIVER HOLE No		rencer I or	ı		
	LOCA				u River				PTH OF HOLE 15. OF		ENCED 31			
		/ATIC		11,00110	1035		m ·		PTH OF OVERBURDEN 5.5		LETED 8			
	COO	ROIN	ATE	E767.6	44.5 NE		<u>3.5</u>	LE	NGTH OF ROCK DRILLING 9.5	O_m *DRILLI		D BY Wil, M.Liew		
	ANG	LE F	ROM	HOLIZO	NTAL	9	<u>o</u> .	TO	TAL LENGTH OF CORE 15.0			atan		
	BEA	RING	OF	ANGLE	HOLE			CO	RE RECOVERY 74-10	<u>Ю</u> % <b>х</b> :др	PLIED GEOTE	CHN	CS	
		NAME		· *	Č.				BSERVATION OF CORE	N-VALUE	PERMEABILITY		Z O	
	ОЕРТН	ROCK N	100	CORE	CEMENTA TION KIND OF BIT CASING	COLOR	ARO ARESS	COPE	DESCRIPTION	N: SPT	K (cm/sec) :	рертн	ELEVATION	
1		ğ			3 ×80	8 8	ž	8		Nd: CPT	K (CA) 1467			
	0m			0 → 100 <sub>%</sub>			1-		0.45 SAND with rounded		! 	Om	1035.96♥	
	1 1	1	00	ii ii ii	1				pebble approx 70% sand		. :	-		
	1-1	SAND	00	8					COBBLES with some	. Nd >50	tz 1.37m	E-1		
	1	vs.	Ö	l l l l l l					boulders; mainly subrounded	·	8-2-1992		:	
	2-		$\mathcal{O}_a$	N				ĺ	to rounded, mostly	Nd >50-	<b>4</b> 1.72 x10 <sup>-2</sup>	-2		
	1	ш	o.g			rey			adameilite and sandstone		ļ	E		
ı	3-	۸ >	Ø,			ં	'		cobbles, adamellite	Nd >50	1	E-3	<b>!</b> . !	
		S.	20		=			1	cobbles at 0.82 to 0.90m,		<b>4</b> 1.31 x 10 <sup>-2</sup>	Ē.		
	4-		0 (+)		g B			ĺ	1.70 to 1.80m, 2.50 to 2.62m,	NO > DU	1.51 XIO	-4		
	7		$\cap$		core	1			2.82 to 3.00m, and 3.85 to	Nd > 50		5		
	5-1		Š.0°	1	2		1-4		5.50 4.60m	140 > 30 -			1030.46	
ļ	6		4		Series					Nd > 50	48.29 x 10 <sup>-3</sup>	6		
			۵ ا		:				COBBLES and BOULDERS	1102 00		E -		
ł	7-3		0.		9				with sandy silt; mainly	Nd >50-	! •	E E-7	'	
			Δ		Longy				subangular to angular,					
	8		٩Δ		ı				medium-grained sandstone	Nd >50 -	41.15x10.	8		
	111	S	00		with				cobbles and boulders,			<u>-</u>		
i	9-	A V E	0.0		1	gre		ĺ	opprox. 20 to 40 %	Nd >50		E-9		
i	i.i.	œ	$\langle \rangle$		Corebarre	ا تا			sondy silt, slightly			E-		
	10-	ပ			a a	Greenish		İ	cemented, dense	Nd >50 →	■1.13x10 <sup>-3</sup>	Ho		
1	1	¥	ل ہ		8	S. S.		1						
	1-3	SO	(].		일			1		i		1 .	ļ. l	
i		PINOSUK	00		Σ	'		į				<u> </u>		
	2-	u.	诊.		87		-					-2		
	1		40						12,76		-4		1023.20	
	3-1		100			grey			COBBLES with sandy silt; medium-grained		47.13x10	E-3		
									sandstone cobbles with			4		
	4-3		۵.۵			Brownish			red mudstone pebbles			E.		
			Qª			ê			15.00			E 5	1020.96	
Ì	5-								End of borehole			Ē,		
	6											6		
											1	E		
	7-											Ę-,		
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					ų,							20	.	
1	20 3					- <b>L</b> i	, ,	<del></del> _	▶ driffer's note ◀	<u> </u>	40-5		لسسسا	
. (	+): Ad	amell	itė			٠		10	ack), 2(subsack), 3(peos), 4(fragment), 5 grain		◀ Open- End	· .		
		٠.		∵″.`^ <u>L</u> '	- core loss		1	hard) –	S(soft) Voter Table	et ev	Packer Te		ENT CO ITO	
	15.57		u i jiy	· . <del>•</del>	- ROD		i (fresh	}~~ 5{de	composed)	ECEL	TRIC POWER DEV TOKYO.		.UJJ,W rna	
			76	1.37							, IONIO.	- rac estat		

SMALL SCALE HYDROELECTRIC GEOLOGIC LOG OF DRILL HOLE POWER DEVELOPMENT PROJECT AT UPPER LIWAGU RIVER HOLE No. L I - 4 (SHEET L OF L) 15.00 COMMENCED 21 - 1 - 1992 DEPTH OF HOLE m Mesilau River Intake LOCATION DEPTH OF OVERBURDEN 6.25 m COMPLETED 27 - 1 - 1992 ELEVATION 1035.34 m LENGTH OF ROCK DRILLING 8.75 m \* DRILLED BY WII, M. Liew COORDINATE E767,623.3 N662, 597.5 TOTAL LENGTH OF CORE 15.00 m LOGGED BY T. Hatano ANGLE FROM HOLIZONTAL 35-100 % X: APPLIED GEOTECHNICS CORE RECOVERY BEARING OF ANGLE HOLE OBSERVATION OF CORE N-VALUE PERMEABILITY N: SPT DESCRIPTION ğ K (cm/sec) om|1035,34 ₩ COBBLES and BOULDERS; N >50 mainly subrounded 27-1-1992 to rounded, mostly € 8.64 x 10<sup>-3</sup> adamellite and sandstone Nd > 50 cobbles and boulders, approx. 75% adamellite core Nd > 50 cobbles and boulders Nd > 50 -5 **4**6.26 x 10 <sup>4</sup> 1029.09 6.25 COBBLES with some N >50 boulders and sandy silt; subangular to Nd >50 -44.45x10 4 angular, medium-grained Nd >50 sandstone cobbles, approx. 20 to 40 % Nd >50 -402 x10 4 sandy silt, slightly cemented, dense Nd > 50 1023.34 €2.93×10<sup>73</sup> COBBLES with sandy Nd >50 silt; medium-grained sandstone cobbles with **Brownish** soft red mudstone peoble and sandy silt 1020.34 End of borehole ■ Open-End Test (†): Adomellite Pocker Test ELECTRIC POWER DEVELOPMENT CO., LTD. TOKYO. JAPAN

SMALL SCALE HYDROELECTRIC BROKEST AT LIBRED LANAGED BASED HOLE NO. 1.T.-1. (SHEET A

BEARING OF ANGLE HOLE	### ### ### ### ### ### ### ### ### ##	POWER DEVELO LOCATION He ELEVATION COORDINATE E767.8	ad Pond 1031.62 318.0 N661,692	DE 	PTH OF OVERBURDEN 3.8 NGTH OF ROCK DRILLING 16.2	O m COMPL O m DRILLE	ENCED 18 - ETED 23 - D BY Litto	1 - 1992 1 - 1992 , M. Liew
Second   S	No.   No.	The state of the s				<del></del>		
SILT	1	ROCK HAME LOG CORE RECOVERY	CEMENTA. TION KIND OF BIT CASING COLOR WEATHER			N: SPT		DEPTH ELEVATION
	? (rick), 2(substack), 3(pecel, 4(fragmont), 5 grain Packer, Test	ANDSTONE SILISTONE SANDSTONE SILISTONE WITH Sandstone SANDSTONE CLAY SILT CLAY E	NMLC Corebarrel with Longyear Grade 3A core bit  Brownish grey Yellowish brown  Reddish Reddish Prown, sometime grey  Brown  Bro	2 2 3 4 3 4 3	Sandy silty CLAY with sandstone fragments Sandy SILT with sandstone fragments Sandy SILT with sandstone fragments Sandysilty CLAY with sandstone fragments  Sandysilty CLAY with sandstone fragments  Medium grained 4.40 SANDSTONE  Slightly weathered, brecciated SILTSTONE with sandstone interbeds; approx. 30 to 40% sandstone fragments, approx. 70 to 60% siltstone fragments, with vein of calcite  10.40 10.70  12.00  12.00  12.00  12.00  12.00  Slightly weathered, siltstone fragments, with vein of calcite  16.70  Slightly weathered, brecciated SANDSTONE; with occasional fault gouge, with vein of calcite  16.70  Slightly weathered, brecciated SILTSTONE; with yein of calcite  16.70  Jointed and brecciated SANDSTONE; with fault gouge  Jointed and brecciated SANDSTONE; with fault gouge	O N=16  Nd >50  Nd >50  Nd >50  Nd >50  V 9.90m  23-1-1992  Nd >50  Nd >50	1.76x10 <sup>-3</sup> 1.18x10 <sup>-4</sup> 1.62x10 <sup>-4</sup>	-2 -3 -027.82 -4 -5 -6 -7 -6 -7 -6

SMALL SCALE HYDROELECTRIC GEOLOGIC LOG OF DRILL HOLE POWER DEVELOPMENT PROJECT AT UPPER LIMAGU RIVER HOLE No. LT - 2 (SHEET | OF | ) 20.00 m COMMENCED 11 - 1 -1992 DEPTH OF HOLE Head Pond 0.40 m COMPLETED 17 - 1993 19.60 m DRILLED BY Litto, M. Liew 17 - 1 - 1992 DEPTH OF OVERBURDEN **ELEVATION** 1035.53 m LENGTH OF ROCK DRILLING COORDINATE E767, 725.5 N661, 707.5 20.00 m LOGGED BY T. Hatano TOTAL LENGTH OF CORE ANGLE FROM HOLIZONTAL" 86-100 % X: APPLIED GEOTECHNICS CORE RECOVERY BEARING OF ANGLE HOLE OBSERVATION OF CORE ELEVATION N-VALUE PERMEABILITY RECOVER DEPTH SORE N: SPT DESCRIPTION Š K (cm/sec) No: CPT om(035.53 ₽ 0 - 100 1035.13 Soft sandy SILT with roots Extremely weathered Nd > 50 -4 4 SANDSTONE Slightly weathered 3 3 3 SANDSTONE; sandstone **4**1.68x10<sup>-3</sup> Nd > 50 -SANDSTONE 2.80 pieces to substicks Slightly weathered 3,47m 16-1-1992 SANDSTONE; joints **4**1.69x10<sup>--4</sup> 2 with dark brown clay grey Nd >50infill and calcite vein, 2 2 sandstone substicks BRECCIA **43**,54 x 10<sup>−4</sup> 6~ FAULT Nd > 50 FAULT BRECCIA; sand stone fragments with clay 4 4 ⊙N=27 4.03 x 10<sup>-5</sup> Breccioted SILTSTONE; 2 4 9.00 highly brecciated, 9.30 soft fragments, with Longyear N > 50sandstone substich 3.46 x 10<sup>-5</sup> brown at 9.00 to 9.30 m 2 4 4 Reddish ¥17¥ N=39 0 Greensh grey SANDSTONE; sandstone Corebarrel 2 2 12.35 stick, hard core 2.65x 10<sup>-5</sup> FAULT BRECCIA; sand-stone brecciated fragments 4 12.75 N:33 @ Brecciated SILTSTONE 4 4 2 with sandstone; highly brecciated, soffragments 14.50 FAULT BRECCIA; mainly N=30 @ sandstone fragments grey Slightly weathered : 3 3 15.85 SANDSTONE; sondstone Greenish Nd > 50piece to substick, with 2 2 culcite vein. 16.80 2 1.12 x 10<sup>-5</sup> Brecciated SILTSTONE brown with sandstone fragments; firm to stiff clayey 8 reddish 4 siltstone, highly brecciated 1015.53 20.00 parmer's note & End of borehole Open-End Test Hesicki, Zisubencki, Siciocet, Alfragmenti, 5 gram Pocker Test -<del>♥</del> Water Table ELECTRIC POWER DEVELOPMENT CO., LTD. TOKYO. JAPAN

SMALL SCALE HYDROELECTRIC GEOLOGIC LOG OF DRILL HOLE

						MALL SCALE HYDROELECTRIC POWER DEVELOPMENT PROJECT AT UPPER LIWAGU RIVER HOLE No. L.P 1 (SHEET 1 OF 1.)												
	CATIO			nsto		PRO	JJE(	4 اد						1991				
	EVATIO				975	. 08		 n		PTH OF OVERBURDEN 4.5		LETED 12						
co	ORDI	IATE	E 767,7		-					NGTH OF ROCK DRILLING 15.4		ED BY Andy						
AN	GLE F	ROM	HOLIZO	NTAL			90	<u>.</u>	TO	TAL LENGTH OF CORE 20.0	O m LOGGE	D BY T. H	atan	0				
BE.	ARING	OF	ANGLE	HOLE					CC	RE RECOVERY	) % X:AP	PLIED GEOTE	CHNI	cs				
	NAME	IJ	RY	د کے	5 (2					BSERVATION OF CORE	N-VALUE	PERMEABILITY	_	NO.				
DEPTH	ROCK R	0 7	CORE	CEMEN	CASING	COLOR	NG	SS SS	CUTTING	DESCRIPTION	N: SPT	K (cm/sec)	рертн	ELEVATION				
	Į §		L	3		8	WE	₹	8		Nd:CPT	K (GR/340)						
Or	SILT	- 7 -	0 <b>→</b> 100 <sub>%</sub>		:				ļ	0.25, Soft sandy SILT	<b>**</b> 5	ģ	0m	975.08 🖁				
	1			1	brown	Ĺ	_			with roots		}	_					
1 -	1	-						ļ		Sandy clayey SILT	⊙N=9		1					
-	SILT				Dark	brown			İ	with traces of		-4	-					
2.	, y	-			· 1					weathered sandstone	511-57	<b>4</b> 1.18x10 <sup>-4</sup>	-2	l. [				
	9 6					Yellowish				fragments; all rock	⊙N=23		-3					
3-	] <del>,</del>					olla				material is converted			<u>.</u>					
4-	Sandy	_		, 5.44			·			to soil residual soil	⊙N=24	<b>4</b> 2.00 x 10 <sup>4</sup>	4					
.	3								<u> </u>	4.56				970. 52				
5-	STONE					د ر د				Highly weathered			5					
	TST	.			₹	Reddish	4	4	5	SILTSTONE; moderately decomposed	N=33 ⊙							
6-	SILT				yellow	ď.		ļ	ļ	6.20		<b>4</b> 6.63x 10 <sup>-4</sup>	6					
-	SANDSTONE	•		bir	-	-		3	3	6.80 SANDSTONE		<b>■</b> 6.63X1U						
7-	NDS	•	73111	core	Brownish	Browner grey	3	-4- 2	-5- 2	7.00 Slightly weathered	N >50 -	1	-7 -					
8-	8	-			<u>8</u>	ស័ភ		_	ļ-	7.80 SANDSTONE	N >50 -		8 .					
".	i	Δ		5					ļ	Highly weathered		<b>4</b> 8.90 x 10 <sup>4</sup>						
9-	SANDSTONE	•		Series	ij.	Ę			l	brecciated SANDSTONE;			E-9					
	TSQ.			Se		0				highly weathered sandstone fragments,								
10-	SAN	Δ		9		Yellowish brown	4	}		40 percent of the rock	⊙ N=14	1.45 x 10 <sup>-4</sup>	10					
1 -	4	•		gye		.× 0			Į	material is discomposed			E					
1-	Brecciated	i •		Longyed		Ş		4		and disintegrated to			-1 -					
1 -	H H	Δ		with				Ì.	4	sand and silt	ØN=16		_2					
2-	ш			3		O.W.D	<del>                                     </del>	1		Moderately weathered		1.45 x 10 <sup>-4</sup>	E'	] ]				
3-	N O			rre		é		·		SILT STONE; brecciated,	⊙N=27	1 1	<u> </u>					
	تاسياسا TSTيا			ebar		Ę				with traces sandstone	0,112,			1				
4-	11 S	.		Co		Reddish	50			fragments 14.23			4 .					
-		-11		M L C	:	-				Moderately weathered	⊙N=15		E	. 1				
5-	1	•	g	Σ		ç			3	15.45 SANDSTONE;		<del>                                     </del>	<u>5</u>					
-	ONE	•				brown	3	3	-	sandstone fragments			-					
6-	STC	•				ı	~	"					<del>-</del> 6	]				
	NDST	•			: - '	Yellowish				are cemented by		4.99 x 10 <sup>-4</sup>	7					
7-	SA					ž.		Ì	4	sandy clayey silt 17.70		√ 17.63m	E'	1				
8-	1-	•				-		-	1			<u>-</u> 13-12-1991	-8					
	TONE				: :	grey	[			Moderately weathered SANDSTONE with	1		Ė					
9-	<b>∃</b> ひ 吾							4		siltstone; mainly			E 9					
-	SAND					Brownish							Ė.	055.00				
50	100 ≥	• •		للسبا	<del></del>	00	_	<u> </u>	1	20.00 sandstone tragments	<u></u>	4 0	±20	955.08				
Tissicki, Ziademicki, Sipiecel, Alfragmenti, Sigram													751					
		7	'' ? \ <u>\</u>	- come k	)SS:			l. 10	hardi ~	Stants Water Table	ni ne	Pocker TRIC POWER DEVI		ማድነ ሲህ ጉዜና				
		4	a <b>Tairi</b> Sasta (art	RQD		. *	1	tfreshi	5 (de	composed	ELEL	TOKYO.		ari Walib.				

SMALL SCALE HYDROELECTRIC GEOLOGIC LOG OF DRILL HOLE POWER DEVELOPMENT PROJECT AT UPPER LIWAGU RIVER HOLE No. L.P. 2 (SHEET | 1 OF | 1.) 20.00 m COMMENCED 21 -DEPTH OF HOLE Penstock LOCATION DEPTH OF OVERBURDEN 1.90 m COMPLETED 27 -1. 913.65 m ELEVATION LENGTH OF ROCK DRILLING 18.10 m DRILLED BY Andy, M. Liew COORDINATE E 767, 717.0 N 661, 237.0 TOTAL LENGTH OF CORE 20.00 m LOGGED BY T. Hatano ANGLE FROM HOLIZONTAL 90' 90-100 % X: APPLIED GEOTECHNICS BEARING OF ANGLE HOLE \_ CORE RECOVERY .... OBSERVATION OF CORE N-VALUE PERMEABILITY NAME DEPTH DESCRIPTION K (cm/sec) Na:CPT om 913.65 T 0 **⇒** 100 Soft sondy SILT with pebbles Sondy clayey SILT ON:9 Dark with weathered sandstone ö 911.75 fragments **€**2.92x10<sup>\*4</sup> Slightly weathered 3 2.75 SANDSTONE, substicks SANDSTONE grey 3.00 / Highly weathered 3 Yellowish N >50 4.00 SANDSTONE: fragments **4** 3.42x i0<sup>-3</sup> 4.30 Moderately weathered 3 3 4.63 SANDSTONE; substicks Highly weathered SILTSTONE; disturbed SILTSTONE 0N=13 . 5 is S 4 core, brecciated **∢**5.53 x l0<sup>-5</sup> fragments Moderately weathered N=31 0 SANDSTONE; strongly 5 brecciated, embedded 4 3 Reddish 27-1-1992 grey silty clay matrix 8.37 n N >50 -**4** 3.41 x 10 <sup>4</sup> Slightly weathered 8.29 x 10 4 SANDSTONE; strongly 10 10jointed and brecciated Nd >50 cores, with iron oxide coating on joint planes, mainly 6.37 x 10<sup>5</sup> 3 2 sandstone fragments Brownish N=48 0 SANDSTON N=41 0 17.25 SANDSTONE; substick, 2 2 17.60 with calcite vein 1.47x 104 Nd > 50 SANDSTONE, mainly Grey sandstone fragments, 3 3 9 slightly brecciated N >50 reduter's note 4 End of borehole ◆ Open-End Test Packer Test ✓ Water Table ELECTRIC POWER DEVELOPMENT CO., LTD.

TOKYO, JAPAN

## SMALL SCALE HYDROELECTRIC GEOLOGIC LOG OF DRILL HOLE

SIV				YDROE				- · · ·	~~ ^	7	ODED LINACIL DIVER HOLE N	. 10-3	week 1 or		
		ATION		Powe				O)E(	JI E		PPER LIWAGU RIVER HOLE N PTH OF HOLE 20.0		(SHEET   OF ENCED 18		
		/ATIC			86				Ti		· · · · · · · · · · · · · · · · · · ·		ETED 15		
				E767,7						FE	NGTH OF ROCK DRILLING 2.9	O m <sup>±</sup> DRILLI	BY Andy	, M	.Liew
	ANG	LE F	ROM	HOLIZO	NTAL	·		90	<u>.</u>	TO		O_m LOGGE	D BY TH	atan	0
	BEA	RING	OF.	ANGLE	HOLE					CO	RE RECOVERY40-10	O_% X:AP	PLIED GEOTE	CHNI	cs
	,	JWE		<b>}</b>	ورخ				r		BSERVATION OF CORE	N-VALUE	PERMEABILITY	_	s l
	DEPTH	ROCK NAME	100	CORE	CEMEN	BIT	COLOR	WEATHER ING	HARD.	CUTTING	OESCRIPTION :	N:SPT Nd:CPT	K (cm/sec)	рертн	ELEVATION
	0m			0 + 100%							- CO - CO - CO - CO - CO - CO - CO - CO	<b>₩</b> 5	ρ	Om	861.67 <sup>™</sup>
	Jen		τ <sub>4</sub> -	444	ħ	u,	<u></u>		<del> </del>		0.49 Sandy clayey SILT with roots			<u> </u>	
	1-	SILT	8			brow	χ. 3:		Ì		PEBBLES, COBBLES and	N .>50 →		1	
-	17/11		00			Dark	grey				80ULDERS; mainly			<u> </u>	
	2-		O <sub>0</sub>				Brownish				subrounded to rounded	1		-2	
	-fran		O			**	M <sub>O</sub>	İ			mostly adameilite	N >50			
	3-1		29			. `	<u>a</u>					Nd >50 -		F-3	
ı	4	ĺ	+ +								and sandstone			4.	
-	. 1		Ţ)		.						gravels, approx. 55%		1		
	5-1		$(\cdot,\cdot)$			v* .			1.		adamellite cobbles			5	
	1		00	X							and boulders,			E	
١	6-		O		e Di						adamellite big	⊙N=27		E-6	[ }
	. 4		<i>ر</i> ي.		50			,			boulders at;	⊙N=29			
1	7-1		00		လ						2.00 - 2.22m, 3.30-		,	7	<b>)</b> . )
	,		$\tilde{\mathcal{O}}$		ries						4.62m, 4.62 — 5.15m,			E <sub>a</sub>	
	8		00		Seri	- '						⊙N=8		E	1
	9-	3 / 1	0 0		ear	1.7	grey				7.42 - 7.82m , 9.15 -	0,11-0		E_9	
-	1	RA	(+,)		ngy		l	[:			9.70m			Ė	
	10-	IJ	Ď,		្ន		whitish					⊙N=13	NO TEST	E <sub>10</sub>	
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	, Linit		F-7\		ပ							:	15-1-1992	Ě	
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	1		0								₹ <b>7.1</b> 0			Ē,	844.57
	7-]	,,,	-∏ <sup>™</sup>			33,3					Moderately weathered	⊙N=24		7	J.7.7.
	8-9	TONE				<b>&gt;</b>	Reddish brown				SILTSTONE ; parially			-8	
	- 1	133				Ö	ية إ	3	4	4	organic panticle, softcore			E	
1	9~	S S				nish	3ddis					Nd >50 →		Ë-9	
	-		╨┤			Brownish grey	, Ç	2	5		19.50 Slightly weathered 20.00 SANDSTONE: substick core			Ę	04: 63
į,	20 3			N IN	Y	ш		1 2	1 6	1 6	+ doller's now 4 End of borehole	<u> </u>	<u> </u>	<u> </u> :20	841.67
(	A. E	damel	lite							10	cick), 2(substict), 3(pace), 4(fragment), 5 grain				
	-			- 7 NE	- come k					hard) –	- Woter (dole	ei ec	TRIC POWER DEV	El Opu	EXT CO 1TD
					- ROD			'	[freeh)	5 (de	composed)	CLEA	TOKYO.		

PROJECT: C.I. At Upper Liv	ROJECT: C.1. At Upper Liwagu Mini Hydro Project Site						:
LOCATION Sg. Liwagu Intake	epeth of i	IOLE	15.0	iii	COMMENCED _	19-12-91	
ELEVATION 1049.91m	DIAMETER C	of Hole _	80	:019	COMPLETED _	1-1-92	
COORDINATE N66 2788.5							
ANGLE FROM HORIZONTAL	90 <sup>O</sup>				MEASURED BY	Lu	
BEARING OF ANGLE HOLE							
EQUIPMENT FOR WATER MEAS	UREMENT	Dip meter			٠.		

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASUREMENT	DEPTH OF * WATER LEVEL	ELASPED **	CEMENTING CASING	REMARKS
19-12-91	07 00	-	-		_	
19-12-91	13 00	1.00 m	попе	1 hour	1.00 m	
20-12-91	07 00	1.75 m	1.050 m	13 hours	1.50 m	
20-12-91	13 00	2.60 m	1.030 m	1 hour	1.90 m	
21-12-91	07. 00	2.60 m	0.100 ш	13 hours	2.60 m	
23-12-91	07 00	3.68 m	0.031 m	38 hours	3.00 m	
23-12-91	12 20	4.00 m	0.0315 m	12 mins	3.10 m	
24-12-91	07 00	4.00 m	0.030 m	13 hours	4.00 m	
24-12-91	12 39	5.63 m	1.021 m	7 mins	4.00 m	
26-12-91	06 50	5.63 m	0.0305 m	38 hours	5.50 m	
26-12-91	13 00	6.00 m	0.0315 m	1 hour	5.90 m	
27-12-91	07 05	6.25 m	0.009 m	13 hours	6.25 m	
27-12-91	13 00	6.65 m	0.017 m	1 hour	6.25 m	
28-12-91	06 52	7.08 m	0.030 m	13 hours	6.60 m	
28-12-91	13 00	7.50 m	0.0305 m	1 hour	7.00 m	
29-12-91	07 00	8.00 m	0.032 m	13 hours	7.50 m	

<sup>\*</sup> Mark "none" when water level exists under the bottom of hole \*\* Elapsed time from shutting off of drilling water.

LOCATION Sg.Liwagu Intake	DPETH OF HOLE	15.0	m	COMMENCED	19-12-91
ELEVATION 1049.91m	DIAMETER OF HOLE	80	tem	COMPLETED	1-1-92
E76 5742.5 COORDINATE N66 2788.5					
NGLE FROM HORIZONTAL	90 0			MEASURED BY	Lu
BEARING OF ANGLE HOLE					

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASUREMENT	DEPTH OF * WATER LEVEL	ELASPED** TIME	CEMENTING CASING	REMARKS
29-12-91	11 32	8.78 m	0.0315 m	10 mins	8.19 m	
30-12-91	07 00	9.50 m	0.036 m	13 hours	8.80 m	
30-12-91	06 26	11.45	0.094 m	-14 mins	10.00 m	
31-12-91	06 50	11.45 m	0.040 m	12½ hours	10.00 m	
31-12-91	18 15	14.00 m	0.109 m	6 mins	11.20 m	:
1-1-92	06 50	14.00 m	0.043 m	13 hours	11.20 m	
1-1-92	09 05	15.00 m	0.097 m	12 mins	11.20 m	
				\$4. T		
			:			
				u 19	·	
		1. . 1.5% (35)				
		1				

<sup>\*</sup> Mark "none" when water level exists under the bottom of hole
\*\* Elapsed time from shutting off of drilling water

# RECORD OF WATER LEVEL IN DRILL - HOLE DURING DRILLING PROJECT: G.1. At Upper Liwagu Mini Hydro Project Site HOLE NO. L1-2 LOCATION Liwagu River Intake DPETH OF HOLE 15 COMMENCED 2-1-92 1049.81m DIAMETER OF HOLE 80 ELEVATION . COMPLETED 9-1-92 E76 5732.5 N66 2777.5 COORDINATE ANGLE FROM HORIZONTAL MEASURED BY BEARING OF ANGLE HOLE EQUIPMENT FOR WATER MEASUREMENT Dipmeter DEPTH OF HOLE AT MEASUREMENT DATE DEPTH: OF \* ELASPED \*\* TIME CEMENTING REMARKS WATER LEVEL MEASURED MEASURED TIME CASING

2-1-92	07 00	-	-	•		
3-1-92	07 00	2.00 m	0.032 m	13 hours	1.32 m	
3-1-92	13 ::00	3.00 m	1.70 m	1 hour	2.53 m	
4-1~92	07:00	3.50 m	2.90 m	13 hours	2.53 m	e e e e e e e e e e e e e e e e e e e
4-1-92	13 00	4.50 m	3.31 m	1 hour	2.53 m	
5-1-92	07 00	6.00 m	4.50 m	13 hours	4.49 m	
5-1-92	12 32	7.00 m	4.50 m	12 mins	6.52 m	. 8.
6-1-92	07 00	8.00 m	4.30 m	13 hours	7.30 m	
6-1-92	09 49	9.00 m	4.54 m	15 mins	9.00 m	
7-1-92	07 00	10.00 m	4.76 m	13 hours	9.64 m	
7-1-92	12 18	12.00 m	5.07 m	7 mins	9.64 m	
8-1-92	07 00	13.00 m	5.15 m	13 hours	9.64 m	
8-1-92	17 46	14.00 m	4.60 ո	15 mins	9.64 m	
9-1-92	07 00	14.00 m	5.25 m	13½ hours	9.64 m	
9-1-92	09 50	15.00 m	4.60 m	16 mins	9.64 m	
	······································	<del></del>		<del></del>	·····	

<sup>\*</sup> Mark "none" when water level exists under the bottom of hole \*\* Elapsed time from shutting off of drilling water

PROJECT: G.I. At	Upper Liwagu	Mini Hydro	Project S	lite	OLE	30. <u>Lt-3</u>	
LOCATION Mesil	au Intake :	PETH OF	HOLE	15.0	an .	COMMENCER	31-1-92
ELEVATION _4035.		LAMETER	OF ROLE		171172	COMPLETES	8-2-92
COORDINATE N66 2							
ANGLE FROM HORIZ	CONTAL 90	0				MEASURED BY	Will
BEARING OF ANGLE	HOLE	<del></del>					
EQUIPMENT FOR VA	TER MEASURE	MEN'T	Di	p meter		ı	

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASUREMENT	DEPTH OF * WATER LEVEL	ELASPED **	CEMENTING CASING	REMARK
	<del> </del>	TREASURE PER	MATER CEVEL	-	CASTING	
31-1-92	07 00	-		-	-	:
31-1-92	18 35	3.00 m	0,45 m	10 mins	2,60 m	
1-2-92	07 00	3.00 m	0.60 m	125 hours	2.60 m	
1-2-92	18 43	5.50 m	0.50 m	13 mins	4.20 m	
2-2-92	07 00	5.50 m	0.50 m	12፟፟ኔ hours	4.20 m	
2-2-92	20 18	9.00 п	0.72 m	18 mins	8.00 m	
3-2-92	06 30	9.00 m	1,03 m	10½ hours	8.00 m	
3-2-92	12 23	10.00 m	1,18 m	20 mins	10.00 m	·
7-2-92	09 43	10.00 m	0.62 m	4 day	10.00 п	
7-2-92	18 22	12.00 m	0,41 m	5 mins	12.00 m	
8-2-92	06 30	12.00 ள	0.63 m	12 hours	12.00 m	
8-2-92	17 44	15.00 m	1.37 m	22 mins	13.00 m	
				·		
**************************************	<del></del>	<del></del>				

#### RECORD OF WATER LEVEL IN DRILL - HOLE DURING DRILLING PROJECT: G.I. At Upper Liwagu Mini Hydro Project Site HOLE NO. LI-4 LOCATION Sg.Mesilau Intake DPETH OF HOLE 15 m COMMENCED 21-1-92 ELEVATION 1035.34m DIAMETER OF HOLE 80 nm COMPLETED 27-1-92 ANGLE FROM HORIZONTAL 90 0 MEASURED BY Ampahon BEARING OF ANGLE HOLE EQUIPMENT FOR WATER MEASUREMENT DEPTH OF DATE ELASPED \*\* TIME DEPTH OF \* CEMENTING HOLE AT MEASUREMENT REMARKS MEASURED MEASURED WATER LEVEL TIME CAS INC 06 00 21-1-92 0.21 m 10 mins 1.50 m 21-1-92 18 28 2.00 m 22-1-92 06 30 2.00 m 0.15 m 12 hours 2.00 m 22-1-92 4.00 m 0.22 m 10 mins 4.00 m 18 35 23-1-92 07 00 4.00 m 0.21 m 12½ hours 4.00 m 18 32 0.26 m 12 mins 4.90 m 23-1-92 6.00 m 24-1-92 07 00 6.00 m 0.30 m 12½ hours 4.90 m 24-1-92 18 00 8.00 m 0.12 m 13 mins 7.20 m 06 50 8.00 m 0.20 m 12½ hours 7.20 m 25-1-92 m 80.0 10.0 m 25-1-92 18 00 10.00 m 7 mins 06 55 12½ hours 10.0 m 26~1-92 0.06 m 10.00 m 12.0 m 26-1-92 18 10 12.00 m 0.12 m 7 mins 27-1-92 07 00 12.00 m 0.16 m 125 hours 12.0 m

15.00 m

17 10

27-1-92

1.38 m

12 mins

12.0 m

<sup>\*</sup> Mark "none" when water level exists under the bottom of hole

# RECORD OF WATER LEVEL IN DRILL - HOLE DURING DRILLING PROJECT: G.I. At Upper Liwagu Mini Hydro Project Site HOLE NO. LT-1 LOCATION Head Pond DPETH OF HOLE 20 m COMMENCED 18-1-92 ELEVATION 1031.62m DIAMETER OF HOLE 80 DIM COMPLETED 23-1-92 COORDINATE K76 7818 N66 1692.5 ANGLE FROM HORIZONTAL 90 ° MEASURED BY Lu BEARING OF ANGLE HOLE EQUIPMENT FOR WATER MEASUREMENT Dipmeter

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASUREMENT	DEPTH OF * WATER LEVEL	ELASPED**	CEMENTING CASING	REMARKS
18-1-92	07 00	-	•	-	v	
18-1-92	16 51	5.00 m	2.80 m	10 mins	3.00 m	
19-1-92	07 00	5.00 m	3.20 m	13 hours	4.50 m	
19-1-92	16 94	8.00 m	2.35 ค	18 mins	7.50 m	
20-1-92	07 00	8.00 m	5.50 m	13 hours	8.00 m	
20-1-92	07 40	11.0 m	1.25 m	16 mins	10.0 m	
20-1-92	18 30	11.00 m	1.83 m	12 mins	11.00 m	·
21-1-92	07 00	11.00 т	7.50 m	13 hours	11.00 m	
21-1-92	18 10	13.00 m	8.80 m	10 mins	13.00 m	
22-1-92	07 00	13.00 m	12.73 m	13 hours	13.00 m	
22-1-92	18 20	16.00 m	9.70 m	10 mins	16.00 m	
23-1-92	. 07 00	16,00 m	10.20 m	13 hours	16.00 m	
23-1-92	20 00	20.00 m	9.90 m	10 mins	18.00 m	

<sup>\*</sup> Mark "none" when water level exists under the bottom of hole
\*\* Elapsed time from shutting off of drilling water

PROJECT: C.I. At Upper Liwag	u Mini Hydro Project S	Site H	Ծեն	NO. <u>LT-2</u>
LOCATION Head Pond	DPETH OF HOLE	20	18	COMMENCED 11-1-92
ELEVATION 1035.53m	DIAMETER OF HOLE	80	imm	COMPLETED 17-1-92
COORDINATE E76 7725.5 N66 1707.5	•			
ANGLE FROM HORIZONTAL 90	<b>о</b>			MEASURED BY Lu
BEARING OF ANGLE HOLE				
EQUIPMENT FOR WATER MEASUR	REMENT Dipmeter		·	

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASUREMENT	DEPTH OF * WATER LEVEL	ELASPED**	CEMENTING CASING	REMARKS
11-1-92	13 00	-	-	•	-	
12-1-92	13 00	3.00 m	1.50 m	18ኒ hours	3.00 m	
13-1-92	07 00	4.00 m	2.15 m	13 hours	3.00 m	
13-1-92	16 . 20	8.00 m	2.75 m	17 mins	8.00 m	
14-1-92	07 00	8.00 m	4.20 m	12 hours	8.00 m	
14-1-92	13 00	10.00 m	4.15 m	1 hour	10.00 m	V 1
15-1-92	07 00	12.00 m	3.70 m	13 hours	12.00 m	
15-1-92	-	15.00 m	<b>2.</b> 20 m	15 mins	12.00 m	
16-1-92	07 00	15.00 m	7.30 m	12½ hours	15.00 m	
16-1-92	14 39	20.00 m	3.47 m	12 mins	15.00 m	
	4 14 E E				M. 1	
	•					
				·		

<sup>\*</sup> Mark "none" when water level exists under the bottom of hole

<sup>\*\*</sup> Elapsed time from shutting off of drilling water

PROJECT:	G.I. At Upper L	iwagu Mini Hydro Project	Site	HOLE	NO. LP-1	
LOCATION _	Kundasang	DPETH OF HOLE	20	m	COMMENCED	6-12-91
ELEVATION	975.08m	DIAMETER OF HOLE	80	ווות	COMPLETED	12-12-91
COORDINATE	E76 7727 N66 1434	-				
ANGLE FROM	HORIZONTAL _	90 0			MEASURED B	Y Lu
BEARING OF	ANGLE HOLE					
EQUIPMENT F	FOR WATER MEAS	UREMENT Dipmeter		<del></del>		

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASUREMENT	DEPTH OF * WATER LEVEL	ELASPED ** TIME	CEMENTING CASING	REMARKS
6-12-91	07 00	_	-	•	•	
7-12-91	07 00	2.50 m	2.12 m	13 hours	2.00 m	
7-12-91	13 00	4.00 m	2.03 m	1 hour	3.00 m	
8-12-91	07 30	5.00 m	2,37 m	13½ hours	5.00 m	
9-12-91	07 00	8.00 m	3.59 m	13 hours	7.00 m	
9-12-91	13 00	9.00 m	6.53 m	1 hour	8.50 m	
10-12-91	07 00	- 11,50 m	9,50 m	13 hours	11.00 m	
10-12-91	13 00	12.50 m	4.03 m	1 hour	12.00 m	
11-12-91	07 00	15.00 m	6,60 m	13 hours	13.00 m	
11-12-91	13 00	15.50`m	11.55 m	1 hour	14.35 m	
12-12-91	07 00	18,00 m	17.65 m	13 hours	14.35 m	
12-12-91	13 00	18,80 m	7.97 m	1 hour	17.35 m	
13-12-91	07 00	20,00 m	13.35 m	13 hours	17.35 m	
13-12-91	08 20	20.00 т	17.63 m	ኒ hour	18.78 m	
	: .					

<sup>\*</sup> Mark "none" when water level exists under the bottom of hole \*\* Elapsed time from shutting off of drilling water

#### RECORD OF TEVEL DRILL - HOLE DURING DRILLING WATER -TN

LOCATION	Penstock	DPETH OF	HOLE 20		_ m	OMMENCE	21-1-92
ELEVATION 2	913,65m	DIAMETER	ог носк	80	, 1960 .	COMPLETE	· <u>27-1-92</u>
COORDINATE	E76 7717.5 N66 1236						
ANGLE FROM	HORIZONTAL _	90 0			-	MEASURED	BY Andy
BEARING OF	ANGLE HOLE						
EQUIPMENT F	OR WATER MEA	SUREMENT	Dipmeter		<del></del> .		. %
DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASUREMENT	DEPTH OF *			CEMENTING CASING	REMARKS
21-1-92	07 00	-		•		49	
and the second second	1 '	I all the second	Į.	I	1	_	1

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASUREMENT	DEPTH OF* WATER LEVEL	ELASPED**	CEMENTING CASING	REMARKS
21-1-92	07 00	-	•	•	49.	
21-1-92	14 25	3.95 m	2.42 m	15 mins	3.95 m	
21-1-92	18 30	6.00 m	4.10 m	15 mins	6.00 m	
22-1-92	07 00	6.00 m	5.80 m	9½ hours	6∙00 m	
22-1-92	12 00	7.50 m	5.70 m	10 mins	6.00 m	
23-1-92	07 00	7.50 m	6.09 m	18 hours	6.00 m	
23-1-92	18 25	10.00 m	5.89 m	10 mins	10.00 m	
24-1-92	07 00	10.00 т	9.65 m	12½ hours	10.00 m	
24-1-92	12 30	11.00 m	9.82 m	21 mins	10.45 m	
24-1-92	18 00	12.00 m	9.45 m	25 mins	10.45 m	
25-1-92	07 00	12.00 m	10.00 m	13 hours	10.45 m	
25-1-92	13 15	13.85 m	11.27 m	19 mins	10.45 m	
26-1-92	07 00	15.00 m	10.8 m	13 hours	13.06 m	
26-1-92	12 00	16.00 m	9.45 m	20 mins	13.06 m	
26-1-92	18 30	16.95 m	9.92 m	31 mins	13.06 m	

<sup>\*</sup> Mark "none" when water level exists under the bottom of hole \*\* Elapsed time from shutting off of drilling water

# RECORD OF WATER LEVEL IN DRILL - HOLE OURING DRILLING PROJECT: C.1. At Upper Liwagu Mini Hydro Project Site 1017 NO. LP-2 LONGATION Penstock OPETH OF HOLE 20 ... COMMENCED 21-1-92 ELEVATION 913.65m DIAMETER OF HOLE 80 DE COMPLETED 27-1-92 GOORDINATE N66 1236 ANGLE FROM HORIZONTAL 90 0 MEASURED BY Andy BEARING OF ANGLE HOLE EQUIPMENT FOR WATER MEASUREMENT Dipmeter DATE : TIME DEPTH OF DEPTH OF \* ELASPED \*\* CEMENTING REMARKS HOLE AT MEASUREMENT MEASURED MEASURED WATER LEVEL TIME CASING 27-1-92 07 00 16.95 m 10.82 m 13 hours 13.06 m 27-1-92 15 44 20.00 m 8.37 m 23 mins 13.06 m

<sup>\*</sup> Mark "none" when water level exists under the bottom of hole
\*\* Elapsed time from shutting off of drilling water

PROJECT:	G.1. At Upper Liwa	gu Mini Hydro	Project	Site		_ HOPE	NO. LP-3	<u>.</u>	
LOCATION _	Power House	DPETH OF	HOLE	20.0		n)	COMMENCED _	18-12-91	
ELEVATION	861.67m	DIAMETER	OF HOL	е	80	mm	COMPLETED	15-1-92	
COORDINATE	E76 7662.5 N66 1075								
ANGLE FROM	HORIZONTAL	90 O				٠	MEASURED BY	Ampahon	
BEARING OF	ANGLE HOLE	<del></del>							
EQUIPMENT F	FOR WATER MEASU	REMENT	Dipmeter	· .		<u> </u>			

				4.5		
DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASUREMENT	DEPTH OF* WATER LEVEL	ELASPED ** TIME	CEMENTING CASING	REMARKS
17-12-91	13 00	ter a	•	•	•	
18-12-91	07 05	65 cm	0.08 m	14 hours	. • • • • • • • • • • • • • • • • • • •	
18-12-91	18 35	2.50 m	0.31 m	8 mins	1.50 m	
19-12-91	06 50	2.50 m	0.45 m	12½ hours	2.50 m	_
19-12-91	12 17	3.00 m	1.43 m	8 mins	2.50 m	
20-12-91	07 00	3.29 m	1.66 m	13 hours	2.50 m	
20-12-91	06 07	4.62 m	0.93 m	12 mins	2.50 m	
21-12-91	06 52	4.62 m	1.92 m	13 hours	2.50 m	
21-12-91	17 54	6.00 m	1.07 m	10 mins	2.50 m	
22-12-91	07 00	6.00 m	1.19 m	13 hours	2.50 m	
22-12-91	08 15	6.50 m	None	13 mins	2.50 m	
23-12-91	07 00	8.00 m	None	12 hours	2.50 m	BH caving cement grouting
24-12-91	-	-	•	-	•	No work at
25-12-91	_	-		•	-	No work at
26-12-91	07 60	7.10 m	1.97 m	2支 day	2.50 п	BH caving cement grouting
27-12-91	07 00	6.00 m	2.01 m	13 hours	2.50 m	

<sup>\*</sup> Mark "none" when water level exists under the bottom of hole
\*\* Elepsed time from shutting off of drilling water

DI DUL MEAN	•					
ELEVATION	861.67m	DIAMETER	OF HOLE	80	1MG3	COMPLETED 15-1-92
	E76 7662.5 N66 1075					
ANGLE FROM HO	ORIZONTAL	90°				MEASURED BY Ampahon
BEARING OF AN	GLE HOLE	<u></u>				

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASUREMENT	DEPTH OF * WATER LEVEL	ELASPED ** TIME	CEMENTING CASING	REMARKS
27-12 <b>-9</b> 1	13 00	7.35 m	2.06 m	1 hour	3.25 m	
28-12-91	07 00	7.35 m	1.81 m	13 hours	3.25 m	
28-12-91	13 00	7.35 m	2.16 m	1 hour	4.78 m	
29-12-91	07 00	8.00.m	2.13 m	13 hours	4.78 m	
29-12-91	13 00	9.00 m	2.19 m	1 hour	4.78 m	BH caving cement grouting
30-12-91	07 00	8.00 m	2.70 m	15 hours	4.78 m	
30-12-91	13 15	9.75 m	2.41 m	18 mins	4.78 m	BH caving cement grouting
31-12-91	07 00	8.00 m	2.14 m	14 hours	4.78 m	Hardened cement 8.0 m - 10.0 m
1-1-92	07 00	10.0 m	2.20 m	13 hours	4.78 m	
1-1-92	12 31	10.50 m	2.48 m	15 mins	4.78 m	
2-1-92	07 00	9.50 m	2.91 m	13 hours	4.78 m	Hardened cement 11.0 m = 9.5 m
2-1-92	16 35	12.00 m	2.53 m	10 mins	4,78 m	
3-1-92	07 00	10.50 m	2.44 m	13 hours	4.78 m	Hardened cement 10.5 m - 12.0 m
3-1-92	13 00	12.06 m	2.39 m	1 hour	4.78 m	
4-1-92	07 00	12.06 m	1.30 m	13 hours	4.78 m	
4-1-92	13 00	12.06 m	1.15 m	1 hour	4.78 m	

<sup>\*</sup> Mark "none" when water level exists under the bottom of hole

\*\* Elapsed time from shutting off of drilling water

AP2 - 21

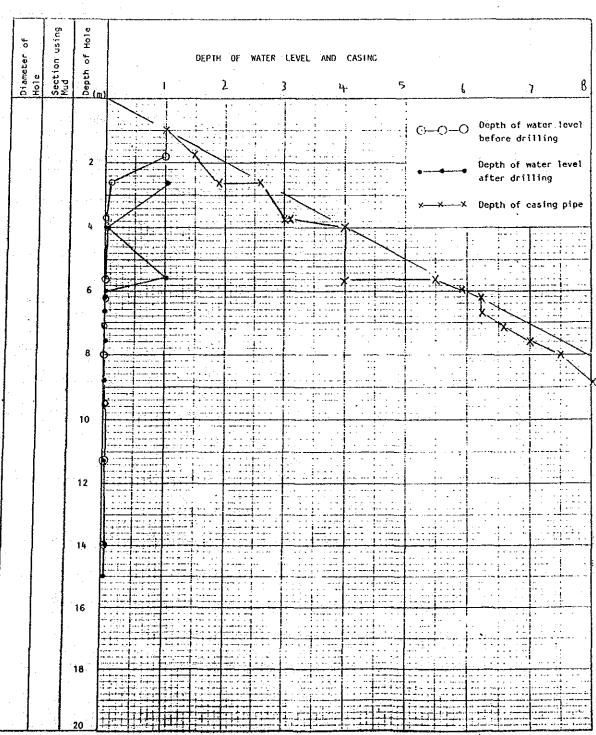
PROJECT:	G.I. At Upper Li	wagu Mini Hydr	o Project S	ite	HOLE	NOLP-3	
LOCATION _	Power House	DPETH OF	HOLE	20.0	m. ·	COMMENCED _	18-12-91
ELEVATION	861.67m	DIAMETER	OF HOLE	80	ma	COMPLETED _	15-1-92
COORDINATE	E76 7662.5 N66 1075	mariji.	•				
ANGLE FROM	HORIZONTAL	90 °				MEASURED BY	Ampahon
BEARING OF	ANGLE HOLE _			•			Section 1
EQUIPMENT F	FOR WATER MEAS	SUREMENT	Dipmeter		_ <del></del>		1 + 1.

DATE MEASURED	TIME MEASURED	DEPTH OF HOLE AT MEASUREMENT	DEPTH OF * WATER LEVEL	ELASPED** TIME	CEMENTING CASING	REMARKS
5~1-92	07 00	12.06 m	1.20 m	13 hours	4.78 m	
6-1-92	13 00	12.06 m	1.39 m	1 hour	4.78 m	
7-1-92	07 00	12.06 m	1.08 п	13 hours	4.78 m	
7-1-92	13 00	12.06 m	2.48 m	1 hour	4.78 m	
8-1-92	07 00	12.06 m	3.92 m	13 hours	4.78 m	
8-1-92	18 15	13.46 m	2.09 m	10 mins	4.78 m	
9-1-92	07 00	13.46 m	3.49 m	13 hours	4.78 m	
9-1-92	14 05	14.00 m	13.22 m	25 mins	4.78 m	
10-1-92	19 00	12.32 m	4.13 m	15 hours	4.78 m	Cement Grout 12.32 m - 14.0
10-1-92	14 16	15.00 m	13.06 m	35 mins	4.78 m	
11-1-92	07 00	12.90 m	3.71 m	15 hours	4.78 m	
11-1-92	14 45	16.09 m	12.94 m	25 mins	4.78 m	1
14-1-92	14 15	16.13 m	4.59 m	70 hours	4.78 m	Cement Grout 16.13 m - 14 m
15-1-92	07 00	16.72 m	5.73 m	13 hours	4.78 m	
	16 30	20.00 m	13.18 m	20 mins	4.78 m	
					54 J	

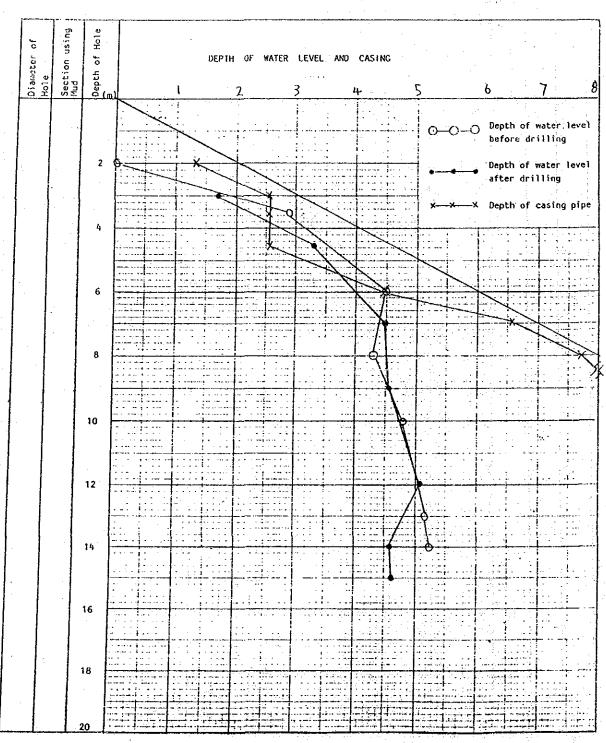
<sup>\*</sup> Mark "none" when water level exists under the bottom of hole

\*\* Elapsed time from shutting off of drilling water

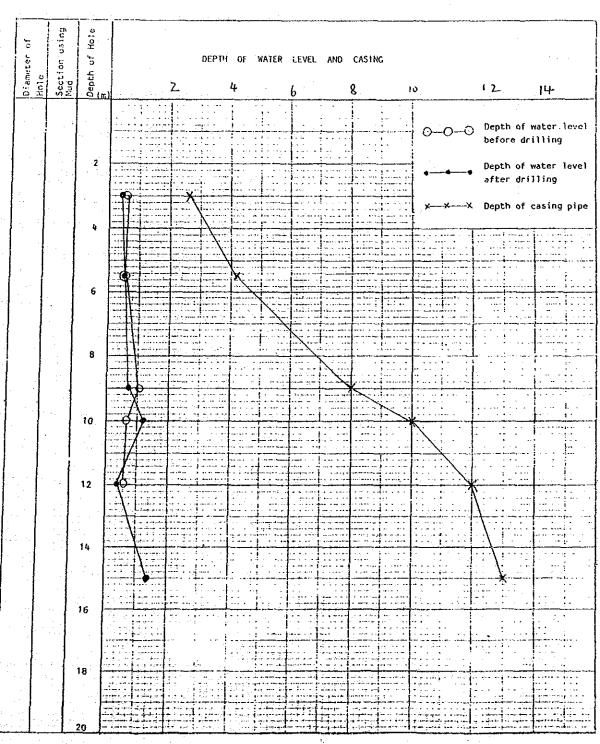
PROJECT: C.1	. At Upper Liv	agu Mini Hydro Project Site HOLE NO. LI-1 (She	et 1 of 1
LOCATION: So	, Liwagu Intak	в	19-12-91
ELEVATION:	1049,91m	DIAMETER OF HOLE: 80 mm COMPLETED:	1-1-92
COORDINATE:	E76 5742.5 N66 2788.5	ANGLE FROM HORIZONTAL: 90° MEASURED BY:	Lu



PROJECT : <u>G.</u>	1. At Upper Li	wagu Mini F	lydro Proj	ect Site HO	re no.	LI-2	(She	unt 1 of	1 .)
LOCATION:	Liwagu River	Intake	DEFTI	OF HOLE:_	15	m	COMMENCED:	2-1-92	
ELF VATION:_	1049.81m	DIAMETER	OF HOLE:_	80 av	m		COMPLETED:	9-1-92	<u> </u>
COORDINATE;	E76 5732.5 N66 2777.5	ANCLE FRO	M HORIZON	AL: 90°	M	EASURED	BY;	Lu	<u> </u>



PROJECT: Geological Investiga	tion At Upper Liwagu HOLE W.	L1+3 (Sheet	1
Michael Michae	ni Hydro Project Site		
COCATION: Mesilau Intake	DEPTH OF HOLE: 15	m COMMENCED: 31	1-1-92
ELEVALION: 1035,96 m D1/	METER OF HOLE: 80 mm	COMPLETED:8	3-2-92
E76 7594 COORDINATE: N66 2603 AND	LE FROM HORIZONTAL: 900	MEASURED BY: Wil	



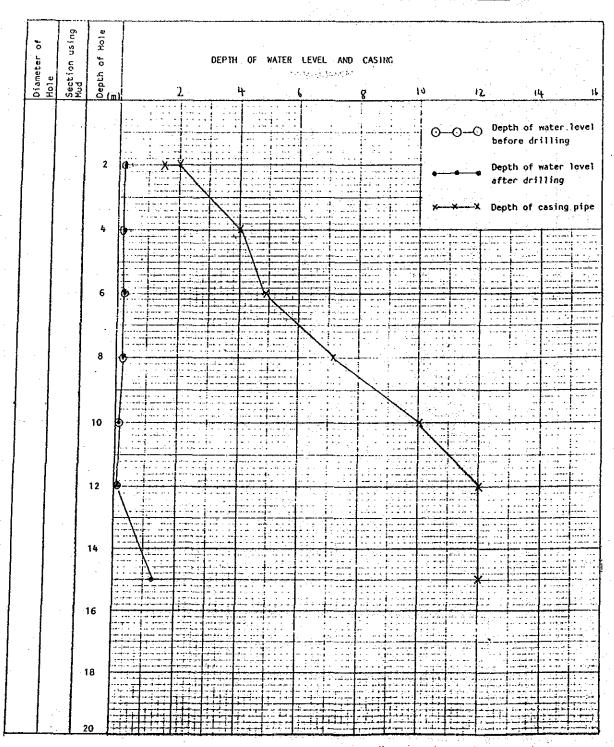
PROJECT: C.1. At Upper Liwagu Mini Hydro Project Site HULE NO. L1-4 (Sheet 1 of 1 v

LOCATION: Sg. Mesilau Intake DEPTH OF HOLE: 15 m COMMENCED: 21-1-92

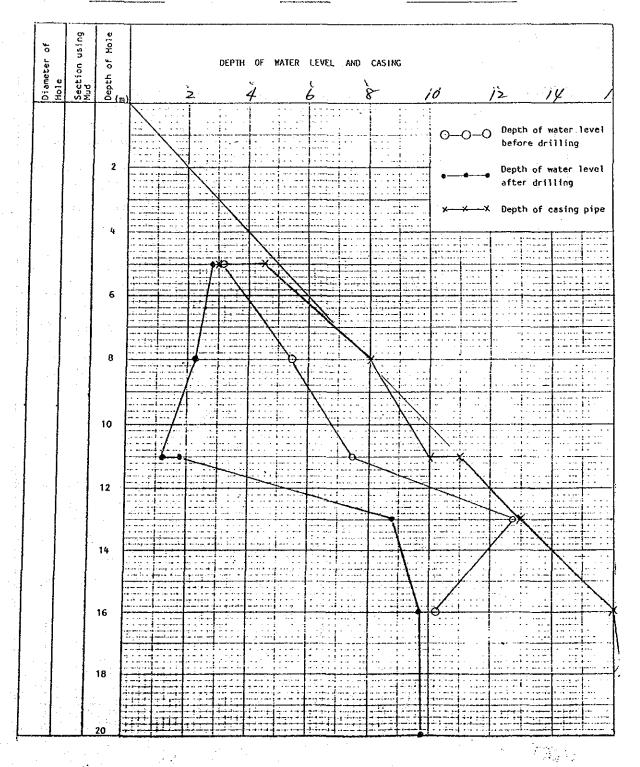
ELEVATION: 1035.34m DIAMETER OF HOLE: 80 mm COMPLETED: 27-1-92

E76 7571

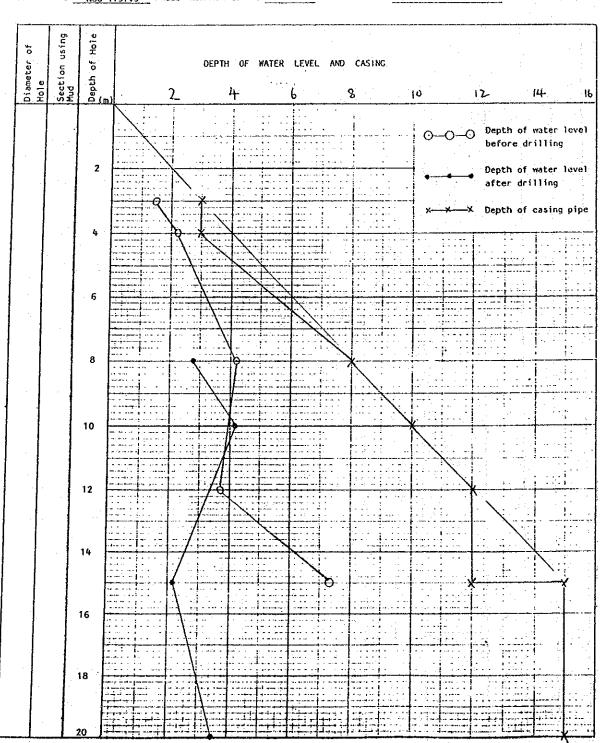
COORDINATE: N66 2597 ANCLE FROM HORIZONTAL: 90 MEASURED 67: Ampahon



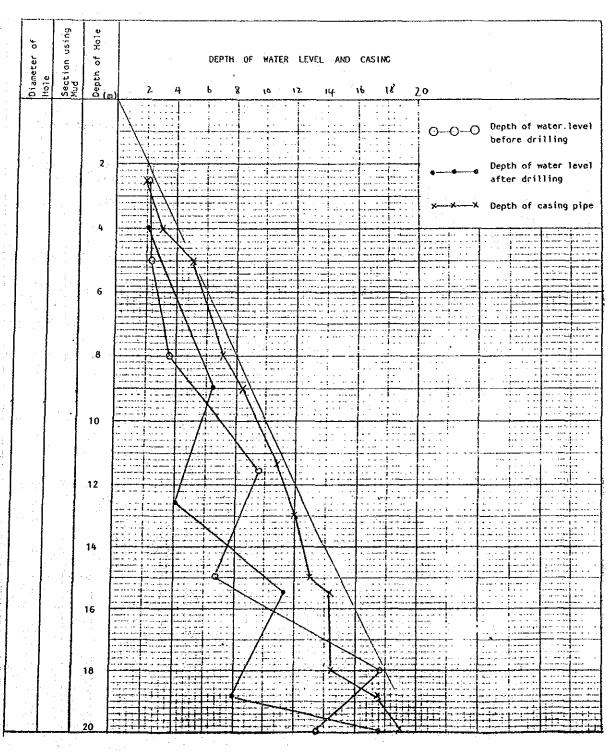
PROJECT:	G.I. At Upper I	Liwagu Mini Hydro Proj	ect SitelOLE NO	. <u>LT-1</u>	(Sheet 1	of 1	)
LOCATION:	Head Pond	DEPTH	OF HOLE: 20	m COME	NCED: 18-1-9	)2	
ELEVATION:	1031 62m	DIAMETER OF HOLE:	80 mm	COMPL	TED: <b>23-1</b> -9	12	_
COORDINATE	E76 7818 N66 1692.5	ANGLE FROM HORIZONT	AL: 90 <sup>0</sup>	MEASURED BY:	Lu		



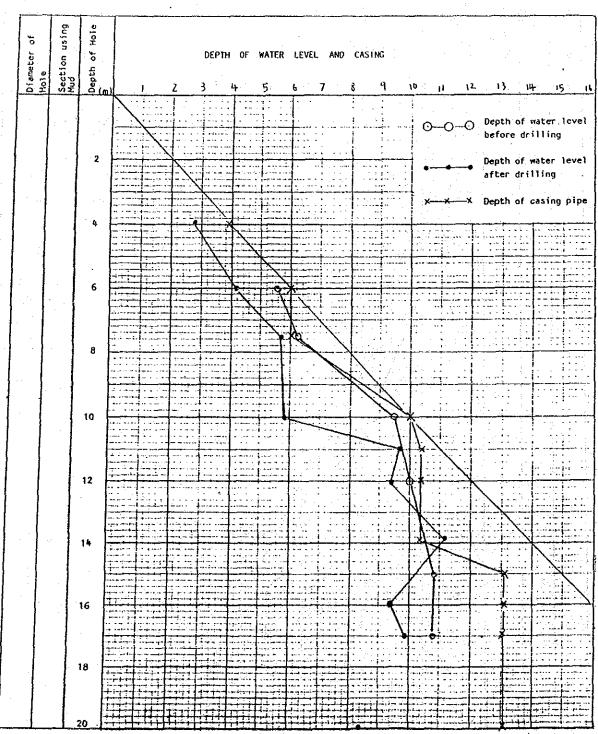
PROJECT: G.	I. At Upper Li	wagu Mini Hydro Project Sit	eHOLE NO LT-2	! Shee	at 1 of	1 )
LOCATION:	Head Pond	DEPTH OF HOL	E: 20 15	COMMENCED:	11-1-92	<u></u> .
ELEVATION:	1035.53m	DIAMETER OF HOLE: 80	_ mm ·	comulino:	17-1-92	
COORDINATE:	E76 7725.5 N66 1797.5	ANGLE FROM HORIZONTAL:	90° MEASURE	D BY:	Lu	· ·



PROJECT: C.	I. At Upper Lin	agu Mini Hydro Project Site HOLE NO. LP-1 (She	et! of 1 i
LOCATION:	Kundasang	DEPTH OF HOLE: 20 m CONMENCED:	6-12-91
ELEVATION:	975.08m	DIAMETER OF HOLE: 80 mm COMPLETED:	12-12-91
COORDINATE;	E76 7727 N66 1434	ANGLE FROM HORIZONTAL: 90° MEASURED BY:	Lu



LOCATION:	Penstock	DEPTH OF HOLE: 20	0 m CONMENCEO: 21-1-92
ELEVATION:	913.65m	DIAMETER OF HOLE: 80 mm	COMPLETED: 27-1-92
COORD I NATE:	E76 7717.5 N66 1236	ANGLE FROM HORIZONTAL: 90°	MEASURED BY: Andy



	LOCATION: Power House DEPTH OF HOLE: 20 m COMMENCED: 18-12-91													
÷			,		··········		_							
ELEVATI		E76	7662.5		OF HOLE:					ren: 1		<del></del> .		
COORDIN	NATE:			INCLE FR	OM HORIZO	INTAL :	90	HEAS	URED BY:	Ampaho	n	<del></del>		
1	g.	0				<del></del>	<del></del>		· · · · · · · · · · · · · · · · · · ·	<del></del>			<del></del>	
اد ه	using	of Hole			DEPTH	OF WAT	TER LF	VEL AND	CASING		*			
Diameter Hole	Section	Depth of	1								,.	2 .	111	16
عُ مَا	Se	100	D)	Σ	4		- 6		8					
			6	<u>:  </u>						. 0-	-00	Depth	of water.	level
1 1				$\leq 1$								Delore	ulliling	į
		2	60			-				•~	••		of water drilling	level
			7	<u>}</u>							_×x	Depth	of casing	pipe
		. 4	/	$\prod$	1								<del></del>	
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		6		4										1
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LOCATI	08 <u>t</u>	iwagu Intake	DATE O	F TEST 20-12	2-91 TESTED I	ky Ampahon
GROUND	ELEV	ATION 1049.91	m SIZE OF C	ASING NW	СНЕСКЕЛ	BY M.Liew
CEOLOG	ICAL	CONDITION OF TH	E BOTTOM OF I	ORILL HOLE _	Yellowish grey we	athered fine-
					grained SANDSTONE	
DEPTH	FROM (	GROUND SURFACE	то тне воттом	of CASING	260 cm	
IE I GHT	FROM	GROUND SURFACE	TO THE TOP O	F CASING	46 cm	
		DIUS OF CASING				
					RATURE 20	°C
					ORILL HOLE BEFORE	
ЕРТН Б	ROM G	ROUND SURFACE T	O WATER SURF	ACE IN THE D	ORILL HOLE AFTER	TEST 31.5
		<del></del>		<del></del>	•	1
Tim	e	Differential	¥	ater Volume		Coefficient Of
Clock Hr min	កាកែ	Head Of Water H (cm)	Accum. Flow	Diff, Flow (lt/min)	Constant Rate Of Flow O (cm <sup>3</sup> /sec)	Permeability  K  (cm/sec)
16 21	0		0			
16 26	5		5.50	1.10	18.33	0.0111
16 31	10		11.00	1,10	18.33	0.0111
16 36	15		17.00	1.20	20.00	0.0122
16 41	20		23.50	1.30	21.67	0.0121
16 46	25		29.50	1.20	20.00	0.0122
16 51	30	77	33.50	0.80	13.33	8.07X10 <sup>-3</sup>
16 56	35		38.00	0.90	15.00	9.08X10 <sup>-3</sup>
7 01	40		44.00	1.20	20.00	0.0122
7 06	45		49.00	1.00	16.67	0.0101
17 11	50		53.50	0.90	15.00	9.08X10 <sup>-3</sup>
T	55		58.25	0.95	15.83	9.58X10 <sup>-3</sup>
7 16				T		8.58X10 <sup>-3</sup>

LOCATI	ON1	Liwagu Intake	DATE OF	TEST 23-1	2-91 TESTED B	Y Ampahon
GROUND	ELEVA	ATION 1049.91	m SIZE OF CA	SING NW	CHECKED	BY M.Liew
CEOLOG	ICAL.C	CONDITION OF THE	E BOTTOM OF D	RILL HOLE	Yellowish grey weath	ered SANDSTONE
DEPTH I	FROM G	ROUND SURFACE	THE BOTTOM	OF CASING	400 cm	
HEIGHT	FROM	GROUND SURFACE	TO THE TOP O	F CASING	36 cm	
INTERNA	AL RAD	IUS OF CASING	$r = \frac{3.90}{1.90}$	cm		
GROUND	TEMPE	RATURE 25	o <sub>C</sub>	WATER TEMPE	RATURE 20	°c
DEPTH F	ROM G	ROUND SURFACE	TO WATER SURF	ACE IN THE I	DRILL HOLE BEFORE	TEST 30.50
DEPTH F	ROM G	ROUND SURFACE T	O WATER SURF	ACE IN THE D	DRILL HOLE AFTER	TEST 11.50
·					<u>,                                    </u>	<u> </u>
Tim Clock	же Т	Differential Head Of	Wa	ster Volume		Coefficient (
Hr min	min	Water H (cm)	Accum. Flow (1t)	Diff. Flow (lt/min)	Constant Rate Of Flow Q (cm <sup>3</sup> /sec)	K (cm/sec)
15 45	0	·	. 0			
15 50	5		3.70	0.74	12.33	8.64X10 <sup>-3</sup>
15 55	10		7,70	0.80	13.33	9.35X10 <sup>-3</sup>
16 - 00	. 15		12.20	0.90	15.00	0.0105
16 05	20		16.40	0.84	14.00	9.81X10 <sup>-3</sup>
16 10	25	. 4 1	19.90	0.70	11.67	8.18X10 <sup>-3</sup>
16 15	30	66.5	23.80	0.78	13.00	9.11X10 <sup>-3</sup>
16 20	35		27.60	0.76	12.67	8.88X10 <sup>-3</sup>
16 25	40		31.80	0.84	14.00	9.81X10 <sup>-3</sup>
16 30	45		36.10	0.86	14.33	0.01005
ļ	50		39.30	0.64	10.67	7.48X10 <sup>-3</sup>
16 35	55		42.20	0.58	9.67	6.78X10 <sup>-3</sup>
16 40						8.88X10 <sup>-3</sup>

					(S	heet 3 0( 5
PROJEC	CT :	G.I. At Upper Liwa	gu Mini Hydro Pr	oject Site	HOLE N	o .L.l-1
10017	TON.	liwagu lotaka	DATE O	e reca: 26-12	2-91 program	ny LU
					7-91 TESTED	
					W. CHECKED	·
GEOLOG	GICAL	CONDITION OF TH	HE BOTTOM OF I	DRTLL HOLE _	Grey fine-grained S	SANDSTONE
		•			625 cm	
HEIGHT	FROM	GROUND SURFACE	TO THE TOP O	F CASING	37 cm.	
INTERN	AL RA	DIUS OF CASING	: $r = _{_{_{_{_{_{_{_{_{_{_{_{_{_{_{_{_{1}}}}}}}}$	cm		
GROUND	TEMP	ERATURE 25	°c	WATER TEMPE	RATURE 20	°c
DEPTH	FROM (	GROUND SURFACE	TO WATER SURF	ACE IN THE	DRILL HOLE BEFORE	TEST 21 cm
DEPTH 1	FROM (	GROUND SURFACE	TO WATER SURF	ACE IN THE	DRILL HOLE AFTER	TEST 7 cm
		· · · · · · · · · · · · · · · · · · ·	<u></u>	· · · · · · · · · · · · · · · · · · ·		T*****
	ne	Differential	W.	ater Volume		Coefficient Of
Clock Hr min		Head Of Water	Accum. Flow	Diff. Flow	Constant Rate Of	Permeability K
111 11111	[10117	H (cm)	(1t)	(lt/min)	Flow Q (cm <sup>3</sup> /sec)	(cm/sec)
15 22	0		0			
15 27	5		3.0	0.60	10.00	8.04X10 <sup>-3</sup>
15 32	10		5.90	0.58	9.67	7.77X10 <sup>-3</sup>
15 37	15		8.65	0.55	9.17	7.37X10 <sup>-3</sup>
15 42	20		11.95	0.66	11.00	8.84X10 <sup>-3</sup>
15 47	25		14.45	0.50	8.33	6.70X10 <sup>-3</sup>
15 52	30	58	17.90	0.69	11.50	9.24X10 <sup>-3</sup>
15 57	35		21.65	0.75	12.50	0.01005
16 02	40		25.65	0.80	13.33	0.01071
16 07	45		29.10	0.69	11.50	9.24X10 <sup>-3</sup>
16 12	50		32.0C	0.58	9.67	7.77X10 <sup>-3</sup>
16 17	55		34.65	0.53	8.83	7.10X10 <sup>-3</sup>
16 22	60		37.65	0.60	10.00	8.04X10 <sup>-3</sup>
			31903		3,	

Coefficient Of Permeability For Steady State Condition:  $K = \frac{10.46}{8.41X10^3}$  cm/sec

	ON LI	wagu Intake	DATE OF	TEST 29-12	-91 TESTED B	Ampahon & Will
GROUND	ELEVA	TION 1049.91	n SIZE OF CA	SING NW	CHECKED	BY M. Liew
GEOLOG	ICAL C	ONDITION OF TH	E BOTTOM OF D	RILL HOLE	Grey fine-grained S	ANDSTONE
DEPTH I	ROM C	ROUND SURFACE	THE BOTTOM	OF CASING	830.00	
HEIGHT	FROM	GROUND SURFACE	TO THE TOP O	F CASING	40.50 cm	• .
INTERNA	L RAD	IUS OF CASING	$r = \frac{3.9}{1}$	0 cm		
GROUND	ТЕМРЕ	RATURE 25	o <sub>C</sub> .	WATER TEMPER	ATURE 20	°c
					RILL HOLE BEFORE	TEST 35.50
					RILL HOLE AFTER	
Time		Differential	Wa	ster Volume	·	Coefficient Of
Clock Hr min	min	Head Of Water H (cm)	Accum. Flow	Diff. Flow (lt/min)	Constant Rate Of Flow Q (cm <sup>3</sup> /sec)	Permeability K (cm/sec)
08 38	0		0			
08 43	.5		7.10	1.42	23.67	0.01452
08 48	. 10		16.70	1.92	32.00	0.01963
08 53	: 15		24.10	1.48	24.67	0.01513
08 58	20	<del></del>	32.20	1.62	27.00	0.01656
09 03	25		39.70	1.50	27.00	0.01656
09 08	30	76	47.30	1.52	25.33	0.01554
	35		55.10	1.56	26.00	0.01595
09 13	40		62.50	1.48	24.67	0.01513
09 13 09 18	45		69.40	1.38	23.00	0.01411
	T		75.80	1.28	21.33	0.01308
09 18	50		85.95	2.03	33.83	0.02075
09 18 09 23	50 55					i '

LOCATI	ON L	iwagu Intake	DATE OF	F TEST 30-	-12-91 TESTED I	Ampahon & Will
GROUND	ELEVA	TION 1049.91	m SIZE OF CA	SING NW	CHECKED	BY M. Liew
GEOLOG	ICAL C	CONDITION OF TH	E BOTTON OF D	ORTLE HOLE	Grey fine-grained S	ANDSTONE
EPTH	FROM G	ROUND SURFACE	го тне воттом	OF CASING	975.00 cm	
EICHT	FROM	GROUND SURFACE	TO THE TOP O	F CASING	43.00 cm	
NTERN	AL RAD	IUS OF CASING :	r =	3.9 cm		
ROUND	TEMPE	RATURE 25	<u></u>	WATER TEMPER	RATURE 20	°c
					ORILL HOLE BEFORE	
	,				RILL HOLE AFTER	
						7
		Differential	: Wa	ater Volume		Coefficient Of
Clock dr min	ការិព	Head Of Water H (cm)			Constant Rate Of Flow Q (cm³/sec)	Permeability K (cm/sec)
09 43	0		0			
09 48	5		4.30	0.86	14.33	7.77X10 <sup>+3</sup>
09 53	10		8.05	0.75	12.50	6.78X10 <sup>-3</sup>
19 58	15		12.85	0.96	16.00	8.67X10 <sup>-3</sup>
0 03	20		16.70	0.77	12.83	6.96X10 <sup>-3</sup>
0 08	25		21.70	1.00	16.67	9.04X10 <sup>-3</sup>
0 13	30	86	25.60	0.78	13.00	7.05X10 <sup>-3</sup>
0 18	35		28.80	0.64	10.67	5.78X10 <sup>-3</sup>
0 23	40		32.70	0.78	13.00	7.05X10 <sup>-3</sup>
0 28	45		36.20	0.70	11.67	6.33X10 <sup>-3</sup>
0 33	50		41.00	0.96	16.00	8.67X10 <sup>-3</sup>
	55		45.0	0.80	13.33	7.23X10 <sup>-3</sup>
0 38		· · · · · · · · · · · · · · · · · · ·			se production to the	8.67X10 <sup>-3</sup>

		OPE	N - END PERI	MEABILITY	TEST	· . (si	heet 1 Of 5
	PROJECT	r : _	G.I.At Upper Liwagu	ı Mini Hydro Proj	ect Site	HOLE No	D. L1-2
	LOCATI	ON L	iwagu River Intake	DATE OF	TEST	92 TESTED R	Υ
	GROUND	ELEV	ATION 1049.81	m SIZE OF CA	SING N	W CHECKED	BY M.Liew
	GEOLOG	ICAL	CONDITION OF TH	E BOTTOM OF D	RILL HOLE	Light grey slightly	weathered fine-
					سدب	grained SANDSTONE	
	DEPTH I	FROM (	GROUND SURFACE	TO THE BOTTOM	OF CASING	263cm	
	HEIGHT	FROM	GROUND SURFACE	TO THE TOP O	F CASING	20cm	
	INTERNA	AL RAI	DIUS OF CASING	; r = <u>3</u>	.9 cm		. •
	GROUND	TEMPI	ERATURE 25	• C	WATER TEMPER	ATURE 20	°c
	DEPTH F	ROM (	GROUND SURFACE	TO WATER SURF	ACE IN THE D	RILL HOLE BEFORE	TEST <u>131</u> cm TEST <u>115</u> cm
٠	Tis	n <del>ė</del>	Differential	We	iter Volume		Coefficient Of
	Clock Hr min	กา๋ต	Head Of Water H (cm)	Accum. Flow	Diff. Flow (1t/min)	Constant Rate Of Flow Q (cm /sec)	Permeability  K (cmVsec)
	08 25	0		0			
	08 30	5		16.20	3.24	54.00	0.0167
	08 35	10		33.20	3.40	56.67	0.0175
	08 40	15		49.50	3.26	54.33	0.0168
	08 45	20		66.25	3.35	55.83	0.0172
	08 50	25		81.85	3.12	52.00	0.0161
	08 55	30	151	99.65	3.56	59.33	0.0183
	09 00	35		117.65	3.60	60.00	0.0185
	09 05	40		134.05	3.28	54.67	0.0169
	09 10	45		151.50	3.49	58.17	0.0180
	09 15	50		168.00	3.30	55.00	0.0169
	09 20	55		183,70	3.14	52.33	0.0161
,	09 25	60		200.10	3.28	54.67	0.0169
	onstant R	ate Of	Flow For Steady S	tate Condition :	0 =	55.58 cm	?sec
C	oefficien	t Of P	ermeability For St	eady State Condi	tion : K =	1.72x10 <sup>-2</sup> cm/	sec
				AP	2 - 37	•	

		in the ren			(8	heet 2 Of 5
PROJEC	T:_	G.I. At Upper Liw	agu Mini Hydro P	roject Site	HOLE N	o. LI-2
LOCATI	ION _	Liwagu River Intake	DATE O	F TEST 4-1	-92 TESTED (	RY LU
GROUNE	ELE	ATION 1049.81	m SIZE OF C	ASING	NW CHECKED	BY M.Liew
GEOLOG	CICAL	CONDITION OF TH	E BOTTOM OF	DRILL HOLE	Light grey slightly	y weathered fine-
				_	grained SANDSTONE	
DEPTH	FROM	GROUND SURFACE	TO THE BOTTON	of CASING	400 cm	
HEIGHT	FROM	GROUND SURFACE	TO THE TOP (	OF CASING	49 cm	
		DIUS OF CASING				
					RATURE 20_	° <sub>C</sub>
						TEST 313 cm
EPTH F	ROM (	GROUND SURFACE	TO WATER SURF	ACE IN THE	DRILL HOLE AFTER	TEST 175 cm
Tie	·	Differential		Coefficient Of		
Clock		Head Of				Permeability
Hr min	min	Water H (cm)	Accum. Flow		Constant Rate Of Flow Q (cm /sec)	
09 -05	0		. 0			
09 10	5		4.80	0.96	16.00	2.06×10 <sup>-3</sup>
09 15	10		10.00	1.05	17.33	2.23×10 <sup>-3</sup>
09 20	.15	:	14.50	0.90	15.00	1.93×10 <sup>-3</sup>
09 25	20		19.60	1.02	17.00	2.19×10 <sup>-3</sup>
09 30	25		24.60	1.00	16.67	2.15x10 <sup>-3</sup>
09 35	30	362	29.35	0.95	15.83	2.04×10 <sup>-3</sup>
09 40	35		34.45	1.02	17.00	2.19x10 <sup>-3</sup>
09 45	40		39.45	1.00	16.67	2.15×10 <sup>-3</sup>
09 50	45		44.15	0.94	15.67	2.02×10 <sup>73</sup>
09 55	50		48.65	0.90	15,00	1.93×10 <sup>-3</sup>
10 00	55		53.75	1.02	17.00	2.19x10 <sup>-3</sup>
10 05	60		1	- 1		2.28×10 <sup>-3</sup>
10 05	- "	<u> </u>	59.05	1.06	17.67	2.28×10

Constant Rate Of Flow For Steady State Condition:  $0 = \frac{16.40}{cm^3/sec}$ Coefficient Of Permeability For Steady State Condition:  $K = \frac{2.11 \times 10^{-3}}{cm/sec}$ 

			<del></del>		-92 TESTÉD B	
					CHECKED	•
GEOLOG	ICAL (	CONDITION OF TH	E BOTTOM OF D	RILL HOLE	Light grey slightly	y weathered fine-
		* .		. ·	grained SANDSTONE	····
DEPTH 1	FROM (	GROUND SURFACE	TO THE BOTTOM	OF CASING _	652 cm	
HEIGHT	FROM	GROUND SURFACE	TO THE TOP O	F CASING	39.5 cm	
INTERNA	AL RAE	DIUS OF CASING	$r = _{3.90}$	cm		•
GROUND	TEMPE	ERATURE 25	°C 1	WATER TEMPER	ATURE 20	°c
DEPTH I	rom c	ROUND SURFACE	TO WATER SURF	ACE IN THE D	RILL HOLE BEFORE	TEST 403
DEPTH 1	ROM G	GROUND SURFACE 1	TO WATER SURF	ACE IN THE D	ORILL HOLE AFTER	TEST 188
Time Differential		Differential	Wa	ater Volume		Coefficient Of
Clock		Head Of Water	Accum, Flow	Diff, Flow	Constant Rate Of	Permeability K
Hr min	min	H (cm)	(1:)	(It/min)	Flow Q (cm <sup>3</sup> /sec)	(cm/sec)
10 03	0		0			
10 08	5		12.50	2.50	41.67	4.39x10 <sup>-3</sup>
10 13	10		23.30	2.16	36.00	3.79.10-3
10 18	15		35.75	2.49	41.50	4-37x10 <sup>-3</sup>
10 23	20		46.75	2.20	36.67	3.86x10 <sup>-3</sup>
10 28	25		60.20	2.69	44.83	4.72×10 <sup>-3</sup>
10 33	30	442.5	71.15	2.19	36.50	3.85x10 <sup>-3</sup>
10 38	35		82,65	2.30	38.33	4.04x10 <sup>=3</sup>
	40		95.00	2.47	41.17	4.34x10 <sup>-3</sup>
10 43	45		108.00	2.60	43.33	4.57x10 <sup>-3</sup>
10 43 10 48	50		119.20	2.24	37.33	3.93×10 <sup>-3</sup>
			131.50	2.46	41.00	4.32×10 <sup>-3</sup>
10 48	55		·			4.64x10 <sup>-3</sup>

)

ROJEC	T : _0	.1. At Upper Liwag	u Mini Hydro Pr	oject Site	HOLE N	o. L1-2
LOCAT:	ION L	imágu Ríver Intake	DATE C	DE TEST 5-1	1-92 TESTED I	BY <u>10</u>
				•	CHECKED	
	•	•			Light grey slightly	est and a second
			· · · · · · · · · · · · · · · · · · ·	-	grained SANDSTONE	
ертн	FROM G	ROUND SURFACE	TO THE BOTTO	— M OF CASING	775 cm	
		GROUND SURFACE				
	•	IUS OF CASING				
					RATURE 20	°C
		•				
srin i	rkon Gi	KOURD SURRACE I	O WAIER SURI	ACE IN THE D	KILL NULL AFIEK	TEST 136 cr
. Yiu	ne .	Differential	,	ater Volume		Coefficient Of
Clock		Head Of Water	Accum. Flow	Diff. Flow	Constant Rate Of	Permeability K
ir min	min	H (cm)	(1t)	(1t/ໝາກ)	Flow Q (cm <sup>3</sup> /sec)	(cm/sec)
14 26	0		0			
14 31	5		6.0	1.20	20.00	2.08×10 <sup>-3</sup>
	10		12.80	1 20	22.67	2.35x10 <sup>-3</sup>
14 36			·	1.36	22,07	2.35x10
			19.90	1.42	23.67	<u> </u>
14 41	15		·····			2.46x10 <sup>-3</sup>
14 41 14 46	15		19.90	1.42	23.67	<u> </u>
14 41 14 46 14 51	15 20 25	449	19.90	1.42	23.67	2.46×10 <sup>-3</sup> 2.21×10 <sup>-3</sup> 2.01×10 <sup>-3</sup>
14 41 14 46 14 51 14 56	15 20 25		19.90 26.30 32.10	1.42	23.67 21.33 19.33	2.46×10 <sup>-3</sup> 2.21×10 <sup>-3</sup> 2.01×10 <sup>-3</sup> 2.34×10 <sup>-3</sup>
14 41 14 46 14 51 14 56	15 20 25 30		19.90 26,30 32.10 38,85	1.42 1.28 1.16 1.35	23.67 21.33 19.33 22.50	2.46×10 <sup>-3</sup> 2.21×10 <sup>-3</sup> 2.01×10 <sup>-3</sup>
14 51 14 56 15 01	15 20 25 30 35		19.90 26.30 32.10 38.85 45.85	1.42 1.28 1.16 1.35	23.67 21.33 19.33 22.50 23.33	2.46×10 <sup>-3</sup> 2.21×10 <sup>-3</sup> 2.01×10 <sup>-3</sup> 2.34×10 <sup>-3</sup> 2.42×10 <sup>-3</sup>
	15 20 25 30 35 40	449	19.90 26.30 32.10 38.85 45.85	1.42 1.28 1.16 1.35 1.40	23.67 21.33 19.33 22.50 23.33 21.67	2.46×10 <sup>-3</sup> 2.21×10 <sup>-3</sup> 2.01×10 <sup>-3</sup> 2.34×10 <sup>-3</sup> 2.42×10 <sup>-3</sup> 2.42×10 <sup>-3</sup> 2.45×10 <sup>-3</sup>
14 41 14 46 14 51 14 56 15 01 15 06	15 20 25 30 35 40 45	449	19.90 26.30 32.10 38.85 45.85 52.35	1.42 1.28 1.16 1.35 1.40 1.30	23.67 21.33 19.33 22.50 23.33 21.67 23.67	2.46×10 <sup>-3</sup> 2.21×10 <sup>-3</sup> 2.01×10 <sup>-3</sup> 2.34×10 <sup>-3</sup> 2.42×10 <sup>-3</sup>

Coefficient Of Permeability For Steady State Condition : K = 2.27x10<sup>-3</sup>

					(SI	heet 5 Of	5
PROJECT	r : _	G.I. At Upper Liw	agu Mini Hydro Pı	roject Site	HOLE NO	oL1-2	
					,		
LOCATI	ON L	iwagu River Intake	DATE OF	TEST 6-1-	92 TESTED R	γ τυ	
GROUND	ELEV	ATION 1049.81	m SIZE OF CA	SING NW	СИЕСКЕВ	BY M. Liew	
GEOLOG	ICAL (	CONDITION OF TH	E BOTTON OF D	RILL HOLE	Light grey slightly	weathered fine-	_
				****	grained SANDSTONE		
DEPTH I	FROM C	GROUND SURFACE	TO THE BOTTOM	OF CASING	964 cm		
HEIGHT	FROM	GROUND SURFACE	TO THE TOP O	F CASING	33.5 cm		
INTERNA	L RAD	IUS OF CASING	r = 3.90	cm	·		
CROUND	ТЕМРЕ	RATURE 25	°c	WATER TEMPER	RATURE 21	°c	·
рертн б	ROM G	ROUND SURFACE	TO WATER SURF	ACE IN THE I	DRILL HOLE BEFORE	TEST387	_ cm
рертн г	ROM G	ROUND SURFACE	TO WATER SURFA	ACE IN THE I	DRILL HOLE AFTER	TEST 93	cm
· · ·		·					
Tim	e,	Differential	Wa	iter Volume		Coefficient Of	
Clock		Head Of				Permeability	
Hr min	min	Water H (cm)	Accum. Flow	Diff. Flow (lt/min)	Constant Rate Of Flow Q (cm /sec)	(cm/sec)	
15 49	0		0				<u></u>
15 54	5		18.30	3.66	61.00	6.76×10 <sup>-3</sup>	_
15 59	10		35.80	3.50	58.33	6.47x10 <sup>-3</sup>	,
16 04	15		53.60	3.56	59.33	6.58×10 <sup>-3</sup>	_
16 09	20		72.60	3.80	63.33	7.02×10 <sup>-3</sup>	<b>-</b>
16 14	25		89.10	3.30	55.00	6.10×10 <sup>-3</sup>	
16 19	30	420.5	105.80	3.34	55.67	6.17x10 <sup>-3</sup>	
16 24	35		123.80	3.60	60.00	6.65x10 <sup>-3</sup>	
16 29	40		141.10	3.46	57.67	6.39×10 <sup>-3</sup>	
16. 34	45		155.60	2.90	48.33	5.36×10 <sup>-3</sup>	
16 39	50		176.00	4.08	68.00	7.54×10 <sup>-3</sup>	
16 44	55		192.85	3.37	56.17	6.23×10 <sup>-3</sup>	
16 49	60		210.20	3.47	57.83	6.41×10 <sup>-3</sup>	
stant Ra	te Of	Flow For Steady S		0 =		) sec	

AP2 - 41

Coefficient Of Permeability For Steady State Condition :  $K = \frac{6,47 \times 10^{-3}}{\text{cm/sec}}$ 

LOCAT	1 3N	Mesilau Intake	DATE OF	F TEST 31-	1-92 TESTED B	1 W111/LU
GROUN	n elev	ATTON 1035.96	m SIZE OF C	VSING NW	CHECKED	ny M. Liew
GEOLO	GICAL (	COSERTION OF TE	HE BOTTOM OF I	RILL HOLE	Sandstone and ada	mellite cobbles
			e e e			•
DEPTR	FROM (	GROUND SURFACE	TO THE BOTTOM	OF CASING	200 cm	
HE1GHT	FROM	GROUND SURFACE	TO THE TOP O	F CASING	52 cm	And the second second
		OIUS OF CASING	•			1
					RATURE 20	°c
					ORILL HOLE BEFORE	<del></del>
						· · · · · · · · · · · · · · · · · · ·
)LY I H	rkum G	KOUND SURFACE	IO WATER SURF.	ACE IN THE D	ORILL HOLE AFTER	1631
Τí	me	Differential	Wa	ster Volume		Coefficient Of
Clock		Head Of Water	Accum. Flow	Diff. Flow	Constant Rate Of	Permeability K
Hr min	min	H (cm)	(lt)	(lt/min)	Flow Q (cm /sec)	(cm/sec)
14 04	0		0.00			
14 09	5		10.00	2.00	33.33	0.0157
14. 14	10		21.20	2.24	37.33	0.0176
14 19	15	·	32.40	2.24	37.33	0.0176
14 24	20		45.30	2.58	43	0.0202
14 29	25		57.50	2.44	40.67	0.0192
14 34	30	99	65.90	1.60	28	0.0132
4 39	35		77.70	2.36	39.33	0.0185
4 44	40		85.20	1.50	25	0.0118
4 49	45		97.40	2.44	40.67	0.0192
4 54	50		109.60	2.44	40.67	0.0192
	55		122.30	2.54	42.33	<b>0.</b> 0199
4 59		7		· · · · · · · · · · · · · · · · · · ·	·	

					(\$)	neut 2 Of 6
PROJECT	· : _G	.1. At Upper Liwag	u Mini Hydro Pro	ject Site	HOLE No	. <u>L1-3</u>
LOCATIO	ON Me	esilau Intake	DATE OF	TEST 1-2-5	92 TESTED B	y Will/LU
					N CHECKED	
					ight grey fine-graine	
000000				_	obbles	
NEDTU U	DOM C	GROUND SURFACE	የለ ጥሀዩ <u>የ</u> ለተገለM			
				_		•
	- ,	GROUND SURFACE			Giu	•
		DIUS OF CASING				0,
			•		RATURE 20	
					ORILL HOLE BEFORE	
DEPTH F	ROM G	ROUND SURFACE	TO WATER SURF	ACE IN THE D	DRILL HOLE AFTER	TEST 37 c
		Differential	. Wa	ster Volume	· · · · · · · · · · · · · · · · · · ·	0
Clock	e	Head Of		200 00		Coefficient Of Permeability
Hr min	min	Hater H (cm)	Accum, Flow (1t)	Diff. Flow (lt/min)	Constant Rate Of Flow Q (cm /sec)	K (cπ/sec)
12 01	0		. 0			
12 06	5		8.30	1.66	27.67	0.0107
12 11	10		19.50	2.24	37.33	0.0144
12 16	15		29.40	1.98	33.00	0.0127
12 21	20		43.10	2.24	45.67	0.0176
12 26	25		52.40	1.86	31.00	0.0119
12 31	30	121	63.70	2.26	37.67	0.0145
12 36	35		70.50	1.36	22.67	8.73x10 <sup>-3</sup>
12 41	40	:	80.00	1.90	31.67	0.0122
12 46	45		87.40	1.48	24.67	9.51×10 <sup>-3</sup>
12 51	50		96.50	1.82	30.33	0.0117
12 56	55		109.20	2.54	42,33	0.0163
13 01	60		122.20	2.60	43.33	0.0167
onstant Ra	ate Of	Flow For Steady S	tate Condition :	Q <u>=</u> -	33.95 cm <sup>3</sup>	/sec
pefficient	of Pe	ermeability for St	eady State Condi	tion:K = 0	.0131 cm/	sec
			4 4	-		

	ion.	Mesilau Intake.	DATE O	F TEST 2-2-	92 PESTER :	(y W131/LU
GROUN	D ELEV	ATION 1035.96	m SIZE OF C	ASTNG NW	енескей	BY M. Liew
GEOLOG	H CAL	CONDITION OF T	HE BOTTOM OF I	DRILL HÖLL 👱	Light grey fine-grai	ned SANDSTONE
DEPTH	FROM (	GROUND SURFACE	TO THE BOTTOM	OF CASING	600 Cm	
		GROUND SURFACE		:		
		DIUS OF CASING			<del></del>	
					RATURE 20	°c
		* .				
DEPTH	FROM G	ROUND SURFACE	TO WATER SURF	ACE IN THE I	DRILL HOLE BEFORE	1521
DEPTH 1	FROM G	ROUND SURFACE	TO WATER SURF	ACE IN THE I	DRILL HOLE AFTER	TEST 45
Tie	ne	Differential	W	ster Volume		Coefficient Of
Clock		Head Of Water	Accum. Flow	Diff Flow	Constant Rate Of	Permeability K
Hr min	mîn	H (cm)	(1t)	(It/min)	Flow Q (cm /sec)	(cm/sec)
09 10	0		0.00			
09 15	S		5.20	1.04	17.33	5.73×10 <sup>-3</sup>
<del></del>	5 10		5.20 12.00	1.04	17.33	5.73×10 <sup>-3</sup> 7.50×10 <sup>-3</sup>
09 15			:			7.50x10 <sup>-3</sup>
09 15 09 20 09 25	10		12.00	1.36	22.67	7.50x10 <sup>-3</sup> 7.05x10 <sup>-3</sup>
09 15 09 20 09 25 09 30	10 15		12.00 18.40	1.36	22.67	7.50x10 <sup>-3</sup> 7.05x10 <sup>-3</sup> 9.15x10 <sup>-3</sup>
09 15 09 20 09 25 09 30 09 35	10 15 20	141	12.00 18.40 26.70	1.36 1.28 1.66	22.67 21.33 27.67	7.50x10 <sup>-3</sup> 7.05x10 <sup>-3</sup>
09 15 09 20 09 25 09 30 09 35	10 15 20 25	141	12.00 18.40 26.70 35.40	1.36 1.28 1.66	22.67 21.33 27.67 29.00	7.50x10 <sup>-3</sup> 7.05x10 <sup>-3</sup> 9.15x10 <sup>-3</sup> 9.59x10 <sup>-3</sup> 8.49x10 <sup>-3</sup>
09 15 09 20 09 25 09 30 09 35	10 15 20 25 30	141	12.00 18.40 26.70 35.40 43.10	1.36 1.28 1.66 1.74	22.67 21.33 27.67 29.00 25.67	7.50x10 <sup>-3</sup> 7.05x10 <sup>-3</sup> 9.15x10 <sup>-3</sup> 9.59x10 <sup>-3</sup>
09 15 09 20 09 25 09 30 09 35 09 40 09 45	10 15 20 25 30 35	141	12.00 18.40 26.70 35.40 43.10	1.36 1.28 1.66 1.74 1.54	22.67 21.33 27.67 29.00 25.67	7.50x10 <sup>-3</sup> 7.05x10 <sup>-3</sup> 9.15x10 <sup>-3</sup> 9.59x10 <sup>-3</sup> 8.49x10 <sup>-3</sup>
09 15 09 20 09 25 09 30 09 35 09 40 09 45	10 15 20 25 30 35 40	181	12.00 18.40 26.70 35.40 43.10 50.80 56.30	1.36 1.28 1.66 1.74 1.54 1.54	22.67 21.33 27.67 29.00 25.67 25.67	7.50x10 <sup>-3</sup> 7.05x10 <sup>-3</sup> 9.15x10 <sup>-3</sup> 9.59x10 <sup>-3</sup> 8.49x10 <sup>-3</sup> 8.49x10 <sup>-3</sup> 6.06x10 <sup>-3</sup>
09 15 09 20 09 25 09 30 09 35 09 40 09 45 09 50	10 15 20 25 30 35 40	141	12.00 18.40 26.70 35.40 43.10 50.80 56.30 67.10	1.36 1.28 1.66 1.74 1.54 1.54 1.10	22.67 21.33 27.67 29.00 25.67 25.67 18.33	7.50x10 <sup>-3</sup> 7.05x10 <sup>-3</sup> 9.15x10 <sup>-3</sup> 9.59x10 <sup>-3</sup> 8.49x10 <sup>-3</sup> 8.49x10 <sup>-3</sup> 6.06x10 <sup>-3</sup>

Coefficient Of Permeability For Steady State Condition :  $K = \frac{8.29 \times 10^{-3}}{10^{-3}}$ 

		•				heet <u>.4</u> Of _
PROJE	ur:	G.I. At Upper Liwa	igu Mini Hydro Pr	oject Site	aoga, w	n. LI-3
LACAT	י איניני	Mesilau Intake	DATE (A)	ie wiestwo ou	<b>2-92</b> TENTED B	V W(11/1a
			- <del></del>		сивскер	
			•			
GEULU	GTCAL	COMPLETON OF Th	IF ROLLOW OF I	DRILL HOLE	Light grey fine-grai	ned SANDSTUNE
						,
DEPTH	FROM	GROUND SURFACE	TO THE BOTTOM	1 OF CASING	800 cm	•
HE I GH	r from	GROUND SURFACE	TO THE TOP O	OF CASING	35 cm	
INTERN	NAL RA	DIUS OF CASING	: r = <u>3.9</u>	c.m		
GROUNI	темр	ERATURE 25	°C	WATER TEMPE	RATURE 20	°c
EPTH	FROM	GROUND SURFACE	TO WATER SURF	ACE IN THE I	ORILL HOLE BEFORE	TEST 137
EPTH	FROM (	GROUND SURFACE	TO WATER SURF	ACE IN THE I	ORILL HOLE AFTER	TEST 19
			· · · · · · · · · · · · · · · · · · ·			· · · · · · · · · · · · · · · · · · ·
- 71	ne	Differential	W.	ater Volume		Coefficient Of
Clock Hr min		Head Of Water	Accum. Flow	Diff. Flow	Constant Rate Of	Permeability K
*11 111111	101181	H (cm)	(1t)	(lt/min)	Flow Q (cm /sec)	(cm/sec)
<del></del>	<del> </del>					
17 05	0		0			
17 05 17 10	<del>\</del>		0	0.3	5.0	1.36×10 <sup>-3</sup>
	5			0.3	5.0	
17 10 17 15	5		1.50			1.36×10 <sup>-3</sup> 1.08×10 <sup>-3</sup> 1.90×10 <sup>-3</sup>
17 10 17 15 17 20	10		1.50	0.24	4.0	1.08×10 <sup>-3</sup> 1.90×10 <sup>-3</sup>
17 10 17 15 17 20 17 25	5 10 15 20		1.50 2.70 4.80	0.24	4.0 7.0	1.08×10 <sup>-3</sup>
17 10 17 15 17 20 17 25 17 30	5 10 15 20	172	1.50 2.70 4.80 5.80	0.24 0.42 0.20	4.0 7.0 3.33	1.08×10 <sup>-3</sup> 1.90×10 <sup>-3</sup> 9.03×10 <sup>-3</sup>
17 10 17 15 17 20 17 25 17 30 17 35	5 10 15 20 25		1.50 2.70 4.80 5.80	0.24 0.42 0.20 0.18	4.0 7.0 3.33 3.00	1.08×10 <sup>-3</sup> 1.90×10 <sup>-3</sup> 9.03×10 <sup>-3</sup> 8.13×10 <sup>-4</sup>
17 10 17 15 17 20 17 25 17 30 17 35	5 10 15 20 25		1.50 2.70 4.80 5.80 6.70 8.30	0.24 0.42 0.20 0.18	4.0 7.0 3.33 3.00 5.33	1.08×10 <sup>-3</sup> 1.90×10 <sup>-3</sup> 9.03×10 <sup>-3</sup> 8.13×10 <sup>-4</sup> 1.44×10 <sup>-3</sup> 9.03×10 <sup>-4</sup>
17 10	5 10 15 20 25 30 35		1.50 2.70 4.80 5.80 6.70 8.30 9.30	0.24 0.42 0.20 0.18 0.32	4.0 7.0 3.33 3.00 5.33 3.33	1.08×10 <sup>-3</sup> 1.90×10 <sup>-3</sup> 9.03×10 <sup>-3</sup> 8.13×10 <sup>-4</sup> 1.44×10 <sup>-3</sup>
17 10 17 15 17 20 17 25 17 30 17 35 17 40	5 10 15 20 25 30 35		1.50 2.70 4.80 5.80 6.70 8.30 9.30	0.24 0.42 0.20 0.18 0.32 0.20 0.30	4.0 7.0 3.33 3.00 5.33 3.33 5.00	1.08×10 <sup>-3</sup> 1.90×10 <sup>-3</sup> 9.03×10 <sup>-4</sup> 1.44×10 <sup>-3</sup> 9.03×10 <sup>-4</sup> 1.36×10 <sup>-3</sup> 2.71×10 <sup>-4</sup>
17 10 17 15 17 20 17 25 17 30 17 35 17 40 17 45	5 10 15 20 25 30 35 40		1.50 2.70 4.80 5.80 6.70 8.30 9.30 10.80	0.24 0.42 0.20 0.18 0.32 0.20 0.30 0.06	4.0 7.0 3.33 3.00 5.33 3.33 5.00 1.00	1.08×10 <sup>-3</sup> 1.90×10 <sup>-3</sup> 9.03×10 <sup>-3</sup> 8.13×10 <sup>-4</sup> 1.44×10 <sup>-3</sup> 9.03×10 <sup>-4</sup> 1.36×10 <sup>-3</sup>

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Coefficient Of Permeability For Steady State Condition: K = 1.15x10<sup>-3</sup> cm/sec

in that	100 _ 101	Mesilau Intake	DATE OF	FATEST 3-2	-92 TESTED B	y Will/ Lu
GROUNI	) ELEV	ATION 1035.96	m SIZE OF CA	ASINGM	епескер	DY M. Liew
GEOLOG	HCM.	CONDITION OF TH	E BOTTOM OF E	orila Hole	Light grey sine-	grained
				_	SANDSTONE	
DEPTH	FROM (	GROUND SURFACE	TO THE BOTTOM	OF CASING	1000 cm	et e e
HEIGHT	FROM	GROUND SURFACE	TO THE TOP O	F CASING	45 cm	en la la company
INTERN	AL RAD	IUS OF CASING	: r =3.9	сп		
GROUND	TEMPE	RATURE 25	°c	WATER TEMPE	RATURE 20	°c
		to a			DRILL HOLE BEFORE	
		•		*	DRILL HOLE AFTER	
<del> </del>		<u> </u>				
		Differential	¥ d	iter Volume		Coefficient Of
Clock Hr min	min	Head Of Water H (cm)	Accuma, Flow	Diff. Flow (lt/min)	Constant Rate Of Flow Q (cm <sup>3</sup> /sec)	
11 03	0		0			
11 08	5		1.10	0.22	3.67	1.25x10 <sup>-3</sup>
11 13	10		2.00	0.18	3.00	1.02x10 <sup>-3</sup>
11 18	15		2.80	0.16	2.67	9.09×10 <sup>-4</sup>
1 23	20		3.50	0.14	2.33	7.93×10 <sup>-4</sup>
1 28	25		4.50	0.20	3.33	1.13x10 <sup>-3</sup>
1 33	30	137	5.10	0.30	5.00	1.70×10 <sup>-3</sup>
1 38	35	·	6.00	0.18	3.00	1.02×10 <sup>-3</sup>
1 43	40 .		7.20	0.24	4.00	1.36x10 <sup>-3</sup>
	45		8.40	0.24	4.00	1.36x10 <sup>-3</sup>
1 48	50		9.10	0.14	2.33	7.93×10 4
1 48	[		10.00	0.18	3.00	1.02x10 <sup>-3</sup>
	55					-3

1.30.00	I ON	Marilan lababa	DATE O	v mesm 8−2	2-92 PESTED B	v Will/LU
					CHECKED	
GEOLÓG	HCAL	CONDITION OF TH	IE BOTTOM OF I	DRILL HOLE _	Light grey fine-grain	ned SANDSTONE
	* *.				***************************************	
DEPTH	FROM (	GROUND SURFACE	TO THE BOTTON	OF CASING	1300 cm	
HE1GHT	FROM	GROUND SURFACE	TO THE TOP O	OF CASING	22 Cin	
INTERN	AL RAI	DIUS OF CASING	: r = 3.	9 cm	•	•
GROUND	TEMPI	ERATURE 25	°c	WATER TEMPE	RATURE 20	°c
EPTH	FROM C	ROUND SURFACE	TO WATER SURF	ACE IN THE I	DRILL HOLE BEFORE	TEST 178 c
ЕРТН !	FROM G	ROUND SURFACE	TO WATER SURF	ACE IN THE I	ORILL HOLE AFTER	TEST c
			· · · · · · · · · · · · · · · · · · ·			,
Time Differential			W	ater Volume		Coefficient Of
Clock Hr min	<b>[</b> .	Head Of Water	Accum. Flow	Diff. Flow	Constant Rate Of	Permeability K
	181111	H (cm)	(1t)	(it/min)	Flow Q (cm <sup>3</sup> /sec)	(cm/sec)
10 41	0		0	0		
10 46	5		0.70	0.14	2.33	5.43x10 <sup>-4</sup>
10 51	10		1.80	0.22	3.67	8.55x10 <sup>-4</sup>
0 56	15		2.40	0.12	2,00	4.66x10 <sup>-4</sup>
1 01	20		3.40	0.20	3.33	7.76×10 <sup>-4</sup>
1 06	25		4.60	0.24	4.00	9.32x10 <sup>-4</sup>
1 11	30	200	5.90	0.26	4.33	1.01x10 <sup>-3</sup>
	35		6.90	0.20	3.33	7.76×10 <sup>-4</sup>
1 16	40		7.50	0.12	2.00	4.66×10 <sup>-4</sup>
	45		8.20	0.14	2.33	5.43×10 <sup>4</sup>
			9.00	0.16	2.67	6.22×10 <sup>-4</sup>
1 21	50			0.22	3.67	8.55×10 <sup>-4</sup>
1 21	50 55		10.10	0,42		

		in the rea	MCMDICITI		(:	Sheet 1 Of 6
PROJE	CT : _	G.I. At Upper Liwag	u Mini Hydro Pro	ject Site	HOLE	Yo. L1-4
		1		•		
LOCA1	TION _S	g. Mesilau Intake	DATE O	F TEST 22-1-	92 TESTED	BY Will & Ampahon
GROUN	O ELEV	ATION 1035,34	m SIZE OF C	ASING I	NW CHECKED	BY Michael Liew
GEOLO	GIÇAL	CONDITION OF T	IE BOTTOM OF I	DRILL HOLE _	Light grey SANDSTO	NE and ADAMELLITE
					boulders	
DEPTH	FROM	GROUND SURFACE	TO THE BOTTOM	OF CASING	200 cm	
REIGH	T FROM	GROUND SURFACE	TO THE TOP O	F CASING	61 cm	
INTER	NAL RAI	DIUS OF CASING	: r = 3.9	cm		
		ERATURE 25			RATURE 20	°c
					DRILL HOLE BEFOR	E TEST 15 c
		1 * 1				
DEF IN	r KOPI C	NOUND SUKERUE	TO MATER SORP	WOE IN THE I	ATTER HATE WLIEK	TEST 15 C
Ţ	ime	Differential	ater Volume		Coefficient Of	
Clock	T	Head Of	A 51	Co	Permeability	
Hr mir	min	Water H (cm)	Accum. Flow (1t)	Diff. Flow (It/min)	Constant Rate Of Flow Q (cm /sec)	
06 10	0		0			
06 15	5		4,2	0.84	14	8.59X10 <sup>-3</sup>
06 20	10		8.0	0.76	12.67	7.77X10 <sup>-3</sup>
06 25	15		12.0	0.80	13.33	8.18X10 <sup>-3</sup>
06 30	20		15.9	0.78	13.0	7.97X10 <sup>-3</sup>
06 35	25		19.4	0.70	11.67	7.16X10 <sup>-3</sup>
06 40	30	76	23.9	0.90	15	9.20X10 <sup>-3</sup>
06 45	35		28.5	0.92	15.33	9.40X10
06 50	40		33.0	0.90	15	9.20X16 <sup>-3</sup>
06 55	45		38.1	1.02	17	0.0104
07 00	50		42.8	0.94	15.67	9.61X10 <sup>-3</sup>
07 05	55		46.7	0.78	13	7.97X10 <sup>-3</sup>
	60				en en en en en en en en en en en en en e	-3
07 10			50.7	0.80	13.33	8.18X10

Constant Rate Of Flow For Steady State Condition:  $Q = \frac{14.08}{\text{cm}^3/\text{sec}}$ Coefficient Of Permeability For Steady State Condition:  $K = \frac{8.64 \times 10^{-3}}{\text{cm/sec}}$ 

•			ALCO IL I I I	1031	÷St	neer 2 of 6
PRO SIG	m	G.I. At Upper Liw	agu Mini Hydro P	roject Site	ROLE: Se	L1-4
! WOAT	ire.	So Masilau Intake	DATE O	I TERRET OF	A A OR THEOREM	Will & Ampahon
			•	*	снескев :	
GERMAN	GTCAL	COMDITION OF TH	IE BOTTOM OF I	MILL. HOLE	Grey medium to coarse	SAND
DEPTH	FROM	GROUND SURFACE	TO THE BOTTOM	- 1 OF CASING	400 cm	
		GROUND SURFACE				
•		DIUS OF CASING			<del></del>	
		•			RATURE 20	o <sub>c</sub> .
						•
					DRILL HOLE BEFORE	•
DEPTH	FROM	GROUND SURFACE	TO WATER SURF	ACE IN THE I	ORILL HOLE AFTER	TEST 20 cm
Ťi	me	Differential		ater : Volume		Coefficient Of
Clock	. =	Head Of				Permeability
Hr min	min	H (cm)	er Accum. Flow Diff. Flow Constant R m) (1t) (1t/min) Flow Q (cm		Constant Rate Of Flow Q (cm <sup>3</sup> /sec)	K (cπ√sec)
17 25	ó		0			-
17 30	5.		2,50	0.5	8.3	3.63X10 <sup>-3</sup>
17 35	10		4.80	0.46	7.67	3.36X10 <sup>-3</sup>
17 40	15		7.30	0.5	8.33	3.65X10 <sup>-3</sup>
17 45	20		9.70	0.48	8.00	3.50X10 <sup>-3</sup>
17 50	25		12.10	0.48	8.00	3.50X10 <sup>-3</sup>
17 55	30	106.5,	14.80	0.54	9.00	3.94X10 <sup>-3</sup>
18 00	35		17.30	0.50	8.33	3.65X10 <sup>-3</sup>
18 05	40		19.90	0.52	8.67	3.80X10 <sup>~3</sup>
18 10	45		22.10	0.44	7.33	3.21X10 <sup>-3</sup>
18 15	50		24.90	0.56	9.33	4.08X10 <sup>-3</sup>
18 20	55		27.50	0.52	8.67	3.80X10 <sup>-3</sup>
18 25	60		29.90	0.48	8.00	3.50X10 <sup>-3</sup>
			1			

Constant Rate Of Flow For Steady State Condition: Q = 8.30						cm³/sec			
Coeffi	lefent	Of	Permeability	For	Steady	State Condition	: K =	3.63X10 <sup>-3</sup>	cm/sec
٠					•				
					: ·	AP2 -	49		
٠					٠				

-१हर-स्ट	. T :	G.1. At Upper Liwa	gu Mini Hydro Pr	oject Site	c) - 211 - 22 - 31014 - 3	Short 3 0 6 No. L1-4
	·				-1-92 TESTED	
					AM CHECKED	
					Lighy grey mottled	* .
***************************************				,	boulders	
ne p eu	EDOM	GROUND SURFACE	TO THE BOTTON	- OF CASING		
•			•			
	•				76 cm	
		DIUS OF CASING		•	20	0
GROUND	TEMP	ERATURE 2	5 °C	WATER TEMPE	RATURE 20	C
DEPTH	FROM	GROUND SURFACE	TO WATER SURF	ACE IN THE	DRILL HOLE BEFOR	E TEST 26 C
рертн і	FROM (	GROUND SURFACE	TO WATER SURF	AGE IN THE	DRILL HOLE AFTER	TEST 24 c
Tin	ne	Differential	,500 is <b>W</b> a	ater Volume		Coefficient Of
Clock Hr min	ការែ	Head Of Water H (cm)	Accum, Flow	Diff. Flow (lt/min)	Constant Rate Of Flow Q (cm <sup>3</sup> /sec)	Permeability  K (cm/sec)
10 05	0		0			
10 10	-5		0.40	0.08	1.33	6.08X10 <sup>-1</sup>
10 15	10		0.75	0.07	1.17	5-35X10 <sup>-4</sup>
10 20	15		1.20	0.09	1.5	6.86X10 <sup>-4</sup>
10 25	20		1.62	0.084	1.4	6.40X10 <sup>-4</sup>
10 30	25		2.06	0.088	1.47	6.72X10 <sup>-4</sup>
10 35	30	102	2.47	0.082	1.37	6.26X10 <sup>-4</sup>
10 40	35		2.89	0.084	1.40	6.40X10 <sup>-4</sup>
10 45	40		3.32	0.086	1.43	6.54X10 <sup>-4</sup>
10 50	45		3.76	0.088	1.47	6.72X10 <sup>-4</sup>
10 55	50		4.18	0.084	1.40	6.40X10 <sup>-4</sup>
1 00	55		4.56	0.076	1.27	5.80X10 <sup>-4</sup>
1 05	60		4.92	0.072	1.20	5.48X10 <sup>-4</sup>

Constant Rate Of Flow For Steady State Condition:  $Q = \frac{1.37}{\text{cm}^3/\text{sec}}$ Coefficient Of Permeability For Steady State Condition:  $K = \frac{6.26 \times 10^{-4}}{\text{cm}/\text{sec}}$ 

Loca	rtást.	es Maritan lakaba	MATE M	е тисет — <b>25</b> -	1-92 TESTED B	v Will & Ampahon
					NW CHECKED	
GEORA	arijal,	COMPLETON OF TH	E BOLLON OF L	KILL INGE _	Light grey fine-gra	ILEG SAMOSTONC
B.111011			ma muu bammau		800	
		GROUND SURFACE	•	_		•
	-	GROUND SURFACE			CM	• .
		DIUS OF CASING	<del>:</del>		20	0
GROUN	D TEMPI	ERATURE 25	°C	WATER TEMPER	RATURE 20	°c
DEPTH	FROM C	GROUND SURFACE	TO WATER SURF	ACE IN THE D	RILL HOLE BEFORE	TEST 22
DEPTH	FROM C	ROUND SURFACE	TO WATER SURF	ACE IN THE E	DRILL HOLE AFTER	TEST 4
			ater Volume	· · · · · · · · · · · · · · · · · · ·		
Clock	ine	Differential Head Of	, <del>,</del>	ater volume		Coefficient Of Permeability
Hr mi	กดเก	Water H (cm)	Accum. Flow (1t)	Diff. Flow (lt/min)	Constant Rate Of Flow Q (cm <sup>3</sup> /sec)	K (cm/sec)
09 0	2 0		0			
09 0	7 5		0.25	0.05	0.83	4.50X10 <sup>-4</sup>
09 1	2 10		0.50	0.05	0.83	4.50X10 <sup>-4</sup>
09 1	7 15		0.74	0.048	0.80	4.34X10 <sup>-4</sup>
09 2	2 20		1.00	0.052	0.87	4.72X10 <sup>-4</sup>
09 2	7 25		1.30	0.06	1.00	5.42X10 <sup>-4</sup>
09 3	30	86	1.58	0.056	0.93	5.04X10 <sup>-4</sup>
7.7	35		1.83	0.05	0.83	4.50X10 <sup>-4</sup>
09 3	40		2.03	0.04	0.67	3.63X10 <sup>-4</sup>
	45		2.25	0.044	0.73	3.96X10 <sup>-4</sup>
09 42			2.50	0.05	0.83	4.50X10 <sup>-4</sup>
09 42	50		2.75	0.05	0.83	4.50X10 <sup>-4</sup>
09 3; 09 42 09 47 09 52	30					

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OPEN	 END	PERMEABILITY	TEST
UFFIN	 1 13 17	THE KIND AND THE FORE	163

LOCATÍ	08 <u>s</u>	g. Mesilau Intake	DATE: OF	TEST 25-	1-92 TESTED F	Y Will & Ampahon
GROUND	ELEŸ	ATTON 1035.34	m SIZE OF CA	SING NW	СНЕСКЕР	BY M. Liew
GEOLOG	ICAL C	NT TO ROITIGROS	E BOTTOM OF D	RILL HOLE _	Light grey fine-grai	ned SANDSTONE
					- 1	
рерти (	FROM G	ROUND SURFACE	TO THE BOTTOM	OF CASING	1000 cm	
HEIGHT	FROM	GROUND SURFACE	TO THE TOP O	F CASING	60 cm	. a t
INTERNA	L RAD	IUS OF CASING	r = 3.9	cm		÷
GROUND	TEMPE	RATURE25	°c 1	WATER TEMPE	RATURE 20	°C
EPTH F	ROM G	ROUND SURFACE T	O WATER SURF	ACE IN THE I	DRILL HOLE BEFORE	TEST27
ЕРТН Б	ROM G	ROUND SURFACE T	O WATER SURFA	ACE IN THE I	DRILL HOLE AFTER	TEST 3
<del></del>	· · · · · · · · · · · · · · · · · · ·			<u> </u>		
Time Differential		Water Volume			Coefficient Of Permeability	
Hr min	ការ៉ែ		Accum, Flow (lt)	Diff. Flow (It/min)	Constant Rate Of Flow Q (cm /sec)	
16 41	0		0	:		
16 46	.5		0.20	0.04	0.67	3.59X10 <sup>-4</sup>
16 51	10		0,40	0.04	0.67	3.59X10 <sup>-4</sup>
16 56	15		0.60	0.04	0.67	3.59X10 <sup>-4</sup>
17 01	20		0.80	0.04	0.67	3.59X10 4
17 06	25		1.05	0.05	0.83	4.45X10 <sup>-4</sup>
17 11	30	87	1.25	0.04	0.67	3.59X10 <sup>-4</sup>
17 16	35		1.45	0.04	0.67	3.59X10 <sup>-4</sup>
17 21	40	100	1.65	0.04	0.67	3.59X10 <sup>-4</sup>
17 26	.45	100	1.90	0.05	0.83	4.45X10 <sup>-4</sup>
	50		2.20	0.06	1.00	5.36X10 <sup>-4</sup>
17 31	55		2.45	0.05	0.83	4.45X10 <sup>-4</sup>
17 31 17 36	60		2.68	0.046	0.77	4.13X10 <sup>-4</sup>
			ate Condition :	Q =	0.75 cm <sup>3</sup>	?sec
7 41	te Of I	Flow For Steady St	and the second second			
17 36 17 41		meability For Ste	ady State Condit	tion: K = 4	.02X10 <sup>-4</sup> cm/	sec

1 43-11-19		So Marilau lotaka				N 64233 # #maskam
					1-92 TESTED B	
					CHECKED	
GEOLOG				KIG, HOLE	Light grey fine-grai	ined SANDSTONE
D.D. view						
		GROUND SURFACE	•	_		
	•	GROUND SURFACE		<del></del>	66 Cm	•
		DIUS OF CASING				0
•			1.		ATURE 20	
					RILL HOLE BEFORE	
DEPTH I	FROM G	ROUND SURFACE	TO WATER SURF	ACE IN THE E	RILL HOLE AFTER	TEST 5
Tie	ne .	Differential	W	ater Volume		Coefficient Of
Clock		Head Of Water	Accum Flow	Diff. Flow	Constant Rate Of	Permeability K
Hr min	min	H (cm)	(1t)	(1t/min)	Flow Q (cm /sec)	(cm/sec)
17 03	0	·	. 0			
17 08	5		0.5	0.1	1.67	1.18X10 <sup>-3</sup>
17 13	10		0.9	0.08	1.33	9.38X10 <sup>-4</sup>
17, 18	15		1.40	0.1	1.67	1.17X10 <sup>-3</sup>
17 23	20		1.45	0.01	0.17	1.19X10-4
17 28	25		1.80	0.07	1.17	8.25X10 <sup>-4</sup>
17 33	30	66.10	2.20	0.08	1.33	9.38X10 <sup>-4</sup>
17 38	35		2.58	0.076	1.27	8.96X10 <sup>-4</sup>
17 43	40		3.00	0.084	1.4	9.87X10 <sup>-4</sup>
17 48	45		3.35	0.07	1.17	8.25X10 <sup>-4</sup>
17 53	50		3.80	0.09	1.5	1.06X10 <sup>-3</sup>
17 58	55		4.20	0.08	1.33	9.38X10 <sup>-4</sup>
18 03	60		4.55	0.07	1.17	8.25X10 <sup>-4</sup>
nstant Ra	te Of	Flow For Steady St	tate Condition :	0 =	1.265 cm <sup>3</sup> /	
	Of Pe	rmeability For Ste	eady State Condi	tion: K = 2.	93X10 <sup>-3</sup> cm/s	sec

LOCATI	ON.	Head pond	DATE OF	TEST 18-	1-92 TESTED	BY Litto
GROUND	ELEV	ATION 1031.62	m SIZE OF CA	SING N	W CHECKED	BY Michael Lie
GEOLOG	ICAL (	CONDITION OF TH	E BOTTOM OF D	RILL HOLE _	Yellowish brown s	andy silty CLAY
					with weathered sam	ndstone fragments
DEPTH I	FROM (	ROUND SURFACE	TO THE BOTTOM	OF CASING	200 cm	
					<u>73</u> cm	
NTERNA	L RAD	IUS OF CASING	r = 3.9	cm		
					RATURE 20	
		78.			DRILL HOLE BEFORE	-
		•		- 1	DRILL HOLE AFTER	
		NOONO SOREMOD				
Tim	e .	Differential	Wa.	oter Volume		Coefficient Of
Clock Hr min	min	Head Of Water H (cm)	Accum, Flow	Diff. Flow (lt/min)	Constant Rate Of Flow Q (cm /sec)	Permeability  K (cm/sec)
08 50	0		0		-	
08 55	5		0			
09 00	10		0			
09 05	15	·	0			
09 10	20		00			
09 15	25		0		<i>,</i>	
09 20	30		0			4
09 25	35		0			
09 30	40	151	0.2	0.04	0.67	1.14X10 <sup>-4</sup>
09 35	45		0.2	0		
09 40	50		0.2	О		
	55		0.2	0		
09 45						

LOCATION	lead Pond	DATE OF	TEST18-1	1-92 TESTED B	Y Litto
GROUND ELEVA	TION 1031.62	m SIZE OF CA	SING NW	CHECKED	BY M. Liew
GEOLOGICAL C	ONDITION OF T	IE BOTTOM OF D	RILL HOLE	Dark grey sandy :	silty CLAY
DEPTH FROM G	ROUND SURFACE	TO THE BOTTOM	OF CASING	500 cm	
HEIGHT FROM	GROUND SURFACE	TO THE TOP O	F CASING	64 cm	
INTERNAL RAD	US OF CASING	: r = <u>3.9</u>	cm_		
GROUND TEMPE	RATURE 25	°C V	VATER TEMPE	RATURE 20	°c
DEPTH FROM GE	ROUND SURFACE	TO WATER SURFA	ACE IN THE	ORILL HOLE BEFORE	TEST 207
DEPTH FROM GE	ROUND SURFACE	TO WATER SURFA	CE IN THE I	DRILL HOLE AFTER	TEST 0
	<u>.</u>	1	· · · · · · · · · · · · · · · · · · ·		
Time Clock	Differential Head Of	₩a	Coefficient Of Permeability		
Hr min min	Water H (cm)	Accum. Flow	Diff. Flow (lt/min)	Constant Rate Of Flow Q (cm 3/sec)	K (cm/sec)
17 35 0	· · · · · · · · · · · · · · · · · · ·	0			-
17 40 5		0			-
17 45 10		0	·		**
17 50 15		0		:	
17 55 20	·	0			-
18 00 25		0			•
18 05 30	271	0			-
18 10 35	· · · · ·	0			•
18 15 40		0			-
18 20 45		0			. •
18 25 50		0			-
18 30 55		0	el.		_
18 35 60		0			*
istant Rate Of I	Flow For Steady S	State Condition :	Q =	3	Isec
			tion K = 15	- cm/	Sec
	rmeability For St	eady State Conditi			

LOCATI	ON	Head pond	DATE OF	TEST 19-1	-92 TESTED B	γ Litto
					W CHECKED	
GEOLOG	ICAL (	CONDITION OF TH	E BOTTOM OF I	RILL HOLE	Grey SILTSTONE	
DEPTH :	FROM (	GROUND SURFACE	TO THE BOTTOM	OF CASING	600 Cin	
HEIGHT	FROM	GROUND SURFACE	TO THE TOP O	F CASING	57cm	
NTERNA	AL RAD	DIUS OF CASING	: r = <u>3.9</u>	cm		
					RATURE 20	°c
					ORILL HOLE BEFORE	
		;		-	ORILL HOLE AFTER	
Tin	ie .	Differential Water Volume				Coefficient Of
Clock Hr min	min	Head Of Water H (cm)	Accum. Flow (lt)	Diff. Flow (lt/min)	Constant Rate Of Flow Q (cm /sec)	Permeability K (cm/sec)
10 11	0		. 0	0		
10 16	5		0.2	0.04	0.67	1.76X10 <sup>-3</sup>
10 21	10		0.2	0		
10 26	15		0.2	0		
10 31	20		0.4	0.04	0.67	1.76X10 <sup>-3</sup>
10 36	25		0.4	0		
10 41	30	270	0.6	0.04	0.67	1.76X10 <sup>-3</sup>
10 46	35		0.6	0		
10 51	40		0.6	0		
0 56	45		0.8	0.04	0.67	1.76X10 <sup>-3</sup>
	50		0.8	0		
1 01	55		0.8	0		
1 01						· · · · · · · · · · · · · · · · · · ·

PROJECT	: 0	At Upper Liwag	u Mini Hydro Pro	ject Site	HOLE No	LT-1
LOČATI	ON	Head pond	DATE OF	TEST19-	1-92 TESTED B	YLitto
GROUND	ELEV	ATION 1031.62	m SIZE OF CA	SING N	W CHECKED	BY M. Liew
GEOLOGI	ICAL (	CONDITION OF THE	E BOTTOM OF D	RILL HOLE	Brown sandy silty	CLAY
		·		-		
DEPTH I	FROM (	GROUND SURFACE	то тне воттом	OF CASING	800 cm	
неіснт	FROM	GROUND SURFACE	TO THE TOP O	F CASING	43cm	
INTERNA	AL RAD	DIUS OF CASING	: r = 3.9	cm		
GROUND	TEMPE	RATURE 25	°c ·	WATER TEMPER	RATURE 20	°c
<b>ДЕРТН Б</b>	ROM C	ROUND SURFACE	TO WATER SURF	ACE IN THE I	ORILL HOLE BEFORE	TEST 2.21
DEPTH F	'ROM G	ROUND SURFACE T	TO WATER SURFA	ACE IN THE I	ORILL HOLE AFTER	TEST 0
	<u> </u>	T				1
Tim	ie T	Differential	Wa	Water Volume		
Clock Hr min	ក្រាំក្រ	Head Of Water H (cm)	Accum. Flow	Diff. Flow (1t/min)	Constant Rate Of Flow Q (cm /sec)	Permeability  K (cm/sec)
						<del></del>
17 29	0		0			
17 29 17 34	5		0			
17 34						
17 34	5	45.21	0	0.04	0.67	1.18X10 <sup>-4</sup>
17 34 17 39	5	45.21	0	0.04	0.67	1.18X10-4
17 34 17 39 17 44 17 49	5 10 15	45.21	0 0,2		0.67	1.18X10 <sup>-4</sup>
17 34 17 39 17 44 17 49 17 54	5 10 15 20	45.21	0 0 0.2	. 0 .		
17 34 17 39 17 44 17 49 17 54 17 59	5 10 15 20 25	45.21	0 0 0.2 0.2	0.04		
17 34 17 39 17 44 17 49 17 54 17 59	5 10 15 20 25 30	45.21	0 0.2 0.2 0.4	0.04		
17 34 17 39 17 44 17 49 17 54 17 59 18 04 18 09	5 10 15 20 25 30 35	45.21	0 0.2 0.2 0.4 0.4	0 0.04		
17 34 17 39 17 44 17 49 17 54 17 59 18 04 18 09 18 14	5 10 15 20 25 30 35 40	45.21	0 0.2 0.2 0.4 0.4	0 0.04 0 0	0.67	1.18X10 4
17 34 17 39 17 44 17 49	5 10 15 20 25 30 35 40 45	45,21	0 0.2 0.2 0.4 0.4	0 0.04 0 0 0	0.67	1.18X10 4

					(:	Sheet 5 Of 5
PROJEC	r : C.	l. At Upper Liwagu	Mini Hydro Proje	ect Site	HOLE A	lo. LT-1
LOCATI	אט <u>-</u>	Head pond	DATE OF	TEST	-92 TESTED	BY Litto
GROUND	ELEV	ATION 1031.62	m SIZE OF CA	SING N	e checked	BY M. Liew
CEOLOC	ICAL (	CONDITION OF TH	d 46 MOTTON OF D	RILL HOLE	Brownish grey SILTS	STONE
DEP'TH	FROM (	ROUND SURFACE	то тне воттом	OF CASING	1000 cm	
HEIGHT	FROM	GROUND SURFACE	TO THE TOP O	F CASING	30 cm	
INTERNA	AL RAD	Olus of Casing	: r = 3.9	CHI		
GROUND	TEMPE	RATURE 25	. °C 1	WATER TEMPER	RATURE 20	°c
			4.5		ORILL HOLE BEFORE	TEST 5 C
Time Differential		Wa	ter Volume		Coefficient Of	
Clock Hr min	min	Head Of Water H (cm)	Accum. Flow	Diff. Flow (lt/min)	Constant Rate Of Flow Q (cm³/sec)	Permeability  K (cm/sec)
12 10	0		0			
12 15	5		0.2	0.04	0.67	
12 20	10		0,4	0.04	0.67	
12 25	15		0.6	0.04	0.67	
12 30	20		0.9	0.06	1.00	
12 35	25	207	1.2	0.06	1.00	0.72
12 40	30		1.5	0.06	1.00	
12 45	35	:	1.6	0.02	0.33	
	40		1.8	0.04	0.67	
12 50	40					
12 50 12 55	45		2.0	0.04	0.67	
12 55	45		2.0	0.04	0.67 0.67 0.67	
12 55 13 00	45 50		2.0	0.04	0.67	

LOCATION	Head Pond	DATE OF	TEST 11-	1-92 TESTED B	y Ampahon & Lit
				СНЕСКЕД	
GEOLOGICAL C	CONDITION OF TH	e bottom of d	RILL HOLE _C	rey weathered SANDST	ONE
DEPTH FROM G	ROUND SURFACE	TO THE BOTTOM	OF CASING	250 cm	
HEIGHT FROM	GROUND SURFACE	TO THE TOP O	F CASING	35 cm	
INTERNAL RAD	IUS OF CASING	: r = <u>3.90</u>	cm	•	
GROUND TEMPE	RATURE 25	o <sub>C</sub>	WATER TEMPER	ATURE 20	°c
DEPTH FROM G	ROUND SURFACE	TO WATER SURF	ACE IN THE D	RILL HOLE BEFORE	TEST 204
DEPTH FROM G	ROUND SURFACE	TO WATER SURF	ACE IN THE D	RILL HOLE AFTER	TEST 53
	<del>,</del>	<u> </u>			<u> </u>
Time Clock	Differential Water Volume Head Of			Coefficient Permeability	
Hr min min	Water H (cm)	Accum. Flow (1t)	Diff. Flow (lt/min)	Constant Rate Of Flow Q (cm /sec)	K (cm/sec)
16 07 0		.0			
16 12 5		ţ.	0,8	13.33	2.60X10 <sup>-3</sup>
16 17		6	0.4	6.67	1.30X10 <sup>-3</sup>
16 22 15		8	0.4	6.67	1.30X10 <sup>-3</sup>
16 27 20		11	0.6	10.00	1.95X10 <sup>-3</sup>
16 32 25		15	0.8	13.33	2.60X10 <sup>-3</sup>
16 37 30	239	17	0.4	6.67	1.30X10 <sup>-3</sup>
16 42 35		19	0.4	6.67	1.30X10 <sup>-3</sup>
16 47 40		21	0.4	6.67	1.30X10 <sup>-3</sup>
16 52 45		25	0.8	13.33	2.60X10 <sup>-3</sup>
		26	0.2	3.33	6.50X10 <sup>-3</sup>
16 57 50		27	0.2	3,33	6.50X10 <sup>-3</sup>

LOCATI	ON	Head Pond	DATE OF	TEST 12-1	-92 TESTED	Y Ampahon & Lit
					CHECKED	
					Grey weathered SAI	3
ЭЕРТН	FROM (	GROUND SURFACE	TO THE BOTTOM	OF CASING	400 cm	
		GROUND SURFACE				eria. Naziratek (hajar
	٠.	DIUS OF CASING			•	
					RATURE 20	٠ ٥٠ - ١٠ - ١
					ORILL HOLE BEFORE	
						4
EPTH I	CROM G	ROUND SURFACE	IO WATER SURF.	ACE IN THE L	DRILL HOLE AFTER	TEST 47
Γis	se .	Differential	We	iter Volume		Coefficient O
Clock	<u>.                                      </u>	Head Of			Permeability	
Hr mîn	យរូប	Water H (cm)	Accum. Flow (1t)	Diff. Flow (1t/min)	Constant Rate Of Flow Q (cm /sec)	(cm/sec)
14 30	0	•	0			
14 35	5		0,4	0.08	1.33	1.78X10 <sup>-4</sup>
14 40	10		0.8	0.08	1.33	1.78X10-4
4 45	15		1.10	0.06	1.00	1.34X10
4 50	20		1.50	0.08	1.33	1.78X10 <sup>-4</sup>
4 55	25		1.80	0.06	1.00	1.34X10 4
5 00	30	348	2.30	0.10	1.67	2.24X10 <sup>-4</sup>
5 05	35		2.70	0.08	1.33	1.78X10 <sup>-4</sup>
5 10	40		3.0	0.06	1.00	1.34X10 -4
<u>, , , , , , , , , , , , , , , , , , , </u>	45		3.25	0.05	0.83	1.11X10 <sup>-4</sup>
	50		3.60	0.07	1.17	1.57X10 <sup>-4</sup>
				0.11	1.83	2.45X10 <sup>-4</sup>
5 15	55		4.15	V• I I		

d)

					(3)	
ROJECT	i :	G.I. At Upper Liwa	gu Mini Hydro Pro	oject Site	HOLE No	. LT-2
LOCATION Head Pond DATE OF TEST 13-1-92 TEST						Y Ampahon & Litte
ROUND	BY M. Liew					
					Grey weathered	
		•			·	
EPTH I	FROM C	GROUND SURFACE	TO THE BOTTOM	OF CASING	600 cm	
IGHT	FROM	GROUND SURFACE	TO THE TOP OF	F CASING	89 cm	
		DIUS OF CASING	• •	<del></del> -		
				<del></del>	ATURE 20	°c
				6.00	RILL HOLE BEFORE	
		•	2		ORILL HOLE AFTER	
r in r	KON G	ACOND SORFACE	O WALER SORE	OE IN THE E	ALLE HOLE AFTER	1531
Time Differential		Wa	Water Volume			
lock		Head Of			Constant Rate Of	Permeability K
กได้เก	min		/1 (1t)			(cm/sec)
2 52	0		0			
	0 5		0.80	0.16	2,67	2.78X10 <sup>-4</sup>
2 57	ļ			0.16	2.67 4.00	2.78X10 <sup>-4</sup> 4.21X10 <sup>-4</sup>
2 57 3 02	5		0.80			i
2 57 3 02 3 07	5		0.60 2.00	0.24	4.00	4.21X10 <sup>-4</sup> 3.50X10 <sup>-4</sup>
2 57 3 02 3 07 1 12	5 10 15		0.80 2.00 3.00	0.24	4.00	4.21X10 <sup>-4</sup>
2 57 3 02 3 07 12	5 10 15 20	443	0.80 2.00 3.00	0.24 0.20 0.16	4.00 3.33 2.67	4.21X10 <sup>-4</sup> 3.50X10 <sup>-4</sup> 2.81X10 <sup>-4</sup> 4.91X10 <sup>-4</sup>
2 57 3 02 3 07 3 12 3 17	5 10 15 20 25	443	0.80 2.00 3.00 3.80 5.20	0.24 0.20 0.16 0.28	4.00 3.33 2.67 4.67	4.21X10 <sup>-4</sup> 3.50X10 <sup>-4</sup> 2.81X10 <sup>-4</sup> 4.91X10 <sup>-4</sup> 2.63X10 <sup>-4</sup>
2 57 3 02 3 07 3 12 3 17 3 22	5 10 15 20 25	443	0.80 2.00 3.00 3.80 5.20	0.24 0.20 0.16 0.28	4.00 3.33 2.67 4.67 2.50	4.21X10 <sup>-4</sup> 3.50X10 <sup>-4</sup> 2.81X10 <sup>-4</sup> 4.91X10 <sup>-4</sup> 2.63X10 <sup>-4</sup> 2.81X10 <sup>-4</sup>
2 57 3 02 3 07 3 12 3 17 3 22 27	5 10 15 20 25 30 35	443	0.80 2.00 3.00 3.80 5.20 5.95	0.24 0.20 0.16 0.28 0.15	4.00 3.33 2.67 4.67 2.50 2.67	4.21X10 <sup>-4</sup> 3.50X10 <sup>-4</sup> 2.81X10 <sup>-4</sup> 4.91X10 <sup>-4</sup> 2.63X10 <sup>-4</sup> 2.81X10 <sup>-4</sup> 4.21X10 <sup>-4</sup>
2 57 3 02 3 07 8 12 8 17 8 22 8 27 8 32	5 10 15 20 25 30 35 40		0.80 2.00 3.00 3.80 5.20 5.95 6.75	0.24 0.20 0.16 0.28 0.15 0.16 0.24	4.00 3.33 2.67 4.67 2.50 2.67	4.21X10 <sup>-4</sup> 3.50X10 <sup>-4</sup> 2.81X10 <sup>-4</sup> 4.91X10 <sup>-4</sup> 2.63X10 <sup>-4</sup> 2.81X10 <sup>-4</sup>
2 52 2 57 3 02 3 07 3 12 3 17 3 22 3 27 3 32 3 37	5 10 15 20 25 30 35 40		0.80 2.00 3.00 3.80 5.20 5.95 6.75 7.95	0.24 0.20 0.16 0.28 0.15 0.16 0.24	4.00 3.33 2.67 4.67 2.50 2.67 4.00	4.21X10 <sup>-4</sup> 3.50X10 <sup>-4</sup> 2.81X10 <sup>-4</sup> 4.91X10 <sup>-4</sup> 2.63X10 <sup>-4</sup> 2.81X10 <sup>-4</sup> 4.21X10 <sup>-4</sup> 3.50X10 <sup>-4</sup>

LOCATI	ON	Head Pond	DATE OF	TEST13-1	-92 TESTED	BY Ampahon & Litt
GROUND	ELEVA	TION 1035.53	m SIZE OF CA	SING NW	CHECKED	BY M. Liew
GEOLOG	ICAL C	ONDITION OF TH	E BOTTOM OF D	RILL HOLE _	Reddish brown sand	ly silty CLAY
DEPTH	FROM G	ROUND SURFACE	TO THE BOTTOM	OF CASING	800 cm	
		GROUND SURFACE				and the state of t
		IUS OF CASING				
					RATURE 20	00
			- 4 .			•
					DRILL HOLE BEFOR	
EPTH F	ROM GI	ROUND SURFACE 1	TO WATER SURFA	ACE IN THE	DRILL HOLE AFTER	TEST 15
		0.00	Wa	ter Volume		
Clock		Differential Head Of				Coefficient Of Permeability
Hr min	min	Water H (cm)	Accum. Flow (1t)		Constant Rate Of Flow Q (cm /sec)	
16 45	0		0	<u> </u>		
16 50	5		0	0		
16 55	10		0.10	0.02	0.33	6.33×10 <sup>-5</sup>
17 00	15		0.10	0		
17 05	20		0.15	0.01	0.17	3.26x10 <sup>-5</sup>
17 10	25		0.15	0		
17 15	30	243	0.20	0.01	0.17	3.26x10 <sup>-5</sup>
7 20	3.5		0.20	0		
7 25	40	-	0.20	O.	:	
7 30	45		0.25	0.01	0.17	3.26x10 <sup>-5</sup>
7 35	50		0.25	0		
	55		0.25	0	· · · · · · · · · · · · · · · · · · ·	
7_40		1	V.4J		·	<del></del>