Table 1.10 Detail Output of Case II Study

Condition of study

- (1) H.W.L. E1. 187 m
- (2) L.W.L. El. 150 m
- (3) Firm Power 0.kW
- (4) Installed Capacity O kW
- (5) Irrigation purpose only Before Kotmale

All the computer outputs of Case II study are mentioned in this Table. Outputs concerning the existing tanks are also available for the other studies with Moragahakanda reservoir.

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	RESERVOIR AND TANK OPER	1 4 1	3	ATURAL RUNOFF AT HORAGAHAKANDA	VERTED FLOW TO DEMANUMA (MCM) 3.3	VERTED FLOW TO SYSTEM HAIH AND M	HCH) 1.0	RAGAHAKANDA RESERVOJR	INFLOW TO RESERVOIR RFLFASE FOR POWFR GENERATION (MCM) RFLFASE FOR IRRIGATION (MCM) 141.0	EVAPORATION 2.9 RESERVOIR WATER LEVEL (EL.M) 187.0 STORAGE VOLUME (MCM) 631.0	0UT (MEW) 49.0 0UTPUT (MW) 0.0	ATURAL RUNOFF BFTWEEN DAM SITE AND ELAMERA ANICUT (MCP) 8.6	TER REGUIREMENTS AT ELAHERA Nicut	YSTEM G AND D1 (HCM) 149,7 YSTEM D2 (HCM) 0.	TUAL DIVERTED FLOW AT ELAHERA NICUT	0 SYSTEM G AND D1 (MCM) 149.7 0 SYSTEM D2 (MCM) 49.6	0.81 (4)	-NATURAL INFLON -NATURAL FROM IDSTREAM (MCM) 11.7	REQUIREMENTS (MCM) 10.0	TANK WATER LEVEL STORAGE VOLUME 1, RULE CURVE(MCM) 25.3 2, ACTUAL (MCM) 25.3	FFIGIT (MCM) 0.	WINNERIYA TANK	NATURAL INFLOW SUPPLY FROM UPSTREAM (MCM) 112.0 RELEASE TO KANTALAI TANK (MCM) 69.8	UDDILLA TANK (MEN) 50.0 MENTS (MEN) 30.0 (4CM) 2.3	STORAGE VOLUME, 1, RULE CURVE (MCM) 91.8		AUDULLA TANK	L INFLOW FROM MINNERIYA TANK (MCT) 58-1 REGOLIREMENTS (MCT) 46-0	TANK WATER LEVEL (EL.M) 73.2 STORAGE VOLUME 1.RULE CURVE(MCM) 128.3	OUT 2, ACTUAL (MCH) 128,3	13. KANTALAT TANK	THELOW FROM (MCM) 12.0 FROM MINNERIYA TANK (MCM) 63.1 EQUIREMENTS 53.0	EVAPORATION TANK WATER LEVEL 59.3 STORAGE VOLUME 1.RULE CURVE(MCM) 160.6	PILL OUT 2.ACTUAL (MCM) 160.6 EFICIT (MCM) 0.	MCM) 167.	PARAKRAMA SAMDURA TANK (MCM) 2_0	SUPPLY FROM ANGAMADILLA (MCM) 75-1 WATER REGUIREMENTS (MCM) 39-0	CHCM) 2.0 WATER LEVEL (EL.M) 58.9 GE VOLUME 1.RULE CURVE(MCM) 120.0	(WCH) 0.000	CH) 92,1	7

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TVERTED FLOW						•	1				į		
TUNNEL		00.0	78,00	00.09	89,00	.51.00	147.00	140.00	13.00	100.00	156.00	147.00	104.00
ATÜRAL RUNOFF AT MO Dam site	NDA (MCM) 33	00.0	101.00	•	53.00	28.00	00"97	30.00			0	125,00	162.00
3. DIVERTED FION TO DEMAHUMA	(MCH)	3.30	1.50	0.70	0.80	3.30	3.60	3.70	3-10.	1.80	2-50	1.30	1-40
-DIVERSION REQUIREMENTS	. 5		' e				٥	4	ř.		~	0	9
-ACTUAL DIVERSION -ACCUMULATED DEFICIT	CHCH		00.00	o d	- 4	31,93	83.00	71.07 0	23.00	51.00	53.00	od	- d
HAKA													
NFLOW TO RESERVO ELEASE FOR POWER	(101)	5.70	7.0	~ O	6.0		٠.	70			5.0		62.
ELEASE FOR TRRIGATION VAPORATION	CMCMO	205	M 2	C 60 1	2 7 7 1 2 1 3 2 1 3 2 1 3 2 1 3 1 3 1 3 1 3 1	200	5	~ ~ ~	4.5	200	40	86.0	32.
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6. NATURAL RUNOFF BETWEEN DAM S AND ELAHERA ANICUT	ITE 1	9.80	90.9	2.40	3.18	1.68	2.76	1.80	0.78	2.28	3.54	7.50	9.72
7, WATER REQUIREMENTS AT ELAHER ANICHT	٠,							,					
	(MCM) 12	6.20	129.26	144.09	75.04	78.09	146.81	150.81	151.70	119.02	150.05	94,35	141,89
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-TO SYSTEM G AND D1 -TO SYSTEM D2	(HCH) 12	6.20	129.26	144.09	75.04	78.09	146.81	33,75	148.20	53.86	150.05	5r. 16	141,89
9. WATER REQUIREMENTS OF SYSTEM	ی												
	(нсн)	1.00	10.00	16.00	21.00	22.00	23.00	10.00	24.00	21,00	17.00	3.00	JO - 7
GIRITALE TANK		•			•		ı	,	,			•	•
-NATURAL INFLOW -SUPPLY FROM UPSTREAM	1 1	200	- C C	, M		2.20	ر ام د	96.		- 84			15.37
WATER REGUIREMENT Evaporation	CHEMO	2 ~ O	- n	0.0	- 0	0.4	2 4	o m	٥٧		2.0	2.0	9.0
TANK WATER LEVEL Storage volume 1, Rule	1 2 2	5.2	91.56 22.60		٩,۲,	~ ~	88 43,84	% ~	NB			Ψ,Ν,	é. E.
SPILL OUT	CHUH)	s	. o	0	;;		e			7.00	& O	7.0	2.8 0.
DEFICIT	X U	•	o ,			•	•	•	•				•
MIRNERIYA TAN			. '		,	,		,	•	•	4	1	,
TREAM	I 2 2 2	4 N 0	01.23	N Ni ~	200	10.00	0 V V	0,0	105.35	~ ~ ~	W 101 V	29,00	112.00
RELEASE TO KAUDULE		~ 0	. D V	9.0		· · ·		~ ~		M W	, O 4	0	N 6
EVAPORATION Tank water Level	(HCH)				, • • • • • • • • • • • • • • • • • • •	. M M	W W W	M M M	, W. W.	. — «	40	0.0	2.0
STORAGE VOLUME	I CI S	4	40	94	90	40	914	40 6	9	40,4	0.4	0.0	9,
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-NATURAL INFLOW	4047	0.	100	١.	2.0	2.0		:	.	10	100	9	12
-SUPPLY FROM MINNERLYA TANKWATER REGUIREMENTS	(HCH) - 8	3.00	38,66	30,05	3,00	30.00	36.61	74.00	39.44	13.20	25.00	28 4 20 0	37.00
EVAPORATION Tank water level	L. I.		72.5	* ~	20.	~ ~	2.0	- K	- S	- %	, o.		- ~
STORAGE VOLUM	CHCH)	8 8 W	2 2	~ ~	~ ~	ω ea ~ ~	90	o. co. eo eo	พพ จื๊	77	พูพ	m m	0,0
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ANTALAL TANK		1							1		}	İ	1
INATURAL INFLOR SUPPLY FROM MINNERIYA TANK	(000	25.02	22,55	200 200 200 200 200 200 200 200 200 200	16.00	0 % N	004	42,34	2000	2000	2 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2000
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	(MCM)	8.20	72.94	33.60	41.82	31.75	26.75	56.77	10.22	132,72	22,46	67.50	159,28
PARAKRAMA S				-									
	(HCH) 7	احدي	~ ~	33.30	12.00	0 TI	90	44.55		29.05	- №	5.00	4 M
WATER REQUIREMENTS Evaporation	(ECE)	97.	2.0	2.0	2.0	0 M	2.0	8.5	٠٠.	::	4 L	N -	- 2
TANK WATER LEVEL Storage volume 1.Rule curv	7 X	.0.0	58 18,8	٠.٥	55	58.42 118,40	56.67	٠.	v.e.	7.4	-,-	r, r,	٠,٠
2.ACTUAL SPILL OUT	(HCH)	38	<u>-</u> 9	7. d	25.0	₹ . q	0.0	0.0	M	& C	, ,	2.0	2.9
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H 16. SPILL OUT AT ANGAMABILLA	(MCM) 4	2.35	4.43	0.00	29.16	00.0	••	00.0	•	101.82	00.0	• 0	126.07
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78,66 136,91 1,55 167,75 183,78 76.00 20.00 40.00 40.00 20.04 37.93 141.00 133.60 24.00 83.00 80.7 141.89 141,89 00.4 72.02 NO V 117.70 138.05 171.46 243.65 47,00 19,00 1,00 1,00 1,00 1,00 0,00 0,00 12.00 12.00 14.70 14.70 14.70 80.00 142.91 9 4.86 142.91 8 112.07 72.84 38.28 12.00 12.00 13.00 130.97 79.00 16.00 27.23 192.27 146.34 172.67 765.77 151.08 7.4 20.00 29.26 100 24.00 24.00 24.00 24.00 24.00 35.43 0.03 116.03 170.25 221.82 75.00 63.77 116.69 116.69 11.00 99.0 200 200 200 200 200 200 200 200 8 20.2 75.00 77,90 155,40 174,885 305,35 151.70 151.70 14.00 4 98.0 27,00 0044-144 0044-144 0094 0094 0094 0094 0094 \$6.30 0.00 1.78.35 3.86.21 16.00 150.81 150.81 19.00 000 ő 39.14 000 94,60 144,71 182,75 505,64 35.00 83.00 2,10 JUNE 040077 24.17 77.00 77.00 77.00 78.20 78.20 78.20 15.90 146.81 146,81 2 106.70 0 0 0 0 0 21 3 82 184.58 559.73 63.00 81.00 25.00 25.50 25.50 25.50 25.50 136.90 136.90 72,22 37,22 37,22 72,33 108,70 0 10.00 20.39 47.00 3.29 124.00 124.00 34.00 34.00 34.00 1184.0 135.10 0 3.78 109.99 109.99 21.40 21.40 21.40 21.40 39.22 00. 51.13 111,07 20,45 7,645 184,70 5,63,05 1.00 27.82 15.00 2.82 72.95 122.60 122.60 12.00 8.00 8.00 143.90 16.00 79.63 79.63 8 3.18 53 2,88 6,00 0,38 91,37 21,80 0,0 46.43 146.80 183.63 531.76 46.00 53.00 36.87 147.56 147.56 31 05 31 00 2 95 72 45 111 60 111 60 36.55 49.00 135.20 135.20 2.76 34.24 MAR. 3.00 52.01 45.48 37.00 2.50 136.22 104.13 14.00 129.27 132,19 5.00 61.00 61.00 2.72 2.72 148.90 148.90 00. 6.36 00.6 127,33 374.70 0 339.12 2 71 187.00 631.00 45.99 900 000 15.87 10.05 12.00 73.20 73.20 128.30 8 55.02 55.02 7,00 11,00 12,29 59,10 135,10 90 136,09 129.75 | # | | Y | 265 O. GIRITALE TANK

-NATURAL INFLOM

-SUPPLY FROM UPSTREAM

-WATER REQUIREMENTS

-WATER REQUIREMENTS

-EVAPORATION

-TANK WATER LEVEL

-STORAGE VOLUME

2.ACTUAL

(MCM)

ROWN

(MCM) - DIVERTED FLOW TO SYSTEM HAIH AND MH
--DIVERSION REQUIREMENTS (MCM)
--ACTUAL DIVERSION (MCM)
--ACCUMULATED DEFICIT (MCM)
--INFLOW TO RESERVOIR
--RELEASE FOR POWER GENERATION (MCM)
--RELEASE FOR IRRIGATION (MCM)
--RESERVOIR WATER LEVEL (FL.M)
--SPILL OUT
--POWER OUTPUT (MCM)
--SPILL OUTPUT (MCM)
--POWER OUTPUT (MCM) -NATURAL INFLOW
-SUPPLY FROM HINNERIYA TANK (MCM)
-WATER REQUIREMENTS (MCM)
-EVAPORATION (MCP)
-TANK WATER LEVEL
-STORAGE VOLUME 1, RULE CURVE(MCM)
-SPILL OUT 2.ACTUAL (MCM)
-DEFICIT (MCM) -NATURAL INFLOW
-SUPPLY FROM WINNERIYA TANK (MCW)
-MATER REQUIREMENTS (MCM)
-EVAPORATION (MCM)
-TANK WATER LEVEL (ELM)
-STORAGE YOLUME 1, RULE CURVE(MCM)
-SPILL OUT (MCM)
-SPILL OUT (MCM) AND AR (MCM) (MCM) ELAHERA KANDA CURVE CHOWS CHONS LLIA (HCH) U -NATURAL INFLOW
-NATURAL INFLOW
-SUPPLY FROM ANGAMADILLA
-WATER REGUIREMENTS
-EVAPORATION
-TANK WATER LEVEL
-STORAGE VOLUME 1, RULE C ΑŢ NATURAL RUNOFF BETWEFN And Elahera Anicut 9 WATER REGUIREMENTS
ANICUT REQUIREMENTS ¥ G AND 5 MATURAL RUNOFF DAM SITE DIVERTED G AND -SPILL OUT -DEFICIT KAUDULLA TA SYSTEM DUT ISYSTEM ACTUAL D ANICUT SPILL -10 SY -10 SY UATER 2 æ I-129

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	******* RESERVOIR AND TANK OPERATION FOR MORAGAHAKANDA IRRIGATION PROJECT (YEAR == 1956) *****	
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1. DIVERTED FLOW THROUGH POLGO.	CHCH)	63,00	48.00	62,00	53,00	88.00	129.00	143.00	143.00	144.00	151.00	147.00	144.00
2. NATURAL RUNGFF AT MORAGAHAK. DAW SITE.	ANDA	32.00	54.00	4	49.00	30.00	15.00	5.00		00-2	10.00	00*66	102.00
3. DIVERTED FLOW TO DEWAHUMA 4. 4. DIVERTED FLOW TO SYSTEM H/II	CMCM)	3.30	1.30	0 40	06	3.30	3.60	3,70	3-10	0.00	25.5	1.30	3.40
DIVERSION REDUIREMENTS ACTUAL DIVERSION ACCUMULATED DEFICIT	333	80.00 46.45 33.55	82.00 50.45 65.10	78.00 60.02 83.08	83.00 50.71 115.37	83.00 70.19 128.18	83.00 83.00 128.18	83.00 83.00 128.18	77.00	77.00	00.69	24.00	43.00
GAMAKANDA RES													
INFLOW TO RESERVOIR RELEASE FOR POWER GENERATI	111	7.	5.00	1,2	4	N 0 0	40.0	M. 0	40.	6.7	80 0 4	~	9
E LEV	(HCE)	173.64	167.39	159.08	150.00 21.70	150.00	150.00	150,00	150.001	150.00	150.00	162.72	167.82
SPILL OUT POWER OUTPUT ENERGY OUTPUT (1	223		•••			000	000	000	000			000	000
TURAL RUNOFF BETWFEN DAM ND ELAHERA ANJCUT	SITE (MCM)	1.92	3.24	3.06	76.5	1.80	0.0	0.30	0.18	0.12	0.60	76.5	6.12
7. WATER REQUIREMENTS AT ELAHEI	₩ ₩			-					ļ				
SYSTEM G AND DI SYSTEM D2	(147.59	135.66	3,48	146.81	151,70	146.81 26.98	151,70	151.70	146,81	151,03	129.01	138.65
8. ACTUAL DIVERTED FLOW AT ELAP	HFRA											و مسوران المن المن المن المن المن المن المن ال	
-TO SYSTEM G AND DI -TO SYSTEM D2	(101)	147,59	135.66	147,30	110.30	44.78	56.94 0.	60.03	64.47	0.00	88.63 0.	129.01	138.65
9. WATER REQUIREMENTS OF SYSTEM	Z C							1		1		- 1	
10. GIRITALE TANK	(H)	14.00	15.00	18.00	23,00	29.06	23.60	19.00	27.00	27.00	23.00	3.00	00-7
-NATURAL INFLOW	Ĭ	•	•								٥	۰	•
-SUPPLY FROM UPSTREAM -WATER REQUIREMENTS -EVADORATION -TANK WATER LEVEL -STORAGE VOLUME 1, RULE CURN -SPILL OUT -DEFICIT		2 2 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	72.00 71.56 71.56 72.60	21.80 21.80 21.80 00.13	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	27.27	45 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	86.00 86.01 7.30 0.75 0.00	13.00 0.23 0.23 82.78 2.30 2.30 0.0	8 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2000 2000 2000 2000 2000 2000 2000 200	8 9 2 2 6 8 9 2 4 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	12.37 5.00 0.27 91.61 22.80 22.80
11. WINNERIYA TANK													
NATURAL INFLOW SUPPLY FROM UPSTREAM	TI	000	2 de	200	0.80	0.20		27.00	24.87	28,35	OM.	0.41	0.0
S TANK		147 E	M M M M M M M M M M M M M M M M M M M	20 20 30 4 50 50 50 50 50 50 50 50 50 50 50 50 50	- M D M D C C C C C C C C C C C C C C C C	W W W C C	0 4 5 6 0 C C C C C C C C C C C C C C C C C C	0 4 4 8 0 C C C C C C C C C C C C C C C C C C	# 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	32.00	. E. W - 9.	10.00	1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
SELL OUT 2.ACTUAL DEFICIT		900	9 9 9	9000	400	,	, o	9000		4 0 0	9 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	9000	0 00
C. KAUDULLA IANK		- '	- '		_ ¹		_] '				l'	١,	'
-NATURAL INFLOW -SUPPLY FROW MINNERIYA TANK -WATER REQUIREMENTS -EVAPORATION -TANK WATER LEVEL -SIORAGE VOLUME 1-RULE_CURV	C C C C C C C C C C C C C C C C C C C	2.00 48.39 42.00 72.20 72.16	32.60 59.00 70.77 70.77	31.00 2.62 71.26 71.160	15.75 15.00 72.61 72.60	54.00 54.00 108.77	22.00	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 62.00 64.00 15.90	18 00 00 00 00 00 00 00 00 00 00 00 00 00	N W & & & & & & & & & & & & & & & & & &	73.00 15.00 70.78 70.78	25 00 25 00 1 25 00 72 19 72 19 72 19
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URAL IN PLY FRO ER REOU	1221		0000	443.55 49.00 49.00 49.00	7,00		20.00	00.00			OM-OC		27,00 57,51 35,00
STORAGE VOLUME 1.RULE CUR SPILL OUT DEFICIT	VECHEN) (HEH) (HEH)	00-00	200	2 20	- M NO O	124,00 60,19 0	100	0000	,	4000F		M00	000
4. NATURAL RUNDEF AT ANG	(MCM)	65,55	48.58	29.42	19.06	13.20	10.10	3.70	28-0	2.88	07.6	86.06	87,88
PARAKRAMA SAMDURA Natural Inflow	I :	2.0	0,	_0,	e.		2.0	•	9	• '	9.	7.0	9
ANGAHADILLA EMENTS FVF		60.00 2.00 84.05	48.00 68.00 7.34 58.43		18,09 9,00 2,00 2,87	46.00	50.00 17.23 17.23	N N N N		2 C C C	00.00	10.00	17.00 17.00 1.85
STORAGE VOLUME SPILL OUT	- w			000 000	>-0		-07-00	18.50	18.50	20 20 20 20 20 20 20 20 20 20 20 20 20 2	4 1 0	- M 0	
16. 5911	3.	00*0	00*0			00.0	00.0	0.0			:	12,65	56.99
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1. DIVERTED FLOW THROWGH POLGOL	CHCHO	00.66	78,00	54.00	00.69	70.00	147.00	152.00	131.00	121.00	116.00	147.00	152.00
1	¥ ₹		0				0.5	17.	2.0		0.99		
3. DIVERTED FLOW TO DEWANDER	K AND PH	3.30	1.30	02.0	0.80	3,30	3,40	3,70	3,10	- Bo	2.50	1.30	1.40
DIVERSION REQUIREMENTS ACTUAL DIVERSION ACCUMILATED DEFICET		79.00	25.00	78.00	74.00	6.00	83.00 83.00	68.00 70.77	56.00	74.00		000	
OPAGAHAKANDA	ř				į	į	į						
INFLOW TO RESERVOIR RELEASE FOR POWER GENERATI RELEASE FOR IRRIGATION	III	7.0	7.00	5.0	4 O IV	2.0	4.0	200	7.9	8.2	8 0	7.00	٠
NATER LEVE LUME UT	(EL.13)	2.11 164.33 135.55 0.	166.70 168.28 0.	156.91 63.11 0.	150.00 21.70 0.00	150-00	0.56 150.00 21.70 0.	150.00	150.00 21.70 0.	150.00 21.70 0.00	157,72	174,33 295,78 0.	187.05 631.00 210.33
ENERGY OUTPUT ATURAL RUNOFF BETWEEN DAM	DOMWH TTE			9 ,	9				6 6	76 0		0.0	D
NO ELANERA ANICUI TER REQUIREMENTS AT ELAHE NICUI	L C		•	•	•	n •	•		•		•	•	•
SYSTEM G AND D1 SYSTEM D2	(#U#)	16.56	112,14	151.55	146.81	151,70	146.81	34.00	151,70	146,83	134,03	43,61	10.05
EU FLOW AT ELA	Ĭ												
-TO SYSTEM G AND D1 -TO SYSTEM D2 9. WATER REQUIREMENTS OF SYSTE	(((((((((((((((((((146.56	112.14	151.55	75.88	0.00	92.96	93.96	77.71	47.82 0.00	134,03	43.61	12,75
	(MCF)	11.00	• 0	22.00	27.00	27.00	23.00	19.00	27.00	24.00	6.00	3.00	00.4
O. GIRITALE JANK -NATURAL INFLOS	3 2		•								0	0	
AATER REQUI	I I	70	0,0	No		~ 0	E 0	K 0	200	. EQ C		90	
RATION WATER LEVEL GE VOLUME 1.RULE CUR 2.ACTUAL OUT	**************************************	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.4.50	0.45 0.45 0.00 0.00 0.00 0.00	0 6 7 7 7 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 6 7 7 7 7 0 0 0 0 0 0 0 0 0 0 0 0 0 0	8	00 00 00 00 00 00 00	800 800 844 900 900 900 900	044400 	88 00 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	89.19 14.70 14.70	922 922 922 923 932 932 932 932 932 932
MINNERSYA TAN	'	•	!	!	;		!	ı i	•		'	•	
SUPPLY FROM UPSTREAW	2 2 1	9 %	9 1	٠ کار کار	000			D 4		0.6	2.0	r. √.	80.00
S TANK S TANK		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	24.44 24.60 24.60 24.60 24.60 24.60	200000000000000000000000000000000000000	22.25 20.55 20.50	24.00 24.00 38.95	4 6 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	39.00 89.72 89.72	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	22.25	20272	
SPILL OUT	1 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		000	N N ← O S)) - O C		9 0 0	9 0 0 0		, o o o	(A)
KAUDULLA TAN	ר ר	•					•	. !	;		.		•
S TANK S TANK		00.02 10.03 22.5 00.03	3000 200 275 275 28 275 28 25 25 25 25 25 25 25 25 25 25 25 25 25	31.05 31.05 31.00 72.45	21.63 19.00 72.63 72.63	37.00 3.05 3.05 56.56	77.700	- 9 - 6 k	66.00	24. 44. 44. 44. 44. 44. 44. 44. 44. 44.	22.22 22.22 20.00 20.00 20.00	26.53 26.53 4.00 7.00 70.78	77.64
SPILL OUT DEFICIT	7 7 7 7		3 O O	- O O	1000	m o o	0.0		8 0 0	, v a a	, M	M	0 M C
KANTALAL WATURAL I SUPPLY FR	3 2 2	200	200	080	0.0	0.0		0.00	0.0	200	0 ~ 0	?º	m. s
VADORATION ANK WATER LEVEL	E E E	ು ಚಿತ್ರ	יים רי	1 N 2 W 10	2 m 5			200					2 0
STORAGE VOLUME 1,RULE CUR 2,ACTUAL SPILL OUT DEFICIT	CHCH)	0400	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	200	N & O O		8 C O O					-W00	141.00
. 14. NATURAL RUNOFF AT ANGAMADII 15. PARAKRAMA SAMDURA TANK	(MCM)	62.26	73.60	29,84	8.46	16.68	26.08	11.98	2.58	1.76	51.04	99.86	533.75
-NATURAL INFLOU	1 1	0.7	0.4		0,1	2.4	۰ ۲	0,4		•	0.0	ė,	0
REGUIREMENTS ATION		40%	9 60 7	900	N N	2 - W	, - v	4W 7	30.6	745	,00	- M-	20.2
TANK WATER LEVEL Storage volume 1, Rule cur 2, actual Spill out	(EL.M) VE(MCM) CMCM)	59.10 135.10	59,10 118,80 135,10	59.10 123.00 135.10	58.83 135,10 128,53	118.40 112.94	56 37 81 00 74 92	53,41 66,00 32,30	51.80 8.00 0.00 0.00	51.80 20.40 18.50	55.53 27.70 59.17	59.10 47.30 135.10	59.10 95.10 135.10
-DEF1017	ž	•			•	•	•	•	٠.	4			• '
T 16. SPILL OUT AT ANGAMADILLA	CECE	20.60	20-25	05 - 0	•	c	ć	ć	ď	00.0	ċ	27 00	

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	ERTED FLOW THROUGH POLG Næl	E S	9	7.0	05.0	. N	3.0	26.0	52.0	52.	0.80	2	0	9
	. NATURAL RUNOFF AT MORAGAHA DAM SITE	Z Z	14.0	0	0.40	8	2.0	24.0	8	2.0	80	0.		07.
	. DIVERTED FLOW TO DEWAHUWA	()	3.3		7-0	8	7	3	7.	3.1	∞,	2.5	卢	-31
	 DIVERSED FLOW TO SYSTEM H.I. DIVERSION REQUIREMENTS 	2 2	0	. 5	M	6.0	9	2.0	3.0	0	9	, P	μ. Ο	2,0
Continue Continue	ACCUAL DIVERSION ACCUMULATED DEFICIT	E E	0 0	200	md	0	0	2	M 0		0	ma	n 0	Na
	. MORAGAHAKANDA RESERVOIR													
	INFLOW TO RESERVOIR Release for Power Generali Belease for Irpication	III	7.00	68.7	94.3	20.5	* 0	8,6	82.3	0.00	7.0	2.0	68,7	53.6
1.	EVAPORATION RESERVOIR WATER LEVEL	ΣΣ	87.0	M &	5.7	87.7	-0	S S S S S S S S S S S S S S S S S S S	4	N N	1 4 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	100 100 100 100 100 100 100 100 100 100	~ M	7 7
1. CHARLE SECRET IN THE THE TABLE STATE AND TH	STORAGE VOLUME SPILL DUT PROPER OUTPUT	X	5.55 0.50 0.50		0.0 0.0 0.0 0.0	64.0 4.0	-00			* • • • • • • • • • • • • • • • • • • •			, , ,	, , ,
A CHANGE DUMINE LAW AT LEAST A CHANGE DUMINE LAW AT LEAST	, MATURAL RUNOFF BETWEEN DAM	3	•	• •	١,	٩	"	-	١	•	•		•	•
1. CHARLE TOWN IN	. WATER REQUIREMENTS AT ELAHE	[]	•	•		•	•	•	•	•	•	-	è	•
A CHAIL MATERIAL FLOW AT ELABORA A CHAIL MATERI	ANICUT	Į į	3	28.0	ا ا	4	9	12	50-		7 7	4	7	1 4
10. 011114 1 114 1	-SYSTEM DS	1 2		ċ	•	•			, m	Ċ	• •			
The strates of the first of the	ANICOT	r												
1. DITLIFETER DE SENTE CONTRACTOR DE SENTE DE SE	-TO SYSTEM G AND D1	1 X	2 E	28.	M M	W W	51.7	2.0	30	. o	4.	36.0	m 0	40.
11. GITTLE TANK THE STATE OF T	. WATER REQUIREMENTS OF SYST	- 1	ŀ				- {			- 1	}	-		
11 11 12 12 12 12 12 12	0.61	Σ		٥.	6	•	ē.	0°	<u>.</u>	•		6	٥.	7.00
The property of the property	NATURAL INFLOM	Z C	ė,	.`	٠.	.'		•	•	0.0	٠.	٠.	0,	01
11. **THORESTAY THE CASE OF TH	SUPPLY PROM UPSIKER WATER REQUIREMENTS EVAPORATION		400	On	400	100	40.4	200		70°	4W0		200	12.0
11. HINNERTY TANK 12. TOTAGE VALUE FOR THE TOTAGE	STORAGE VOLUME 1. RULE CUR		200		7.84	7.4	7.4.	e eo e	0 V V	~ ~ ~ ~	44	900		- 2.0
11. MINNESTER TANK	SPILL OUT CONT	I I I					100	100	·		• • •	.		
The state of the	MINHERIYA TAN		1											
	NATURAL INFLOW Supply From upstream	11	2.0	0 4 0	90	N 40	0.4	20	0,0	0.	0.4	8.5	0.4	2.0
12. CANDULA TAME TAME CANTER TAME CANT	RELEASE TO KANTALA! TAN RELEASE TO KAUDULLA TAN	I I	2.0	34.3	M	C N	00	80 V	6.2	0.5	M W	0 K	9.4	2 2
The range of the colored for	WATER REGUIREMENT EVAPORATION TANK SATED - ESS	111	000	W ~ F	0 F F	200	0 M P	0 W P	~ w .	• M •	es to to	W W .	0 v 0	2.2
12. KAUDULIA TANK	STORAGE VOLUME 1. BULE GUR		- 6 0	- d 4	-00	- 0 0	, d 4	- of o	ر خرا د د مرا د	• d <	- 0i0	4 40 4	, o, o	244
12. KAUDULA TANK TANDALLA TANK TAN	SPILL OUT	II EI												
-WATURE LEVEL (WENT TANK (MENT) 33.00 % 60 % 60 % 60 % 60 % 60 % 60 % 60 %	2. KAUDULLA TAN													
-WATER REQUIREMENTS (WCH) 32.00 49.00 19.00 17.00 4.00 2.15 134 110 120 13.00 2.15 134 110 120 13.00 2.15 134 110 13.00 2.15 134 110 13.00 2.15 134 134 110 13.00 2.15 134 134 110 13.00 2.15 134 134 134 134 134 134 134 134 134 134	NATURAL INFLOW SUPPLY FROM MINNERITA TAN	1 2	3.0	6.0	6.4	8 9 0	6.0	2.2	2.0	2 2 2	1.0	9 W	3.0	3.0
STILE OFFICE STILE CURVECTED 17.20 17.	WATER REQUIREMENTS EVAPORATION	ĐĐ;	20.2	0.4	000	20.0	3 K	200	2.10	0.00	5.0	0.0	2.0	W - 1
13. KANITALAI TAMA	TANK WATER LEVEL STORAGE VOLUME 1.RULE CUR	# 5] :	23.0	72.5	2.5.4	7	73.27	2.0	10 00 00 10 00 00	ທຸທຸກ ໝົວ ເ	0 4	, w	0 V u	76.5
3. KANTALAL TANK	- PEFICIT COUT C. ACTUAL C	3 Z Z	7. 		200				· • • •	, 00			n	
-WATCH INVERTIAL TANK (NCCH) 25.0C 52.05 14.10 0.0 0.0 0.0 0.0 14.78 5.00 15.0	ALAI TAM								Ì					
-EVARDRATION (RCH) 52,00	NATURAL INFLOW Supply from Minnerita Tan Later deculpriments	III	D 40 C	1.0	200	7.0	000	0.00	20.7		2.4	0.80	20.0	0.40
-STORAGE VOLUME 1, RULE CURVE(MEN) 160,60 148,90 135,20 163,90 174,00 78,20 39,70 11,90 8,70 36,80 61,60 141,00 6,40 141,00 6,	EVAPORATION TANK KATER FREE FREE FREE FREE FREE FREE FREE FR	E E =	0.00) N 6	2000	0 N O		, N 4	2.2) - O	- 0 9	2 ~ ~	240	20.0
-SPILL OUT -SPILL OUT	STORAGE VOLUME 1, RULE CURV 2, ACTUAL	EE	000	0.0	35.2	6 6 6 9	900	10 E		0.0	8 7	 ∞	0.0	
15. PARAKRAMA SAMDURA TANGAMADILLA 15. PARAKRAMA SAMDURA TANK (MCM) 3.00 1.00 1.00 1.00 0.0 0.0 3.00 0.0 0.0 0.0 0.0 0.0 0.0	SPILL OUT Deficit	ΣΣ	•••	•		00	• •	00	• •	• •		• •		••
-NATURAL INFLOW -NATURAL INFLOW -NATURAL INFLOW -NATURAL INFLOW -NATURAL INFLOW -NATURAL INFLOW -NATURAL INFLOW -NATURAL INFLOW -NATER REQUIREMENTS -NATER REQUIREMENT	4. NATURAL RUNOFF AT ANGA G. PARAKDAMA SAMBIIRA TANK	I U	52.1	0.0	52	7.7	8	70	s.	0.0		76.07	<u>.</u>	•
### STORAGE VOLUME I, RUCH ANGAMADILLA (MCM) 31,29 38,71 25,75 13,96 41,17 18,39 42,18 25,85 9,43 40,57 60,83 9,9 9,9 9,40 0,400 17,00 17,00 12,00 39,00 61,00 63,00 33,00 14,00 7,00 7,00 9,00 9,00 9,00 17,00 17,00 17,00 17,00 12,00 39,00 61,00 63,00 14,00 7,00 7,00 9,00 9,00 1,00 1,00 1,00 1,00 1,00 1	J. TATAKATA SAMBUKA TAN	1	C	-	. 6	-	9			2.0	ć	9	9	9
EVAPORATION (MCM) 2.29 2.43 3.03 2.96 3.17 3.04 2.63 1.76 1.73 1.35 1.59 2.00 (EL.M) 59.10 59.10 59.10 57.09 55.92 55.92 55.03 57.02 58.90 59.10 57.09 55.92 55.92 55.03 57.02 58.90 59.10 57.09 55.92 55.92 55.03 57.02 58.90 59.10 57.09 55.92 55.92 55.03 57.02 58.90 59.10 57.09 57.09 55.92 55.92 55.03 57.02 58.90 59.10 57.09 57.09 57.09 57.09 57.10 59.10 57.09 55.92 55.03 57.02 58.90 59.10 57.10 57.09 57.09 57.09 57.10 57.10 57.09 55.92 55.03 57.02 58.90 59.10 57.10 57.09 57.09 57.10 57.10 57.09 57.09 57.10	SUPPLY FROM ANGAMA	1 2 2	200	80 7	7 2	- N C		. M	- N	10 K	40	100		0 0
-STORAGE VOLUME 1.RULE CURVE(MCM) 120,00 118,80 123.00 135,10 118,40 81,00 66,00 19,90 20,40 27,70 47,30 95.1 28,11 128,10 128,10 135,1	EVAPORATION TANK WATER LEVEL		22.2	58.4	207	59.9	5.2.5	- M N	. 4 6	5.42		- N	9.0	20.0
16. SPILL OUT AT ANGAMADILLA (MCH) 220.62 0, 103.21 103.64 85.31 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0	STORAGE VOLUME 1.RULE CURV	X 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	35.1	18.8 28.3	35.1	35.1	18.4 35.1	0.4	0.0	0.0	4.0	7.7	2.0	5.5
16. SPILL OUT AT ANGAMADILLA (MCM) 220,62 0, 103,21 103,64 85,31 0.00 0.00 0. 0. 0. 0.00 0. 76.	£F101		•	•							0	90	a o	d o
	16. SPILL OUT AT ANGAMABLE		4	,										

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TANICATION PROJECT	## WAD FW FW FW FW FW FW FW F	. 00 118.00 142.00 15	4 00 37,00 26,00 4	a 80 3. 3. 3. 40 3 4. 60 3 4 60 3 4 60 3 4 60 3 4 60 3 4 60 50 50 50 50 50 50 50 50 50 50 50 50 50	00 6.00 22.00 8 85 74.52 22.00 8		.35 76,18 141,60 11 .0 0 150,45 135,84 16	.19 1.82 1.49 .31 162.57 162.95 15 .17 116.08 120.35 6	000	.62 2.22 1.56		.51 151.70 133.10 15 0.90 4.30 1		.51 151,70 133,10 150 0.96 4,30 16	.00 25.00 20.00 19		0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0	20 240 0.40 0.40 0.40 0.40 0.40 0.40 0.4	00 2 00 9 00 00 00 00 00 00 00 00 00 00 00 0	82 35,83 0, 80 25,68 36,2 00 24,00 42,0	.60 92.90 93.70 9 90 136.90 13 .02 118.74 136.90 10		.00 1.00 1.00 0 .00 37.00 72.00 74 .72 3.12 2.81 2	60 108.70 70.50 3	.00 12.00 5.00 3.00 3.00 0.00 0.00 0.00 0.00 0	43 57.45 55.33 57.45 78.20 39.40 12.	38 30,74 25,74 5		96 30 62 25 50 5	10 58.42 56.67 55.10 66.	0 0
NAMARA SASASASASASASASASASASASASASASASASASA	LAN. TEB. KAR.	0 62.0	2 00 6 00 82 00"	3 · 3 0 1 · 3 0 0 · 7 0 0	31.00 83.00 77.00 53 31.00 48.07 28.56 67 0. 34.93 83.37 68		33,70 39,63 35,74 4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	2.82 2.69 2.86 83.56 179.55 174.33 16 29.58 414.03 295.89 19	0000	.34 1.68 0.54	77 - 18-15 - 18-16 - 1	51.70 137.02 151.55 144 0. 17.16 0. 0	**	51,70 137,02 151,55 144 0. 17,16 0. 0	20.00 18.00 22.00 21		.00 0. .79 10.60 6.58 -	25.30 22.60 21.80 24.25.30 0.00 0.00 0.00 0.00 0.00 0.00 0.00	0.00 0.00000000000000000000000000000000	41.08 34.23 49.79 38 53.07 29.55 39.79 35 26.00 39.00 20.00 6 1.92 2.04 2.49 2	0,25 89,90 89,90 9 6,90 134,90 136,90 13		2.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	28,30 92,86 98,17 12 0,0 0,0	7.00 0.00 1 7.13 30.94 45.01 3 2.00 63.00 48.00 2	2.53 2.72 3.10 2 59.30 57.54 57.24 58 60.60 148.90 135.20 143 60.60 125.82 119.73 143	. 0. 0. .66 38.48 158.46 2		4.00 0, 0, 1.29 1.29 38.13 45.26 1	59.10 58.43 59.10 59 59.10 59 59.10 118.80 123.00 135 10 10 10 10 10 10 10 10 10 10 10 10 10	0 0 0
THE THE PROPERTY OF THE PROPER	, , , , , , , , , , , , , , , , , , ,	1 DIVERTED FLOW THROUGH POLGOLLA (MCH)	. NATURAL RUNOFF AT MORAGAHAKANDA DAM SITE	3. DIVERTED ELOW TO DEWAHUMA (HEN)	272	ORAGAHAKANDA RESERVOJR	THE LOW TO RESERVOIR RELEASE FOR POWER GENERATION (MCH) RELEASE FOR IRRIGATION (MCH)	EVAPORATION RESERVOIR MATER LEVEL (EL+N) 1 STORAGE VOLUME (MCM) 5	OUT CHEN CHEN CHEN CHEN CHEN COUTPUT CHEN COUTPUT	TURAL RUNOFF BETWEEY DAM SITE ND ELAHERA ANICUT	7. WATER REQUIREMENTS AT ELAHERA ANICUT	STEM G AND DI CACH)	B. ACTUAL DIVERTED FLOW AT ELAHERA ANICUT	-TO SYSTEM G AND D1 (UCU) 15	(331)	IRITALE TANK	SUPPLY FROM UPSTREAM CMCM	RETION (HCW) RATION (HCW) RATION (HCW) GE VOLUME 1, RULE CURVE(HCW) OUT (HCW)	MINNERIYA TANK NATURAL INFLOW SUPPLY FROW UPSTREAM CHCM)	TO KANTALAI TANK (MCM) TO KAUDULLA TANK (MCM) OUIREMENTS (MCM) (MCM)	-STORAGE VOLUME 1 RULE CURVECHCM) 1 -STORAGE VOLUME 1 RULE CURVECHCM) 1 -SOTIL OUT	TANK	S TARK (MCR) S (MCR) C (MCR) C (MCR)	SPILL OUT. SPILL OUT. CHEM)	Al TANK L INFLOW FROM MINNERIYA TANK (MCM) REQUIREMENTS (MCM)	EVAPORATION TANK WATER LEVEL STORAGE VOLUME 1, RULE CURVE(MCM) 1 SPILL DUT (MCM) 1	RUNOFE AT ANGAMADILLA	ZAKRAMA S	SUPPLY FROM ANGAWADILLA (MCM) HATER REGULIREMENTS (MCM)	ANK WATER LEVEL TORAGE VOLUME 1, RULE CURVERMEN) TORAGE VOLUME 2, ACTUAL FILL OUT	(#JH)

TEXS			FEB.	HAR.	APR.	F Y H	JUNE)UL	A U.G.	SEPT.	061.	NON	DEC.
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1. 1. DIVERTED FLOW THROUGH POLGO	OLLA (PCP)	98.00	113.00	71,00	104.00	131,00	146.00	152.00	144.00	137,00	152,00	147.00	118.00
RAL RUNOFF Site	ANDA	164.00	302.00	73.00	58,00		23.00	٥.	•	٩		143,00	
4. DIVERTED FLOW TO DEWAHUWA	CHCH)	1.10	1-10	0.70	0.80	3.30	1.40	3.70	3.10	1-80	2.50	1.30	1-60.
DIVERSION REQUIREMENTS ACTUAL DIVERSION ACCUMULATED DEFICIT	ŝŝ	000	000	000.7	8 8 0 0 0 0	59.00	72.00	000	12.00	00.17	8 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	000	9 9 0
ORAGAHAKANDA RES													
INFLOW RELEASE RFLFASE	1010	^ 0	412.70	N 00		~ 0		0 S	4 . 0 K	7 0 0	~ · · ·	7.00	9.0%
h WATER LEVE LUME UT	(((((((((((((((((((185,74 593,73 0	3.07 187.00 631.00 372.36	187 631 631 00 138 00 00 00 00 00 00 00 00 00 00 00 00 00	187.00 631.00 144.51	187,00 631,00 56,87	4,39 186,43 614,30 0.0	631.00 81.00 81.00	681.00 681.00 86.15 00.15	187.00 631.00 31.72	187.00 687.00 687.00 687.00	187,08 631,00 284,62	187.00 631.00 102.46
ATURAL BUNANG ELAHER	SITE	36.8	18.12	4,38	3,48	5.04	1.38	2.70				82 5	2.94
AVICUT	F								1			!	! !
-SYSTEM G AND D1 -SYSTEM D2 8. ACTUAL DIVERTED FLOW AT ELA	CACA)	38.64 0.	•••	74,36	7.45	42.72	105,47	80.15 12.53	114.84	79.77	71.19	n. 19	109,16
8 0	(101)	88.64	370,95	126.86	7.45	99,59	105.47	151,70	141.19	76.39	145.88 44.72	115.62	145.98
9. WATER REQUIREMENTS OF SYSTE													
10. GIRLTALE TANK	CHOHO	8.00 8.00	ċ	22.00	7.00	29.00	23.00	17.00	27,00	27.00	21.00	00 ° m	13.00
-NATURAL INFLOW	Ţ	ç	•			•					e.	٠.	
FROM UPSTREAM REQUIREMENTS ATTOR FOOTBALEVEL		20000	000000000000000000000000000000000000000	6 00 6 00 6 00 6 00 6 00 6 00 6 00 6 00	00.36	27.00	N N O 8 H	20 48 5 20 48 5 20 48 5	W. W. W. W. W. W. W. W. W. W. W. W. W. W		100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	000	10.00
SPIL OUT 2.ACTUAL		1 M	M	M	W 0 0	. N O O	moo.	W 0 0	1 N O O		M	Mr.	11000 M
11. FINNERIYA TANK													
SUPPLY FROM UPSTREAM RELFASE TO MANTALAT TAN	2 2 2	0 4 0	26.00	0.4	13.00	• •	0 11/4	ONIC	0.00	46.00	00.5	5.,	9 2 4
OUT NE		34 C C C C C C C C C C C C C C C C C C C	2000	- 6- 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1000	12.00	46.00	32.00	07.0	9000	, ways	0 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	20.05 20.05 20.05 20.05
STORAGE VOLUME 1. PULE CUR	I I	90	· 0, 0,	90	136,98	40	i o o	:40	.00	00.00	-0:0		9
	II	•	0 . 5	00	0.0		00					24.3	
-HATURAL INFLOC	1	3.0	9.2		0.	3.0		0.2		20	20.2	9	
-SUPPLY FROW MINNERIYA TANKAATER REQUIREMENTSEVAPORATIONTANK WATER LEVELSTORAGE VOLUME 1. RILLE CURN	(((((((((((((((((((34.12 23.00 23.20 73.20	18.00 73.20 14.50	24.00 24.00 73.20 111.90	04450	28.17 28.00 73.20	72.00	7 2 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	10.89 64.00 67.62 15.90	28,85 6,00 1,42 69,47	69.06 11.00 12.06 12.06 12.06	16.00 00.00 00.00 00.00 00.00 00.00	41427 227 227 116.50
, AC 1 UA		,		,	000	800	000		0 N 0 0	,	n 0 0	M	£
13. KANTALAI TANK													
-NATURAL INFLOM -SUPPLY FROM WINNERLYA TANK -WATER REQUIREMENTS -EVAPORATION	1111	27.00 17.13 22.00 2.53	7.00	► ~ U M	0 0 0 n	22 26.49 51.00 3.42	7 O T	17.00 37.00 2.24	7456		20.00		
IANK WATER LEVEL STORAGE VOLUME 1. SPILL OUT DEFICIT	(HCH) (HCH) (HCH) (HCH)	W C C C C	160 60	185.20 160.60 0.00	143.40	154.67	78.20 78.20 0.00	W-0	0.00	48800 87.	- 000 - 000	N-000	4.00 4.00
NATURAL RUNDEF AT ANG	CH2H)	151.36	471,83	45.46	176.03	22.96	12,45	40.33	86.6	10.98	61,96	230.61	136.71
FAKAKAMA SAMDOKA NATURAL INFLOR Supply from angar	23	9.0	0.4	.0.0	7	2.0		20	90	0,0	0.1	7.0	2.0
REQUIREN	1111		~~~	9000	0.0	4 4 M (- m	20.2	0.00		• • •	<u> </u>	7
TANK WATER LEVEL STORAGE VOLUME 1.RULE CUR SPILL OUT	(# C # C # C # C # C # C # C # C # C # C		138,80	123,00 135,10	135,10	118.40 132.69	56.67 81.00 81.00	56.40 66.00 75.42	30,43 30,45	20.40	0 V 0 C	58.92 47.30 130.64	95.10 95.10 01.25.1
-0EF1CIT	X 1	6	0					• 0					40
16. SPILL OUT AT ANGAMADILLA		130.89	463,33	23.18	176.03	.	ċ	•	•	•	•	157,21	62.76
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Authority was present Authority was Auth	IVERTED ELOW THROUGH POLGOLLA UNNEL	0.80	N O	m m		19.0	7.0	0.9	10.	٦	0.9	i o	
	. NATURAL RUNOFF AT MORAGAHAKANDA DAM SITE) 112.0	5.0	1.0	0.0	3.0	5.0	0.4	0.9	2.0	•	0.0	55.0
	DIVERTED FLOW TO DEWAHUMA (MC	~ ⋾	1.30	0.70	0.80	4	34.50	3.70	3.10	ec'	2.50		
	DIVERSION REQUIREMENTS (MC ACTUAL DIVERSION ACCUMULATED DEFICII	0.00		0.0	5.4	8 2 2	2 c d	W W G	9 9 0	7.0 0.0	0.0	0,5	
	. MORAGAMAKANDA RESERVOTR												
A CONTINUE WAS INCLUDED 1	CHC CARESERVOIR CHC RELEASE FOR POWER GENERATION CMC RELEASE FOR IRRIGATION CMC	166,7	W 00	600	4.05	85.4 0 17.5	9.56	82. 83. 84.	96.0 0.0	76.2 0.5 5.5	9.50	7.07	6.00
Author March Mar	EVAPORATION RESERVOIR WATER LEVEL (EL. STORAGE VOLUME	187.0	3.0	88.0	2 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	14 82 % 14 80 %	84.0	840	2 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	W N 8	7 0 ° 0 ° 0 ° 0 ° 0 ° 0 ° 0 ° 0 ° 0 ° 0	2000	2000 2000
4. WITH LEASE MENTER LEAVE IN THE CASE OF 12.0 1.10 1.10 1.10 1.10 1.10 1.10 1.10	CPILL OUT POWER OUTPUT FWERGY OUTPUT CAGEOUTPUT	158,4 0 0	, . j	22.0	٠							• • •	200
1. WITH REDITER TOW AT ELLIPS 1. WITH REDITER TOW AT ELLIPS	. NATURAL RUNOFF BETWEEN DAM SITE AND ELAHERA ANICUT	7.9 (٥,	0	œ.	٠,	٠.	٠.	•	۲.	•	•	m,
1.0 STRIPLE EAST DE COURT LEADER 1.0 STRIPLE EAST DE COURT LEADER	" WATER REQUIREMENTS AT ELAHE ANICUT								:	!	; 		i
1.	SYSTEM G AND D1 (MC System D2 (MC	12.0	ъ. О		M 0	٦.	ģ.	8.0	51.7	8.4		0.0	v 0
1.	, ACTUAL DIVERTED FLOW AT ELAHERA ANICUT										!		
10. Interest to 19 19 19 19 19 19 19 19 19 19 19 19 19	TO SYSTEM G AND D1 CMC	12,0	6.8	2.6		-	90	800	51.7	11.4	- C- C- C- C- C- C- C- C- C- C- C- C- C-		5.0
11. CHILLIAN TANK	WATER REQUIREMENTS OF SYSTEM		- 1	1	١,	;]'		1 1	1,	•	ļ	- ['
The control of the	O. GIRITALE TANK	.0.	•	•	*	•	e.	0	ė.	~	°.	•	٩
The contribution of the	NATURAL INFLOV	2.0	- Y	C M	0.4		۰ «	٠ «	• ^	٠ «	0.5	0.0	0.4
	WATER REGUIREMENTS (MC EVAPORATION TANK WATER LEVEL SIORAGE VOLUME 1.RULF CURVECHE	0 0 0 N	V 0 W V V	00000	0000	0444	. n o m h i	W 0 0 V	W0 W W	W044	-048	00-61	0000
THE PROPERTY AND TANK THE PROPERTY OF THE PROP	SPILL OUT 2, ACTUAL CHG DEFICIT (MC	E		M	M	٠	,	•	<u>~</u>	٠			M
### FEERES TO KANDALL TANK (TWEN) 0.00 11.00 0.00 0.0	1. MINNERIYA TANK	2,	, ,	ć	-	ح م			ć	C	4	α.	
12. KANDRIAL INFORMERY TANK (CREEN) 13.0 12.0 12.0 12.0 12.0 12.0 12.0 12.0 12	SUPPLY FROM UPSTREAM (MC		4 4 4	N O	40	S P P	4.01	CMI	0 0 io	400	W 0	10 01	N N O
12. KADOLLA TANK	RELEASE TO KAUDULLA TANK _ CMC WATER REQUIREMENTS	10 M	, 22 54 10 54 10 10 10 10 10 10 10 10 10 10 10 10 10	4 M 00 C	7007	- 6 6 6	, 0 N L	, 0 4 k	, e w .	, O M k	- 0.00	, G , V	96 24
12. KAUDILA TANK	STORAGE VOLUME 1.RULE CURYECTOR 2.ACTUAL	136.9	440	~ d a	- 010 - 010	~ 040	36.	44.	- 40	4 6 5 V	, 0, 0 , 0, 0	400	100
11. ANUBALL TANK	-SPILL OUT	15.6	•••	••	••	•••	••	••	••	••	••		
- STORAGE VOLUE I RULE CURECACE) 183 7 2 2 0 11 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0	Z. KAUDULLA TANK	7.2	٩	١	٩				t.		' C	1~	ļ
	SUPPLY FINTLOW SUPPLY FINTLOW MATER REGUIREMENTS CMC EVAPORATION	2000	404	9000	, ss ss ss	-0 V W		40.0	400	200	1 N N T	1 - W -	00-
13. KANINALITANK 14. KANINALITANK 15.74 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	TANK WATER LEVEL STORAGE VOLUME 1.RULE CURVE(ME 2.ACTUAL (MC	73.2 2.2 3.3 3.3 3.3 3.3 3.3 3.3 3.3 3.3	244 244 285 285	w ← œ ∈	22.4	N 80 80 8	9000	ນ ດ ດ ພິສິສ	ນຄານ ຜູ້ຜູ້ຜູ້	6 4:44 6 8 0 0	ธออ รูนน์	- M. W.	4 40 EC
13. KANTALAI TANK										• •	•		
	KANTALAI TANK NATURAL INFLOW	19.2	2.0	0.	2.0	0.7		.		2.0	٠,٠	2.0	1 0
-STORAGE VOLUME 1, RULE CURVEMENT) 160,60 148,20 135,20 141,20 78,20 11,90 8,70 36,80 81,60 141,20 100,60 144,28 144,00 78,20 11,90 8,70 36,80 81,60 140,60 144,28 144,00 78,20 11,90 8,70 36,80 81,60 160,60 144,28 144,00 78,20 11,90 8,70 36,80 81,60 160,60 100,6	SUPPLY FROM MINNERIYA TANK (4C Mater Reguiremenis Kvadoration	0000		MOMP	n ← N α	- 5 K V	- 00 A	N 0 N 0	wa.o	- 0 W &	- 66-	~ ₩ E π γ φ φ C	000
14. NATURAL RUNDEF AT ANGAMADILLA (MCM) Z80,68 R3,53 53,63 36,20 29,42 12,50 47,56 9,75 16,73 21,43 91,06 225,7 15. PARAKRAMA SAMDURA TANK (MCM) Z80,68 R3,53 53,63 36,20 29,42 12,50 47,56 9,75 16,73 21,43 91,06 225,7	STORAGE VOLUME 1, RULE CURVECHE 2, ACTUAL CMC	160.00	800	N 0 C	10 N	4 4 6	60 EC C	000		80 80 6	• • •		0.0
15. PARAKRAMA SAMDURA TANK 15. PARAKRAMA SAMDURA TANK CHCH) 6.00 1.00 2.00 2.00 0. 0. 0. 0. 2.00 7.0 -HATURAL INFLOW -TANK WATER LEVEL LANGE LANGE LANGE LANGE LANGE LANGE LANGE LANGE LANGE LANGE LANGE LANGE LANGE LANGE LANGE L	DEFICIT NATURAL RUNOFF AT ANGAMADILLA	0		0			• •		· i	ָן • וְיַ			i i
-MATURAL INFLOW (MCM) 6.00 4.00 1,00 2,00 0,00 0,00 0,00 0,00 15,00 15,72,74 39,40 16,58 1,24 72,74 39,40 15,72 12,39 47,13 9,66 16,58 21,24 72,74 39,60 15,74 39,60 15,74 39,60 15,74 39,60 15,74 39,60 15,74 39,60 15,74 39,60 15,74 39,60 15,74 39,60 15,74 39,60 15,74 39	CMCM • PARAKRAMA SAMDURA TANK	280.	^•	7	9	*	•	3	•		•	5 -	. 63
-WATER REQUIREMENTS (MCM) 11.00 24.00 17.00 7.00 27.00 60.00 63.00 54.00 15.00 5.00 9.0 (MCM) 2.29 2.43 3.07 2.96 3.17 3.04 2.58 1.76 1.08 0.94 1.09 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.	-MATURAL INFLOW CMC -SUPPLY FROM ANGAMADILLA CMC	7.2	7 2	-0:	0.0	0.4	2.3	20.	00	0 9	2.0	2 2	0 9
-STORAGE VOLUME TARVOLLE CURVERMENT 170,00 118,40 H1,00 00,00 19,40 E7,70 67,50 73,5	WATER REGUIREMENTS (MC EVAPORATION TANK WATER LEVEL (EL.	22.2	24.0	~ m o	20.05	50 to	0000	W W W .	2(~ - v	7 O O O I	~ 1	0 - 0
-DEFICIT (MCH) G. O. O. O. O. O. O. O. O. O. O. O. O. O.	STORAGE VOLUME 1, HULE CURVERNE SPILL QUT	135.1	× × × ×	က်က်တော်လ	,	7	- 4 0 0			2000		nn d	
	DEFICIT OPFICIT SOLE OUT AT AUGAMANTILA (MC	, ,	0,00	. O.	0 %			• •	.				

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(FCE) (FCE) OL AT ELAHEDA	95.08	136.70	114,29	70.68	129.29	145,83	35,72	0,12	81.07	127.89	140,75	146,13
CECE)	95.98	136.70	114.29	70,68	149.10	145.83	35.72	151.70	81.07	127.89	140.75	148.83
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DIVERTED FLOW THROUGH POLGOLLA TUNNEL	00°64 (H3	58.00	58.00	45.00	44.00	98.00	143.00	135,00	79.00	116.00	120.00	136.00
NATURAL PUROFF AT MORAGAHAKANDA _ DAM SITE	CH) 120.00	118.00		40.00	31.00	24.00	20.00	18.00	10.00	58.00	189.00	246.00
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ION R WATER LEV	CM) 187.00	187.00	185,59 589,31	182.37	177.69 370.62	171.50	166.60		150.00	161.04	178.87 398.21	187.00
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NATURAL BUNOFF BETWEEN DAM SITE AND ELAHERA ANICUT	CM) 7.20	7.08	3,36	07.2	1.86	1.44	1.20	1.08	0 • 0	3,.8	11,34	14,76
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-STORAGE VOLUME 1.RULE CURVE(MCM) 160.60 148.90 135.20 143.90 124.00 78.20 39.7 -SPILL OUT -SPILL OUT -MATURAL RUNDEF AT ANGAMADILLA -NATURAL INFLOW -SUPPLY FROM ANGAMADILLA -SUPPLY FROM ANGAMADILLA -SUPPLY FROM ANGAMADILLA -NATURAL INFLOW -SUPPLY FROM ANGAMADILLA -NATURAL INFLOW -SUPPLY FROM ANGAMADILLA -NATURAL INFLOW -SUPPLY FROM ANGAMADILLA -SUPPLY FROM ANGAMADILA -SUPPLY FROM ANGAMADILA -SUPPLY FROM ANGAMADILA -SUPPLY FROM ANGAMADILA -SUPPLY FROM ANGAMADILA -SUPPLY FROM ANGAMADILA -SUPLY FROM ANGAMADILA -SUPPLY FROM ANGAMADILA -SUPPLY FROM ANGAMADILA -SUPPLY FROM ANGAMADILA -SUPPLY FROM ANGAMADILA -SUPPLY FROM ANGAMADILA -SUPPLY FROM ANGAMADILA -SUPPLY FROM ANGAMADILA -SUPPLY FROM ANGAMADILA -SUPPLY FROM ANGAMADILA -SUPPLY FROM	48.90 141.65 143.90 124.00 78.20 39.70 11.90 8.70 36.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	AGE VOLUME 1, RULE CURVE (MP.) 166,60 146,90 135,20 143,90 124,00 78,20 39,70 11,90 8,70 36,80 81,60 141,00
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SUPPLY FROM ANGAMADILLA (MCM) 39.29 38.13 32.26 11.96 32.47 26.50 50.5 WATER REDUIREMENTS (MCM) 39.00 52.00 15.00 10.00 46.00 61.00 63.0 EVAPORATION	38.13 32.26 11.96 32.47 26.50 50.55 9.66 14.58 19 52.00 15.00 10.00 46.00 61.00 63.00 54.00 13.00 52.43 7.96 2.96 3.17 2.90 2.55 1.76 1.08 18.80 123.00 135.10 118.40 81.00 66.00 19.90 20.40 27 18.80 135.10 135.10 118.40 81.00 66.00 19.90 20.40 33 0.00 0.00 0.00 0.00 0.00 0.00 0.00	LY FROM ANGAMADILLA (MCM) 39.29 38.13 32.26 11.96 33.47 26.50 50.55 9.66 14.58 19.70 59.96 74.58
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1. DIVERTED FLOW THROUGH POLGOLLA (HCM)	85.00	00"77	32.00	101.00	119.00	147,00	142.00	112.00	131.00	143.00	131,00	121.00
2. NATURAL RUNDFF AT MORAGAMAKANDA DAM SITE		00*76	36.00	00.09	31.00	•	13.00	29.00	24.00	93.00	63,00	•
22 2	3.30	1.30	4	0.80	3.30	3.40	3.20	3.10	1.80	_ 2.50 _	. ax. i	1.40
**DIVERSION REQUIREMENTS (MC#)	00.44	57.00	20.57	29.00	80.00 80.00	83.00	83.00	00.64	75.00	000	77	• • •
GAHAKANDA PESERVOIP	•		1: 4 2					4	•			
LOW TO RESERVOIR EASE FOR POWER GENERATION (MCM		78,7	45.7	~ • •	65.7	80.0	67.3	6.0	2 0	2.0	۲۰۰۰ ا	· ·
CARATION (MCA	183.24	181.48	3.10		121.22							187.00
VOLUME T TPUT		N 000	- 000	•	N	,		M 000	,	n 0000	9000	-
RAL RUNOFF BETWEEN DAM SITE ELAHERA ANJOUT	8.04	5,64	2.16	3.60	1.86	1.32						10.74
TER REQUIREMENTS AT ELAHERA NICUT		- 1		ļ		į		ł				
-SYSTEM G AND D1 (HCM)	148.70	133,53	151.55	105.58	151.70	146,81	34.68	109.68	55.46	23.55	102,39	12,42
TUAL DIVERTED FLOW AT ELAHERA Nicut											1	
00	148.70	133.53	151,55	105,5R	151.70	146.81	147.57	109.68	55,46	23.55	102.39	21.76
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(MCM)	12.00	13,00	22.00	20.00	29.00	23.00	19,00	18.00	27,00	12.00	15.00	4.00
NATURAL INFLOR		•	• • •	Ċ.	• '	•'	0	'	9	e,	9	01
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TANTURAL INFLOR	0.0	0.0		0.0	0.0		9.0	6.4	0.0	٠,	•	0.
RELEASE TO KANTALAI TANK (MCH RELEASE TO KAUDULLA TANK (MCH	2 0 N	- 0 2	200	olo W Sign D	4 4 V	1 K C	20.0		C M M	°. °.	- K M	ח' ה מסר
MENTS	34,00	36.00	20.00	2 4 9	34.00	02.00	8 8 6 8 4 6 1 4 4 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	W 600	0 2 6	9 5 6 7 8 8	2.42	2.29
STORAGE VOLUME 1. RULE CURVECACM	990	4 - C		000	01-	. 0 80 C			0.0	. 0 0	900	. O O
103)	::				•		•					••
-NATURAL INFLOR	0	0,	0,	0.0			-	0.	0	77	0	ļ.,
FROM MINNERITA TANK REGULTREMENTS ATION FOR	5005	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7		2000	53.25 53.00 31.00	22.00	00.00 00.00 00.00	4.00 4.00 4.00 4.00 4.00	02.70	62. 62. 62.	40.00 40.00 40.00	7, 1,00 1,00 1,00
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KANIALAI IANK NATURAL INFLOW SUPPLY FROM MINNERIYA TANK (MC*	0.7	2.0		7.0	0.0		0.0		0.0	٠.	9.0	٩.
REQUIREMENTS (SCR RATION (SCR WATER LEVEL (EL.*	52.5	2 2 2 2	2 M C	₹ ₩ ₩	53.5					000	17,00	527
STORAGE V	000		135.20	n n c	440	.c. co c	0.00	- MC	~ ~ ~	36 14 41.96		141,00
RUNOFF AT ANGAMADILLA			• •					• •				
2	131.96	34.36	78.92	37,40	32,76	26.75	38.90	13.26	8	36.42	29.22	169.26
SUPPLY FROM ANGAMADILLA (PCM	N N		25.07	- 4	্ৰা	0.00	- 40 t	- M	- B	200	0 el	다니
ATER REGUIREMENTS (RCM VAPORATION (ACM ANK MATER LEVEL	220	C	0 m 0	0 70	4 W E	-~~	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	3 C P	5 T T		4 + 6	0,40
STORAGE W		80 v C	135.10	135,10	118.40		00.99	19.40 34.48	20.50	67.52	64.00	135.10
FICIT (MCM	0	0.0	0	?		30			, 20			
16. SOLII OHT AT ANGAMADIIIA (KIE)	0		•						•	•		

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有一种,我们是我们的,我们是我们的,我们是我们的,我们们的,我们们的,我们们的,我们们	******** RESERVOIR AND TANK OPERATION FOR WORAGAMAKANDA IRRIGATION PROJECT (YEAR 1970) ********
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WILLIAM THE PRINTED AND THE	" HATURAL RUNOFF BETWEEN DAM SIT AND ELAHERA ANJOUT	HOH)		~	1.14	-	D.	٥		•	. 4				
Comparison Com	• WATER REQUIREMENTS AT ELAHERA ANICUT									 	ı	ł			
The straint interior took in the first 19,70 19,50 19,	SYSTEM G AND D1 C SYSTEM D2	HCH) 15	1.70	33.5	17.5	14.4	51.7	φ. φ.	0.4	7.0	80	5.0	39.7	4.33	
C. STITLE THE THE THE THE THE THE THE THE THE TH	. ACTUAL DIVERTED FLOW AT ELAHER ANICUT								 	ļ					i
Contract Face Contract Fac	TO SYSTEM G AND D1	MCH) 15	07.	33.5	50.4	14.4	51.7	15.9	6.0	8.0	٠.,	8.0	80		
Column C	. WATER REQUIREMENTS OF SYSTEM		:											'	
STATE COLOR PRINTER COLOR PRINTER COLOR PRINTER PR	. GIRITALE TA	CH)	M :	3.0	2.0	° 0	0.0	3.0	6	0.	•	5.0	0	. 00	
	NATURAL INFLOW	(Y))))))))))))))))))		•`	٠.	•	٠.	• •	٠.	٠.	•	-		0.1	
	EVAPORATION TANK WATER LEVEL STORAGE VOLUME 1.RULE CURVEC	- 600 100 100 100 100 100 100 100 100 100	MONING	00000	Jace c	40-446 000	00	. w o a w w c	00000N	1000000	0-000	4 0 4 8 8 6 - 0 4 7 9 9	7000440	22.00 22.00 22.00 20.00 20.00	1
## ## ## ## ## ## ## ## ## ## ## ## ##	* PINNERIYA TANK									;;			;;		
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- THINK UNITER LEVEL 10.00	RELEASE TO ANATOLA TANK RELEASE TO RAUDULLA TANK RECOURS REQUIREMENTS EVAPORATION		MOW 2		. W B V	40 M	800	40 A		4-4	- MM			67.15	
2. KAÜDULI TANK	TANK WATER LEVEL STORAGE VOLUME 1.RULE CURVES 2.ACTUAL (2 () () () () () () () () () (0 40 0 0 0 0	0.00.0 0.00.0	000	o ojo c	o aloc o ola	0000	o dv c	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0	0 0 0 C	0 40 0 C	0 0 0 0 0 0 0	ı
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STORAGE VOLUME 1. RULE CURFF(FLZ) 178.7 72.7 72.7 72.7 72.7 72.7 72.7 72.7	NATURAL INFLOW SUPPLY FROM MINNERIYA TANK (MATER REQUIREMENTS FVADORATION	NO CO	MOM	0-04		0.00	- V V V	0,000	ME OV	OMM	0000	2000	0 M O O	11.00	
**************************************	TANK WATER LEVEL Storage volume 1. Rule Curyer 2. actual	HCH) 12	040	4.96	727	122	N N N N N N N N N N N N N N N N N N N	400	W O O	244	900	4 8 0	27.0	C 4 4	1
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- Spill Out at angular Level (ELM) 58.36 57.26 5	KANTALAI JANK NATURAL INFLOM SUPPLY FROM WINNERIYA TANK WATER REQUIREMENTS	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	000	0-0	V V 60 +	0000	0.00	0.00	0.00	25.0	0000		0000	28°85 7°00 7°00	
SPILL OUT SPILL OUT CHCH) 154,19 128,70 129,70 140,35 142,87 102,70 5,43 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	TANK WATER LEVEL STORAGE VOLUME 1.RULE CURVEC	1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	7 0	57.69 48.90	25.0	10 N	27.72	, with 4	2 2 N	86	- ec r		- 0 0 - M - 1	20.	1
4. NATURAL RUNOFF AT ANGAMADILLA 43.34 36.73 30.43 32.26 20.65 9.34 9.40 10.46 2.52 10,46 38.30 1 5. PARAKRAHA SAHDURA TANK -NATURAL INFLOW -SUPPLY FROW ANGAHADILLA (MCM) 62.00 1.00 1.00 1.00 5.00 1.00 5.00 1.00 5.00 5	SPILL OUT 2.ACTUAL C DEFICIT	C C C C C C C C C C C C C C C C C C C		0.00	000	v. 0	8.00		*		M		• • •		
5. PARAKRAMA SAMDURA TANK -NATURAL INFLOW -NATURAL INFORMATION -NA	4. NATURAL RUNOFF AT ANGAMADILLA (HCH) 4	m	6.7	7.0	2.2	9.0			1 4		0	KG	145.38	-
-SUPPLY FROW ANGAHADILLA (MCM) 42.95 36.40 30.16 51.97 20.47 9.26 9.32 10.37 2.50 10.57 23.17WATER REQUIREMENTS (MCM) 52.00 41.00 24.00 18.00 53.00 53.00 23.00 23.00 53.00 3.00WATER REQUIREMENTS (MCM) 52.00 41.00 24.00 2.85 0 53.00 53.00 3.00 3.00TANK WATER LEVEL (EL.M) 58.64 58.43 58.60 59.10 58.42 56.26 55.69 52.15 52.91 53.17 55.81TANK WATER LEVEL (EL.M) 58.64 58.43 58.60 59.10 58.40 57.75 61.59 21.52 52.91 53.17 55.81TANK WATER LEVEL (MCM) 120.00 118.80 123.00 135.10 118.40 66.00 19.90 20.40 27.75 47.30SPILL QUI CHEM) 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.	S. PARAKRAMA SAMDURA TANK NATURAL INFLOW	(101		2.0		0.		0	2	9	0	n	5.0	80	
=EVAPORATION -EVAPORATION -E	SUPPLY FROM ANGAMADILLA C	# (E)	이이	40	40	48. 000	20.0	O M	NO.	W 00	· ·	N 0 0	W.W.	K. O.	•
-SPILL QUI	EVAPORATION TANK WATER LEVEL STORAGE VOLUME 1, RULE CURVEC	ACE 2	240	2,36 18,43 18,80	58.6 23.6	50°3	5.85	0.001	400	- 29 60 60	-001	- N V (- 20 P.	59.70	
. SPILL QUT AT ANGAMADILLA (MEM) 0. 0.00 0. 0. 0.00 0.00 0.00 0.00 4.8	PILL OUT	HCH)	٤	00.00				, ,	- 0-0						1
	6. SPILL OUT AT ANGAMADILLA (£	•	٠.	• 0	• 0	•	•	•	٥.	ė.	•		81.01	

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1. DIVERTED ELOW THROUGH POLGOLLA (M	CH) 87,0	0 43.00	24.00	114.00	130,00	147.00	144.00	151,00	147.00	150.00	107.00	80.00
, NATURAL RUNOFF AT MORAGAHAKAN DAM SITE	61.	19.	•	•	21.00	18.00	26.00		P 1	-	21.00	•
IVERTED FLOW TO SYSTEM HAIH	HH		1 4		7	4 7	7 ,	1	9		ri i	ا الله الإ
-ACTUAL DIVERSION -ACCUMULATED DEFICIT	0 0 0	23.40	32.49	83.00	8 110	83.00	28 20 20 20 20 20 20 20 20 20 20 20 20 20	78.00	00.72	83.00	83.00	00.17
UMAGAMAKANDA RESERVOIR	H) 130	0 36,30	8.	2,2	٠.	7.	~	ō.	~	0.5	۲.	4.6
RELEASE FOR POWER GENERATION (RELEASE FOR TRRIGATION (EVAPORATION	148	159.3		0-10	OMIC	70.02	r√in.	050	OM C		0 20 0	. ~4*
OIR WATER LEVEL E VOLUME OUT	4,74,74 4,74,74 10,000,000,000,000,000,000,000,000,000,	455.91 7 55.18 0.00		21.70	150,000 21,70 0.00	20-00	21.70	21.021				
ENERGY OUTPUT (1000	O M	< −				•	9			•		
TER REGUIREMENTS AT ELAHERA	•	-	•		•	•	• i	• 1	•	•	•	•
-SYSTEM G AND D1 CM	CH) 151.7	133,53	151.55	140.25	151,70	146,81	151,70	151,70	141,53	151.70	146.81	134,33
8, ACTUAL DIVERTED FLOW AT ELAHERA ANICUT]	1] 	į	
110 SYSTEM G AND D1	CH) 151.7	26,97	00.0	63.70	64.43	78,12	83.27	103.27	116.22	91.65	43.57	102.87
V. WALER REGULARINGS OF STREET G	23.0	0 13.00	22,00	17.00	29.00	23.00	19.00	26.00	20.00	24.00	21.00	00.7
IRITALE TANK									!	•		
SUPPLY FROM UPSTREAM	15.7	00	v	• •	0 ~	ئارە	-8-	80	۰	٠.,	٠.	o m
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JINNERIYA TANK				;	•	;	:	•	;	;		;
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TO KAUDULLA TANK (M.	5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		C 20 C	24.7	C 60 60		9 0 0			22.87	200	3 3 0 3 4 0 3 4 0 4 4 0 7 6 0 7 6 0 7 7 6 0 7 7 6 0 7 7 6 0 7 7 6 0 7 7 6 0 7 7 6 0 7 7 6 0 7 7 6 0 7 7 6 0 7 7 6 0 7 7 6 0 7 7 6 0 7 7 6 0 7 7 7 6 0 7 7 7 6 0 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
EVAPORATION TAVK WATER LEVEL STORAGE VOLUME 1.RULE CURVE(M	89.0 89.0	89 - 9 136 - 9	400	~ 6 6 M 6 6	~ 0		89.30 36.90	800	W - Q	N O O		- 0.9
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L INFLOW FROM MINNERIYA TANK (M REGUIREMENTS ATION (F	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	3 32.03	60.0	16.82 10.00 20.00	28,00	007	0 0	0 0 M 0	25.91		39.00	41.68 11.00
TANK WATER LEVEL STORAGE VOLUME 1.RULE CURVE(M. Z.ACTUAL (M.	H) 67.5	114.5	111.60	- 40 -	• = •	20. 50 5.00 5.00	39.90		800	vn ∞ ←	OMO	W R
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INFLOW INNERIYA TANK CH EDUIRFWENTS	H) 27.6	292	0.0	10.00		000	000			00M		
EVAPORATION TANK WATER LEVEL STORAGE VOLUME 1.RULF CURVERM	H) 53	2 - 2 - 4 - 4 - 4 - 4 - 4 - 4 - 4 - 4 -	2.23	~~~ ~ 4,0	7 8 7				C 40 K		0 0 0	-46
SPILL OUTS	22.00		000						00.00		000	
RAKRAM	H) 48.34	39.83	16.80	28.02	16.74	11.92	21.44	28.02	33,36	22.38	16.74	76,36
NATURAL INFLOW SUPPLY FROM ANGAMADILLA CM	47.9	39.4	- VOI	0.7	+ o]	40 I	2.	٥٠	0.2	0.0	0.0	5 N
REQUIREMEN ATION ATER LEVEL F VOLUME	52,00 27,7 27,7 28,84 120,00	58,00 2,39 118,80	26.00 27.96 123.96	3 2 3 4 4 6 6 4 4 4 6 4 4 4 6 4 4 4 4 6 4	39.00 3.13 57.90 118.40	61.00 2.80 55.12 81.00	66.00 66.00 66.00	54.00 14.00 19.90	1,05 20,40 20,40	29.00 1.17 53.03 27.70	24,00 1110 52,39 47,30	24 24 24 24 24 24 24 24 24 24 24 24 24 2
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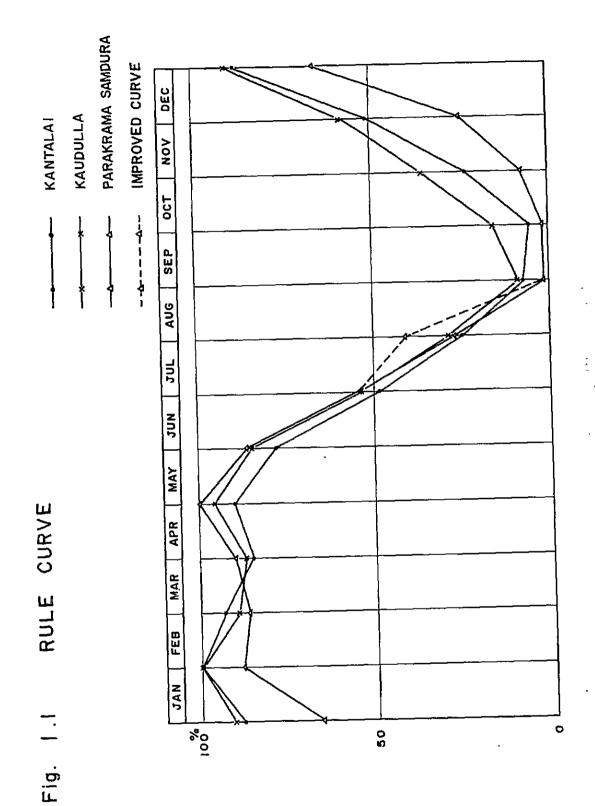
		JAR	FEB	HAR.	APR.	F 4 X 3 1 1 1	JUNE	105	AUG.	SEPT.	061.	. VOX	066.
1. DIVERTED ELOW THROUGH POLGOLLA	HUMD	85,00	36.00	39.00	84.00	101.00	140.00	139,00	150.00	146.00	152,00	147,00	144,00
. NATURAL RUNOFF AT MORAGAHAKAN DAM SITE		78,00	38.00	45.00	22.00	25.00	25.00	23.00	30.00	29,00		145.00	116.00
4. DIVERTED FLOW TO SYSTEM H.IH AN "DIVERSION REQUIREMENTS (M -ACTUAL DIVERSION CM -ACCUMULATED DEFICIT	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	7 00	83.00 28.37 54.63	75.00		75.00 80.04 109.65	• • • •	62.00 83.00	76.00	1	58.00		00.74
IAKANDA RESERVOIR	á	,	بر بر	0	٥	•	ر. ب	4	0	~	, ,	7 7	9
TO RESERVOIM FOR FOR TRRIGATION CONTRACTOR C		0.4	4 0 M	2 C C C C C C C C C C C C C C C C C C C	39.03	201	20.02		62.06			-040	- 0 N +
ATION OF WATER LEVEL (E OUT OUT OUTPUT (1000		000	21.70	0-000		70-000	00-000	00000	0-000		0 - 0 0 0	20000	
RUNOFF BETWEEN DAM SIT AHERA ANICUI EQUIREMENTS AT ELAHERA		89°7	2 • 2 B	2,70	1.32	1.50	1.50	1,38	1.80		3. t	•	9
SYSTEM G AND DI		10.53	134.59	138,75	145,52	151.70	146.81	138.99	151.70	146,81	151.70	135,41	139.67
<u> </u>	4							•	j	1	1	-	
-TO SYSTEM G AND D1 (A) -TO SYSTEM D2 (A) UATER PEDUTREMENTS OF SYSTEM G		0.70	45.21	51.25	40.35	42.63 0.	78.54	75.119	101,09	97.32	114.41	135.41	139_67
	K C M O M	18,00	14.00	12.00	25.00	28.00	23.00	15.00	27.00	27,00	24,00	8.00	8.00
GIRTTALE TANK NATIDAL TREFOC	3	•			•	•	c	-	c	•	c	-	•
REQUIREMENTS C		0,00	0 N C +	4 50 0 +		M' - 0 +	15.00		11.00	000	6000	· 64 4 60	0 N O +
-STORAGE VOLUME 1, RULE CURVEC -SPILL GUT -DEFICIT	2272	00 m m m m m m m m m m m m m m m m m m					000	W W	WW.	4 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		22.80
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STORAGE VOLUME 1, RULE CURVEC 2, ACTUAL (SPILL OUT (9000	9000	9 - 0	4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	이 - 이 -	9,000	000	9600	4 6 0 0 V	66.00	9600	9000
KAUDULLA TANK	- 1	1	j	j		ļ	-		•	i	1	ŀ	ł
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SPILL OUT 2.ACTUAL (DEFICIT (0 0	7 . 3	0.00	2.0	9 6	W 0 4		0 N	6.0	\$ 0 0 • • • 0	4	
NATURAL INFLOR	<u> </u>	0.4	50	~0	7.0	0.0		2.0	. 00	0.	200	2.2	0.0
MEDUIMEMENTS RATION WATEP LEVEL GE VOLUME 1, PULE		2 2 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	62 - 00 1 - 8 4 1 - 8 6 1 - 8	42.80 135.20	25.69	124.00	28.29	39,70	42,86	2 4 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	0 4 4 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	22.00	56.1.89 1.89 2.1.9.1.4.
SPILL OUT DEFICIT NATURAL PUNOFF AT ANGAMABILLA	221 111	4.00 	004 N			.2.		008	2.0	900		57. 0. 0.	·
ARAKRAMA SAMDURA TANK	6 (H3)	5.32	32,72	38.30	17.68	21.50	22.50	19.62	26.20	27.26	19.62	117,30	70°96
SUPPLY FROM ANGAWADILLA C WATER REDUIREMENTS	(I) (I)	2.0	222	500		2.5	2.0	0 4 0	0 0 0	0 %	000	7 0 7 0	0.40
VAPORATION ANK WATER LEVEL TORAGE VOLUME 1	25.55	1,94 0,00 1,00 1,00 1,00 1,00 1,00 1,00 1,0	2.24 57.61 18.80 00.03	29.02 123.00 133.17	59,10 135,10	58.61 118.60 123.24	8 1,59 81,00 81,59	2, 2, 5, 6, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	54,88 14,88 10,40	20, 40 20, 40 49, 58	55.64 27.70 60.57	122.89	59.10 95.10 135.10
-0EFIC11 (5 to 1			٠ ،		0		00	• •	• •	. '		
1. 10. SPILL OUT AT AMBAMADILLA CE	E.	•	0.00	00.0	15.79	•	00.0	•	6. °		3.17	48.64	, r. 63

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4 E K	******* RESERVOIR AND TANK OPEPATION FOR MORAGAHAKANDA IRRIGATION PROJECT (YEAR 1976) RESERVE	
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Existing Canal Layout

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Fig.

I-156

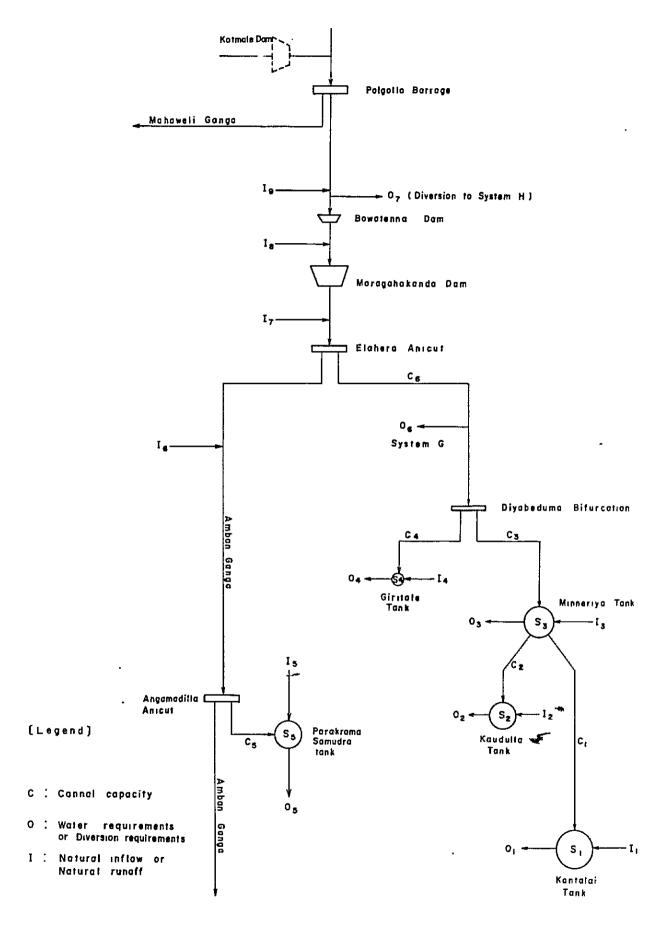
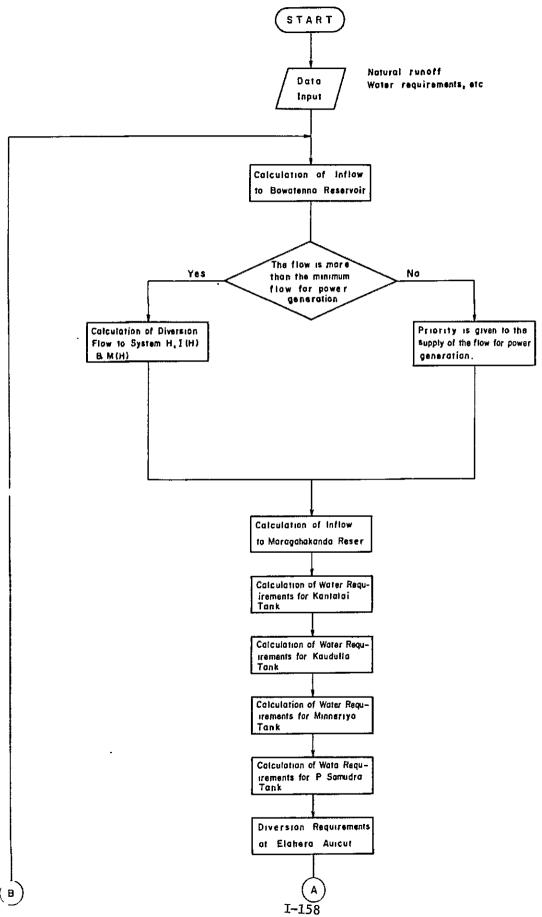
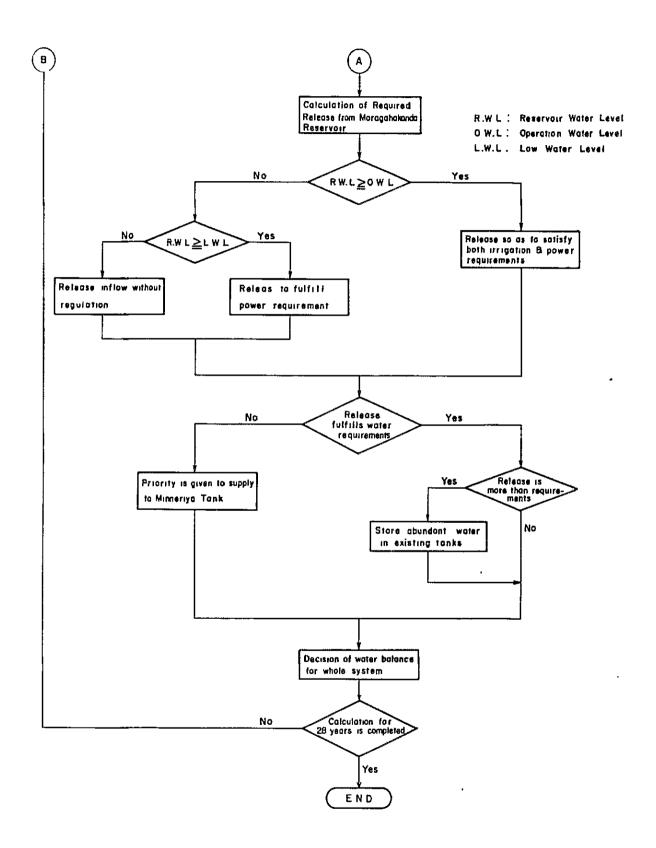
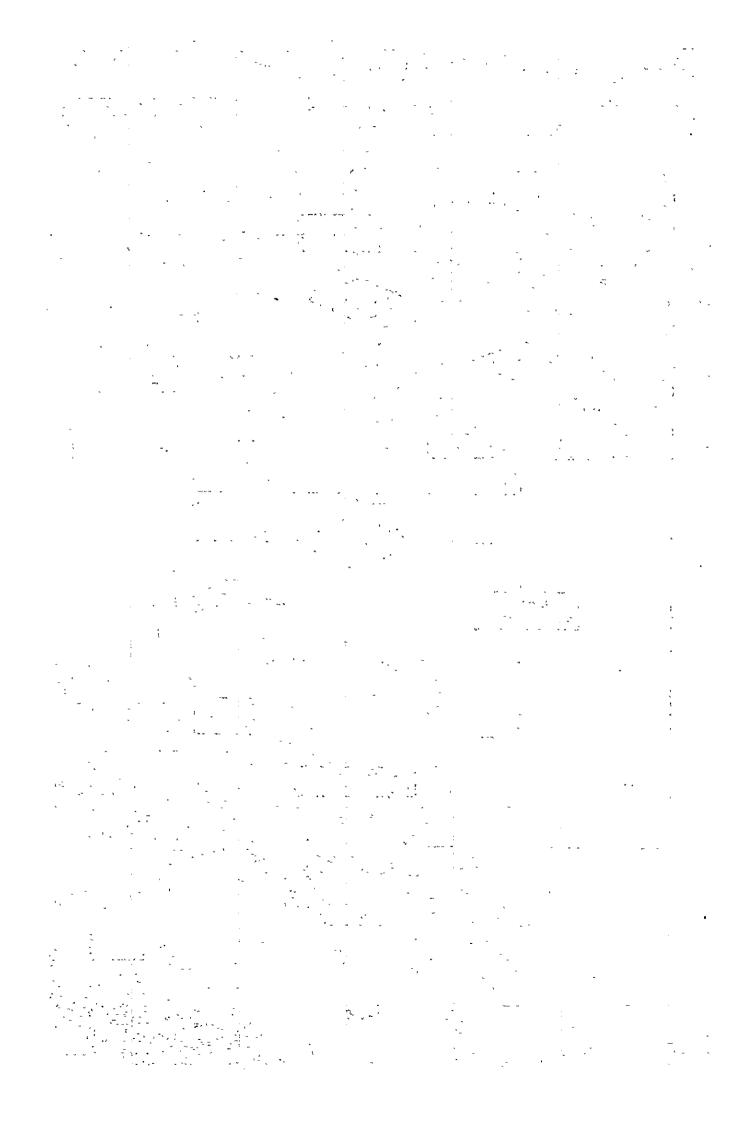


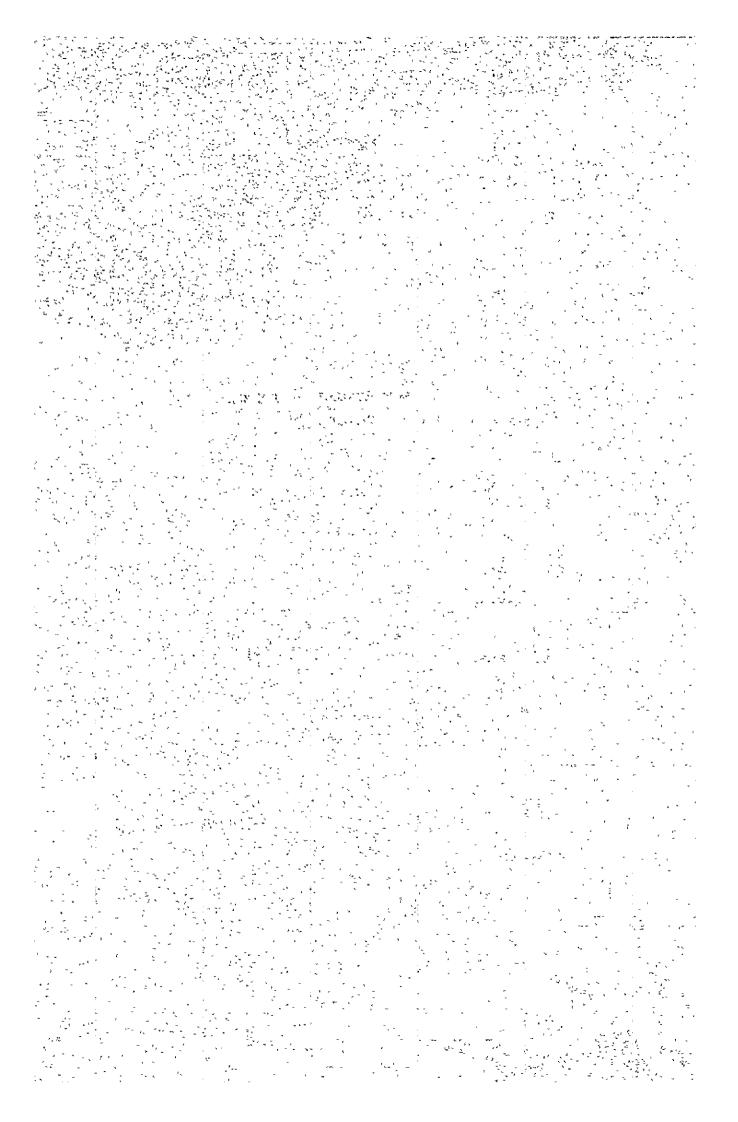
Fig. 1.3 Flow Diagram I-157

Fig. 1.4 Flow Chart of Computation Procedures











ANNEX II: FOUNDATION AND

CONSTRUCTION MATERIAL



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1. General Geology

Topography of Sri Lanka is characterized by three steps of peneplains. The highest peneplain forms the so-called Central Highland including Nuwara Eliya, from 1,500 m to 1,800 m in altitude, in the center of the island. Topography of this area is rather of steep mountains as the result of deep downward erosion below the surface of the peneplain. The highest peak Pidurutalagala (2,527 m) is located in this zone. The middle penelpain forms the area of 90 m or 120 m to 750 m in altitude, surrounding the highest peneplain, and is characterized by mildly undulating terrain, hills and small mountains. The lowest peneplain is developed extensively in the coastal region within 120 m in altitude, surrounding the middle peneplain. Topographic characteristic of the lower peneplain is flat plain with scattered heights of erosion remnant.

Geologically, the island of Ceylon is a part of very old and stable continental mass of the South Indian Shield, consisting of highly crystalline metamorphic rocks (See Fig. II.1.1). The most part of the island is composed of pre-Cambrian Highland Series and Cambrian Vijayan Series; the former exposed in a belt with 50 to 100 km of width stretching in the direction of north northeast to south southwest through the middle part of the island and the latter forming about 50 km wide belts on both sides of it. Miocene sedimentary rock beds are located on the northwestern coastal region. Besides these there is a very local patch of Mesozoic rocks in the northwestern part. Quaternary deposits are composed of unconsolidated material of various grain sizes, from clay to gravels, of which some are flood and terrace deposits formed along rivers, some are residual soil and scree or talus on hill slopes and others are marine and lacustrine.

Geological history of Sri Lanka starts in the pre-Cambrian era with thick sedimentation in a geosyncline, which underwent regional metamorphism to produce metamorphic rocks of the Highland Series. In Cambrian period, another metamorphism exerting a part of the above metamorphic rocks resulted in polymetamorphosed Vijayan Series. From the late Paleozoic to the late Mesozoic, it was a part of Gondwana Land which covered the southern hemisphere extensively. During this period, the tectonic activity in Sri Lanka was predominantly upheaval and erosion, but for a very partial sedimentation occured in Jurassic. The subsequent periods

after disappearance of the Gondwana Land up to the recent age have still kept on seeing upheaval and erosion in the most parts of the island, except in the northwestern part where marine transgression occured in Miocene. The outstanding development of the peneplains was also due to these activities.

Foldings are observed in these metamorphic rock beds of the Highland Series and the Vijayan Series. Trend of the folding axes shows north-south in general and northwest-southeast in the southwestern part on the area of the Highland Series. In the area of the Vijayan Series, those axes are more varying in direction and less continuous. Faults show main trends of northeast-southwest and nothwest-southeast.

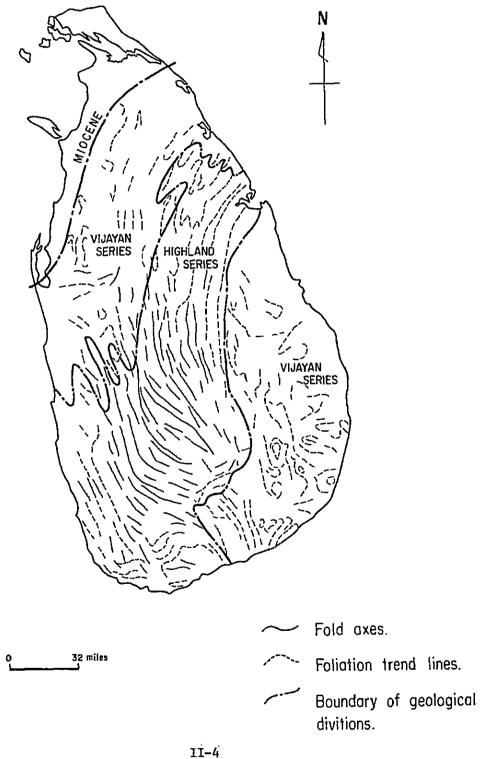
The Mahaweli Ganga, the biggest river in Sri Lanka with 330 km of length, originates in the mountain ridges, more than 1,800 m high, in Muwara Eliya, flows about 85 km intricately bending but generally northward to Kandy, then 55 km southeastward and then 190 km north and north northeastward till it pours into Koddiyar Bay near Trincomalee. The final course of 190 km is situated for the most part on the lower peneplain below EL.120 m. The Amban Ganga is the biggest tributary of the Mahaweli. Originating on a mountain slope at 1,300 m in altitude about 12 km southeast of Matale town, it flows 50 km northward to the existing Bowatenna dam, then 25 km eastward to Elahera and then about 45 km northeastward until it flows into the Mahaweli main stream at its 80 km upstream from the estuary.

The irrigation area of the Project develops in an extensive lower peneplain on the west bank of the lower Mahaweli Ganga and the Amban Ganga in the downstream reaches from the proposed damsite, about 4 km southwest from Elahera. From geological viewpoint the project area is situated for the most part in the zone of the pre-Cambrian Highland Seies and partially in the transition zone from the Cambrian Vijayan Series exposed on the eastern side of the Mahaweli main stream, all of which are composed of highly crystalline metamorphic rocks.

(See Fig. II.1.21)

The Highland Series comprises three groups of rocks, that is, Khondalite group, Charnockite and Kadugannawa gneisses, as described in the Table II.1.1, which occur in alternating thin strata and not in regionally separate formations. Rocks of the Highland Series are characterized by such contained minerals as garnet, sillimanite, graphite, cordierite and hypersthene, which are very rare or lacked in the polymetamorphic Vijayan Series. Quaternary unconsolidated deposits covering these rocks are within a few meters in thickness generally in the Project area.

The main geological divisions and simplified Fig 11.1.1 geological structure.



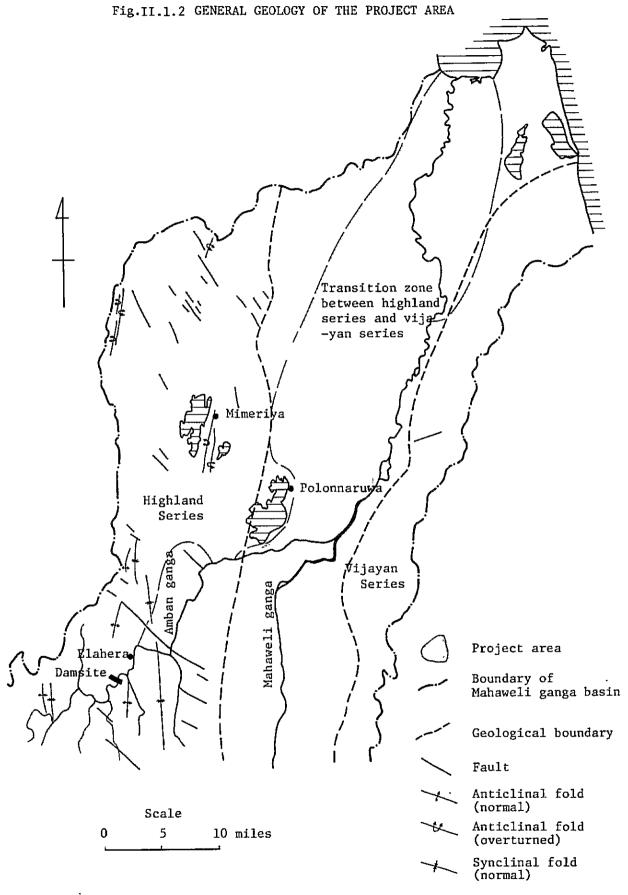




Table $_{
m II.1.1}$ Stratigraphic column of the project area

Era	Period	Formation	Main rock types and lithological o	lescription
Ceno	Quat	Alluvial Deposit	River bed and flood plane deposit. Composed m	mainly of clay, silt, sand, with gravels
-zoic	-ernary	Reddish brown earth	Clayey sand, silt and loam. Residual deposit	and talus deposit.
Paraeo -zoic	Cambrian	Vijayan series	Gneiss, gneissose granite, granitic gneiss, granite, Augen gneiss, migmatite	: Composed of quartz, microcline (potassium feldspar), plagioclase, biotite and hornblende.
			(Khondalite group) Garnet - sillmanite schist and gneiss or Khondalite.	: Metamorphosed clays or shales (alumina-rich sediment). Characterized by alumina-rich minerals as sillimanite and garnet (almandin). Garnets are very large. Containing small amounts of graphite
i.			Quartzite and Quartz schist	: Metamorphosed sandstones. Composed of shapless crystalline quartz, with small amounts of sillimanite, garnet and magnetite. Quartz schist contains much feldspar. Frequently jointed and very permeable.
Pre-can	nbrian	Highland series	Quartz-feldspar granulite and garneti- ferous gneiss.	: Metamorphosed sandy clays or clayey sands. Light coloured rocks. Composed mainly of quartz and feldspar, with varying amounts of mica and garnet. Sometimes containing sillimanite and graphite.
			Crystalline limestone or Marble.	: Metamorphosed sedimentary limestone. Generally white coloured rocks. Composed mainly of calcite and dolomite, with varying amounts of silicate minerals. Partly accompanied by solution caves.
			Calc granulite and calc gneiss	: Metamorphosed calcareous muds or marls and calcareous sands. Dark greenish to blackish green coloured rocks. Composed mainly of diopsite, scapolite and hornblende, with abundant sulphide minerals. Sometimes containing much mica.
			Graphitiferous schist	: Metamorphosed muds with much organic matter. Characterized by many graphite and sulphide minerals.
			(Charnockites) Charnockites have several various rock types, range from fine to coarse-grained in the size of minerals, from acidic to basic in mineral composition, and from equigranular to gneissic in texture. (Kadugannawa gneisses) Amphibolites (hornblende-plagioclase schist)	 Greenish-grey or bluish-grey coloured rock. Characterized by greenish or greyish coloured crystals of quartz and feldspar, and dark pyroxene (hypersthene). Composed mainly of quartz and feldspar or plagioclase or pyroxene, with mica, hornblende and garnet. Methamorphosed sediments or volcanic rocks. Composed mainly of hornblende, plagioclase, feldspar, mica and some pyroxene. Metamorphosed impure calcareous rocks or volcanic rocks.

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2. Foundation

2.1. Foundation investigations

One of the previous investigations was performed by UNDP/FAO as a part of the Mahaweli Ganga Irrigation and Hydropower Survey from 1959 to 1968. It comprised geological mappings of the reservoir area with topographic map in scale of 1 inch to 0.5 miles and of the damsite in scale of 1 inch to 200 ft, core drilling at 40 spots with more than 1,500 m of total length, nine observation trenches and geophysical investigations. The other previous investigation was carried out by the Irrigation Department of the Government up to 1978, with 29 core drilling holes totaling 902.1 m (2,959.75 ft) to obtain the additional data.

Succeeding and based on the study of the results of those previous investigations, proposed and performed were the present froundation investigations for supplementary data, that includes geological mapping of the damsite in scale of 1/1,200 (1 inch to 100 ft), core drilling with water pressure test, test grouting, adit excavation, in-situ rock mechanical test and geophysical (seismic) exploration. Detailed quantities for each item are as follows:

(1) Core drilling

Hole No.	Depth (m)	Inclination of hole	Water press. test (times)	Location and remarks
DM-29	46.00	Vetical	-	Quarry site "Q-I"
DM-30	52.70	60° from hori-	14	Main damsite
DM-31	52.40	zontal	14	tt
DM-32	12.00	Vertical	_	п
DM-33	13.90	tr	_	11
DM-34	15.60	ti	_	11
DM-35	60.95	n	18	First sub damsite
DM-36	61.25	11	16	Second sub damsite
DM-37	61.60	11	18	Ħ
DM-38	58.35	n	14	11
DM-39	91.45	11	_	Quarry site "Q-II"
DM-40	91.75	"	_	11
DM-41	45.70	11	-	b T
DW-1	30.00	п	_	Diversion weir site
DW-2	19.50	11	_	IT .
14 holes	713.15		94	

(2) Seismic exploration

 Exploration line	Length (m)	Location	Reamrks
CA	800	Main damsite	Parallel to dam axis
СВ	385	11	11
CC	305	II .	Vertical to dam axis
CD	305	11	11
CE	205	11	ti
RA	800	First sub damsite	Parallel to dam axis
RB	300	11	Vertical to dam axis
EA	605	Second sub damsite	Parallel to dam axis
EB	405	tī	11
	ł I		l

continued

Exploration line	Length (m)	Location	Reamrks
EC	505	Second sub damsite	Parallel to dam axis
NCP-A	355	Diversion weir site	Vertical to river
NCP-B	335	"	***
12 lines	5,305		

(3) Test adit

ı	 	Length		
No.	Open cut (m)	Tunnel (m)	Total (m)	Location
1	7.2	25.8	33.0	Right bank of main damsite
2	9.00	26.50	35.50	n
3	9.75	48.75	58.50	11
4	7.00	29.00	36.00	Left bank of main damsite
5	4.50	40.50	45.00	11
6	15.00	30.00	45.00	Right bank of first sub damsite
7	65.00	α	65.00+α	Left bank of first sub damsite
8	16.00	21.00	37.00	II
	133.45	221.55+α	355.00+α	

No.7 is not completed.

(4) Test grouting

Location: Left bank of first sub damsite

Hole No.	Drilling depth (m)	Depth of grouting section (m)	Remarks
GH-1	27.45	11.05 - 27.45	Grouting hole
GH-2	27.45	13.60 - 27.45	11
GH-3	38.00	4.85 - 38.00	tt
GH-4	27.45	12.67 - 27.45	Check and grouting hole
GH-5	27.70	12.95 - 27.70	Grouting hole
GH-6	27.45		· Check hole
6 holes	175.50		

(5) Rock test

Location: Test adit No.5, left bank of main damsite

Plate load test : 4 points Rock shear test : 4 points

-Method of test grouting

The test grouting was performed in the following procedures.

(1) Sequence of the work

The grout holes GH3, GH1 and GH2, allocated at three corners of a regular triangle with side length of 2.15 m, were drilled, water-pressure-tested and grouted by step of 4.5 m (15 ft) in down-stage from the top. Then, a check hole GH4 was drilled at the center of the said triangle and water-pressure-tested by 4.5 m down-stage to examine the effect of the above groutings. As the results of the water pressure tests in GH4 were not satisfactory, the hole was grouted by 4.5 m up-stage. And then, a grout hole GH5 was drilled, water-pressure-tested and grouted by 4.5 m down-stage at the symmetric position with GH4 in relation to the line GH1 to GH2, so as to make a smaller triangle GH2-GH4-GH5 with side length of 1.23 m. Last of all, a check hole GH6 was drilled and water-pressure-tested at the center of the smaller triangle to examine the effect of groutings with the shorter spaced holes.

(2) Grouting pressure

The maximum allowable pressure for the test gouting was as below.

Depth (m)	Max. allowable pressure	(kg/cm ²)*
4.85 - 14.0	3.0 - 4.0	
14.0 - 18.5	6.0	
18.5 - 23.0	8.0	
23.0 - 27.5	10.0	

^{*} The pressure read at the neck of the holes.

(3) Mix proportion of grout

Mix proportion of grout used for the test is as follows. The mix proportion in the left column of the table below is changed to that in the right column when the gouting is in the condition as indicated in the middle column.

Mix proportion	When average grout	Mix proportion
Cement grout	take in 20 minutes	shall be changed to:
(cement/water	is more than:	
in weight)	lit./min./m	
1/10	6	1/5
1/5	6	1/3
1/3	5	1/2
1/2	4	1/1
1/1	Regardless the grout t 1/1 is to be continued completion. If grout extraordinarilly much,	until

Mortar grout (sand/cement/water in weight)

1/1/1.3 To be continued until completion.

Grouting was started with injection of grout at 1/10 in case that foregoing water pressure test showed leakage lower than 10 Lugeon unit. Otherwise, it was started at 1/5.

-Method of in-situ rock test

In-situ rock tests comprise plate loading tests at three spots to obtain the moduli of elasticity and deformation and a shear test with four concrete test blocks placed on bed rock, all performed for charnockite in the adit No.5 on the left bank of the main damsite. The principles and methods of the tests are as follows:

(1) Plate loading test

Principle

Moduli of elasticity and deformation are given by the following equation.

E or D =
$$\frac{1 - \mu^2}{2a}$$
 . $\frac{\Delta P}{\Delta s}$

Where,

D: Modulus of deformation (kg/cm²)
E: Modulus of elasticity (kg/cm²)

μ: Poisson's ratio (assuming 0.2)

a: Radius of loading plate (cm)

 ΔP : Certain increase of load (kg)

 Δs : Increase of displacement by the above increase of load (cm)

As Poisson's ratio does not effect much difference in the values of E or D, a certain appropriate value for μ is assumed. The radius of loading plate (a) is given of itself. It is the purpose of test to obtain $\Delta P/\Delta s$. The value $\Delta P/\Delta s$ is obtained from inclination of load-displacement curve, and varies depending on the inclination of what part of the curve is taken, as shown in Fig. II.2.1. So called "tangential elasticity" (Et) is calculated with the inclination of the curve in the section of rather high load or the range of expected load effected from the designed size of structure. As the curve is usually steeper in the range of high loading, the tangential elasticity is higher than the other values following. So called "secantial elasticity" (Es) is calculated by the inclination of a straight line combining the bottom and the top of each load-displacement curve, and is used in case when the design condition is not yet established. This Es inplies partly the effect of non- elastic irrevocable displacement. Deformation modulus (D) that counts all dis-

placement from the start of the test shows a total deformability characteristic of bed rock, both elastic and non-elastic. Naturally the value D is smaller than the others.

Creep ratio (Cf) is calculated by the following equation.

$$Cf = \frac{dc}{de}$$

Where,

dc: Displacement by creep (Amount of displacement during the sustained load)

de: Elastic displacement (Amount of displacement by the load increased form zero to the sustained load, in the loading cycle for observation of creep)

(See Fig. II.2.2)

Method

Equipments used for the test are as follows:-

Hydraulic test jack with a separate oil pump capacity 100 ton 1 unit Steel loading plate diameter 350 mm, thickness 32 mm 2 nos. Dial gauge nimimum reading 1/100 mm, stroke 50 mm 4 nos. Column supports for 2 m, spherical adjuster, steel channel beam for dial gauge supporter, dial gauge holders, etc.

Loading patterns are shown in the load-time graph in the drawings of tests. Applied maximum load was 40 tons (41.6 kg/cm²) and 60 tons (62.4 kg/cm²), that are approximately the expected load from the designed dam. Rate of loading up and down was 3.55 ton/min. (3.7 kg/cm² every minutes.) Vertical displacement was read by four dial gauges every minutes (every 5 tons of charge of load) in the course of loading up and down, and every 5 minutes when load was sustained.

After cyclic loadings with increasing peak, the final maximum load was sustained for 3.5 to 4 hours or until displacement diminished below observable range, to measure creep. During this sustained load for creep the dial gauge readings were made at 1, 3, 5, 10 minutes after the final load was reached and then every ten minutes in the following 20 minutes, and every 30 minutes until completion.

Fig. II.2.1. $\Delta P/\Delta s$ on load-displacement curve

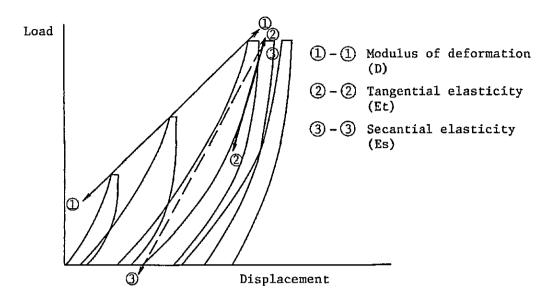
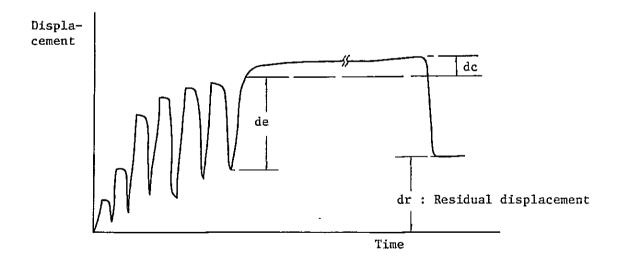


Fig. II.2.2.Creep ratio



(") Block shear test

:minciple

Block shear test is based on the following equation, that gives shear strength as a function of cohesive strength (or shear resistance) To and internal friction angle \emptyset .

$$\overline{\tau} = \mathcal{T} \cdot \tan \phi + 70$$

Where,

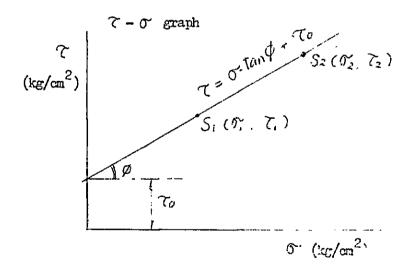
7: Shear strength kg/cm²

O': Normal stress kg/cm²

Ø: Internal friction angle

To: Cohesive strength kg/cm²

The equation is graphically represented as below.



To obtain values of To and ϕ that are characteristic of the foundation rock in question, three or four concrete test blocks with size of 60 cm x 60 cm in the base are placed on cleaned rocks which are as similar in condition as possible and horizontally sheared with jacks under different normal (vertical) loads. If concrete of the test blocks is placed carefully enough to stick tight to the rock and if strength of the rock is lower than the concrete, the shear plane develops in the foundation rock to give shear strength of the rock. If strength of the rock is higher than the concrete, obtained shear strength would be not of the rock but of the concrete or the boundary between both. In any case, the situation is similar to the failure in the foundation of concrete dam and the result gives a range of design value.

Though theoretically two pairs of measurement value (On, Tn) are sufficient to solve the equation, possible deviation of the obtained data due to test error and actual differences of rock conditions at test spots necessitates the use of more than two test blocks. Four blocks were placed in this test.

Actually, shearing force is loaded by jacks dipping about 17° from horizontal, for the purpose of rendering the axis of this inclined load meet that of the normal load at the center of the base of the test block and thereby preventing occurence of moment in the block. In consequence, the shearing force in the horizontal direction is one of the elements of the inclined force loaded by the jacks; the other element is additional normal load. Hence,

$$Tn = \frac{Pi. \cos \theta}{A}$$

$$\sigma n = \frac{Pn + Pi. \sin \theta}{A}$$

Where,

Tn: Shear stress at failure of block No.n kg/cm²
On: Normal stress at failure of block No.n kg/cm²
Pi: Inclined load at failure kg
Pn: Constant normal load applied on block No.n by vertical jack kg
A: Area of sheared plane cm²
O: Dip of the inclined load from horizontal

The values of On, Tn (n=1, 2, 3, 4) are plotted on the σ - τ coordinate and by drawing the line "T= σ . tan ϕ + To" through the plotted points the values of To and ϕ are obtained.

Method

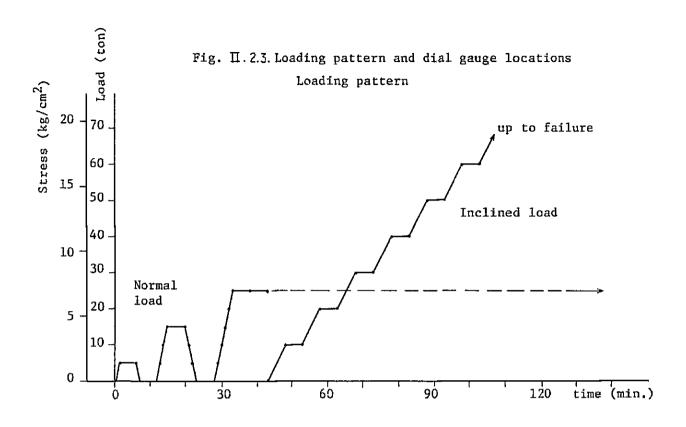
Equipments used for the test are as follows:-

gauge supporter, dial gauge holders, steel plates, etc.

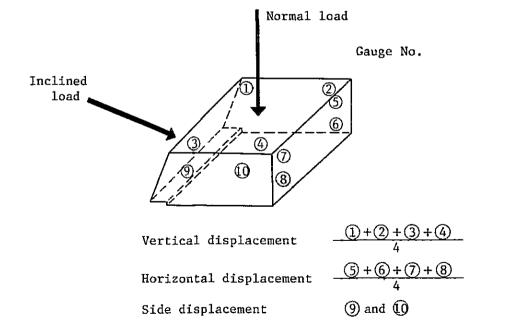
Hydraulic test jack with a separate oil pump capacity 100 tons 1 unit capacity 200 tons 2 units Dial gauge minimum reading 1/100 mm, stroke 50 mm 10 nos. Column supports for 2 m, spherical adjuster, steel channel beam for dial

The test was performed with concrete test blocks with 60 cm x 60 cm in the size of the base which were placed at four spots on cleaned foundation rocks subject to the test. Four different normal loads, i.e. 1, 10, 25 and 35 tons, were applied on those four blocks, and under those constant normal load gradually increased was the inclined load, of which horizontal element worked for shearing while the vertical element adds to the normal load. Loading pattern and dial gauge locations are as shown in Fig. II.2.3. Vertical displacement and horizontal displacement of the blocks were obserbed with four dial gauges respectively to be represented by the average values. Horizontal displacement in the direction right angle to the shearing was also recorded with two dial gauges. The reading of dial gauges was done at every beginning and end of jacking-up operations to increase the inclined load by the rate of 10 tons per 5 minutes. The inclined load in every step was sustained for 5 minutes.

After shearing had completed in each test block, it was re-tested (the second loading) by increasing the inclined load from zero under the same normal load. This is to examine frictional resistance.



Dial gauge location



2.2 Geology of the damsite

Foundation rocks of the damsite, as classified below, are the members of the pre-Cambrian Highland Series.

- (a) Crystalline limestone: Composed mainly of calcite, and containing mica and quartz in various ratio. The component minerals are medium grained. White to pale grey, hard and massive in fresh condition.
- (b) Calc gneiss: Composed of calcite, quartz, feldspar, mica and small amount of other basic minerals. Sometimes distinguished from crystalline limestone by less calcite content but the boundary is obscure. Though most of it shows gneissose foliation, it is not flaky but massive and hard.
- (c) Charnockite: Dark grey to dark blue coloured due to so tinted quartz and feldspar. Containing hyperthene. Fine to medium grained. Some granulitic. Often accompanied by garnets. Hard and massive, rarely foliated.
- (d) Quartzite: Some containing many garnet crystals within a few millimeters in diameter. Hard and cracky. Irregularly intercalating in thin strata among the other rock beds.
- (e) Gneiss: Generally highly siliceous and hard. Foliated but not flaky.

 Massive and solid in fresh condition. Often containing much garnet and some granolitic. Gneissose rocks in the Highland Series are various in mineral components as shown in Table II.1.1. The rocks of different mineral composition are so intricately mixed but so similar in mechanical and physical characteristics that they can classified in a single category "gneiss" for the engineering purpose.

Condition of the above rocks except for quartzite is no doubt very good with high strength, scarse cracks and little leakage, when they are fresh. A problem that requires strong precaution is solution cavities

in the crystalline limestone and the calc gneiss, as discussed in Paragraph 2.2.

Topographic trend in the damsite is oriented predominantly north northeast to south southwest, in which direction stretch the ridges and rivers. The river bed of the Amban Ganga, around 135 m in altitude, is about 50 meters wide, accompanied by another 50 m wide flood terrace in 140 m to 145 m in altitude on the right bank. Slopes on both banks show approximately 1 vertical/2 horizontal in gradient. The left bank rises up to EL.220 m, and then descend to about EL.150 m in a presumably ancient river channel which is connected to the present river course in both the upstream and downstream vicinities and thus renders the left bank an isolated hill. This ancient river channel, now dry and passed by Naula-Elahera motor road, shows about 100 m of width at the bottom, with slopes of 1/1.5 to 1/2 on both sides. This requires the sub-dam No.1 when the main dam on the Amban Ganga is designed to have high water level around 200 m in altitude.

Approximately 300 m northwest from the said ancient river channel, another short flat valley with 180 m of altitude at the top is encountered along the eastern foot of Mt. Moragahakanda, and this requires the sub-dam No.2. All of these channels and ridges tend to develop in the direction of NNE-SSW.

Those topographic trends are closely related with the geological structure. The rock beds show generally strike of N-S to N40°E and dip of 10 to 20°W, that is, mildly dipping from right bank toward left bank. The bedding is homoclinal, with occasinal small folds with several meters of length. Faults, though not exposed, are suggested by low velocity zones (1.7 - 2.7 km/sec.) detected in the geophysical (seismic) exploration, and its direction is assumed NW-SE from geomorphological characteristics observed in aerial photographs.

The foundation rock is classified into four zones from viewpoint of rock condition as shown in Table II.2.1, based on the results of drilling, adit and seismic exploration. Because of gradual change of the rock conditions, boundaries of those zones are often obscure. However, they roughly coinside with the boundaries of seismic velocity zones. Rocks

in "intensively weathered zone" and "moderately weathered zone" which show the P-wave velocity less than 1.7 km/sec. are so deteriorated, insufficient in stability and unreliable in effect of grouting that they are not applicable for foundations of concrete gravity dam and impervious core zone of fill dam. On the other hand, rocks in "slightly weathered zone" and "fresh rock zone" are competent enough for those foundations, though the former is a little inferior to the latter. Actually, the "slightly weathered zone" is composed for the most part of virtually fresh rock but some weathering along cracks at 1 to 2 m intervals.

Table II.2.1. Rock classification of the damsite area

Rock classification	Velocity (Primary wave) km/sec	Geological condition
Intensively weathered zone	0.6 - 1.0	Mostly decomposed by weathering, looks like a sediment of sandy silt. Containing big fresh boulder (sometimes 2 m to 3 m in diameter)
Moderately weathered zone	1.2 - 1.5 (partly 1.5 - 1.7)	Partly decomposed by weathering, having wide open cracks (sometimes l m in width) filled by weathered sandy silt and clay.
Slightly weathered zone	2.0 - 2.7 (Partly 1.7 - 2.0)	Mostly fresh rock, with rare cracks. Cracks are stained by weathering, sometimes containing weathered clay (1 cm to 10 cm in width)
Fresh rock	5.5 - 6.0 (partly 4.4)	Massive and solid rock, with rare cracks. Cracks are closed tightly.

Quaternary deposits found in the damsite are, on one hand, residual soil which is reddish brown mixture of sand, silt and clay, or sandy loam, with occasional rock fragments, produced from intensive weathering and deterioration of bed rocks, and, on the other hand, yellowish brown sandy or silty deposits on the river bed and the flood plain. The residual soil, mainly developping on the hill slopes with 1 to 3 m of thickness, sometimes accompanied by talus deposits, show 0.2 to 0.3 km/sec. of P-wave velocity, whereas the river deposits show around 1.5 km/sec., a high velocity presumably due to saturation.

Geological condition of each damsite is as described below.

(1) Main damsite

- Base rock: The river bed and the upper parts of the right bank slope are occupied by charnockite, and the other parts by gneiss.
- Geological structure: General strike and dip of the bedding plane shows N-S to N40°E/15 to 20°W. No fault is found.

 Predominant joints trend N85°W/85°SW (in the adit No.6) and N70°E/80°NW (in the adit No.5).
- Quaternary deposits: River bed deposit, composed of sand, sandy silt and clay with occasional gravels, are 6 to 8 m in thickness. The residual soil is 1 to 2 m thick on the both banks.
- Rock condition: The intensively weathered zone (0.7 1.2 km/sec.) is 10 m thick, and the moderately weathered zone (1.2 1.7 km/sec.) is lacked in this site. The slightly weathered zone with 1.7 2.0 km/sec. of velocity (this velocity is a little lower than in the slightly weathered zone in the other places) is 10 m thick on the right bank and 10 to 20 m, thickening up-slope, on the left bank. The fresh rock zone shows P-wave velocities of 4.4 to 5.5 km/sec. in the river bed and the right bank, and 6.0 km/sec. on the left bank.

(2) Sub-dam No.1

Base rock: Gnisses are in the upper levels of the both banks, and crystalline limestones - calc gneisses in the lower levels.

Geological structure: Strike and dip of the strata is similar to that in the main damsite, i.e. N-S to N40°E/10-20°W.

A fractured zone in the drill hole DM22 is the only fault that is confirmed. Two other faults are assumed running through two low velocity zones on the seismic exploration line RA. None of those three are deemed to have major or extensive fractures around them, from rather small discrepancies of beddings on both sides.

Quaternary deposits: The area is covered by residual soil in 1 to 2 m of thickness.

Rock condition: The intensively weathered zone has 3 to 7 m of thickness. The moderately weathered zone is observed only in the bottom of the valley and the upper parts of the left bank, and is 3 to 5 m thick. The slightly weathered zone (2.0 - 2.4 km/sec.) is about 20 m thick on the right bank, 10 to 15 m under the bottom of valley and 8 to 10 m on the left bank. P-wave velocity in the fresh rock zone shows 5.5 to 6.0 km/sec., and partially 4.5 km/sec..

Cavity: Three drill holes through calc gneiss on the left bank slope have encountered sections of no core recovery which are deemed to be solution cavities in the calcareous rock.

They are located:-

- in a part of the section 19.8 m - 22.35 m of depth, in the whole section 23.65 m - 28.40 m, and in a part of the section 29.4 m - 31.3 m

in the hole DH24

- in the section 15.3 m - 19.55 m in the hole DM19

- in the section 6.8 m - 7.45 m, and in the section 9.35 m - 14.2 m

in the test grout hole GH-3.

on the other hand in the adit No.8 which is situated in the upper part of the same slope, open fissures are found within 20 m of vertical depth from the ground surface. Two of them are 0.2 to 0.5 m wide openings developed along sub-vertical joints, trending N10°E and N70"W, filled with loose black sandy loam. The other one is about 0.5 m wide and develops along a joint in N70°E/30°SE, that is nearly parallel to the ground surface. The former two appear to change the widths and pinch out within a short distance. The latter seems continuous for a considerably wide range but not developping deep underground from its direction. Very probably, the latter is connected with those cavities found in the drillings. In effect, location of the cavities is limitted within about 30 m of depth and no other cavities have been found in other parts of the foundation except on the left bank of the sub-dam No.2, though it does not prove that no cavities exist in the other parts.

(3) Sub-dam No.2

- Base rock: Calc gneiss is exposed on the left bank, that is the foot of Mt. Moragahakanda. Charnockite with 20 m of thickness is at the bottom of the valley. The right side is composed of gneiss.
- Geological structure: General strike and dip of the bed rocks is nearly N-S/10-20°W. Two faults are assumed by low velocity zones on the seismic exploration line EA on the right bank.
- Quaternary deposits: Residual soil is within 2 m of thickness.

 Fairly large area of the rock surface is exposed without covering of Quaternary deposits.
- Rock condition: The intensively weathered zone prevails the surface of bed rocks all over the area with 3 to 5 m of thickness.

 The moderately weathered zone shows 3 to 8 m of thickness at the bottom of the valley and on the right bank, and

is lacked in the other area. The slightly weathered zone is 10 to 20 m thick and is underlain by the fresh rock zone with 5.3 - 6.0 km/sec. of P-wave velocity.

2.3 Dam foundation engineering

2.3.1 Strength of the foundation

In-situ rock tests on shear strength and elasticity, performed in charnockite in the adit No.5 on the left abutment of the main damsite, obtained the following results. (See Fig. II.2.4 and Table II.2.2)

Shear strength Cohesion 36 kg/cm²

Internal friction angle 53°

 $(\tau=36 + \sigma \cdot \tan 53^{\circ} \text{ kg/cm}^2)$

where, $\boldsymbol{\tau}$ is shear strength and $\boldsymbol{\sigma}$ is

vertical stress)

Modulus of elasticity 84,000 - 90,000 kg/cm²

Modulus of deformation 51,000 kg/cm²

The plate loading tests for measurement of modulus of elasticity and deformation were made with the maximum load at 40 to 60 kg/cm², taking into consideration the actual stress effected from the dam of designed size. Because of very high solidity of the foundation rock, the movement was generally too small and irregular within the said load to result in a stable load-displacement curve usable for calculation. Only one test out of four observed exceptionally calcurable displacement, and it is the basis of the above moduli of elasticity and deformation. It should be noted, therefore, that those values are rather lower ones for this foundation and the average can be far higher.

The charnockite, subject to:the test, was in fresh or partly slightly weathered, hard and massive condition with scarse cracks which were tightly closed. Though it is in the velocity zone of 1.9 - 2.0 km/sec. that falls under the slightly weathered zone, the rock condition is apparently almost similar to the fresh rock zone. The value obtained for shear strength should be taken to be nearly maximum in this area, and use of some lower moderate value is recommendable for design.

Gneiss and calcareous rocks have not been tested, but no much difference from charnockite is conceivable in the aspect of strength in the

field observation. Thus, from mechanical point of view, the slightly weathered zone and the fresh rock zone are competent enough for foundations of concrete gravity dam and impervious core of fill dam.

2.3.2 Permeability of the foundation

Permeability distribution in the foundation rock is shown in Lugeon Map (D. II.4) which is based on data of water pressure tests in drill holes. Zoning is as follows:

-Main damsite

Zone of high leakage more than 50 in Lugeon unit forms a superficial layer within 10 to 20 m in depth. It is underlain by zone of 5 to 15 Lugeon unit, about 10 m in thickness. Watertight zone with less than 1 Lugeon unit is found below 20 m of depth on the left bank, about 10 m in the river bed and 20 - 25 m on the right bank.

-Sub-dam No.1

High leakage zone over 50 Lugeon unit shows thickness generally ranging from 5 m to 20 m, with tendency of being thinner on the right bank and thicker on the left bank, except for a part on the left bank where the high leakage is observed to 40 m of depth though cavities were found only to 31 m of depth. Underlying is zone of 15 to 30 Lugeon unit, that is still fairly permeable, in about 5 m of thickness. Zone of 1 to 5 Lugeon unit with thickness from 10 m to 15 m is found under the bottom of the valley. Watertight zone of less than 1 Lugeon unit is found deeper than 5 to 15 m on the right bank, 25 to 35 m in the bottom of the valley and 20 to 40 m on the left bank.

-sub-dam No.2

The available water pressure test data on the presently proposed dam axis are only for the left bank. Zone of more than 50 Lugeon unit lies within 5 m of depth, and the underlying 10 to 15 meters' thickness is occupied by two layers of 30 - 50 and 5 - 15 in Lugeon unit. The impervious zone below I Lugeon unit lies 15 to 20 m under the ground surface. As for the right bank, if inferred from the data on now abandoned alternative axis about 100 m to north, high leakage condition is encountered probably to about 16 m of depth, and the underlying zone is

Fig. II.2.4. Shear strength

Normal stress - shear stress graph

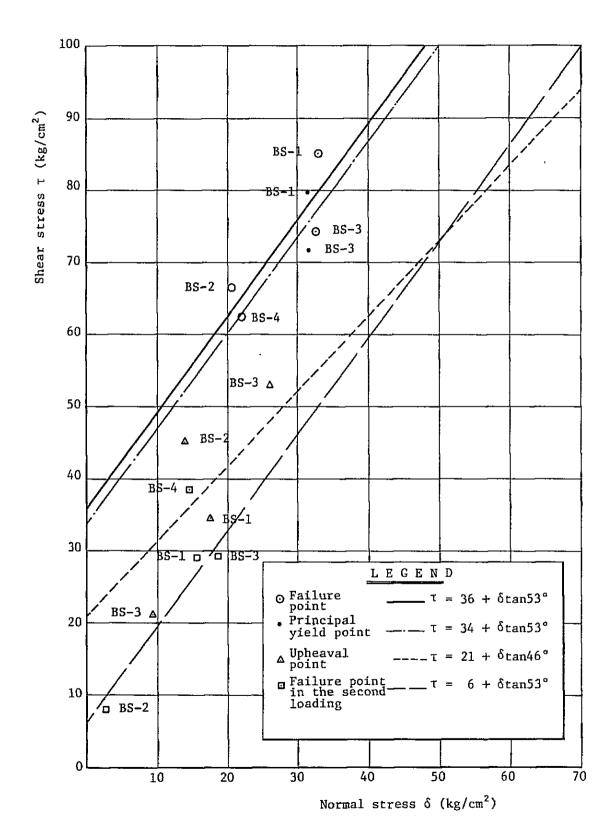


Table II. 2.2. Results of in-situ rock test

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					e T	to lso one.				test	ring 's not
BS-4 Pn = 10 ton	30t $r = 9.27$ r = 21.25	1 1	$35t$ $\mathcal{T} = 21.86$ $\mathcal{T} = 62.43$	45t T = 14.55 7 = 38.52	Displacement was generally very little	under the applied maximum load of 40 to 60 tons in the plate loading test. Also creep was sometimes very little or none.	70	23	(48)	Upheaval point : an inclined load where the test	block begins upward displacement. Principal yield point: the load where shearing displacement rate start to increase. Failure point: the load where the load does not rise any more.
	Pi= 80t	ı	Pi=235t	Pi=145t	ot was	aol la	Constant normal load Inclined load Normal stress (kg/cm²) Shear stress (kg/cm²) val point : an incline begins upward displac ipal yield point : the acement rate start to ure point : the load wh any more.				
3 5 ton	$\sigma = 25.97$ $\gamma = 53.13$	5 = 31.65 $7 = 71.72$	T = 32.46	r = 18.66 T = 29.22	Jacemen	er the took in a sp was a	որք, որու	Inclined load	L stres: stress	oint : 6	ns upwan yield po nt rate int : th
Bs-3 Pn = 35						unde 60 t cree	Conste	Inclin	Norma] Shear	aval pc	block begins u Principal yiel displacement r Failure point rise any more.
	Pi=200t	Pi=270t	Pi=280t	Pi=110t	Note:		P n	F.	 بہرب	Uphe	blocl Prin disp Fail rise
ton	$rac{3}{7} = 14.08$ $rac{7}{7} = 45.16$	1 1	$\Re = 20.58$ $\Re = 66.41$	= 2.71 = 7.97							
BS-2 $Pn = 1 ton$				30t ?=		Creep ratio Cf %	1	63	20	ľ	
	Pi=170t	ı	Pi=250t	Pi= 3		of tion		0		Q	
ton	17.50 34.53	31.31	32.93 85.00			Modulus of deformation D kg/cm ²	1	86,000	1	52,000	
BS-1 Pn = 25	t 3	۴ ۲-	キ と !! !	الا عا الحر عا	1		l	00	000	000	
F.	P1=130t	Pi=300t	Pi=320t	Pi=105t		Secantial elasticity Es kg/cm ²	ţ	250,000	1,247,000	84,000	
	int		nt	nt	s t	Tangential elasticity Et kg/cm ²				000,06	
Block No.	Upheaval point	Principal	Failure point	est Failure point	ling te	Tange elast Et ke	'		1	90,	
Bloc	Uphea	Principal	Failt	Re-test Failt	Plate loading test	Test No.	PL-1	PL-2	PL-2'	PL-3	

deemed to show fairly low leakage, such as less than 10 Lugeon unit.

The leakage condition are roughly correlated with the classification of rock conditions as below.

Intensively weathered zone

Moderately weathered zone

Slightly weathered zone upper part

lower part

15 - 30 Lug. unit,

partly less than 15

Fresh rock zone

Less than 5 Lug. unit,

Mostly less than 1.

The leakage conditions are not much related with the sort of rock, except for some parts of calcareous rocks as on the left bank of the subdam No.1 where the developed solution cavities and the accompanying decomposition by weathering are obviously the cause of very high leakage. Groundwater tables measured in the drilling holes are all higher than the water level of the Amban Ganga and rising toward both banks. This is a negative evidence to possibility of such solution cavities as to cause serious water leakage and deformation of groudwater regime in the damsite.

2.3.3 Excavation line

(1) Foundation of concrete gravity dam and impervious core zone of fill type dam

Excavation lines are determined from the strength of rock and the permeability or its treatability. In the rock classification in Table IL.2.1, the intensively weathered zone and the moderately weathered zone are not applicable for foundation of concrete dam and impervious core because of their insufficient stability. Permeability in those zones are not only so high as 50 Lugeon unit but also difficult to improve by grouting because of intensive deterioration of the rocks. The slightly weathered zone and the fresh rock zone are acceptable in the aspect of strength, as clarified in Section 2.3.1. In view of leakage, the upper part of the slightly weathered zone is highly permeable with more than 50 Lugeon unit. However, considering that this leakage is obviously

through open cracks in hard rock, it can be rather easily improved by grouting. In consequence, the foundation excavation shall be to the surface of the slightly weathered zone.

The rocks surrounding the solution cavities will have to be excavated deeper than the other parts, because they are intensively weathered to a considerable depth along with the development of the cavities and because it is deemed rather difficult and uneconomical to treat them by gouting or concrete replacement, as explained in Section 2.3.4.

The proposed excavation lines for the damsites are shown in Geological Profile of the Damsite (D. II.3).

(2) Foundation of shell zone of fill type dam

Organic top soil and residual soil in 1 to 2 m of thickness should be removed for the foundation of shell zone. In the other words, the excavation line it shall rest on the surface of the intensively weathered zone.

2.3.4 Foundation treatment

If the intensively weathered zone and the moderately weathered zone are excavated, no difficulties are seen in treatment of the slightly weathered zone by grouting for consolidation and leakage cut-off in the reach of high permeability. Treatment of the solution cavities is the only problem.

Test gruting was performed on the left abutment of the sub-dam No.1 through the calcareous rocks to examine effectiveness of grouting for the cavities and the surroundings.

By the grout hole GH3 which was drilled first to 38 m of depth, it was confirmed that cavities and high leakage zone were located within 26 m of depth. On the other hand, the zone to 14 m is so intensively weathered that it is, no doubt, the subject to excavation. Consequently, interest is concentrated to the section between 14 m and 26 m.

<u>Depth</u> m	Geological condition	Leakage Lug.unit
0 - 15	Intensively weathered zone with cavity (Decomposed rock)	More than 100
14 - 26	Slightly weathered zone and fresh rock zone, occasionally with cavities.	35 - 62
26 - 38	Fresh rock zone	less than 1

Cavities were encountered in the depth from 10 m to 20 m, and some open fissures were also found at 1 to 2 m intervals in the depth from 10 m to 26 m. These open fissures seem to be connected with the cavities. The fresh rock zone between 26 m and 38 m is solid, massive and watertight.

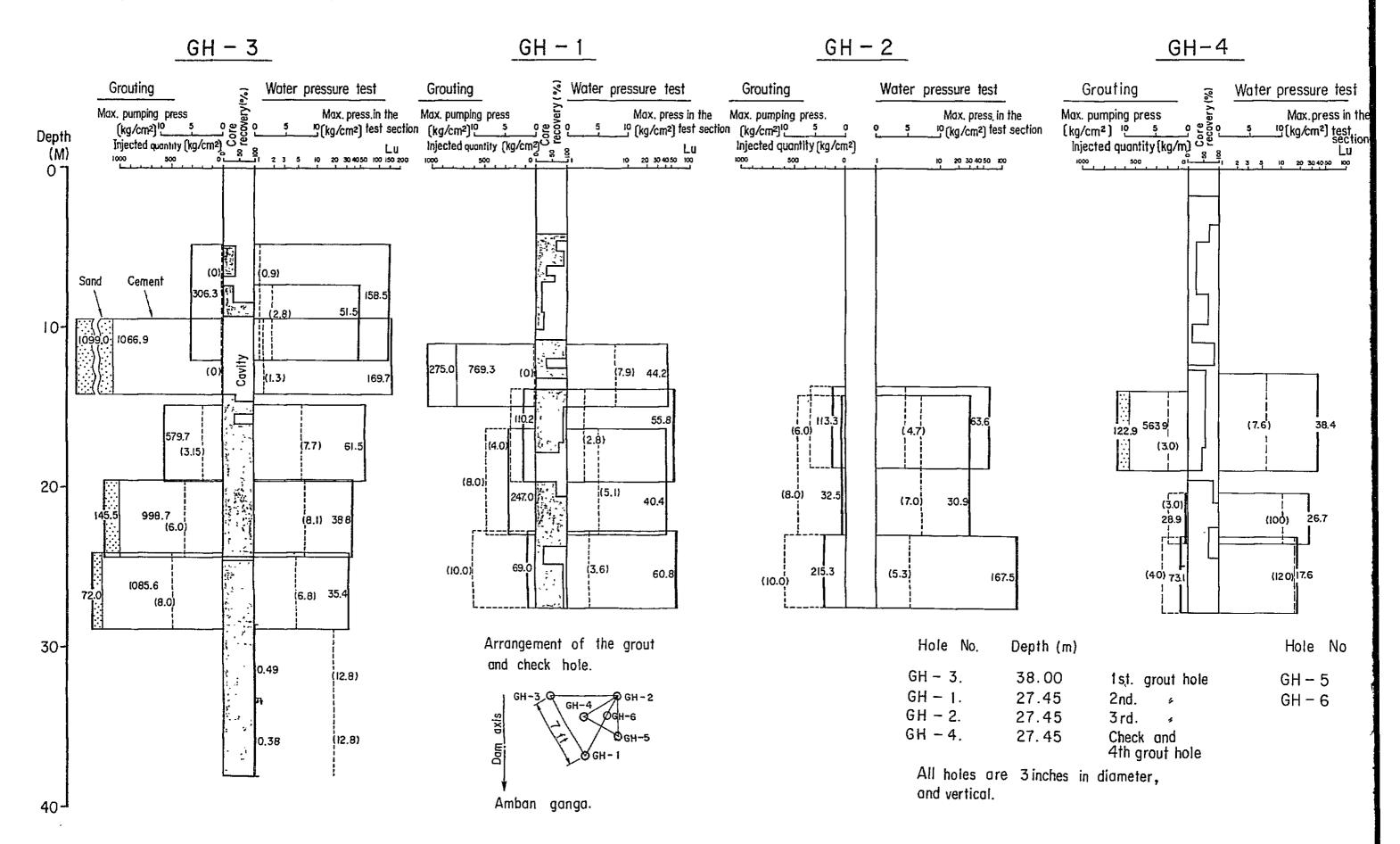
Grouting was carried out by injecting neat cement-water mixture and partly fluid mortar into five grout holes, in order, by stage as follows:-

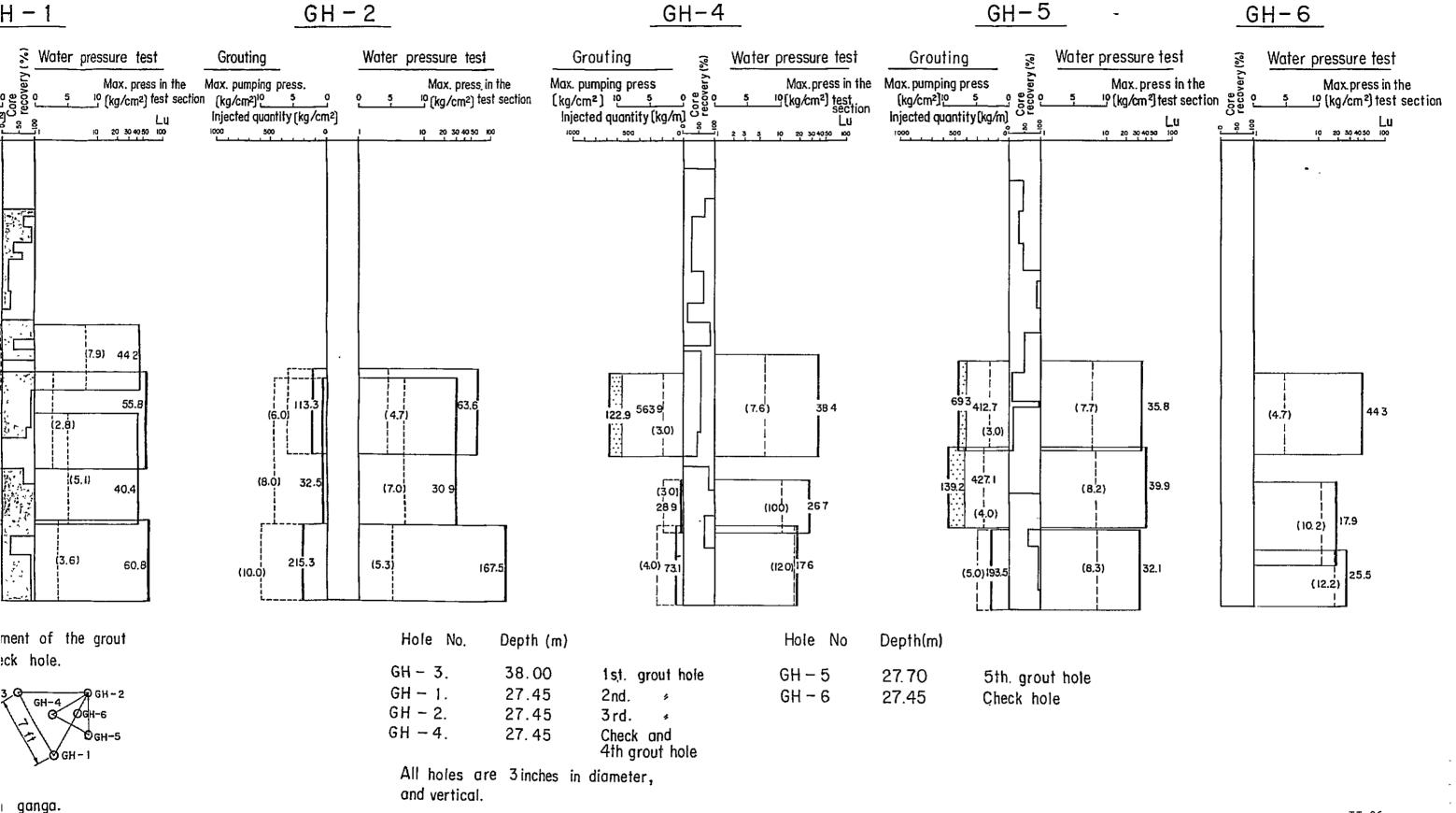
The	lst	stage	4.85	-	14.0 п
The	2nd	stage	14.0	_	18.5
The	3rd	stage	18.5	-	23.0
The	4th	stage	23.0	_	27.5

Table II 2.3 Results of Grouting Test

Water pressure test					Grouting									
	Stag	Depth	(m)	Max.		Lugeon	Max.	Max. den-	Grouting	Grout	Cemen	it	Sand	
No.	No.	Береп	(1117)	press. in the test sec- tion kg/cm ²	cient of permea- bility cm/sec	unit	pumping press. kg/cm ²	sity of grout S:C:W	time min	Injected volume litre	Injected quantity kg		Injected quantity kg	
GH3	1 " 2 " 3 " 4 " 5 6	7.29 - 4.83 - 9.42 - 14.83 - 14.88 - 19.53 - 19.71 - 24.05 - 24.05 - 24.05 - 28.63 - 33.20 -	12.04 14.20 19.61 18.19 24.31 24.54 28.88 28.88 28.88 33.45	7.7 3.5 8.1 2.2	6.59x10 ⁻⁴ 5.28x10 ⁻⁴ 2.04x10 ⁻³ 7.63x10 ⁻⁴ 9.76x10 ⁻⁴ 4.66x10 ⁻⁴ 1.51x10 ⁻³ 4.62x10 ⁻⁴ 5.81x10 ⁻⁴ 1.41x10 ⁻⁴ 9.05x10 ⁻⁶ 5.45x10	51.5 158.5 169.7 61.5 95.7 38.8 117.8 35.4 44.6 9.1 0.49 0.38	0 0 1.05 3.15 0 6.0 0 8.0 8.0	0:1:1 0.97:1:1.3 0:1:1 0:1:1 0:1:1 0.97:1:1.3 0:1:1 0.97:1:1.3	74.6 63 94.3 114.6 90.6	3,443 10,333 4,800 877 4,200 3,020 3,400 4,105 4,650	2,208.3 5,100 2,205 392 1,785 1,666 1,554 1,805 1,885	306.3 1066.9 461.3 118.4 373.4 625.3 321.7 373.7 390.2	5,253 - - 703 - 348	1099.0 - - 145.5 - 72.0
	<u>+</u>	Total		-	·	L	·	·	·—	38,828	18,600.3	<u></u>	6,304	
GH1	1 2 3 4	11.07 - 13.82 - 16.28 - 22.66 -	19.61 22.86	7.9 2.8 5.1 3.6	4.15x10 ⁻⁴ 6.40x10 ⁻⁴ 5.08x10 ⁻⁴ 6.67x10 ⁻⁴	44.2 55.8 40.4 60.8	0 4.0 8.0 10.0		142.2 129.0 145.6 74.1	6,333 2,560 4,068 1,444	2,954 638 1,625 329	769.3 110.2 247.0 69.0	1,056	275.0 - -
		Total						,		14,405	5,546		1,056	
GH2	2 3 4	13.59 - 14.12 - 22.86 -	22.86	4.7 7.0 5.3	7.36×10 ⁻⁴ 3.78×10 ⁻⁴ 8.81×10 ⁻⁴	63.6 30.9 167.5	6.0 8.0 10.0	0:1:3 0:1:3 0:1:1	75.9 65.1 271.4	2,240 1,300 3,110	578 284 984	113.3 32.5 215.3	-	-
	,	Total		<u> </u>	·					6,650	1,846			
GH4	3 }	12.67 - 20.50 - 22.70 -	23.16	10.0	5.53x10 ⁻⁴ 4.80x10 ⁻⁴ 3.37x10 ⁻⁴	38.4 26.7 17.6	3.0 3.0 4.0	0.97:1:1.3 0:1:5 0:1:3	188.6 64.5 85.6	6,210 668 1,500	2,735 140 347	563.9 28.9 73.1	596 - -	122.9
		Total								8,378	3,222		596	
GH5	3	12.95 - 18.05 - 22.90 -	22.85	8.2	5.72×10 ⁻⁴ 5.93×10 ⁻⁴ 5.16×10 ⁻⁴	35.8 39.9 32.1	3.0 4.0 5.0	0.97:1:1.3 0.97:1:1.3 0:1:1		5,150 4,550 2,636	2,208 2,050 929	412.7 427.1 193.5	371 668 -	69.3 139.2
		Total	_			<u>-</u> -	-			12,336			1,039	•
GH6	3	13.65 - 20.15 - 24.15 -	25.00	4.7 10.2 12.2	6.70x10 ⁻⁴ 2.79x10 ⁻⁴ 4.62x10 ⁻⁴	44.3 17.9 25.5								

Fig \coprod .2.5 Result of grouting test.





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The depths of the stages were subject to modification depending on the actual rock condition encountered in the grout holes. The tested spacing of the grout holes were 2.15 m and 1.23 m. (See Table II.2.3 and Fig. II.2.5).

Grout takes in each of the five grout holes were as follows:-

Hole No.	Grouting	section m	Grout ta	ake kg/m
GH3	14.85 -	28.90	803.7	
GHl	13.80 -	27.45	189.9	
GH2	13.60 -	27.45	133.3	
GH4	12.65 -	27.45	217.7	
GH5	12.95 -	27.70	351.7	
		Average	grout take	339.3 kg/m

The effect of grouting was examined by comparing the leakage in check hole GH6 after grouting with that in grout holes prior to grouting. In this comparison, leakage rate in Lugeon unit decreased from 61.5 to 44.3 in the 2nd stage, from 38.8 to 17.9 in the 3rd stage and from 35.4 to 25.5 in the 4th stage. (Test in the 1st stage was renounced because this stage was within the intensively weathered zone that was inevitably to be excavated.) Improvement of permeability is clearly seen but not sufficient.

As mentioned in Section 2.2, the cavities observed in the adit No.8 were narrow openings of crevice type at widths from 20 cm to 50 cm, which were sub-vertical or inclined and filled with loose sandy loam. It seems that the injected grout was likely to be more or less isolated into small pockets in this sandy loam, which was neither penetrated nor washed out.

All of the above knowledges lead to the following strategy for treatment of the cavities.

(a) The fact that improvement of permeability was not sufficient with 1.23 m of grout hole spacing would not always mean that the hole spacing was still too large. On the contrary, it seems very probably that any shorter hole spacing could not result in remarkably better effect. Thorough washing-out of the filling material in the cavities is essential. (b) The narrow crevice-shape of the cavities as observed in the adit No.8 renders it very difficult to make any manual work inside, such as for washing or concrete placing. In view of conceivable difficulties in washing for grouting, construction of deep concrete cut-off wall by excavation of trench or adits is a method worth consideration.

Principle for general foundation treatment for the area without cavities will be as follows:-

- (a) The foundation treatment shall comprise curtain grouting, consolidation grouting for concrete gravity dam and blanket grouting for fill type dam. Drainage holes shall be drilled for up-lift pressure relief.
- (b) Grout curtain to decrease leakage should be deep enough to reach the fresh and watertight zone with permeability lower than 5 Lugeon unit, that is, 20 to 30 m deep from the excavation line.
- (c) Depths of consolidation and blanket groutings for the purpose of tightening the surfacial zone of the foundations for concrete gravity dam and impervious core zone of fill dam shall be 5 or 10 m. These works can be concentrated only to the parts of frequent cracks.
- (d) In view of high solidity of the rocks, with very sparse joints and high shear strength, fairly high grouting pressure, if necessary, can be applied with little risk of damaging the foundation.