3. COLLECTED DATA

DATA LIST

I) HYDROLOGICAL DATA

1. Tide Table

1984 Penang

1986 Penang

1987 Penang

1988 Penang

2. Water Level

i) Water level of Sg. Perai

Station No. 1A, 4, 5, 8 and 11.

11/3/1987 -- 20/3/87

ii) Water level of Sg. Perai

Station : Sg. Samagagah

6/4/87 -- 8/6/87

iii) Water level of Sg. Perai

Station : Titi Timbul

17/4/87 -- 8/6/87

iv) Water level of Sg. Perai

Station : Perai Barrage

10/7/88 -- 14/7/88

v) Water level of Sg. Perai (Study Team)

Station : 1A, 3, 3A

5/2/88 -- 6/2/88

vi) Water level of Sg. Perai (Study Team)

Station : 1A, 3, 3A, 11.

18/3/88 -- 19/3/88

vii) Water level of Sg. Kulim

Station : Ara Kuda

1978 -- 1987 (Daily)

1978 -- 1987 (Hourly)

3. Rainfall

Staion No.	Name	Monthly & Max. Records	Daily JPT Records
5504035	Lahar Ikan Mati	1959 - 1980	1978 - 1987
	Parit Logan		1981 - 1987
5404041	Malakoff Estate (Ladang Malakoff)	1959 - 1980	1981 - 1987
	Sg. Dua	--	1981 - 1987
5404043	Sg. Kulim Headworks	1959 - 1980	1981 - 1987
5406083	Bukit Mertajam Estate	1959 - 1980	--
5304045	Bukit Berapit Reservoir	1959 - 1980	1981 - 1987
	(Hydrological Data Rainfall Records - Bahagian Parit dan Taliair Kementerian Pertanian) Malaysia		(Daily)

4. Map

i) Place of Rainfall station & water level station.

ii) Rancangan Pengairan Sg. Kulim - Kawasan K2.

5. River Gauging Records for Sg. Kulim at Ara Kuda

20/4/87 -- 14/12/87 N = 35 Times

11/1/88 -- 22/2/88 N = 3 Times

6. Meteorological Data

At Penang 1/5/84 -- 31/5/84

II)SURVEYING DATA

1,SUNGAL PRAI CROSS SECTION AREA

2,Others data of survey
Site survey figurs

III)GATE OPERATION'S DATA

1, BOOK OF DATA

NO.	TITLE NAME	REMARKS
1.	SUNGAI PRAI DRAINAGE AND RECLAMATION PROJECT VOLUME 2 (TENDER DOCUMENTS FOR SUBCONTRACT DOUBLE STAGE ROLLER GATE)	SEPTEMBER.1968
2.	RANCANGAN MENAMBAK DAN MEMARIT SUNGAI PERAI (Sungai perai drainage and reclamation project) Instruction to Tenders	1978
3.	INSTRUCTION MANUAL OF OPERATION AND MAINTENANCE	Kontrek JPT. PP.10A/78 KUMPULAN TEKNIK SDN.BHD.
4.	BRIEF OPERATION INSTRUCTION	KUMPURAN TEKNIK SDN.BHD.
5.	RANCANGAN MENAMBAK DAN MEMARIT SUNGAI PERAI (DOUBLE STAGE ROLLER GATES DESIGN OF HOIST AND ACCESSORIES)	JPT

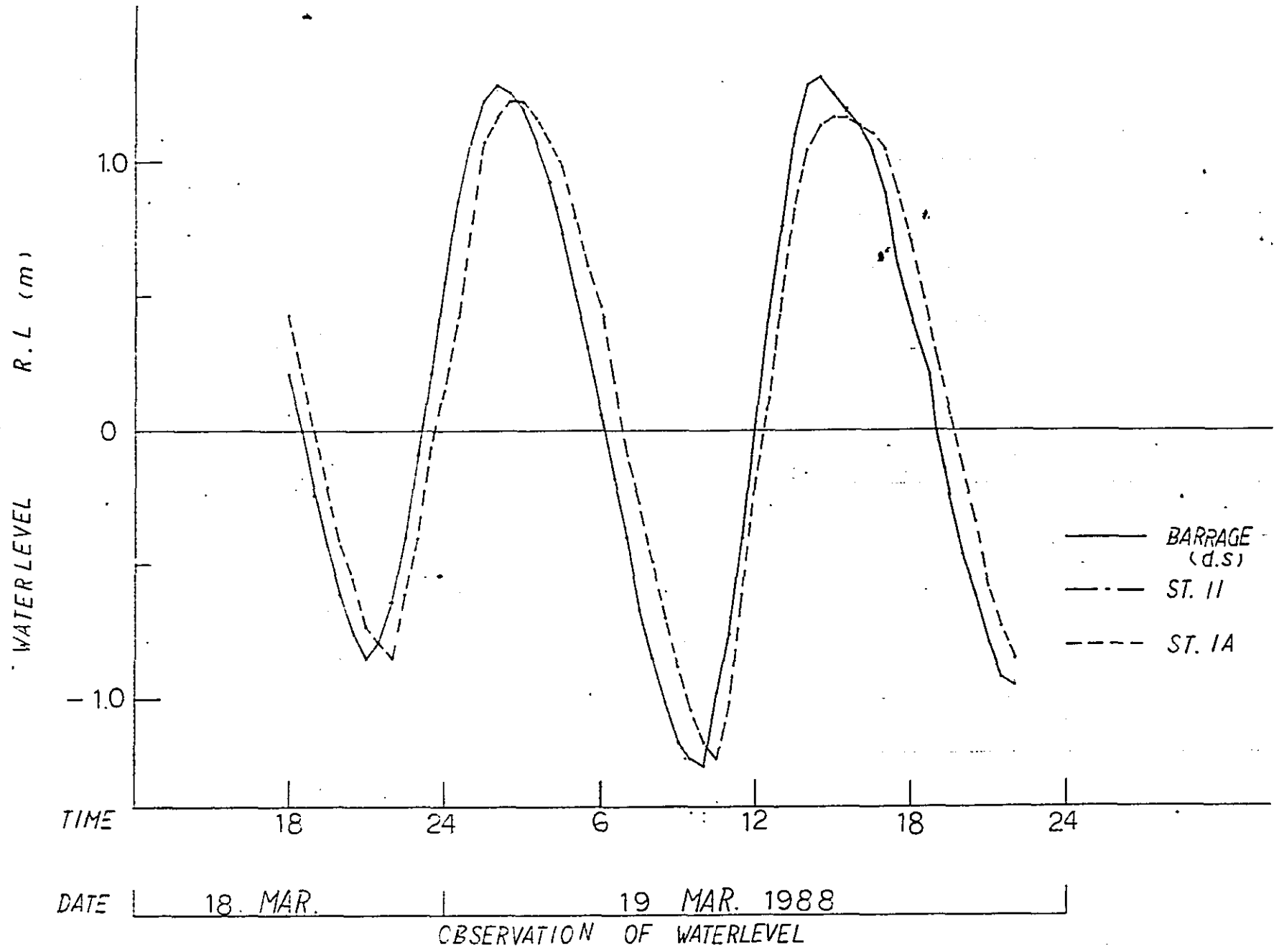
DATA OF GATE FIGURES

NO.	TITLE NANE	DRAWING NO.
1.	DOWNSTREAM ELEVATION.ELEVATION A-A AND B-B	B/1632
2.	ELECTORICAL CONTROL	KT/SP/E-1
3.	HYDRAURIC SYSTEM	KT/SP/E-2
4.	EQUIPMENT LAYOUT PLAN	KT/SP/E-3
5.	ASSEMBLY OF TOP LEAF	KT/SP/1Ba
6.	ASSEMBLY OF BOTTOM LEAF	KT/SP/2Ba
7.	TOP LEAF-SHOP DRAWING NO.1	KT/SP/3
8.	BOTTOM LEAF-SHOP DRAWING NO.1	KT/SP/4
9.	BOTTOM LEAF-DETAILS OF RUBBER SEALS	KT/SP/4B
10.	GENERAL LAY-OUT OF ROLLER GUIDES	KT/SP/5
11.	GENERAL DETAILS OF ROLLER GUIDES	KT/SP/6
12.	ROLLER GUIDES -- SHOP DRAWING NO. 1	KT/SP/7
13.	STOP - LOG ASSEMBLY AND DETAILS OF SEALS	KT/SP/19
14.	STOP - LOG ASSEMBLY OF LIFTING BEAM	KT/SP/20
15.	STOP - LOG DETAILS OF LIFTING BEAM	KT/SP/21
16.	STOP - LOG DETAILS OF HOOKS	KT/SP/22

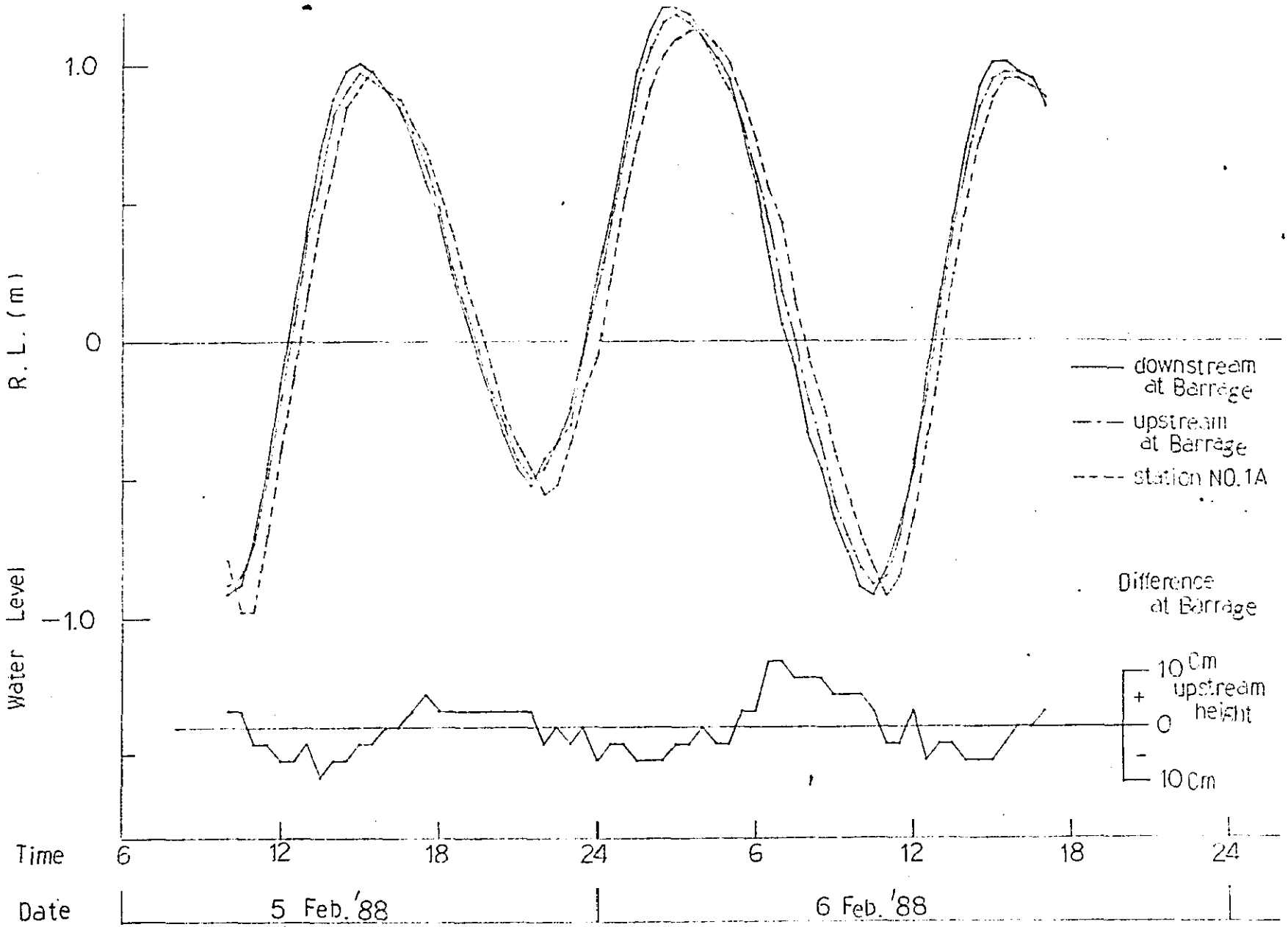
NO.	TITLE NANE	DRAWING NO.
1.	LOCATION PLAN	P.P.103/1
2.	SITE PLAN	P.P.103/2
3.	GENERAL PLAN	P.P.103/3
4.	DOWNSTREAM ELEVATION, ELEVATION A-A & B-B	P.P.103/4
5.	ELEVATION AND SECTION OF INTERMEDIATE AND SIDE PIER	P.P.103/5
6.	UPSTREAM ELEVATION AND KEY PLAN OF PILING ARRANGEMENT FOR BARRAGE FLOOR	P.P.103/8
7.	DETAILS OF ROLLER GATE AND ERECTION STRAP	P.P.103/16
8.	TYPICAL SECTION OF DEVIATION OF CANAL AND DRAIN PIPE	P.P.103/31
9.	LOCATION PLAN OF DEVIATION ROAD	P.P.103/34

I HYDROLOGICAL DATA

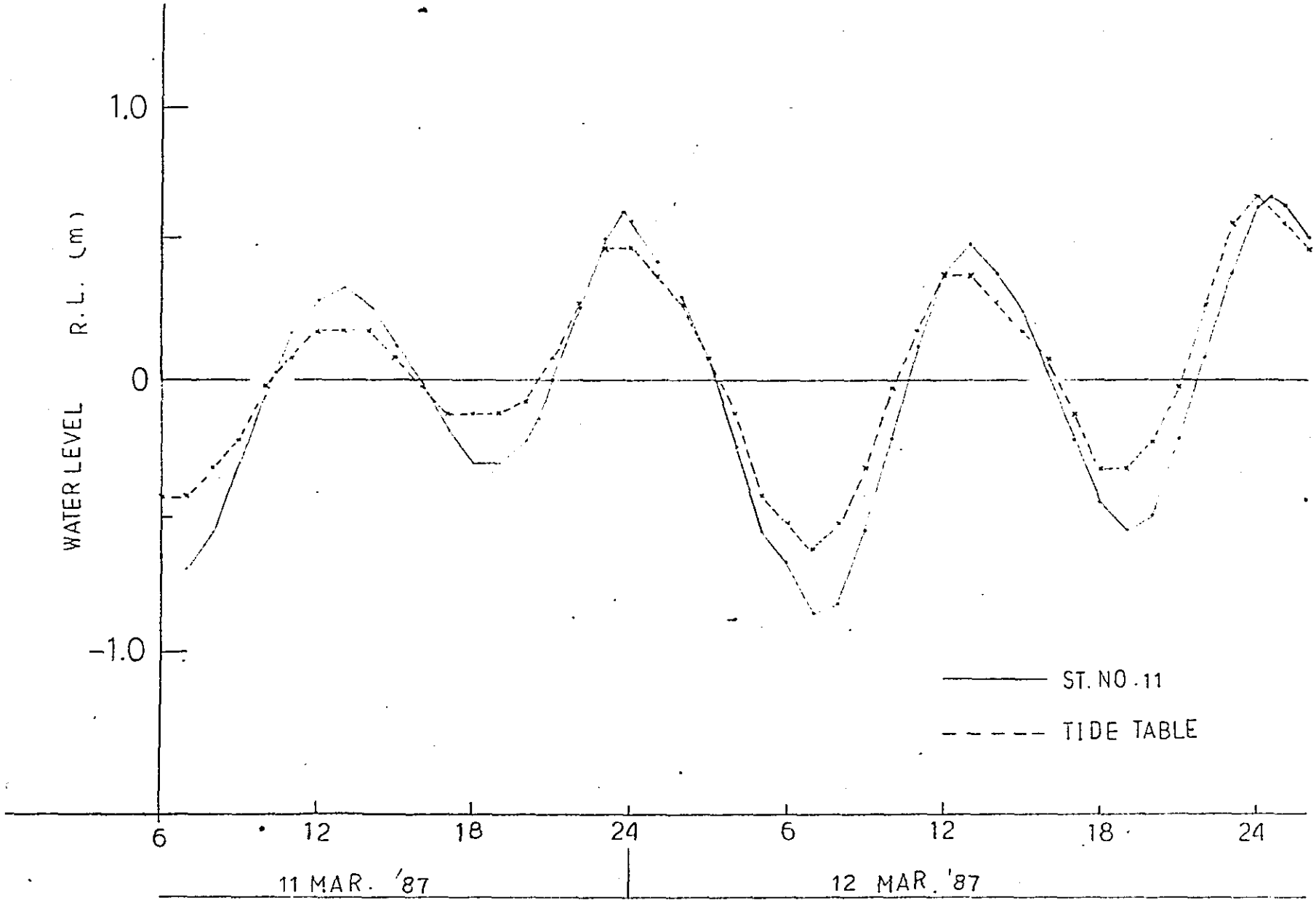
OBSERVATION OF WATERLEVEL



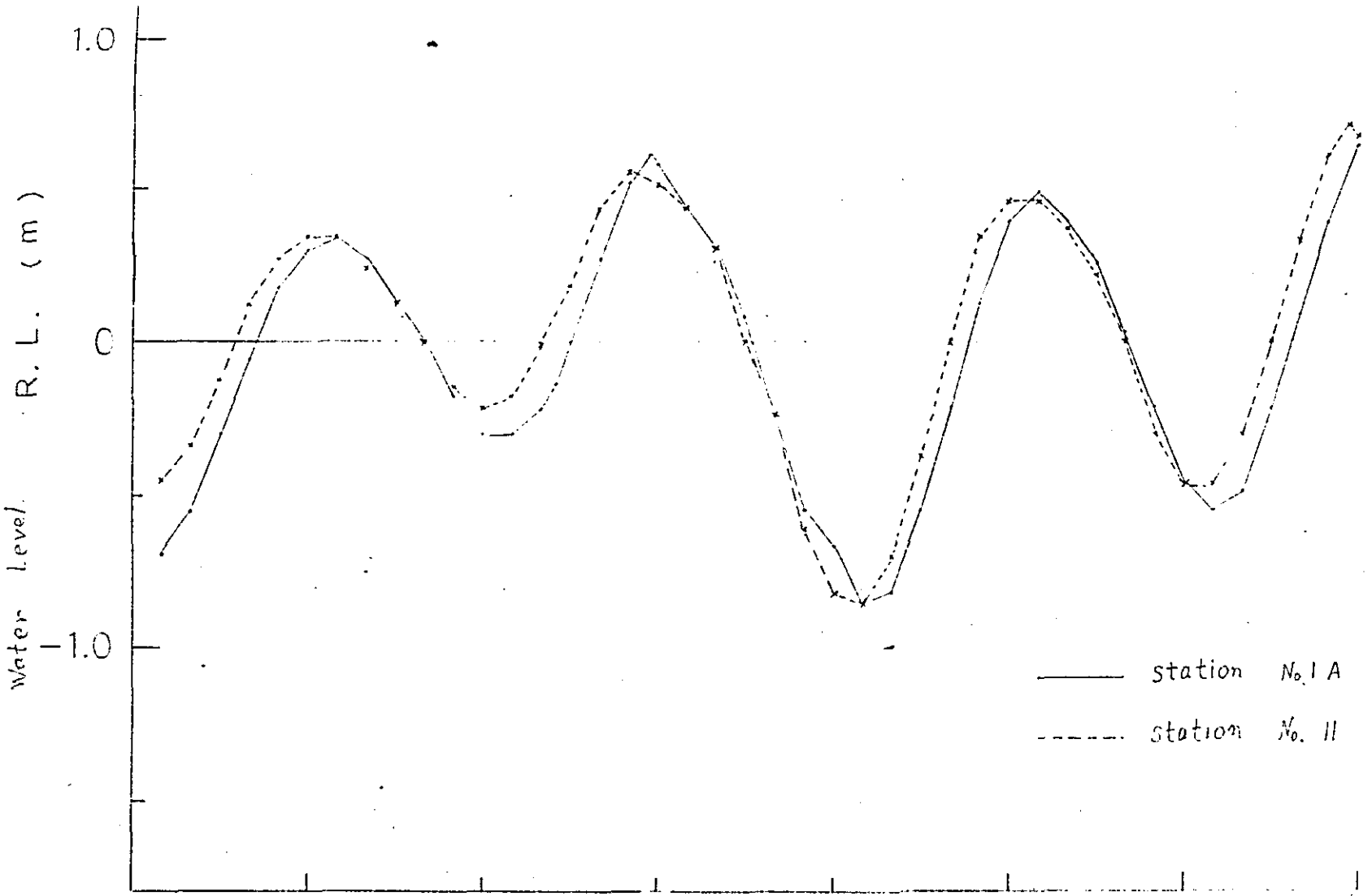
OBSERVATION OF WATERLEVEL



Relation of Water Level between Barrage and st. NO.1A



Relation of waterlevel between Tide Table and St. No. 11.



Relation of water Level between st. No. 1A and St. No II

APPROACH TO RUNOFF DISCHARGE BY RAINFALL

Runoff discharge using Probable Rainfall

1. Probable Rainfall

The Probable Rainfall of 10 years return period and 40 years return period was calculated by using the Weight Method that is the ratio of catchment area of probable rainfall of each river basin.

2. Calculation of Runoff Discharge

Peak discharge was calculated by the Kadoya's Method which is the popular formula used in Japan. But the formula for calculating the rainfall intensity we used the Mononobe's Method because it requires the 1 day maximum rainfall data only.

Condition

a) Catchment area : A = 437.63 km^2
(Remark : Catchment area of Perai Barrage)

b) Coefficient of Kadoya : C = 300
(Remark : Natural mountain 250 -- 300)

c) Runoff percentage : F = 0.50

d) Coefficient of Mononobe : n = 0.55

e) Probable Rainfall of tha day :

T = 1/10 Y : R_{24} = 152.4 (mm)

T = 1/40 Y : R_{24} = 179.4 (mm)

Calculated by Computer

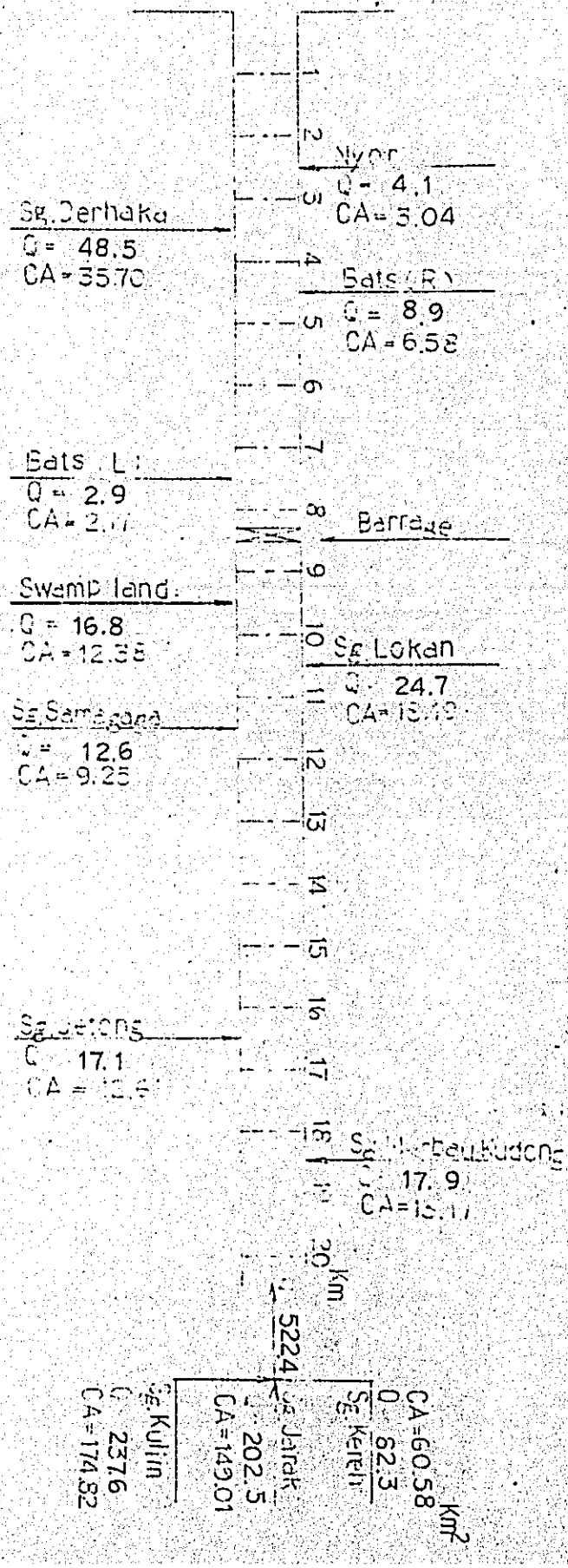
Result

	T = 1/10	T = 1/40
Time of arrival of flood (min)	656	611
Mean rainfall intensity (mm/hr)	4.89	5.99
Peak discharge (m3/sec)	594.8	728.0
Specific discharge (m3/sec/km2)	1.359	1.664

APPROACH TO RUNOFF DISCHARGE BY RAINFALL

T=1/10 Y

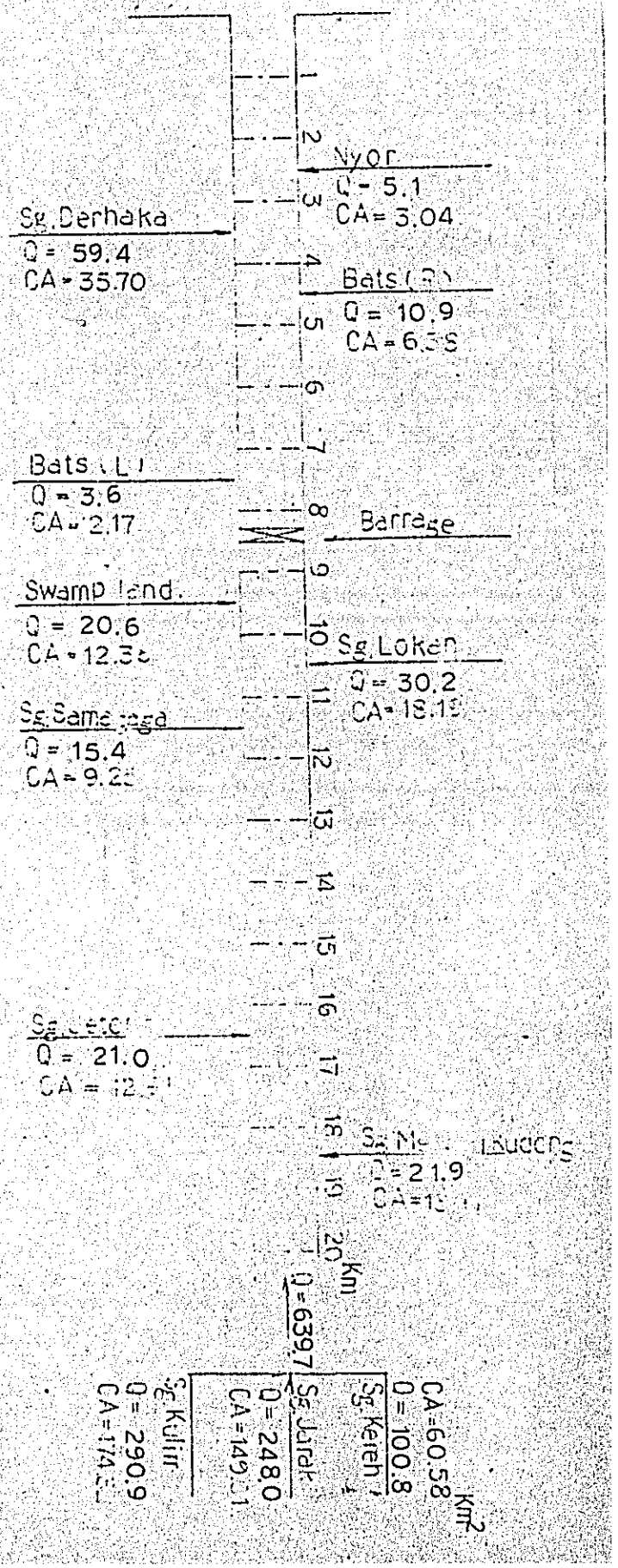
q=1.359 m3/sec/Km2



APPROACH TO RUNOFF DISCHARGE BY RAINFALL

T=1/40 Y

q=1.664 m3/sec/Km2



Tab. Return Period Of Rainfall

	1/2	1/5	1/10	1/40	1/100	1/200	Rem.
MARAKOFF ESTATA	108.3	153.1	183.6	243.3	283.5	317.3	SG KERAH
SG. KLIM HEADWORKS	119.1	138.4	149.0	165.7	175.0	181.5	SG KULIM
BUKIT MERAH PAPI STATION	102.7	131.4	151.5	191.8	219.5	241.2	
METEOLOGICAL St. B'WORTH	126.3	160.5	180.6	214.8	235.1	249.7	
BUKIT BERAPIT RESERVOIR	92.1	115.4	130.8	160.1	177.3	194.0	
BUKIT MERTAJAM ESTATE	101.5	122.6	135.4	157.8	171.3	181.2	SG JARAK

1 Day Maximum Rainfall

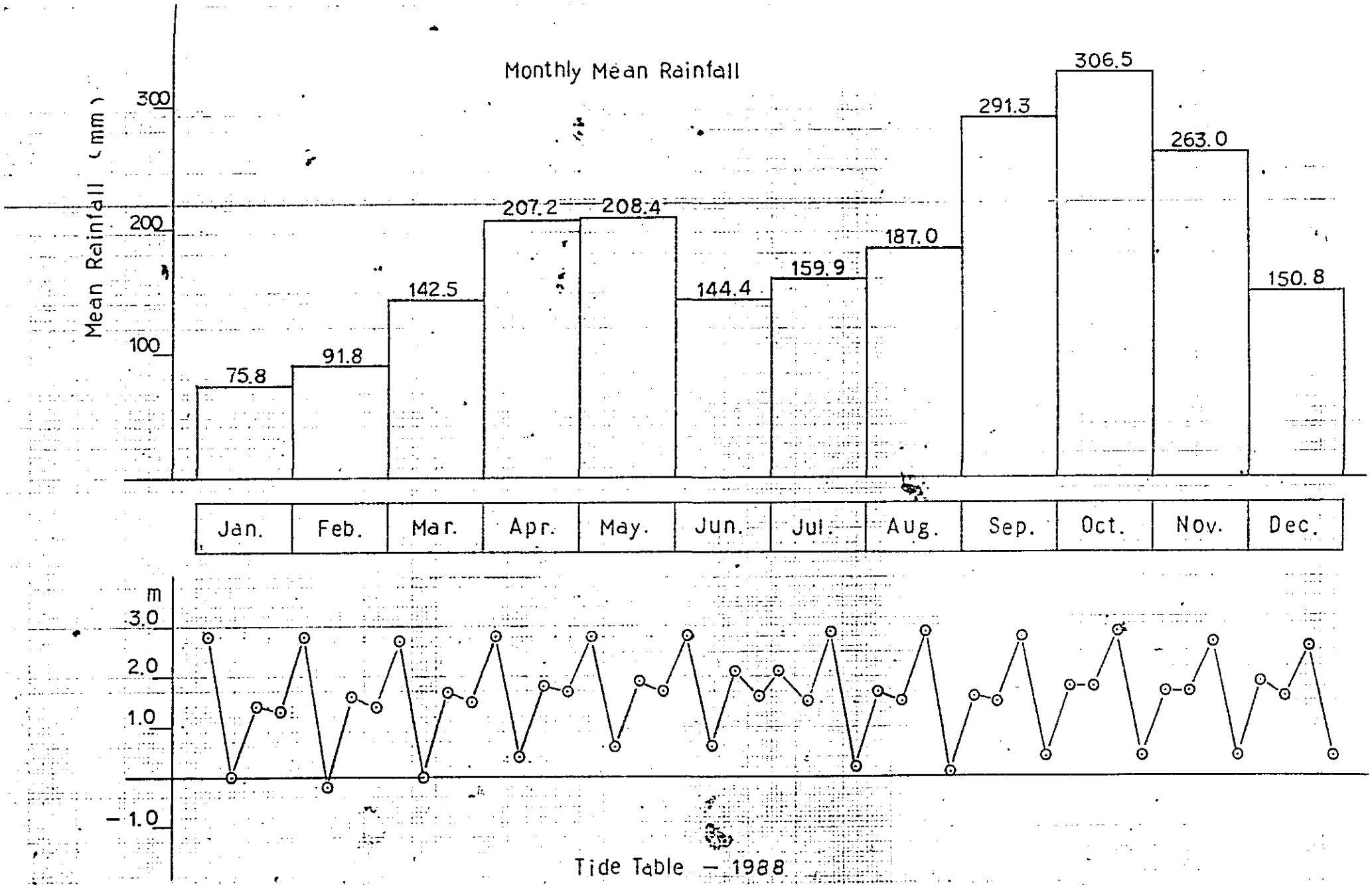
Year	MARAKOFF	SG. KULIM	MERAH PADI	METEOLOGICAL TO	ZERAPIT	MERTAJAM	Rem
1958	183.4	117.8	76.2	138.7	94.0	65.5	
59	111.8	74.9	76.2	141.5	106.7	94.7	
1960	67.8	78.5	129.0	87.1	58.4	68.8	
61	81.0	119.9	102.1	92.5	92.7	93.2	
62	154.7	128.8	106.2	167.4	147.3	138.7	
63	122.7	105.4	109.2	69.1	69.9	78.0	
64	162.6	157.5	134.9	181.1	81.3	123.2	
65	99.1	134.9	81.0	138.6	106.7	130.8	
66	112.0	94.5	106.7	109.2	78.7	126.7	
67	110.7	109.2	72.4	113.0	123.2	-	
68	88.4	107.7	83.3	106.2	102.9	-	
69	219.2	88.9	82.3	130.3	75.7	-	
1970	108.0	124.5	109.7	152.9	88.9	-	
71	108.0	124.5	109.7	152.9	99.1	109.7	
72	259.1	147.3	110.0	190.5	119.4	127.0	
73	104.4	135.1	108.0	133.4	132.1	105.9	
74	93.0	106.2	83.1	128.8	94.0	101.6	
75	78.5	122.4	180.8	70.4	130.0	95.0	
76	200.0	**	179.0	219.0	155.5	134.0	
77	133.0	**	133.5	135.0	98.5	110.0	
78	113.5	126.5	175.5	**	102.0	77.0	
79	136.0	106.0	70.0	86.5	104.5	102.0	
1980	150.0	117.0	120.5	111.6	66.5	91.0	
81	80.0	158.0	closed	closed.	71.0		
82	80.0	110.0			70.0		
83	69.0	104.0			70.0		
84	145.5	108.0			78.5		
85	50.0	146.0			122.5		
86	55.0	143.0			87.5		
87	57.0	155.0			70.0		
Station NO.	5404041	5404043	5404044	5403042	5304045	5406083	

Monthly Mean Rainfall (mm)

Station Name	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	Mean	Rem.
MARAKOFF ESTATE	69.3	73.7	115.7	186.4	212.6	150.8	172.6	197.1	314.8	340.4	260.2	140.3	2.235.6	186.3	5404041 1958 ~ '87
SG. KULIM HEADWORKS	73.8	81.9	152.2	222.5	232.0	137.8	154.1	184.1	281.0	330.6	284.3	147.7	2.280.5	190.1	5404043 1958 ~ '87
BUKIT MERAH PADI STATION	62.1	63.7	108.7	170.0	167.5	139.3	172.8	185.2	262.7	332.3	212.2	137.3	1985.5	165.5	5404044 1959 ~ '80
METEOLOGICAL STATION BUTTERWORTH	81.6	142.6	167.5	202.2	218.9	170.8	157.1	202.3	275.2	343.9	280.7	122.7	2.390.9	199.3	5403042 1959 ~ '80
BUKIT BERAPIT RESERVOIR	74.6	74.1	131.8	180.6	174.9	96.3	125.9	173.2	250.1	329.9	247.1	172.8	1971.3	164.3	5304045 1959 ~ '87
BUKIT MERTAJAM ESTATE	91.3	114.8	172.2	231.2	247.2	174.6	199.7	210.0	293.7	358.7	343.7	214.1	2.508.2	234.0	5406083 1959. ~ '80
Total	757.7	550.5	855.1	1242.9	1250.1	866.6	959.2	1121.9	1747.5	1838.8	1578.2	907.6	13 672.0	1139.5	
Mean	75.8	91.8	142.5	207.2	208.4	144.4	159.9	187.0	291.3	306.5	263.0	150.8	2278.7	189.9	

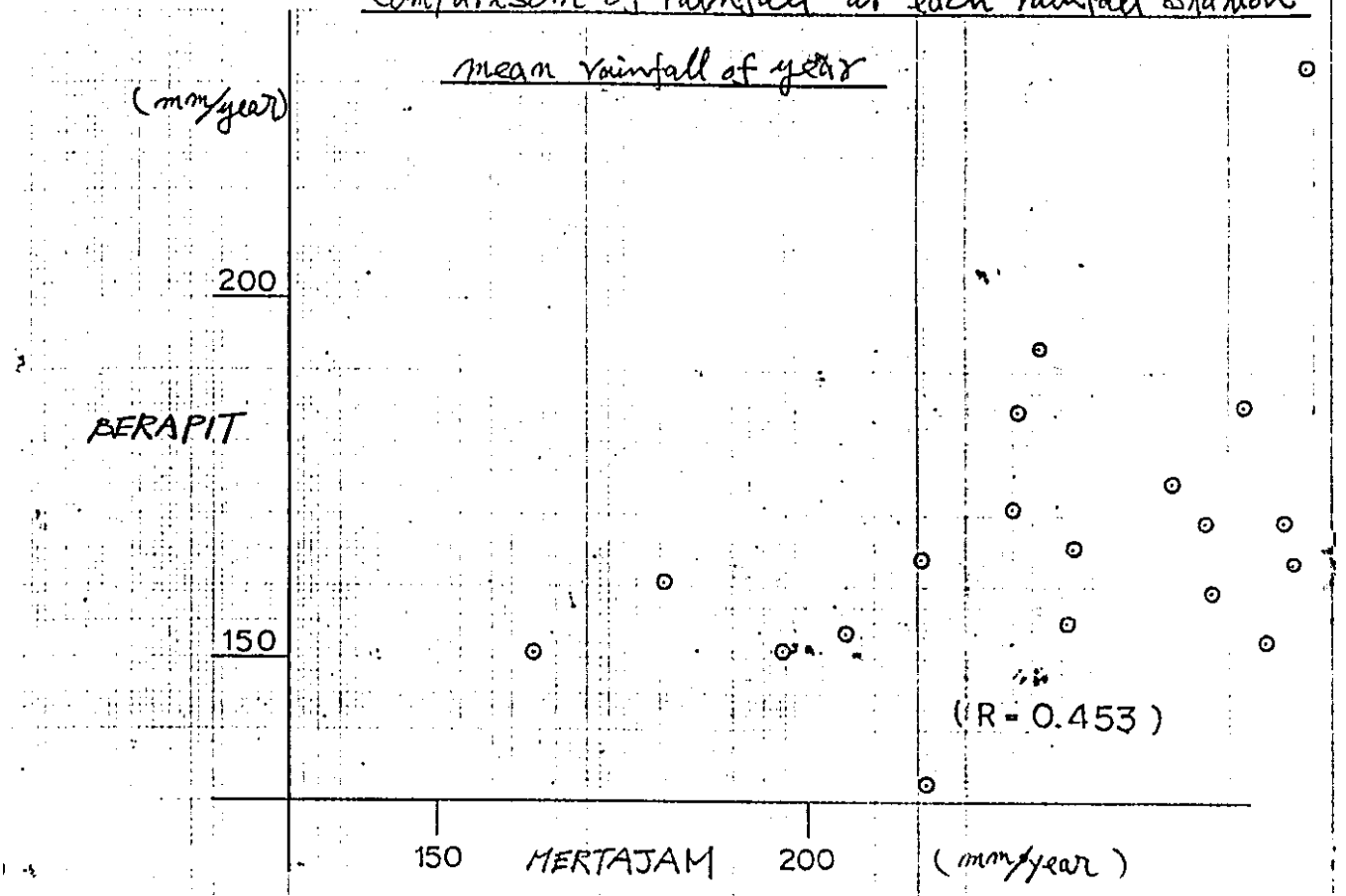
Rem. 1) SG. KULIM HEADWORK except 1976 ~ '77.

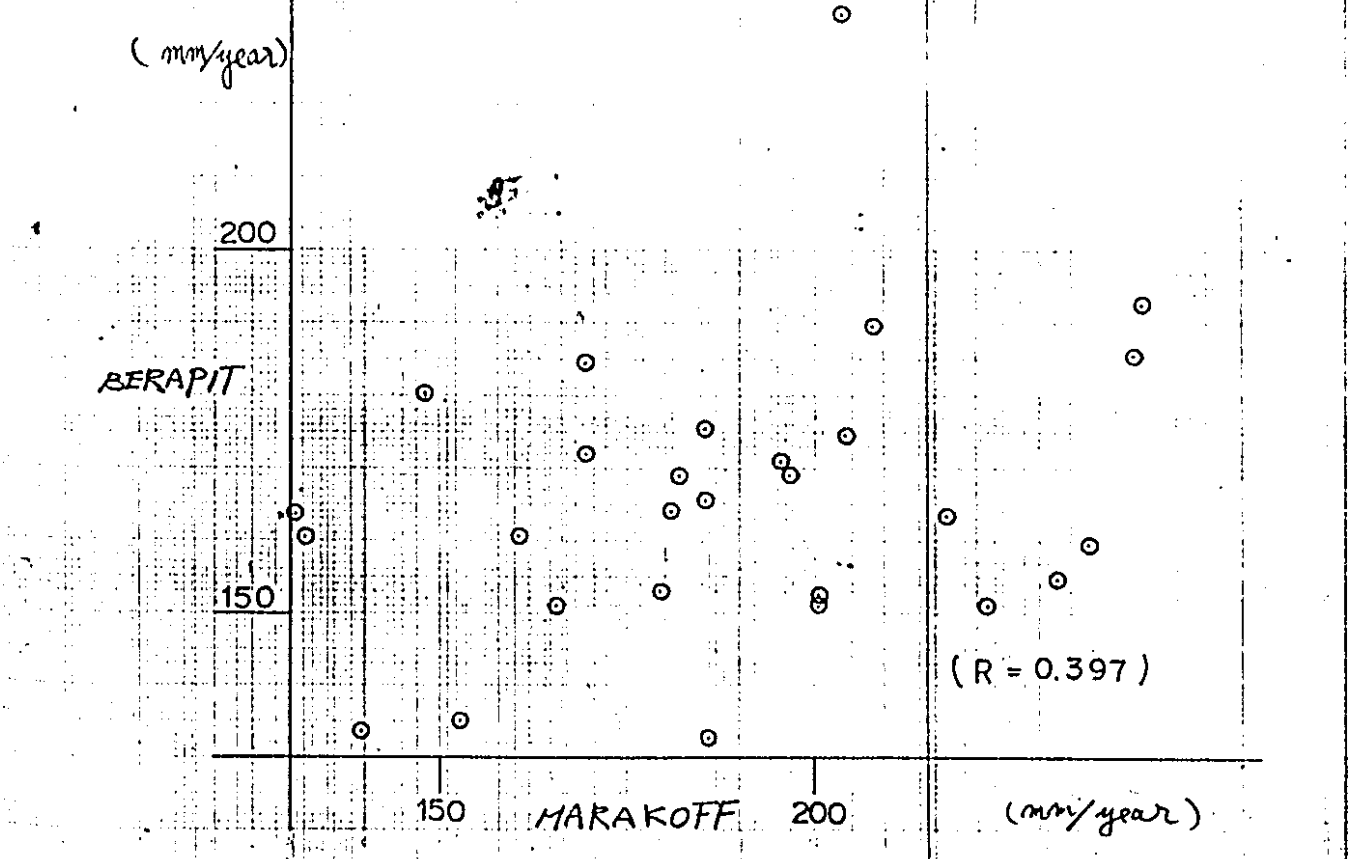
2) METEOLOGICAL STATION BETTER WORTH except 1960, 1978

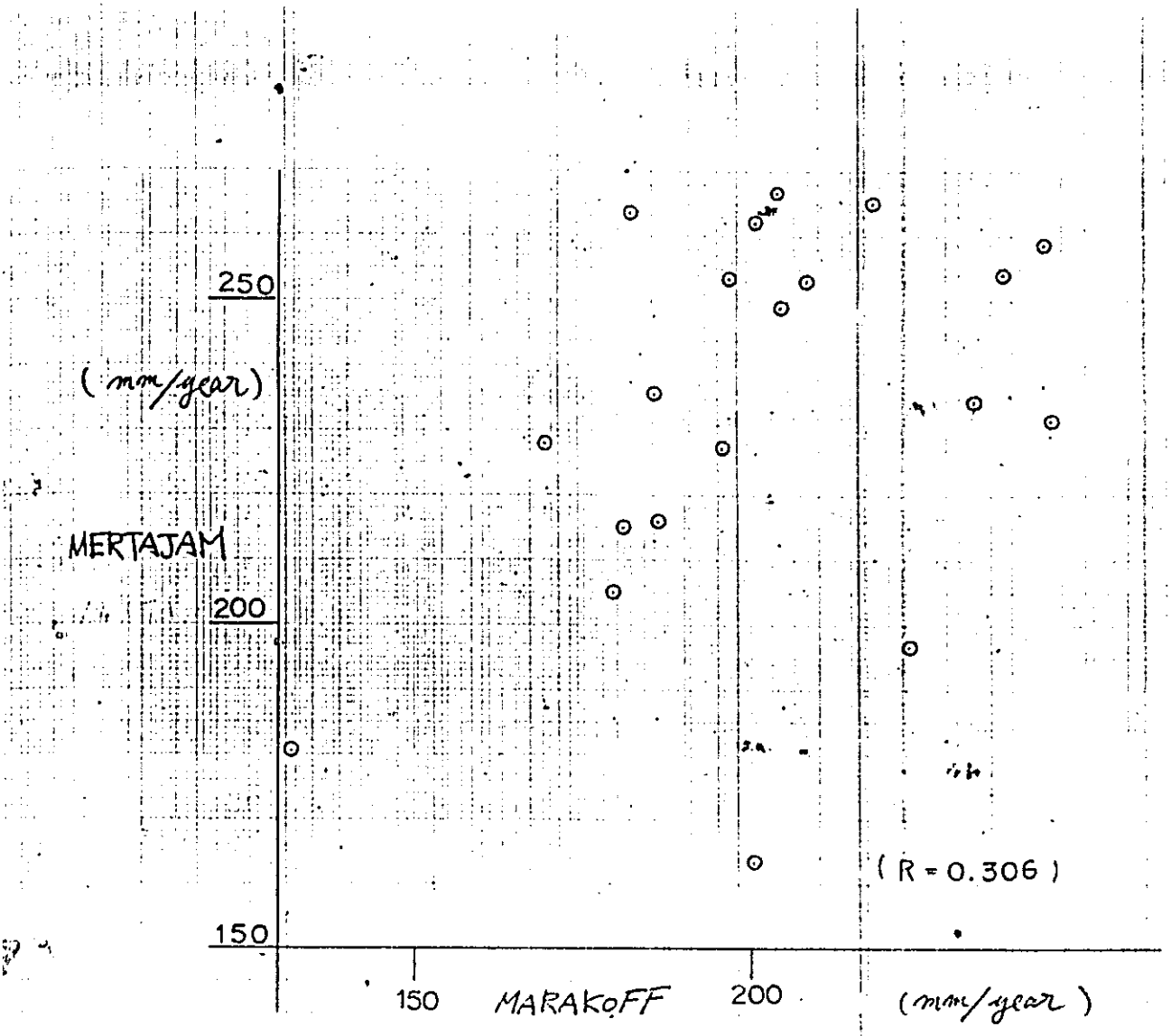

Monthly Mean Rainfall
Mean Rainfall (mm)
300
200
100
75.8
91.8
142.5
207.2
208.4
144.4
159.9
187.0
291.3
306.5
263.0
150.8
Jan.
Feb.
Mar.
Apr.
May.
Jun.
Jul.
Aug.
Sep.
Oct.
Nov.
Dec.
m
3.0
2.0
1.0
-1.0

Comparison of rainfall at each rainfall station

mean rainfall of year







Tab - CORRELATION

	BERAPIT	MERTAJAM	MARAKOFF
BERAPIT		0.453	0.397
MERTAJAM	0.453		0.306
MARAKOFF	0.397	0.306	

NOTE. 1) mean of year (rainfall)

APPROACH TO RUNOFF DISCHARGE BY WATERLEVEL

Calculation of Ordinary Discharge

Frequent water level is in Table ____ (recent 10 years. record 1978 - 87)

Ordinary water level is between 20.0 to 20.4 feet and the mean water level is 20.2 feet.

This water level was changed to the discharge by using the H - Q curve.

$Q = (3.4158h - 58.9)^2$ Q : Discharge (ft3/sec)

$= (3.4158*20.2 - 58.9)^2$ h : Water Level (ft)

= 102.0 (ft3/sec) CA : 139.13 (km2)

= 2.9 (m3/sec) q : Specific discharge (m3/sec/km2)

q = 2.8 / 139.15 = 0.021 (m3/sec/km2)

** The most frequent discharge was computed by using the most frequent water level i.e. 19.7 feet.

$Q = (3.4158h - 58.9)^2$

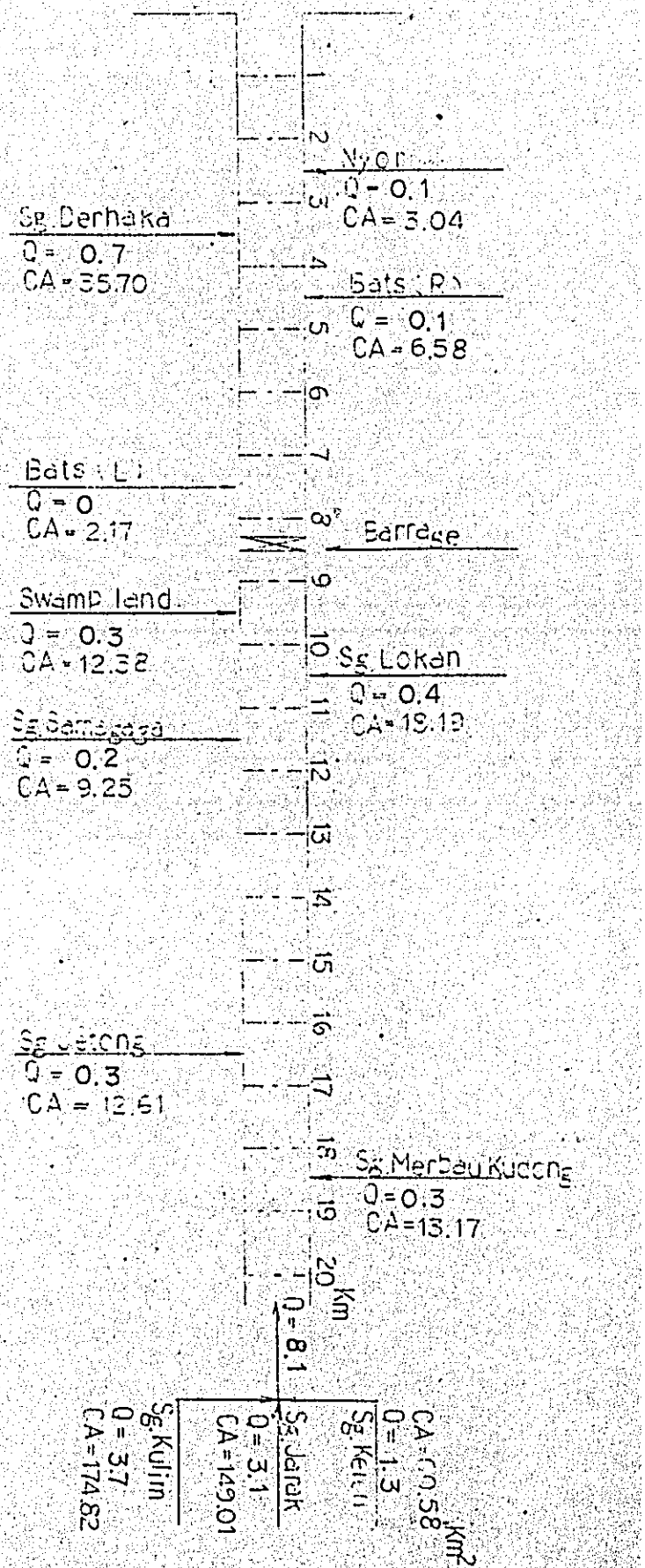
$= (3.4158*19.7 - 58.9)^2$

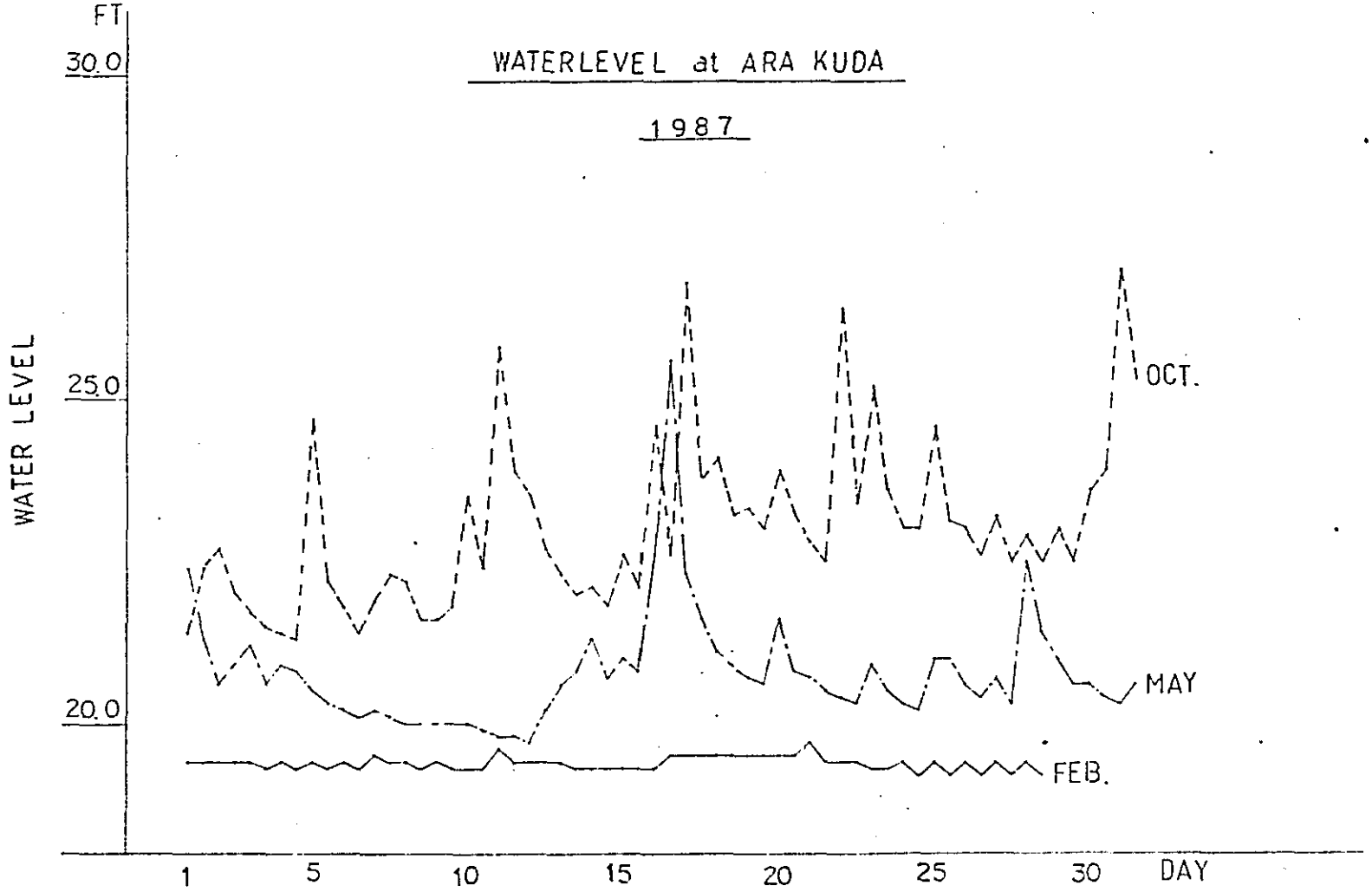
$= 70.4\ (ft^3/sec)$

$= 2.0\ (m^3/sec)$

$q = 2.0 / 139.15 = 0.014\ m^3/sec/km^2$

ORDINARY DISCHARGE
q=0.021 m3/sec/Km2




FT
30.0
25.0
20.0
WATER LEVEL
WATERLEVEL at ARA KUDA
1987
OCT.
MAY
FEB.
1
5
10
15
20
25
30
DAY

Return period of Maximum Water level

T	X	REMARK
$\frac{1}{2}$	Feet 28.1	highest high-water level = 31.9 ft
$\frac{1}{5}$	29.5	
$\frac{1}{10}$	30.3	
$\frac{1}{40}$	31.6	
$\frac{1}{100}$	32.4	

ARA KUDA

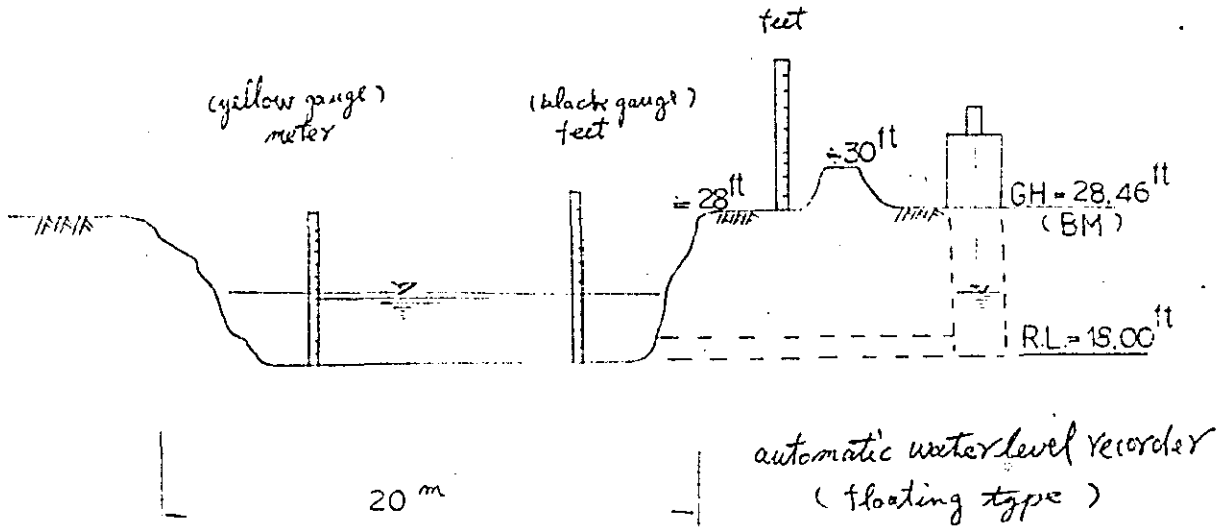
A) Maximum Water level

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1978	20.1	21.5	21.2	23.0	25.6	20.4	21.0	21.6	24.2	25.2	22.0	20.2	25.6
79	19.4	19.4	19.8	22.8	20.8	22.7	20.9	23.0	26.5	23.5	28.0	22.8	28.0
80	19.7	19.8	22.2	20.8	21.4	23.4	21.8	27.2	26.0	25.0	28.2	28.3	28.3
81	21.3	24.2	21.0	26.8	31.9	30.7	22.2	21.8	26.2	23.4	22.7	20.7	31.9
82	19.7	19.4	20.5	23.2	27.7	20.5	21.0	20.7	23.5	26.8	27.6	27.5	27.7
83	28.4	22.1	21.6	23.8	24.1	23.6	21.3	20.6	25.6	24.4	20.8	22.5	28.4
84	23.6	25.5	23.4	28.2	25.7	21.3	25.6	21.9	21.6	26.8	28.1	27.2	28.2
85	21.8	28.4	27.0	25.8	25.6	21.8	23.8	23.2	27.7	27.6	28.6	24.7	28.6
86	21.9	20.4	22.2	22.2	23.4	25.8	20.9	21.6	27.2	24.4	26.3	22.7	27.2
87	20.1	19.7	21.0	20.8	25.6	25.0	23.3	24.4	28.6	27.0	28.3	27.8	28.6

B) Minimum Water level

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1978	19.2	19.0	19.2	19.2	19.6	19.1	19.0	19.1	19.3	19.3	19.3	18.9	
79	18.7	18.7	18.7	19.1	19.2	19.2	19.1	19.1	19.3	19.5	20.4	19.6	
80	19.3	19.3	19.3	19.4	19.2	19.4	19.0	19.4	19.6	20.8	20.2	21.1	
81	19.7	19.5	19.4	19.8	20.5	20.0	19.2	19.1	19.8	19.6	19.8	19.4	
82	19.0	18.8	18.9	19.2	20.1	19.3	19.3	19.1	19.5	19.8	21.7	20.5	
83	20.0	19.4	19.1	19.0	20.0	19.6	19.2	19.1	19.8	19.8	16.4	19.7	
84	19.4	20.1	20.0	21.0	20.8	19.7	19.5	19.5	19.4	19.8	19.8	20.7	
85	20.0	20.1	20.5	20.8	20.0	19.5	19.4	19.4	19.4	20.3	21.7	20.3	
86	19.7	19.3	19.3	19.5	19.8	19.8	19.3	19.4	19.6	20.0	20.7	20.0	
87	19.4	19.2	19.2	19.4	19.7	19.3	19.1	20.0	19.8	21.3	22.0	21.1	

ARA KUDA Waterlevel station



(Remark)

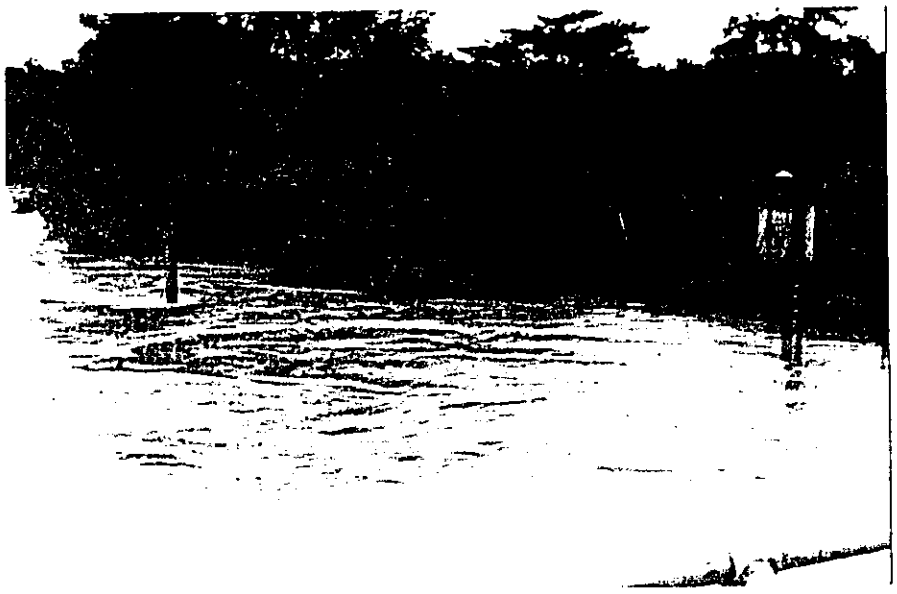
1. Research for H-Q curve.

1. survey and velocity (River gauging)

1987 35 times/month
1988 3 "

2 occur flood : above 28 feet

WATERLEVEL STATION IN SG. 'KULIM AT ARA KUDA



1978 ~ 1987 (N=10Y)

Water level	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	A·Total	%
											16		16	16	0.4
18.5 ~ 18.9	22	30	9								3		64	80	2.2
19.0 ~ 19.4	56	96	92	40	8	30	53	82	1	1	4	24	487	567	15.5
19.5 ~ 19.9	93	74	93	73	40	100	166	114	48	26	15	46	888	1.455	39.8
20.0 ~ 20.4	74	24	47	50	58	94 *	45 *	44	72	61	30	40	639	2.094	57.4
20.5 ~ 20.9	* 31	* 19	* 27	39	59	* 36	20	* 33	43	31	29	40	407	2.501	68.5
21.0 ~ 21.4	18	16	14	* 38	55	18	11	12	36	48	15	37	318	2.819	77.2
21.5 ~ 21.9	7	7	10	20	* 28	7	5	12	25	30	18	36	205	3024	82.8
22.0 ~ 22.4	4	8	9	14	22	7	4	6	* 15	30	32	* 28	179	3.203	87.7
22.5 ~ 22.9	1	2	4	8	10	1	1	1	16	* 22	38	20	124	3327	91.1
23.0 ~ 23.4	2	2	1	7	9	2	1	4	14	22	21	13	98	3425	93.8
23.5 ~ 23.9	1		1	1	1	1	2		5	12	* 22	6	52	3477	95.2
24.0 ~ 24.4		1	1	1	4	1		1	4	6	18	8	45	3522	96.4
24.5 ~ 24.9	1	1		2	3		1		7	5	6	4	30	3552	97.3
25.0 ~ 25.4			1		5	1			3	5	9		24	3576	97.9
25.5 ~ 25.9		1		3	4	1	1		2	3	7	1	23	3.599	98.5
26.0 ~ 26.4				1					4	2	5		12	3.611	98.9
26.5 ~ 26.9				1					1	3	2	1	8	3.619	99.1
27.0 ~ 27.4			1	1				1	1	2	3	3	12	3.631	99.4
27.5 ~ 27.9					1				2	1	2	2	8	3.639	99.6
28.0 ~ 28.4		1		1							4	1	7	3.646	99.8
28.5 ~ 28.9									1		1		2	3.648	99.9
29.0 ~ 29.4					1								1	3.649	99.9
29.5 ~ 29.9															
30.0 ~ 30.4															
30.5 ~ 30.9						1							1	3.650	99.9
31.0 ~ 31.4															
31.5 ~ 31.9					2								2	3652	100
32.0 ~ 32.4															
32.5 ~ 32.9															
FEET															
Total	310	282	310	300	310	300	310	310	300	310	300	310	3.652		

Tab. Water level Occur Account (at ARA KUDA)

Rem : * at 80% Water level

Rem : Above 28.0ft happened flood

1987

Water level	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	A·Total
18.5 ~ 18.9														
19.0 ~ 19.4		20	12				2						34	34
19.5 ~ 19.9	27	8	14	20	1	9	21		5				105	139
20.0 ~ 20.4	4		2	8	8	9	4	4	7				46	185
20.5 ~ 20.9			2	2	11	5	2	11					33	218
21.0 ~ 21.4			1		6	2		4	2	1		8	24	242
21.5 ~ 21.9					1	1		6	3	3		4	18	260
22.0 ~ 22.4					2	3		3	2	5	5	9	29	289
22.5 ~ 22.9					1		1	1	3	4	7	5	22	311
23.0 ~ 23.4							1	1	2	5	5		14	325
23.5 ~ 23.9										4	2	2	8	333
24.0 ~ 24.4								1		1	6	2	10	343
24.5 ~ 24.9									2	3	1		6	349
25.0 ~ 25.4						1			1	1	1		4	353
25.5 ~ 25.9					1				1	1	1		4	357
26.0 ~ 26.4										1	1		2	359
26.5 ~ 26.9										1			1	360
27.0 ~ 27.4										1			1	361
27.5 ~ 27.9									1			1	2	363
28.0 ~ 28.4											1		1	364
28.5 ~ 28.9									1				1	365
29.0 ~ 29.4														
29.5 ~ 29.9														
30.0 ~ 30.4														
30.5 ~ 30.9														
31.0 ~ 31.4														
31.5 ~ 31.9														
32.0 ~ 32.4														
32.5 ~ 32.9														
FEET														
Total	31	28	31	30	31	30	31	31	30	31	30	31	365	

Tab. Water level Occur Account

1986

Water level	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	A·Total
18.5 ~ 18.9														
19.0 ~ 19.4		7	7				3	1					18	18
19.5 ~ 19.9	6	19	11	8	4	3	21	23					95	113
20.0 ~ 20.4	22	2	6	8	15	16	3	3	7			13	95	208
20.5 ~ 20.9	1		4	8	6	6	4	3	6		5	11	54	262
21.0 ~ 21.4	1		1	5	1	2			3	6	5	3	27	289
21.5 ~ 21.9	1		1	1	1	1		1	2	9	3	1	21	310
22.0 ~ 22.4			1		1	1			4	6	6	2	21	331
22.5 ~ 22.9					1				3	4	4	1	13	344
23.0 ~ 23.4					2				2	1	1		6	350
23.5 ~ 23.9										2	3		5	355
24.0 ~ 24.4									1	3	1		5	360
24.5 ~ 24.9									1				1	361
25.0 ~ 25.4											1		1	362
25.5 ~ 25.9						1							1	363
26.0 ~ 26.4											1		1	364
26.5 ~ 26.9														
27.0 ~ 27.4									1				1	365
27.5 ~ 27.9														
28.0 ~ 28.4														
28.5 ~ 28.9														
29.0 ~ 29.4														
29.5 ~ 29.9														
30.0 ~ 30.4														
30.5 ~ 30.9														
31.0 ~ 31.4														
31.5 ~ 31.9														
32.0 ~ 32.4														
32.5 ~ 32.9														
FEET														
Total	31	28	31	30	31	30	31	31	30	31	30	31	365	

Tab. Water level Occur Account

1985

Water level	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	A·Total
18.5 ~ 18.9														
19.0 ~ 19.4								1					1	1
19.5 ~ 19.9						14	15	22	16				67	68
20.0 ~ 20.4	14	4			1	13	10	3	5	1		3	54	122
20.5 ~ 20.9	10	8	5		10	2	2	3	2	3		7	52	174
21.0 ~ 21.4	4	10	6	12	5		2	1	3	7		8	58	232
21.5 ~ 21.9	3	1	6	10	10	1	1			5	2	9	48	280
22.0 ~ 22.4		1	7	7	2				1	2	5	2	27	307
22.5 ~ 22.9		1	3		1					4	3		12	319
23.0 ~ 23.4		1			1			1	1		6	1	11	330
23.5 ~ 23.9			1				1			2	3		7	337
24.0 ~ 24.4			1								3		4	341
24.5 ~ 24.9		1							1	1	1	1	5	346
25.0 ~ 25.4			1							2			3	349
25.5 ~ 25.9				1	1					1	2		5	354
26.0 ~ 26.4										1	2		3	357
26.5 ~ 26.9											1		1	358
27.0 ~ 27.4			1							1	1		3	361
27.5 ~ 27.9									1	1			2	363
28.0 ~ 28.4		1											1	364
28.5 ~ 28.9											1		1	365
29.0 ~ 29.4														
29.5 ~ 29.9														
30.0 ~ 30.4														
30.5 ~ 30.9														
31.0 ~ 31.4														
31.5 ~ 31.9														
32.0 ~ 32.4														
32.5 ~ 32.9														
FEET														
Total	31	28	31	30	31	30	31	31	30	31	30	31	365	

Tab. Water level Occur Account

1984

Water level	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	A·Total
18.5 ~ 18.9														
19.0 ~ 19.4														
19.5 ~ 19.9	8					2	8	14	7	2			41	41
20.0 ~ 20.4	9	4	19			13	3	10	15	15	3		91	132
20.5 ~ 20.9	5	7	4		1	12	5	6	4	8	1	1	54	186
21.0 ~ 21.4	4	6	4	9	8	3	6		3	3	3	8	57	243
21.5 ~ 21.9	2	3	2	2	5		3	1	1	1	2	8	30	273
22.0 ~ 22.4	1	6		3	7		3				4	2	26	299
22.5 ~ 22.9		1	1	4	4						2	3	15	314
23.0 ~ 23.4	1	1	1	4	3					1	1	4	16	330
23.5 ~ 23.9	1						1				4	1	7	337
24.0 ~ 24.4				1	1						3	1	6	343
24.5 ~ 24.9				2	1		1					2	6	349
25.0 ~ 25.4					1						2		3	352
25.5 ~ 25.9		1		2			1				3		7	359
26.0 ~ 26.4				1									1	360
26.5 ~ 26.9										1			1	361
27.0 ~ 27.4				1								1	2	363
27.5 ~ 27.9											1		1	364
28.0 ~ 28.4				1							1		2	366
28.5 ~ 28.9														
29.0 ~ 29.4														
29.5 ~ 29.9														
30.0 ~ 30.4														
30.5 ~ 30.9														
31.0 ~ 31.4														
31.5 ~ 31.9														
32.0 ~ 32.4														
32.5 ~ 32.9														
FEET														
Total	31	29	31	30	31	30	31	31	30	31	30	31	366	

Tab. Water level Occur Account

1983

Water level	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	A·Total
~ 18.4											16		16	16
18.5 ~ 18.9											3		3	19
19.0 ~ 19.4			10	23			4	17			3		57	76
19.5 ~ 19.9		18	17	1		9	18	10			4	7	84	160
20.0 ~ 20.4	11	8	3	5	6	12	7	3	1	15	2	14	87	247
20.5 ~ 20.9	8	1			9	3	1	1	5	8	2	4	42	289
21.0 ~ 21.4	5				8	1	1		4	4		3	26	315
21.5 ~ 21.9	1		1		3	1			8			1	15	330
22.0 ~ 22.4	3	1			2	2			1	1		1	11	341
22.5 ~ 22.9	1								2	1		1	5	346
23.0 ~ 23.4	1				1	1			3	1			7	353
23.5 ~ 23.9				1		1			1				3	356
24.0 ~ 24.4					2				1	1			4	360
24.5 ~ 24.9	1								2				3	363
25.0 ~ 25.4									1				1	364
25.5 ~ 25.9									1	1			1	365
26.0 ~ 26.4														
26.5 ~ 26.9														
27.0 ~ 27.4														
27.5 ~ 27.9														
28.0 ~ 28.4														
28.5 ~ 28.9														
29.0 ~ 29.4														
29.5 ~ 29.9														
30.0 ~ 30.4														
30.5 ~ 30.9														
31.0 ~ 31.4														
31.5 ~ 31.9														
32.0 ~ 32.4														
32.5 ~ 32.9														
FEET														
Total	31	28	31	30	31	30	31	31	30	31	30	31		

Tab. Water level Occur Account

1982

Water level	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	A·Total
18.5 ~ 18.9		19											19	19
19.0 ~ 19.4	23	9	26	6		6	5	22					97	116
19.5 ~ 19.9	8		2	1		17	20	5	6	1			60	176
20.0 ~ 20.4			2	9	4	6	5	3	13	3			45	221
20.5 ~ 20.9			1	8	9	1		1	5	2		6	33	254
21.0 ~ 21.4				3	9		1		4	7		5	29	283
21.5 ~ 21.9				2	2				1	2		5	12	295
22.0 ~ 22.4					4					5	4	7	20	315
22.5 ~ 22.9					1					1	8	2	12	327
23.0 ~ 23.4				1						4	3	3	11	338
23.5 ~ 23.9									1	2	8		11	349
24.0 ~ 24.4										1	1	1	3	352
24.5 ~ 24.9										1	2		3	355
25.0 ~ 25.4					1						3		4	359
25.5 ~ 25.9										1			1	360
26.0 ~ 26.4														
26.5 ~ 26.9										1		1	2	362
27.0 ~ 27.4														
27.5 ~ 27.9					1						1	1	3	365
28.0 ~ 28.4														
28.5 ~ 28.9														
29.0 ~ 29.4														
29.5 ~ 29.9														
30.0 ~ 30.4														
30.5 ~ 30.9														
31.0 ~ 31.4														
31.5 ~ 31.9														
32.0 ~ 32.4														
32.5 ~ 32.9														
FEET														
Total	31	28	31	30	31	30	31	31	30	31	30	31	365	

Tab. Water level Occur Account

1981

Water level	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	A·Total
18.5 ~ 18.9														
19.0 ~ 19.4								9					9	9
19.5 ~ 19.9	9	17	16	1			26	18	1	10	2	29	129	138
20.0 ~ 20.4	11	5	6	7		16	2	3	5	13	14		82	220
20.5 ~ 20.9	7	3	8	9	4	3	2		6	2	6	2	52	272
21.0 ~ 21.4	4		1	6	10	6			7	1	5		40	312
21.5 ~ 21.9		2		1	3	2		1	1	1	1		12	324
22.0 ~ 22.4				2	2	1	1		3	1			10	334
22.5 ~ 22.9				2					2		2		6	340
23.0 ~ 23.4				1	1				1	3			6	346
23.5 ~ 23.9					1								1	347
24.0 ~ 24.4		1			1	1							3	350
24.5 ~ 24.9					2				1				3	353
25.0 ~ 25.4					3								3	356
25.5 ~ 25.9					1								1	357
26.0 ~ 26.4									3				3	360
26.5 ~ 26.9				1									1	361
27.0 ~ 27.4														
27.5 ~ 27.9														
28.0 ~ 28.4														
28.5 ~ 28.9														
29.0 ~ 29.4					1								1	362
29.5 ~ 29.9														
30.0 ~ 30.4														
30.5 ~ 30.9						1							1	363
31.0 ~ 31.4														
31.5 ~ 31.9					2								2	365
32.0 ~ 32.4														
32.5 ~ 32.9														
FEET														
Total	31	28	31	30	31	30	31	31	30	31	30	31	365	

Tab. Water level Occur Account

1980

Water level	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	A Total
18.5 ~ 18.9														
19.0 ~ 19.4	13	21	6		1	2	2						45	45
19.5 ~ 19.9	18	8	20	21	13	15	22	4	1				122	167
20.0 ~ 20.4			3	5	12	5	3	8	8				44	211
20.5 ~ 20.9			1	4	2	2	3	8	6	1	2	1	30	241
21.0 ~ 21.4					3	4		4	2	7	1		21	262
21.5 ~ 21.9						1	1	2	4	6	5	2	21	283
22.0 ~ 22.4			1					3	2	3	3	4	16	299
22.5 ~ 22.9									2	8	7	7	24	323
23.0 ~ 23.4						1			1	4	3	5	15	338
23.5 ~ 23.9									1	1	2	3	7	345
24.0 ~ 24.4									1		1	4	6	351
24.5 ~ 24.9											2	1	3	354
25.0 ~ 25.4									1	1			2	356
25.5 ~ 25.9												1	1	357
26.0 ~ 26.4									1				1	358
26.5 ~ 26.9											1		1	359
27.0 ~ 27.4											2	2	5	364
27.5 ~ 27.9														
28.0 ~ 28.4											1	1	2	366
28.5 ~ 28.9														
29.0 ~ 29.4														
29.5 ~ 29.9														
30.0 ~ 30.4														
30.5 ~ 30.9														
31.0 ~ 31.4														
31.5 ~ 31.9														
32.0 ~ 32.4														
32.5 ~ 32.9														
FEET														
Total	31	29	31	30	31	30	31	31	30	31	30	31	366	

Tab. Water level Occur Account

1979

Water level	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	A·Total
18.5 ~ 18.9	22	11	9										42	42
19.0 ~ 19.4	9	15	19	4	7	12	17	16					99	141
19.5 ~ 19.9		2	3	9	16	12	9	10		11		4	76	217
20.0 ~ 20.4				5	4	3	4	3	4	6		9	38	255
20.5 ~ 20.9				5	3	2	1		4	2	7	8	32	287
21.0 ~ 21.4				1	1			1	6	6		2	17	304
21.5 ~ 21.9				3					3	1	4	6	17	321
22.0 ~ 22.4				1					2	3	4	1	11	332
22.5 ~ 22.9				2		1			4		5	1	13	345
23.0 ~ 23.4								1	4	1	2		8	353
23.5 ~ 23.9									2	1			3	356
24.0 ~ 24.4											3		3	359
24.5 ~ 24.9														
25.0 ~ 25.4											2		2	361
25.5 ~ 25.9											1		1	362
26.0 ~ 26.4											1		1	363
26.5 ~ 26.9									1				1	364
27.0 ~ 27.4														
27.5 ~ 27.9														
28.0 ~ 28.4											1		1	365
28.5 ~ 28.9														
29.0 ~ 29.4														
29.5 ~ 29.9														
30.0 ~ 30.4														
30.5 ~ 30.9														
31.0 ~ 31.4														
31.5 ~ 31.9														
32.0 ~ 32.4														
32.5 ~ 32.9														
FEET														
Total	31	28	31	30	31	30	31	31	30	31	30	31	365	

Tab. Water level Occur Account

1978

Water level	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	A·Total
18.5 ~ 18.9														
19.0 ~ 19.4	11	24	12	7		10	20	16	1	1	1	24	127	127
19.5 ~ 19.9	17	2	10	12	6	19	6	8	12	2	9	6	109	236
20.0 ~ 20.4	3	1	6	3	8	1	4	4	7	8	11	1	57	293
20.5 ~ 20.9			2	3	4				5	5	6		25	318
21.0 ~ 21.4			1	2	4		1	2	2	6	1		19	337
21.5 ~ 21.9		1		1	3			1	2	2	1		11	348
22.0 ~ 22.4				1	2					4	1		8	356
22.5 ~ 22.9					2								2	358
23.0 ~ 23.4				1	1					2			4	362
23.5 ~ 23.9														
24.0 ~ 24.4									1				1	363
24.5 ~ 24.9														
25.0 ~ 25.4										1			1	364
25.5 ~ 25.9					1								1	365
26.0 ~ 26.4														
26.5 ~ 26.9														
27.0 ~ 27.4														
27.5 ~ 27.9														
28.0 ~ 28.4														
28.5 ~ 28.9														
29.0 ~ 29.4														
29.5 ~ 29.9														
30.0 ~ 30.4														
30.5 ~ 30.9														
31.0 ~ 31.4														
31.5 ~ 31.9														
32.0 ~ 32.4														
32.5 ~ 32.9														
FEET														
Total	31	28	31	30	31	30	31	31	30	31	30	31	365	

Tab. Water level Occur Account

CHECK OF H – Q CURVE

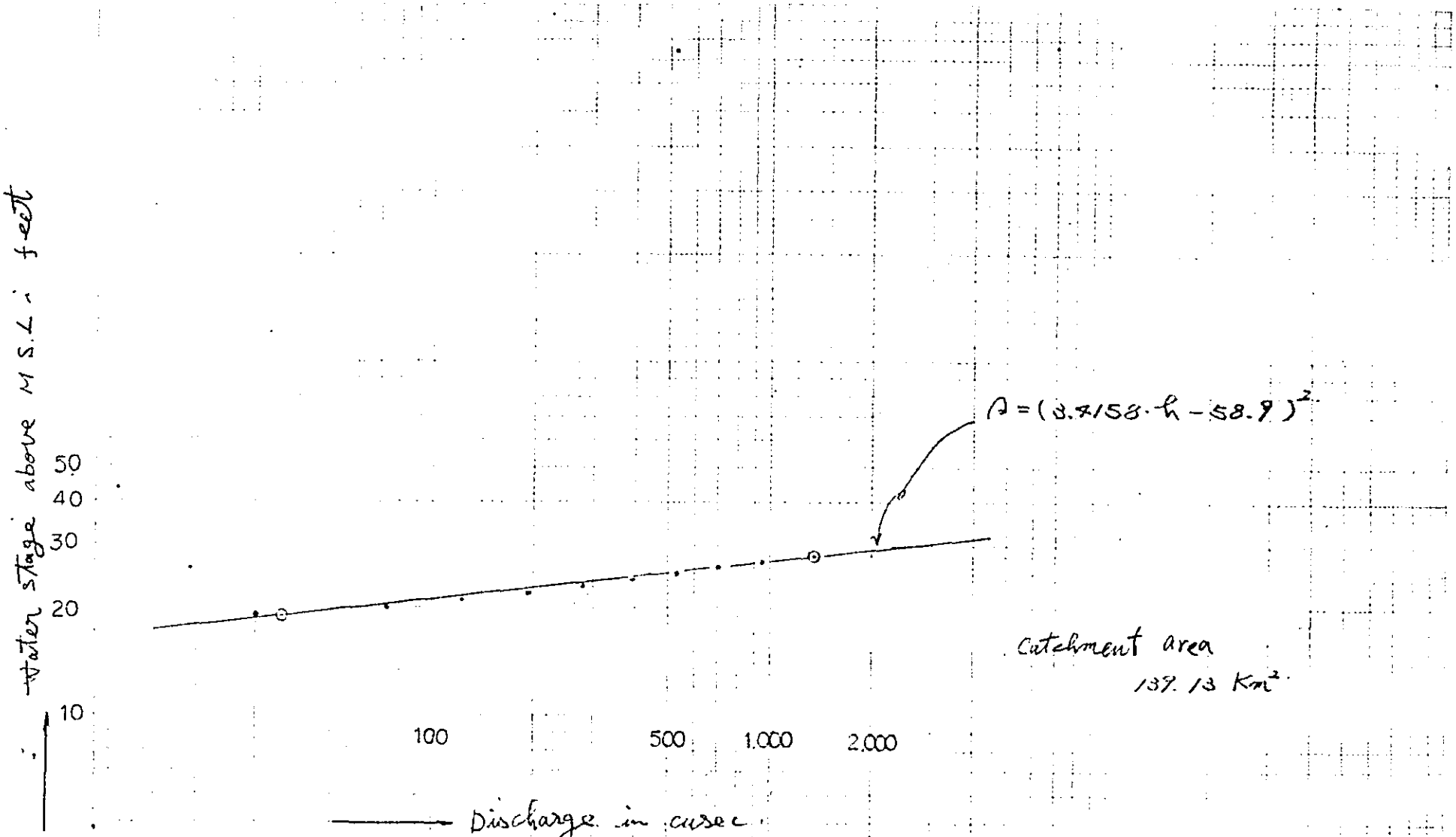


Fig 3-2-1 Stage-Discharge curve at ARA KUDA gauging station in SG KLIM

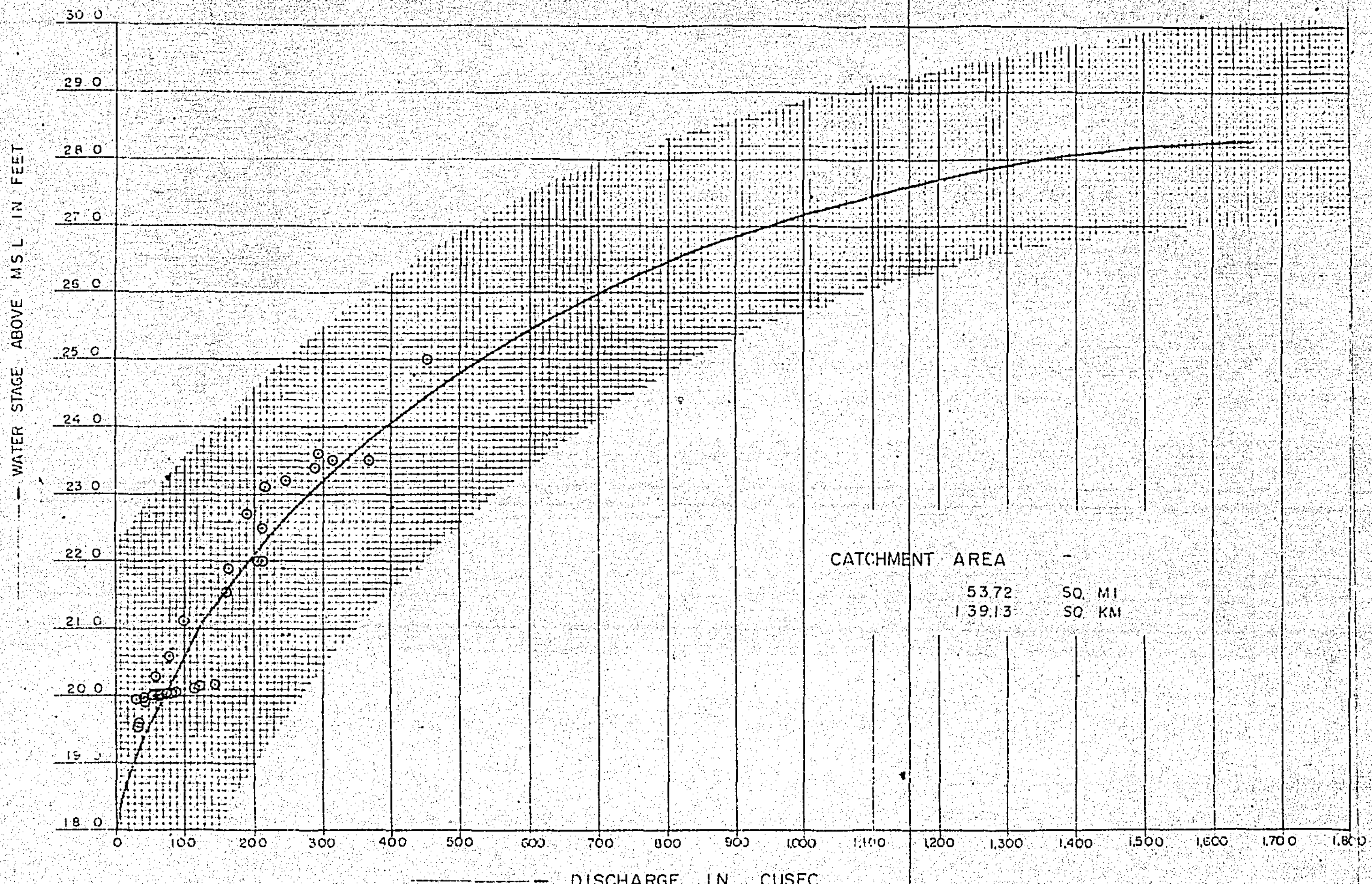


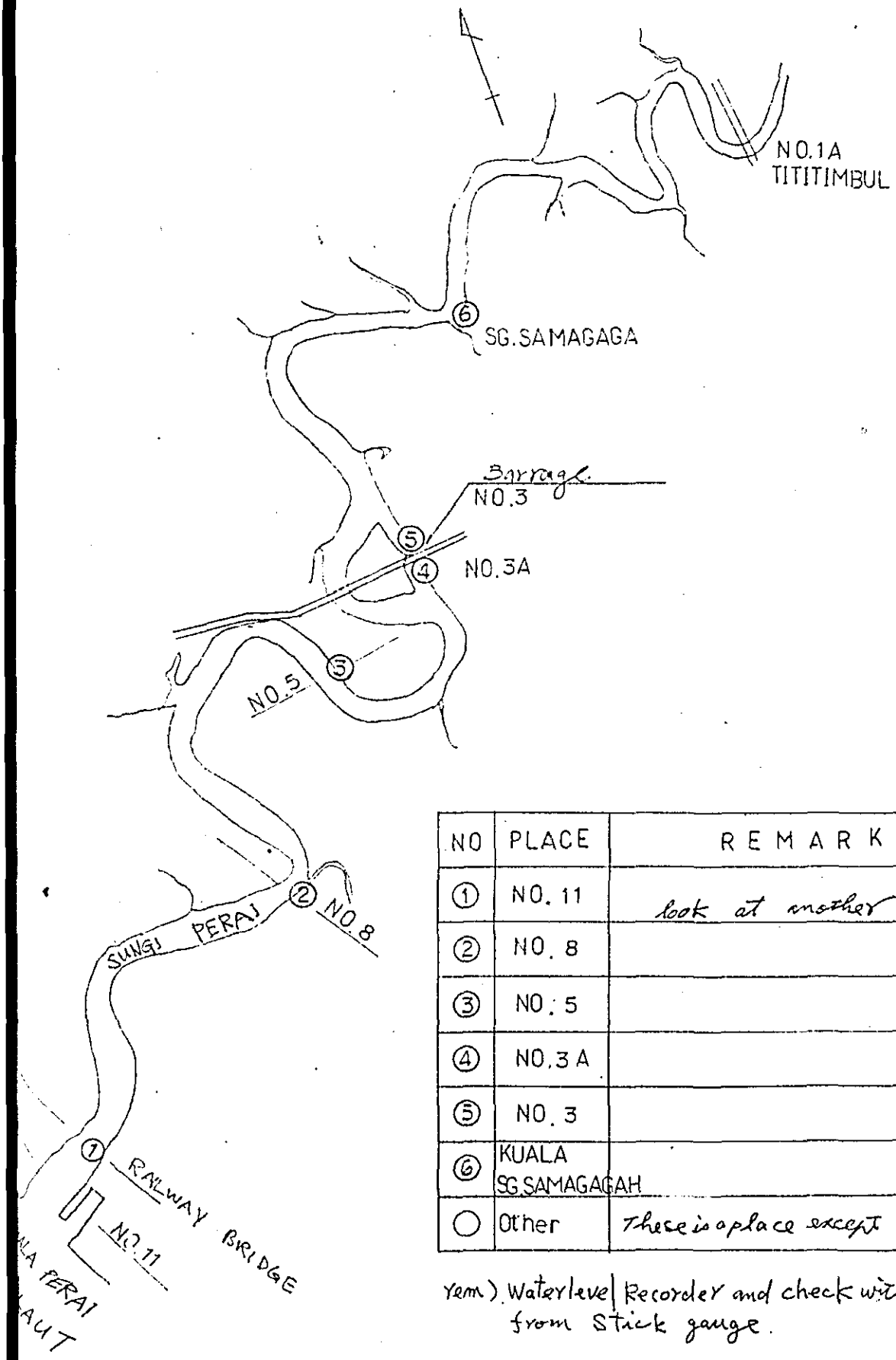
FIG. 3-2-2 STAGE — DISCHARGE CURVE AT ARA KUDA GAUGING STATION IN SG. KULIM

* H-Q curve used from Feasibility F. Plan because ~~same~~ recently data are also same F. Plan also used.

THE PLACE OF WATERLEVEL STATION

NO	PLACE	REMARK
1	NO.11	CHECK OF PENANG,S TIDE TABLE
2	NO.8	A MIDDLE PLACE BETWEEN RIVERMOUTH AND PRAI BARRAGE
3	NO.5	ALAST OF DOWNSTREAM AT FACTORY,S AREA
4	NO.3A	A DOWNSTREAM AT BARRAGE
5	NO.3	A UPSTREAM AT BARRAGE * RECORD OF HEADLOSS AT BARRAGE
6	A RIVER MOUTH OF SG.SAMAGAGAH	A MIDDLE PLACE BETWEEN BARRAGE AND TITI TIMBUL * THIS PLACE NEEDS ANALYSIS OF DRAINAGE BECOUSE THERE IS PADDI FIELD BEHIND RIVER

The Place Of Waterlevel Station

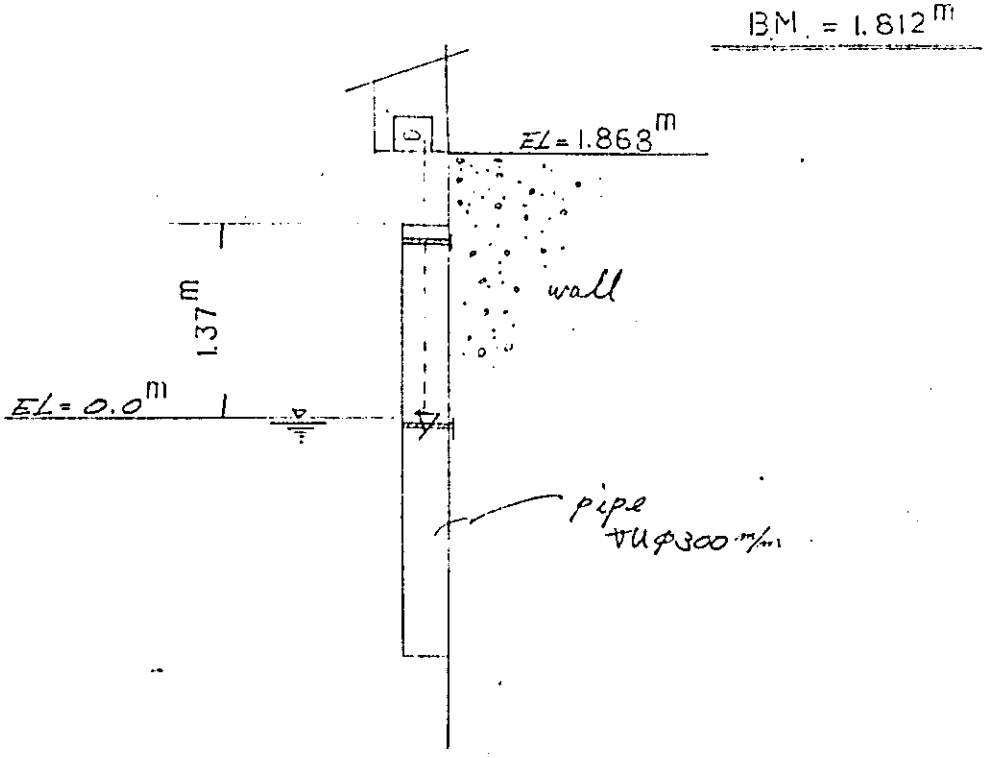


NO	PLACE	REMARK
①	NO. 11	look at another page.
②	NO. 8	
③	NO. 5	
④	NO. 3 A	
⑤	NO. 3	
⑥	KUALA SG SAMAGAGAH	
○	Other	There is a place except tidal river

Rem) Waterlevel Recorder and check with Readings from Stick gauge.

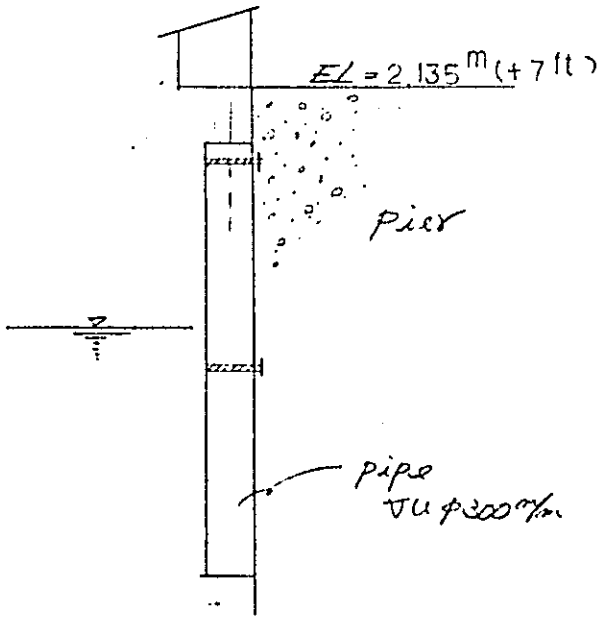
Setting for Water level Recorder

① Railway Bridge

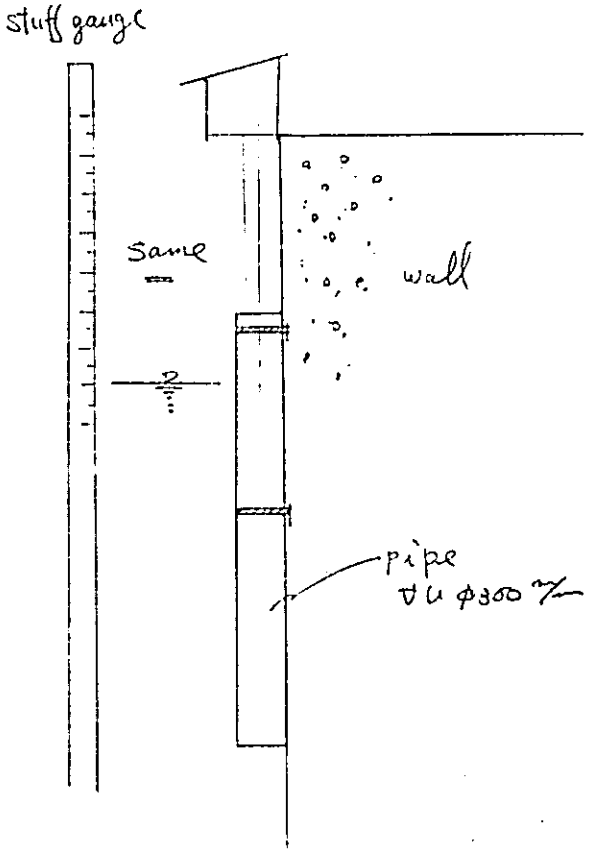


Barrage

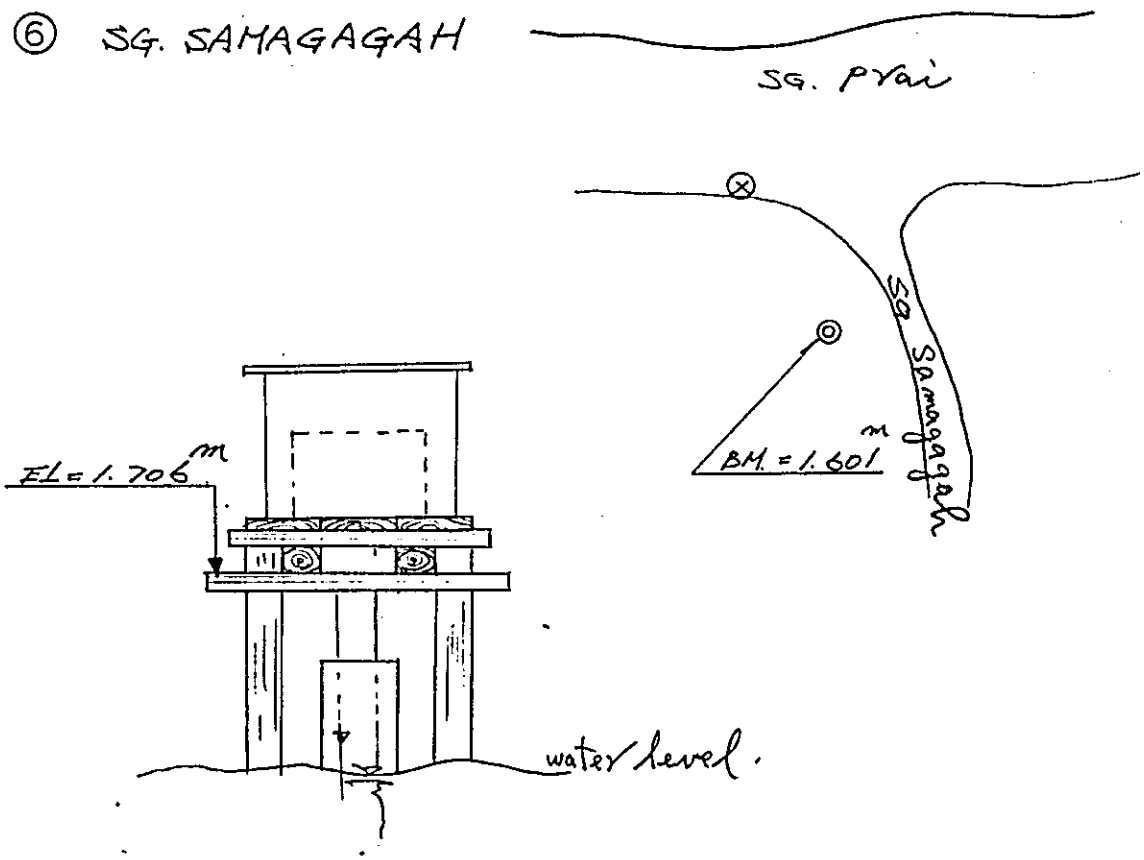
④ Downstream



⑤ up stream



⑥ SG. SAMAGAGAH



RAINFALL DATA LIST

Tab 1 — Monthly Rainfall (IN SG. KERETH BASIN)

Station Name: MARAKOFF ESTATE — STATION NO : 3303001

Summary of Rainfall (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Mean	Max 1 Day	Max 2 Day	Max 3 Day	Remarks
1958	78.9	150.6	119.6	103.6	257.9	149.7	88.4	237.0	136.7	316.5	767.6	18.3	2306.8	192.2	183.8			
1959	26.4	124.0	83.3	188.7	331.5	310.1	108.2	225.3	210.6	367.5	204.0	131.1	2360.7	196.7	111.3			
1960	97.0	0.3	73.7	206.8	160.1	188.5	229.4	154.2	256.0	161.0	230.1	226.6	1985.7	165.5	67.8			
1961	108.7	163.3	343.2	345.7	228.6	202.2	212.1	151.4	183.0	287.1	333.5	243.0	2908.8	242.4	81.0			
1962	121.9	5.1	68.8	170.4	173.2	205.5	256.3	245.0	222.8	603.5	190.5	152.9	2405.9	200.5	154.7			
1963	126.7	41.4	209.7	12.2	158.2	187.8	101.9	186.9	239.4	370.6	607.5	163.3	2947.6	195.4	122.7			
1964	100.6	78.2	67.1	205.0	350.5	89.4	252.7	158.5	60.8	230.0	425.7	81.0	2838.5	236.5	162.6			
1965	9.7	98.6	246.6	216.7	135.9	70.4	159.8	338.6	296.2	423.5	316.5	305.1	2787.6	232.3	99.1			
1966	141.5	111.3	256.5	252.0	276.1	150.6	382.8	219.2	247.4	307.4	182.6	117.3	2612.1	217.7	112.0			
1967	162.1	47.5	65.9	282.2	191.0	181.1	98.8	212.3	227.8	345.6	355.7	56.4	2182.4	181.9	110.7			
1968	77.7	11.9	105.9	324.9	118.9	151.4	371.6	385.8	374.9	318.8	206.8	298.1	2677.7	223.1	88.4			
1969	170.0	61.7	112.3	89.8	127.0	165.4	99.1	285.2	208.3	407.4	225.3	112.0	2060.0	171.2	219.2			
1970	171.5	0.	90.2	195.1	196.1	79.8	345.0	108.2	265.9	345.9	231.1	232.2	2471.0	205.9	108.0			
1971	40.7	129.3	186.4	191.8	200.9	212.1	71.4	276.4	164.8	355.8	138.4	225.8	2192.8	183.6	108.0	185.6	298.8	
1972	52.6	171.5	96.8	297.2	59.4	119.6	62.2	84.0	398.9	453.6	265.4	177.3	2217.5	185.6	259.1	299.1	465.6	
1973	24.2	25.6	103.1	241.8	211.1	171.7	286.0	187.7	154.0	338.1	361.4	177.0	2225.7	185.5	107.4	158.5	170.5	
1974	14.5	92.2	72.9	222.0	217.6	78.5	136.6	120.7	272.5	197.9	165.7	29.6	1582.7	131.9	93.0	119.1	132.3	
1975	185.9	151.4	172.0	176.1	196.9	198.1	225.5	187.0	230.5	333.0	278.0	237.5	2478.9	207.1	78.5	100.6	100.6	
1976	0.	12.5	138.5	136.0	242.5	197.0	107.5	155.5	425.0	377.5	221.5	152.5	2158.0	179.8	240.0	255.5	242.5	
1977	38.0	148.5	0.	126.5	335.0	174.5	50.5	242.0	380.0	447.0	152.0	138.5	2232.5	186.0	133.0	165.0	165.0	
1978	68.0	25.5	41.5	58.0	283.0	509.0	192.5	275.0	281.5	327.5	250.5	17.5	2706.5	225.5	113.5	173.0	206.0	
1979	36.0	15.0	57.0	255.0	172.5	150.0	95.0	78.0	377.0	237.0	322.5	28.5	2178.5	181.1	136.0	272.0	272.0	
1980	0.	112.0	109.0	98.0	143.5	74.0	120.5	331.5	630.0	355.5	209.5	117.5	2752.0	229.7	150.0	179.0	209.0	
1981	23.0	96.0	79.5	237.5	157.0	109.5	68.0	177.5	327.5	143.5	96.0	7.5	1520.5	126.7	80.0			
1982	0.	17.5	118.5	129.0	306.0	55.0	125.0	85.0	362.0	326.5	337.0	107.0	1923.5	160.3	80.0			
1983	37.0	78.0	98.0	62.0	321.0	219.0	138.0	91.0	271.0	191.0	92.0	112.0	1833.0	152.8	69.0			
1984	183.5	147.0	93.0	518.5	66.0	62.5	216.0	179.0	98.0	151.5	159.5	186.0	2031.5	169.3	145.5			
1985	53.0	140.5	155.0	207.0	190.0	78.5	97.0	178.5	249.0	248.0	138.0	51.0	1775.5	148.0	50.0			
1986	16.0	0	78.5	59.0	156.0	56.0	70.0	203.5	347.5	319.0	212.0	65.0	1568.5	130.7	55.0			
1987	0.	0.	41.0	79.0	196.0	124.5	117.0	274.0	260.5	165.5	286.0	167.5	1670.0	139.2	57.0			
Total	2078.1	2211.4	3771.5	5592.6	6378.7	4525.7	5177.8	5912.4	7742.5	10212.6	7806.3	7210.0	67069.4	5589.2	3632.9			
Mean	69.3	73.7	115.7	186.4	212.6	150.8	172.6	197.1	258.1	340.4	260.2	240.3	2235.6	186.3				

Tab — Monthly Rainfall (IN SG. KULIM BASIN)

Station Name: SG KULIM HEADWORKS — STATION NO: 5307073

Summary Of Rainfall (mm.)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Mean	Annual 1 Day	Annual 2 Day	Annual 3 Day	Remarks
1958	150.7	186.1	115.1	180.1	255.2	160.5	58.0	287.2	250.0	151.9	276.0	89.9	2.727.7	202.3	117.8			
1959	6.7	173.2	198.1	216.9	310.6	230.6	67.3	195.1	197.1	332.2	261.7	185.7	2.317.3	192.9	77.9			
1960	65.8	87.2	193.0	186.2	160.5	175.0	283.7	99.1	225.0	135.6	285.2	206.5	2.072.8	172.7	78.5			
1961	76.5	120.1	211.8	221.0	191.8	186.7	208.8	105.7	167.2	321.8	227.9	173.0	2.175.7	181.3	119.9			
1962	75.7	15.0	157.3	123.7	219.7	285.2	171.7	167.7	155.0	527.3	168.1	173.3	2.186.1	182.2	128.8			
1963	91.7	68.8	327.6	10.9	185.7	185.7	151.0	231.7	198.6	321.7	161.3	100.1	2285.7	190.5	105.7			
1964	38.6	139.7	26.7	277.6	387.3	81.3	252.3	84.6	657.6	372.7	333.1	77.7	2.684.0	223.7	157.5			
1965	9.9	28.9	192.0	251.7	133.9	57.9	126.5	253.8	379.7	226.3	370.8	320.5	2337.9	178.8	137.9			
1966	70.7	80.3	178.3	182.9	159.5	82.0	315.5	206.8	182.1	277.1	182.1	269.2	2.186.2	182.2	74.5			
1967	268.7	22.1	116.8	254.5	277.9	173.5	96.3	152.7	168.6	374.1	387.6	29.2	2.271.7	186.8	109.2			
1968	21.1	29.0	171.2	286.5	101.1	110.2	231.1	377.1	111.3	289.6	260.7	292.7	2.278.0	189.8	107.7			
1969	208.3	21.6	179.8	325	219.7	87.9	99.3	192.0	179.2	351.3	271.3	179.6	1.967.5	164.0	88.9			
1970	269.2	17.3	80.8	368.6	218.1	72.7	307.0	167.3	373.7	768.7	279.7	189.2	3.031.7	252.6	124.5			
1971	52.2	207.2	127.3	207.0	136.9	205.7	67.1	260.6	367.8	517.7	120.7	257.8	2.510.7	209.2	124.5	195.6	250.2	
1972	53.6	77.5	71.7	96.3	57.7	79.2	63.8	91.8	370.1	377.7	239.3	199.9	1.925.0	160.4	147.3	226.1	266.7	
1973	74.5	27.7	148.1	207.8	360.9	209.0	139.2	177.5	153.2	298.1	373.1	209.0	2.372.8	197.9	135.1	156.7	170.7	
1974	10.9	83.8	39.7	250.7	227.8	61.7	150.6	102.7	325.6	305.3	201.7	72.1	1.828.7	152.7	106.2	153.2	201.7	
1975	126.0	161.3	202.7	180.8	187.7	90.9	226.0	150.0	232.0	298.0	226.0	172.5	2.239.0	186.6	122.7	170.0	170.0	
1976	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	
1977	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	
1978	16.5	107.0	97.0	157.0	317.0	286.5	186.0	252.5	258.5	376.0	115.0	18.5	2.156.5	179.7	126.5	138.0	170.0	
1979	29.5	23.0	57.0	209.0	202.5	136.5	218.5	108.0	135.5	266.0	271.0	29.0	2.135.5	178.0	106.0	117.0	132.0	
1980	18.0	116.0	143.0	218.5	152.5	91.0	136.0	330.0	237.0	381.0	228.0	196.0	2.609.0	217.4	117.0	170.0	173.0	
1981	2.0	101.0	103.0	357.0	176.0	109.0	66.0	257.0	215.0	177.0	137.0	29.0	1.923.0	160.3	158.0			
1982	17.0	57.0	165.0	203.0	205.0	7.0	152.0	107.0	308.0	376.0	218.0	173.0	2.319.0	193.3	110.0			
1983	81.0	33.0	115.0	202.0	387.0	223.0	103.0	167.0	121.0	157.0	158.0	138.0	2.185.0	182.1	107.0			
1984	229.0	222.0	299.0	487.0	173.0	76.0	208.0	177.0	187.0	189.0	331.0	157.0	2.709.0	225.8	108.0			
1985	61.0	147.0	279.0	232.0	296.0	82.0	172.0	243.0	226.0	436.0	318.0	87.0	2.569.0	214.1	176.0			
1986	9.0	9.0	88.0	114.0	246.0	92.0	67.0	219.0	435.0	361.0	256.0	112.0	2.008.0	167.3	143.0			
1987	0.	0.	193.0	143.0	249.0	173.0	85.0	177.0	312.0	410.5	360.0	106.5	2.211.0	184.3	165.0			
Total	2065.6	2794.2	4262.8	6230.7	6735.0	3.775.6	4314.7	5.155.7	7.867.5	9.257.7	7961.1	7127.0	63.854.9	5321.4	3.351.0			
Mean	73.8	81.9	152.2	222.5	232.0	134.8	154.1	184.1	281.0	330.6	284.3	177.7	2.280.5	190.1				

Tab

Monthly Rainfall

Station Name: BUKIT MERAH PADI STATION

STATION NO : 5X0X0XX

Summary Of Rainfall (mm.)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Mean	Annual 1 Day Maximum	Total 2 Day	Total 3 Day	Remarks
1958															76.2			
1959	15.0	181.1	133.6	217.2	177.5	223.5	110.7	180.6	200.7	718.3	114.6	113.5	2 088.3	169.7	76.2			
1960	27.6	83.2	150.9	228.0	94.0	218.2	219.5	125.7	258.6	157.7	383.7	211.3	2 158.4	178.5	129.0			
1961	179.3	73.9	184.9	147.0	90.9	178.5	182.9	83.1	198.9	385.3	367.5	159.8	2 207.0	183.9	102.1			
1962	67.6	37.0	137.2	89.2	169.4	303.0	159.3	216.2	125.5	520.7	181.9	247.1	2 231.1	185.9	106.2			
1963	58.4	76.2	190.8	11.2	137.2	154.9	80.8	289.3	209.6	282.2	412.5	79.2	1 902.3	158.5	101.2			
1964	51.6	59.9	58.9	236.2	403.9	89.4	277.3	96.3	582.2	367.0	287.5	87.6	2 587.8	215.7	137.9			
1965	2.5	38.6	156.7	178.0	118.8	91.7	174.0	377.0	276.1	269.0	238.0	350.8	2 171.2	180.9	81.0			
1966	105.9	152.4	118.9	113.8	117.9	71.4	311.2	318.0	133.9	132.6	69.1	159.0	1 807.9	150.7	106.7			
1967	191.5	36.8	90.4	92.7	190.5	123.2	87.1	133.9	177.3	386.8	267.2	34.3	1 731.7	144.3	72.4			
1968	21.1	90.4	128.3	173.5	80.0	200.9	238.8	247.1	175.8	310.1	116.6	231.4	1 963.5	163.6	83.3			
1969	102.6	86.6	86.6	51.6	284.1	170.4	87.6	227.8	155.2	321.6	284.7	71.9	1 870.7	155.9	82.3			
1970	228.8	1.8	55.6	211.1	237.8	81.0	311.4	174.2	270.8	664.7	158.2	194.1	2 575.5	214.6	109.7			
1971	70.1	50.0	74.2	112.3	54.6	179.9	67.3	264.7	404.9	380.5	50.8	165.4	1 845.0	153.8	109.7	215.1	270.6	
1972	19.6	77.2	33.8	389.1	78.0	51.3	60.2	85.6	376.2	213.6	156.5	194.8	1 655.4	138.0	110.0	189.4	269.2	
1973	36.6	28.6	119.6	230.1	216.4	221.5	141.7	127.0	85.9	260.4	380.7	128.3	1 993.8	166.5	108.0	188.5	276.9	
1974	2.0	20.6	97.8	192.8	142.0	69.1	112.3	54.9	201.7	337.1	162.1	42.9	1 375.3	114.6	85.1	157.0	178.8	
1975	156.7	140.5	123.0	148.6	61.7	75.3	78.5	150.5	222.5	328.0	270.5	161.0	1 959.0	163.3	120.8	185.9	185.9	
1976	0.	42.0	200.0	107.0	200.0	45.0	112.5	46.5	357.0	257.5	160.5	93.5	1 643.5	136.5	129.0	184.5	199.0	
1977	22.0	60.0	9.5	243.0	189.0	69.0	58.0	217.5	444.0	446.5	100.5	187.0	2 013.0	167.8	133.5	159.0	177.0	
1978	23.5	30.0	71.5	125.5	327.5	231.5	174.5	239.0	227.0	373.0	36.0	12.0	1 872.5	156.0	145.5	171.0	171.0	
1979	26.0	38.5	55.0	370.0	103.0	157.5	203.5	161.0	185.5	229.0	318.0	57.5	1 863.5	155.7	70.0	75.5	106.0	
1980	9.5	125.5	124.0	157.1	197.5	76.0	56.5	369.0	570.0	270.4	196.5	103.0	2 287.6	180.4	120.5	186.0	209.5	closed.
1981																		
1982																		
1983																		
1984																		
1985																		
1986																		
1987																		
Total	1410.9	1394.1	2390.7	3763.0	3618.7	3067.2	3172.6	4073.9	5778.8	7311.6	4691.4	3020.4	43 680.0	3640.0	2507.3			
Mean	69.1	68.4	108.7	170.0	164.5	139.3	142.8	185.2	262.7	332.3	213.2	137.3	1985.5	165.5				

N.23

Tab _____ Monthly Rainfall

Station Name METEOLOGICAL STATION BUTTERWORTH STATION NO.: 5X030X2

Summary Of Rainfall (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Mean	Annual Maximum 1 Day	2 Day	3 Day	Remarks
1958																		
1959	20.8	162.1	97.8	136.1	125.0	339.6	77.7	155.2	211.8	307.8	189.2	125.7	1,745.8	142.2	149.7			
1960	89.1	76.2	164.7	181.9	172.2	245.1	182.1	136.7	329.9	**	241.8	178.3	**	**	87.1			
1961	117.9	145.8	183.9	190.0	252.0	265.9	77.9	136.9	329.9	191.5	259.5	109.5	2202.2	183.5	92.5			
1962	76.7	3.6	147.5	170.2	216.7	271.3	225.3	187.9	265.0	536.7	86.1	116.8	2.270.2	189.2	167.7			
1963	73.7	100.1	256.8	3.8	192.3	173.7	77.7	221.0	198.7	253.5	290.3	70.9	1910.9	159.2	69.1			
1964	191.0	96.1	118.9	176.9	397.5	102.1	270.3	169.7	577.6	609.0	398.5	77.0	3.086.3	257.2	181.1			
1965	0.	111.8	240.8	103.9	69.5	82.8	211.1	283.5	327.1	196.3	788.7	280.7	2.890.2	199.2	183.6			
1966	211.1	283.5	327.1	196.3	788.7	280.7	188.0	267.3	177.8	258.3	87.6	167.1	2.911.5	243.1	109.2			
1967	188.0	267.3	177.8	283.3	87.6	167.1	73.7	196.3	195.8	282.7	211.8	29.5	2.092.9	174.4	113.0			
1968	73.7	196.3	195.8	282.7	211.8	29.5	308.9	219.1	281.4	269.7	174.5	214.4	2.647.8	219.0	106.2			
1969	308.9	219.1	281.4	269.7	174.5	214.4	65.5	246.9	363.0	376.4	367.3	153.7	3.270.8	270.1	130.3			
1970	65.5	246.9	363.0	376.4	367.3	153.7	397.5	202.9	258.3	613.7	257.0	218.7	3.520.9	293.4	152.9			
1971	38.7	93.2	92.5	74.7	214.7	189.5	72.1	272.3	581.7	788.2	77.7	231.4	2427.1	202.3	152.9	267.7	292.9	
1972	27.9	103.4	54.1	278.4	110.7	157.3	48.3	56.6	611.4	238.0	157.3	125.5	1.971.9	164.3	120.5	220.2	288.3	
1973	51.8	7.6	106.4	200.7	262.4	288.3	233.9	155.7	105.9	184.2	420.7	91.2	2.109.2	175.8	133.4	192.8	212.9	
1974	9.7	247.0	50.5	170.2	183.5	131.3	116.1	161.8	299.2	341.5	161.0	18.2	1.875.0	156.3	128.8	149.8	198.1	
1975	127.0	116.3	261.2	169.9	181.3	130.8	231.0	180.0	267.0	411.5	188.0	128.0	2.371.2	195.1	70.4	78.0	131.1	
1976	0.5	25.0	115.5	233.0	285.1	151.1	118.7	208.1	530.0	397.9	199.0	97.5	2.356.4	196.4	217.0	264.5	282.0	
1977	265	102.5	11.5	203.0	388.0	92.9	62.0	148.9	599.0	455.5	162.2	70.0	2.207.0	183.9	135.0	137.0	211.0	
1978	**	35.2	30.8	109.7	124.0	253.2	186.7	275.6	218.9	463.2	138.5	18.5	**	**	**	**	**	
1979	87.0	87.2	82.0	377.7	90.7	186.2	371.7	104.9	237.2	262.7	317.0	98.0	2.108.2	175.7	86.5	137.5	180.5	
1980	20.2	86.7	139.0	127.7	116.9	57.2	125.0	317.5	602.0	273.0	173.6	126.5	2216.7	184.7	111.6	155.7	184.7	
1981																		
1982																		
1983																		
1984																		
1985																		
1986																		
1987																		
Total	1632.8	2851.2	3349.8	4044.3	4378.3	3716.9	3.281.8	4096.2	6.803.5	6877.0	7.617.2	2753.3	47818.2	3985.0	2.850.7			
Mean	81.6	142.6	167.5	202.2	218.9	170.8	164.1	204.8	340.2	343.9	380.7	137.7	2.390.9	199.3				

Closed

註) 1960 年至 1978 年除外

Tab — Monthly Rainfall

Station Name: BUKIT BERAPIT RESERVOIR — STATION NO.: 5307015

Summary of Rainfall (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Mean	Annual Maximum 1 Day	2 Day	3 Day
1958															97.0		
1959	25	90.2	154.7	229.9	160.0	171.5	78.9	124.5	273.8	768.6	181.6	129.5	2.090.7	174.2	106.7		
1960	109.2	50.6	186.1	181.6	183.4	120.7	242.6	104.1	99.1	163.8	278.1	171.8	1.811.1	150.9	68.4		
1961	72.4	115.6	142.6	203.5	122.7	118.1	171.2	106.7	266.7	287.5	429.5	184.1	2.222.6	185.2	92.7		
1962	123.2	17.8	96.0	178.0	192.0	107.7	138.6	193.0	110.0	522.7	112.0	77.8	1.831.8	152.7	147.6		
1963	76.5	41.9	182.9	76.2	172.8	123.4	62.0	120.7	183.9	416.3	526.8	128.6	2.065.7	171.0	69.9		
1964	33.0	100.3	71.9	133.4	269.1	142.2	188.5	71.9	182.6	273.8	154.7	67.6	1.915.7	159.6	81.6		
1965	6.1	17.8	144.8	125.7	79.9	86.1	126.0	217.4	237.7	273.8	276.9	327.6	1.858.8	154.9	106.7		
1966	113.3	112.3	132.8	201.9	78.7	81.8	207.0	217.4	96.6	302.3	228.9	188.2	1.957.9	163.2	78.7		
1967	236.2	56.4	77.0	210.1	398.0	120.9	85.1	88.1	115.6	388.4	251.0	130.3	2.029.1	169.1	123.2		
1968	11.4	82.3	101.9	285.1	108.0	81.3	168.1	181.9	98.3	397.3	167.6	171.2	1.874.4	156.2	102.9		
1969	96.5	85.1	331.0	106.2	194.6	121.9	85.9	155.4	147.6	463.3	292.6	135.4	2.215.5	184.6	75.7		
1970	394.5	8.0	172.7	273.1	172.5	90.7	224.0	83.8	329.9	574.3	402.8	150.3	2.791.6	232.6	88.9		
1971	22.9	159.5	133.4	157.0	138.4	135.6	102.4	278.9	283.5	445.8	159.5	401.0	2.420.1	193.3	99.1	156.2	175.3
1972	68.3	89.9	33.0	310.9	25.4	82.3	44.5	47.8	370.6	392.4	277.9	223.0	1.986.0	165.5	113.4	217.7	260.4
1973	43.5	30.0	195.8	185.3	197.6	121.9	84.0	183.4	86.4	465.3	283.5	293.8	2.105.5	175.5	132.1	174.0	184.7
1974	39.4	74.9	130.8	296.4	230.1	71.9	171.2	84.1	330.7	268.4	210.8	61.6	1.926.3	160.5	98.0	176.1	166.4
1975	179.6	143.0	181.4	243.6	163.8	95.8	186.5	117.5	138.0	225.0	239.5	243.0	2095.5	177.4	130.0	131.6	131.6
1976	4.0	48.5	215.5	117.5	163.0	78.0	78.0	207.5	414.5	248.0	147.5	116.0	1839.0	153.3	155.5	271.0	275.0
1977	62.5	62.0	5.0	130.0	109.5	118.5	81.0	240.5	297.0	406.5	172.0	69.0	1.589.5	132.5	98.5	126.0	136.0
1978	14.0	145.0	138.0	176.0	263.0	95.0	151.5	179.5	259.0	278.5	91.0	19.0	1.809.5	150.8	102.0	107.5	152.0
1979	19.0	12.5	172.0	249.5	135.0	79.5	137.5	207.0	222.5	185.0	210.5	75.5	1.867.5	155.6	107.5	120.0	132.5
1980	30.5	116.0	45.0	175.0	138.0	55.5	112.0	273.0	422.5	351.0	319.5	216.5	2.274.5	189.5	66.5	112.0	126.5
1981	3.0	77.0	115.0	178.5	191.5	88.5	45.0	172.5	280.5	134.5	107.5	12.5	1.378.0	114.8	71.0		
1982	17.5	87.0	71.0	178.5	270.0	1.5	147.0	85.0	255.0	473.5	287.0	169.5	1.842.5	160.5	70.0		
1983	72.5	44.0	47.0	40.5	299.0	119.5	65.5	73.5	388.5	182.5	108.0	159.5	1.621.0	135.1	70.0		
1984	222.3	302.0	146.5	334.0	116.5	33.5	270.0	44.5	89.0	200.0	219.0	165.0	2.046.3	172.2	78.5		
1985	61.5	176.0	302.5	191.0	193.5	28.5	110.0	104.0	192.5	286.0	399.5	119.0	2.164.0	180.3	122.5		
1986	47.0	22.5	75.0	120.0	212.5	125.0	117.5	130.0	451.5	313.0	231.0	102.5	1.847.5	154.7	87.5		
1987	5.0	6.0	112.0	61.5	138.5	150.0	77.5	189.0	311.0	271.5	182.0	137.5	1.603.5	133.6	70.0		
Total	2.143.3	2.459.1	3822.5	5.238.7	5.072.0	2.792.8	3.451.1	4.151.6	7.254.7	9.567.3	7.165.2	4.171.7	57.148.1	4.764.9	2892.5		
Mean	74.6	78.1	131.8	180.6	174.7	96.3	125.9	143.2	250.1	329.9	247.1	143.8	1.971.3	164.3			

Tab

Monthly Rainfall

Station Name KOLAMAIR CEROK TO'KUN STATION NO.: 530X07X7

Summary of Rainfall (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Mean	Annual Maximum 1 Day	2 Day	3 Day	Remarks
1958	25.5	68.6	180.1	185.2	378.0	224.3	112.0	321.3	238.8	256.3	287.2	72.7	2589.8	215.8				
1959	37.3	89.7	204.5	289.6	208.3	227.3	105.7	201.7	332.7	510.5	179.1	161.3	2547.6	212.1				
1960	130.3	77.5	186.7	271.8	128.3	176.1	257.0	90.2	159.8	186.7	376.7	226.8	2.220.6	185.1				
1961	69.7	137.6	223.5	278.9	138.9	187.7	191.8	117.3	276.7	379.2	381.8	202.7	2.601.7	216.8				
1962	137.1	75.7	240.7	213.9	207.7	168.9	213.9	177.5	201.9	605.5	207.0	109.2	2.480.0	206.7				
1963	157.1	73.7	212.1	78.7	212.1	135.9	78.7	118.1	154.7	708.9	617.7	175.6	2.332.7	177.7				
1967	24.9	176.8	76.5	177.1	375.7	203.2	262.7	70.9	612.7	309.1	176.0	42.3	2.461.6	205.1				
1965	0.	75.7	125.7	95.3	85.9	58.7	122.7	362.2	260.7	507.7	479.3	511.2	2.557.5	212.9				
1966	107.1	212.3	172.7	213.7	73.7	110.0	236.7	367.0	73.7	272.8	311.7	160.8	2278.9	189.9				
1967	205.7	80.0	66.0	337.1	357.7	122.2	118.6	150.2	118.9	782.1	370.3	20.3	2.610.8	217.6				
1968	8.9	50.8	183.1	337.3	30.7	123.2	187.7	247.7	158.8	758.5	173.5	208.3	2.370.5	195.0				
1969	87.7	120.7	304.3	117.7	281.9	177.1	77.9	223.5	88.9	795.8	267.2	152.1	2375.7	198.0				
1970	303.8	15.2	137.1	335.8	167.7	86.9	212.1	125.7	306.1	566.7	353.3	187.2	2.796.3	233.0				
1971	45.7	147.3	117.3	120.7	191.8	161.3	100.3	355.6	350.8	707.7	166.6	377.2	2.509.3	209.1	101.6	133.7	157.5	
1972	57.7	97.3	23.6	325.1	11.7	173.5	55.7	67.8	705.1	747.8	369.3	303.9	2.915.7	159.0	121.9	213.7	259.1	
1973	72.9	58.3	236.2	272.5	326.1	162.6	89.9	165.1	90.2	593.3	386.8	287.8	2.731.7	227.6	96.5	161.3	177.7	
1974	80.0	117.9	167.9	331.2	253.3	107.7	119.9	50.3	350.8	205.2	183.1	72.6	2.029.6	169.1	96.5	167.6	200.7	
1975	211.8	172.7	158.0	243.1	157.9	113.3	210.0	137.5	168.5	256.5	256.5	223.5	2.307.0	192.3	60.5	77.5	87.1	
1976	15.0	37.0	230.5	108.5	159.5	83.0	165.0	249.0	318.0	347.0	177.5	100.5	1.987.5	165.7	107.5	177.5	178.5	
1977	96.0	79.5	24.0	117.0	131.0	137.0	31.5	218.0	375.0	259.5	230.0	123.5	1.985.0	165.7	102.0	127.0	163.0	
1978	55.5	138.0	173.5	190.5	127.0	80.5	115.5	176.5	159.0	317.5	125.5	42.5	1.701.5	141.8	80.0	107.5	136.5	
1979	21.5	85.5	152.5	220.5	183.5	97.5	117.5	177.0	305.5	175.0	365.0	98.0	2.056.0	171.3	80.0	122.5	125.0	
1980	7.5	89.5	135.5	157.0	168.5	81.0	139.0	318.5	307.5	278.5	267.0	177.0	2.226.5	185.5	71.0	108.5	151.0	
1981	18.5	98.5	95.5	219.5	217.0	121.5	103.5	124.0	328.5	209.0	124.0	117.0	1.665.5	138.8	72.0			
1982	27.5	25.0	67.0	120.0	283.0	2.5	143.0	79.0	256.5	338.0	377.0	170.5	1.883.0	156.9	75.0			
1983	86.5	51.0	62.0	80.5	326.5	89.5	56.0	94.5	377.0	197.5	139.0	132.0	1.682.0	140.2	67.5			
1984	229.0	274.0	181.5	292.5	136.0	55.0	257.5	85.5	170.5	211.0	245.0	211.5	2.419.0	201.6	85.0			
1985	100.0	186.5	362.5	235.0	146.0	45.0	140.0	109.0	216.5	309.0	448.0	167.0	2.464.5	205.0	100.0			
1986	61.5	15.0	92.5	186.5	243.5	181.0	167.0	126.0	437.5	277.5	226.0	120.0	2.134.0	177.8	70.0			
1987	0.	10.0	89.0	84.5	183.5	85.0	110.5	182.5	312.0	287.5	283.5	120.0	1.747.0	145.6	77.5			
Total	2537.6	2869.3	4623.0	6441.6	6207.8	3715.8	4282.7	5272.3	7981.1	10.687.0	8430.1	4757.0	68.012.2	5.667.8	2.774.8			
Mean	84.6	95.5	154.1	214.7	206.9	123.9	142.8	175.7	266.0	356.3	281.0	158.6	2.267.1	188.9				

1965 — 1/1

1a6 Monthly Rainfall

Station Name: LAHAR IKAN MATI STATION NO 5504035

Summary of Rainfall (mm.)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Mean	Annual 1 Day	Maximum Totals 2 Day	3 Day	Remarks
1958																		
1959																		
1960															77.2			
1961															67.1			
1962															107.1			
1963															70.7			
1964															162.6			
1965							**	**	195.3	**	278.1	270.8	**	**	129.8			
1966	105.9	125.2	334.3	238.6	193.8	285.7	272.8	238.8	183.7	**	**	**	**	**	119.1			
1967	**	67.8	75.7	117.9	98.6	200.2	86.9	292.9	182.1	338.6	212.1	27.9	**	**				
1968	87.8	87.8	78.8	242.8	138.9	165.1	757.7	230.9	190.8	367.8	182.6	237.7	2.332.7	191.4				
1969	65.3	57.2	130.8	58.4	173.3	178.8	38.9	224.8	279.7	372.7	228.1	101.3	1.872.3	153.5				
1970	183.4	0	168.9	207.0	219.5	86.7	327.4	109.2	285.5	780.6	213.6	227.1	2.510.8	209.2				
1971	29.7	250.7	151.6	58.4	279.4	252.7	76.5	202.2	680.0	611.4	98.6	237.5	2868.7	239.1	101.6	187.2	227.6	
1972	25.1	78.0	52.8	241.8	71.4	243.3	71.7	96.6	334.0	297.1	84.6	173.2	1.675.8	139.7	241.3	317.5	398.8	
1973	20.1	27.2	90.7	193.0	159.2	277.1	222.0	288.6	152.1	395.4	272.0	180.6	2.157.7	179.8	132.1	159.5	163.1	
1974	23.1	258.6	89.7	238.5	196.1	98.0	87.1	186.7	256.6	271.0	158.2	17.5	1.880.8	156.7	96.5	138.4	173.8	
1975	186.4	147.8	80.3	115.6	273.1	64.5									81.5	95.5	116.8	NO DATA
1976																		NO DATA
1977	**	**	**	**	**	**	**	**	**	**	**	102.0	**	**	**	**	**	MISSING OR INCOMPLETE DATA
1978	27.0	131.0	122.0	76.5	386.0	277.0	160.5	139.0	236.0	179.0	202.0	19.0	1.952.0	162.7	79.3	118.0	157.0	
1979	35.5	32.0	7.5	170.0	177.0	219.5	280.0	96.0	192.0	165.0	357.0	97.0	1.762.5	146.9	82.0	127.0	155.0	
1980	2.0	38.5	61.5	173.5	178.0	85.0	185.5	302.0	782.0	385.5	255.5	88.5	2.097.5	174.8	93.0	175.0	185.5	
1981	45.0	112.0	96.5	139.0	220.5	117.5	62.0	157.5	376.0	214.0	146.0	11.0	1.637.0	136.4	165.0			
1982	0.	10.0	175.5	269.5	237.5	67.0	137.5	90.0	414.0	352.0	209.0	102.0	2.100.0	175.0	182.0			
1983	3.0	48.0	97.5	130.0	433.5	207.5	102.5	81.0	392.0	191.0	81.5	60.5	1.765.0	147.1	94.5			
1984	218.0	180.0	87.0	386.0	146.5	161.0	266.0	108.5	179.0	159.0	118.0	126.0	2.107.0	175.6	116.5			
1985	51.0	103.5	111.0	188.5	251.0	33.0	77.5	149.0	352.5	440.5	234.0	81.5	2.075.0	172.9	132.5			
1986	4.0	9.5	74.5	126.5	249.0	62.0	137.5	264.5	431.0	307.5	199.0	60.5	2.317.5	193.1	250.0			
1987	11.5	0.	51.0	138.5	143.0	68.0	98.5	316.5	443.0	177.5	447.5	183.5	2.078.5	173.2	115.0			
Total																		
Mean																		

Monthly Rainfall (in SG. JARAK BASIN)

Station Name KELANG BAHARU, KULIM Station No. 5720093

Summary of Rainfall (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Mean	Annual 1 Day	Maximum 2 Day	Totals 3 Day	Remarks
1958															65.5			
1959	22.6	170.9	259.7	270.3	235.5	329.7	171.0	123.0	302.8	296.1	257.7	271.3	3070.3	255.9	94.7			
1960	81.0	87.7	184.7	241.3	159.7	M.R.	313.2	165.1	279.7	251.0	275.1	217.7	—	—	68.8			
1961	137.6	267.5	235.7	287.7	170.2	280.2	245.7	98.0	176.5	297.7	302.3	285.2	3099.7	258.3	72.2			
1962	132.6	33.5	165.1	376.7	257.6	232.7	258.1	122.4	237.5	270.2	257.6	152.9	2743.2	261.7	138.7			
1963	155.7	125.6	172.5	69.3	277.9	114.6	233.9	159.5	197.3	388.1	421.5	345.0	2727.5	227.3	78.0			
1964	166.6	107.7	83.3	291.6	293.7	74.2	234.8	157.2	629.8	268.8	259.0	91.7	3078.1	259.0	123.2			
1965	7.6	41.7	248.7	219.5	145.5	50.3	188.7	314.2	284.7	534.2	389.3	380.5	2814.9	234.6	130.8			
1966	118.9	117.9	267.0	278.6	136.7	175.5	238.8	206.8	248.9	566.9	459.7	365.8	3181.2	265.1	126.7			
1967	230.6	146.1	49.3	355.6	419.6	241.0	207.8	188.5	254.8	555.8	447.5	66.0	3162.4	263.6	—			
1968	47.8	62.8	136.7	359.3	172.7	199.4	215.6	299.0	92.2	437.9	186.4	169.9	2359.7	196.6	—			
1969	99.8	135.9	173.5	109.0	347.2	241.8	114.3	317.0	146.1	576.9	318.3	167.6	2739.4	227.9	—			
1970	155.2	5.3	183.6	301.0	317.5	117.6	180.3	99.8	379.8	573.6	570.0	323.1	3198.8	266.6	—			
1971	57.9	180.8	150.6	92.2	156.0	189.5	109.0	320.8	468.6	414.3	177.8	451.6	2771.1	230.9	109.7	167.6	172.7	
1972	60.2	202.7	98.3	330.4	145.5	172.5	137.1	62.5	307.0	380.5	463.3	270.0	2825.0	235.4	127.0	161.0	208.3	
1973	67.6	74.4	372.4	470.7	437.1	210.6	286.5	286.5	180.3	337.4	437.1	258.6	3533.2	294.4	105.9	130.6	178.3	
1974	78.5	171.5	97.5	333.5	292.4	103.4	135.4	108.7	281.2	198.6	295.4	67.1	2166.2	180.5	101.6	122.9	157.7	
1975	199.9	196.9	302.3	443.7	217.9	56.6	259.0	149.0	286.0	255.0	297.0	313.0	2934.5	244.7	95.0	108.2	108.2	
1976	2.0	42.0	181.0	285.0	196.0	125.0	197.5	153.5	340.0	467.0	398.0	71.0	2458.0	204.8	134.0	207.0	211.0	
1977	75.0	124.0	40.0	157.0	254.0	188.0	87.0	331.0	372.0	623.0	201.0	131.0	2589.0	215.8	111.0	141.0	163.0	
1978	42.0	92.0	114.0	219.0	307.0	164.0	114.0	203.0	234.0	339.0	99.0	25.0	1952.0	162.7	77.0	107.0	127.0	
1979	84.0	81.0	69.0	351.0	93.0	235.0	171.0	301.0	328.0	311.0	590.0	65.0	2578.0	214.9	102.0	133.0	170.0	
1980	86.0	119.0	118.0	207.0	240.0	170.0	179.0	432.0	476.0	360.0	450.0	253.0	3040.0	253.3	91.0	125.0	142.0	
1981																		
1982																		
1983																		
1984																		
1985																		
1986																		
1987	—																	
Total	2,408.8	2526.5	3942.3	6,186.1	5,438.8	3,666.8	4,394.7	4,620.5	6,462.2	10,091.7	7561.6	4,711.0	57,077.1					
Mean	91.3	114.8	177.2	281.2	247.2	174.6	199.7	210.0	293.7	458.7	343.7	214.1	2,808.2	234.0				

HYDROLOGIC - OBSERVATIONS

ITEN	STATION. NO	GAUGING STATION	OLD MARK	REMARKS
RAIN FALL	5505035	LAHAR IKAN MATI	A	1978 — '87
		PARIT LAGAN	B	1981 — '87
	5505071	MARAKOFF ESTATE	C	1981 — '87 LADANG MARAKOFF
	5505072	METEOLOGICAL STATION Butter worth	D	STN. KAJICUACA BUTTERWORTH
		SG. DUA	E	1981 — '87
		MAYFIELD ESTATE	F	CLOSE
	5505073	SG. KULIM HEADWORKS	G	1981 — '87
		SG. KULIM HEADWORKS	H	JICA, CLOSE
	5505074	BUKIT MERAH PAPI STATION	I	CLOSE (1950)
	5406083	BUKIT MERTAJAM ESTATE	J	KELANG BAHARU, KULIM
		BUKIT MERTAJAM ESTATE	K	JICA CLOSE
	5305075	BUKIT BERAPIT RESERVOIR	L	1981 — '87
		P.W.D OFFICE KULIM	M	CLOSE
		BUKIT BESAR RESERVOIR	N	CLOSE

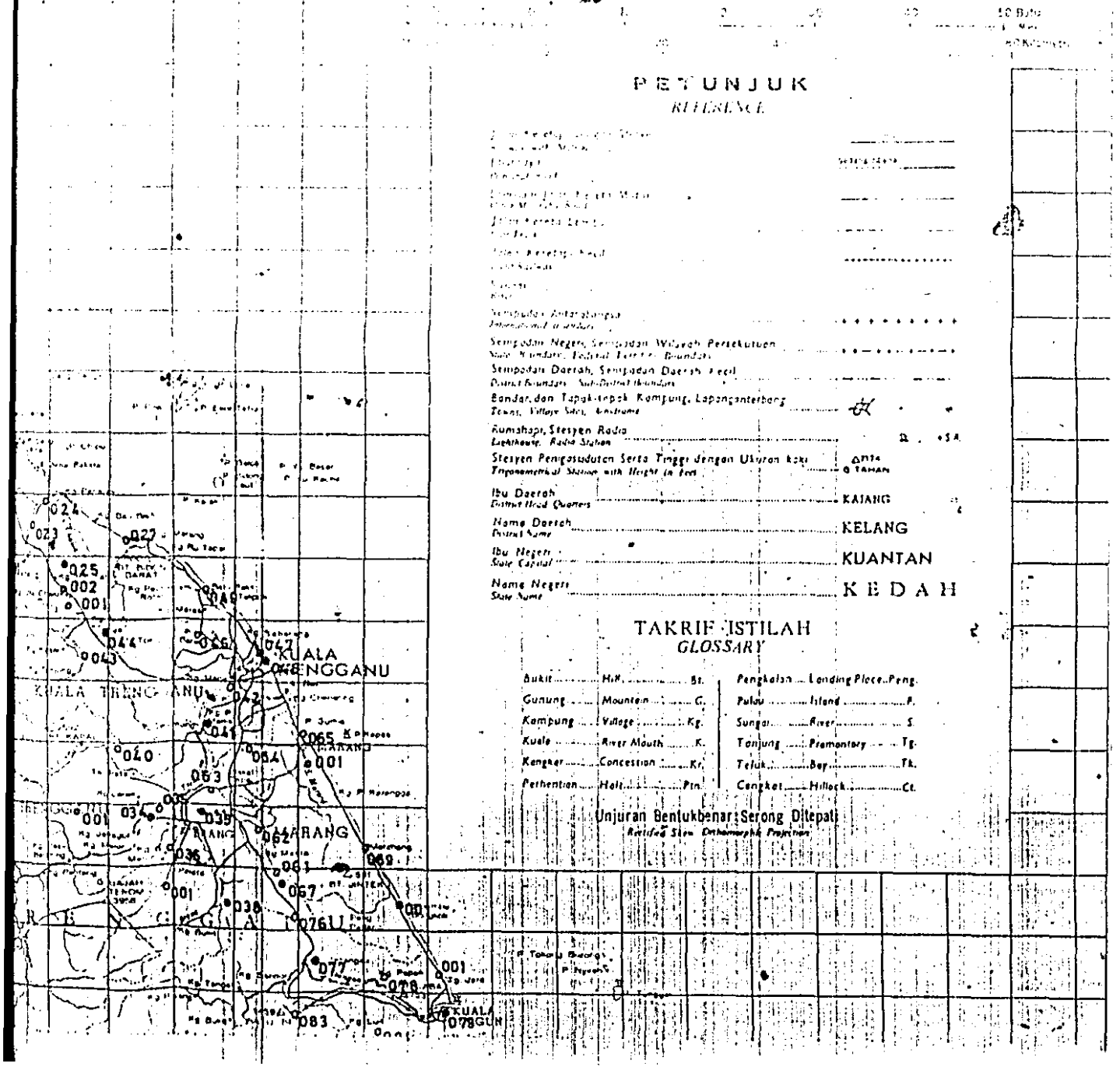
MINISTRY OF AGRICULTURE

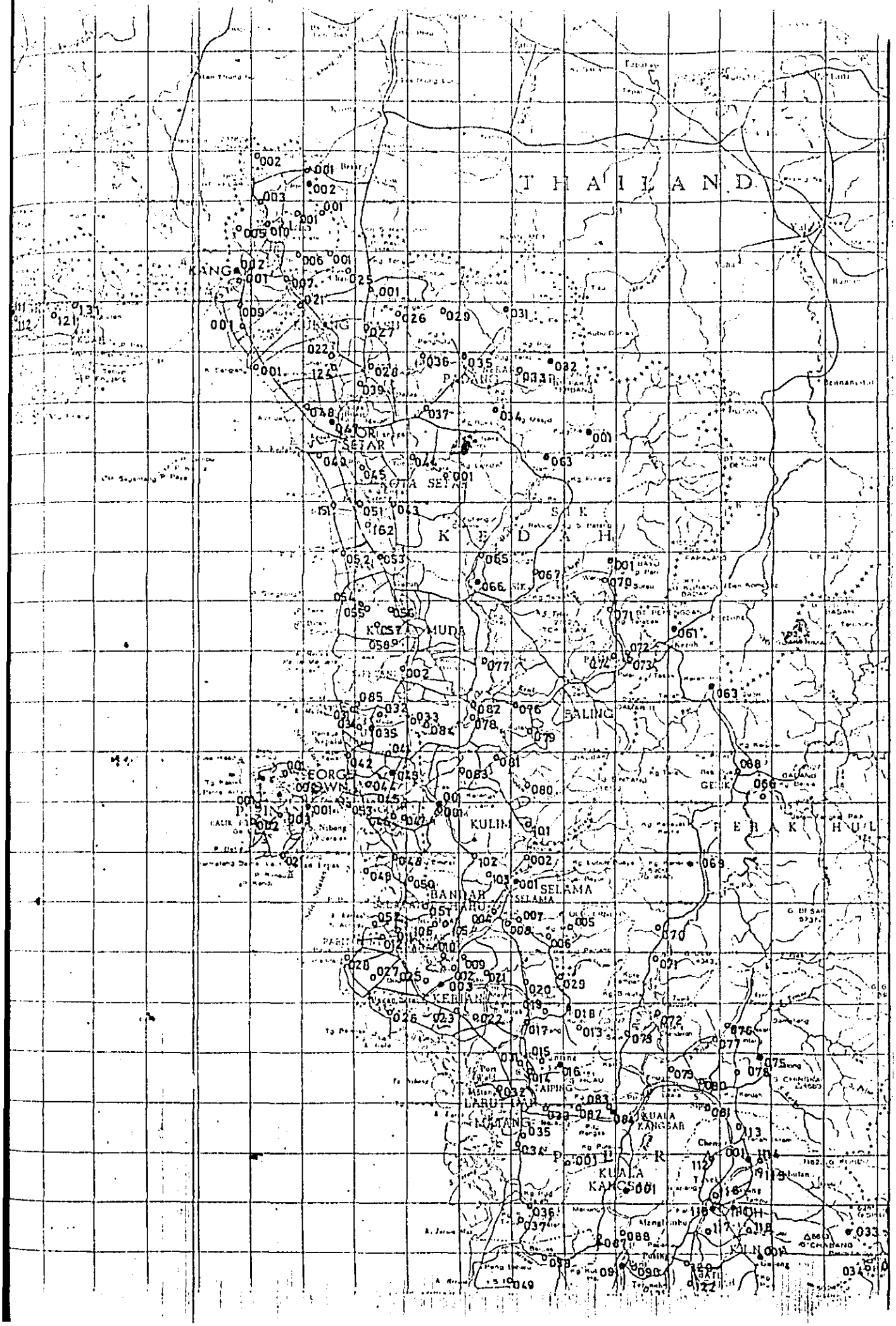
DRAINAGE AND IRRIGATION DIVISION

RAINFALL STATIONS IN PENINSULAR MALAYSIA

(as described in Rainfall Records Publication 1975-1980)

1:1,000,000




T H A I L A N D
K E D A H
SETAR
KULIM
BALING
SELAMA
KUALA KANGSAR
P E R A K
P E R L I S

HYDROLOGIC OBSERVATIONS

MARK	GAUGING STATION	ITEM	RECORD	REMARKS
A	[illegible]	RAINFALL	FROM 1966	AUTOMATIC TYPE
B	[illegible]	RAINFALL	FROM 1953	
C	[illegible] ESTATE	RAINFALL	FROM 1958	
D	METEOROLOGICAL STATION BUTTERWORTH	RAINFALL	FROM 1955	
E	SG [illegible]	RAINFALL	FROM 1946	
F	[illegible] ESTATE	RAINFALL	FROM 1947	
G	SG [illegible] HEADWORKS	RAINFALL	FROM 1946	
H	SG [illegible] HEADWORKS	RAINFALL	FROM 1967	AUTOMATIC TYPE
I	BUKIT [illegible] PWD STATION	RAINFALL	FROM 1946	
J	BUKIT MERTAJAM ESTATE	RAINFALL	FROM 1958	
K	BUKIT MERTAJAM ESTATE	RAINFALL	FROM 196[illegible]	AUTOMATIC TYPE
L	BUKIT [illegible] RESERVE	RAINFALL	FROM 19[illegible]	
M	[illegible]	RAINFALL	FROM 1[illegible]	
N	BUKIT [illegible] RESERVOIR	RAINFALL	FROM 1948	
O	SG [illegible] HEADWORKS	WATER LEVEL	FROM 19[illegible]	
P	SG [illegible] AT TASEK GELUGOR	WATER LEVEL	FROM 1967	
Q	SG [illegible] AT ARA KUDA	WATER LEVEL	FROM 1961	
R	SG KULIM AT GUA PERAH	WATER LEVEL	FROM 1967	
S	SG PRAI AT PERMATANG PASIR	WATER LEVEL	FROM 1967	TIDAL RIVER
T	SG PRAI AT PERMATANG PAUH	WATER LEVEL	FROM 1967	TIDAL RIVER
U	SG PRAI AT NEW BRIDGE	WATER LEVEL	FROM 1967	TIDAL RIVER

SUMMARY OF SG PRAI BASIN

NO	DESIGNATION	CATCHMENT AREA		ACCUMULATED CATCHMENT AREA		LENGTH OF RIVER (CENTRE OF GRAVITY OF EACH BASIN)	
		IN SQ MI	IN SQ KM	IN SQ MI	IN SQ KM	IN MI	IN KM
1	JARAK	57.53	149.01	57.53	149.01	15.70	25.26
2	KERIH	23.39	60.59	80.92	209.60	10.27	16.52
3	KULIM	67.50	174.82	148.42	384.41	17.86	28.62
4	GUA [illegible]	3.09	8.00	151.51	392.42	1.0	1.63
5	GUA [illegible]	1.[illegible]	[illegible]	152.38	394.[illegible]	2.5	3.46
6	SANI [illegible]	1.[illegible]	[illegible]	153.40	397.[illegible]	2.90	4.66
7	SANI [illegible]	35.7	9.25	166.97	432.63	1.95	3.14
8	BATU [illegible]	2.84	7.[illegible]	169.81	439.80	1.17	1.89
9	BATU [illegible]	2.24	5.58	172.35	446.38	2.86	4.60
10	DERHAKA	13.06	33.45	[illegible]	[illegible]	6.85	11.03
11	DERHAKA (2)	0.87	2.26	[illegible]	[illegible]	0.94	1.52
12	DERHAKA (3)	1.93	4.99	186.13	482.06	1.76	2.83
13	NYOR	1.18	3.04	187.31	485.12	4.24	6.83
	SWAMP LAND	4.78	12.38	192.09	497.50		

LEGEND

- RIVER
- WATERSHED
- RAINFALL GAUGING STATION
- RIVER STICK GAUGING AND FLOW DISCHARGE GAUGING STATION
- TIDAL LEVEL GAUGING STATION
- SWAMP LAND

SCALE

MILE 1 1/2 0 1 2 3 MILES

KILOMETER 1 1/2 0 1 2 3 4 KILOMETERS

FIG. 3-2-1 LOCATION MAP OF HYDROLOGIC GAUGING

WATERLEVEL DATA LIST

at ARA KUDA

(1978 — 1987)

Water level Data List (Feet)

1987 Ara Kuda

	Jan.		Feb.		Mar.		Apr.		May.		Jun.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	20.1	20.0	19.7	19.7	19.3	19.2	19.5	19.7	22.7	21.3	20.7	19.3
2	20.1	20.0	19.7	19.7	19.3	19.3	19.6	19.7	20.6	20.9	19.7	20.0
3	20.0	20.0	19.7	19.3	19.3	19.3	20.3	19.8	21.2	20.6	20.8	20.2
4	20.0	20.0	19.7	19.3	19.3	19.3	20.1	19.8	20.9	20.8	22.1	21.3
5	19.9	19.9	19.7	19.3	19.4	19.3	19.8	19.6	20.5	20.3	21.8	21.9
6	19.8	19.8	19.7	19.3	19.7	19.3	19.6	19.6	20.2	20.1	21.3	21.0
7	19.8	19.8	19.5	19.7	20.3	19.5	19.6	19.5	20.2	20.1	20.8	20.7
8	19.8	19.7	19.7	19.3	20.8	19.8	19.6	19.5	20.0	20.0	20.5	20.3
9	19.8	19.7	19.7	19.3	20.7	19.9	19.5	19.5	20.0	20.0	20.2	20.1
10	19.7	19.7	19.3	19.3	19.8	19.7	19.5	19.5	20.0	19.9	20.1	20.0
11	19.6	19.7	19.6	19.7	19.7	19.6	20.0	19.7	19.8	19.8	20.0	19.9
12	19.7	19.7	19.7	19.7	19.6	20.1	19.9	19.6	19.7	20.2	19.9	19.8
13	19.7	19.6	19.7	19.3	19.9	19.7	19.5	19.7	20.6	20.3	19.9	19.8
14	19.6	19.6	19.3	19.3	19.6	19.6	19.6	19.7	21.3	20.7	19.8	19.8
15	19.6	19.6	19.3	19.3	19.8	19.9	19.6	19.5	21.0	20.8	19.7	19.6
16	19.6	19.6	19.3	19.5	19.6	19.7	19.7	19.5	22.6	25.6	19.6	19.5
17	19.6	19.6	19.5	19.5	19.7	19.2	19.6	19.6	22.3	21.6	19.6	19.6
18	19.6	19.5	19.5	19.5	19.7	19.3	19.6	20.1	21.1	20.9	19.6	19.6
19	19.5	19.5	19.5	19.5	19.7	19.7	20.2	19.8	20.7	20.6	19.6	19.6
20	19.6	19.6	19.5	19.5	19.7	19.7	19.8	19.6	21.6	20.8	19.6	19.6
21	19.6	19.6	19.7	19.7	19.7	19.3	19.6	19.5	20.7	20.5	20.2	20.0
22	19.6	19.6	19.7	19.7	19.3	19.2	19.5	19.6	20.7	20.3	22.7	21.0
23	19.6	19.6	19.3	19.3	19.3	19.7	20.7	19.8	20.9	20.5	22.2	25.0
24	19.6	19.6	19.7	19.2	21.0	19.9	19.7	19.6	20.3	20.2	22.2	21.7
25	19.6	19.6	19.7	19.2	19.8	19.6	19.7	19.8	21.0	21.0	21.0	20.7
26	19.5	19.6	19.7	19.2	19.7	19.5	20.6	20.0	20.6	20.7	20.6	20.5
27	19.5	19.5	19.7	19.2	19.7	19.6	20.0	19.9	20.7	20.3	20.5	20.7
28	19.8	19.6	19.7	19.2	19.6	19.7	19.9	19.8	22.5	21.7	20.3	20.3
29	19.6	19.6			19.5	19.3	20.2	19.9	21.0	20.6	20.2	20.1
30	19.5	19.5			19.7	19.7	20.3	20.8	20.6	20.7	20.0	19.9
31	19.5	19.7			19.6	19.3			20.3	20.6		

Water level Data List

1987 Ara Kuda

	Jul.		Aug.		Sep.		Oct.		Nov.		Dec.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	20.3	20.0	21.6	20.5	20.1	19.9	21.6	22.4	24.2	23.2	21.9	22.0
2	20.0	19.9	20.9	20.5	19.9	19.8	22.7	22.0	24.0	23.6	22.6	22.3
3	19.9	19.8	20.3	21.6	19.9	19.8	21.7	21.5	24.0	23.3	23.8	22.6
4	19.8	19.8	21.9	22.0	19.9	19.8	21.4	21.3	24.9	24.1	22.3	22.2
5	19.7	19.7	22.0	21.3	19.9	20.0	24.7	22.2	24.4	23.4	22.0	21.8
6	19.7	19.7	21.9	21.1	20.1	20.2	21.8	21.4	25.7	24.3	22.6	22.6
7	19.7	19.7	21.5	23.2	20.1	20.0	21.9	22.3	24.3	24.3	24.2	22.9
8	19.7	19.6	21.5	21.1	20.1	20.0	22.2	21.6	25.4	23.9	22.5	22.8
9	19.6	19.6	20.9	20.8	19.9	19.8	21.6	21.8	27.2	25.3	22.3	22.1
10	19.6	19.5	20.7	22.1	19.9	19.9	23.5	22.4	25.7	24.5	22.0	22.2
11	19.5	19.5	21.3	20.9	19.8	20.0	25.8	23.9	24.1	23.8	27.8	23.6
12	19.5	19.5	20.7	20.7	20.0	19.8	23.5	22.7	23.7	23.4	24.4	23.1
13	19.4	19.4	21.0	20.7	19.8	21.2	22.3	22.0	23.3	23.3	22.9	22.7
14	19.4	19.5	20.6	20.6	21.4	21.5	22.1	21.8	23.1	22.9	23.0	23.0
15	19.7	19.5	20.8	21.2	24.8	22.6	22.6	22.1	22.8	23.3	22.6	22.4
16	19.7	19.6	22.1	24.4	22.3	22.4	24.6	22.6	23.5	23.0	22.3	22.1
17	19.7	19.5	22.6	21.8	22.5	21.6	26.8	23.8	22.7	22.6	22.1	21.9
18	19.7	19.5	21.5	21.2	21.4	21.3	24.1	23.2	22.5	22.5	22.2	21.8
19	19.5	19.4	21.0	20.9	22.8	25.0	23.3	23.0	22.7	22.5	21.8	21.7
20	19.5	19.6	20.7	21.5	28.6	24.7	23.9	23.2	22.4	22.4	21.7	21.6
21	19.9	19.6	20.8	20.7	23.4	22.8	22.8	22.5	22.2	22.2	21.5	21.5
22	19.6	19.4	20.6	20.6	27.8	24.6	24.4	23.4	22.6	22.3	21.5	21.5
23	19.9	19.5	20.5	20.5	24.9	23.4	25.2	23.6	22.1	22.5	21.4	21.4
24	19.7	19.7	20.5	20.8	25.6	23.8	23.0	23.0	22.4	22.5	21.4	21.3
25	20.0	19.2	20.7	20.4	23.1	22.7	24.6	23.1	22.9	23.1	21.3	21.2
26	19.3	19.1	20.4	20.6	22.6	22.3	23.0	22.6	23.3	22.6	21.1	21.1
27	19.2	23.3	20.5	20.3	22.9	22.3	23.2	22.5	22.7	22.4	21.1	21.1
28	22.5	21.0	20.3	20.2	22.0	21.8	22.9	22.5	22.2	22.1	21.1	21.2
29	20.7	20.3	20.2	20.1	21.8	21.6	23.0	22.5	22.0	22.3	21.2	21.1
30	20.2	19.9	20.1	20.0	21.9	21.6	23.6	23.9	22.1	22.3	21.2	21.4
31	20.0	20.8	20.0	20.0			27.0	25.3			22.0	21.3

Water level Data List (Feet)

1986 Ara Kuda

	Jan.		Feb.		Mar.		Apr.		May.		Jun.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	20.3	20.3	19.7	19.6	19.5	19.4	19.6	19.6	20.5	20.2	20.2	20.2
2	21.9	20.9	19.6	19.6	19.4	19.4	19.7	19.7	20.1	20.1	20.1	20.1
3	21.1	20.7	19.6	19.7	19.4	19.4	19.6	19.5	20.7	20.3	20.0	20.2
4	20.6	20.5	19.6	19.6	19.4	19.4	19.6	19.5	20.2	20.1	20.6	20.3
5	20.4	20.4	19.6	19.6	19.3	19.4	20.2	19.8	20.0	20.1	20.4	20.1
6	20.3	20.3	19.6	19.6	19.5	19.5	19.6	19.6	20.1	19.9	20.2	20.3
7	20.3	20.3	19.6	19.6	19.4	19.4	19.8	19.7	19.9	19.8	20.1	20.0
8	20.2	20.2	19.5	19.5	19.4	19.3	19.8	19.6	21.0	23.4	19.9	19.9
9	20.2	20.1	19.5	19.5	19.4	19.4	19.7	19.7	22.0	21.2	20.8	20.2
10	20.1	20.1	19.5	19.5	20.0	19.6	21.8	22.2	20.8	20.5	23.4	25.8
11	20.1	20.1	19.5	19.5	19.5	19.4	21.1	20.7	20.4	20.3	22.4	21.7
12	20.1	20.1	19.5	19.6	19.8	19.7	21.3	20.7	20.2	20.1	21.3	21.0
13	20.2	20.2	19.6	19.5	19.9	19.6	20.9	20.6	20.0	20.0	20.9	20.7
14	20.2	20.2	19.5	19.5	19.6	19.5	21.2	20.7	20.0	19.9	20.8	20.6
15	20.1	20.1	19.5	19.5	20.7	20.1	20.7	20.4	19.9	19.9	21.2	20.8
16	20.1	20.1	19.4	19.4	20.2	20.0	20.3	20.8	20.0	20.9	20.5	20.9
17	20.1	20.1	19.4	19.4	20.5	20.1	21.0	20.4	20.2	20.2	20.5	20.4
18	20.0	20.0	19.3	19.3	22.2	21.0	20.7	20.4	20.1	20.6	20.3	20.4
19	20.0	20.0	19.3	19.3	20.5	20.3	20.4	20.4	20.3	20.2	20.3	20.2
20	20.0	20.0	19.4	19.3	20.1	19.9	20.6	20.3	20.0	19.9	20.2	20.1
21	20.0	20.0	19.4	19.3	19.8	19.9	20.1	20.0	19.9	19.8	20.1	20.0
22	20.0	20.0	19.3	19.4	21.5	20.5	20.0	19.9	19.9	19.8	20.0	20.0
23	20.0	19.9	20.4	19.7	20.2	20.5	20.1	19.9	19.9	23.0	20.0	20.0
24	20.0	19.9	19.6	19.6	21.1	20.4	20.9	20.2	21.0	20.6	19.9	19.8
25	20.0	19.9	20.2	19.7	20.2	20.2	20.1	19.9	20.3	20.2	19.9	19.9
26	19.9	19.8	19.6	19.6	19.9	19.8	20.5	20.7	20.2	20.1	19.9	20.2
27	19.8	19.8	19.6	19.5	19.8	19.8	21.3	20.5	20.1	20.0	20.1	19.9
28	19.8	19.7	19.5	19.5	20.1	19.8	20.7	20.7	20.1	19.9	20.2	19.9
29	19.8	19.7			19.7	19.7	20.4	20.2	19.9	22.5	21.9	20.9
30	19.8	19.7			19.6	20.1	20.1	20.0	21.7	20.8	20.3	20.4
31	19.8	19.7			19.8	19.9			20.5	20.5		

Water level Data List

1986 Ara Kuda

	Jul.		Aug.		Sep.		Oct.		Nov.		Dec.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	19.8	19.7	20.2	19.7	19.6	22.1	23.2	22.2	24.9	24.3	20.7	20.7
2	19.7	19.6	20.5	21.6	20.8	20.3	21.3	21.7	25.1	23.4	20.7	20.8
3	19.7	19.6	20.6	20.8	20.2	20.4	22.2	21.6	22.9	22.6	20.7	20.6
4	19.8	19.6	20.8	20.5	20.1	20.0	21.4	21.7	23.8	22.9	22.1	21.3
5	19.7	19.6	20.2	20.0	20.1	20.0	21.8	21.8	22.4	22.5	21.8	21.1
6	19.6	19.6	19.9	19.8	22.0	21.4	22.9	23.9	22.3	22.0	21.0	21.0
7	19.5	19.6	19.7	19.7	20.8	20.6	22.5	22.0	21.9	23.5	22.7	21.4
8	19.6	19.6	19.7	19.7	21.0	20.7	21.7	22.1	23.0	23.4	22.3	21.5
9	20.6	20.6	19.6	19.6	20.4	20.3	22.7	22.1	22.4	22.1	21.2	21.0
10	20.9	20.9	19.6	19.7	20.6	20.5	22.1	21.7	22.3	22.1	20.9	20.8
11	20.4	20.6	19.6	19.6	20.4	20.6	23.5	24.1	21.9	22.6	20.8	20.7
12	20.5	20.1	19.6	19.6	20.2	20.2	24.4	23.0	22.3	22.3	20.7	20.6
13	20.0	19.9	19.5	19.5	20.0	20.0	22.1	22.0	22.5	24.3	20.6	20.6
14	19.8	19.8	19.5	19.5	19.9	21.0	21.8	21.9	23.6	23.3	20.5	20.4
15	19.7	19.7	19.6	19.6	22.0	21.8	21.7	21.5	22.9	22.5	20.1	20.5
16	19.6	19.6	19.6	19.6	21.2	20.9	21.5	22.7	22.2	22.1	20.3	20.3
17	19.6	19.6	19.6	19.7	20.7	20.5	21.9	21.6	22.0	21.9	20.3	20.3
18	19.6	19.6	19.7	19.8	20.4	20.3	21.3	21.2	21.7	21.6	20.4	20.4
19	19.5	19.6	19.6	19.6	20.3	20.8	21.1	21.1	21.5	21.5	21.3	20.7
20	19.4	19.5	19.5	19.5	21.6	27.2	21.1	21.0	21.4	21.3	20.6	20.6
21	19.5	19.5	19.5	19.5	23.4	22.3	22.0	21.4	21.3	21.2	20.4	20.4
22	19.4	19.3	19.5	19.5	21.6	21.6	21.2	20.0	21.1	21.1	20.3	20.3
23	19.3	19.3	19.6	19.5	22.6	21.8	21.2	22.0	21.1	21.0	20.2	20.2
24	19.3	19.3	19.4	19.4	21.6	21.8	21.3	21.1	21.2	21.0	20.2	20.1
25	19.5	19.3	19.4	20.5	23.3	22.1	21.1	21.1	20.9	20.9	20.1	20.1
26	19.8	19.7	20.1	19.9	21.6	22.1	22.6	21.6	20.8	20.8	20.1	20.1
27	19.7	19.5	19.9	19.8	22.3	22.2	21.4	21.5	20.7	20.9	20.1	20.1
28	19.4	20.4	19.9	19.8	21.6	24.6	21.5	21.5	21.6	21.1	20.7	20.3
29	19.9	19.6	19.8	19.7	22.9	22.1	21.7	21.7	20.9	20.9	20.1	20.1
30	19.6	19.5	19.7	19.7	24.0	22.5	24.4	22.5	20.7	20.9	20.2	20.1
31	19.5	20.4	19.6	19.6			23.9	23.2			20.1	20.0

Water level Data List (Feet)

1985 Ara Kuda

	Jan.		Feb.		Mar.		Apr.		May.		Jun.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	21.8	21.2	20.8	20.1	20.8	20.5	21.8	21.5	21.0	21.8	20.4	20.4
2	21.2	21.1	20.2	20.2	21.1	21.0	21.8	21.8	20.8	20.6	20.8	20.4
3	21.0	21.0	20.4	20.2	21.4	20.8	21.8	21.0	20.7	20.8	20.8	20.6
4	21.0	20.9	20.1	20.1	20.8	20.8	21.4	21.0	20.9	20.8	21.8	20.8
5	20.9	20.7	20.6	21.0	20.7	20.6	22.4	21.0	20.8	20.6	20.8	20.4
6	20.8	20.6	21.8	20.6	20.9	20.6	22.4	21.4	20.6	20.6	20.4	20.2
7	20.7	20.7	20.6	20.4	22.8	21.8	21.8	21.0	20.8	20.6	20.8	20.1
8	20.6	20.5	20.5	20.4	22.0	21.2	21.0	21.0	21.4	20.0	20.2	20.0
9	20.6	20.5	20.5	20.6	21.2	21.9	21.9	25.8	23.2	22.4	20.2	20.0
10	20.9	20.6	21.0	20.8	23.0	25.0	22.4	21.6	21.9	21.7	20.1	20.2
11	20.7	20.4	21.0	21.0	27.0	23.4	22.0	21.5	21.8	21.8	20.0	20.1
12	20.5	20.4	24.0	24.9	22.8	22.1	22.2	21.0	21.6	21.8	20.0	20.0
13	20.4	20.8	28.4	24.2	21.8	21.5	21.7	21.5	22.2	21.6	19.9	19.9
14	20.8	20.8	23.4	22.4	21.5	21.4	21.5	21.8	25.6	23.8	19.9	19.9
15	20.8	20.1	22.1	21.7	24.8	22.7	21.6	21.8	22.8	21.9	19.8	19.9
16	20.8	20.1	21.6	22.8	22.8	21.9	21.2	21.9	21.8	21.4	19.9	20.0
17	20.8	20.1	21.9	21.6	21.8	21.6	21.6	21.5	21.4	21.6	20.0	20.0
18	20.2	20.1	21.4	21.4	21.5	21.4	21.4	21.2	21.6	21.4	20.2	20.2
19	20.2	20.0	21.8	21.2	22.1	22.5	21.1	21.9	22.8	21.8	20.0	19.9
20	20.1	20.2	21.2	21.1	21.4	21.4	21.0	20.8	21.4	21.4	19.9	19.8
21	20.8	20.2	21.4	21.0	21.4	21.2	21.8	21.1	21.5	21.8	19.8	19.7
22	20.1	20.2	20.9	20.8	22.0	21.4	21.8	22.4	21.2	21.7	19.7	19.7
23	20.1	20.1	21.0	20.9	21.8	21.1	22.1	21.6	21.5	21.4	19.7	19.7
24	20.2	21.0	21.8	21.0	21.0	21.0	21.4	21.8	21.8	21.0	19.7	19.7
25	21.8	21.0	20.9	20.9	21.5	21.2	21.4	21.8	21.8	21.8	19.7	19.6
26	21.8	21.1	20.9	20.7	20.9	20.9	21.6	21.8	21.0	21.0	19.7	19.6
27	20.9	20.7	20.8	20.7	22.4	23.9	21.8	21.2	20.9	20.9	19.6	19.5
28	20.6	20.6	20.9	20.6	22.8	22.4	21.1	21.1	20.8	20.7	19.6	19.5
29	20.4	20.2			22.8	21.9	21.0	21.0	20.6	20.5	19.5	19.5
30	20.8	20.2			22.4	22.2	21.0	21.5	20.6	20.5	19.5	19.5
31	20.8	20.1			22.1	21.8			20.4	20.8		

Water level Data List

1985

Ara Kuda

	Jul.		Aug.		Sep.		Oct.		Nov.		Dec.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	19.5	19.6	19.6	19.6	19.6	19.6	23.9	23.1	25.3	27.0	21.9	21.7
2	19.5	19.5	19.5	19.5	19.7	19.7	22.9	21.9	28.6	25.2	21.4	21.6
3	19.5	19.4	19.5	19.5	19.6	19.6	21.6	21.3	24.3	23.5	21.6	21.6
4	20.0	19.7	19.4	19.5	19.6	20.4	21.5	21.4	24.1	23.1	21.6	21.5
5	19.6	19.5	19.4	19.5	20.0	19.7	21.2	21.0	23.4	25.9	21.5	21.4
6	19.5	19.5	19.4	19.6	19.6	19.5	20.8	20.8	26.2	24.0	21.3	21.3
7	19.5	19.5	20.2	19.7	19.5	19.5	20.7	20.7	23.6	23.1	21.2	21.3
8	19.5	19.5	19.6	19.5	19.4	19.5	20.5	20.5	23.4	22.8	21.8	21.4
9	19.6	21.8	20.1	20.7	19.5	19.5	20.4	20.4	26.2	24.7	21.4	21.3
10	20.3	19.9	20.3	20.1	19.5	19.5	20.3	21.2	24.6	24.6	21.4	21.2
11	20.0	19.8	19.8	19.8	19.5	19.6	21.3	25.8	28.8	28.4	28.4	21.7
12	19.8	19.7	19.7	19.7	19.6	21.2	27.6	25.8	23.1	22.9	22.2	21.6
13	19.6	23.8	19.7	19.6	21.4	20.4	24.0	24.8	22.8	25.8	21.5	21.3
14	20.9	20.4	19.6	19.6	20.7	20.3	22.9	22.8	24.9	23.4	21.2	21.3
15	20.1	20.0	20.5	19.6	20.0	20.0	22.4	22.1	23.3	23.4	24.7	22.6
16	19.9	19.7	19.7	19.6	20.0	19.9	21.8	21.8	24.4	22.6	22.1	21.8
17	19.7	19.8	19.6	19.5	19.8	19.8	21.6	21.6	23.1	22.5	21.7	21.7
18	20.4	19.8	19.5	19.5	19.8	19.8	21.4	21.3	22.4	22.4	21.6	21.5
19	19.8	19.6	19.9	19.7	19.6	19.6	21.2	21.3	22.5	23.2	21.4	21.3
20	19.7	19.6	19.7	19.7	20.7	20.0	21.1	21.2	23.5	22.8	21.2	21.1
21	20.0	19.7	19.6	19.5	20.4	20.0	21.3	21 2	22.6	22.4	21.6	21.0
22	19.8	20.6	19.6	19.7	19.8	19.8	21.1	21.4	22.7	22.4	20.8	20.8
23	21.7	20.5	19.4	19.3	19.7	19.5	21 6	21.3	22.4	22.4	20.6	20.8
24	20.3	20.2	20.6	23.2	19.7	19.9	22.6	21.6	22.1	22.1	20.7	20.7
25	20.1	19.7	20.8	20.3	19.8	19.7	22.2	21.6	22.1	21.8	20.6	20.6
26	19.7	19.9	21.3	20.4	24.0	27.7	23.5	22.2	21.9	21.7	20.6	20.6
27	21 2	20.4	20.1	19.9	23.2	22.7	22.0	25.0	22.1	21.8	20.6	20.6
28	20.1	20.0	19.9	19.8	24.7	22.9	22.6	22.2	22.8	21.8	20.5	20.5
29	19.9	20.0	19.7	19.7	22.3	21.7	22.2	21.7	21.8	22.2	20.4	20.4
30	19.9	19.8	19.6	19.6	21.4	21.2	23.4	26.3	23.3	22.1	20.4	20.4
31	19.7	19.7	19.6	19.6			25.3	23.5			20.3	20.3

Water level Data List (Feet)

1984 Ara Kuda

	Jan.		Feb.		Mar.		Apr.		May.		Jun.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	20.2	20.0	23.1	21.7	20.2	20.2	22.9	21.8	22.9	22.8	20.8	21.1
2	20.1	20.0	22.0	21.5	20.6	20.3	21.4	21.0	23.4	22.7	21.2	21.3
3	20.0	19.9	22.8	21.8	21.2	20.6	21.3	21.0	23.3	22.6	21.2	21.0
4	20.0	19.8	21.5	21.3	20.5	20.3	21.2	21.2	22.4	22.3	20.8	20.7
5	20.2	19.9	22.3	21.5	21.2	20.7	21.1	21.0	22.3	21.8	20.7	20.6
6	19.9	19.7	21.2	21.0	20.4	20.3	22.2	23.4	21.9	22.0	20.7	20.6
7	19.8	19.6	21.0	21.0	20.2	20.2	24.2	23.8	21.9	22.9	20.7	20.7
8	19.7	19.5	21.0	20.9	20.1	20.1	22.6	22.4	22.2	21.9	20.8	20.6
9	19.6	19.4	21.0	20.9	20.1	20.1	22.2	22.0	21.8	21.8	20.6	20.4
10	19.6	19.4	22.0	21.2	20.0	20.0	28.2	23.8	23.2	22.1	20.6	20.6
11	19.6	19.4	20.9	20.8	20.0	20.0	22.9	22.4	22.4	24.9	20.6	20.4
12	19.8	19.5	20.8	20.7	20.0	20.0	22.2	21.8	22.8	22.1	20.3	20.3
13	19.9	19.6	22.2	21.2	20.5	20.1	21.8	21.5	21.9	21.7	20.4	20.3
14	21.8	20.4	25.5	22.5	20.2	20.1	21.4	21.3	21.6	21.5	20.4	20.9
15	20.5	20.0	21.7	21.6	20.0	20.0	21.8	21.3	24.1	22.1	20.6	20.3
16	20.9	20.3	22.0	21.6	20.0	20.1	22.1	21.6	22.1	21.7	20.3	20.6
17	20.0	20.0	22.4	21.6	20.1	20.0	21.4	21.2	22.0	25.4	20.5	20.4
18	20.0	20.0	21.3	21.0	20.0	20.0	21.3	21.0	22.8	22.2	20.2	20.2
19	20.4	20.1	21.0	20.9	20.3	20.3	25.5	27.3	22.1	21.8	20.2	20.1
20	20.1	20.0	20.8	20.6	20.1	20.0	24.3	25.6	21.6	21.5	20.2	20.0
21	20.1	20.6	20.6	20.3	20.2	20.0	24.5	23.7	22.0	21.6	20.1	19.9
22	21.3	20.4	20.4	20.2	20.1	20.0	23.0	22.7	21.6	21.4	20.0	19.9
23	20.9	20.4	20.4	20.2	20.3	20.2	23.2	21.6	21.4	21.3	20.0	20.0
24	20.4	21.4	20.3	20.3	20.4	20.4	21.4	21.0	21.4	21.3	20.1	20.0
25	22.2	21.3	20.6	20.4	20.7	20.3	21.2	21.0	21.1	21.1	20.2	20.0
26	23.6	21.7	21.8	20.7	20.9	21.0	25.4	26.0	21.2	21.2	20.0	19.9
27	21.2	20.8	20.5	20.5	23.4	21.5	24.3	25.5	21.1	21.0	19.9	19.7
28	20.7	20.6	20.5	20.3	21.8	21.0	24.6	23.6	21.0	20.9	19.8	19.7
29	21.0	21.9	20.3	20.1	21.0	21.0	22.9	22.8	20.9	20.8	19.8	20.0
30	23.4	21.8			22.6	21.8	23.0	22.4	21.2	21.3	20.0	19.9
31	21.3	21.1			21.5	21.2			21.2	20.9		

Water level Data List

1984 Ara Kuda

	Jul.		Aug.		Sep.		Oct.		Nov.		Dec.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	19.9	19.8	20.5	20.3	19.6	19.7	19.8	19.8	20.0	19.8	21.0	21.2
2	19.7	19.8	20.2	20.0	19.6	19.7	19.8	19.8	20.7	20.1	21.3	21.2
3	19.7	19.6	20.7	20.2	19.6	19.6	19.8	23.2	20.6	20.1	21.2	22.2
4	19.7	19.8	20.2	20.0	19.8	19.6	26.8	23.0	20.1	20.0	22.8	21.7
5	19.9	19.8	20.0	21.9	19.5	19.5	21.9	21.5	20.6	21.0	21.7	21.7
6	20.0	20.1	20.8	20.6	19.5	19.5	21.3	21.0	22.5	21.8	21.2	21.0
7	20.2	20.3	20.5	20.3	19.5	20.7	20.8	20.7	27.6	23.1	21.0	20.9
8	20.1	20.0	20.8	20.3	20.1	19.8	20.7	20.6	23.0	23.7	22.8	21.5
9	19.8	19.7	20.3	20.3	19.8	20.2	20.7	20.6	22.3	22.1	21.2	21.1
10	19.6	19.5	20.2	20.0	20.3	20.1	20.7	20.3	24.1	22.7	21.2	21.1
11	19.6	19.7	20.0	19.9	20.0	20.0	20.3	20.3	22.2	22.0	21.0	20.9
12	21.7	20.5	20.0	20.0	20.2	21.0	20.2	20.7	21.9	25.1	20.9	20.7
13	21.0	21.3	19.9	19.9	21.6	20.6	20.3	20.2	24.3	22.3	24.5	21.7
14	22.0	21.6	19.9	19.8	20.7	21.0	20.2	20.2	23.1	20.0	23.7	21.9
15	25.6	22.3	20.0	19.8	20.7	20.2	20.1	20.1	28.1	27.9	21.7	21.6
16	28.7	22.7	19.9	19.7	20.1	20.1	20.0	21.2	25.6	23.7	25.7	27.2
17	21.8	21.7	19.9	19.6	20.0	20.0	20.7	20.7	23.6	25.1	24.8	23.7
18	21.2	21.1	19.7	19.5	20.0	19.9	20.3	20.7	24.1	23.1	22.5	22.2
19	24.6	22.7	19.7	19.6	20.0	19.9	21.2	20.7	28.2	25.6	22.0	21.7
20	22.0	21.5	19.8	20.7	19.9	20.2	20.5	20.3	25.6	23.8	23.0	21.8
21	21.3	21.2	19.9	19.8	20.3	21.7	20.2	20.1	23.9	23.8	21.6	21.5
22	21.0	20.8	20.2	19.8	20.5	20.2	20.0	20.0	23.7	23.0	21.3	24.2
23	20.8	21.0	19.8	19.7	20.1	20.2	20.0	20.0	23.5	22.7	23.1	22.2
24	20.8	20.5	19.7	19.9	20.0	20.0	20.0	20.0	22.5	22.7	21.8	21.7
25	20.5	22.2	20.6	20.2	19.9	19.9	20.1	20.1	22.2	22.2	21.8	21.7
26	21.5	20.8	20.0	19.9	20.3	20.0	20.2	20.8	22.0	21.9	23.0	22.0
27	20.7	21.0	19.8	19.8	20.9	20.7	20.8	20.5	21.8	21.7	21.8	21.6
28	20.9	20.6	19.8	19.9	20.3	20.1	20.5	20.3	21.6	21.5	21.8	21.7
29	20.6	20.5	19.7	19.6	20.5	20.2	20.2	20.3	21.7	21.3	23.5	22.0
30	20.7	20.6	19.7	19.7	20.0	19.9	20.7	20.1	21.3	21.2	21.7	21.7
31	20.6	20.2	19.8	19.6			20.0	20.0			21.7	21.8

Water level Data List (Feet)

1983 Area Kuda

	Jan.		Feb.		Mar.		Apr.		May.		Jun.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	21.8	22.2	20.1	20.0	21.6	20.7	19.7	19.2	22.9	23.3	20.3	20.1
2	22.3	21.9	20.1	19.8	20.2	19.9	19.3	19.2	24.1	20.1	20.2	20.1
3	22.9	21.9	20.0	19.9	19.9	19.7	19.6	19.3	21.2	20.7	20.0	19.9
4	23.4	24.6	20.0	19.8	19.8	19.6	19.4	19.4	20.2	20.6	19.9	19.8
5	23.0	22.4	19.9	19.9	19.7	19.5	19.4	19.3	21.7	24.0	19.8	19.8
6	22.0	21.6	19.9	19.7	19.6	19.5	19.4	19.3	21.7	20.9	20.5	20.0
7	21.6	21.4	19.8	19.8	19.6	19.5	19.4	19.2	21.5	20.9	20.0	19.9
8	21.4	21.2	19.8	19.6	19.6	19.4	19.4	19.2	22.0	21.0	19.9	19.8
9	21.1	21.2	19.8	19.7	19.6	19.3	19.3	19.2	20.9	20.7	19.8	19.7
10	21.1	21.1	19.8	19.6	19.6	19.6	19.3	19.2	21.0	20.6	19.9	20.0
11	21.1	21.1	19.7	19.7	20.4	19.7	19.4	19.4	20.5	20.5	19.8	19.6
12	21.1	20.8	19.7	19.4	19.6	19.4	19.4	19.4	20.5	20.4	19.7	19.6
13	20.8	20.6	19.9	19.6	19.6	19.5	19.4	19.3	21.0	20.4	19.6	19.8
14	20.7	20.6	19.7	19.7	19.9	19.6	19.4	19.3	20.5	20.5	21.6	20.6
15	20.7	20.6	20.3	20.0	19.5	19.2	19.4	19.2	20.3	20.2	22.4	21.2
16	20.6	20.5	19.9	19.7	19.4	19.2	19.3	19.2	20.3	20.2	23.5	21.4
17	20.6	20.6	19.7	19.6	19.3	19.1	19.3	19.2	20.1	20.0	22.0	21.2
18	20.6	20.5	19.6	19.6	19.7	19.4	19.4	19.1	21.3	22.0	20.3	20.5
19	20.6	20.4	19.6	19.5	19.5	19.5	19.2	19.2	21.0	20.8	20.4	20.4
20	20.5	20.4	22.1	20.5	19.4	19.4	19.2	19.1	21.4	20.8	20.3	20.2
21	20.4	20.2	20.4	20.2	20.1	19.7	19.2	19.1	20.6	20.4	23.4	21.3
22	20.3	20.2	20.4	20.0	19.6	19.4	19.2	19.0	21.0	20.7	21.1	20.6
23	20.3	20.2	20.0	19.9	19.4	19.2	19.4	19.0	21.1	21.2	20.5	20.3
24	20.3	20.3	19.8	19.7	19.4	19.1	19.2	19.2	21.0	20.6	20.3	20.2
25	20.3	20.2	19.8	19.8	19.2	19.1	19.1	20.0	20.6	20.4	20.1	20.1
26	20.3	20.2	20.6	20.0	19.2	19.1	20.0	20.0	20.3	20.2	20.1	20.0
27	20.2	20.1	19.9	19.7	19.6	19.3	20.1	20.1	20.8	21.8	20.0	20.0
28	20.1	20.0	19.9	19.9	19.4	19.4	20.1	20.1	20.9	20.6	20.0	19.9
29	20.1	20.0			19.4	19.3	20.1	20.2	20.4	20.3	19.9	19.8
30	20.1	20.0			19.4	19.4	23.8	21.3	20.3	20.2	19.8	19.6
31	20.1	20.0			19.8	19.4			20.3	20.5		

Water level Data List

1983 Ara Kuda

	Jul.		Aug.		Sep.		Oct.		Nov.		Dec.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	20.5	19.9	19.3	19.4	21.4	20.2	20.5	20.2	19.1	19.1	19.9	19.7
2	19.8	19.6	19.4	19.3	20.0	19.8	20.2	20.2	18.9	18.6	19.8	19.8
3	19.7	19.6	20.6	19.9	25.0	22.2	20.2	20.2	18.9	19.9	20.3	19.9
4	19.6	19.6	20.1	19.8	21.8	20.0	20.3	20.0	19.1	19.4	19.8	19.8
5	19.7	19.7	19.7	19.6	24.0	22.9	20.4	19.9	18.8	18.8	19.8	20.2
6	19.6	19.5	19.7	19.5	22.5	20.6	20.0	19.9	18.2	18.2	22.2	21.2
7	19.9	19.8	19.5	19.5	23.4	21.4	20.4	20.0	18.1	17.9	20.7	20.3
8	19.7	19.6	19.5	19.5	21.6	21.2	20.3	19.9	17.8	18.1	20.3	20.2
9	19.6	19.4	19.4	19.4	21.1	21.3	20.0	20.0	18.0	17.9	20.2	20.1
10	19.6	20.1	19.4	19.3	23.8	24.8	20.1	20.0	17.7	17.6	20.0	19.8
11	19.6	20.3	19.4	19.3	24.6	24.3	20.0	19.9	17.7	17.9	19.8	19.6
12	19.9	19.7	19.4	19.4	23.1	22.2	20.4	20.0	18.5	19.5	19.8	19.9
13	20.0	19.6	19.4	19.4	23.2	22.6	20.1	19.8	19.9	19.7	20.0	19.8
14	19.7	19.5	19.4	19.3	22.5	21.9	19.9	20.0	19.8	20.8	20.0	19.9
15	19.6	19.6	19.3	19.4	25.6	23.8	20.9	20.2	20.7	20.5	20.0	19.9
16	21.2	21.3	19.8	19.7	23.8	22.8	20.1	19.8	20.2	20.0	20.2	20.0
17	20.4	20.1	19.7	19.4	22.4	21.9	20.1	21.4	19.8	19.8	20.4	20.0
18	20.0	20.4	19.4	19.2	21.7	21.4	22.6	21.7	20.0	19.5	20.0	19.7
19	20.3	20.2	19.3	19.1	21.7	21.2	21.1	20.7	19.3	18.9	21.0	20.3
20	20.1	19.9	19.3	19.1	20.0	21.6	24.7	22.4	18.7	18.4	20.0	19.8
21	20.0	19.7	19.3	19.2	21.5	21.4	22.4	21.6	18.1	18.1	22.5	20.7
22	19.9	19.8	20.2	19.7	21.2	21.1	21.4	21.1	17.9	17.9	20.6	20.1
23	19.7	19.5	19.6	19.5	21.3	21.8	20.9	20.5	17.7	17.4	20.2	19.8
24	19.6	19.5	19.8	19.5	21.7	21.1	20.6	20.5	17.3	17.3	20.1	19.8
25	19.6	19.5	19.5	19.3	21.3	20.9	20.5	20.3	17.1	16.9	19.8	19.7
26	19.5	19.4	19.3	19.2	20.8	20.8	20.5	20.3	16.9	16.8	19.8	19.8
27	19.5	19.3	19.4	19.4	20.8	20.7	20.4	20.3	16.8	16.8	20.8	20.3
28	19.4	19.2	19.5	19.3	20.7	20.5	20.8	20.5	16.6	16.5	21.2	20.4
29	19.4	19.4	19.3	19.3	20.6	20.4	20.5	20.2	16.6	16.4	21.3	20.4
30	19.4	19.3	19.4	19.3	20.4	20.5	20.4	23.4	16.5	16.4	21.8	20.8
31	19.3	19.2	19.9	20.1			21.4	21.0			20.5	20.2

Water level Data List (Feet)

1982 Ara Kuda

	Jan.		Feb.		Mar.		Apr.		May.		Jun.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	19.7	19.6	19.0	19.0	19.1	19.2	19.3	19.2	27.7	24.2	20.5	20.5
2	19.6	19.6	19.1	19.0	19.1	19.1	19.4	19.3	22.4	21.9	20.4	20.3
3	19.6	19.6	19.1	19.2	19.0	19.0	19.3	19.3	21.4	21.3	20.3	20.3
4	19.5	19.4	19.3	19.2	19.0	19.0	19.2	19.2	21.1	21.0	20.3	20.2
5	19.4	19.4	19.2	19.2	19.1	19.2	19.2	19.2	21.1	20.8	20.1	20.0
6	19.5	19.5	19.2	19.1	19.2	19.1	19.2	19.2	20.7	20.7	20.0	19.9
7	19.6	19.5	19.1	19.1	19.0	19.0	21.0	20.0	21.3	21.0	19.9	19.9
8	19.6	19.5	19.2	18.9	19.0	19.3	21.0	20.2	20.8	20.7	19.9	19.9
9	19.5	19.4	18.9	18.9	19.1	19.1	19.9	19.7	20.5	20.5	19.9	19.8
10	19.4	19.4	18.9	18.9	19.1	19.2	20.6	20.2	20.3	20.2	19.8	19.8
11	19.3	19.2	18.9	18.9	19.3	20.5	20.9	20.2	20.3	20.1	19.8	19.8
12	19.2	19.2	18.9	18.9	19.5	19.3	21.0	20.2	20.2	20.3	19.7	19.7
13	19.3	19.2	18.9	18.8	19.3	19.2	21.5	20.5	20.3	20.1	19.7	19.6
14	19.2	19.2	18.8	18.8	19.1	19.0	20.4	20.3	21.1	20.4	19.6	19.6
15	19.3	19.2	18.8	18.8	19.0	18.9	20.8	20.5	20.7	20.4	19.7	19.6
16	19.3	19.2	18.8	18.8	19.0	19.0	20.4	20.3	21.4	20.7	19.7	19.7
17	19.2	19.2	18.9	18.9	19.1	19.1	20.2	20.5	20.4	20.8	19.8	19.7
18	19.2	19.2	18.9	18.9	20.2	19.4	21.2	20.9	21.0	20.7	19.7	19.6
19	19.2	19.2	18.9	18.9	19.6	20.0	20.8	20.3	25.0	25.0	19.6	19.5
20	19.2	19.2	18.8	18.8	19.8	19.4	20.3	20.2	22.8	22.2	19.5	19.5
21	19.2	19.2	18.8	18.8	19.2	19.1	20.0	20.0	22.0	21.5	19.4	19.4
22	19.2	19.2	18.8	18.8	19.1	19.0	20.4	20.3	21.8	21.3	19.4	19.4
23	19.2	19.2	18.8	18.8	19.1	19.0	20.9	20.9	21.1	20.8	20.3	19.9
24	19.1	19.1	18.8	18.8	19.1	19.1	20.4	20.9	20.8	20.7	19.7	19.6
25	19.0	19.1	18.8	18.8	19.0	19.1	20.3	20.0	20.6	20.5	19.6	19.6
26	19.1	19.1	18.8	18.8	19.1	19.0	20.2	20.0	21.3	20.7	19.5	19.4
27	19.1	19.1	18.8	18.9	19.1	19.0	20.2	19.9	20.7	20.8	19.4	19.4
28	19.2	19.2	19.4	19.3	19.1	19.0	20.6	20.2	21.0	22.4	19.4	19.3
29	19.2	19.1			19.0	19.1	20.0	20.1	22.4	21.5	19.4	19.3
30	19.1	19.1			19.2	19.2	23.2	22.8	21.0	20.9	19.4	19.3
31	19.1	19.0			19.2	19.2			20.7	20.6		

Water level Data List

1982 Ara Kuda

	Jul.		Aug.		Sep.		Oct.		Nov.		Dec.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	19.4	19.3	19.4	19.3	19.5	19.5	19.9	19.8	24.5	23.1	23.2	23.2
2	19.4	19.3	19.3	19.2	20.5	23.5	20.2	20.6	23.6	22.3	26.8	23.9
3	19.4	19.4	19.2	19.2	21.5	20.9	21.0	21.3	22.4	22.5	24.0	23.2
4	21.0	20.5	19.2	19.2	20.5	20.3	22.1	21.8	21.7	22.3	22.9	22.7
5	20.0	19.8	19.5	19.3	20.2	20.0	22.2	21.5	22.8	22.8	22.8	22.5
6	20.3	19.9	19.3	19.2	19.8	19.8	21.2	21.8	22.4	22.3	22.3	22.3
7	20.0	19.8	19.2	19.2	19.8	20.0	21.2	21.0	22.4	22.3	22.4	22.2
8	19.8	19.9	19.2	19.2	20.0	19.8	20.8	21.0	21.8	22.9	22.2	22.2
9	19.8	19.8	19.2	19.2	19.8	19.7	21.0	20.8	22.9	22.0	22.3	23.4
10	19.7	19.7	19.2	19.2	19.6	19.7	20.8	21.0	22.8	22.4	23.2	22.2
11	19.7	19.6	19.3	19.3	20.6	20.6	20.6	20.5	22.6	22.8	22.4	22.2
12	19.5	19.5	19.7	19.3	19.8	19.6	20.4	20.4	23.3	24.6	22.1	21.9
13	19.5	19.4	19.3	19.2	19.6	20.1	20.3	20.3	23.9	22.8	21.9	21.7
14	19.6	19.5	19.2	19.2	20.5	21.1	20.3	20.3	22.3	22.1	21.7	21.7
15	19.6	19.5	19.2	19.2	20.3	20.5	26.8	22.8	21.8	22.5	22.2	22.4
16	19.5	19.5	19.2	19.2	21.1	20.5	23.0	22.9	23.8	22.4	22.2	21.6
17	20.3	19.8	19.2	19.2	20.3	20.2	22.2	21.6	22.9	22.9	21.8	21.7
18	19.6	19.7	19.2	19.2	20.5	20.3	21.3	21.2	22.6	23.0	21.6	21.4
19	20.2	20.0	19.3	19.3	20.2	20.1	21.6	21.3	27.3	27.6	21.3	21.4
20	19.8	19.7	19.5	19.4	21.0	20.5	21.0	20.9	23.8	23.6	21.4	21.4
21	19.9	19.8	19.3	19.3	20.6	20.7	21.0	24.1	23.2	23.2	21.2	21.1
22	19.7	19.6	19.2	20.1	21.2	20.5	23.0	21.8	23.1	22.9	21.0	21.0
23	19.6	19.6	19.3	19.3	20.4	20.4	23.7	22.1	24.3	23.2	21.0	20.9
24	19.5	19.5	19.2	19.7	20.3	20.3	22.1	21.5	23.3	23.7	20.8	20.8
25	19.4	19.3	20.6	20.7	20.2	20.1	23.4	22.8	23.5	23.1	20.8	20.7
26	19.3	19.4	19.8	19.7	20.2	20.2	25.5	23.1	23.6	23.8	20.6	20.7
27	19.5	19.4	19.3	19.3	20.0	20.0	22.8	22.2	23.9	23.4	20.6	20.7
28	19.5	19.5	19.2	19.1	19.9	20.0	24.5	22.5	25.4	23.6	20.6	20.6
29	19.5	19.5	19.3	19.2	20.0	20.0	22.3	22.0	25.4	24.2	20.6	20.5
30	19.5	19.5	19.2	20.0	19.8	19.9	23.6	22.4	25.4	23.9	21.7	21.0
31	19.5	19.4	20.0	19.5			22.6	23.2			27.5	22.8

Water level Data List (Feet)

1981 Ara Kuda

	Jan.		Feb.		Mar.		Apr.		May.		Jun.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	20.8	20.7	19.7	19.7	20.9	20.6	19.8	19.8	24.8	22.0	30.7	24.7
2	20.7	20.6	19.8	19.9	20.8	20.3	20.6	20.0	22.4	21.6	24.4	23.9
3	20.5	20.5	20.0	19.9	20.1	20.1	22.7	21.0	21.7	21.4	22.4	22.0
4	20.3	20.3	20.5	20.1	20.1	20.0	20.3	21.0	21.8	21.4	21.8	21.7
5	20.3	20.4	20.0	19.8	20.0	19.9	22.0	21.2	23.8	22.1	21.5	21.3
6	21.3	20.8	19.8	20.1	19.9	19.9	22.1	21.2	23.2	25.2	21.2	21.1
7	20.8	20.6	19.9	19.8	19.8	19.7	22.6	21.2	24.0	22.6	21.4	21.1
8	20.6	20.5	19.7	19.7	19.7	19.6	21.0	21.9	22.1	21.8	21.0	21.0
9	21.2	21.2	19.6	19.6	19.8	20.6	21.2	21.0	21.7	21.4	20.9	20.8
10	21.3	20.8	19.6	19.6	20.6	20.6	21.1	20.8	21.2	21.2	20.9	21.4
11	21.0	20.6	19.6	19.6	20.6	20.6	20.9	20.6	21.1	21.1	21.0	20.8
12	20.4	20.5	19.6	19.6	20.7	20.6	23.2	21.5	21.2	21.0	21.0	20.8
13	20.5	20.3	19.6	19.5	20.6	20.6	21.0	20.9	21.3	21.1	20.7	20.6
14	20.3	20.3	19.5	19.7	20.6	20.6	20.8	20.8	21.3	20.9	20.5	20.5
15	20.3	20.3	19.7	19.8	20.8	21.0	20.9	20.7	21.0	20.8	20.4	20.4
16	20.2	20.2	19.6	19.7	20.9	19.7	20.7	20.5	20.8	20.6	20.4	20.4
17	20.1	20.0	19.7	19.7	19.6	19.6	20.5	20.3	21.3	20.7	20.4	20.3
18	20.0	20.0	19.7	19.6	19.6	19.6	20.2	20.2	20.7	20.7	20.4	20.3
19	19.9	20.0	19.6	19.6	19.6	19.6	20.2	20.2	20.7	20.7	20.3	20.2
20	20.0	20.0	19.8	19.7	19.6	19.6	20.4	20.4	23.2	21.8	20.2	20.1
21	20.0	20.0	20.6	20.2	19.6	19.8	21.0	20.5	21.2	21.0	20.1	20.0
22	20.2	20.0	20.0	19.8	20.3	19.8	20.8	20.4	21.1	20.8	20.1	20.1
23	19.9	19.9	19.7	19.7	19.7	20.0	20.2	20.2	21.0	20.6	20.1	20.0
24	19.9	19.9	20.1	20.0	19.8	19.8	20.6	20.3	20.6	20.6	20.1	20.0
25	19.8	19.8	20.4	20.5	19.7	19.7	21.4	20.5	20.5	24.8	20.1	20.1
26	19.8	19.8	21.5	20.6	19.7	19.7	20.3	20.2	24.9	25.3	20.2	20.2
27	19.8	19.8	20.8	21.5	19.6	19.6	20.1	20.1	25.4	25.4	20.2	20.2
28	19.8	19.8	24.2	21.7	19.7	19.6	20.1	20.5	25.2	25.8	20.0	20.0
29	19.8	19.8			19.6	19.6	20.3	20.2	27.3	29.0	20.0	20.1
30	19.8	19.8			19.6	19.4	26.8	23.4	30.5	31.6	20.0	20.0
31	19.7	19.7			19.4	19.6			31.9	31.2		

Water level Data List

1981 Ara Kuda

	Jul.		Aug.		Sep.		Oct.		Nov.		Dec.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	19.9	19.9	20.0	19.8	20.4	20.4	20.2	20.0	21.2	20.9	19.8	19.8
2	19.8	19.8	19.6	19.6	21.5	20.6	20.0	20.0	21.4	22.5	19.8	19.8
3	19.8	19.7	19.6	19.6	20.5	20.2	19.9	19.9	22.7	21.9	19.9	19.9
4	19.8	19.7	19.6	19.6	20.1	20.0	19.9	20.4	21.4	21.2	19.9	19.9
5	19.5	19.4	19.6	19.6	19.9	19.8	20.2	20.0	21.0	21.0	20.7	20.0
6	19.2	19.6	19.6	19.6	20.1	22.4	20.0	19.9	21.0	21.0	19.8	19.8
7	19.6	19.4	19.6	19.5	24.9	23.0	20.0	19.8	21.0	21.1	19.7	19.7
8	19.7	19.6	19.5	19.5	23.0	26.2	20.0	19.9	20.6	20.4	19.7	19.7
9	19.6	19.6	19.5	19.5	26.2	23.0	19.9	19.8	20.4	20.4	19.7	19.7
10	19.8	19.8	19.5	19.5	22.6	21.3	20.2	19.8	20.4	20.4	19.7	19.9
11	19.9	19.7	19.6	19.6	22.9	22.0	19.8	19.6	20.4	20.4	19.7	19.6
12	19.6	19.6	19.6	19.5	21.4	21.2	19.6	19.7	20.4	20.3	19.6	19.6
13	19.6	19.6	19.6	19.5	21.0	21.0	20.0	19.9	20.3	20.2	19.9	19.8
14	19.9	19.8	19.6	19.4	26.0	23.0	20.0	20.2	20.5	20.5	19.6	19.6
15	20.6	20.0	19.5	19.4	22.1	21.7	20.2	20.2	20.4	21.4	19.6	19.6
16	20.4	20.0	19.5	19.4	21.4	21.2	20.6	20.4	20.6	20.5	19.7	19.6
17	20.0	19.8	19.4	19.2	21.0	20.8	20.1	20.0	20.4	20.5	19.7	19.6
18	19.8	19.8	19.2	19.2	20.8	20.7	19.9	19.8	20.5	20.4	19.7	19.6
19	19.9	19.8	19.3	20.2	20.6	20.6	19.8	19.8	20.7	20.4	19.6	19.6
20	19.9	19.8	20.0	19.5	20.5	20.5	19.7	19.6	20.3	20.3	19.6	19.4
21	19.9	19.8	19.8	19.2	20.4	20.3	19.7	19.6	20.4	20.2	19.5	19.5
22	19.7	19.7	19.2	19.1	21.2	21.4	19.7	19.6	20.1	20.1	19.6	19.6
23	19.8	19.7	19.1	19.1	21.0	20.6	20.1	19.7	20.0	20.1	19.6	19.6
24	19.7	19.7	21.8	20.1	20.7	23.0	19.7	19.8	20.0	20.0	19.7	19.6
25	19.6	19.5	19.7	19.5	22.0	21.5	20.5	20.1	20.0	20.0	19.6	19.6
26	19.8	19.7	19.4	19.3	21.3	21.0	20.5	23.2	20.0	19.9	19.6	19.6
27	19.5	19.6	19.4	19.3	20.8	20.6	23.4	21.8	19.9	19.9	19.6	19.5
28	19.6	19.6	19.2	19.2	20.5	20.4	23.4	21.9	19.8	20.2	19.5	19.4
29	19.6	19.6	19.6	19.7	20.4	20.3	21.5	21.3	20.0	19.9	19.6	19.6
30	19.7	22.2	19.7	19.5	20.3	20.2	21.0	21.0	19.8	19.8	20.6	20.0
31	20.6	20.2	19.3	19.3			22.0	21.4			19.9	19.7

Water level Data List

1980 Ara Kuda

	Jan.		Feb.		Mar.		Apr.		May.		Jun.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	19.6	19.6	19.3	19.3	19.7	19.7	19.4	19.6	19.6	19.6	19.9	19.8
2	19.6	19.6	19.3	19.3	19.7	19.7	19.8	19.6	20.2	19.8	19.6	21.0
3	19.5	19.5	19.3	19.3	19.6	19.6	19.6	19.6	20.5	19.9	23.7	21.2
4	19.5	19.5	19.4	19.4	19.7	19.7	19.7	19.7	20.0	20.0	21.2	20.3
5	19.5	19.5	19.5	19.5	19.7	19.7	19.6	19.6	20.0	20.0	20.6	20.7
6	19.5	19.5	19.4	19.4	19.8	19.8	19.6	19.6	21.1	20.6	21.3	20.6
7	19.4	19.4	19.3	19.3	19.8	20.1	20.3	19.8	20.2	20.2	20.4	20.3
8	19.7	19.7	19.3	19.4	20.1	19.8	19.6	19.4	20.0	19.9	21.5	21.8
9	19.6	19.6	19.4	19.3	19.8	19.8	20.2	19.8	19.9	19.9	21.0	20.7
10	19.6	19.6	19.3	19.3	19.7	19.4	19.7	19.5	19.8	19.6	20.5	20.4
11	19.6	19.6	19.3	19.3	19.3	19.3	20.6	20.4	20.3	19.9	20.3	20.2
12	19.5	19.5	19.3	19.3	19.4	19.3	19.9	19.8	20.0	19.9	20.1	20.1
13	19.5	19.5	19.3	19.3	19.4	19.4	20.0	20.1	20.3	21.2	20.0	20.0
14	19.5	19.5	19.3	19.3	19.3	19.4	19.8	19.7	20.2	20.4	20.0	20.0
15	19.5	19.5	19.3	19.3	19.3	19.4	20.0	19.7	21.4	20.3	19.9	19.9
16	19.4	19.4	19.3	19.3	19.3	19.3	19.6	19.6	20.2	19.9	19.7	19.7
17	19.4	19.4	19.3	19.3	22.2	20.5	19.7	19.6	20.0	19.7	19.7	19.7
18	19.4	19.4	19.3	19.3	20.1	19.8	19.8	19.6	19.8	19.6	19.7	19.6
19	19.4	19.4	19.3	19.3	19.8	19.6	19.5	19.5	19.6	19.7	19.7	19.6
20	19.4	19.4	19.3	19.3	19.8	19.6	20.8	20.8	19.7	19.6	19.6	19.6
21	19.4	19.4	19.3	19.3	19.7	19.5	20.5	20.1	19.6	19.5	19.6	19.5
22	19.4	19.4	19.4	19.4	19.5	19.4	20.0	19.7	19.5	19.3	19.5	19.5
23	19.4	19.4	19.4	19.5	19.4	19.3	19.7	19.7	19.5	19.3	19.4	19.4
24	19.4	19.4	19.7	19.7	19.4	19.5	19.6	19.6	19.5	19.3	19.5	19.4
25	19.3	19.3	19.8	19.8	19.5	19.5	19.7	19.6	19.5	19.3	19.5	19.8
26	19.4	19.4	19.8	19.7	19.6	19.6	19.5	19.5	19.4	19.2	19.7	19.7
27	19.4	19.4	19.7	19.7	20.5	19.7	20.5	19.9	19.4	19.5	19.8	19.6
28	19.7	19.7	19.8	19.8	19.6	19.5	19.7	19.7	20.3	19.7	19.6	19.5
29	19.6	19.6	19.7	19.7	19.5	19.5	19.7	19.6	19.8	19.5	19.5	19.5
30	19.5	19.5			19.5	19.4	19.6	19.4	19.5	20.2	19.4	19.4
31	19.5	19.5			19.5	19.3			20.8	19.9		

Water level Data List

1980 Ara Kuda

	Jul.		Aug.		Sep.		Oct.		Nov.		Dec.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	19.4	20.8	19.5	19.4	20.2	20.3	22.6	22.3	21.3	22.1	24.1	23.2
2	20.0	19.6	19.5	19.5	20.2	20.0	21.8	23.3	21.3	21.5	22.7	22.5
3	19.6	19.5	20.8	19.8	20.0	19.9	21.6	21.4	21.3	21.1	22.5	22.3
4	19.5	19.5	27.2	23.8	19.8	19.6	21.3	22.0	20.8	20.5	22.5	22.8
5	19.5	19.5	21.8	21.1	19.7	20.1	21.9	21.6	21.5	20.5	24.2	22.8
6	19.4	19.4	20.7	21.2	20.7	22.7	22.8	22.9	21.6	22.8	22.5	22.3
7	19.5	19.8	20.6	21.0	23.0	21.0	22.7	22.4	23.8	24.8	23.7	22.5
8	19.4	19.4	20.9	20.8	20.8	20.8	22.0	21.0	26.8	24.8	22.2	24.0
9	19.5	19.8	21.3	21.8	20.5	20.8	21.9	22.6	22.5	21.5	25.5	23.4
10	19.6	19.4	22.4	21.3	21.0	20.2	23.0	22.1	21.3	22.6	23.1	22.6
11	19.5	19.4	20.7	20.6	22.5	21.8	22.9	22.4	20.6	20.5	23.4	22.5
12	19.5	19.4	20.5	20.4	21.3	21.9	22.3	22.6	21.1	21.8	22.2	22.1
13	19.5	19.6	20.7	20.5	20.7	20.5	21.7	21.6	22.1	21.9	22.1	21.9
14	19.8	19.5	20.4	20.3	20.4	20.4	23.4	22.6	20.2	22.1	21.8	21.8
15	19.5	19.4	20.2	20.2	20.3	20.5	23.0	22.2	22.7	21.8	22.0	21.1
16	20.6	19.0	23.0	21.3	20.3	20.2	23.6	23.2	21.8	21.5	22.2	21.8
17	19.8	19.0	22.4	22.2	20.2	20.2	26.0	23.4	21.9	21.3	21.9	21.3
18	19.8	19.8	21.2	21.1	20.6	20.3	22.6	22.3	21.9	23.5	21.9	23.6
19	20.1	19.9	20.3	20.6	20.5	20.5	22.1	21.8	27.0	25.3	27.0	25.3
20	19.7	19.6	20.5	20.5	20.2	20.1	21.4	21.5	23.1	22.8	23.1	22.8
21	19.5	21.8	20.4	20.3	21.6	21.3	21.5	21.4	22.5	21.9	22.5	21.9
22	20.6	20.2	20.2	20.2	22.1	21.3	21.3	21.3	28.2	24.0	28.3	24.0
23	20.0	19.8	20.1	20.1	21.3	20.9	21.2	21.3	24.0	22.9	24.0	22.9
24	19.7	19.7	20.8	20.4	26.0	22.5	22.7	21.8	22.5	22.6	22.5	22.6
25	19.6	19.6	20.2	20.0	22.0	21.5	21.3	21.2	23.1	22.9	23.1	22.9
26	19.5	19.5	20.3	20.0	21.9	21.4	21.0	21.0	27.2	24.3	27.2	24.3
27	19.5	19.5	19.8	19.9	21.9	21.8	20.9	21.0	24.8	23.4	24.8	23.4
28	19.5	19.5	20.1	19.9	22.8	23.9	21.0	21.2	23.0	22.7	23.0	22.8
29	19.5	19.4	19.9	19.8	25.4	23.7	21.1	21.8	22.5	22.6	22.5	22.8
30	19.5	19.4	22.4	22.0	22.6	24.0	21.3	21.2	23.5	23.0	23.5	23.0
31	19.5	19.4	21.0	20.5			20.9	20.8			20.8	20.8

11月と12月のdata必要

Water level Data List

1979 Ara Kuda

	Jan.		Feb.		Mar.		Apr.		May.		Jun.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	19.1	19.0	18.7	18.7	19.3	19.0	19.1	19.7	20.7	20.7	19.6	19.5
2	19.0	19.0	18.7	18.7	19.3	19.1	19.1	19.8	20.5	20.2	19.7	19.7
3	19.0	18.9	18.7	18.7	19.2	18.9	20.1	20.8	20.1	20.0	19.3	19.6
4	19.0	19.0	18.7	18.7	19.0	18.8	21.5	21.7	19.9	19.8	19.7	19.7
5	19.3	18.9	18.7	18.7	19.1	18.9	22.1	22.0	19.7	19.6	19.3	19.3
6	19.0	18.8	18.8	18.7	19.0	19.0	21.9	21.6	20.0	19.7	19.3	19.3
7	19.0	18.8	18.8	18.7	19.0	19.1	21.1	21.0	19.8	19.6	19.6	19.6
8	18.9	18.8	18.8	18.7	19.1	19.0	20.8	20.3	19.6	19.5	20.5	19.9
9	18.8	18.8	18.8	18.6	19.0	19.0	19.5	19.2	19.6	19.5	20.7	20.6
10	18.9	18.9	18.7	18.6	19.0	18.9	19.3	19.3	19.5	20.6	22.7	21.8
11	18.9	18.9	18.7	18.6	18.9	18.9	20.4	20.0	20.0	19.8	20.2	20.1
12	18.9	19.0	18.7	19.5	18.8	18.8	20.6	20.1	20.8	21.0	19.9	19.9
13	18.9	19.0	19.4	19.3	18.9	18.9	22.8	21.4	20.2	19.9	20.2	19.9
14	18.9	18.9	19.3	19.3	19.0	19.0	20.7	20.1	19.7	19.7	20.1	19.9
15	18.8	18.9	19.3	19.3	19.0	19.0	20.0	19.6	19.7	19.6	19.8	19.7
16	18.8	18.9	19.2	19.5	19.8	19.3	19.6	19.7	19.7	19.5	19.7	19.6
17	18.9	18.9	19.3	19.2	19.1	19.1	19.6	19.4	19.6	19.4	19.5	19.5
18	18.9	18.9	19.2	19.1	19.0	19.0	19.6	19.4	19.5	19.4	19.6	19.8
19	18.9	18.9	19.1	19.1	18.9	18.8	19.5	19.3	19.3	19.2	19.8	19.7
20	18.9	18.9	19.2	19.2	19.0	18.7	19.4	19.8	19.3	19.2	19.6	19.5
21	18.9	18.9	19.2	19.2	19.0	18.8	20.0	19.6	19.2	19.4	19.5	19.4
22	18.8	18.8	19.2	19.2	19.0	18.8	19.6	19.3	19.4	19.4	19.4	19.4
23	18.8	18.8	19.1	19.1	19.0	18.8	19.2	19.3	19.5	19.5	19.3	19.5
24	18.8	18.9	19.1	19.0	19.0	18.7	19.3	19.3	19.6	19.6	19.3	19.2
25	18.9	18.9	19.0	19.0	18.9	18.7	19.8	19.5	19.5	19.5	19.2	19.2
26	18.95	18.9	19.4	19.2	18.8	18.7	22.8	21.1	19.5	19.4	19.2	19.2
27	18.85	18.8	19.2	19.0	18.8	18.7	20.6	20.2	19.4	19.5	19.3	19.3
28	18.8	18.8	19.3	19.0	18.8	18.7	20.4	20.1	19.4	19.4	19.3	19.3
29	18.8	18.8			18.8	18.7	20.2	19.9	19.5	19.4	19.3	19.3
30	18.7	18.7			18.8	19.8	21.8	20.8	19.4	19.8	19.3	19.3
31	18.7	18.7			19.5	19.2			20.3	19.8		

Water level Data List

1979 Ara Kuda

	Jul.		Aug.		Sep.		Oct.		Nov.		Dec.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	19.2	19.3	19.4	19.4	21.8	21.2	19.9	19.9	20.1	20.8	21.9	21.8
2	19.2	19.3	19.4	19.3	23.1	22.7	19.8	19.9	20.5	20.4	21.7	21.6
3	19.2	19.2	19.3	19.3	23.0	22.6	19.9	19.7	20.7	20.7	21.5	21.4
4	19.3	19.4	19.3	19.3	26.5	23.5	19.7	19.5	20.5	20.5	21.4	21.5
5	19.3	19.3	19.3	19.3	23.5	19.9	19.7	19.6	20.5	20.4	22.0	21.9
6	19.3	19.3	19.4	19.4	23.0	19.9	21.0	21.3	20.8	20.9	22.8	22.0
7	19.2	19.2	19.4	19.4	22.5	19.8	19.9	19.9	20.9	20.9	21.9	21.8
8	19.2	19.2	19.4	19.4	22.5	19.9	20.0	19.9	24.0	22.8	21.5	21.4
9	19.1	19.1	19.3	19.3	22.8	22.4	19.7	19.6	27.5	28.0	21.3	21.2
10	19.1	19.1	19.2	19.1	22.5	23.5	19.7	19.6	22.8	22.0	21.0	21.0
11	19.5	19.6	19.2	19.2	23.4	22.2	19.9	19.9	22.3	22.3	20.9	20.9
12	19.4	19.3	19.2	19.2	21.3	22.0	19.9	19.8	22.9	22.9	20.8	20.8
13	19.2	19.2	19.3	19.3	22.9	22.0	19.6	19.6	22.7	22.3	20.7	20.7
14	19.5	19.5	19.2	19.2	22.0	21.6	19.8	20.9	23.0	22.8	20.7	20.7
15	19.3	19.3	19.4	19.4	21.4	21.0	20.2	21.0	23.0	22.9	20.7	20.6
16	19.2	19.2	19.5	19.5	21.2	20.8	22.0	23.0	21.6	21.5	20.6	20.5
17	19.2	19.2	19.3	19.3	20.7	20.7	22.2	21.0	21.6	22.8	20.5	20.5
18	19.2	19.3	19.4	19.4	21.0	19.7	22.0	21.2	23.7	24.0	20.5	20.5
19	20.2	20.0	19.4	19.4	20.6	19.3	22.0	21.4	24.1	24.2	20.4	20.4
20	19.4	19.3	19.6	19.7	20.3	19.4	20.4	20.3	25.6	25.6	20.3	20.3
21	19.8	19.9	23.0	22.0	20.1	21.0	20.3	20.1	26.1	25.6	20.2	20.2
22	20.9	20.9	20.0	20.0	21.0	21.0	20.0	20.0	25.1	23.9	20.2	20.2
23	19.6	19.6	19.9	19.8	21.1	21.9	20.1	20.0	22.0	21.9	20.2	20.2
24	19.7	19.8	19.7	19.7	21.6	21.0	20.1	20.2	21.9	21.8	20.2	20.2
25	19.9	20.0	19.7	19.7	20.7	20.3	23.5	21.5	21.9	21.9	20.1	20.1
26	19.8	20.0	19.7	19.7	20.6	20.4	21.5	21.5	21.9	21.9	20.0	20.0
27	20.0	20.0	19.7	19.7	20.3	20.2	21.4	21.4	22.1	22.1	20.0	20.0
28	19.8	19.8	19.8	19.8	21.0	20.0	21.4	21.4	25.0	23.2	19.9	19.9
29	19.7	19.6	20.2	19.9	20.0	20.3	21.3	21.3	22.5	22.2	19.8	19.8
30	19.7	19.6	20.2	21.0	20.2	20.1	21.1	21.4	22.1	22.0	19.7	19.7
31	19.5	19.4	19.7	20.0			20.9	20.9			19.6	19.6

Water level Data List

1978 Ara Kuda

	Jan.		Feb.		Mar.		Apr.		May.		Jun.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	20.0	20.0	19.2	19.2	19.3	19.2	19.7	19.5	19.7	19.8	19.7	19.7
2	19.9	19.9	19.2	19.2	20.2	19.7	19.4	19.5	19.8	19.6	19.7	19.8
3	19.8	19.8	19.3	19.3	19.5	19.4	19.4	19.4	20.0	22.1	19.7	19.7
4	19.8	19.8	19.3	19.2	19.4	19.3	19.7	19.6	21.4	20.7	19.8	19.7
5	19.7	19.7	19.2	19.2	19.3	19.4	19.7	19.6	20.4	20.2	19.9	19.8
6	19.7	19.6	19.1	19.2	20.3	19.7	19.5	19.5	20.5	20.3	19.8	19.8
7	19.6	19.6	19.2	19.2	19.6	19.4	19.4	19.4	20.3	20.2	19.7	19.6
8	19.6	19.6	19.2	19.2	19.4	19.4	19.5	19.4	21.0	20.6	19.7	19.6
9	19.7	19.7	19.4	19.2	19.4	19.4	19.3	19.3	22.6	21.4	19.6	19.6
10	19.6	19.6	19.3	19.3	19.4	19.4	19.2	19.2	22.8	21.5	19.7	19.6
11	19.6	19.7	19.2	19.2	19.4	19.4	19.3	19.2	21.7	21.0	19.6	19.7
12	19.6	19.5	19.2	19.2	19.4	19.4	19.3	19.3	23.0	21.6	19.7	19.7
13	19.5	19.7	19.1	19.2	19.4	19.3	19.3	19.4	22.2	21.5	19.6	19.5
14	19.4	19.6	19.1	19.0	19.3	19.2	19.5	19.5	25.4	22.5	19.6	19.5
15	19.3	19.3	19.1	19.1	19.4	19.2	19.6	19.4	21.6	21.4	19.6	19.5
16	19.4	19.4	19.6	19.2	19.3	19.2	21.0	19.8	21.1	20.8	19.5	19.6
17	20.0	19.8	19.2	19.2	19.5	19.3	19.4	19.5	20.7	21.7	19.6	19.5
18	20.1	19.8	19.2	19.2	20.2	19.7	19.6	19.7	20.9	21.4	19.5	19.4
19	19.8	19.7	19.2	19.2	21.2	20.2	19.8	19.5	20.9	20.6	19.3	19.4
20	19.6	19.6	19.0	19.2	19.8	19.9	23.0	21.5	20.6	20.6	19.4	19.4
21	19.5	19.5	19.1	19.1	19.7	20.3	22.2	21.9	20.4	20.3	19.4	19.4
22	19.4	19.4	19.4	19.2	20.4	20.5	21.0	21.1	20.7	20.5	19.4	19.4
23	19.4	19.4	19.3	21.5	20.0	19.8	21.8	20.9	20.3	20.4	19.4	19.4
24	19.4	19.3	20.0	19.6	19.6	19.6	20.6	20.4	20.2	20.1	19.4	19.4
25	19.3	19.3	19.6	19.5	20.0	19.7	20.2	20.4	20.1	20.0	19.4	19.4
26	19.7	19.5	19.3	19.2	19.6	19.6	20.2	20.0	20.1	20.0	19.3	19.2
27	19.4	19.4	19.1	19.2	20.6	20.1	20.6	20.4	20.2	20.0	19.2	19.1
28	19.4	19.3	19.4	19.4	19.9	19.8	20.1	20.5	19.9	19.9	19.2	19.2
29	19.3	19.3			19.8	19.7	20.2	20.5	19.8	19.8	20.0	20.4
30	19.2	19.2			19.7	19.5	19.7	19.8	19.8	19.9	19.7	19.6
31	19.2	19.2			19.5	19.5			19.8	19.8		

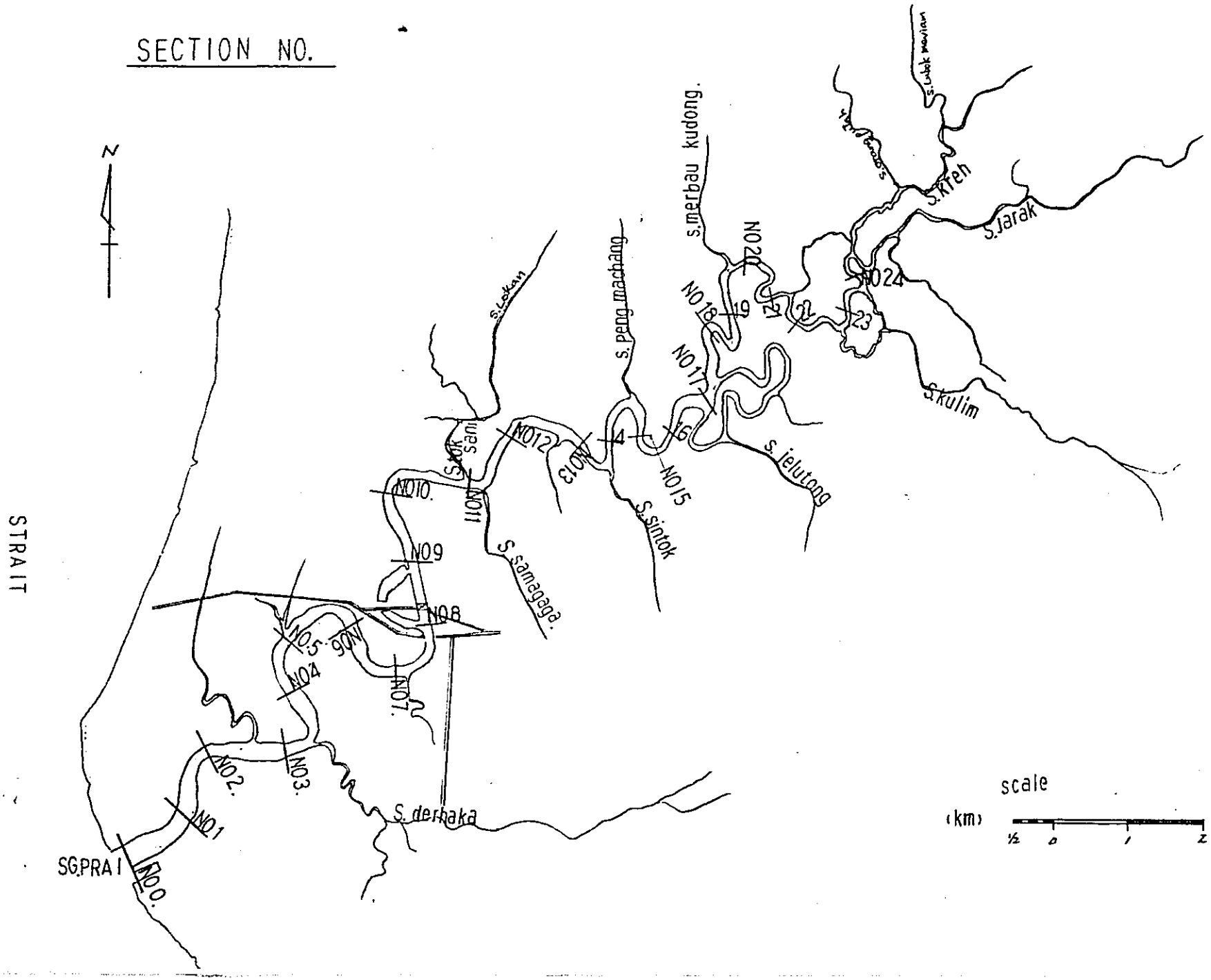
Water level Data List

1978 Ara Kuda

	Jul.		Aug.		Sep.		Oct.		Nov.		Dec.	
	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM	6 AM	6 PM
1	19.7	20.1	19.2	19.1	20.7	20.8	19.4	19.8	20.6	20.5	19.4	19.3
2	20.2	20.4	19.2	19.1	21.1	20.2	19.4	20.2	20.6	20.4	19.4	19.3
3	19.9	19.7	19.2	19.2	19.9	19.7	20.2	19.8	22.0	21.2	19.4	19.3
4	19.6	19.6	19.3	19.2	19.9	19.7	19.6	19.4	21.0	20.7	19.5	19.4
5	19.5	19.3	19.2	19.2	20.9	20.2	19.5	19.5	20.6	20.3	19.5	19.3
6	19.4	19.2	19.2	19.1	20.8	24.2	23.0	21.0	20.3	20.4	19.4	19.6
7	19.4	19.2	19.2	19.1	21.6	21.8	20.8	20.3	20.4	20.2	19.6	19.4
8	19.3	19.3	19.2	19.1	21.6	21.1	20.2	19.9	20.3	20.1	20.2	19.6
9	19.3	19.3	19.1	19.1	20.8	20.6	19.8	20.2	20.2	20.0	19.6	19.4
10	19.2	19.3	19.2	19.6	20.7	20.3	20.4	20.2	20.1	19.9	19.6	19.4
11	19.3	19.4	19.8	19.7	20.3	21.3	20.8	20.2	20.0	19.9	19.4	19.4
12	19.4	19.3	19.6	19.4	20.6	20.3	21.4	22.3	20.2	19.8	19.4	19.2
13	19.4	19.3	19.4	19.8	20.2	20.2	22.2	21.8	19.9	19.8	19.4	19.2
14	19.3	19.3	20.2	19.9	20.1	19.9	21.4	21.0	19.8	19.7	19.4	19.1
15	19.4	19.3	19.8	19.8	20.0	20.0	21.2	20.9	20.2	19.9	19.4	19.2
16	19.4	19.3	19.7	19.4	20.2	19.8	20.7	20.4	20.2	20.2	19.4	19.2
17	19.3	19.2	19.5	20.2	19.8	19.6	20.2	20.1	20.3	21.7	19.4	19.2
18	19.2	19.0	20.2	19.7	19.7	19.6	20.2	20.2	20.6	20.2	19.3	19.2
19	20.3	19.9	19.9	19.7	19.6	19.5	20.8	20.4	20.2	19.9	19.2	19.1
20	19.7	19.4	20.2	19.7	19.9	19.7	20.2	20.3	19.8	19.8	19.2	19.1
21	19.4	19.2	19.7	19.4	19.8	19.8	21.0	21.8	19.9	19.7	19.2	19.2
22	19.7	21.0	19.4	19.4	19.6	19.6	21.7	21.6	19.7	19.6	19.2	19.2
23	20.2	19.7	19.4	19.2	20.1	20.3	21.4	21.1	20.7	19.9	19.2	19.0
24	19.6	19.6	19.4	19.2	20.2	19.9	20.7	22.0	20.6	20.2	19.1	19.0
25	19.6	19.3	19.4	19.3	20.0	19.8	23.0	21.6	20.0	19.7	19.0	19.0
26	19.4	19.3	19.4	19.3	19.7	19.5	25.2	22.6	19.8	19.6	19.2	19.0
27	19.4	19.2	19.4	19.3	19.5	19.4	22.2	21.6	19.7	19.5	19.1	19.0
28	19.3	19.1	19.3	19.3	19.6	19.8	21.4	21.2	19.5	19.3	19.1	19.0
29	19.3	19.2	21.6	21.3	19.6	19.6	21.3	20.9	19.5	19.3	19.1	19.0
30	19.4	19.2	20.5	21.0	19.4	19.3	21.2	20.8	19.4	19.3	19.1	19.0
31	19.2	19.2	21.1	21.3			20.9	20.7			19.1	18.9

II. SURVEYING DATA

DISTANCE	LEFT BANK	RIGHT BANK	NOTE
0			RIVER MOUTH
900	NO.1.WATERLEVEL		RAILWAY BRIDGE
1000			
2000			
3000			CONCRETE BRIDGE
250	NO.2,WATERLEVEL		
400	SG.DERAHAKA		
600	SG.DERAHAKA		PUMP STATION
4000			
5000		DRAINAGE	
6000			
800	NO.3,WATERLEVEL		
7000			
300	DRINAGE		
500		MARELE FACTORY	
8000			
8322.3	BARRAGE	NO.4,5,WATERLEVEL	
9000			
10000		SG.TOKSANI	
11000			
100	SG.SAMAGAGAH		NO.6,WATERLEVEL
12000			
600		SG.PENGHALAN NIBANG	
13000			
600	SG.SINTOK		
14000			
600		SG.MERBAU KUDONG	
15000			
500			TITITIMBUL
16000			
600	SG.JELTONG		
17000			
18000			
19000			
350		SG.MERBAU KUDONG	
600		SG.PUTIH	
20000			
21000			
700	PUMP STATION		
22000			
450	SG.KULIM		
23000			
500	SG.DATOK		
24000			
350	SG.JARAK		


SECTION NO.
N
STRAIT
SG.PRAI
NO.0
NO1
NO2
NO3
S. derhaka
NO4
NO5
NO6
NO7
NO8
NO9
NO10
NO11
NO12
NO13
NO14
NO15
NO16
NO17
NO18
NO19
NO20
NO21
NO22
NO23
NO24
S.Lokan
S.Sami
S.samagaga
S.peng machang
S.merbau kudong
S.Sintok
S.jelutong
S.kulim
S.Jarak
S.Kreh
scale
(km)
½
0
1
2

II-1

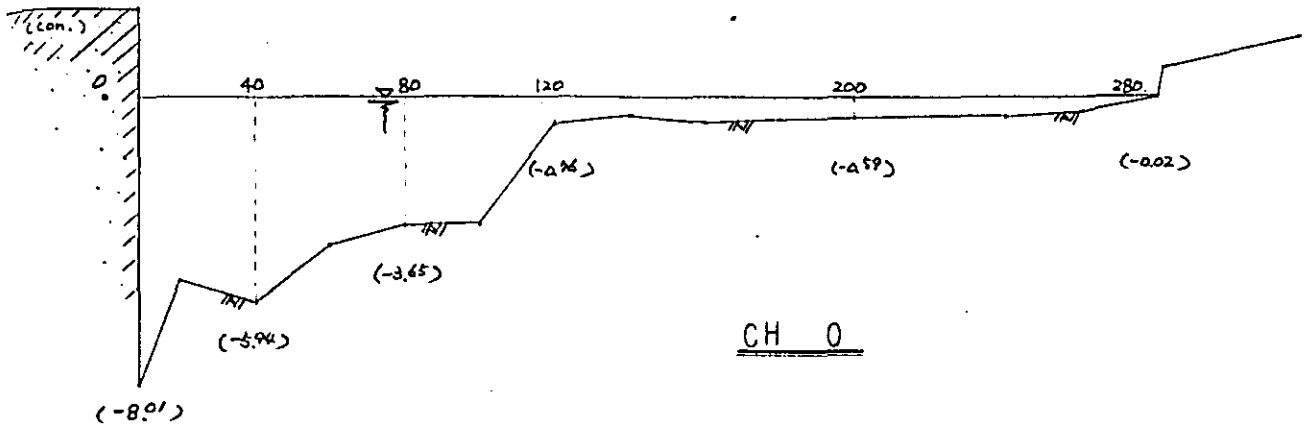
SUNGAI PRAI CROSS SECTION AREA TABLE

STATION NO.	DISTANCE (m)	CROSS SECTION AREA (m²)	WATER SURFACE WIDTH (m)	MEAN DEPTH	FIGURE NO.
NO 0	0	581	291	2.00	BALIK PULAU SEBERANG PERAI CH 0
1	1,000	677	203	3.33	〃 CH 1,000
2	2,000	446	163	2.74	〃 CH 2,000
3	3,000	612	175	3.50	〃 CH 3,000
4	4,000	455	173	2.63	〃 CH 4,000
5	5,000	392	173	2.27	〃 CH 5,000
6	6,000	399	181	2.20	〃 CH 6,000
7	7,000	398	115	3.46	〃 CH 7,000
8	8,000	403	134	3.01	〃 CH 8,000
	8,322	BARRAGE			
9	9,000	349	109	3.20	BPSP/S/SG.P/M2 CH 600
10	10,000	560	107	5.23	〃 CH 1,600
11	11,000	376	106	3.55	〃 CH 2,600
12	12,000	309	95	3.25	〃 CH 3,600
13	13,000	286	89	3.21	〃 CH 4,600
14	14,000	213	67	3.18	BPSP/S/SG.P/M1 CH 1,000
15	15,000	226	72	3.14	〃 CH 2,000
16	16,000	195	69	2.83	〃 CH 3,000
17	17,000	231	100	2.31	BPSP/S/SG.P/M4 CH 300
18	18,000	184	48	3.83	〃 CH 1,300
19	19,000	178	50	3.56	〃 CH 2,300
20	20,000	126	57	2.21	〃 CH 3,300

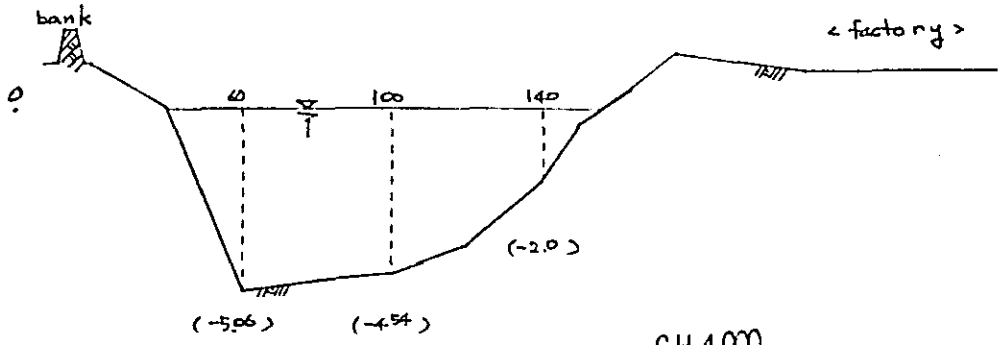
STATION NO.	DISTANCE (m)	CROSS SECTION AREA (m²)	WATER SURFACE WIDTH (m)	MEAN DEPTH (m)	FIGURE. NO.
NO. 21	21,000	160	51	3.14	BPSP/S/SG.P/M CH 4.300
22	22,000	91	42	2.17	〃 CH 5,300
23	23,000	110	48	2.29	〃 CH 6,300
24	24,000	69	36	1.92	〃 CH 7,300

NOTE: Water surface width and cross section area are shown at the water level of RL ± 0.

SG. PRAI CROSS SECTION



CH 0



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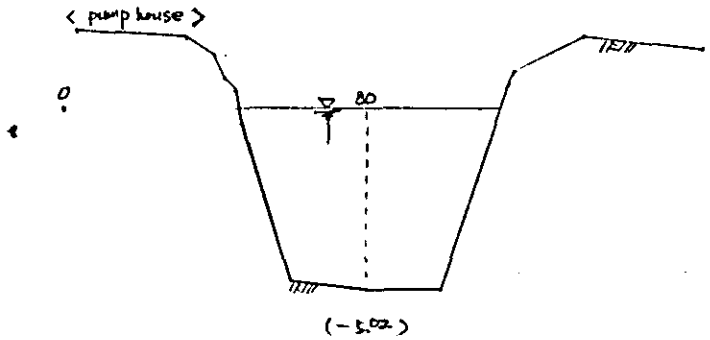

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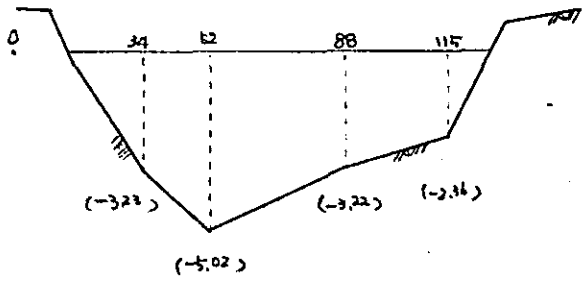

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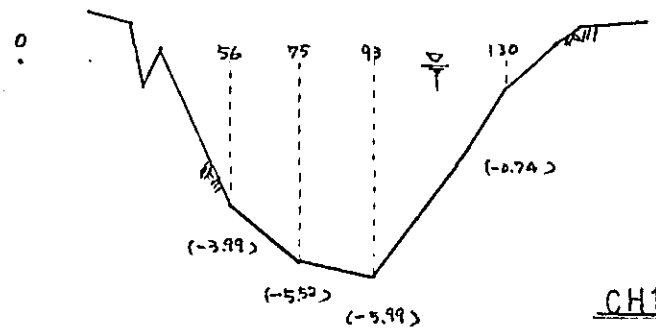
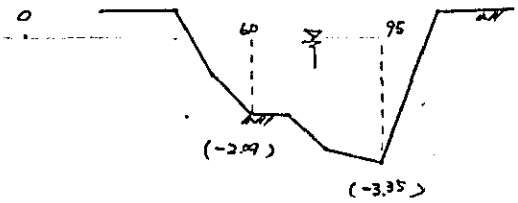


CH 11.000



CH 20.000

SCLE L = 1:2000
D = 1:200

NOTE 1. Water surface show RL 0.0 .

2. Depth scunding was useing rope.

2.others DATA OF SURVEY

	TITLE NAME OF COLLECED FIGURES	NO
	PROJEK PEMBANGUNAN PERTANIAN BERSEPADU BALIK PULAU - SEBERANG PERAI	
①	*SUNGAI PERAI	
	LAYOUT PLANS	BPSP/S/SG/M1,M2,M3
	LONGITUDINAL SECTIONS	JER/PG/7
	CROSS SECTIONS 12.1986 - 5,1987 & 3,1988	
②	*RANCANGAN PENCEGAHAN BANJIR MAK MANDIN BAGAN SERAI	
	PELAN ALIGNMENT	JP/86/PG/115
	UKURAN(DIMENSION) BUND	
	SITE SURVEY	

Ⅲ A DATA OF GATE

THE HISTORY OF PRAI BARRAGE

year / month	1978	1979	1980	1981
Jan.	FINALISING ON LAND AQUISITION			25/1 GATE WORK COMPLETED
Feb.				
Mar.		23/3 SITE CLEARING		
Apr.				
May			< UNDER CONSTRUCTION >	
June		4/6 EXCAVATION OF BARRAGE		11/6 EARTH WORK COMPLETED
July				MAIN WORK COMPLETED 31/7 SPEED TEST OF GATES
Aug.		22/8 PILING START		
Sep.				
Oct.				
Nov.	2/11 SITE INSPECTION			3,4/11 SPEED TEST OF GATES
Dec.		28/12 FIRST CONCRETING STARTS	1,6/12 FIX GATE GUIDE	

THE HISTORY OF BARRAGE

year / month	1982	1983	1984	1985
Jan.				
Feb.	25,26/2 SPEED TEST OF GATES			
Mar.			29/3 CONSTRUCTION OF GANGWAY	
Apr.	12/4 OPENING CEREMONY			
May				
June				
July				
Aug.				
Sep.	28/9 1/2"WIRE ROPE SNAPED (GATE NO1) 3/4"WIRE ROPE SNAPED (GATE NO4)		21/9 REPAIR&REPAINT GATE NO1	
Oct.				
Nov.		13/11 GATE NO3 FELL (WIRE SNAPPED)	<10/12 GATE NO.1 TOOK OUT	
Dec.		19/12 FINAL PAYMENT OF CONTRACT		

THE HISTORY OF PARRAGE

month \ year	1986	1987	1988	
Jan.				
Feb.				
Mar.	13/3 GATE NO4 FELL (WIRE SNAPPED)	13/3 STEEL PLATE TEST		
Apr.		9/4 STEEL PLATE TEST		
May				
June				
July				
Aug.				
Sep.				
Oct.				
Nov.				
Dec.				

PRAI BARRAGE CHECK TABLE

TABLE —

N A M E	C O M M E N T
TOTAL FACILITY	There is the problem of operation. The cause is the adherence of rolling parts.
HOISTING EQUIPMENT	1.Adherence of rolling parts 2.No damage of the wier .
GATE GUIDE	1.Rust condition 2.Attachment condition to the concrete
GATE LEAF	1.Rust condition (1)Skin plate - No.2,3,4 inside corroded (2)Girder-Especially No.3,4 corroded (3)Roller-No.2,3,4 almost can not roll (4)Seal - Damaged (5)Others - Damaged

The present operation's objects are to maintain the h-
-ydrauric pressure system and hoisting equipment system.
The present condition cannot function at ordinary oper-
-ation.

Now we cannot find the damage of wire rope. But the st-
-ructural damage by rust is progressing.

You should check the gate everyday. Especially you must check the wire rope and the supporting structure of ga-
-te leaf.
If you find the unusual condition on gates,you should correspond to the situation.

TABLE —

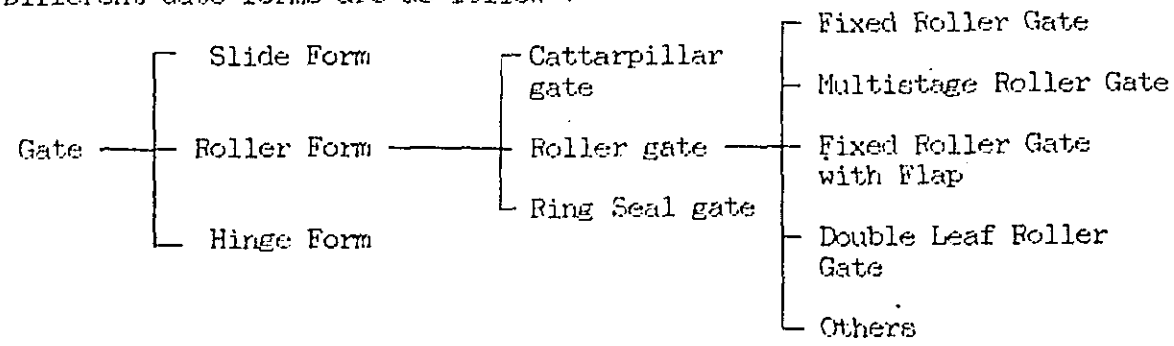
GATE COMPARISON TABLE

GATE NAME	PRAI BARRAGE	KERIAN BARRAGE	KEDAH BARRAGE
TYPE	DOUBLE LEAF ROLLER GATES	FIXED ROLLER GATES	FIXED ROLLER GATES
CONPLETION YEAR	1981	1975	1970
NUMBER of GATES	N = 4 gates H = 18 ft W = 45 ft	N = 5 gates H = 20 ft W = 45 ft	N = 7 gates H = 20 ft W = 45 ft
MATERIALS	STEEL	STEEL	STEEL
HISTORY	REPAIR gate NO. 1 (9.1984)	REPAIR ALL gates (.91)	NO REPAIR
CONDITION	IN RUST	NO RUST	NO RUST
IMPRESSION	• There are salinity defferences between sites of 3 gates. We can not see any barnacles at KERIAN and KEDAH BARRAGE. (It seems that the fact depends on the salinity.)		

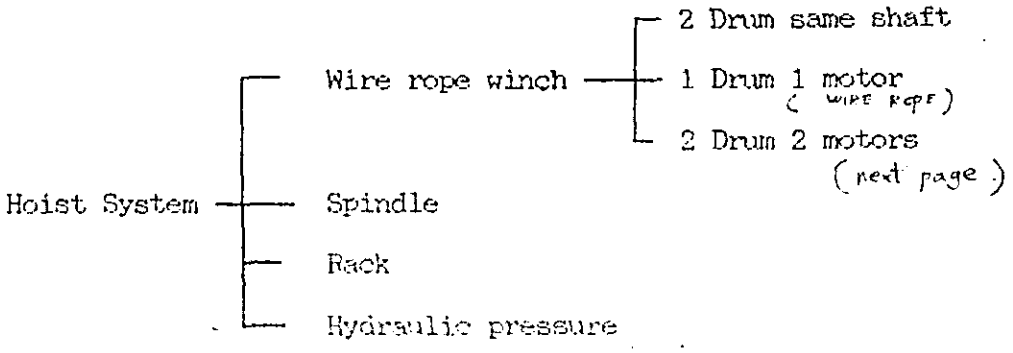
For further understanding :

1. Description of Double Leaf Gate

Different Gate forms are as follow :-



2. Gate Hoist



Advantages of 1 drum 1 motor :-

* no need operation bridge
* the ability is stable
* it is very economical
* no engagement with wire rope arrangement

Disadvantages

* need to be careful for wire rope under water

3. The setting condition of the gate

Usually the gate is under more strigent condition than other type of steel structure. This is because they are always subject to sunshine,

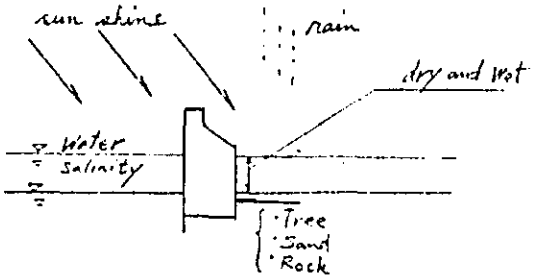
rain, dry and wet, water, collapse of sand and rock. Refer to the figure below. For Gate painting, it is important to paint the gate at the suitable time.

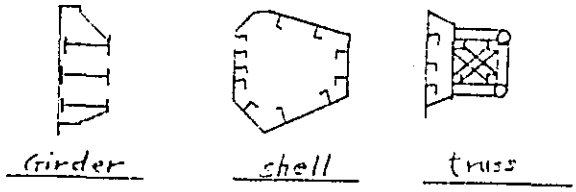
4. Maintenance Plan

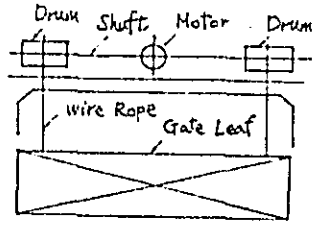
In general, when we use the gates for different objectives, we must maintain the facility at the same time. For that purpose we must check the gate condition of the gates. Hence we need the maintenance plan.

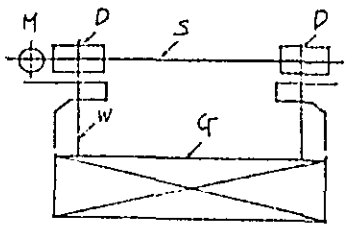
For example, the plan has to include the rotation of checking staff, checking points and the method of checking. It is also very important to report the result correctly the officer after checking.

In this type of hoist system, wire rope maintenance is very important.

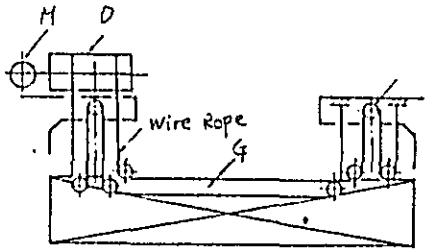




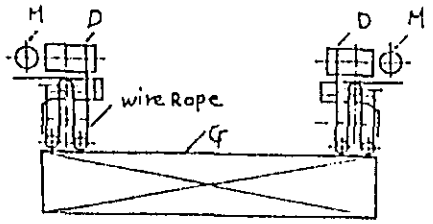




• 2 Drum Same SHaft



• 1 Drum Wirerope



• 2 Drum 2 Motors

4. REFERENCE DATA

Outline of Mathematical Simulation Model

1. Basic equations

The basic equation of water flow in an open channel are an equation of motion ① and equation of continuty ②. With the down stream terminal of a channel as origin, therefore, they are

$$\frac{1}{g}\cdot\frac{dV}{dt} + \frac{1}{g}\cdot\frac{d}{dX}\left(\frac{V^2}{2}\right) + i + \frac{dh}{dX} + \frac{n^2 V|V|}{R^{4/3}} = 0 \qquad ①$$

$$\frac{dA}{dt} + \frac{dQ}{dX} - q = 0 \qquad ②$$

where, g :gravity acceleration,

t : time,

V : flow velocity,

i : channel slope,

h : water depth,

X : distance,

n : coefficient of roughness,

R : hydraulic mean depth,

A : water flow section,

Q : flow discharge,

q : latelal inflow discharge per unit length.

2.Difference equations

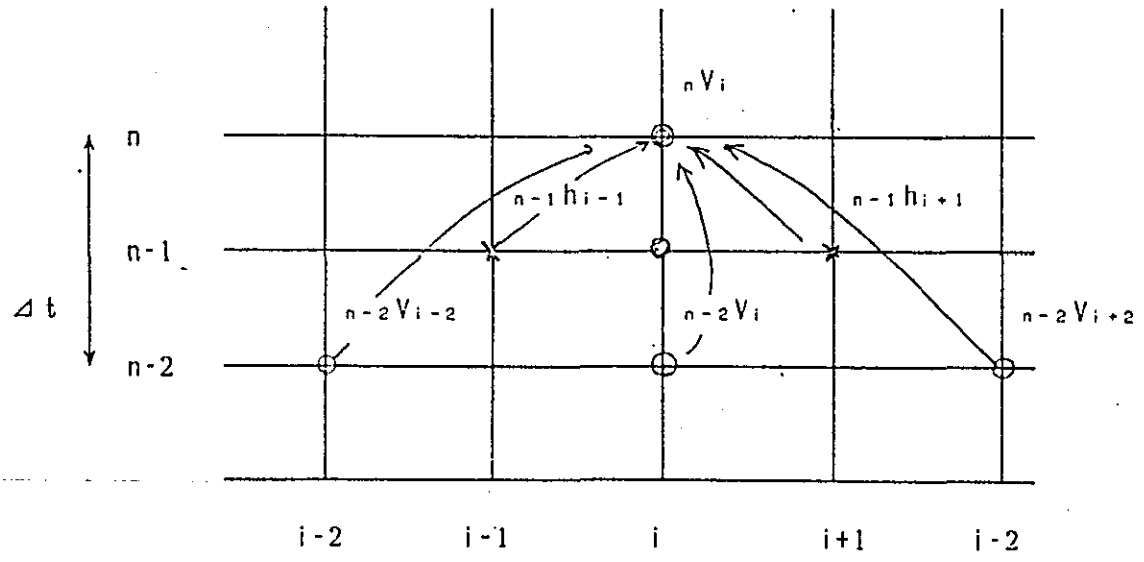
Center Difference Equation of Motion

$$\frac{1}{g}\cdot\frac{{}_{n}V_{i}-{}_{n-2}V_{i}}{\Delta t}+\frac{1}{2g}\cdot\frac{{}_{n-2}V^{2}_{i+2}-{}_{n-2}V^{2}_{i-2}}{2\Delta X}+\frac{{}_{n-2}h_{i+1}-{}_{n-1}h_{i-1}}{\Delta X}+$$

$$\frac{Z_{i+1}-Z_{i-1}}{\Delta X}+\frac{n^{2}\,|\,{}_{n-2}V_{i}\,|\,({}_{n}V_{i}+{}_{n-2}V_{i})/2}{\tilde{R}^{4/3}}=0 \qquad ③$$

sufix i : distance

n : time



(i : odd number)

◎ : center of difference

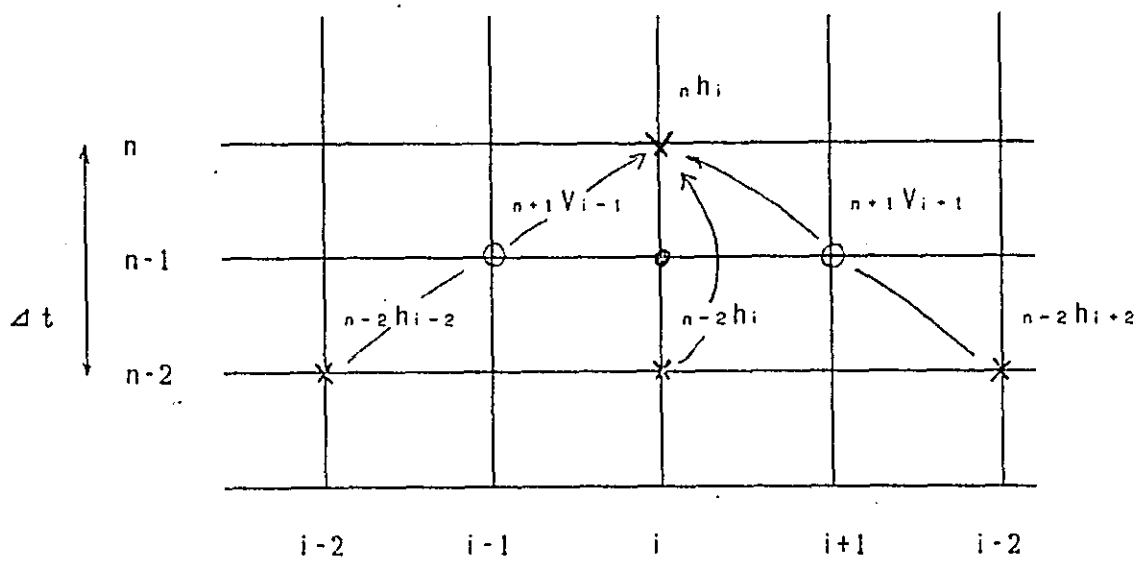
× : water depth point

○ : velocity point

Fig.1 Grid System of Motion Equation

Center Difference Equation of Continuity

$$\frac{1}{4}\left(3W_2 + \frac{W_1 + W_3}{2}\right)\frac{{}_nh - {}_{n-2}h_i}{\Delta t} + \frac{\left(\frac{A_2 + A_3}{2}\right)V_1 - \left(\frac{A_1 + A_2}{2}\right)V_m}{\Delta X} - q = 0 \qquad ④$$



(i : even number)

Fig.2 Grid System of Continuty Equation

3. Basic data of computation

The following data required to computation the hydraulic behavior of tidal flow :

a. roughness coefficent

b. crosssectional area and water surface width

c. river bed elevation

d. tide, water surface stage-time relationship

e. discharge-time rerationship at upstream

f. lateral inflow

EXAMPLE NO.1:

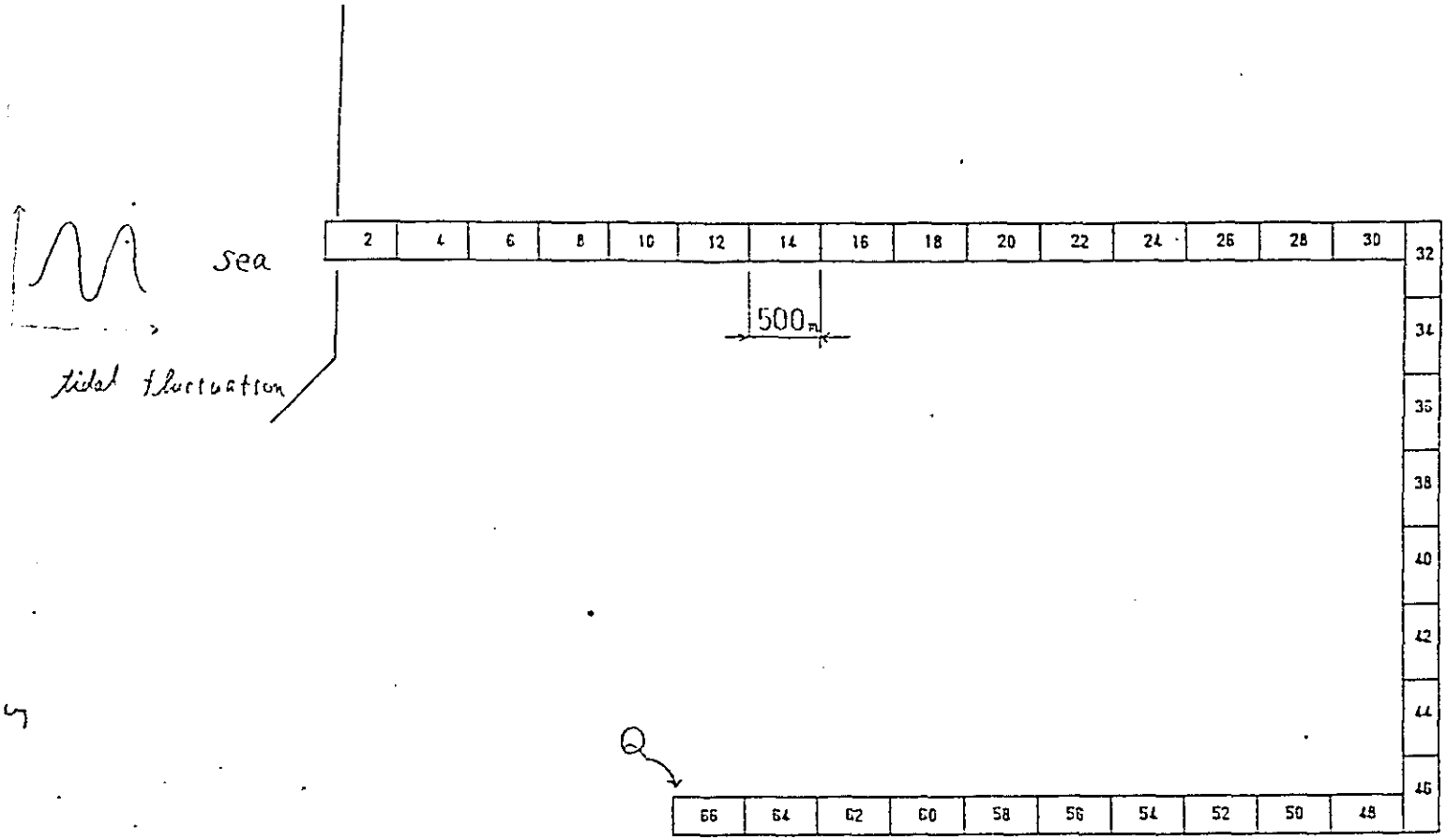
Compuet the logtidunal profile and fluctuation of the channel with following condition.

Diagram of channel is as shown in Fig.3. Taidal fluctuation at mesh no. 2. are as shown in Fig.4.

Table 1. gives the list of channel bed elevation. Table 2. gives the list of channel width.

RESULT

Longitudinal profile of Water stage are ploted as shown in Fig.5. water stage fluctuations at meshes no. 16, 34, 36, 46, 66.



total river length 16km

Fig. 3 Daiagram of Model.

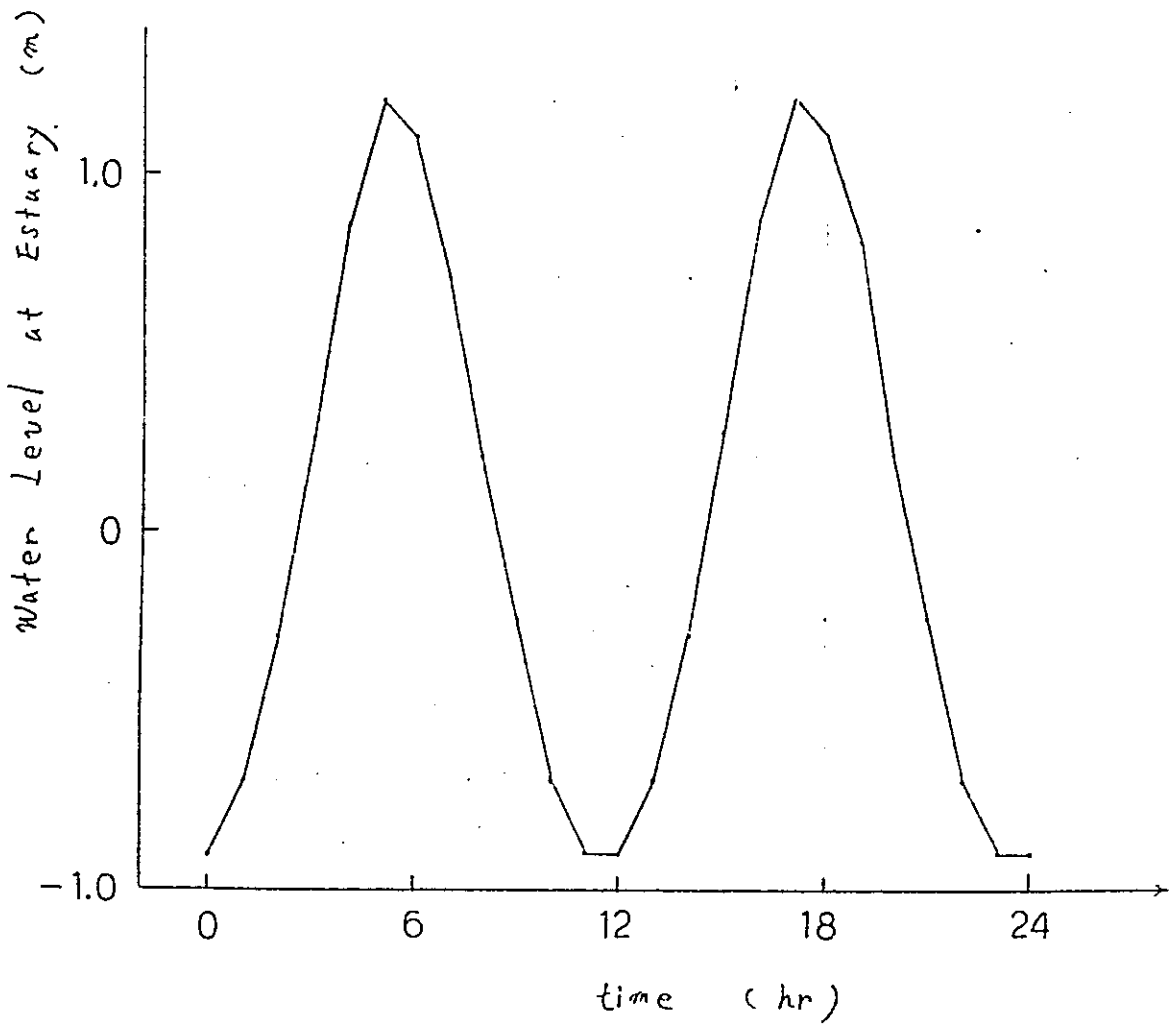


Fig. 4 Tidal fluctuation

Table 1. Bed elevation of channel

Mesh No.2 to Mesh. No. 66

HV(M,2),M=2,ME,2 BED ELEVATION							
-4.950	-4.850	-3.900	-4.750	-4.200	-3.350	-4.750	-4.350
-3.050	-3.650	-3.300	-3.800	-3.050	-2.650	-3.400	-3.[illegible]
-3.250	-3.220	-3.220	-3.380	-3.380	-5.350	-5.350	-5.350
-4.350	-3.450	-3.450	-3.850	-3.850	-4.350	-4.350	-4.[illegible]
-2.700							

Table 2. Bottom width of channel

Mesh No. 2 to Mesh No. 66

BM(M,1),M=2,ME,2 BOTTOM WIDTH							
295.000	265.000	180.000	205.000	260.000	192.000	245.000	161.000
161.000	163.000	184.000	148.000	182.000	151.000	218.000	[illegible]
104.000	163.000	163.000	132.000	132.000	104.000	104.000	104.000
104.000	123.000	123.000	94.000	94.000	92.000	94.000	104.[illegible]
116.000							

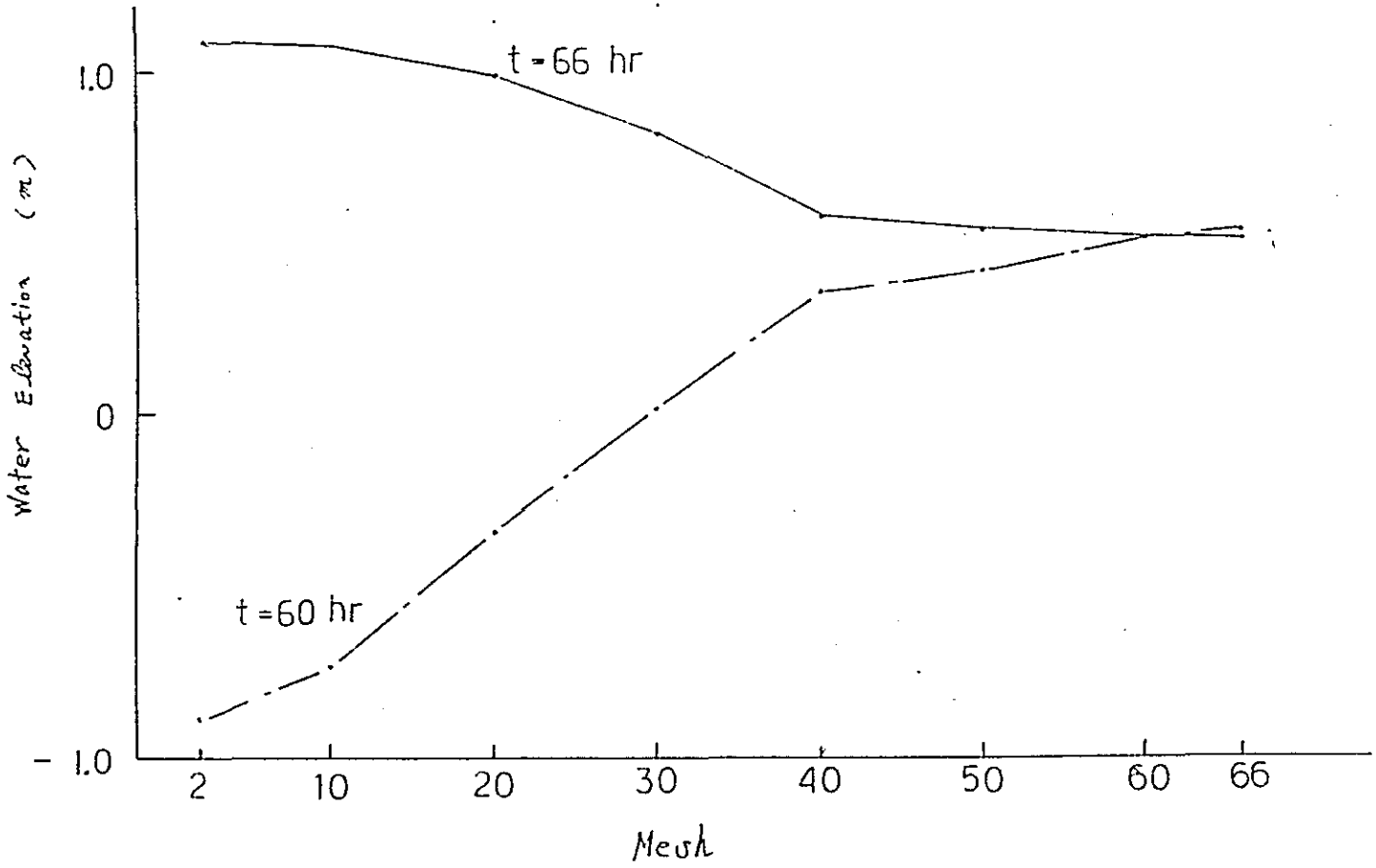


Fig. 5 Longitudinal Water Stage Profile

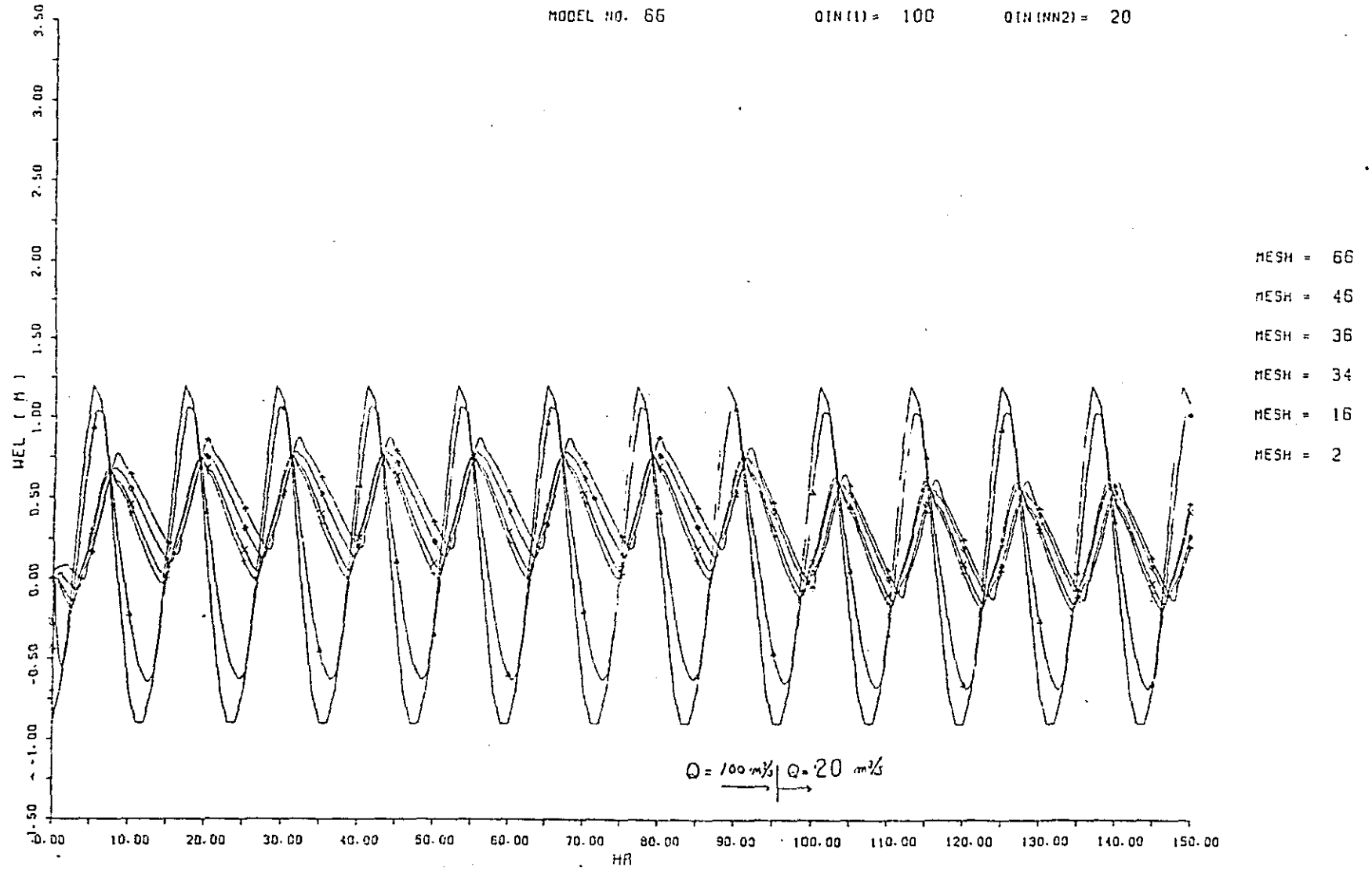


Fig. 6 Fluctuation of Water Stage

EXAMPLE NO.2:

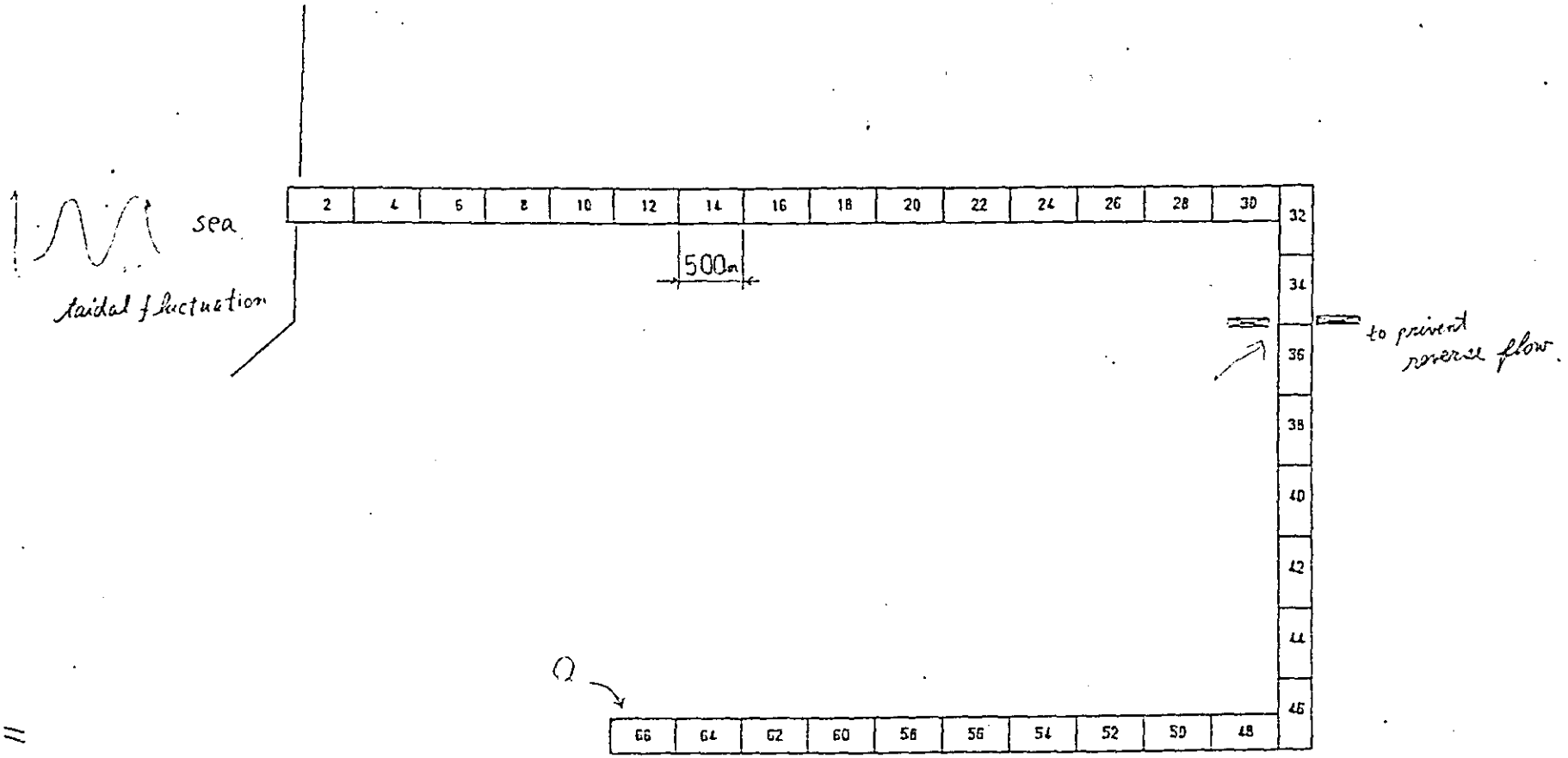
Compuet the logtidunal profile and fluctuation of the channel when the reverse flow is privented at section of mesh no.35 between mesh no.34 and mesh no.36. The conditions are the same as the example 1.

Diagram of channel is as shown in Fig.7.

RESULT

Longitudinal profile of Water stage are ploted as shown in Fig.8.

Water stage fluctuations at meshes no. 16, 34, 36, 46, 66. are ploted as shown in Fig.9



total river length 16 km.

Fig. 7

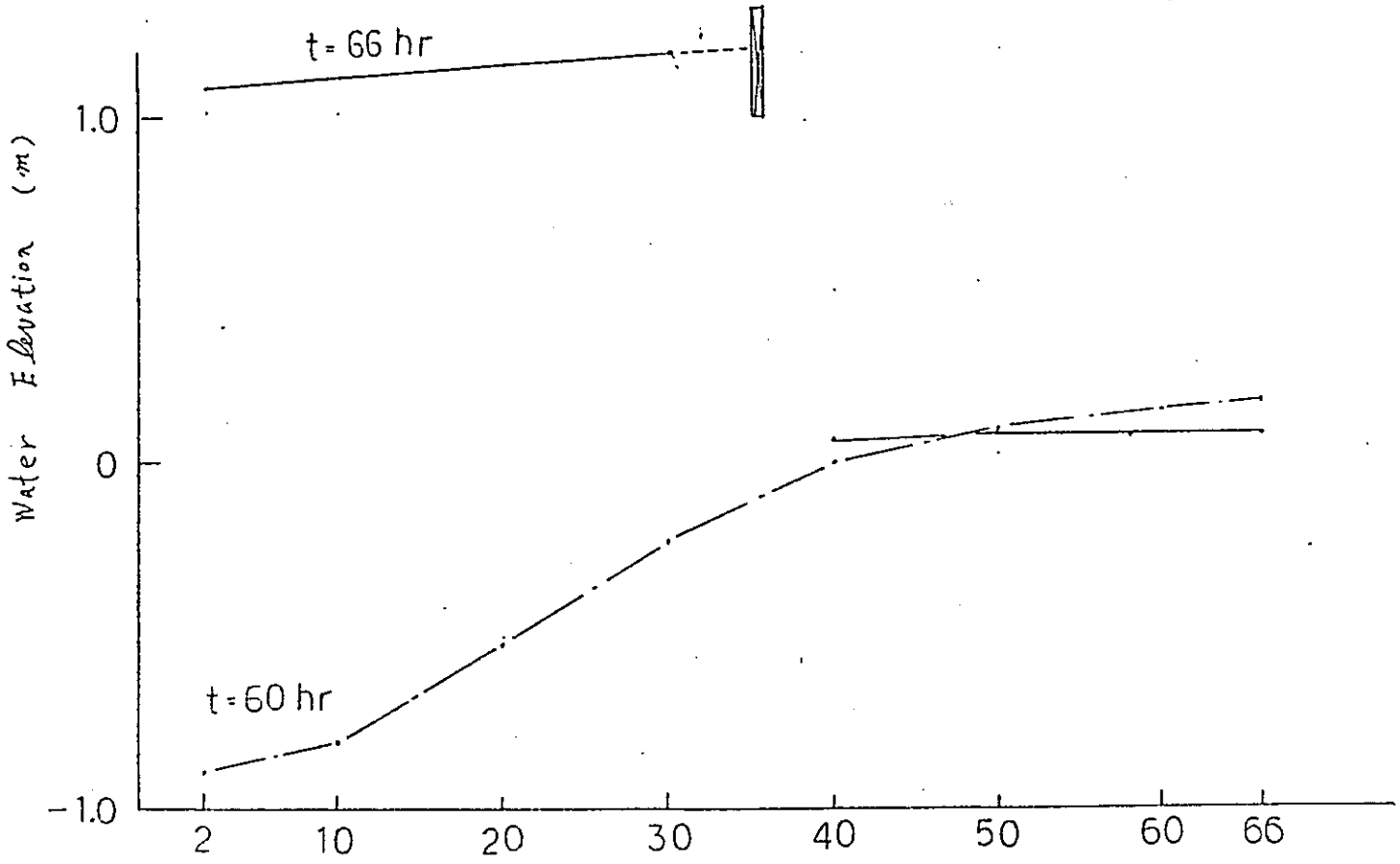


Fig 8 Longtudinal Water Stage Profile

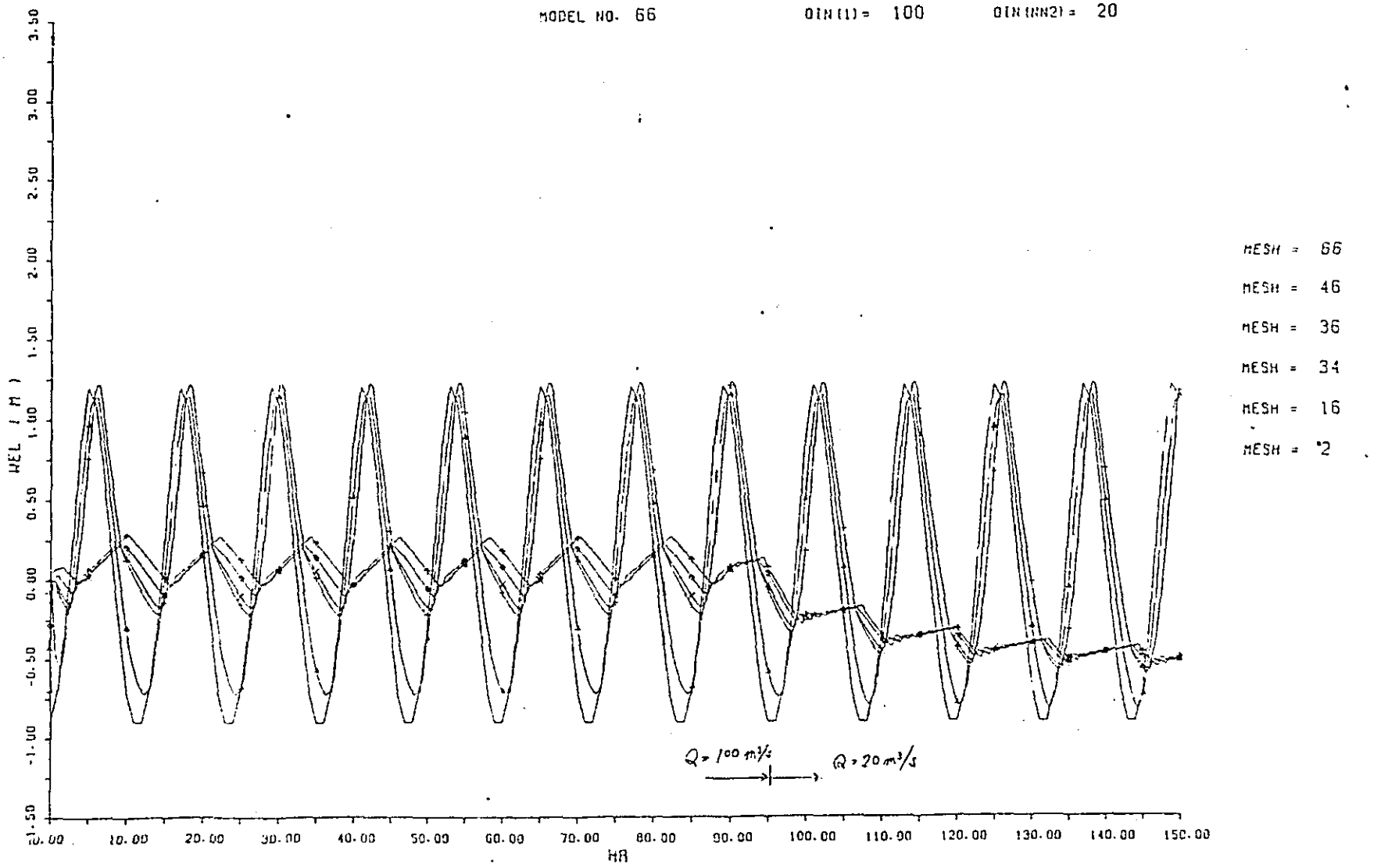


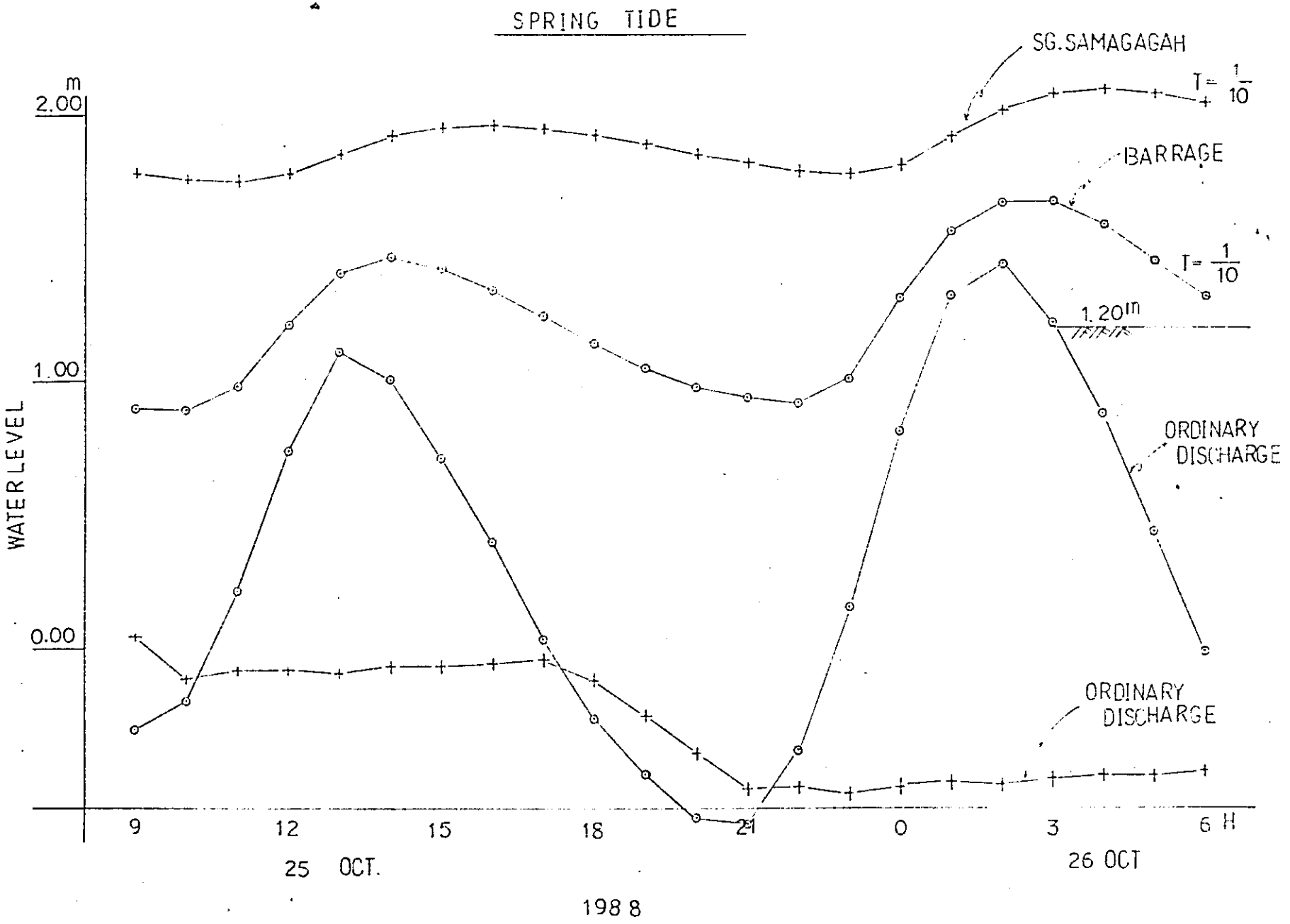
Fig. Fluctuation Water Stage.

Waterlevel of result by computer calculation
(Spring Tide)

Day & Hours		Barrage (no. 16)	SG SAMAGAGAH (no.22)	Remark.
OCT.				
25	0 : 00	1.228	1.292	1. 25~26. OCT. 1988.
	1	1.242	1.510	
	2	1.507	1.722	2. Discharge T = 1/10 Y
	3	1.442	1.805	
	4	1.056	1.850	3. upstream waterlevel :
	5	1.229	1.860	H = 130 m
	6	1.113	1.875	
	7	1.017	1.826	4. Coefficient of roughness:
	8	0.948	1.801	N = 0.04
	9	0.904	1.777	
	10	0.893	1.757	
	11	0.979	1.748	
	12	1.216	1.779	
	13	1.405	1.854	
	14	1.461	1.922	
	15	1.420	1.955	
	16	1.342	1.960	
	17	1.245	1.946	
	18	1.154	1.920	
	19	1.053	1.888	
	20	0.982	1.854	
	21	0.936	1.822	
	22	0.923	1.796	
	23	1.007	1.782	
26	0	1.311	1.816	
	1	1.566	1.921	
	2	1.668	2.017	
	3	1.677	2.080	
	4	1.588	2.101	5 3:30 WL = 1.686
	5	1.456	2.086	
	6	1.324	2.051	

Water level of result by Computer Calculation
(Spring Tide)

Day & Hours		Bairoge (No. 16)	Sg SAMAGAGA H. (No. 22)	Remark.
OCT.				
25	0 : 00	1.258	1.292	1. 25~26 OCT 1988
	1	1.340	1.302	
	2	1.318	1.296	2. Discharge :
	3	1.120	1.213	ordinary discharge
	4	0.912	1.075	
	5	0.625	0.883	3. upstream waterlevel :
	6	0.379	0.678	H = 1.30 m
	7	0.087	0.459	
	8	- 0.137	0.248	4. Coefficient of roughness
	9	- 0.301	0.051	N = 0.04
	10	- 0.195	- 0.108	
	11	0.217	- 0.086	
	12	0.238	- 0.079	
	13	1.106	- 0.093	
	14	1.012	- 0.065	
	15	0.713	- 0.063	
	16	0.406	- 0.056	
	17	0.086	- 0.039	
	18	- 0.261	- 0.123	
	19	- 0.469	- 0.247	
	20	- 0.635	- 0.392	
	21	- 0.652	- 0.520	
	22	- 0.375	- 0.515	
	23	0.157	- 0.574	
26	0	0.806	- 0.524	
	1	1.320	- 0.503	
	2	1.449	- 0.510	
	3	1.222	- 0.489	
	4	0.879	- 0.576	
	5	0.444	- 0.476	
	6	- 0.009	- 0.460	

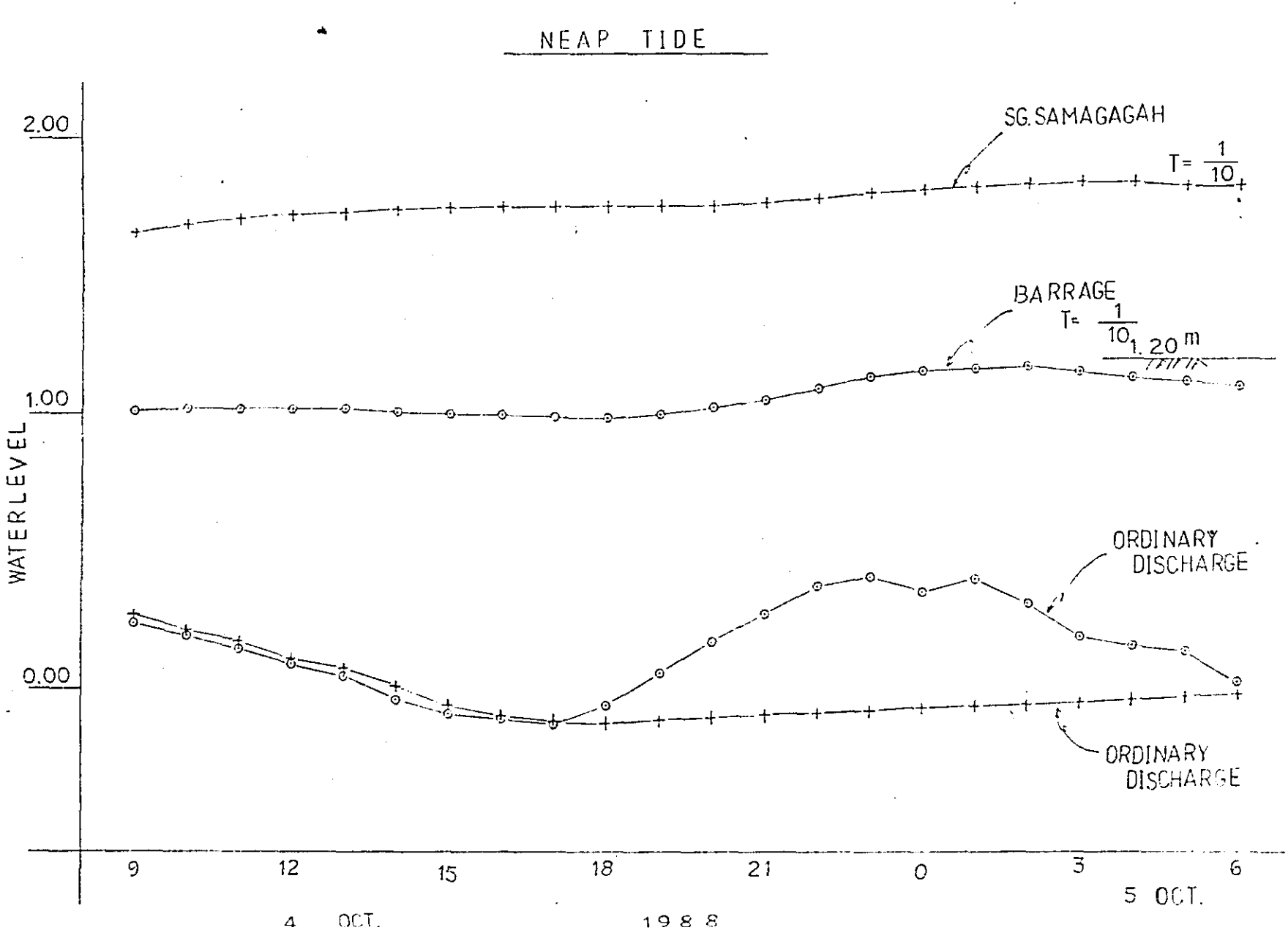

SPRING TIDE
SG.SAMAGAGAH
T= 1/10
BARRAGE
T= 1/10
1.20m
ORDINARY DISCHARGE
ORDINARY DISCHARGE
m
2.00
1.00
0.00
WATER LEVEL
9
12
15
18
21
0
3
6 H
25 OCT.
26 OCT
1988

Waterlevel of result by Computer Calculation
(Loop Table)

Day	Hours	Barrage (140.16)	CASIMAGAGAN (110.22)	Remark.
OCT.		m	m	
4	0 : 00	0.700	0.880	1. 4~5 OCT. 1988
	1	0.591	0.845	
	2	0.476	0.661	2. Discharge : ordinary D.
	3	0.397	0.520	
	4	0.340	0.410	3. upstream waterlevel :
	5	0.302	0.332	H = 1.30 m
	6	0.279	0.285	
	7	0.268	0.271	4. Coefficient of roughness
	8	0.290	0.276	N = 0.04
	9	0.235	0.271	
	10	0.193	0.215	
	11	0.188	0.176	
	12	0.089	0.112	
	13	0.045	0.076	
	14	− 0.039	0.011	
	15	− 0.097	− 0.061	
	16	− 0.113	− 0.103	
	17	− 0.182	− 0.122	
	18	− 0.068	− 0.125	
	19	0.075	− 0.116	
	20	0.163	− 0.107	
	21	0.267	− 0.098	
	22	0.367	− 0.090	
	23	0.406	− 0.083	
5	0	0.352	− 0.072	
	1	0.402	− 0.064	
	2	0.313	− 0.057	
	3	0.188	− 0.047	
	4	0.158	− 0.039	
	5	0.142	− 0.031	
	6	0.027	− 0.022	

Waterlevel of result by Computer Calculation
(Nsap Tiole)

Day	Hours	Barrage (No 16)	SAMAGAGAM (No 22)	Remark.
OCT.				
4	0 : 00	0.700	0.880	1. 4 ~ 5 OCT. 1983
	1	0.658	1.036	
	2	0.706	1.168	2 Discharge : T = 1/10 T
	3	0.773	1.283	
	4	0.832	1.379	3. upstream waterlevel :
	5	0.883	1.458	H = 1.30 m
	6	0.926	1.523	
	7	0.962	1.577	4 Coefficient of roughness
	8	0.992	1.622	N = 0.04
	9	1.016	1.659	
	10	1.018	1.688	
	11	1.024	1.709	
	12	1.018	1.725	
	13	1.018	1.735	
	14	1.007	1.743	
	15	0.991	1.746	
	16	0.983	1.747	
	17	0.981	1.747	
	18	0.981	1.748	
	19	0.996	1.750	
	20	1.023	1.756	
	21	1.055	1.765	
	22	1.098	1.778	
	23	1.132	1.795	
5	0	1.151	1.811	
	1	1.161	1.823	
	2	1.167	1.834	
	3	1.152	1.839	
	4	1.130	1.839	
	5	1.118	1.836	
	6	1.099	1.833	


NEAP TIDE
2.00
1.00
0.00
WATER LEVEL
SG. SAMAGAGAH
T= 1/10
BARRAGE
T= 1/10
1.20 m
ORDINARY DISCHARGE
ORDINARY DISCHARGE
9
12
15
18
21
0
3
6
4 OCT.
1988
5 OCT.

```
10 'PRAI RIVER'
20  ' B:PRAI6".A
30 PRINT "UNSTEDY FLOW CALCULATION PROGRAM      10 Feb.,1988 "
40    DIM H(70,2),V(70,2),A0(70),Q0(70),Q9(70),W0(150)
50 '
60 GOSUB 480  :' sub data
70 GOSUB  400  :' sub initial
80 GOSUB 1380  :' sub print
84   IF J0>25 THEN   GOSUB 1570 :'sub lprint
90  J8=1  :  Z5$="open"
100 FOR J=J8 TO J9
110   GOSUB 710 :'bound
120   GOSUB 950 : ' area
130   GOSUB 1090 : ' discharge
140  FOR I=4 TO I0-2 STEP 2
150    X1=Q9(I)
160    GOSUB 1150  :'sub contin
170  NEXT I
180  IF Q1<-999 THEN 220
190 I=I0 : X1=Q1
200 GOSUB 1150  :'sub contin
210 '
220    FOR  I=3 TO I0-1 STEP 2
230      GOSUB 1200 :'motion
240    NEXT I
250     V(1,2)=V(3,2)
260    IF Q1<-999 THEN V(I0+1,2)=V(I0-1,2)
264 '
270 ' *****  gate operation       K0... mesh no of gate  *****
274 '
280    K0=19 : W8=H(K0+1,2)+V(K0+1,1):W9=H(K0-1,2)+V(K0-1,1)
281           IF  H(K0+1,2)+V(K0+1,1)<H(K0-1,2)+V(K0-1,1) THEN 310
282      Z4$="open"
283      IF Z4$<>Z5$ THEN PRINT " J=";J,Z4$,W8,W9
284      IF Z4$<>Z5$ AND J0>25  THEN LPRINT " J=";J,Z4$,W8,W9
285      Z5$=Z4$
300    GOTO 330
310 '
320      V(K0,2)=0   : Z4$="close"
322      IF Z4$<>Z5$ THEN PRINT " J=";J,Z4$,W8,W9
324      IF Z4$<>Z5$ AND J0>25  THEN LPRINT " J=";J,Z4$,W8,W9
326      Z5$=Z4$
327 '     ***** end of gate operation *****
328 '
330    GOSUB 830 :'sub shift
340  IF J/J0-INT(J/J0)<>0 THEN 370
350    GOSUB 1380 :'sub print
360  IF J0>25 THEN   GOSUB 1570 :'sub lprint
370 NEXT J
380 END : '---------------------- end of main ---------------------
390 '
400 ' subroutine initial water depth
410 W4=W2-W1
420 FOR I=2 TO I0 STEP 2
430 F1=(I/2-1)/(I0/2-1)
440 H(I,1)=W1+W4*F1-V(I,1)     : PRINT H(I,1),V(I,1)
450  NEXT I
460 RETURN :' ---- end of sub -----
```

```
'
'subroutine data
INPUT "calculation case and comment ";Z$
INPUT "output interval  JO ";JO
  RESTORE 1770
  READ IO,K1,J7
 J9=(J7-1)*K1
PRINT "calculation case and comment ";Z$
PRINT "IO  K1  J7   J9  ";IO,K1,J7,J9
INPUT "roughness coefficient  n= ";N
G=9.8  : N2=N*N
READ TO,XO
'
'  input channel condition data
'  V(i,1)... bottom elevation of channel,  V(i,2)... top EL of bank
'  H(i-1,1)... side slope of channel,  H(i-1,2)... botttom wudth of channel
 FOR I=2 TO IO STEP 2
   READ V(I,1),V(I,2),H(I-1,1),H(I-1,2),09(I)
  PRINT V(I,1),V(I,2),H(I-1,1),H(I-1,2),09(I)
NEXT I
'  data input of tidal fluctuation
 FOR I=1 TO J7 : READ WO(I) : WO(I)=WO(I)-1.42  : NEXT I
 FOR I=1 TO J7 :PRINT WO(I); : NEXT I :PRINT
'
  W1=WO(1)
INPUT "input initial upstream water surface =";W2
INPUT "input upstream discharge Q1 =";Q1
RETURN : '---------------------- end of sub data -----------------
'
'bound
      K=INT(J/K1)+1 : D6=WO(K+1)-WO(K) : F1=(J-K1*(K-1))/K1
      W1=WO(K)+D6*F1
' dounsteream boundary condition
      H(2,1)=W1-V(2,1) :H(2,2)=H(2,1) : V(1,1)=V(3,1)
' upstream boundary condition
    IF Q1>-999 THEN 800
      H(IO,1)=W2-V(IO,1) :H(IO,2)=H(IO,1) : V(IO+1,1)=V(IO-1,1)
    GOTO 810
      V(IO+1,1)=0 : QO(IO+1)=0
RETURN : '---------------------- end of sub bound -----------------
'
' shift
 FOR I=2 TO IO STEP 2
   W3=H(I,1)+V(I,1)
  IF W3>V(1,2) THEN 880
   GOTO 900
PRINT USING " No.= ###  WEL = ###.###   Top of bank = ###.### ";I,W3,V(I,2)
PRINT USING " Depth= ###.#  Bottom EL = ###.### ";H(I,2),V(I,1)
 NEXT I
FOR I=4 TO IO   STEP 2 : H(I,1)=H(I,2) : NEXT I
FOR I=1 TO IO+1 STEP 2 : V(I,1)=V(I,2) : NEXT I
RETURN : '---------------------- end of sub shift -----------------
```

```
940 '
950 ' ***** subroutine area *****
960  FOR I=2 TO IO STEP 2
970    D=H(I,1) : B=H(I-1,2) :S=H(I-1,1)
980 ' cross sectio area
990    A0(I)=(B+S*D)*D
1000 ' surface width
1010    A0(I-1)=B+2*S*D
1020 ' weted perimater
1030    T=B+2*SQR(1+S*S)*D
1040 ' hydraulic radius
1050    Q0(I)=A0(I)/T
1060  NEXT I
1070    Q0(IO+2)=A0(IO)
1080 RETURN : '---------------------- end of sub area -----------------
1084 '
1090 ' ***** subroutine discharge *****
1100  FOR I=3 TO IO STEP 2
1110    Q0(I)=V(I,1)*( A0(I-1)+A0(I+1) )/2
1120  NEXT I
1130 RETURN : '---------------------- end of sub discharge -----------------
1140 '
1150 ' ***** subroutint contin *****
1160    W=( A0(I+2)+A0(I)*6+A0(I-2) )/8
1170    D1=Q0(I+1)-Q0(I-1)
1180    H(I,2)=H(I,1)+(X1-D1)*T0/(X0*W)
1190 RETURN : '---------------------- end of contin -----------------
1194 '
1200 ' ***** subroutint motion *****
1210 G0=G*T0
1220   R4=((Q0(I+1)+Q0(I-1))/2)^(4/3)
1230 ' R4= (Q0(I+1)+Q0(I-1))/2
1240 '                                R4=R4^(4/3)
1250   IF R4>0  THEN 1280
1260     PRINT USING " R4 weted perimater =< 0  mesh No.= ##  R4=-###.##";I,R4
1270   STOP : END
1274 '
1280     U0=N2*ABS(V(I,1))/(2*R4)
1290     G1=1/G0+U0
1300     D2=( V(I+2,1)*V(I+2,1)-V(I-2,1)*V(I-2,1) )/(2*G)
1310     D3=H(I+1,2)-H(I-1,2)
1320     D4=V(I+1,1)-V(I-1,1)
1330     G3=(1/G0-U0 )*V(I,1)
1340     D5=G3-(D2+D3+D4)/X0
1350     V(I,2)=D5/G1
1360 RETURN : '---------------------- end of motion -----------------
```

```
1370 '
1380 ' ***** subroutint print *****
1390    T9=T0*J/3600
1400  PRINT : PRINT USING "J= #####    time = ####.## hour ";J,T9
1410  PRINT "No.      WEL      H        BH      V         Q      DQ      m";
1420  PRINT "     W      area    R"
1430  I=2 : W3=H(I,1)+V(I,1)
1440  PRINT USING " ### ###.### ##.### ###.### ###.### ######.## ##.## ##.## ###.
# ####.# ##.##";I,W3,H(I,1),V(I,1),V(I-1,1),Q0(I-1),Q9(I),H(I-1,1),A0(I-1),A0(I)
,Q0(I)
1450  FOR I=4 TO I0   STEP 2
1460        W3=H(I,1)+V(I,1)
1470  PRINT USING " ### ###.### ##.### ###.### ###.### ######.## ##.## ##.## ###.
# ####.# ##.##";I,W3,H(I,1),V(I,1),V(I-1,1),Q0(I-1),Q9(I),H(I-1,1),A0(I-1),A0(I)
,Q0(I)
1480  NEXT I
1490    IF Q1>-999 THEN 1520
1500  PRINT USING "                                    ###.### ######.## ";V(I0+1,1),Q0(I
0+1)
1510 GOTO 1530
1520  PRINT USING "                                    ###.### ######.## ";V(I0+1,1),-Q1
1530  PRINT "coefficient of roughness n = ";N ,Z$ : PRINT
1540 RETURN : '---------------------- end of print  ----------------
1550 '
1560 ' ***** subroutint lprint *****
1570    T9=T0*J/3600
1580  LPRINT : LPRINT USING "J= #####    time = ####.## hour ";J,T9
1590  LPRINT "No.      WEL      H        BH      V         Q      DQ      m";
1600  LPRINT "     W      area    R"
1610  I=2 : W3=H(I,1)+V(I,1)
1620  LPRINT USING " ### ###.### ##.### ###.### ###.### ######.## ##.## ##.## ###
.# ####.# ##.##";I,W3,H(I,1),V(I,1),V(I-1,1),Q0(I-1),Q9(I),H(I-1,1),A0(I-1),A0(I
),Q0(I)
1630  FOR I=4 TO I0   STEP 2
1640        W3=H(I,1)+V(I,1)
1650  LPRINT USING " ### ###.### ##.### ###.### ###.### ######.## ##.## ##.## ###
.# ####.# ##.##";I,W3,H(I,1),V(I,1),V(I-1,1),Q0(I-1),Q9(I),H(I-1,1),A0(I-1),A0(I
),Q0(I)
1660  NEXT I
1670    IF Q1>-999 THEN 1700
1680  LPRINT USING "                                   ###.### ######.## ";V(I0+1,1),Q0(
I0+1)
1690 GOTO 1710
1700  LPRINT USING "                                   ###.### ######.## ";V(I0+1,1),-Q1
1710  LPRINT "coefficient of roughness n = ";N ,Z$ : LPRINT
1720 RETURN : '---------------------- end of print  ----------------
```

```
1730 '
1740 ' -----  data area -----
1750 '      DT,DX
1760 '      I0,K1,J7
1770 DATA  36, 60,48
1780 '      DT,DX
1790 DATA  60,1000
1800 ' cross section data
1810 DATA -4.95, 30.0,  0, 295.0,    0          :'No.2
1820 DATA -3.90, 30.0,  0, 302.0, 4.2
1830 DATA -4.20, 30.0,  0, 205.0,48.9
1840 DATA -4.75, 30.0,  0, 192.0, 9.0
1850 DATA -3.50, 30.0,  0, 161.0,    0
1860 DATA -3.30, 30.0,  0, 184.0,    0
1870 DATA -3.05, 30.0,  0, 182.0,    0
1880 DATA -3.40, 30.0,  0, 116.0, 3.0
1890 DATA -3.25, 30.0,  0, 104.0,17.0          :'No.18(No.34)
1900 DATA -3.22, 30.0,  0, 163.0,24.9
1910 DATA -3.38, 30.0,  0, 132.0,12.7
1920 DATA -5.35, 30.0,  0, 104.0,    0
1930 DATA -4.35, 30.0,  0, 104.0,    0          :'No.26(No.50)
1940 DATA -3.45, 30.0,  0, 123.0,    0
1950 DATA -3.85, 30.0,  0,  94.0,    0
1960 DATA -4.35, 30.0,  0,  94.0,17.3
1965 DATA -4.02, 30.0,  0, 100.0,    0
1970 DATA -2.70, 30.0,  0, 116.0,18.1          :'No.36 (No.66)
1980 ' fluctuation   data    (spring tide  25-26 okt,1988)
1990 DATA 2.7, 2.8, 2.6, 2.3, 1.7, 1.2, 0.7, 0.5, 0.5, 0.8, 1.4, 2.0
2000 DATA 2.4, 2.5, 2.3, 2.0, 1.6, 1.1, 0.6, 0.4, 0.5, 0.8, 1.4, 2.1
2010 DATA 2.6, 2.8, 2.8, 2.5, 2.0, 1.5, 0.9, 0.5, 0.4, 0.5, 0.9, 1.6
2020 DATA 2.1, 2.4, 2.4, 2.2, 1.9, 1.4, 0.9, 0.6, 0.5, 0.7, 1.1, 1.8
2030 ' ----- end of data area -----
```

ANNEX I

PRAI BARRAGE GATE OPERATION STUDY

Application For Experts

Background Information

The Sg. Prai river basin is situated in the central part of Seberang Prai, in the state of Pulau Pinang. The Sg. Prai originates from the confluence of the Sg. Kulim, Sg. Jarak and Sg. Kerah, and flows south-westerly into the Straits of Malacca. The Sg. Prai/Sg. Kulim basin has a total catchment area of 895 sq. km of which the Sg. Prai with a length of 18 km contributes some 410 sq. km. The topography is generally flat and lowers west-ward from the foothills to the Straits with a mean gradient of about 1:4,000. The climate is tropical with mean temperatures of about 27 C and mean annual rainfall of approximately 2,320 mm.

The flood discharge of the river is 570 cumecs (cubic metres per second) with a mean of 14 cumecs and the dry weather flow is 5.7 cumecs. The middle and lower reaches of the river are tidal, and with the estimated tidal flow at 570 cumecs during spring tide and 200 cumecs during neap tide, there is frequent inundation of the riverine areas during high tide.

A proposal to drain and reclaim the tidal swamp area was formulated under the First Malaysia Plan. Under the proposal, a tidal barrage was to be constructed to permit the reclamation of 670 ha of tidal swamp along the Sg. Prai while improving the drainage of 1,900 ha of padi land and 520 ha of coconut. Fresh water was to be impounded upstream of the barrage for industrial water supply. At the same time, the barrage would incorporate a permanent bridge to replace the existing pontoon bridge.

In 1968, under the technical assistance of the Japan Overseas Technical Cooperation Agency, the detailed design of the proposed Prai Barrage was completed. The barrage was located some 8 km from the river estuary and its primary function was to prevent ingression of saline water and to maintain the water upstream at a controlled level through manipulation of the gates (four numbers of 13.7 metres wide double stage roller gates). The barrage structure was completed in 1981.

Over the last few years, the State Drainage and Irrigation Department have made attempts to formulate gate operation procedures so as to achieve the primary function of maintaining a controlled water level upstream. Due to a lack of expertise to compute the complex hydraulic analysis, these attempts were on a trial and error basis and have not been sucessful to date. In fact, attempts to close the gates have only resulted in aggravating the tide levels in the downstream reach of the river, causing inundation in lowlying areas.

Owing to the intensive land use in recent years, the damage potential is increasing, and consequently, the residents in these areas have objected strongly to further trial and error attempts at formulating the gate operation procedures. There is thus a need to formulate such procedures through the use of mathematical modelling of the river behaviour. Both the State and Federal Drainage and Irrigation Department do not have the necessary expertise to carry out this task and assistance is now sought under the Colombo Plan for technical assistance and expertise to carry out a study of the Prai Barrage gate operation and to formulate gate operation procedures.

Study Objectives

The objectives of the study are :

1. To analyze the unsteady flow hydraulics of the Sg. Prai within its tidal reaches using mathematical modelling approach.

2. To formulate gate operation procedures for the Prai Barrage so as to minimise flooding both upstream and downstream, while maintaining a controlled water level upstream, taking into consideration drainage and irrigation requirements of affected agricultural land.

3. To propose other countermeasures as are necessary, to mitigate flooding of lowlying areas.

Study Team

The study team shall comprise four experts in the following fields :

1. A Senior Drainage and Irrigation Engineer who shall also act as the team leader. He shall lead the team in the formulation of the gate operation procedures, and provide the expert input on drainage and irrigation considerations. He should have at least fifteen years experience in reclamation projects in tidal areas. Total input required is 6.5 manmonths.

2. A Hydrologist who shall be responsible for the hydrological analysis of the river basin. He should have at least ten years experience in work of a similar nature. Total input required is 5.0 manmonths.

3. A Mechanical Engineer who shall provide the expert input on mechanical considerations especially with regards to the gate operation. He should have at least ten years experience in the mechanical aspects of tidal barrages. Total input required is 6.0 manmonths.

4. A Hydraulic Engineer who shall provide the expert input on the hydraulic analysis of unsteady flow in the Sg. Prai using mathema-

tical modelling techniques. He should have at least ten years experience in unsteady flow analysis in rivers. Total input required is 6.5 manmonths.

Duration Of Study

The study shall commence in mid May, 1987, when the study team shall make a first visit to the project area to assess the present situation, identify the problems and formulate an observation and data collection programme. Data collection will be carried out with the assistance of Drainage and Irrigation Department staff over the following four months. For this programme, assistance is sought from the Government of Japan for the provision of three sets of automatic water level recorders.

On completion of the data collection programme, the study team will return to Malaysia to carry out the hydraulic analysis and formulate the gate operation procedures. The detailed study programme is given in Annex II.

Request for Technical Equipment under the Technical Cooperation Programme

An important pre-requisite to the successful analysis of the river hydraulics is the data collection programme, with particular emphasis on the fluctuating water levels in the tidal reaches of the Sg. Prai. A total of three sets of automatic water level recorders will be necessary to permit the effective capturing of this information. Assistance is sought from the Government of Japan to provide these equipment under the technical cooperation programme.

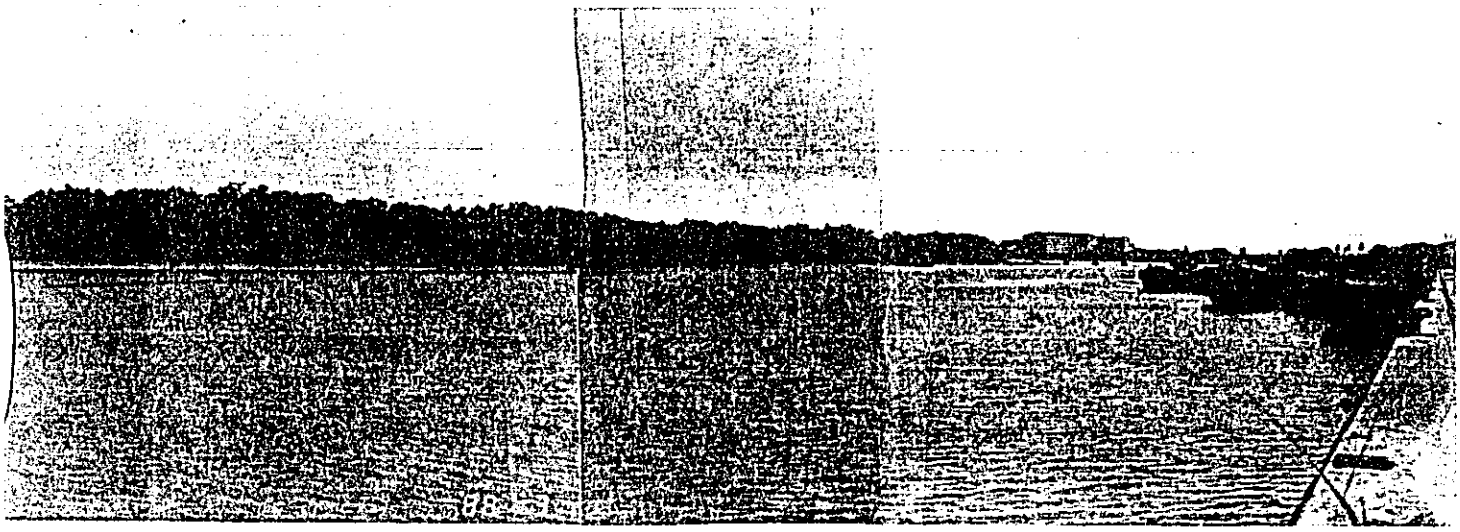
ANNEX II

Study Programme

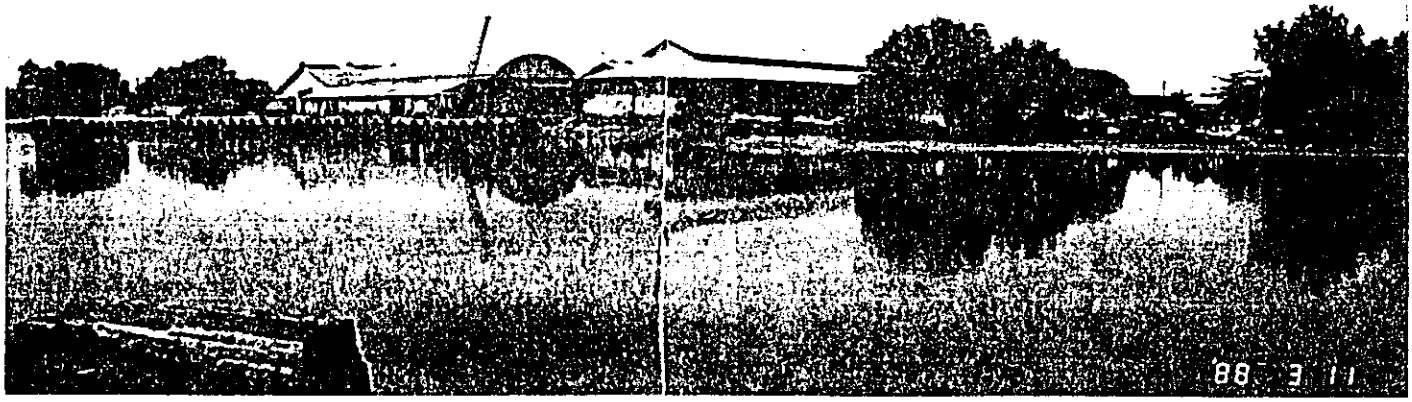
Month :	1987 May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Expert											
Senior Drainage and Irrigation Engineer/ Team Leader	xxxx				xxxxxxxxxxxxxxxxxxxxx						
Hydrologist	xxxx				xxxxxxxx				xxxxxxxx		
Mechanical Engineer	xxxx				xxxxxxxxxxxxxxxxxxx						
Hydraulic Engineer	xxxx				xxxxxxxxxxxxxxxxxxxxx						
Data Collection Programme		xxxxxxxxxxxxxxx									

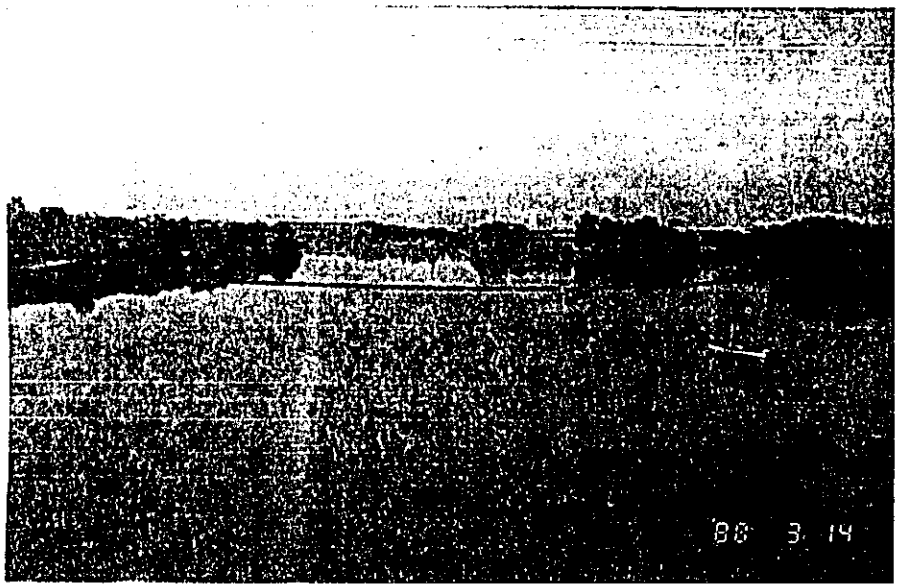
SG. PRAI

RIVER MOUTH

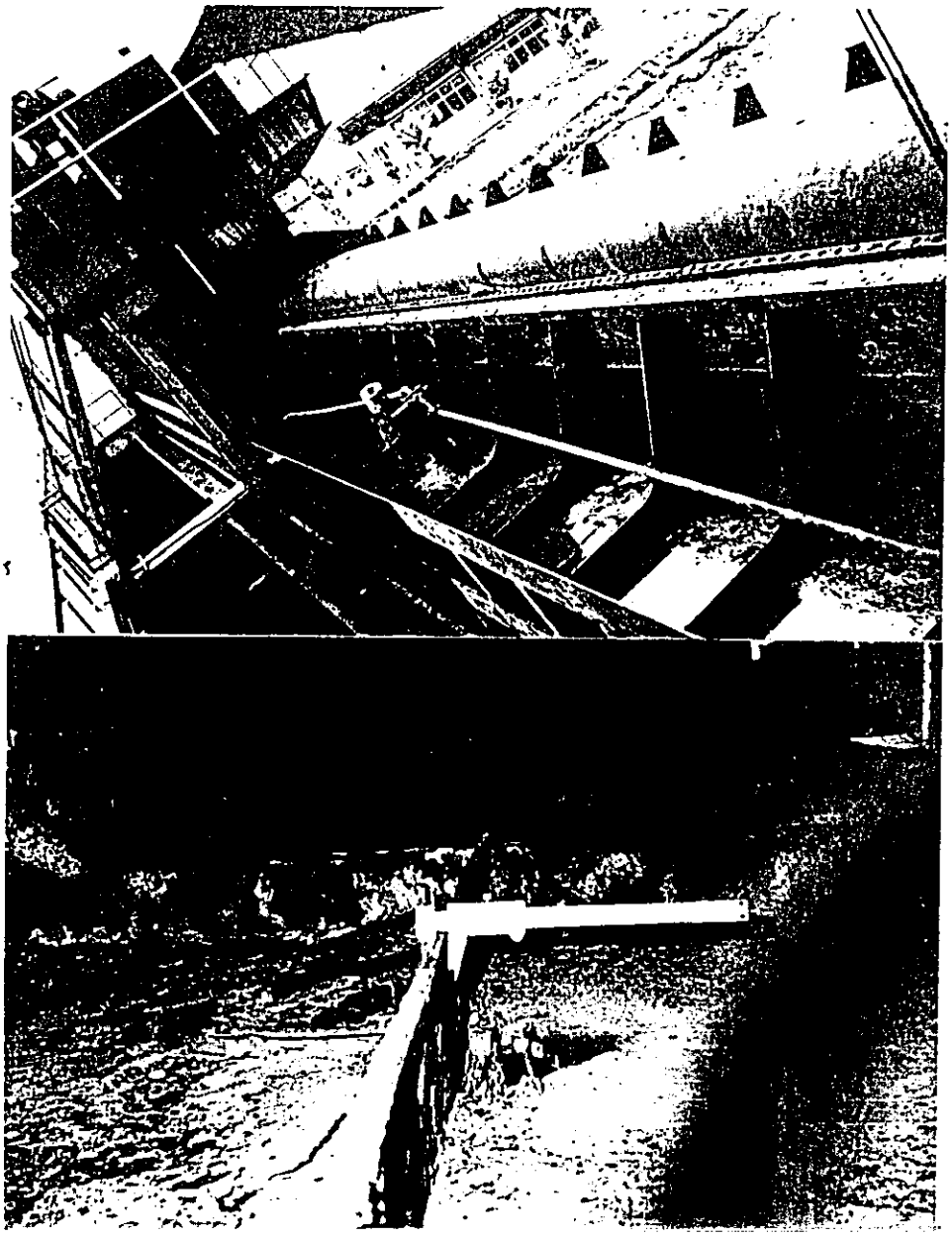


. MARBLE FACTORY



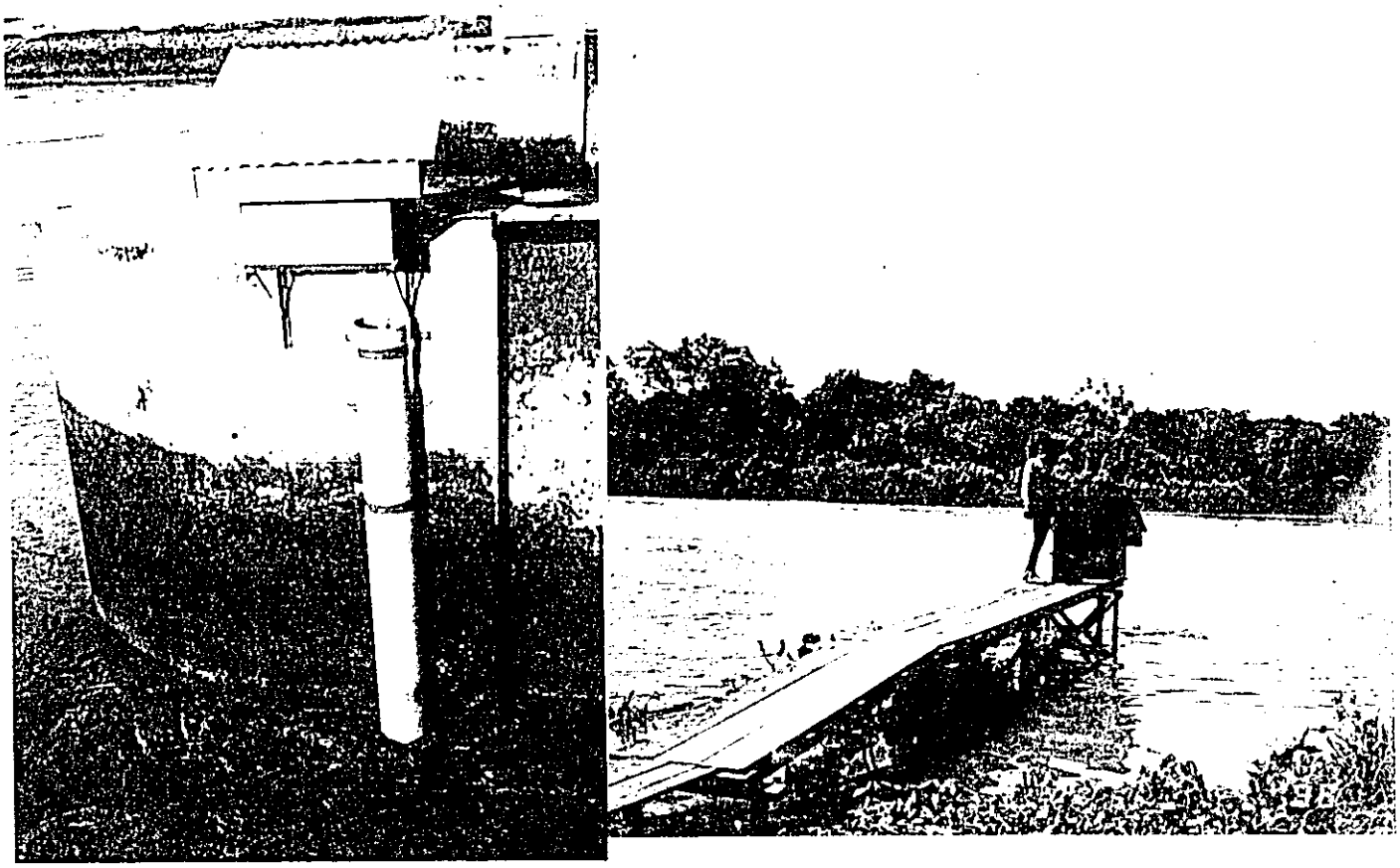


SG. PRAI BARRAGE



THE PRESENT
CONDITION.

CONSTRUCTION OF AUTOMAT WATER LEVEL RECORDER



OBSERVATION OF WATER LEVEL