

TABLES

VOLUME 2

MAIN REPORT

TABLE 2.3.1 WATER QUALITY INDEX OF MUDA RIVER BY DOE CLASSIFICATION

YEAR	OVERALL INDEX WQI	INDEX BY- BOD	INDEX BY SS	INDEX BY NH4-N
1985	83	93	78	86
1986	86	95	73	88
1987	81	93	73	82
1988	82	91	74	79
1989	79	91	69	74
1990	81	92	72	80
1991	80	94	72	72
1992	79	95	71	87
1993	81	89	71	72
1994				
Mean	81.33	92.56	72.56	80.00

	OVERALL:	BOD:	SS:	NH4-N:
Dirty	< 60	< 80	< 70	< 71
Slightly dirty	61 - 80	80 ~ 90	70 ~ 75	71 ~ 91
Clean	81 <	90 <	75 <	91 <

Note: The index figures are obtained from DOE.

TABLE 2.3.2 : RESULTS OF WATER QUALITY TESTS BY JICA STUDY TEAM (FIRST SURVEY)

(BASED ON DOE CLASSIFICATION)

Locn.	pH	DO mg/l	Elct. Cond umhos/cm	Turb NTU	SS mg/l	BOD mg/l	T.Coli. no./100ml	NH3-N mg/l	As mg/l	Cd mg/l	Cr(VI) mg/l	Pb mg/l	Fc mg/l	T-Hg mg/l	P mg/l	Ch mg/l	F mg/l
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First Sampling

M1	II	II	I	II	I	II	III	IV	II	II	II	II	V?	II?	V?	II?	II
M2	II	II	I	II	I	II	II	IV	II	II	II	II	V?	II?	V?	II?	II
M3	II	II	I	II	III	II	III	IV	II	II	II	II	V?	II?	V?	II?	II
M4	II	II	I	II	II	II	II	IV	II	II	III<	II	V?	II?	V?	II?	II
M5	II	II	I	I	II	I	II	IV	II	II	III<	II	V?	II?	V?	II?	II
C1	II	II	I	II	I	II	III	III	II	II	II	II	V?	II?	V?	II?	II
K1	III	II	I	II	III	III	III	III	II	II	II	II	V?	II?	V?	II?	II
S1	II	II	I	II	II	II	III	IV	II	II	II	II	V?	II?	V?	II?	II
F1	III	II	I	I	II	II	II	III	II	II	II	II	V?	II?	V?	II?	II
F2	II	II	I	II	II	II	III	IV	II	II	III<	II	V?	II?	V?	II?	II

Second Sampling

M3	II	II	I	II	I	I	II	III	II	II	III<	III	V?	II?	V?	II?	II
K1	III	II	I	II	I	I	III	III	II	II	III<	III	V?	II?	V?	II?	II

Note: The sampling was carried out in November 1994.

? means "still questionable" or "not accurate"

TABLE 2.3.3 RESULTS OF WATER QUALITY TESTS BY JICA STUDY TEAM (SECOND SURVEY)

(BASED ON THE DOE CLASSIFICATION)

Loca.	pH	DO mg/l	Elect. Cond umhos/cm	Turb NTU	SS mg/l	BOD mg/l	T.Coli. no./100ml	NH3-N mg/l	As mg/l	Cd mg/l	Cr(VI) mg/l	Pb mg/l	Fe mg/l	T-Hg mg/l	P mg/l	Ch mg/l	F mg/l	TDS mg/l	COD mg/l	F.Coli. no./100ml	T-N mg/l	Sc mg/l
First Sampling																						
M1	II	III	I	II	I	II	III	IV	II	II	II	II	III	II	II	II	II	I	II	III	-	-
M2	II	III	I	II	II	II	III	IV	II	II	II	II	III<	II	II	II	II	I	III	III	-	-
M3	II	III	I	II<	II	II	III	II	II	II	II	II	III<	II	II	II	II	I	II	III	-	-
M4	II	III	I	II<	II	II	III	IV	II	II	II	II	III<	II	II	II	II	I	II	III	-	-
M5	II	III	-	II<	III	II	III	III	II	II	II	II	III<	II	II	II	II	-	-	III	-	-
C1	II	III	I	II	I	I	III	III	II	II	II	II	III<	II	II	II	II	I	I	III<	-	-
K1	II	III	I	II	I	II	III	III	II	II	II	II	III<	II	II	II	II	I	II	III<	-	-
S1	II	III	I	II<	II	III	III	IV	II	II	II	II	III<	II	II	II	II	I	II	III<	-	-
F1	II	III	I	II	I	III	III	IV	II	II	II	II	III<	II	II	II	II	I	I	III	-	-
F2	II	IV	I	II<	III	V	III	IV	II	II	II	II	III<	II	II	II	II	II	V	III<	-	-
Second Sampling																						
M1	II	III	II	II<	III	II	III	III	II	II	II	II	III<	II	II	II	II	I	III	III<	-	III<
M2	II	III	II	II<	III	II	III	III	II	II	II	II	III<	II	II	II	II	I	II	III	-	II
M3	II	III	II	II<	III	I	III	IV	II	II	II	II	III<	II	II	II	II	I	II	III<	-	II
M4	II	III	II	II<	II	III	III	IV	II	II	II	II	III<	-	II	II	II	I	II	III	-	II
M5	II	III	-	II	III	III	III	IV	II	-	II	III	II	II	II	II	II	-	-	III	-	III<
C1	II	III	II	II<	II	II	III	III	II	II	II	II	III<	II	II	II	II	I	II	III<	-	III<
K1	II	III	II	II<	IV	II	III	V	II	II	II	II	III<	II	II	II	II	I	III	III<	-	II
S1	II	II	II	II<	IV	I	III	III	II	II	II	II	III<	II	II	II	II	I	III	III	-	III<
F1	II	III	II	II	II	II	III	III	II	II	II	II	III<	II	II	II	II	I	I	III	-	II
F2	V	IV	II	II<	III	IV	V	IV	II	II	II	II	III<	II	II	II	II	II	III	III<	-	III<

Note: II< or III< mean that the further classification by DOE standards is impossible.
 - means that no classification is available or not appropriate to make classification.

TABLE 2.3.4 ESTIMATION OF ANNUAL BED LOAD AT RIVER DISCHARGE STATION

% of Time	Pinang Tunggal (4, 172 km ²)		Ldg. Victoria (4, 010 km ²)		Jam. Syed Omar (3, 330 km ²)		Jeniang Bridge (1, 740 km ²)		N a m i (1, 220 km ²)		Kg. Tiban (825 km ²)	
	Discharge* (m ³ /s)	Bed Load (Mg)	Discharge (m ³ /s)	Bed Load (Mg)	Discharge (m ³ /s)	Bed Load (Mg)	Discharge (m ³ /s)	Bed Load (Mg)	Discharge** (m ³ /s)	Bed Load (Mg)	Discharge** (m ³ /s)	Bed Load (Mg)
5	375	2,195	356	1,524	276	1,524	78	760	24	730	85	2,567
10	288	1,401	273	804	212	804	58	423	18	584	63	1,837
15	241	908	229	433	177	433	46	232	14	464	51	1,304
20	201	643	191	265	148	265	38	143	12	386	41	988
25	160	437	152	153	118	153	31	90	10	324	34	761
30	136	298	129	89	100	89	25	58	8	273	28	589
35	119	223	113	59	88	59	22	39	7	235	24	472
40	104	172	99	41	76	41	19	27	6	206	20	386
45	91	133	86	28	67	28	16	20	5	181	18	319
50	79	102	75	19	58	19	15	15	5	164	16	274
55	70	80	67	14	52	14	13	11	4	147	14	234
60	62	63	58	10	45	10	11	8	3	131	12	196
65	53	48	50	7	39	7	9	6	3	114	10	161
70	45	35	42	4	33	4	8	4	3	101	9	133
75	36	25	34	3	27	3	7	3	2	89	8	111
80	29	16	27	1	21	1	6	2	2	78	7	90
85	21	10	20	1	15	1	5	1	2	66	5	70
90	14	5	13	0	10	0	4	1	1	53	4	51
95	7	2	7	0	5	0	3	0	1	41	3	34
100	0	0	0	0	0	0	1	0	0	27	1	19
Total		6,797		3,454		3,454		1,844		4,398		10,596

Data Source : Discharge data of Ldg. Victoria and Jeniang are from "Hydrological Data, Streamflow and River Suspended Sediment Records 1975-1980"

Note * : Discharge of Ldg. Victoria was modified based on catchment area considering influence of Muda dam.

** : Discharge of Jeniang was modified based on catchment area considering influence of Muda dam.

TABLE 4.1.1 PRINCIPAL FEATURES OF INTAKE FACILITIES
(DOMESTIC/INDUSTRIAL WATER)

No	NAME of Pumping Station	OPERATION	FACILITY	CAPACITY (cum/day)	NOTE
MD- 1	Lahar Tiang	P.W.A	p	315,000	E
MD- 2	Sungai Petai	P.W.D	p	68,300	E
MD- 3	Pinang Tunggai	P.W.D	p	27,300	E
MD- 4	Kolim	P.W.D	p	160,000	U
MD- 5	Kuara Ketil	P.W.D	p	15,000	E
MD- 6	Teloi	P.W.D	p	21,400	E
MD- 7	Jeniang	P.W.D	p	14,600	E
MD- 8	Jeneri	P.W.D	p	8,700	E
MD- 9	Lubuk Merbau	P.W.D	p	1,400	E
MD-10	Nami	P.W.D	p	4,000	E
SD- 1	Bikan	P.W.D	p	6,000	E
KD- 1	Sungai Lima	P.W.D	p	18,200	E
CD- 1	Batu Lima	P.W.D	p	10,000	E

Remarks ; E : Existing U : Under construction
P.W.A : Penang Water Authority
P.W.D : Public Works Department

TABLE 4.1.2 ACTUAL INTAKE DISCHARGE FROM MUDA RIVER SYSTEM
(DOMESTIC/INDUSTRIAL WATER)

(UNIT : 1000 m3)

PUMPING STATION	93 JAN	FEB	MAR	APR	MEI	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANUAL
Lahar Tiang	15,856	15,495	17,547	17,366	16,961	16,503	17,347	17,084	15,706	14,639	14,672	14,777	193,953
Pinang Tunggai	669	631	683	624	708	662	682	675	692	714	673	648	8,064
Sg Petani	2,475	2,397	2,504	2,414	2,538	2,347	2,508	2,514	2,416	2,510	2,391	2,528	29,542
Kuala Ketil	93	93	93	93	93	93	93	93	93	93	93	93	1,116
Nami	27	33	41	46	49	41	49	47	48	49	37	41	507
Batu Lima	248	252	175	166	172	163	95	172	162	161	144	139	2,048
Jeniang	401	349	398	395	439	407	393	409	408	416	384	385	4,786
Jenari	6	38	15	20	23	17	19	50	63	56	205	227	738
Lubuk Merbau	41	41	41	41	41	41	41	41	41	41	41	41	493
Sg Limau	195	195	195	195	195	195	195	195	195	195	195	195	2,343
Bikan	92	92	92	92	92	92	92	92	92	92	92	92	1,107
Teloi	32	32	32	32	32	32	32	32	32	32	32	32	380
TOTAL	20,135	19,648	21,816	21,484	21,343	20,593	21,546	21,404	19,948	18,998	18,959	19,198	245,077

TABLE 4.1.3 PRINCIPAL FEATURES OF INTAKE FACILITIES
(IRRIGATION WATER)

No	SUPPLY SCHEME	OPERATION	FACILITY	CAPACITY (cum/day)	IRRIGATION AREA(ha.)	RIVER SYSTEM
MA- 1	Kota-2	D.I.D(S.Petani)	p	598,000	2,390	Muda river
MA- 2	Pekura	D.I.D(S.Petani)	p	329,000	1,780	Muda river
MA- 3	Sungai Muda	D.I.D(Perai)	p	1,223,000	6,777	Muda river
MA- 4	Pinang Tunggal	D.I.D(Perai)	p	990,000	1,178*	Muda river
MA- 5	Pinang Tunggal	D.I.D(S.Petani)	p	88,000	279	Muda river
MA- 6	Terat Batu	D.I.D(Kulim)	p	14,000	28	Muda river
MA- 7	Pantai Perai	D.I.D(S.Petani)	p	132,000	259	Muda river
MA- 8	Sidam Kanan	D.I.D(Kulim)	p	60,000	453	Muda river
MA- 9	Sidam Kiri	D.I.D(S.Petani)	p	88,000	219	Muda river
MA-10	Kg. Kemumbong	D.I.D(S.Petani)	p	18,000	55	Muda river
MA-11	Lubok Kiab	D.I.D(S.Petani)	p	12,000	53	Muda river
MA-12	Pantai Cicak	D.I.D(S.Petani)	p	14,000	40	Muda river
MA-13	Padang Cicak	D.I.D(S.Petani)	p	24,000	71	Muda river
SA- 1	Merbau Pulas	D.I.D(S.Petani)	p	23,000	95	Sedim river
SA- 2	Ulu Sedim/Siputeh	D.I.D(S.Petani)	w		114	Sedim river
SA- 3	Ulu Bakai	D.I.D(S.Petani)	w		75	Sedim river
SA- 4	Kg. Badang	D.I.D(S.Petani)	w		75	Sedim river
SA- 5	Kg. Mempelam	D.I.D(S.Petani)	w		67	Sedim river
SA- 6	Padang Meha	D.I.D(S.Petani)	w		150	Karangas river
SA- 7	Titi Karangas	D.I.D(Kulim)	w		225	Karangas river
KA- 1	Kg. Tawar	D.I.D(S.Petani)	w		40	Keul river
KA- 2	Kg. Landak	D.I.D(S.Petani)	p	24,000	40	Keul river
KA- 3	Kg. Iboi	D.I.D(S.Petani)	w		186	Keul river
KA- 4	Pulai	D.I.D(S.Petani)	p	73,000	239	Keul river
KA- 5	Simpang Empat	D.I.D(S.Petani)	w		28	Keul river
KA- 6	Kg. Luar	D.I.D(S.Petani)	p	51,000	181	Keul river
KA- 7	Tanjung Pari	D.I.D(S.Petani)	w		101	Keul river
KA- 8	Sg. Tiak	D.I.D(S.Petani)	w		109	Keul river
KA- 9	Limau/Corok Sikin	D.I.D(S.Petani)	p	22,000	85	Keul river
CA- 1	Tanjung Besar	D.I.D(S.Petani)	p	59,000	172	Chepir river
CA- 2	Sg. Teloi	D.I.D(S.Petani)	p	22,000	71	Chepir river
CA- 3	Tanjung Sik	D.I.D(S.Petani)	w		91	Chepir river
CA- 4	Sg. Chepir	D.I.D(S.Petani)	p		118	Chepir river
JA- 1	Kg. Parit	D.I.D(S.Petani)	w		192	Jeneri river

Remarks; p : Pumping w : Headwork
Source; Information from State DID (kedah)
IADP Pulau Pinang
Note; Including a part of Jarak Scheme (173 ha.)

TABLE 5.2.1 PRESENT LAND USE IN MUDA RIVER BASIN AND KEDAH STATE

Item	Muda River Basin		Kedah State	
	(km ²)	(%)	(km ²)	(%)
1. Agricultural land	1,771	42.06	4,756	51.22
(1) Mixed Horticulture	163	3.88	426	4.59
(2) Rubber	1,393	33.09	2,504	26.96
(3) Oil Palm	76	1.80	219	2.36
(4) Paddy	131	3.11	1,448	15.60
(5) Others	8	0.18	158	1.70
2. Non-Agricultural Land	2,439	57.94	4,530	48.78
(1) Urban and Associated Area	2	0.05	122	1.31
(2) Forest	2,361	56.09	3,944	42.47
(a) Forest	2,251	53.46	3,483	37.51
(b) Scrub Forest	109	2.59	334	3.60
(c) Scrub Grass	2	0.04	127	1.37
(3) Newly Cleared Land	62	1.48	129	1.39
(4) Lake & Swamp	14	0.33	162	1.75
(5) Others	Nil	0.00	172	0.00
Grand Total	4,210	100.00	9,285	100.00

Source : Land use map from Ministry of Agriculture
Development Statistics of Kedah Darul Aman

TABLE S.4.1 POPULATION IN AND OUT OF MUDA RIVER BASIN

Classification of Area	Area		Population				Population Density			Average Annual			
	(km ²)	(% to State Total)	('000 Person)		(% to State Total)		(Person/km ²)			Population Growth (%/year)			
			1991	2000	2010	1991	2000	2010	1991-2000		2000-2010		
1. State of Kedah	9,446	100.0	1,205	1,577	2,033	100.0	100.0	100.0	138	167	215	2.17	2.57
3.1 Out of Muda River Basin	5,296	56.1	947	1,128	1,426	72.6	71.5	70.2	178.8	213.0	269.3	2.00	2.37
3.2 In Muda River Basin	4,150	43.9	358	449	607	27.4	28.5	29.8	86.2	108.1	146.2	2.60	3.06
(1) Upper Reaches of Muda River Basin	978	10.4	11	15	21	0.8	0.9	1.0	11.3	15.2	21.4	3.43	3.46
(2) Middle Reaches of Muda River Basin	1,103	11.7	69	81	99	5.3	5.1	4.9	62.6	73.6	90.2	1.85	2.05
(3) Lower Reaches of Muda River Basin	297	3.1	131	191	302	10.1	12.1	14.9	442.9	643.4	1,018.2	4.32	4.70
(4) Upper Reaches of Kechil River Basin	554	5.9	12	12	13	0.9	0.8	0.6	21.4	22.4	23.5	0.52	0.51
(5) Lower Reaches of Kechil River Basin	684	7.2	90	100	113	6.9	6.3	5.6	131.7	146.0	165.2	1.17	1.24
(6) Sedim River Basin	533	5.6	44	50	58	3.4	3.1	2.9	83.2	92.9	109.1	1.25	1.61
2. State of Perlis	795	100.0	184	223	301	100.0	100.0	100.0	231.4	286.8	378.6	2.46	2.82
3. State of P. Pinang	1,031	100.0	1,065	1,276	1,659	100.0	100.0	100.0	1,033.0	1,237.6	1,609.1	2.07	2.66

TABLE 5.4.2 POPULATION DENSITY IN MUDA RIVER BASIN

Classification of Area		Area (km ²)	Population			Population Density (Person/km ²)			Average Annual Population Growth (%/Year)	
No. District	Munkin		1991	2000	2010	1991	2000	2010	1991-2000	2000-2010
I. Upper Reaches of Muda River Basin		978.43	11,079	14,918	20,965	11.3	15.3	21.4	3.43	3.46
1	Sik Sok	859.16	8,026	10,355	13,818	9.3	12.1	16.1	2.95	2.90
2	Pondang Padang Peliang	119.32	3,053	4,533	7,145	32.0	47.5	74.9	4.58	4.65
II. Middle Reaches of Muda River Basin		1,103.13	69,043	81,134	99,456	62.6	73.6	90.2	1.85	2.05
3	Sik Sik	654.80	35,019	45,250	61,156	53.5	69.1	93.5	2.95	3.06
4	Sik Jenari	139.00	11,608	11,882	12,117	83.5	85.5	87.2	0.35	0.20
5	Padang Terap Tekai	142.92	6,994	8,163	9,649	128.8	150.3	177.7	1.77	1.69
6	Kuala Muda Gurno	39.85	6,386	7,157	8,136	801.2	898.0	1,020.9	1.30	1.29
7	Kuala Muda Tehel Kiri	126.61	9,036	8,731	8,358	71.4	69.0	66.0	-0.39	-0.44
III. Lower Reaches of Muda River Basin		296.53	131,342	190,777	301,915	442.9	643.4	1,018.2	4.33	4.70
8	Kuala Muda Kota	6.22	2,974	3,292	3,701	478.1	529.3	595.0	1.16	1.18
9	Kuala Muda Kuala	6.92	2,603	2,803	3,036	376.2	405.1	438.8	0.84	0.80
10	Kuala Muda Pekula	21.66	8,632	11,245	15,211	398.5	519.1	702.3	3.04	3.07
11	Kuala Muda Pinang Tunggal	36.17	3,240	3,085	2,737	89.6	85.3	75.7	-1.16	-1.19
12	Kuala Muda Rantau Panjang	10.21	2,684	2,776	2,882	262.9	271.9	282.2	0.38	0.38
13	Kuala Muda Sidam Kiri	68.19	6,914	6,607	6,256	101.4	95.9	91.7	-0.51	-0.54
14	Kuala Muda Sungai Pasi	36.63	44,628	79,546	151,703	1,218.3	2,171.6	4,141.5	6.76	6.67
15	Kuala Muda Sungai Petani	110.53	59,667	81,422	116,388	899.7	1,227.7	1,755.0	3.58	3.64
IV. Upper Reaches of Kechil River Basin		554.39	11,842	12,400	13,052	21.4	22.4	23.5	0.51	0.51
16	Baling Siang	554.39	11,842	12,400	13,052	21.4	22.4	23.5	0.52	0.51
V. Lower Reaches of Kechil River Basin		684.14	90,095	99,867	112,996	131.7	146.0	165.2	1.17	1.24
17	Baling Bongor	41.36	5584	6,313	7,290	135.0	152.6	176.2	1.40	1.45
18	Baling Baling	46.93	8,166	8,179	8,202	174.0	174.3	174.8	0.02	0.03
19	Baling Pulai	153.30	19,972	23,042	27,307	130.3	150.3	178.1	1.63	1.71
20	Baling Kupang	191.30	23,442	25,275	27,598	122.5	132.1	144.3	0.86	0.88
21	Baling Tehel Kanan	124.37	14,647	16,937	19,997	117.8	136.2	160.7	1.66	1.67
22	Baling Tawar	126.88	18,284	20,121	22,612	144.1	158.6	178.2	1.09	1.17
VI. Sedim River Basin		533.28	44,394	49,556	58,162	83.2	92.9	109.1	1.25	1.61
23	Baling Bakai	279.80	12,552	12,708	12,912	44.9	45.4	46.1	0.14	0.16
24	Kulim Bagan Sasa	61.33	5,352	5,560	5,827	87.3	90.7	95.0	0.43	0.47
25	Kulim Karangan	80.10	6,949	10,101	15,678	86.8	126.1	195.7	4.33	4.49
26	Kulim Padang Maba	58.66	7,597	7,422	7,232	129.3	126.5	123.3	-0.25	-0.26
27	Kulim Sidam Kanan	38.82	9,594	11,513	14,203	247.1	296.6	365.9	2.09	2.12
28	Kulim Pandang China	14.57	2,360	2,252	2,312	539.7	515.1	528.7	-0.53	-0.59
Muda Basin Total		4,150.00	357,794	448,701	606,546	86.3	108.1	146.2	2.60	3.06

TABLE 5.6.1 PRESENT INDUSTRIAL ESTATES (AS OF 1993)

State	Developed by	District	Industrial Estate	Area in Operation (ha)	Area Developed (ha)	Occupancy Rate (%)	
Kedah	KSDC	Kota Setar	Mergong II	35.20	41.40	85.0	
			Mergong Barrage	31.14	40.60	76.7	
		Kuala Muda	Tikam Batu	32.81	36.00	91.1	
			Bakar Arang	174.80	225.80	77.4	
			Sungai Petani	221.75	251.72	88.1	
		Kulim	Kulim	145.98	174.00	83.9	
		KSDC AREA TOTAL			641.68	769.52	83.4
	KEDA	KEDANG	Kubang Pasu	Binjal	0.90	3.49	25.8
			Padang Terap	Naka	0.64	5.66	11.3
			Baling	Baling	1.29	6.87	18.8
			Sic	Sik	10.91	12.45	87.6
			Jeniang	Jeniang	2.32	6.66	34.8
			Pendang	Sg. Tiang	0.84	0.84	100.0
			Langkawai	Langkawai	3.94	3.94	100.0
KEDA AREA TOTAL			20.84	39.91	52.2		
State Total				662.52	809.43	81.9	
Penang	PDC	S.P.U.	Mak Mandin	55.61	756.69		
			Seberang Jaya	22.19			
		S.P.T.	Perai	340.54			
			Perai F.I.Z.	154.90			
			Bukit Tengah	77.65			
		Penang Island	Bayan Lepas	57.74	230.13		
			Bayan Lepas F.I.Z.	172.39			
State Total				881.02	986.82	89.3	
Grand Total				1,543.54	1796.25	85.9	

Note : KSDC = Kedah State Economic Development Corporation

KEDA = Kedah Regional Economic Authority

PDC = Penang Development Corporation

S.P.U. = Seberang Perai Utara (Seberang Perai North)

S.P.T. = Seberang Perai Tengah (Seberang Perai Central)

F.I.Z. = Free Industrial Zones

Source : Development Statistics of Kedah Darul Aman by Kedah SEPU, February, 1994.

Penang Statistic by Penang Development Corporation, February, 1994.

TABLE 5.6.2 INDUSTRIAL AREA DEVELOPMENT PROJECTED BY STATE GOVERNMENT
(YEAR OF 1993 AND 2000)

State	Developed by	District	Industrial Area (Industrial Estate)	Area Developed			
				1993 (ha)	2000 (ha)		
Kedah	KSDC	Kubang Pasu	Bukit Kayu Hitam		179		
			Kota Setar	Mergong II	41	66	
		Kuala Muda	Mergong Barrage	41	41		
			Pokok Sena		176		
			Sungai Petani	252	252		
			Bakar Arang	226	226		
			Bakar Arang Light		7		
			Kempas Park		3		
			Tikam Batu	36	36		
		Baling	Kuala Ketil		738		
		Kulim	Kulim	174	174		
			Kulim Hi-Tech Park		255		
		KSDC AREA TOTAL				770	2,154
		KEDA	Kubang Pasu	Binjal	3	9	
				Pg Terap	6	15	
	Baling		Baling	7	18		
	Sic		Sik	12	33		
	Pendang		Jeniang	7	18		
			Sg. Tiang	1	2		
	Langkawai		Langkawi	4	11		
	Kubang Pasu		IKS KEDA Park		10		
	Pendang		IKS KEDA Park		10		
	Kulim		IKS KEDA Park		14		
	KEDA AREA TOTAL				40	140	
	Private	Kubang Pasu	Darulaman		87		
			Kota Setar	Sri Tandop		81	
		Kuala Muda	BKT. Selambau		163		
Sungai Petani Park				202			
Kulim		Selarogan (MIEL)		5			
		Taman Makmur Light		0			
PRIVATE AREA TOTAL					538		
KEDAH STATE TOTAL				809	2,832		
Penang	PDC	SPU/SPT	Butterworth	757	1,472		
		SPT	Kepala Batas		202		
		SPU	Tasek Gelugor		77		
		SPT	Bukit Mertajam		206		
		SPU	Permatang Tinggi		64		
		SPS	Jawi (Valdor)		435		
		SPS	Nibong Tebal		152		
		MPPP P. Pinang	Bayan Lepas	230	262		
		PENANG STATE TOTAL				987	2,869
GRAND TOTAL				1,744	5,701		

Source: Kedah Development Action Plan (1991-2000)
Report from KSDC (written in Japanese)
Draft Structural Plan by Seberang Perai Municipal Council (1985-2000)
Penang Island Structure Plan

TABLE 5.7.1 PRESENT MONITORING SYSTEM OF MUDA RIVER AND MADAI IRRIGATION AREA

Monitoring Purpose	Agency in Charge	Monitoring Item/Point		Monitoring Location
		Item	Point	
1. Monitoring for Muda River in Kedah State				
1-1 Flood Forecasting & Warning	DID	Water Level	10	Gauging Station
		Rainfall	3	- ditto -
1-2 Allocation for Irrigation Water	DID	Water Level	28	Intake Point
1-3 Allocation for Domestic & Industrial Water	PWD	Water Level	17	Intake Point
		Water Quality	17	- ditto -
1-4 River Water Quality Control	DOE	Water Quality	17	Sampling Point
1-5 River Channel Stability	DID	River Bed Elevation	3	Gauging Station
1-6 Hydrological Data Base	DID	Water Level	10	Gauging Station
		Water Level & Discharge	3	- ditto -
		Rainfall	16	- ditto -
2. Monitoring for MADA Irrigation System				
2-1 Control of Low Flow Regime of the River	MADA	Water Level	8	Gauging Station
		Gate Control of Pdg. Terap Barrage	1	Barrage
		Gate Control of Muda/Pedu/Ahning Dam	3	Dam Reservoir
		Water Quality of Muda/Pedu Dam Reservoir	2	- ditto -
2-2 Allocation for Irrigation Water	MADA	Rainfall	70	Irrigation Area
		Gate Control of Irrigation Facility	9	- ditto -
3. Monitoring for Muda River in P. Pinang State				
3-1 Flood Forecasting & Warning	DID	Water Level	2	Gauging Station
3-2 Intake of Irrigation Water	DID	Water Level	2	Intake Point
3-3 Intake of Domestic & Industrial Water	PWA	Water Level	1	Intake Point
		Gate Control of Muda Barrage	1	Barrage
3-4 River Channel Stability	DID	River Bed Elevation	2	Gauging Station
		Sand Mining	9	Mining Point
3-5 Hydrological Data Base	DID	Water Level & Discharge	2	Gauging Station

TABLE 7.1.1 ACTUAL AND PROJECTED POPULATION (ABSTRACTED FROM MUDA RIVER SYSTEM)

NO	NAME OF INTAKE FACILITIES	NAME OF TREATMENT PLANT	NAME OF SCHEME	ACTUAL		IN 2000		IN 2010		NOTES
				SERVICE AREA	POPULATION	SERVICE AREA	POPULATION	SERVICE AREA	POPULATION	
1	Labar Tiang	Sg.Dua	Muda river	68% of P.Pinang	1,104,400	P.Pinang	1,037,000	P.Pinang	1,612,000	supplied from other T/W : 1,165,000 cum/d
2	Pinang Tunggal (old,new)	Pinang Tunggal Sg.Petani	Kuala Muda	Sg.Petani,Sg.Pasir St.Meriam,Kuala, Pinang Tunggal,Kota Haji Kudong,Simpur Pekura,Pantau Panjang (Sidam Kanan,Padang Maha,part of Kulim, part of Naga Lilit)	209,000	Sg.Petani,Sg.Pasir St.Meriam,Kuala, Pinang Tunggal,Kota Haji Kudong,Simpur Pekura,Pantau Panjang	204,800	Sg.Petani,Sg.Pasir St.Meriam,Kuala, Pinang Tunggal,Kota Haji Kudong,Simpur Pekura,Pantau Panjang	418,300	supplied from Merbok & Tushah : 3,000 cum/d supply to Kulim : 9,080 cum/d
3	Kulim phase 2 stage-1 stage-2	Kulim phase 2	Kulim water supply	-----	-----	Bagan Sena,Junjong Keladi,Kulim,Lunas Mahang,Naga Lilit Padang Maha,Sedim Sidam Kanan,Sg.Seluang Sg.Ular Terap	183,700	Bagan Sena,Junjong Keladi,Kulim,Lunas Mahang,Naga Lilit Padang Maha,Sedim Sidam Kanan,Sg.Seluang Sg.Ular Terap	292,700	supplied from Pinang Tunggal : 9,080 cum/d Sg.Ular T/W : 27,000 cum/d Bkt Tok Alang : 10,000 cum/d
4	Kuala Ketil	Kuala Ketil	Kuala Ketil	Sidam Kiri,Tawar part of Telui Kiri	19,800	Sidam Kiri,Tawar part of Telui Kiri(30%	28,200	Sidam Kiri,Tawar part of Telui Kiri(30%	31,400	
5	Telui	Telui	Telui Kanan	Telui Kanan	7,300	Telui Kanan	18,000	Telui Kanan	20,000	
6	Jeniang	Jeniang	Jeniang	part of Telui Kiri Gurun,Sik, Ayer Puteh Jenari	13,400	part of Telui Kiri (30%) Gurun (20%) AVer Puteh(20%) Jenari (33%)	33,500	part of Telui Kiri (30%) Gurun (20%) AVer Puteh(20%) Jenari (33%)	37,000	
7	Jeneri	Jeneri	Jeneri	Padang Kerbau Padang Paliang part of Rambai Padang Pusing	13,100	Padang Kerbau Padang Paliang part of Rambai Padang Pusing(30%)	27,700	Padang Kerbau Padang Paliang part of Rambai Padang Pusing(30%)	30,500	
8	Lubuk Merbau	Lubuk Merbau	Lubuk Merbau	part of Tokai Jenari	6,700	part of Tokai (20%) Jenari (33%)	7,500	part of Tokai (20%) Jenari (33%)	9,100	
9	Nami	NAMI	Nami	SOK,part of Tokai	5,800	SOK,part of Tokai (20%)	14,400	SOK,part of Tokai (20%)	18,900	
10	Sg.Limau	Sg.Limau	New Baling	Kupang,Baling,Pulau Bongor,Siong	42,200	Kupang,Baling,Pula Bongor,Siong	75,000	Kupang,Baling,Pula Bongor,Siong	83,400	
11	Batu Lima	SIX(Dr.5)	Six	part of Sik Jenari	13,900	part of Sik (80%) Jenari (33%)	41,400	part of Sik (80%) Jenari (33%)	53,100	
12	Bikan	Bikan	Kg.Bikan	Bakal, part of Bagan Sena	6,200	Bakal, part of Bagan Sena	12,700	Bakal,	12,900	

TABLE 7.1.2 ACTUAL AND PROJECTED POPULATION (ABSTRACTED FROM KEDAH RIVER SYSTEM)

NO	NAME OF INTAKE FACILITIES	NAME OF TREATMENT PLANT	NAME OF SCHEME	ACTUAL		IN 2000		IN 2010		SOURCE SUPPLY
				SERVICE AREA	POPULATION	SERVICE AREA	POPULATION	SERVICE AREA	POPULATION	
1	Bukit Pinang	Bukit Pinang	Kota Setar	part of KOTA SETAR (40%) Putat (50%) Nega (50%) Tanjung (50%) Jeham (50%) Padang Perahu (50%) Ah (50%) Perling (50%) Kepalu (50%) Gurun (70%)	193,000	part of KOTA SETAR (40%) Putat (50%) Nega (50%) Tanjung (50%) Jeham (50%) Padang Perahu (50%) Ah (50%) Perling (50%) Kepalu (50%) Gurun (70%)	249,200	part of KOTA SETAR (40%) Putat (50%) Nega (50%) Tanjung (50%) Jeham (50%) Padang Perahu (50%) Ah (50%) Perling (50%) Kepalu (50%) Gurun (70%)	314,200	Central Canal
2	Kodiang	Kodiang	Kodiang	part of Kaporu, Ah Perling	7,300	closed	closed	closed	closed	SE-Padang Terap
3	Changloon	Changloon	Changloon	Sr.Kaka, Temin, Kubang Pasu Binjal Husba part of Perling Ah Kepalu	30,800	Sr.Kaka, Temin, Kubang Pasu Binjal Husba part of Perling (50%) Ah (50%) Kepalu (50%)	71,300	Sr.Kaka, Temin, Kubang Pasu Binjal Husba part of Perling (50%) Ah (50%) Kepalu (50%)	96,000	Southern Canal
4	Air Hitam	Air Hitam	Air Hitam	Hitan	4,500	closed	closed	closed	closed	Air Cadang
5	Palubang	Palubang	Palubang	part of KOTA SETAR (60%) Nega (50%) Jeham (50%) Putat (50%) Tanjung (50%) Padang Perahu (50%) Celong, Malau, Jitra Wang Tepus, Peluban St. Tinggal, Jerlun	191,000	part of KOTA SETAR (60%) Nega (50%) Jeham (50%) Putat (50%) Tanjung (50%) Padang Perahu (50%) Celong, Malau, Jitra Wang Tepus, Peluban St. Tinggal, Jerlun	324,500	part of KOTA SETAR (60%) Nega (50%) Jeham (50%) Putat (50%) Tanjung (50%) Padang Perahu (50%) Celong, Malau, Jitra Wang Tepus, Peluban St. Tinggal, Jerlun	393,300	SE-Padang Terap
6	Sanglang	Sanglang	Sanglang	Sanglang	6,300	closed	closed	closed	closed	Lana Dulu Canal
7	Kuala Nerang Padang Sana	Kuala Nerang Padang Sana	Kuala Nerang	PADANG TERAP (excluding a part of Tokai)	34,200	PADANG TERAP (excluding a part of Tokai)---40%	51,200	PADANG TERAP (excluding a part of Tokai)---40%	62,000	SE-Padang Terap Sg. Padang Sana
8	Jenu	Pendang	Pendang	Bukit Raya, Toblar Gaur Kepyang part of Rambai Padang Pusing Ayer Puteh	56,200	Bukit Raya, Toblar Gaur Kepyang part of Rambai (70%) Padang Pusing (70%) Ayer Puteh (90%)	60,900	Bukit Raya, Toblar Gaur Kepyang part of Rambai (70%) Padang Pusing (70%) Ayer Puteh (90%)	60,900	
9	Arau Canal	Arau Canal	Kangar		42,000		41,000		40,000	

TABLE 7.2.1 ANNUAL MINIMUM STORAGE VOLUME OF DAM RESERVOIR
(IN CASE OF ONLY BERIS DAM CONSTRUCTED)

(unit : 1,000 cum)

YEAR	MUDA & PEDU	AHNING	BERIS
1952	575219.3	200000.0	103426.5
1953	100951.9	200000.0	75568.6
1954	.0	99988.5	68699.5
1955	.0	.0	85836.5
1956	175048.1	68556.8	108607.4
1957	280791.3	113397.6	101521.6
1958	233092.8	172962.0	89545.9
1959	149072.8	200000.0	100826.5
1970	.0	164972.4	95637.1
1971	157936.3	200000.0	105645.8
1972	73149.3	200000.0	96470.7
1973	354419.4	200000.0	105553.5
1974	677283.6	200000.0	102242.9
1975	506777.8	200000.0	102316.2
1976	514032.7	200000.0	96410.1
1977	316016.9	200000.0	53577.4
1978	26027.0	200000.0	56986.7
1979	.0	.0	.0
1980	.0	.0	.0
1981	.0	.0	.0
1982	.0	.0	.0
1983	.0	.0	.0
1984	.0	.0	10859.3
1985	.0	.0	23354.4
1986	.0	.0	41174.6
1987	.0	.0	41990.7
1988	369408.4	86299.5	96591.2
1989	660367.9	177752.3	107298.2
1990	275804.6	199536.7	100520.0
1991	10470.0	199580.2	90905.2

TABLE 7.2.2 RESULT OF WATER DEMAND AND SUPPLY BALANCE SIMULATION
(IN CASE OF ONLY BERIS DAM CONSTRUCTED)

WATER BALANCE OF MUDA & KEDAH RIVER SYSTEM CASE ---- 0 (unit : million cum)

YEAR	MUDA RIVER SYSTEM						KEDAH RIVER SYSTEM					
	REPLENISHMENT		DEFICIT		WATER-USE		REPLENISHMENT		DEFICIT			
	BERIS DAM	M/R DAM	BEFORE CONTROL	AFTER CONTROL	BEFORE CONTROL	AFTER CONTROL	F/M DAM	AHNING DAM	M/R DAM	J.TRASFER	BEFORE CONTROL	AFTER CONTROL
1952	11.7	.0	10.8	.0	11.7	.0	830.6	.0	.0	.0	830.6	.0
1953	38.7	.0	23.8	.0	38.7	.0	924.8	.0	.0	.0	924.8	.0
1954	45.7	.0	23.1	.0	45.7	.0	639.8	100.1	.0	.0	739.8	.0
1955	25.4	.0	21.2	.0	26.4	.0	433.3	127.3	.0	.0	610.5	47.9
1956	6.1	.0	4.5	.6	6.1	.0	460.9	.0	.0	.0	460.9	.0
1957	13.3	.0	11.0	.0	12.3	.0	440.4	.0	.0	.0	440.4	.0
1958	23.5	.0	20.3	.0	23.5	.0	843.3	.0	.0	.0	843.3	.0
1959	15.5	.0	11.3	.0	15.5	.0	399.4	.0	.0	.0	399.4	.0
1970	18.8	.0	15.7	.0	18.8	.0	371.6	33.0	.0	.0	606.6	.0
1971	14.3	.0	12.8	.0	14.3	.0	334.7	.0	.0	.0	334.7	.0
1972	14.3	.0	17.4	.0	18.5	.0	387.7	.0	.0	.0	387.7	.0
1973	8.3	.0	8.2	.0	8.3	.0	333.0	.0	.0	.0	333.0	.0
1974	13.2	.0	13.0	.0	13.2	.0	677.0	.0	.0	.0	677.0	.0
1975	17.2	.0	10.8	.0	12.7	.0	456.1	.0	.0	.0	456.1	.0
1976	17.7	.0	14.3	.0	17.7	.0	348.6	.0	.0	.0	348.6	.0
1977	61.4	.0	24.7	.0	61.4	.0	783.6	.0	.0	.0	783.6	.0
1978	48.3	.0	29.8	.0	48.3	.0	943.3	.0	.0	.0	943.3	.0
1979	63.2	.0	49.2	16.7	103.3	40.1	247.0	203.6	.0	.0	771.4	318.8
1980	21.8	.0	43.7	33.6	90.2	68.5	229.5	66.2	.0	.0	721.9	426.1
1981	35.9	.0	27.7	6.2	40.0	4.1	604.8	83.9	.0	.0	941.9	273.2
1982	24.0	.0	33.2	20.3	61.5	37.3	103.5	.8	.0	.0	687.2	593.0
1983	28.8	.0	32.3	16.0	99.9	73.2	436.2	60.4	.0	.0	859.6	402.1
1984	28.4	.0	16.4	.0	26.6	.0	649.0	16.2	.0	.0	765.9	61.7
1985	11.9	.0	8.8	.0	11.9	.0	304.6	18.1	.0	.0	808.3	455.7
1986	31.3	.0	11.6	.0	31.3	.0	414.4	30.5	.0	.0	749.2	304.3
1987	33.9	.0	12.4	.0	33.9	.0	459.2	43.7	.0	.0	832.2	351.3
1988	8.3	.0	2.9	.0	8.3	.0	466.6	.2	.0	.0	406.8	.0
1989	6.4	.0	4.4	.0	6.4	.0	621.3	.2	.0	.0	621.5	.0
1990	15.1	.0	10.4	.0	15.1	.0	812.1	.8	.0	.0	812.9	.0
1991	23.4	.0	19.2	.0	23.4	.0	655.7	.3	.0	.0	655.1	.0

TABLE 7.2.3 ANNUAL MINIMUM STORAGE VOLUME OF DAM RESERVOIR
(IN CASE OF JENIANG TRANSFER CANAL AND NAO K DAM CONSTRUCTED)

(unit : 1,000 cum)

YEAR	MUDA & PEDU	ANNING	BERIS	NAOK I
1962	624223.0	200000.0	103248.9	27400.0
1963	236591.5	200000.0	75563.0	27400.0
1964	101150.1	200000.0	68798.3	27400.0
1965	43229.1	200000.0	85888.4	27400.0
1966	335162.8	200000.0	108456.1	27400.0
1967	525418.1	200000.0	101440.8	27400.0
1968	574765.6	200000.0	89542.9	27400.0
1969	601050.8	200000.0	100808.2	27400.0
1970	499403.4	200000.0	95799.3	27400.0
1971	724259.3	200000.0	105582.5	27400.0
1972	717233.3	200000.0	96455.6	27400.0
1973	963170.9	200000.0	105435.4	27400.0
1974	783514.1	200000.0	101982.2	27400.0
1975	700277.5	200000.0	101889.4	27400.0
1976	789776.6	200000.0	96531.3	27400.0
1977	571171.5	200000.0	53826.1	27400.0
1978	338732.8	200000.0	57689.3	27400.0
1979	.0	128590.5	.0	.0
1980	.0	.0	.0	.0
1981	.0	14605.8	.0	.0
1982	.0	.0	.0	.0
1983	.0	.0	.0	.0
1984	.0	60520.0	11018.2	27400.0
1985	.0	.0	23538.7	.0
1986	.0	.0	41397.8	5622.5
1987	.0	.0	42334.0	.0
1988	431586.1	86948.8	96885.6	27400.0
1989	795413.1	178760.3	107331.4	27400.0
1990	585031.0	199540.8	100599.1	27400.0
1991	372255.1	199680.2	91097.0	27400.0

TABLE 7.2.4 RESULT OF WATER DEMAND AND SUPPLY BALANCE SIMULATION
(IN CASE OF JENIANG TRANSFER CANAL AND NAO K DAM CONSTRUCTED)

(unit : million cum)

YEAR	MUDA RIVER SYSTEM						KEDAH RIVER SYSTEM					
	REPLENISHMENT		DIPICIT		WATER-USE		REPLENISHMENT		DIPICIT			
	BERIS DAM	N/R DAM	BEFORE CONTROL	AFTER CONTROL	BEFORE CONTROL	AFTER CONTROL	P/M DAM	ANNING DAM	N/R DAM	J. TRANSFER		BEFORE CONTROL
1962	11.9	.0	11.0	.0	11.9	.0	739.9	.0	.0	108.7	739.9	.0
1963	35.8	.0	23.6	.0	35.8	.0	870.6	.0	.0	68.6	870.6	.0
1964	46.5	.0	25.0	.0	46.5	.0	690.0	.0	.0	74.3	690.0	.0
1965	26.4	.0	11.1	.0	26.4	.0	539.2	.0	.0	128.1	529.2	.0
1966	8.2	.0	4.7	.0	8.2	.0	387.0	.0	.0	94.3	387.0	.0
1967	12.6	.0	11.1	.0	12.6	.0	374.9	.0	.0	111.3	374.9	.0
1968	25.6	.0	20.5	.0	25.6	.0	607.3	.0	.0	76.0	607.3	.0
1969	15.3	.0	11.5	.0	15.3	.0	531.2	.0	.0	103.0	531.2	.0
1970	16.4	.0	15.5	.0	16.4	.0	580.0	.0	.0	53.7	580.0	.0
1971	14.0	.0	13.1	.0	14.0	.0	338.6	.0	.0	96.3	338.6	.0
1972	16.6	.0	17.5	.0	16.6	.0	518.7	.0	.0	108.3	518.7	.0
1973	8.7	.0	8.4	.0	8.7	.0	279.5	.0	.0	111.6	279.5	.0
1974	15.0	.0	15.4	.0	15.4	.0	610.5	.0	.0	90.2	610.5	.0
1975	12.8	.0	11.2	.0	12.8	.0	384.3	.0	.0	90.6	384.3	.0
1976	17.6	.0	14.4	.0	17.6	.0	463.1	.0	.0	106.0	453.1	.0
1977	61.2	.0	24.4	.0	61.2	.0	731.2	.0	.0	76.4	731.2	.0
1978	47.9	.0	29.0	.0	47.9	.0	695.5	.0	.0	56.7	695.5	.0
1979	63.9	1.3	47.8	13.8	63.9	31.2	684.0	37.0	35.3	109.0	726.3	39.0
1980	21.6	4.6	44.1	29.0	67.9	66.3	271.0	194.6	41.1	101.7	659.4	189.6
1981	35.9	9.3	26.9	.0	35.9	.0	690.4	33.2	91.1	201.4	637.4	2.8
1982	24.0	1.4	31.3	16.8	80.8	56.8	35.3	15.6	11.7	124.5	640.3	547.3
1983	26.0	8.9	31.3	11.8	93.6	68.9	569.2	61.6	25.9	99.2	664.2	267.5
1984	26.5	.0	15.9	.0	26.5	.0	677.9	10.7	.0	134.1	688.6	.0
1985	11.9	.0	8.7	.0	11.9	.0	547.3	82.2	75.9	180.6	741.1	235.8
1986	31.3	.0	11.3	.0	31.3	.0	485.9	35.3	60.5	114.5	691.1	111.4
1987	35.7	.0	12.0	.0	35.7	.0	453.1	45.8	58.5	119.2	618.7	253.3
1988	8.2	.0	3.9	.0	8.2	.0	344.7	.2	.0	135.9	344.9	.0
1989	6.8	.0	4.4	.0	6.8	.0	616.1	.2	.0	137.8	516.2	.0
1990	15.1	.0	10.1	.0	15.1	.0	723.3	.8	.0	124.9	723.3	.0
1991	23.2	.0	19.0	.0	23.2	.0	607.3	.5	.0	81.4	607.5	.0

TABLE 7.2.5 ANNUAL MINIMUM STORAGE VOLUME OF DAM RESERVOIR
(IN CASE OF ALL PROPOSED WATER RESOURCE
DEVELOPMENT STRUCTURES CONSTRUCTED)

(unit : 1,000 cum)

YEAR	MUDA & PEDU	ARRING	BERIS	KAOK & REMAN
1962	624223.0	200000.0	103248.9	267400.0
1963	236591.5	200000.0	75563.0	267400.0
1964	101150.1	200000.0	68798.3	267400.0
1965	43229.1	200000.0	85888.4	267400.0
1966	335182.8	200000.0	108455.1	267400.0
1967	525418.1	200000.0	101440.8	267400.0
1968	574765.6	200000.0	89542.9	267400.0
1969	601050.8	200000.0	100808.2	267400.0
1970	499403.4	200000.0	95799.3	267400.0
1971	724259.3	200000.0	105582.5	267400.0
1972	717233.3	200000.0	96455.6	267400.0
1973	963170.9	200000.0	105435.4	267400.0
1974	783514.1	200000.0	101982.2	267400.0
1975	700277.5	200000.0	101889.4	267400.0
1976	769776.6	200000.0	96531.3	267400.0
1977	571171.5	200000.0	53826.1	267400.0
1978	338732.8	200000.0	57689.3	267400.0
1979	.0	128590.5	.0	153516.3
1980	.0	.0	.0	.0
1981	.0	.0	.0	226165.7
1982	.0	.0	.0	.0
1983	.0	.0	.0	1120.5
1984	.0	28718.3	11018.2	267217.1
1985	.0	.0	23538.7	102601.0
1986	.0	.0	41397.8	241237.4
1987	.0	.0	42334.0	157911.4
1988	431586.1	86948.8	96885.6	267400.0
1989	795413.1	178760.3	107331.4	267400.0
1990	585031.0	199540.8	100599.1	267400.0
1991	372255.1	199680.2	91097.0	267400.0

TABLE 7.2.6 RESULT OF WATER DEMAND AND SUPPLY BALANCESIMULATION
(IN CASE OF ALL PROPOSED WATER RESOURCE
DEVELOPMENT STRUCTURES CONSTRUCTED)

(unit : million cum)

YEAR	MUDA RIVER SYSTEM						KEDAH RIVER SYSTEM					
	REPLENISHMENT		DEFICIT		WATER-USE		REPLENISHMENT		DEFICIT			
	BERIS DAM	K/R DAM	BEFORE CONTROL	AFTER CONTROL	BEFORE CONTROL	AFTER CONTROL	P/K DAM	ARRING DAM	K/R DAM	J. TRANSFER		BEFORE CONTROL
1962	11.9	.0	11.0	.0	11.9	.0	739.9	.0	.0	108.7	739.9	.0
1963	38.8	.0	33.8	.0	38.8	.0	870.6	.0	.0	68.6	870.6	.0
1964	48.5	.0	25.0	.0	48.5	.0	890.0	.0	.0	74.3	690.0	.0
1965	26.4	.0	21.1	.0	28.4	.0	329.2	.0	.0	128.1	329.2	.0
1966	8.2	.0	4.7	.0	8.2	.0	387.0	.0	.0	94.3	387.0	.0
1967	12.6	.0	11.1	.0	12.6	.0	374.9	.0	.0	111.5	374.9	.0
1968	23.6	.0	20.3	.0	23.6	.0	407.3	.0	.0	78.0	407.3	.0
1969	15.5	.0	11.5	.0	15.5	.0	331.2	.0	.0	103.0	331.2	.0
1970	18.4	.0	15.5	.0	18.4	.0	380.0	.0	.0	53.7	380.0	.0
1971	14.8	.0	13.1	.0	14.8	.0	338.6	.0	.0	95.3	338.6	.0
1972	18.8	.0	17.3	.0	18.8	.0	318.7	.0	.0	108.3	318.7	.0
1973	8.7	.0	8.4	.0	8.7	.0	278.5	.0	.0	111.6	278.5	.0
1974	15.6	.0	15.4	.0	15.6	.0	610.5	.0	.0	90.2	610.5	.0
1975	12.6	.0	11.3	.0	12.6	.0	311.3	.0	.0	93.6	311.3	.0
1976	17.6	.0	14.4	.0	17.6	.0	483.1	.0	.0	108.0	483.1	.0
1977	61.2	.0	24.4	.0	61.2	.0	731.2	.0	.0	78.4	731.2	.0
1978	47.0	.0	29.0	.0	47.0	.0	895.5	.0	.0	58.7	895.5	.0
1979	63.9	42.1	47.6	.0	63.9	.0	568.1	77.0	85.3	173.7	730.4	.0
1980	21.6	78.1	44.1	1.8	21.6	.0	288.7	194.1	209.3	271.3	721.2	29.1
1981	33.9	9.3	26.9	.0	33.9	.0	632.3	65.7	148.0	231.9	852.2	5.2
1982	24.0	29.3	31.3	4.6	35.3	31.3	91.1	.8	233.3	287.6	674.8	349.7
1983	26.8	76.3	31.3	.0	26.8	.0	453.8	61.2	197.4	279.0	855.5	157.3
1984	25.3	.0	15.9	.0	25.3	.0	643.2	42.5	3.2	134.1	649.0	.0
1985	11.9	.0	8.7	.0	11.9	.0	348.5	52.4	218.6	781.6	789.1	141.6
1986	31.3	.0	11.3	.0	31.3	.0	472.8	30.3	65.1	115.1	625.3	126.0
1987	33.7	.0	12.0	.0	33.7	.0	452.2	45.8	142.3	188.6	821.0	172.7
1988	8.3	.0	5.9	.0	8.3	.0	344.7	.5	.0	133.9	345.0	.0
1989	6.8	.0	4.4	.0	6.8	.0	318.1	.5	.0	137.8	316.4	.0
1990	15.1	.0	10.4	.0	15.1	.0	722.5	1.4	.0	124.9	723.9	.0
1991	23.2	.0	19.0	.0	23.2	.0	607.2	.7	.0	81.4	607.8	.0

TABLE 7.3.1 ANNUAL MINIMUM STORAGE VOLUME OF DAM RESERVOIR
(IN CASE OF INTEGRATED DAM RESERVOIR OPERATION)

(unit : 1,000 cum)

YEAR	MUDA & PEDU	AHNING	BERIS	NAOK & REMAN
1962	624223.0	200000.0	103248.9	267400.0
1963	287147.8	200000.0	75563.0	215923.7
1964	278996.3	200000.0	68798.3	150420.9
1965	293876.3	200000.0	85888.4	190875.9
1966	597117.0	200000.0	108456.1	267400.0
1967	787351.9	200000.0	101440.8	267400.0
1968	594455.5	200000.0	89542.9	267400.0
1969	620740.6	200000.0	100808.2	267400.0
1970	519093.4	200000.0	95799.3	267400.0
1971	743949.0	200000.0	105582.5	267400.0
1972	736923.1	200000.0	96455.6	267400.0
1973	963170.9	200000.0	105435.4	267400.0
1974	783514.1	200000.0	101982.2	267400.0
1975	700277.5	200000.0	101889.4	267400.0
1976	789776.6	200000.0	96531.3	267400.0
1977	571171.5	200000.0	53826.1	267400.0
1978	369350.2	200000.0	57689.3	236520.2
1979	131262.5	117453.3	.0	53741.5
1980	32190.9	40251.6	.0	1960.6
1981	137943.4	63082.2	.0	108542.3
1982	.0	.0	.0	.0
1983	.0	.0	.0	.0
1984	100817.8	50968.5	11018.2	137816.4
1985	40368.5	21459.1	23538.7	68117.5
1986	37122.0	34090.2	41397.8	110946.4
1987	.0	2295.4	42334.0	57430.8
1988	416646.3	88984.5	96885.6	267400.0
1989	795413.1	180796.0	107331.4	267400.0
1990	585031.0	199540.8	100599.1	267400.0
1991	387034.6	199680.2	91097.0	253044.7

TABLE 7.3.2 ANNUAL MINIMUM STORAGE VOLUME OF DAM RESERVOIR
(IN CASE OF WATER SAVING OPERATION)

(unit : 1,000 cum)

YEAR	MUDA & PEDU	AHNING	BERIS	NAOK & REMAN
1962	624223.0	200000.0	103248.9	267400.0
1963	287147.8	200000.0	75563.0	215923.7
1964	278996.3	200000.0	68798.3	150420.9
1965	293876.3	200000.0	85888.4	190875.9
1966	597117.0	200000.0	108456.1	267400.0
1967	787351.9	200000.0	101440.8	267400.0
1968	594455.5	200000.0	89542.9	267400.0
1969	620740.6	200000.0	100808.2	267400.0
1970	519093.4	200000.0	95799.3	267400.0
1971	743949.0	200000.0	105582.5	267400.0
1972	736923.1	200000.0	96455.6	267400.0
1973	963170.9	200000.0	105435.4	267400.0
1974	783514.1	200000.0	101982.2	267400.0
1975	700277.5	200000.0	101889.4	267400.0
1976	789776.6	200000.0	96531.3	267400.0
1977	571171.5	200000.0	53826.1	267400.0
1978	369350.2	200000.0	57689.3	236520.2
1979	131262.5	117453.3	.0	53741.5
1980	57911.3	57029.5	.0	11315.6
1981	154100.4	82312.9	.0	118784.8
1982	.1	602.5	.0	7129.3
1983	55366.5	.0	.0	12.6
1984	132504.4	68725.2	11159.1	154839.2
1985	80139.9	33433.8	23850.9	80870.0
1986	67929.9	47860.1	41756.0	120688.8
1987	17996.1	36335.2	42884.4	70555.6
1988	435681.6	123757.6	97483.2	267400.0
1989	795761.0	199861.5	107331.4	267400.0
1990	585031.0	199540.8	100599.1	267400.0
1991	387034.6	199680.2	91097.0	253044.7

TABLE 8.1.1 ESTIMATE OF UNIT LOAD RELEASED FROM EACH POLLUTION SOURCE (1993)

	BOD	SS	TN	TP
1. Residential waste Water (g/person/day)				
Produced load				
urine & feces	16	20	7.3	0.7
mixed waste water	23	12	1.4	3.3
sub-total	39	32	8.7	4
Discharged ratio	0.7	0.5	0.75	0.75
Discharged Load	27.30	16.00	6.53	3.00
2. Industrial Waste water (mg/l)				
Discharged load				
Rubber factory	70	120	140	15
Oil-palm factory	70	280	140	15
Small scale factory	70	140	20	8
Large scale factory	210	140	35	15
3. Commercial Industry Waste Water (g/person/day)				
Discharged load				
Big town	24	15	6	0.9
Middle-small town	12	7.5	3	0.45
4. Livestock Farming (g/head/day)				
Discharged load				
Pig	140	100	40	2
Cow	135	38	50	1.2
Chicken	7	5	2	0.1
Other cattle	20	10	4	0.2
5. Farm Land Runoff (kg/ha/year)				
Discharged load				
Paddy	0	0	11	4
farm land(dry)	0	0	0.7	0.3
6. Other pollutant load (Forest runoff,atmospheric fallout,etc.) (kg/sq.km/day)				
Discharged load	1	120	0.08	0.05
Note: The load values are estimated from synthetic study based on some reference data.				

TABLE 8.1.2 ESTIMATE OF UNIT LOAD RELEASED FROM EACH POLLUTION SOURCE (2000)

	BOD	SS	TN	TP
1. Residential waste Water (g/person/day)				
Produced load				
urine & feces	16	20	7.3	0.7
mixed waste water	27	14	1.45	3.5
sub-total	43	34	8.75	4.2
Discharged ratio	0.65	0.45	0.75	0.75
Discharged Load Factor	27.95	15.30	6.56	3.15
<hr/>				
2. Industrial Waste water (mg/l)				
Discharged load				
Rubber factory	60	100	120	13
Oil-palm factory	60	230	120	13
Small scale factory	60	120	15	7
Large scale factory	180	120	30	13
<hr/>				
3. Commercial Industry Waste Water (g/person/day)				
Discharged load				
Big town	30	22	9	1.2
Middle-small town	15	11	4.5	0.6
<hr/>				
4. Livestock Farming (g/head/day)				
Discharged load				
Pig	125	90	36	1.8
Cow	120	36	45	1.1
Chicken	6	4.5	2	0.1
Other cattle	18	9	4	0.2
<hr/>				
5. Farm Land Runoff (kg/ha/year)				
Discharged load				
Paddy	0	0	10	3.5
farm land(dry)	0	0	0.6	0.25
<hr/>				
6. Other pollutant load (Forest runoff,atmospheric fallout,etc.) (kg/sq.km/day)				
Discharged load	1	120	0.08	0.05
<hr/>				
Note: The load values are estimated from synthetic study based on some reference data.				

TABLE 8.1.3 ESTIMATE OF UNIT LOAD RELEASED FROM EACH POLLUTION SOURCE (2010)

	BOD	SS	TN	TP
1. Residential waste Water (g/person/day)				
Produced load				
urine & feces	16	20	7.3	0.7
mixed waste water	32	17	1.8	3.7
sub-total	48	37	9.1	4.4
Discharged ratio	0.6	0.4	0.7	0.7
Discharged Load	28.80	14.80	6.37	3.08
2. Industrial Waste water (mg/l)				
Discharged load				
Rubber factory	50	90	110	12
Oil-palm factory	50	210	110	12
Small scale factory	50	110	13	6
Large scale factory	160	110	27	12
3. Commercial Industry Waste Water (g/person/day)				
Discharged load				
Big town	45	30	15	1.5
Middle-small town	22.5	15	7.5	0.75
4. Livestock Farming (g/head/day)				
Discharged load				
Pig	115	80	33	1.6
Cow	110	32	40	1
Chicken	5	4	1.8	0.08
Other cattle	16	8	3.5	0.18
5. Farm Land Runoff (kg/ha/year)				
Discharged load				
Paddy	0	0	9	3.2
farm land(dry)	0	0	0.5	0.2
7. Other pollutant load (Forest runoff,atmospheric fallout,etc.) (kg/sq.km/day)				
Discharged load	1	120	0.08	0.05
Note: The load values are estimated from synthetic study based on some reference data.				

**TABLE 8.1.4 ESTIMATE OF TOTAL LOAD RELEASED FROM
EACH POLLUTANT SOURCE (1993) (1/3)**

Pollutant Source and Related Description	BOD	SS	TN	TP
1. Residential waste Water				
Discharged Load Unit Value	28	16	6.5	3
Discharged Load (kg/day)				
Point M(P)				
Population	277200	277200	277200	277200
Load	7762	4435	1802	832
Point K				
Population	88216	88216	88216	88216
Load	2470	1411	573	265
2. Industrial Waste water				
Discharged Load U. V.	(mg/l) = (0.001kg/cu.m)			
Rubber factory	70	120	140	15
Oil-palm factory	70	280	140	15
Small scale estate	70	140	20	8
Large scale estate	210	140	35	15
Discharge Load				
Point M(P)				
Rubber Q of factory (cu.m/d)	2500	2500	2500	2500
No. of factory	12	12	12	12
Oil-palmload (kg/day)	2100	3600	4200	450
Oil-palm Q of factory (cu.m/d)	2500	2500	2500	2500
No. of factory	2	2	2	2
load (kg/day)	350	1400	700	75
S. estate Area of estate (ha)	47.33	47.33	47.33	47.33
U. w. use (cu.m/ha/d)	25	25	25	25
load (kg/day)	82.83	165.66	23.67	9.47
L. estate Area of estate (ha)	0	0	0	0
U. w. use (cu.m/ha/d)	40	40	40	40
load (kg/day)	0	0	0	0
Total load (M(P))	2532.83	5165.66	4923.67	534.47
Point K				
Rubber Q of factory (cu.m/d)	2500	2500	2500	2500
No. of factory	2	2	2	2
Oil-palmload (kg/day)	350	600	700	75
Oil-palm Q of factory (cu.m/d)	2500	2500	2500	2500
No. of factory	0	0	0	0
load (kg/day)	0	0	0	0
S. estate Area of estate (ha)	1.29	1.29	1.29	1.29
U. w. use (cu.m/ha/d)	25	25	25	25
load (kg/day)	2.2575	4.515	0.645	0.258
Large fa Area of estate (ha)	0	0	0	0
U. w. use (cu.m/ha/d)	40	40	40	40
load (kg/day)	0	0	0	0
Total load (K)	352.26	604.52	700.65	75.26

TABLE 8.1.4 ESTIMATE OF TOTAL LOAD RELEASED FROM EACH POLLUTANT SOURCE (1993) (2/3)

Pollutant Source and Related Description	BOD	SS	TN	TP
3. Commercial Industry Waste Water (g/person/day)				
Discharge Load Factor	24.00	15.00	6.00	0.90
Discharge load factor (g/person/day) Middle-small town	12.00	7.50	3.00	0.45
Discharge load				
Point M(P) (kg/day)				
Big tow. Population	0	0	0	0
Load(g/day)	0	0	0	0
Small t. Population	55440	55440	55440	55440
Load (g/day)	665	416	166	25
Total	665	416	166	25
Point K				
Big tow. Population	0	0	0	0
Load(g/day)	0	0	0	0
Small t. Population	17643	17643	17643	17643
Load (g/day)	212	132	53	8
Total	212	132	53	8
4. Livestock Farming				
Discharge load factor (g/head/day)				
Pig	140	100	40	2
Cow	135	38	50	1.2
Chicken	7	5	2	0.1
Other small cattle	20	10	4	0.2
Discharge load				
Point M(P)				
Pig Number	1039	1039	1039	1039
Load (kg/day)	145	104	42	2
Cow Number	35569	35569	35569	35569
Load (kg/day)	4802	1352	1778	43
Chicken Number	1163	1163	1163	1163
Load (kg/day)	8.14	5.82	2.33	0.12
Others Number	15080	15080	15080	15080
Load (kg/day)	301.6	150.8	60.32	3.016
Total (M(P))	5257.016	1612.137	1882.656	47.8931
Point K				
Pig Number	72	72	72	72
Load (kg/day)	10.08	7.20	2.88	0.14
Cow Number	15366	15366	15366	15366
Load (kg/day)	2074.41	583.91	768.30	18.44
Chicken Number	93	93	93	93
Load (kg/day)	0.65	0.47	0.19	0.01
Others Number	6516	6516	6516	6516
Load (kg/day)	130.32	65.16	26.06	1.30
Total (K)	2215.46	656.73	797.43	19.90

TABLE 8.1.4 ESTIMATE OF TOTAL LOAD RELEASED FROM EACH POLLUTANT SOURCE (1993) (3/3)

Pollutant Source and Related Description	BOD	SS	TN	TP
5. Farm Land Runoff				
Discharged load U.V.	(kg/ha/year)			
Paddy	0	0	11	4
Farm land(dry)	0	0	0.7	0.3
Discharge load				
Point M(P)				
Paddy				
Area(ha)	4200	4200	4200	4200
Load (Kg/day)	0.00	0.00	126.58	46.03
Farm land				
Area(ha)	10000	10000	10000	10000
Load (Kg/day)	0.00	0.00	19.18	8.22
Total M(P)	0.00	0.00	145.75	54.25
Point K				
Paddy				
Area(Sq. ha)	700	700	700	700
Load (Kg/day)	0.00	0.00	1.34	0.58
Paddy				
Area(Sq. ha)	2000	2000	2000	2000
Load (Kg/day)	0.00	0.00	3.84	1.64
Total K	0.00	0.00	5.18	2.22
6. Other Pollutant load				
Discharged load U.V.	(kg/Sq.km/day)			
	1	120	0.08	0.05
Discharge load				
Point M(P)				
Area(Sq.km)	3188	3188	3188	3188
Load (Kg/day)	3188	382560	255.04	159.4
Point K				
Area(Sq.km)	868	868	868	868
Load (Kg/day)	868	104160	69.44	43.4
Summary of Discharge Load				
	(kg/day)			
Point M(P)				
1. Residential waste Water	7762	4435	1802	832
2. Industrial Waste water	2533	5166	4924	534
3. Commercial Industry	665	416	166	25
4. Livestock	5257	1612	1883	48
5. Farm Land	0	0	146	54
6. Others	3188	382560	255	159
Total	19405	394189	9175	1653
Point K				
1. Residential waste Water	2470	1411	573	265
2. Industrial Waste water	352	605	701	75
3. Commercial Industry	212	132	53	8
4. Livestock	2215	657	797	20
5. Farm Land	0	0	1	1
6. Others	868	104160	69	43
Total	6117	106965	2195	412

TABLE S.1.5 ESTIMATE OF TOTAL LOAD RELEASED FROM EACH POLLUTANT SOURCE (2000) (1/3)

Pollutant Source and Related Description	BOD	SS	TN	TP
1. Residential waste Water				
Discharged Load Unit Value	28.00	16.00	6.50	3.15
Discharged Load (kg/day)				
Point M(P)				
Population	308836	308836	308836	308836
Load	8647	4941	2007	973
Point K				
Population	95241	95241	95241	95241
Load	2667	1524	619	300
2. Industrial Waste water				
Discharged Load U. V.	(mg/l) = (0.001kg/cu.m)			
Rubber factory	60	100	120	13
Oil-palm factory	60	230	120	13
Small scale estate	60	120	15	7
Large scale estate	180	120	30	13
Discharge Load				
Point M(P)				
Rubber Q of factory (cu.m/d)	2500	2500	2500	2500
No. of factory	12	12	12	12
Oil-palm load (kg/day)	1800	3000	3600	390
Oil-palm Q of factory (cu.m/d)	2500	2500	2500	2500
No. of factory	2	2	2	2
load (kg/day)	300	1150	600	65
S. estate Area of estate (ha)	69.12	69.12	69.12	69.12
U. w. use (cu.m/ha/d)	25	25	25	25
load (kg/day)	103.68	207.36	25.92	12.10
L. estate Area of estate (ha)	196.47	196.47	196.47	196.47
U. w. use (cu.m/ha/d)	40	40	40	40
load (kg/day)	1414.584	943.056	235.764	102.1644
Total load (M(P))	3618.26	5300.42	4461.68	569.26
Point K				
Rubber Q of factory (cu.m/d)	2500	2500	2500	2500
No. of factory	2	2	2	2
Oil-palm load (kg/day)	300	500	600	65
Oil-palm Q of factory (cu.m/d)	2500	2500	2500	2500
No. of factory	0	0	0	0
load (kg/day)	0	0	0	0
S. estate Area of estate (ha)	12.03	12.03	12.03	12.03
U. w. use (cu.m/ha/d)	25	25	25	25
load (kg/day)	18.045	36.09	4.51125	2.10525
Large fac. Area of estate (ha)	0	0	0	0
U. w. use (cu.m/ha/d)	40	40	40	40
load (kg/day)	0	0	0	0
Total load (K)	318.05	536.09	604.51	67.11

TABLE 8.1.5 ESTIMATE OF TOTAL LOAD RELEASED FROM EACH POLLUTANT SOURCE (2000) (2/3)

Pollutant Source and Related Description	BOD	SS	TN	TP
3. Commercial Industry Waste Water	(g/person/day)			
Discharge Load Factor	30.00	22.00	9.00	1.20
Discharge load factor (g/person/day)	15.00	11.00	4.50	0.60
Middle-small town				
Discharge load				
Point M(P)	(kg/day)			
Big town Population	0	0	0	0
Load(g/day)	0	0	0	0
Small t. Population	68026	68026	68026	68026
Load (g/day)	1020	748	306	41
Total	1020	748	306	41
Point K				
Big town Population	0	0	0	0
Load(g/day)	0	0	0	0
Small t. Population	18720	18720	18720	18720
Load (g/day)	281	206	84	11
Total	281	206	84	11
<hr/>				
4. Livestock Farming				
Discharge load factor	(g/head/day)			
Pig	125	90	36	1.8
Cow	120	36	45	1.1
Chicken	6	4.5	2	0.1
Other small cattle	18	9	4	0.2
Discharge load				
Point M(P)				
Pig Number	1039	1039	1039	1039
Load (kg/day)	130	94	37	2
Cow Number	35569	35569	35569	35569
Load (kg/day)	4268	1280	1601	39
Chicken Number	1163	1163	1163	1163
Load (kg/day)	6.98	5.23	2.33	0.12
Others Number	15080	15080	15080	15080
Load (kg/day)	271.44	135.72	60.32	3.016
Total (M(P))	4676.573	1514.9475	1700.655	44.1284
Point K				
Pig Number	72	72	72	72
Load (kg/day)	9.00	6.48	2.59	0.13
Cow Number	15366	15366	15366	15366
Load (kg/day)	1843.92	553.18	691.47	16.90
Chicken Number	93	93	93	93
Load (kg/day)	0.56	0.42	0.19	0.01
Others Number	6516	6516	6516	6516
Load (kg/day)	117.29	58.64	26.06	1.30
Total (K)	1970.77	618.72	720.31	18.34

TABLE 8.1.5 ESTIMATE OF TOTAL LOAD RELEASED FROM EACH POLLUTANT SOURCE (2000) (3/3)

Pollutant Source and Related Description	BOD	SS	TN	TP
5. Farm Land Runoff				
Discharged load U.V.	(kg/ha/year)			
Paddy	0	0	10	3.5
Farm land(dry)	0	0	0.6	0.25
Discharge load				
Point M(P)				
Paddy				
Area(ha)	3400	3400	3400	3400
Load (Kg/day)	0.00	0.00	93.15	32.60
Farm land				
Area(ha)	8000	8000	8000	8000
Load (Kg/day)	0.00	0.00	13.15	5.48
Total M(P)	0.00	0.00	106.30	38.08
Point K				
Paddy				
Area(Sq. ha)	580	580	580	580
Load (Kg/day)	0.00	0.00	0.95	0.40
Paddy				
Area(Sq. ha)	1600	1600	1600	1600
Load (Kg/day)	0.00	0.00	2.63	1.10
Total K	0.00	0.00	3.58	1.49
6. Other Pollutant load				
Discharged load U.V.	(kg/Sq.km/day)			
	1	120	0.08	0.05
Discharge load				
Point M(P)				
Area(Sq.km)	3188	3188	3188	3188
Load (Kg/day)	3188	382560	255.04	159.4
Point K				
Area(Sq.km)	868	868	868	868
Load (Kg/day)	868	104160	69.44	43.4
Summary of Discharge Load				
	(kg/day)			
Point M(P)				
1. Residential waste Water	8647	4941	2007	973
2. Industrial Waste water	3618	5300	4462	569
3. Commercial Industry	1020	748	306	41
4. Livestock	4677	1515	1701	44
5. Farm Land	0	0	106	38
6. Others	3188	382560	255	159
Total	21151	395065	8837	1825
Point K				
1. Residential waste Water	2667	1524	619	300
2. Industrial Waste water	318	536	605	67
3. Commercial Industry	281	206	84	11
4. Livestock	1971	619	720	18
5. Farm Land	0	0	1	0
6. Others	868	104160	69	43
Total	6104	107045	2099	440

TABLE 8.1.6 ESTIMATE OF TOTAL LOAD RELEASED FROM EACH POLLUTANT SOURCE (2010) (1/3)

Pollutant Source and Related Description	BOD	SS	TN	TP
1. Residential waste Water				
Discharged Load Unit Value	29.00	15.00	6.30	3.15
Discharged Load (kg/day)				
Point M(P)				
Population	368843	368843	368843	368843
Load	10696	5533	2324	1162
Point K				
Population	107450	107450	107450	107450
Load	3116	1612	677	338
2. Industrial Waste water				
Discharged Load U. V.	(mg/l) = (0.001kg/cu.m)			
Rubber factory	50	90	110	12
Oil-palm factory	50	210	110	12
Small scale estate	50	110	13	6
Large scale estate	160	110	27	12
Discharge Load				
Point M(P)				
Rubber Q of factory (cu.m/d)	2500	2500	2500	2500
No. of factory	12	12	12	12
Oil-palm load (kg/day)	1500	2700	3300	360
Oil-palm Q of factory (cu.m/d)	2500	2500	2500	2500
No. of factory	2	2	2	2
load (kg/day)	250	1050	550	60
S. estate Area of estate (ha)	196.24	196.24	196.24	196.24
U. w. use (cu.m/ha/d)	25	25	25	25
load (kg/day)	245.30	539.66	63.78	29.44
L. estate Area of estate (ha)	557.86	557.86	557.86	557.86
U. w. use (cu.m/ha/d)	40	40	40	40
load (kg/day)	3570.304	2454.584	602.4888	267.7728
Total load (M(P))	5565.60	6744.24	4516.27	717.21
Point K				
Rubber Q of factory (cu.m/d)	2500	2500	2500	2500
No. of factory	2	2	2	2
Oil-palm load (kg/day)	250	450	550	60
Oil-palm Q of factory (cu.m/d)	2500	2500	2500	2500
No. of factory	0	0	0	0
load (kg/day)	0	0	0	0
S. estate Area of estate (ha)	34.15	34.15	34.15	34.15
U. w. use (cu.m/ha/d)	25	25	25	25
load (kg/day)	42.69	93.91	11.10	5.12
Large fac. Area of estate (ha)	0	0	0	0
U. w. use (cu.m/ha/d)	40	40	40	40
load (kg/day)	0	0	0	0
Total load (K)	292.69	543.91	561.10	65.12

TABLE 8.1.6 ESTIMATE OF TOTAL LOAD RELEASED FROM EACH POLLUTANT SOURCE (2010) (2/3)

Pollutant Source and Related Description	BOD	SS	TN	TP
3. Commercial Industry Waste Water	(g/person/day)			
Discharge Load Factor	45.00	30.00	15.00	1.50
Discharge load factor (g/person/day)	22.50	15.00	7.50	0.75
Middle-small town				
Discharge load				
Point M(P)	(kg/day)			
Big town Population	18358	18358	18358	18358
Load(g/day)	826	551	275	28
Small t. Population	68848	68848	68848	68848
Load (g/day)	1549	1033	516	52
Total	2375	1583	792	79
Point K				
Big town Population	0	0	0	0
Load(g/day)	0	0	0	0
Small t. Population	21220	21220	21220	21220
Load (g/day)	477	318	159	16
Total	477	318	159	16
<hr/>				
4. Livestock Farming				
Discharge load factor	(g/head/day)			
Pig	115	80	33	1.6
Cow	110	32	40	1
Chicken	5	4	1.8	0.08
Other small cattle	16	8	3.5	0.18
Discharge load				
Point M(P)				
Pig Number	1039	1039	1039	1039
Load (kg/day)	119	83	34	2
Cow Number	35569	35569	35569	35569
Load (kg/day)	3913	1138	1423	36
Chicken Number	1163	1163	1163	1163
Load (kg/day)	5.82	4.65	2.09	0.09
Others Number	15080	15080	15080	15080
Load (kg/day)	241.28	120.64	52.78	2.7144
Total (M(P))	4279.17	1346.62	1511.9204	40.03884
Point K				
Pig Number	72	72	72	72
Load (kg/day)	8.28	5.76	2.38	0.12
Cow Number	15366	15366	15366	15366
Load (kg/day)	1690.26	491.71	614.64	15.37
Chicken Number	93	93	93	93
Load (kg/day)	0.47	0.37	0.17	0.01
Others Number	6516	6516	6516	6516
Load (kg/day)	104.26	52.13	22.81	1.17
Total (K)	1803.26	549.97	639.99	16.66

TABLE 8.1.6 ESTIMATE OF TOTAL LOAD RELEASED FROM EACH POLLUTANT SOURCE (2010) (3/3)

Pollutant Source and Related Description	BOD	SS	TN	TP
5. Farm Land Runoff				
Discharged load U.V.	(kg/ha/year)			
Paddy	0	0	9	3.2
Farm land(dry)	0	0	0.5	0.2
Discharge load				
Point M(P)				
Paddy				
Area(ha)	2325	2325	2325	2325
Load (Kg/day)	0.00	0.00	57.33	20.38
Farm land				
Area(ha)	6000	6000	6000	6000
Load (Kg/day)	0.00	0.00	8.22	3.29
Total M(P)	0.00	0.00	65.55	23.67
Point K				
Paddy				
Area(Sq. ha)	400	400	400	400
Load (Kg/day)	0.00	0.00	0.55	0.22
Paddy				
Area(Sq. ha)	1300	1300	1300	1300
Load (Kg/day)	0.00	0.00	1.78	0.71
Total K	0.00	0.00	2.33	0.93
<hr/>				
6. Other Pollutant load				
Discharged load U.V.	(kg/Sq.km/day)			
	1	120	0.08	0.05
Discharge load				
Point M(P)				
Area(Sq.km)	3188	3188	3188	3188
Load (Kg/day)	3188	382560	255.04	159.4
Point K				
Area(Sq.km)	868	868	868	868
Load (Kg/day)	868	104160	69.44	43.4
<hr/>				
Summary of Discharge Load				
	(kg/day)			
Point M(P)				
1. Residential waste Water	10696	5533	2324	1162
2. Industrial Waste water	5566	6744	4516	717
3. Commercial Industry	2375	1583	792	79
4. Livestock	4279	1347	1512	40
5. Farm Land	0	0	66	24
6. Others	3188	382560	255	159
Total	26104	397767	9464	2181
Point K				
1. Residential waste Water	3116	1612	677	338
2. Industrial Waste water	293	544	561	65
3. Commercial Industry	477	318	159	16
4. Livestock	1803	550	640	17
5. Farm Land	0	0	1	0
6. Others	868	104160	69	43
Total	6557	107184	2107	480

**TABLE 8.2.1 REQUIRED FACILITIES FOR ALTERNATIVE ACTIVITIES
IN RIVER CORRIDOR ZONE**

Activities	Required Facilities / Structure (Example)
1. Sport	
(1) Jogging, Exercise	Ground / road / path, exercise facilities
(2) Cycling	Road / path, Rental cycle service
(3) Football	Football ground
(4) Tennis	Tennis court
(5) Boat/Canoe	Moorage, Jetty
(6) Golf	Golf course
(7) Swimming	Pool
(8) Others	
2. General Recreation	
(1) Fishing	Jetty, revetment, embankment, pond
(2) Walking/rest	Road / path, bench, hut
(3) Picnic/hiking	Road / path / trail with sign boards
(4) Camping	Camping ground with facilities
(5) Bird watching	Watching hut, trail, sign boards
(6) Landscape view	Bench, platform, hut
(7) Amusement (by facilities)	Amusement park facilities
(8) Play / game on the ground	Play ground facilities
(9) Play in water	Channel, pond, pool
(10) Others	
3. Others	
(1) Marketing of local food	Fish market / vegetable & fruit market
(2) Eating & Drinking	River side restaurant / cafeteria
(3) Getting information of Muda river, etc.	Information center
(4) Getting knowledge of River & dam	River & dam museum
(5) Getting knowledge of Fishery / fish	Fish & Fishery museum, aquarium
(6) River crossing	Ferry service with jetty / platform
(7) Watching show	Theater, multi purpose ground
(8) Joining / watching events	Multi purpose ground
(9) Agricultural activities	Rental farmland, sign board
(10) Others	

TABLE 8.2.2 APPROPRIATENESS OF ALTERNATIVE ACTIVITIES
IN EACH RIVER CORRIDOR ZONE

Activities	Nature Reserve Zone	Nature Use Zone	Agriculture Land Zone	Development Zone
1. Sport				
(1) Jogging, Exercise	X	OO	OO	OO
(2) Cycling	X	OO	OO	OO
(3) Football	X	X	X	OO
(4) Tennis	X	X	X	OO
(5) Boat/Canoe	X	OO	O	OO
(6) Golf	X	X	X	OO
(7) Swimming	X	O	X	OO
2. General Recreation				
(1) Fishing	X	OO	O	OO
(2) Walking/rest	O	OO	OO	OO
(3) Picnic/hiking	O	OO	OO	O
(4) Camping	O	OO	O	O
(5) Bird watching	O	OO	O	O
(6) Landscape view	O	OO	OO	OO
(7) Amusement (by facilities)	X	X	X	OO
(8) Play / game on the ground	X	O	X	OO
(9) Play in water	O	O	X	OO
3. Others				
(1) Marketing of local food	X	O	O	OO
(2) Eating & Drinking	X	O	O	OO
(3) Getting information of Muda river	X	O	O	OO
(4) Getting knowledge of River & dam	X	O	X	OO
(5) Getting knowledge of Fishery / fish	X	O	X	OO
(6) River crossing	O	O	O	OO
(7) Watching show	X	X	X	OO
(8) Joining / watching events	X	O	O	OO
(9) Agricultural activities	X	O	OO	O
OO: Appropriate use O: Appropriate in some conditions X: Not appropriate				

TABLE 9.2.1 EXTENT AND PURPOSE OF PROPOSED WATERSHED ZONING

Classified Zone		Extent	Size		Purpose
			(km ²)	(%)	
Water Source Reserve Area	Zone 1	Present forest reserve area surrounding dam reservoir ^{*1}	240 ^{*2}	5.7	<ul style="list-style-type: none"> • Preserve the water quality, beatification/ morphology of the dam reservoir • Restrain the basin sediment yield, and polluted runoff discharge to dam reservoir. • Preserve the basin waster storage capacity.
	Zone 2	Present forest reserve area in dam catchment area other than Zone 1.	849 ^{*3}	20.1	
	Zone 3	Present cultivation area in the proposed dam catchment area	63 ^{*4}	1.5	
	Zone 4	Present forest reserve area in non-dam catchment area	1,142	27.1	<ul style="list-style-type: none"> • Preserve the water quality, beatification/ morphology of the river. • Restrain the polluted runoff discharge to the natural river flow. • Preserve the basin water storage capacity.
	Zone 5	Present cultivation area to critically effect river water quality and basin runoff condition	255	6.1	
	Sub-total (Present Forest Reserve Area:) (Present Cultivation Area :)		2,529 (2,211) (318)	60.0 (52.5) (7.5)	
River Reserve and Controlled Area	Zone 6	Probable flood inundation area (100-year return period) and shore belt of dam reservoirs	57	1.4	Facilitate river improvement, preserve flood retarding effect; protect river from undesirable activities, and minimize damages caused by flood and channel erosion/ meandering
Potential Land Development Area	Zone 7	Area other than those belonged to above classifications.	1,624	38.6	Use as the potential urban, industrial and agricultural development land.
Grand Total			4,210	100.0	

Note *1 Exclude the shore belt where the detailed zoning plan will be formulated as a part of river reserve area (Zone 6).

*2 Composed of 155 km² for Muda dam and 85 km² for the proposed Beris dam.

*3: Applied solely to the catchment area of Muda dam.

*4: Composed of 31 km² for the proposed Beris dam and 32 km² for the proposed Reman dam.

**TABLE 9.2.2 MONITORING ITEMS AND REQUIRED ACTIVITIES
FOR PROPOSED WATERSHED ZONING**

Classified Zone		Required Activities	Monitoring Items	
			River Basin and Corridor	River and Dam Reservoir
Water Source Reserve Area	Zone 1	<ul style="list-style-type: none"> Freeze any logging activities 	<ul style="list-style-type: none"> Logging activities 	<ul style="list-style-type: none"> Dam inflow and outflow discharge Dam inflow and outflow sediment volume
	Zone 2	<ul style="list-style-type: none"> Provide technical reference on the logging activities, if necessary. 	<ul style="list-style-type: none"> Logging activities 	<ul style="list-style-type: none"> Water quality of dam reservoir Fauna and flora in dam reservoir
	Zone 3	<ul style="list-style-type: none"> Provide technical reference on the agricultural activities, if necessary. 	<ul style="list-style-type: none"> Agricultural activities Alienation or temporary occupation of the land 	<ul style="list-style-type: none"> Basin run-off discharge Basin run-off sediment load River water quality
	Zone 4	<ul style="list-style-type: none"> Provide technical reference on the logging activities, if necessary. 	<ul style="list-style-type: none"> Logging activities 	<ul style="list-style-type: none"> Fauna and flora
	Zone 5	<ul style="list-style-type: none"> Provide technical reference on the agricultural activities, if necessary. 	<ul style="list-style-type: none"> Agricultural activities Alienation or temporary occupation of the land 	
River Reserve and Controlled Area	Zone 6	<ul style="list-style-type: none"> Control the excessive land development activities Control the illegal sand mining and other water works. 	<ul style="list-style-type: none"> Agro-tourism/resort development Agricultural activities Conversion of land Land development Flood damage potential 	<ul style="list-style-type: none"> River flow discharge Scenery of river channel Morphology of river channel Water quality of river flow Sand mining activities Fauna and flora

TABLE 9.3.1 PROPOSED MONITORING ITEMS AND PURPOSE

Monitoring Item	Monitoring Measure	Monitoring Purpose															
		Flood Management				Water Resources Management				River Environment Management							
		(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
1. Monitoring of River																	
1.1 River Hydrology 1 (Water Level & Discharge)	Gauging	●	○	○	○	○	●	●	●	○	○	○	○	○	○	○	○
1.2 River Hydrology 2 (Suspended Sediment & River Bed Material)	Sampling & Laboratory Test	●	●				●	●	●								
1.3 River Hydrology 3 (Water Quality & Pollutant Sources)	Sampling & Laboratory Test									○	○	○	○	○	○	○	○
1.4 River Hydrology 4 (Inflow & Outflow of Dam & Damres)	Gauging		○	●	●	●	●	●	●								
1.5 River Morphology (Erosion/Sedimentation/Maintenance)	Channel Survey & On-site Inspection		○	○	○									○	○	○	○
1.6 Water Abstraction Volume at Intake Point	Gauging									○	○	○	○	○	○	○	○
1.7 Sand Mining (Location/Mining Volume/Mining Measure)	Notification & On-site Inspection									○	○	○	○	○	○	○	○
1.8 Construction of River Structure (Bridges, Water Pipes, River Bank, etc.)	Notification & On-site Inspection													○	○	○	○
1.9 Fauna and Flora	On-site Inspection													○	○	○	○
1.10 Damages caused by Actual Flood	On-site Inspection									○	○	○	○				
1.11 Navigation	Notification & On-site Inspection																○
2. Monitoring of Watershed and River Corridor																	
2.1 Watershed Hydrology (Rainfall and Evaporation)	Gauging	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
2.2 Land Use of Watershed and River Corridor (Vegetation/Land Development)	Survey on Aerial photograph	●	●				●	●	●								
2.3 Infrastructure (Road Network, Water Supply Network, etc.)	Notification & On-site Inspection									○	○	○	○	○	○	○	○

Note : ● = Existing ○ = Proposed # = Real Time Monitoring

TABLE 9.4.1 PROPOSED REFERENCE POINT AND RIVER HYDROLOGICAL MONITORING STATION

Name of Reference Point and Monitoring Station	Class*	River	Catchment Area (km ²)	Present Competent Agency			Location
				Water Level	Discharge	Water Quality	
1. Muda Dam	Class 1	Muda	984	MADA	MADA	MADA	Existing Muda dam site
2. Jeniang	Class 1	Muda	1,740	DD Kedah	DD Kedah	DOE Kedah	Existing water level gauging station (to be transferred to the proposed Jeniang Barrage.
3. Jam. Syed Omar	Class 1	Muda	3,330	DD Kedah	DD Kedah	DOE Kedah	Existing water level gauging station
4. Ldg. Victoria	Class 1	Muda	4,010	DD P. Pinang	DD P. Pinang		Existing water level gauging station
5. Beris Dam Reservoir	Class 2	Beris	116				Proposed Beris dam site
6. Kuala Pegang	Class 2	Ketil	704	DD Kedah	DD Kedah	DOE Kedah	Existing water level gauging station
7. Telui Timor	Class 2	Muda	2,377			PWD Kedah	Existing intake point for D & I water
8. Reman Dam Reservoir	Class 2	Reman	32				Proposed Reman dam site
9. Batu Lima	Class 3	Chepir	233				Existing intake point for D & I water (Controlled by PWD)
10. Muda Barrage	Class 1	Muda	4,201	PWD P. Pinang	PWD P. Pinang	PWD Kedah	Existing Muda Barrage
11. Merbau Pulas	Class 3	Sedim	219				Previous water level gauging station (gauging period : 1961 - 1972)
12. Pdang Cikak	Class 3	Muda	1,550	DD Kedah			Existing monitoring station for flood forecasting.
13. Sik	Class 3	Chepir	153	DD Kedah		PWD Kedah	Existing monitoring station for flood forecasting.
14. Kg. Baru	Class 3	Ketil	148	DD Kedah			Existing monitoring station for flood forecasting.
15. Pufai	Class 3	Ketil	389	DD Kedah		DOE Kedah	Existing monitoring station for flood forecasting.

TABLE 9.4.2 PROPOSED RAINFALL MONITORING STATION

Monitoring Station		Ref.* Number	Location		
	Name		Basin Boundary	Latitude	Longitude
Newly Proposed					
1.	Muda Dam Reservoir (A)		Muda Dam Catchment	6° 09'	100° 51'
2.	Muda Dam Reservoir (B)		Muda Dam Catchment	6° 12'	100° 56'
3.	Muda Dam Reservoir (C)		Muda Dam Catchment	6° 07'	100° 57'
4.	Kg. Siprit		Upper Reaches of Muda River	6° 02'	100° 42'
5.	Kg. Lambang Bata		Upper Reaches of Muda River	5° 53'	100° 36'
6.	Beris Dam Reservoir		Beris Dam Catchment	5° 57'	100° 48'
7.	Air Terjun		Beris Dam Catchment	5° 54'	100° 50'
8.	Kg. Lubok Besar		Upper Reaches of Chepir River	5° 46'	100° 46'
9.	Kg. Legong		Upper Reaches of Ketil River	5° 49'	100° 56'
10.	Kg. Charok Perdiat		Upper Reaches of Ketil River	5° 33'	100° 55'
Existing					
1.	Komplek Rumah Muda	6108001	Muda Dam Catchment		
2.	Kg. Gajah Puteh	5806065	Middle Reaches of Muda River		
3.	Jeniang Klinik	5806066	Middle Reaches of Muda River		
4.	Sik	5807067	Upper Reaches of Chepir River		
5.	Ladang Lubok Segintah	5606077	Lower Reaches of Muda River		
6.	Ladang Bukit karangan	5506082	Lower Reaches of Muda River		
7.	Ladang Henrietta	5505084	Lower Reaches of Muda River		
8.	Lahar Ikan Matu, Kepala Batas	5504035	Lower Reaches of Muda River		
9.	Batu 61 Jln. Baling	5806001	Upper Reaches of Ketil River		
10.	Kg. Terbak	5708071	Upper Reaches of Ketil River		
11.	Hospital Baling	5609072	Middle Reaches of Ketil River		
12.	Pulai	5608074	Middle Reaches of Ketil River		
13.	Batu 27 Jln. Baling	5507076	Lower Reaches of Ketil River		
14.	Ladang Dubin	5407080	Upper Reaches of Sedim River		
15.	Kelang Baharu, Kulim	5406083	Upper Reaches of Sedim River		

Note: *: Reference Number given by DID

TABLE 11.1.1 UNIT PRICE OF BASIC CONSTRUCTION MATERIALS

No.	Material	Unit	F.C. (MR)	L.C. (MR)	Unit Price (MR)
1	Diesel oil *	lit	0.33	0.33	0.66
2	Lubricant *	lit	3.75	3.75	7.50
3	Gasoline *				
	-Unleaded	lit	0.55	0.55	1.10
	-Super	lit	0.57	0.56	1.13
4	Grease	kg	3.00	3.00	6.00
5	Dynamite	kg	7.00	7.00	14.00
6	Cement*	50k/bag	4.50	4.50	9.00
7	Retarder	kg	2.16	0.54	2.70
8	Reinforcement bar*				
	-Round/6mm, 10mm dia.	t	950.00	239.00	1,189.00 average
	-Round/12mm dia.	t	920.00	232.00	1,152.00 1,142.00
	-Round/ 10mm or more	t	870.00	215.00	1,085.00
	-Deformed/10mm dia.	t	980.00	249.00	1,229.00 average
	-Deformed/12mm dia.	t	950.00	239.00	1,189.00 1,180.00
	-Deformed/16mm or more	t	900.00	224.00	1,124.00
9	River sand (for concrete)	m ³	0.00	24.00	24.00
10	Crusher run	m ³	0.00	24.00	24.00
11	Crushed aggregate				
	-Granite 13mm	m ³	0.00	29.00	29.00 average
	-Granite 19mm	m ³	0.00	30.00	30.00 30.00
	-Limestone 13mm	m ³	0.00	26.00	26.00
	-Limestone 19mm	m ³	0.00	29.00	29.00
12	Limestone 23cm	m ³	0.00	24.00	24.00
13	Plywood				
	-1.2m x 2.4m x 6mm	pc	0.00	20.00	20.00
	-0.9m x 2.1m x 6mm	pc	0.00	16.50	16.50
	-0.9m x 1.8m x 6mm	pc	0.00	13.50	13.50
	-1.2m x 2.4m x 12mm	pc	0.00	52.00	52.00
	-0.9m x 1.8m x 12mm	pc	0.00	35.00	35.00
14	Sheetpile				
	-51.0kg/m	m ²	144.00	36.00	180.00
15	Shaped steel	t	1,760.00	440.00	2,200.00
16	Steel pipe pile/600mm dia.	t	2,000.00	500.00	2,500.00
17	Wooden pile (Mangrove)	no.	0.00	5.00	5.00
	Minimum 90mm dia. l=4.2-4.8m				
18	Hume R.C. Pipe				
	dia. 0.45m	m	41.00	41.00	82.00
	dia. 0.60m	m	49.50	49.50	99.00
	dia. 0.90m	m	57.50	57.50	115.00
	dia. 1.20m	m	147.50	147.50	295.00
	dia. 1.50m	m	197.00	197.00	394.00
19	Bitumen*				
	-80/100 penetration	t	183.00	182.50	365.50
	-Cutback	t	182.00	182.00	364.00
20	Fabric reinforcement (wire mesh)				
	A6	m ²	3.40	0.90	4.30
	AB	m ²	5.60	1.40	7.00
	DA4	m ²	3.40	0.90	4.30

As of March 1994

Note: *Government controlled price items

TABLE 11.1.2 LABOUR WAGES

		Unit:MR/day
No.	Category	Wage
1	Foreman	50
2	Operator	45
3	Assistant operator	30
4	Driver	35
5	Mechanic	40
6	Electrician	40
7	Welder	35
8	Concrete worker	30
9	Bar bender	35
10	Mason	40
11	Carpentor	35
12	Painter	30
13	Power operator	45
14	Plumber	35
15	Driller	40
16	Boring worker	40
17	Grout worker	40
18	Fitter	35
19	Skilled laborer	35
20	Semi-skilled laborer	30
21	Common laborer	25
22	Dredge master	95
23	Dredge master's assistant	60
24	Crewman	45
25	Drain layer	35

Note: Inclusive of site allowances

TABLE 11.2.1 ANNUAL DISBURSEMENT SCHEDULE OF BERIS DAM
(1996-2000)

Description	Amount						Unit : Thousand K.						
	1996		1997		1998		1999		2000				
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	
I. Construction Base Cost	62,401	41,600	104,001	0	0	11,346	7,564	19,855	13,236	17,018	11,345	14,182	9,455
1. Preparatory Works (10% of Item I.2)	5,673	3,782	9,455	0	0	2,837	1,891	2,837	1,891	0	0	0	0
2. Main Works	56,728	37,818	94,546	0	0	8,509	5,673	17,018	11,345	17,018	11,345	14,182	9,455
Sub-Total	62,401	41,600	104,001	0	0	11,346	7,564	19,855	13,236	17,018	11,345	14,182	9,455
II. Compensation Cost	0	40,000	40,000	0	40,000	0	0	0	0	0	0	0	0
1. House Excavation	0	15,000	15,000	0	15,000	0	0	0	0	0	0	0	0
2. Land Acquisition	0	25,000	25,000	0	25,000	0	0	0	0	0	0	0	0
III. Administration Cost	0	5,200	5,200	0	1,300	0	1,040	0	1,040	0	1,040	0	780
1. Administration (5% of Item I & II, alloted to L.C. only)	0	5,200	5,200	0	1,300	0	1,040	0	1,040	0	1,040	0	780
IV. Engineering Cost	6,240	4,160	10,400	0	0	936	624	1,872	1,248	1,872	1,248	1,560	1,040
1. Detailed Design (Completed in 1994)	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Construction Supervision	6,240	4,160	10,400	0	0	936	624	1,872	1,248	1,872	1,248	1,560	1,040
V. Physical Contingency (10% of Items I to IV)	6,864	9,096	15,960	0	4,130	1,228	923	2,173	1,552	1,889	1,363	1,574	1,127
VI. Sub-Total (Items I to V)	75,505	100,056	175,561	0	45,430	13,510	10,150	23,900	17,077	20,779	14,997	17,316	12,402
VII. Price Contingency of Item VI (3%F.C. & 3.5%L.C.)	10,922	12,516	23,439	0	3,236	1,253	1,104	3,000	2,519	3,310	2,815	3,360	2,843
VIII. Grand Total	86,427	112,572	199,000	0	48,666	14,763	11,254	26,899	19,496	24,089	17,811	20,676	15,245

Notes : *1 Price Level in December 1994

*2 Figures may not add up to totals due to rounding

TABLE 11.2.2 ANNUAL DISBURSEMENT SCHEDULE OF JENIANG TRANSFER SYSTEM
(1998-2005)

Description	Amount												Unit: Thousand R						
	1998		1999		2000		2001		2002		2003		2004		2005				
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.			
I. Construction Base Cost	46,757	80,389	127,146	0	0	0	0	0	0	4,964	7,691	13,884	24,040	16,150	24,272	11,759	20,386		
1. Preparatory Works	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
2. Main Civil Works	42,506	73,080	115,586	0	0	0	0	0	0	1,986	3,077	2,265	4,232	0	0	0	0		
Sub-Total	46,757	80,389	127,146	0	0	0	0	0	0	4,964	7,691	13,884	24,040	16,150	24,272	11,759	20,386		
II. Compensation Cost	0	4,541	4,541	0	0	0	2,137	0	2,324	0	80	0	0	0	0	0	0		
1. House Evacuation	0	550	550	0	0	0	213	0	300	0	37	0	0	0	0	0	0		
2. Land Acquisition	0	3,991	3,991	0	0	0	1,924	0	2,024	0	43	0	0	0	0	0	0		
III. Administration Cost	0	6,585	6,585	0	659	0	782	0	1,317	0	1,194	0	659	0	659	0	659		
1. Administration (5% of Item I & II, allowed in L.C. only)	0	6,585	6,585	0	659	0	782	0	1,317	0	1,194	0	659	0	659	0	659		
IV. Engineering Cost	4,676	3,039	12,715	842	1,447	1,665	2,818	299	539	0	131	203	511	872	711	1,244	517	897	
1. Detailed Design (60% of Item IV)	2,806	4,823	7,629	842	1,447	1,665	2,818	299	539	0	0	0	0	0	0	0	0	0	
2. Construction Supervision (40% of Item IV)	1,870	3,216	5,086	0	0	0	0	0	0	131	203	511	872	711	1,244	517	897		
V. Physical Contingency (10% of Items I-IV)	5,143	9,955	15,099	84	211	166	348	30	348	0	364	510	917	1,440	2,557	1,686	3,017	1,228	2,194
VI. Sub-Total (Item I to V)	56,576	109,509	166,086	926	2,316	1,831	3,824	329	3,825	0	4,005	5,605	10,085	15,805	26,127	18,546	33,191	13,504	24,135
VII. Price Contingency (3% F.C. & 3.5% L.C.)	18,360	41,159	59,519	116	342	292	718	64	877	0	1,091	1,495	3,195	4,826	10,207	6,378	13,628	5,189	11,102
VIII. Grand Total	74,936	150,669	225,605	1,042	2,658	2,123	4,542	393	4,702	0	5,096	7,100	13,280	20,661	36,335	24,925	46,820	18,693	35,237

Notes: *1. Price Level in December 1994
*2. Figures may not add up to totals due to rounding

TABLE 11.2.3 ANNUAL DISBURSEMENT SCHEDULE OF REMAN DAM
(2000-2007)

Description	Unit: Thousand R																	
	Amount		2000		2001		2002		2003		2004		2005		2006		2007	
	F.C.	L.C.	Total	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	
I. Construction Base Cost	41,116	28,279	69,395	0	0	0	0	0	0	0	0	3,856	16,820	11,569	11,213	7,712	7,476	5,142
1. Preparatory Works (10% of Item I.2.)	3,738	2,571	6,309	0	0	0	0	0	0	0	0	1,869	1,869	1,286	0	0	0	0
2. Main Works	37,378	25,708	63,086	0	0	0	0	0	0	0	0	3,738	14,951	10,283	11,213	7,712	7,476	5,142
Sub-Total	41,116	28,279	69,395	0	0	0	0	0	0	0	0	3,856	16,820	11,569	11,213	7,712	7,476	5,142
II. Compensation Cost	0	35,300	35,300	0	0	0	0	10,590	0	34,710	0	0	0	0	0	0	0	0
1. Lease Possession	0	5,000	5,000	0	0	0	0	1,500	0	3,500	0	0	0	0	0	0	0	0
2. Land Acquisition	0	30,300	30,300	0	0	0	0	9,090	0	21,210	0	0	0	0	0	0	0	0
III. Administration Cost	0	5,235	5,235	0	524	0	524	1,047	0	1,047	0	524	0	524	0	524	0	524
1. Administration (5 % of Item I & II, allowed to L.C. only)	0	5,235	5,235	0	524	0	524	1,047	0	1,047	0	524	0	524	0	524	0	524
IV. Engineering Cost	4,112	2,828	6,940	1,234	848	1,234	848	0	0	164	113	658	452	493	339	329	226	226
1. Detailed Design (60 % of Item IV)	2,467	1,697	4,164	1,234	848	1,234	848	0	0	0	0	0	0	0	0	0	0	0
2. Construction Supervision (40 % of Item IV)	1,645	1,131	2,776	0	0	0	0	0	0	164	113	658	452	493	339	329	226	226
V. Physical Contingency (10% of Items I to IV)	4,523	2,164	11,687	123	137	123	137	0	1,164	0	2,576	577	449	1,748	1,171	838	780	589
VI. Sub-Total (Item I to V)	49,751	78,806	128,557	1,357	1,209	1,357	1,209	0	12,801	0	28,333	6,348	4,942	19,226	13,799	12,878	9,433	6,480
VII. Price Contingency (3% F.C. & 3.5% L.C.)	19,651	31,986	51,597	263	246	312	311	0	4,053	0	10,282	2,183	2,029	7,387	6,347	5,683	4,821	4,022
VIII. Grand Total	69,402	110,752	180,154	1,620	1,455	1,669	1,520	0	16,856	0	38,615	8,532	6,971	26,613	20,146	18,369	14,254	12,607

Notes: * 1. Price Level in December 1994
 * 2. Figures may not add up to totals due to rounding

TABLE 11.2.4 ANNUAL DISBURSEMENT SCHEDULE OF MUDA DOWNSTREAMSTRETCH
(2003-2010)

Description	Unit: Thousand R.																
	2003		2004		2005		2006		2007		2008		2009		2010		
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	
I. Construction Base Cost	141,440	98,463	239,903	0	0	0	0	16,716	11,637	47,575	33,119	38,575	26,854	25,716	17,902	12,858	8,951
1. Preparatory Works (10% of Item I.2)	12,858	8,951	21,809	0	0	0	0	3,857	2,685	9,001	6,266	0	0	0	0	0	0
2. Main Civil Works	128,582	89,512	218,094	0	0	0	0	12,858	8,951	38,575	26,854	38,575	26,854	25,716	17,902	12,858	8,951
Sub-Total	141,440	98,463	239,903	0	0	0	0	16,716	11,637	47,575	33,119	38,575	26,854	25,716	17,902	12,858	8,951
II. Compensation Cost	0	17,409	17,409	0	0	0	8,705	0	8,705	0	0	0	0	0	0	0	0
1. House Evacuation	0	3,725	3,725	0	0	0	1,863	0	1,863	0	0	0	0	0	0	0	0
2. Land Acquisition	0	13,684	13,684	0	0	0	6,842	0	6,842	0	0	0	0	0	0	0	0
III. Administration Cost	0	12,181	12,181	0	1,218	0	1,827	0	1,827	0	1,827	0	1,827	0	1,218	0	1,218
1. Administration (5% of Item I & II, allotted to L.C. only)	0	12,181	12,181	0	1,218	0	1,827	0	1,827	0	1,827	0	1,827	0	1,218	0	1,218
IV. Engineering Cost	14,144	9,846	23,990	4,243	2,954	4,243	2,954	0	849	591	1,414	985	1,414	985	1,414	985	566
1. Detailed Design (60% of Item IV)	8,486	5,908	14,394	4,243	2,954	4,243	2,954	0	0	0	0	0	0	0	0	0	0
2. Construction Supervision (40% of Item IV)	5,658	3,938	9,596	0	0	0	0	0	849	591	1,414	985	1,414	985	1,414	985	566
V. Physical Contingency (10% of Items I to IV)	15,558	13,790	29,348	424	417	424	417	0	1,053	1,756	2,276	4,899	3,593	3,999	2,713	2,011	1,342
VI. Sub-Total (Items I to V)	171,142	151,689	322,832	4,668	4,589	4,668	4,589	0	11,585	19,221	25,035	53,889	39,524	43,988	32,632	29,844	22,116
VII. Price Contingency (3% of C.C. & 3.5% of L.C.)	84,631	87,616	172,248	1,423	1,665	1,665	1,884	0	5,329	8,226	12,795	25,249	22,290	22,548	20,189	16,652	14,976
VIII. Grand Total	255,774	239,306	495,079	6,090	6,255	6,255	6,473	0	16,914	27,547	37,829	79,137	61,814	66,536	52,821	46,496	37,051

Notes : *1. Price Level in December 1994

*2. Figures may not add up to totals due to rounding

TABLE 11.2.5 ANNUAL DISBURSEMENT SCHEDULE OF KUALA KETILSTRETCH
(2001-2004)

Unit: Thousand R.

Description	Amount						2001		2002		2003		2004	
	F.C.	L.C.	Total	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	
I. Construction Base Cost	5,781	8,177	13,958	0	0	0	0	0	0	2,103	2,973	3,679	5,204	
1. Preparatory Works (10% of Item I.2)	526	743	1,269	0	0	0	0	0	0	526	743	0	0	
2. Main Civil Works	5,255	7,434	12,689	0	0	0	0	0	0	1,577	2,230	3,679	5,204	
Sub-Total	5,781	8,177	13,958	0	0	0	0	0	0	2,103	2,973	3,679	5,204	
II. Compensation Cost	0	526	526	0	0	0	0	526	0	0	0	0	0	
1. House Evacuation	0	225	225	0	0	0	0	225	0	0	0	0	0	
2. Land Acquisition	0	301	301	0	0	0	0	301	0	0	0	0	0	
III. Administration Cost	0	724	724	0	109	0	253	0	217	0	217	0	145	
1. Administration (5% of Item I. & II. allotted to L.C. only)	0	724	724	0	109	0	253	0	217	0	217	0	145	
IV. Engineering Cost	578	818	1,396	347	491	0	0	69	98	162	229			
1. Detailed Design (60% of Item IV)	347	491	838	347	491	0	0	0	0	0	0	0	0	
2. Construction Supervision (40% of Item IV)	231	327	558	0	0	0	0	69	98	162	229			
V. Physical Contingency (10% of Items I to IV)	636	1,025	1,661	35	60	0	78	217	329	384	558			
VI. Sub-Total (Items I to V)	6,995	11,270	18,264	381	659	0	857	2,389	3,617	4,224	6,135			
VII. Price Contingency (5% F.C. & 3.5% L.C.)	2,269	4,283	6,552	88	180	0	272	728	1,313	1,453	2,519			
VIII. Grand Total	9,264	15,553	24,816	469	839	0	1,129	3,117	4,930	5,677	8,655			

Notes: * 1. Price Level in December 1994
 * 2. Figures may not add up to totals due to rounding

TABLE 11.2.6 ANNUAL DISBURSEMENT SCHEDULE OF BALING STRETCH
(2001-2003)

Description	Amount						Unit: Thousand R.					
	2001			2002			2003			2003		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
I. Construction Base Cost	2,506	3,313	5,819	0	0	0	0	0	0	2,506	3,313	5,819
1. Preparatory Works (10% of Item I.2)	228	301	529	0	0	0	0	0	0	228	301	529
2. Main Civil Works	2,278	3,012	5,290	0	0	0	0	0	0	2,278	3,012	5,290
Sub-Total	2,506	3,313	5,819	0	0	0	0	0	0	2,506	3,313	5,819
II. Compensation Cost	0	2,121	2,121	0	0	0	0	2,121	0	0	0	2,121
1. House Evacuation	0	1,960	1,960	0	0	0	0	1,960	0	0	0	1,960
2. Land Acquisition	0	161	161	0	0	0	0	161	0	0	0	161
III. Administration Cost	0	397	397	0	79	79	0	199	0	199	0	397
1. Administration (5% of Item I & II, allotted to L.C. only)	0	397	397	0	79	79	0	199	0	199	0	397
IV. Engineering Cost	251	331	582	151	199	350	0	0	0	100	132	232
1. Detailed Design (60% of Item IV)	151	199	350	151	199	350	0	0	0	0	0	350
2. Construction Supervision (40% of Item IV)	100	132	232	0	0	0	0	0	0	100	132	232
V. Physical Contingency (10% of Items I to IV)	276	616	892	15	28	43	0	232	0	261	356	617
VI. Sub-Total (Item I to Item V)	3,053	6,778	9,831	166	306	472	0	2,551	2,867	5,418	3,921	9,339
VII. Price Contingency (3% F.C. & 3.5% L.C.)	912	2,314	3,226	38	83	121	0	808	874	1,682	1,423	3,105
X. Grand Total	3,965	9,093	13,057	204	389	593	0	3,360	3,741	7,101	5,344	12,445

Notes: * 1. Price Level in December 1994

* 2. Figures may not add up to totals due to rounding

TABLE 11.2.7 ANNUAL DISBURSEMENT SCHEDULE OF SIX STRETCH
(2001-2003)

Description	Amount						Unit: Thousand R.					
	2001			2002			2003			2003		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
I. Construction Base Cost	1,828	3,120	4,948	0	0	0	914	1,560	2,474	914	1,560	2,474
1. Preparatory Works (10% of Item I.2)	166	284	450	0	0	0	83	142	225	83	142	225
2. Main Civil Works	1,662	2,836	4,498	0	0	0	831	1,418	2,249	831	1,418	2,249
Sub-Total	1,828	3,120	4,948	0	0	0	914	1,560	2,474	914	1,560	2,474
II. Compensation Cost	0	945	945	0	945	0	0	0	0	0	0	0
1. Labor Evaluation	0	840	840	0	840	0	0	0	0	0	0	0
2. Land Acquisition	0	105	105	0	105	0	0	0	0	0	0	0
III. Administration Cost	0	295	295	0	59	0	59	0	118	0	118	0
1. Administration (5% of Item I & II, allocated to L.C. only)	0	295	295	0	59	0	59	0	118	0	118	0
IV. Engineering Cost	183	312	495	110	187	297	37	62	103	37	140	179
1. Detailed Design (60% of Item IV)	110	187	297	110	187	297	0	0	0	0	0	0
2. Construction Supervision (40% of Item IV)	73	125	198	0	0	0	37	62	99	37	62	99
V. Physical Contingency (10% of Items I to IV)	201	467	668	11	119	130	95	177	306	95	177	306
VI. Sub-Total (Item I to Item V)	2,212	5,139	7,351	121	1,310	1,431	1,046	1,947	2,387	1,046	1,947	2,387
VII. Price Contingency (3% F.C. & 3.5% L.C.)	625	1,637	2,262	28	357	385	279	617	966	279	617	966
VIII. Grand Total	2,838	6,796	9,633	149	1,667	1,816	1,325	2,564	3,341	1,325	2,564	3,341

Notes: * 1. Price Level in December 1994

* 2. Figures may not add up to totals due to rounding

TABLE 11.2.8 (1/2) ANNUAL DISBURSEMENT SCHEDULE OF RIVER ENVIRONMENT IMPROVEMENT WORK (1996-2010)

Description	Amount												Unit: Thousand R.				
	1996		1997		1998		1999		2000		2001			2002			
	F.C.	L.C.	Total	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.		
I. Construction Base Cost	9,073	22,446	31,519	0	0	0	0	1,072	2,653	825	2,041	825	2,041	0	0	577	1,428
1. Preparatory Works (10% of item I.2)	825	2,041	2,866	0	0	0	0	248	612	0	0	0	0	0	0	165	408
2. Main Civil Works	8,248	20,405	28,653	0	0	0	0	825	2,041	825	2,041	825	2,041	0	0	412	1,020
Sub-Total	9,073	22,446	31,519	0	0	0	0	1,072	2,653	825	2,041	825	2,041	0	0	577	1,428
II. Compensation Cost	0	2,018	2,018	0	0	0	0	0	0	0	0	0	0	0	1,413	0	605
1. House Evacuation	0	1,000	1,000	0	0	0	0	0	0	0	0	0	0	0	700	0	300
2. Land Acquisition	0	1,018	1,018	0	0	0	0	0	0	0	0	0	0	0	713	0	305
III. Administration Cost	0	1,677	1,677	0	84	0	84	0	168	0	168	0	84	0	168	0	84
1. Administration (5% of item I & II, allotted to L.C. only)	0	1,677	1,677	0	84	0	84	0	168	0	168	0	84	0	168	0	84
IV. Engineering Cost	907	2,245	3,152	82	202	109	269	36	90	36	90	36	90	218	539	154	382
1. Detailed Design (60% of item IV)	544	1,347	1,891	82	202	109	269	0	0	0	0	0	0	218	539	136	337
2. Construction Supervision (40% of item IV)	363	898	1,261	0	0	0	0	36	90	36	90	36	90	0	0	18	45
V. Physical Contingency (10% of items I to IV)	908	2,839	3,837	8	29	11	35	111	291	86	230	86	221	22	212	73	260
VI. Sub-Total (Items I to V)	10,978	31,225	42,203	90	314	120	389	1,219	3,201	947	2,528	947	2,436	239	2,331	805	2,749
VII. Price Contingency (3% F.C. & 3.5% L.C.)	3,690	12,253	15,943	5	22	11	42	133	472	151	474	184	558	55	635	215	871
VIII. Grand Total	14,668	43,478	58,146	95	337	131	431	1,372	3,674	1,098	3,002	1,131	2,994	294	2,966	1,019	3,620

Notes: *1. Price Level as December 1994
 *2. Figures may not add up to totals due to rounding

TABLE 11.2.8 (2/2) ANNUAL DISBURSEMENT SCHEDULE OF RIVER ENVIRONMENT IMPROVEMENT WORK
(1996-2010)

Description	2003		2004		2005		2006		2007		2008		2009		2010	
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
I. Construction Base Cost	1,031	2,551	1,031	2,551	0	0	825	2,041	825	2,041	825	2,041	825	2,041	412	1,020
1. Preparatory Works (10% of Item I.2)	206	510	206	510	0	0	0	0	0	0	0	0	0	0	0	0
2. Main Civil Works	825	2,041	825	2,041	0	0	825	2,041	825	2,041	825	2,041	825	2,041	412	1,020
Sub-Total	1,031	2,551	1,031	2,551	0	0	825	2,041	825	2,041	825	2,041	825	2,041	412	1,020
II. Contingency Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1. House Emigration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Land Acquisition	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
III. Administration Cost	0	84	0	84	0	84	0	168	0	168	0	168	0	84	0	84
I. Administration (5% of Item I & II, allotted to L.C. only)	0	84	0	84	0	84	0	168	0	168	0	168	0	84	0	84
IV. Engineering Cost	18	45	18	45	18	45	36	90	36	90	36	90	36	90	36	90
1. Detailed Design (60% of Item IV)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Construction Supervision (40% of Item IV)	18	45	18	45	18	45	36	90	36	90	36	90	36	90	36	90
V. Physical Contingency (10% of Items I to IV)	105	268	105	268	2	13	86	230	86	230	86	230	86	221	45	119
VI. Sub-Total (Items I to V)	1,154	2,917	1,154	2,917	20	142	947	2,528	947	2,528	947	2,528	947	2,436	494	1,313
VII. Price Contingency (5% F.C. & 3.5% L.C.)	352	1,070	397	1,210	8	65	403	1,292	444	1,426	486	1,507	529	1,645	298	964
VIII. Grand Total	1,506	4,017	1,551	4,158	28	207	1,350	3,820	1,391	3,953	1,433	3,942	1,476	4,080	792	2,277

Notes : *1 Price Level in December 1994
*2 Figures may not add up to totals due to rounding

TABLE IV.12.2.1

ASSESSMENT MATRIX OF ENVIRONMENTAL IMPACT
FOR BERIS DAM PROJECT

Environment Factors	Breakdown of Project / Scheme				Remarks
	Activities			Existence of Structures	
	Site Invest.	Construction	O & M		
1. Social Environment					
1.1 Resettlement	N	U1	N	A3	Some villages submerged
1.2 Economic Activities	N	B2	B1	B2	Increase of income/job
1.3 Transportation / Public Facilities	N	A1	N	B1	More convenient by the project
1.4 Division of Communities	N	A2	N	A2	Due to resettlement
1.5 Archaeological / Cultural Heritage	U1	U1	U1	U1	No significant site
1.6 Vested Right	U1	U1	U1	U1	No definite right now
1.7 Health and Hygiene	N	A1	N	U1	Generally not significant
1.8 Waste Disposal	A1	A1	A1	N	Increase of waste
1.9 Accident	N	A1	N	N	Only during construction
2. Natural Environment					
2.1 Topography and Geology	A1	U1	N	A1	Effect not significant
2.2 Soil Erosion	A1	A2	N	A2	By logging & land clearing
2.3 Ground Water	N	N	N	U1	
2.4 River and Reservoir / pond	N	N	N	A1	
2.5 Coastal Zone	N	N	N	A1	Far to the coast
2.6 Fauna (Wildlife)	N	A1	N	U1	No valuable species
2.7 Flora (Vegetation)	N	A1	N	U1	Forest logging
2.8 Climate	N	N	N	N	
2.9 Landscape	N	A1	N	B2	Beautiful water front
3. Public Nuisance					
3.1 Air Pollution	N	N	N	N	
3.2 Water Pollution	N	A2	N	U1	Reservoir eutrophication
3.3 Soil Contamination	N	A1	N	N	
3.4 Noise and Vibration	A1	A1	N	N	
3.5 Ground Subsidence	N	N	N	N	
3.6 Odour	N	A1	N	U1	

Assessment Classification

A1 : Adverse impact - minor

A2 : Adverse impact - medium / moderate

A3 : Adverse impact - major / significant

U1 : Unknown due to insufficient data but probably minor impact (A1) or no adverse impact

U2 : Unknown due to insufficient data but probably adverse impact (A2 or A3)

N : No adverse impact

B1 : Beneficial / positive impact - minor

B2 : Beneficial / positive impact - major

TABLE IV.12.2.2

ASSESSMENT MATRIX OF ENVIRONMENTAL IMPACT
FOR JENIANG TRANSFER PROJECT

Environment Factors	Breakdown of Project / Scheme				Remarks
	Activities			Existence of Structures	
	Site Invest.	Construction	O & M		
1. Social Environment					
1.1 Resettlement	N	U1	N	A2	Some houses submerged
1.2 Economic Activities	N	B2	B1	B1	Increase of income/job
1.3 Transportation / Public Facilities	N	A1	N	B1	More convenient by the project
1.4 Division of Communities	N	A1	N	A1	
1.5 Archaeological / Cultural Heritage	U1	U1	U1	U1	No significant site
1.6 Vested Right	U1	U1	U1	U1	No definite right now
1.7 Health and Hygiene	N	A1	N	U1	Generally not significant
1.8 Waste Disposal	A1	A1	A1	N	Increase of waste
1.9 Accident	N	A1	N	N	Only during construction
2. Natural Environment					
2.1 Topography and Geology	A1	U1	N	A1	Effect not significant
2.2 Soil Erosion	A1	A2	N	A1	By logging & land clearing
2.3 Ground Water	N	N	N	U1	
2.4 River and Reservoir / pond	N	N	N	A1	
2.5 Coastal Zone	N	N	N	A1	Far to the coast
2.6 Fauna (Wildlife)	N	U1	N	U1	No valuable species
2.7 Flora (Vegetation)	N	U1	N	U1	Forest logging
2.8 Climate	N	N	N	N	
2.9 Landscape	N	A1	N	B2	Beautiful water front
3. Public Nuisance					
3.1 Air Pollution	N	N	N	N	
3.2 Water Pollution	N	A2	N	U1	Reservoir eutrophication
3.3 Soil Contamination	N	A1	N	N	
3.4 Noise and Vibration	A1	A1	N	N	
3.5 Ground Subsidence	N	N	N	N	
3.6 Odour	N	A1	N	U1	

Assessment Classification

A1 : Adverse impact - minor

A2 : Adverse impact - medium / moderate

A3 : Adverse impact - major / significant

U1 : Unknown due to insufficient data but probably minor impact (A1) or no adverse impact

U2 : Unknown due to insufficient data but probably adverse impact (A2 or A3)

N : No adverse impact

B1 : Beneficial / positive impact - minor

B2 : Beneficial / positive impact - major

TABLE IV.12.2.3

ASSESSMENT MATRIX OF ENVIRONMENTAL IMPACT
FOR LOWER REACH RIVER IMPROVEMENT WORKS

Environment Factors	Breakdown of Project / Scheme				Remarks
	Activities			Existence of Structures	
	Site Invest.	Construction	O & M		
1. Social Environment					
1.1 Resettlement	N	U1	N	A2	Some houses relocated
1.2 Economic Activities	N	B2	B1	N	Increase of income/job
1.3 Transportation / Public Facilities	N	N	N	N	
1.4 Division of Communities	N	A1	N	N	
1.5 Archaeological / Cultural Heritage	U1	U1	U1	U1	No significant site
1.6 Vested Right	U1	U1	U1	U1	No definite right now
1.7 Health and Hygiene	N	A1	N	U1	
1.8 Waste Disposal	A1	A1	A1	N	
1.9 Accident	N	A1	N	N	
2. Natural Environment					
2.1 Topography and Geology	N	U1	N	A1	
2.2 Soil Erosion	A1	A1	N	N	
2.3 Ground Water	N	N	N	U1	
2.4 River and Reservoir / pond	N	A1	N	A1	
2.5 Coastal Zone	N	N	N	B1	River mouth improved
2.6 Fauna (Wildlife)	N	U1	N	U1	No valuable species
2.7 Flora (Vegetation)	N	A1	N	U1	
2.8 Climate	N	N	N	N	
2.9 Landscape	N	A1	N	B1	
3. Public Nuisance					
3.1 Air Pollution	N	N	N	N	
3.2 Water Pollution	N	A1	N	N	
3.3 Soil Contamination	N	A1	N	N	
3.4 Noise and Vibration	A1	A1	N	N	
3.5 Ground Subsidence	N	N	N	N	
3.6 Odour	N	A1	N	U1	

Assessment Classification

A1 : Adverse impact - minor

A2 : Adverse impact - medium / moderate

A3 : Adverse impact - major / significant

U1 : Unknown due to insufficient data but probably minor impact (A1) or no adverse impact

U2 : Unknown due to insufficient data but probably adverse impact (A2 or A3)

N : No adverse impact

B1 : Beneficial / positive impact - minor

B2 : Beneficial / positive impact - major

TABLE IV.12.2.4 ASSESSMENT MATRIX OF ENVIRONMENTAL IMPACT FOR BERIS RESERVOIR RECREATIONAL PARK SCHEME

Environment Factors	Breakdown of Project / Scheme				Remarks
	Activities			Existence of Structures	
	Site Invest.	Construction	O & M		
1. Social Environment					
1.1 Resettlement	N	U1	N	U1	
1.2 Economic Activities	N	B2	B1	B2	Increase of income/job
1.3 Transportation / Public Facilities	N	A1	N	B1	More convenient
1.4 Division of Communities	N	N	N	N	
1.5 Archaeological / Cultural Heritage	U1	U1	U1	U1	No significant site
1.6 Vested Right	U1	U1	U1	U1	No definite right now
1.7 Health and Hygiene	N	A1	N	U1	
1.8 Waste Disposal	A1	A1	A1	A1	Depend on management
1.9 Accident	N	A1	N	N	
2. Natural Environment					
2.1 Topography and Geology	N	U1	N	A1	
2.2 Soil Erosion	A1	A1	N	A1	
2.3 Ground Water	N	N	N	U1	
2.4 River and Reservoir / pond	N	N	N	N	
2.5 Coastal Zone	N	N	N	N	
2.6 Fauna (Wildlife)	N	U1	N	U1	
2.7 Flora (Vegetation)	N	A1	N	A1	
2.8 Climate	N	N	N	N	
2.9 Landscape	N	A1	N	B2	Beautiful park
3. Public Nuisance					
3.1 Air Pollution	N	N	N	N	
3.2 Water Pollution	N	A1	N	A2	Drainage from park
3.3 Soil Contamination	N	A1	N	N	
3.4 Noise and Vibration	N	A1	N	N	
3.5 Ground Subsidence	N	N	N	N	
3.6 Odour	N	A1	N	U1	

Assessment Classification

A1 : Adverse impact - minor

A2 : Adverse impact - medium / moderate

A3 : Adverse impact - major / significant

U1 : Unknow due to insufficient data but probably minor impact (A1) or no adverse impact

U2 : Unknow due to insufficient data but probably adverse impact (A2 or A3)

N : No adverse impact

B1 : Beneficial / positive impact - minor

B2 : Beneficial / positive impact - major

TABLE IV.12.2.5 ASSESSMENT MATRIX OF ENVIRONMENTAL IMPACT FOR MUDA BARRAGE RECREATIONAL PARK SCHEME

Environment Factors	Breakdown of Project / Scheme				Remarks
	Activities			Existence of Structures	
	Site Invest.	Construction	O & M		
1. Social Environment					
1.1 Resettlement	N	U1	N	N	
1.2 Economic Activities	N	B2	B1	B1	Increase of income/job
1.3 Transportation / Public Facilities	N	A1	N	B1	
1.4 Division of Communities	N	N	N	N	
1.5 Archaeological / Cultural Heritage	N	U1	N	U1	Existing Muda barrage
1.6 Vested Right	N	U1	N	U1	No definite right now
1.7 Health and Hygiene	N	A1	N	U1	
1.8 Waste Disposal	A1	A1	A1	A1	Depend on management
1.9 Accident	N	A1	N	N	
2. Natural Environment					
2.1 Topography and Geology	N	U1	N	U1	
2.2 Soil Erosion	A1	A1	N	N	
2.3 Ground Water	N	N	N	U1	
2.4 River and Reservoir / pond	N	A1	N	A1	Cut off of river
2.5 Coastal Zone	N	N	N	N	
2.6 Fauna (Wildlife)	N	N	N	N	No valuable species
2.7 Flora (Vegetation)	A1	N	N	N	
2.8 Climate	N	N	N	N	
2.9 Landscape	N	A1	N	B2	Beautiful park & water front
3. Public Nuisance					
3.1 Air Pollution	N	N	N	N	
3.2 Water Pollution	N	A1	N	U1	
3.3 Soil Contamination	N	A1	N	N	
3.4 Noise and Vibration	N	A1	N	N	
3.5 Ground Subsidence	N	N	N	N	
3.6 Odour	N	A1	N	N	

Assessment Classification

A1 : Adverse impact - minor

A2 : Adverse impact - medium / moderate

A3 : Adverse impact - major / significant

U1 : Unknow due to insufficient data but probably minor impact (A1) or no adverse impact

U2 : Unknow due to insufficient data but probably adverse impact (A2 or A3)

N : No adverse impact

B1 : Beneficial / positive impact - minor

B2 : Beneficial / positive impact - major

TABLE IV.12.2.6

ASSESSMENT MATRIX OF ENVIRONMENTAL IMPACT FOR
BUMBONG LIMA RECREATIONAL PARK SCHEME

Environment Factors	Breakdown of Project / Scheme				Remarks
	Activities			Existence of Structures	
	Site Invest.	Construction	O & M		
1. Social Environment					
1.1 Resettlement	N	U1	N	A2	Some houses relocated
1.2 Economic Activities	N	B2	B1	B1	Increase of income/job
1.3 Transportation / Public Facilities	N	A1	N	B1	
1.4 Division of Communities	N	N	N	N	
1.5 Archaeological / Cultural Heritage	N	U1	N	U1	Existing Muda barrage
1.6 Vested Right	N	U1	N	U1	No definite right now
1.7 Health and Hygiene	N	A1	N	U1	
1.8 Waste Disposal	A1	A1	A1	A1	Depend on management
1.9 Accident	N	A1	N	N	
2. Natural Environment					
2.1 Topography and Geology	N	U1	N	U1	
2.2 Soil Erosion	A1	A1	N	N	
2.3 Ground Water	N	N	N	U1	
2.4 River and Reservoir / pond	N	A1	N	A1	Cut off of river
2.5 Coastal Zone	N	N	N	N	
2.6 Fauna (Wildlife)	N	N	N	U1	No valuable species
2.7 Flora (Vegetation)	N	N	N	N	
2.8 Climate	N	N	N	N	
2.9 Landscape	N	A1	N	B2	Beautiful park & water front
3. Public Nuisance					
3.1 Air Pollution	N	N	N	N	
3.2 Water Pollution	N	A1	N	U1	
3.3 Soil Contamination	N	A1	N	N	
3.4 Noise and Vibration	N	A1	N	N	
3.5 Ground Subsidence	N	N	N	N	
3.6 Odour	N	A1	N	N	

Assessment Classification

A1 : Adverse impact - minor

A2 : Adverse impact - medium / moderate

A3 : Adverse impact - major / significant

U1 : Unknow due to insufficient data but probably minor impact (A1) or no adverse impact

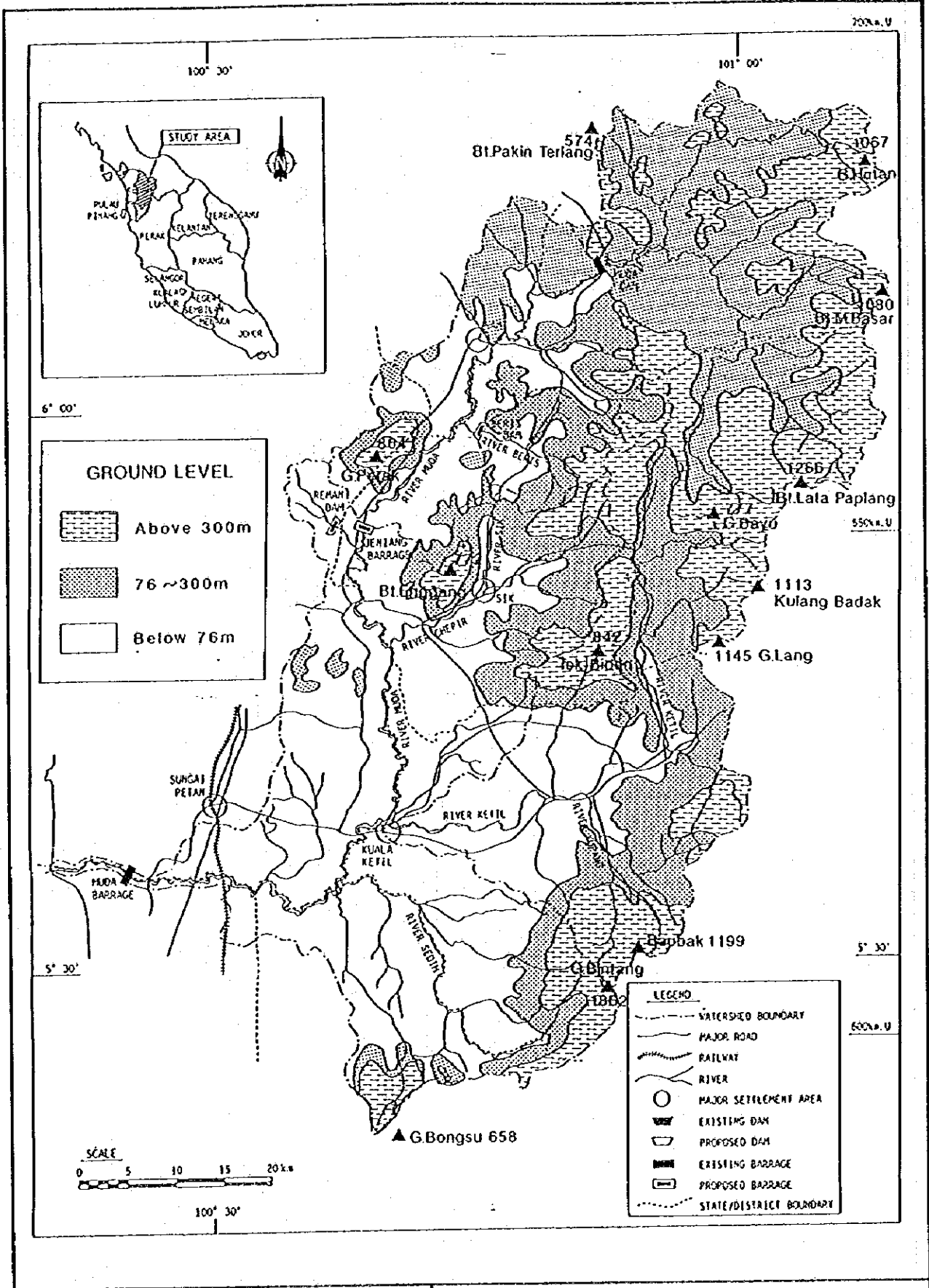
U2 : Unknow due to insufficient data but probably adverse impact (A2 or A3)

N : No adverse impact

B1 : Beneficial / positive impact - minor

B2 : Beneficial / positive impact - major

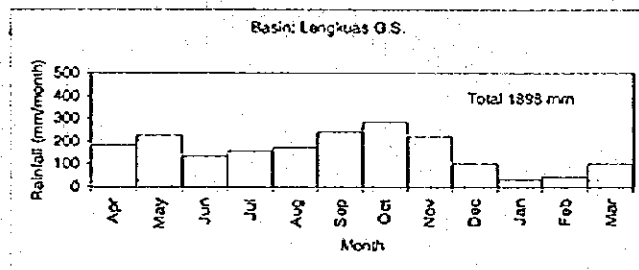
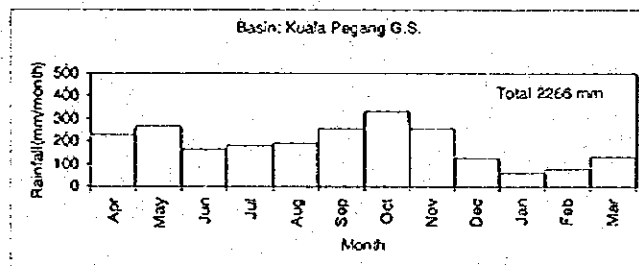
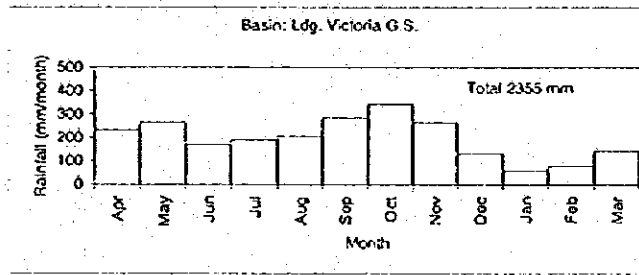
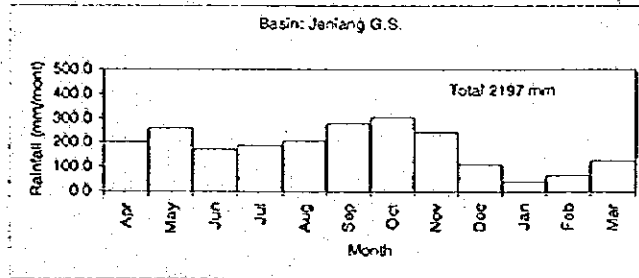
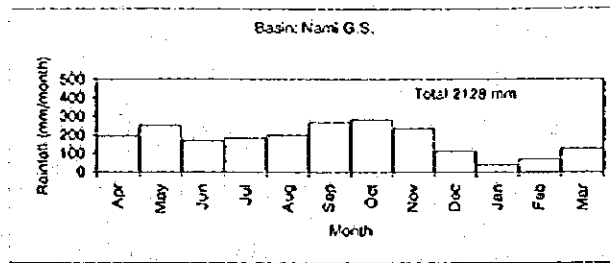
FIGURES
VOLUME 2
MAIN REPORT



COMPREHENSIVE MANAGEMENT PLAN OF MUDA RIVER BASIN

FIG. 2.1.1 TOPOGRAPHY OF MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

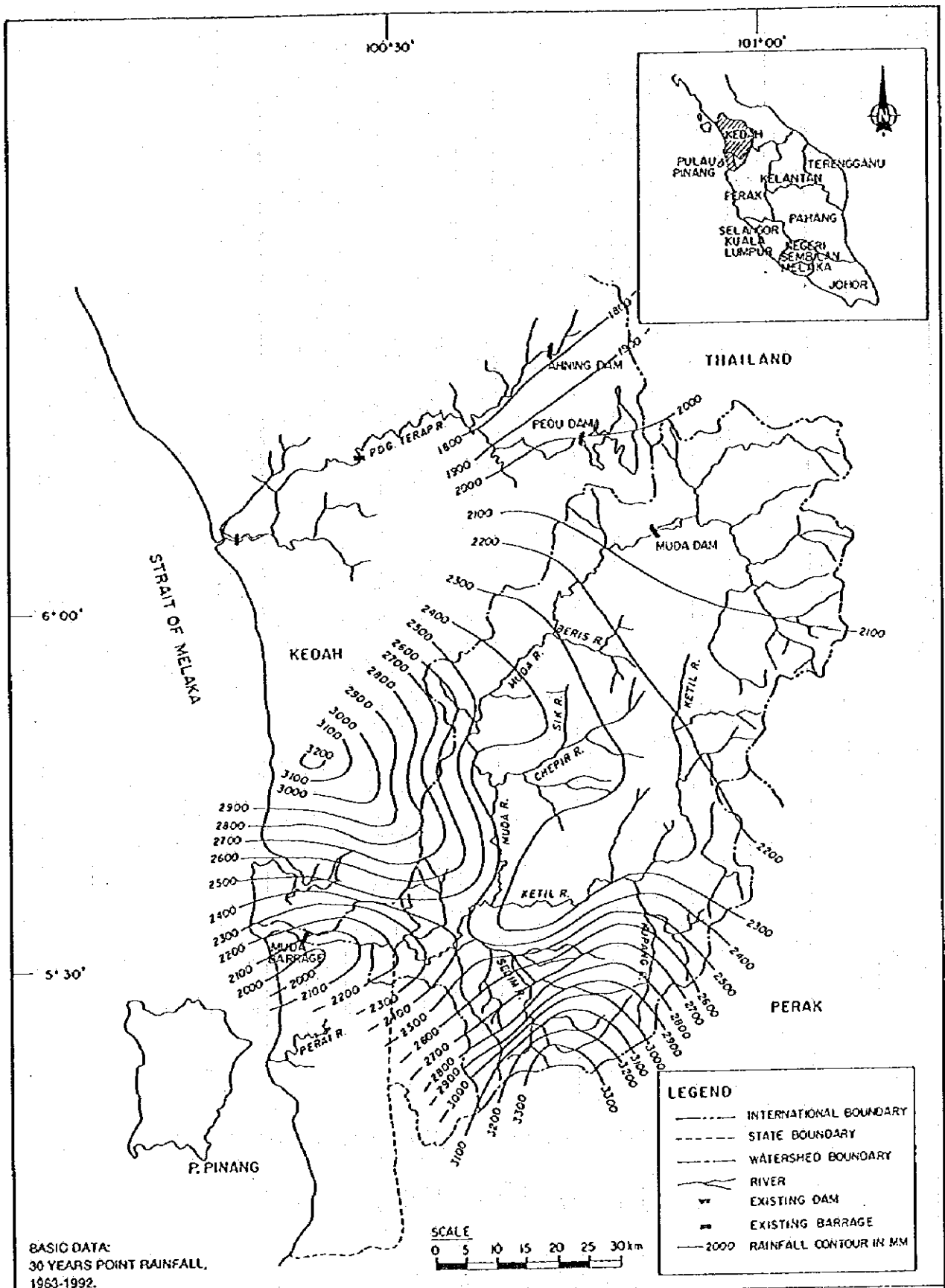


COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

FIG. 2.2.1

HYETOGRAPH OF MONTHLY BASIN AVERAGE
RAINFALL



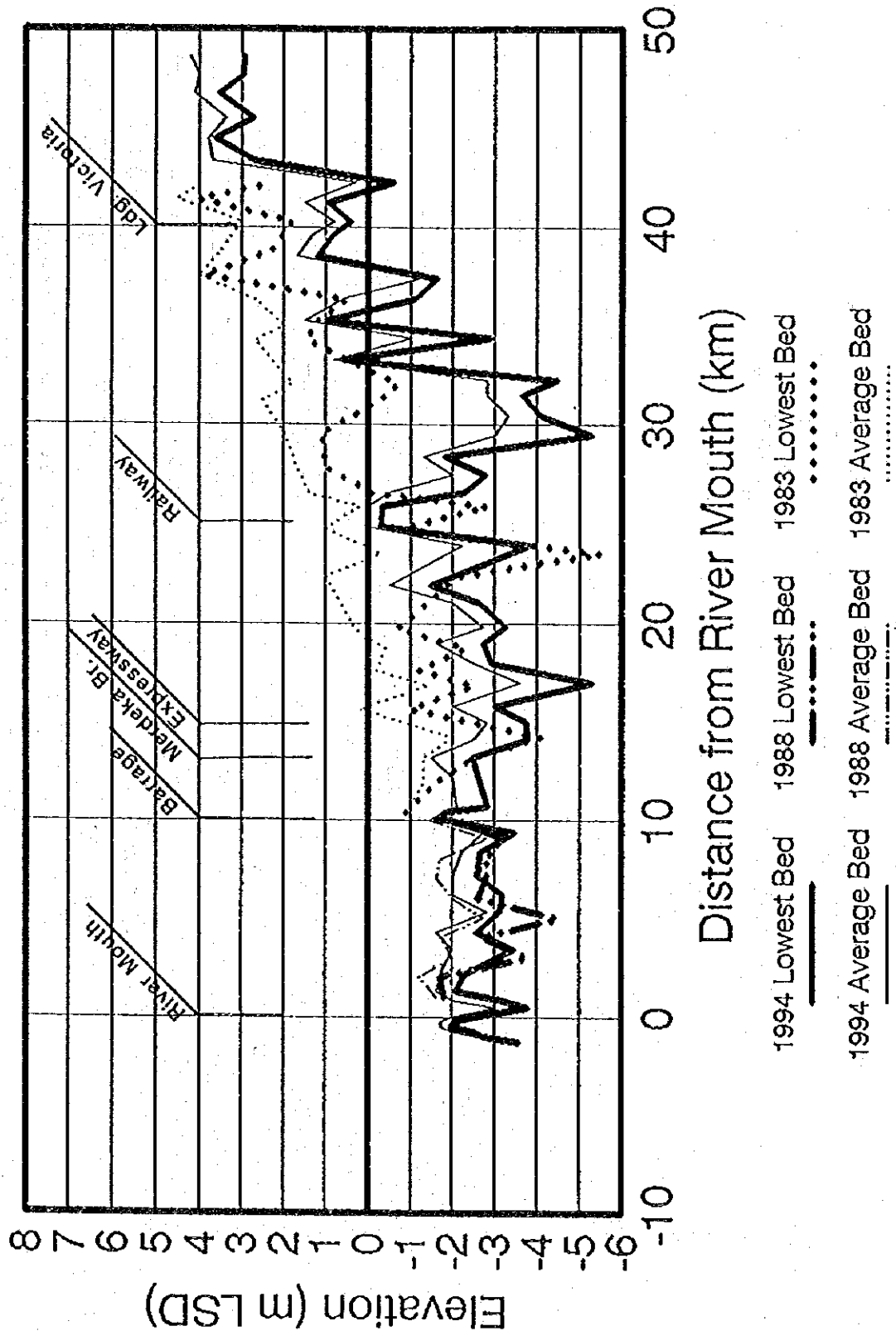
BASIC DATA:
30 YEARS POINT RAINFALL,
1963-1992.

COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

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FIG. 2.2.2
MEAN ANNUAL RAINFALL ISOHYETS OF MUDA
RIVER BASIN

Muda River



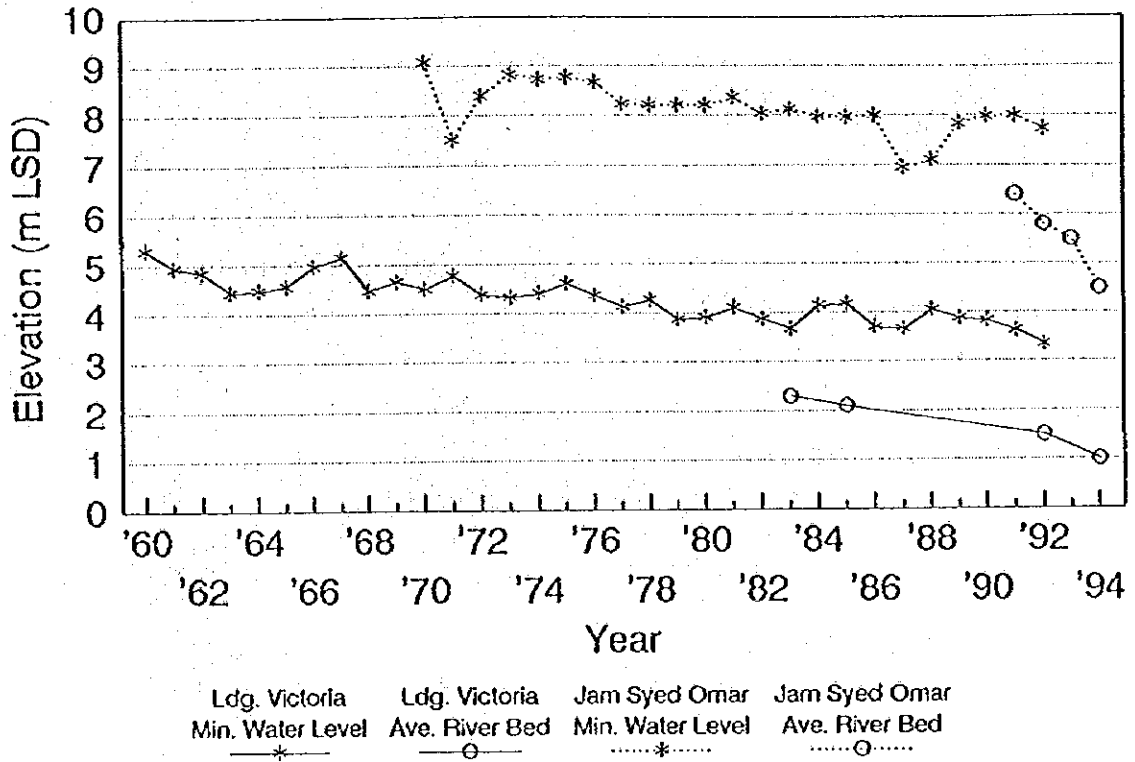
COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

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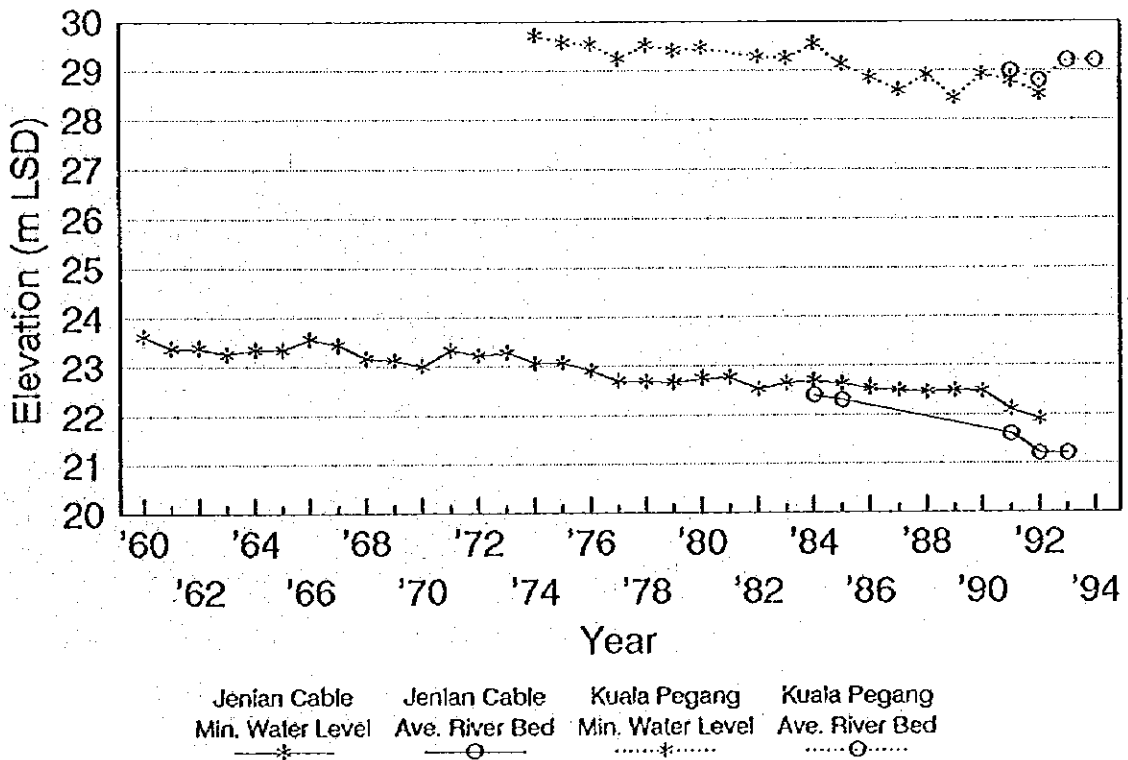
FIG. 2.3.1

CHANGE OF LONGITUDINAL PROFILE OF MUDA
RIVER

Ldg. Victoria and Jam. Syed Omar



Jenlan Cable and Kuala Pegang

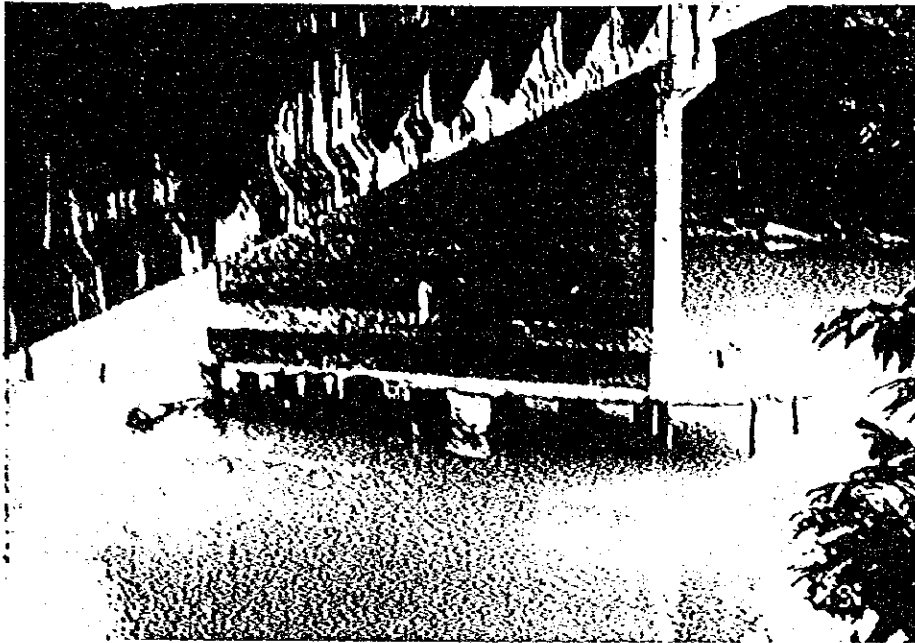


COMPREHENSIVE MANAGEMENT PLAN OF MUDA RIVER BASIN

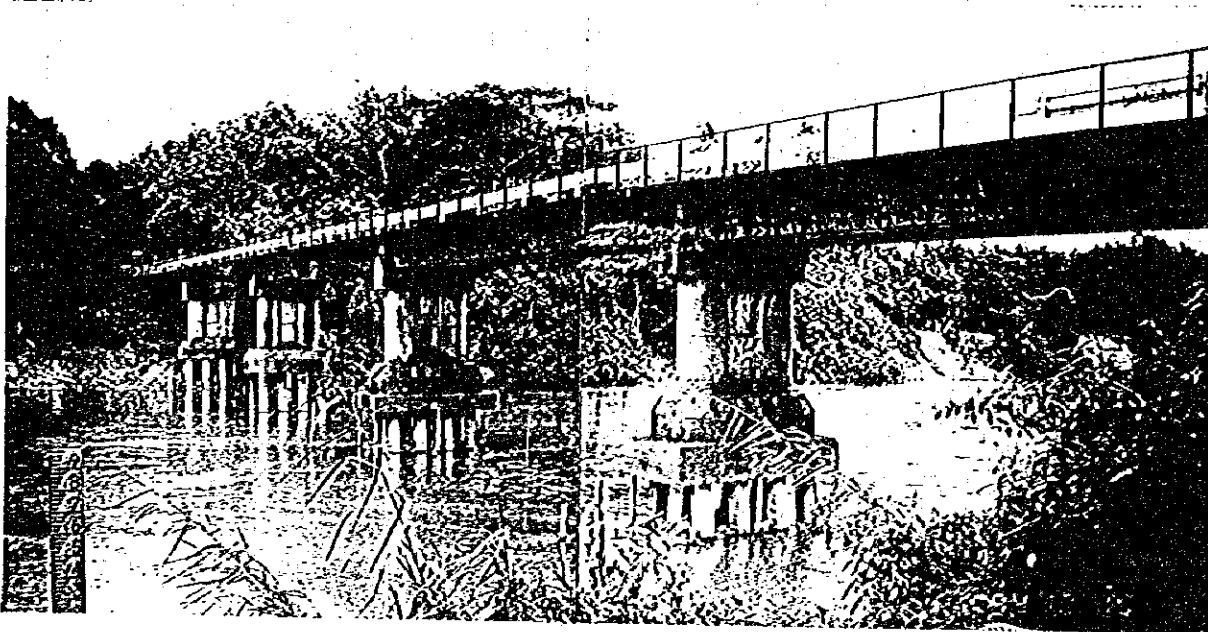
JAPAN INTERNATIONAL COOPERATION AGENCY

FIG. 2.3.2

CHANGE OF ANNUAL MINIMUM WATER LEVEL AT RIVER DISCHARGE STATION



(1) Bridge Crossing Kelil River 1km Upstream of Muda River



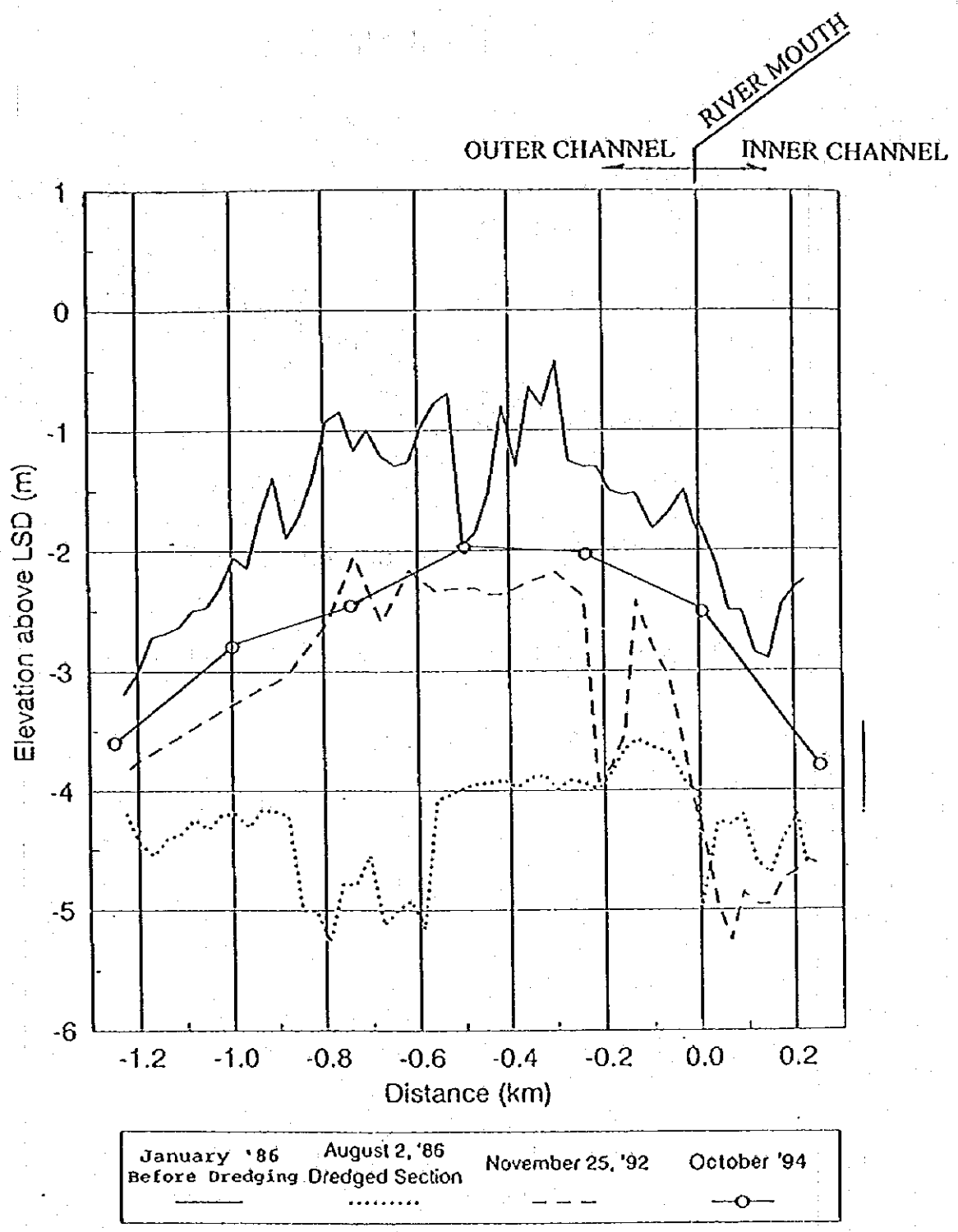
(2) Bridge Crossing Muda River at Ldg. Victoria

COMPREHENSIVE MANAGEMENT PLAN OF
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FIG. 2.3.3

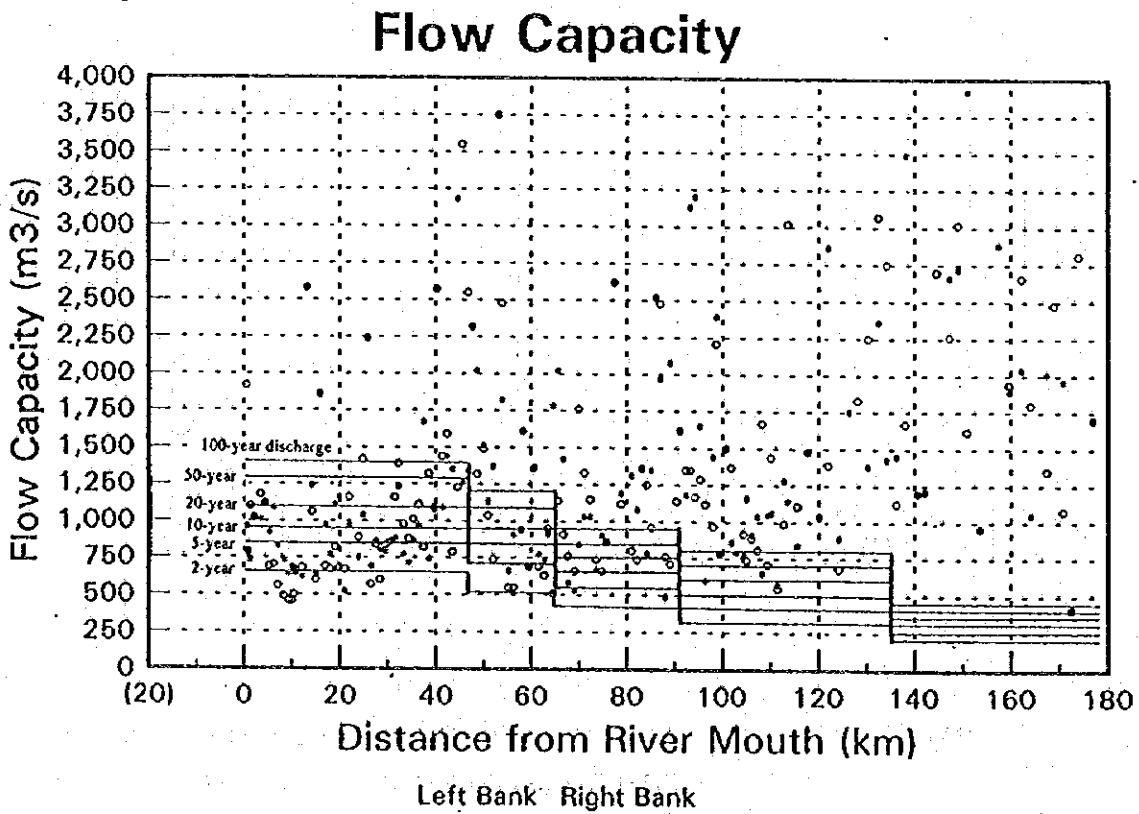
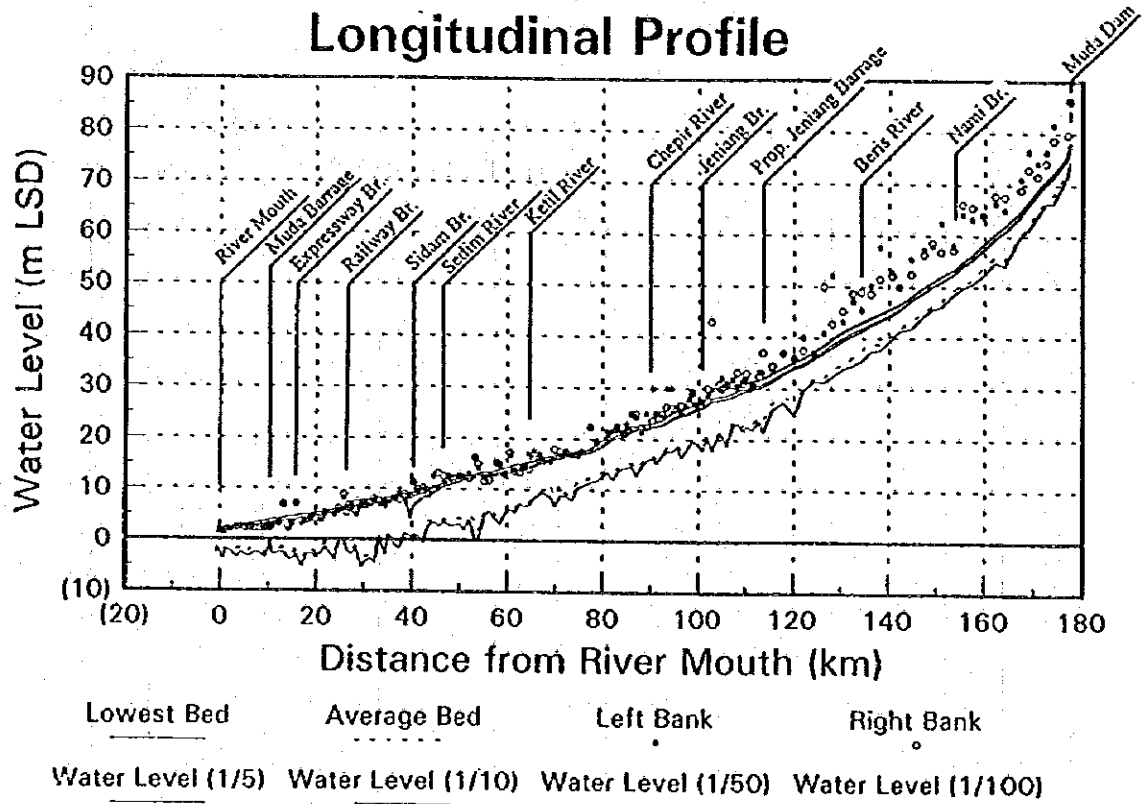
PHOTOGRAPH OF BRIDGE AFFECTED BY RIVER
BED SUBSIDENCE



DATA SOURCE: "THE NATIONAL RIVER MOUTH STUDY" DRAFT FINAL REPORT
VOL. 3 SUPPORTING REPORT, JICA, MARCH 1994

COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN
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FIG. 2.3.4
LONGITUDINAL PROFILE AT MUDA RIVER MOUTH



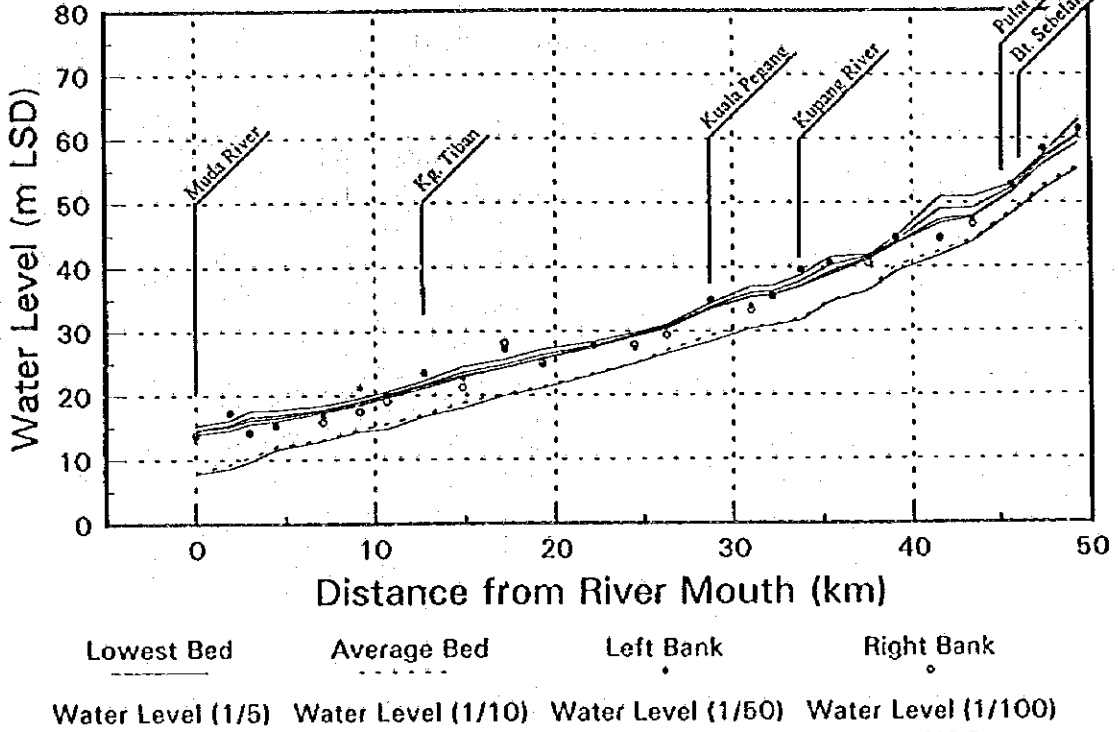
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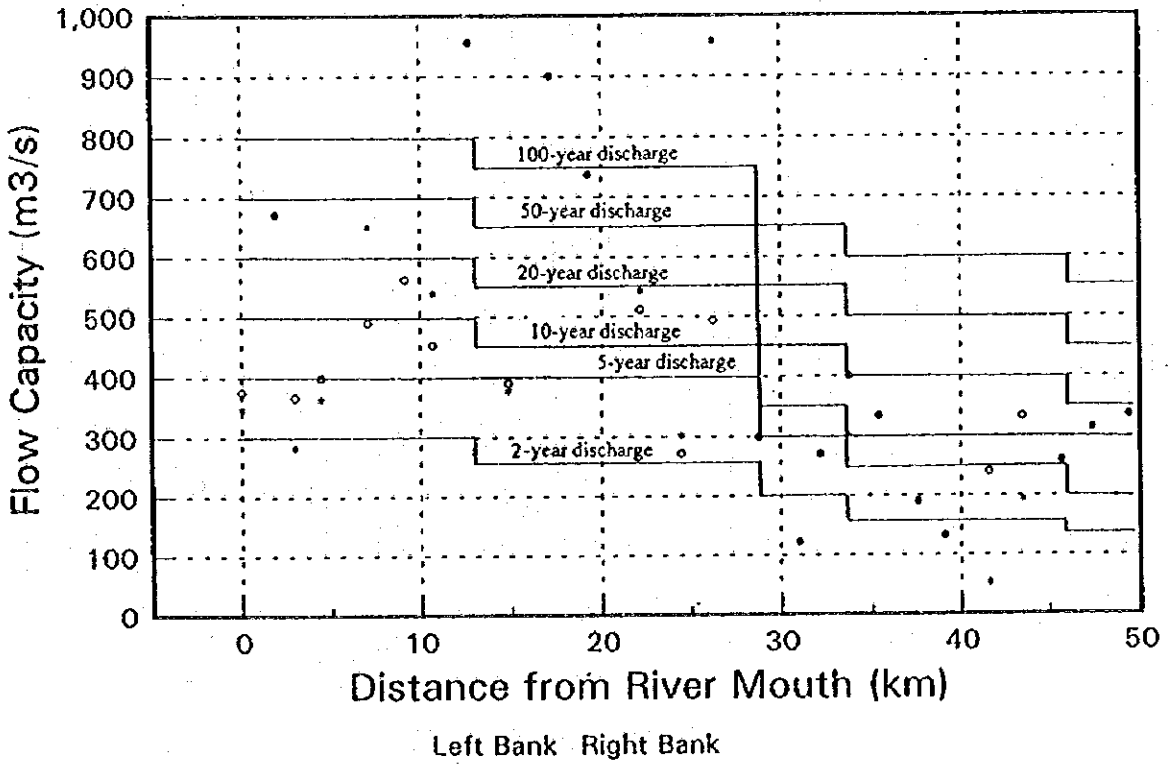
FIG. 2.3.5 (1/3)

FLOOD WATER PROFILE AND FLOW CAPACITY
(MUDA RIVER)

Longitudinal Profile



Flow Capacity

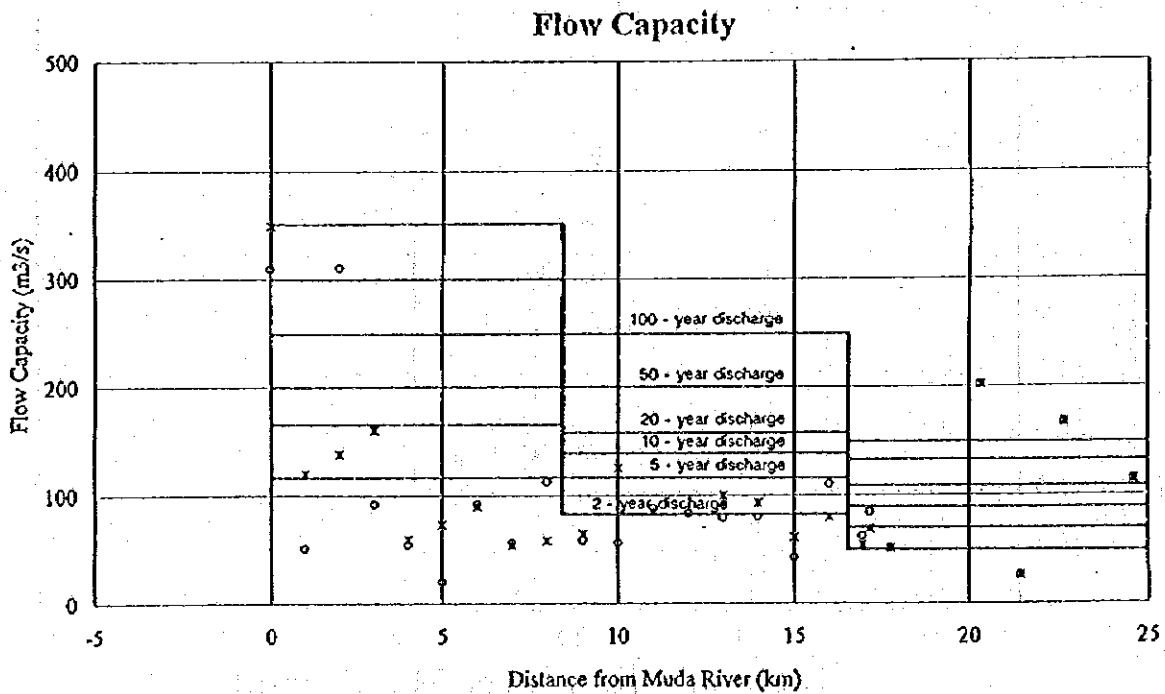
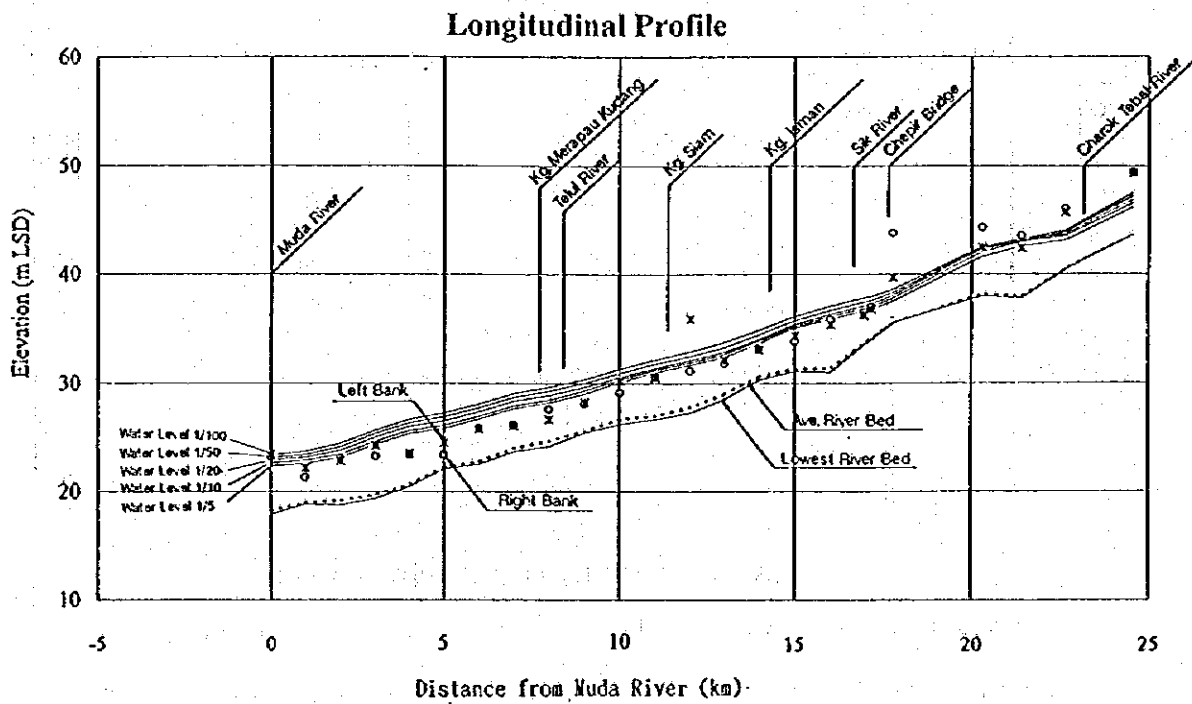


COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

FIG. 2.3.5 (2/3)

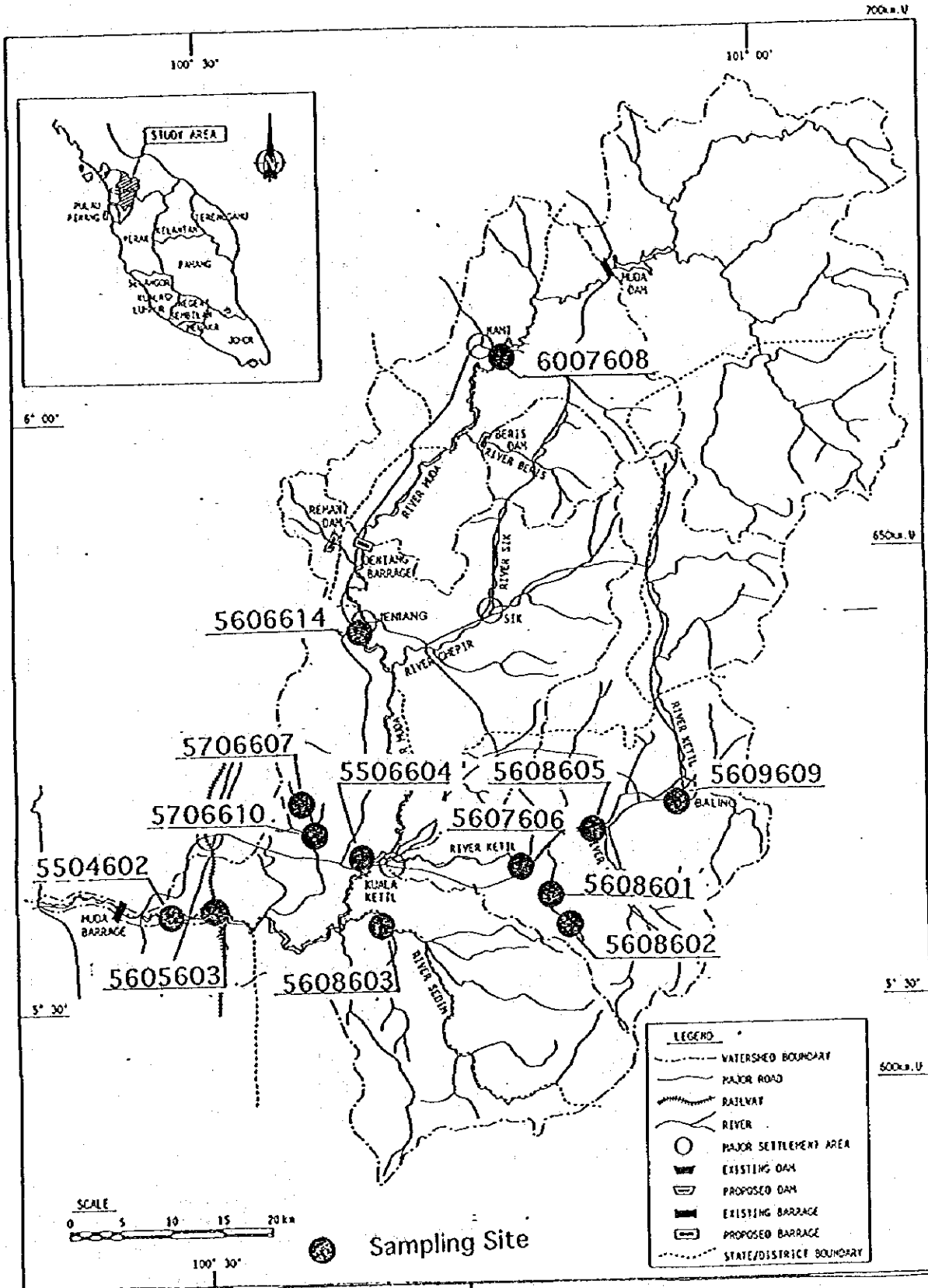
FLOOD WATER PROFILE AND FLOW CAPACITY
(KETIL RIVER)



COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

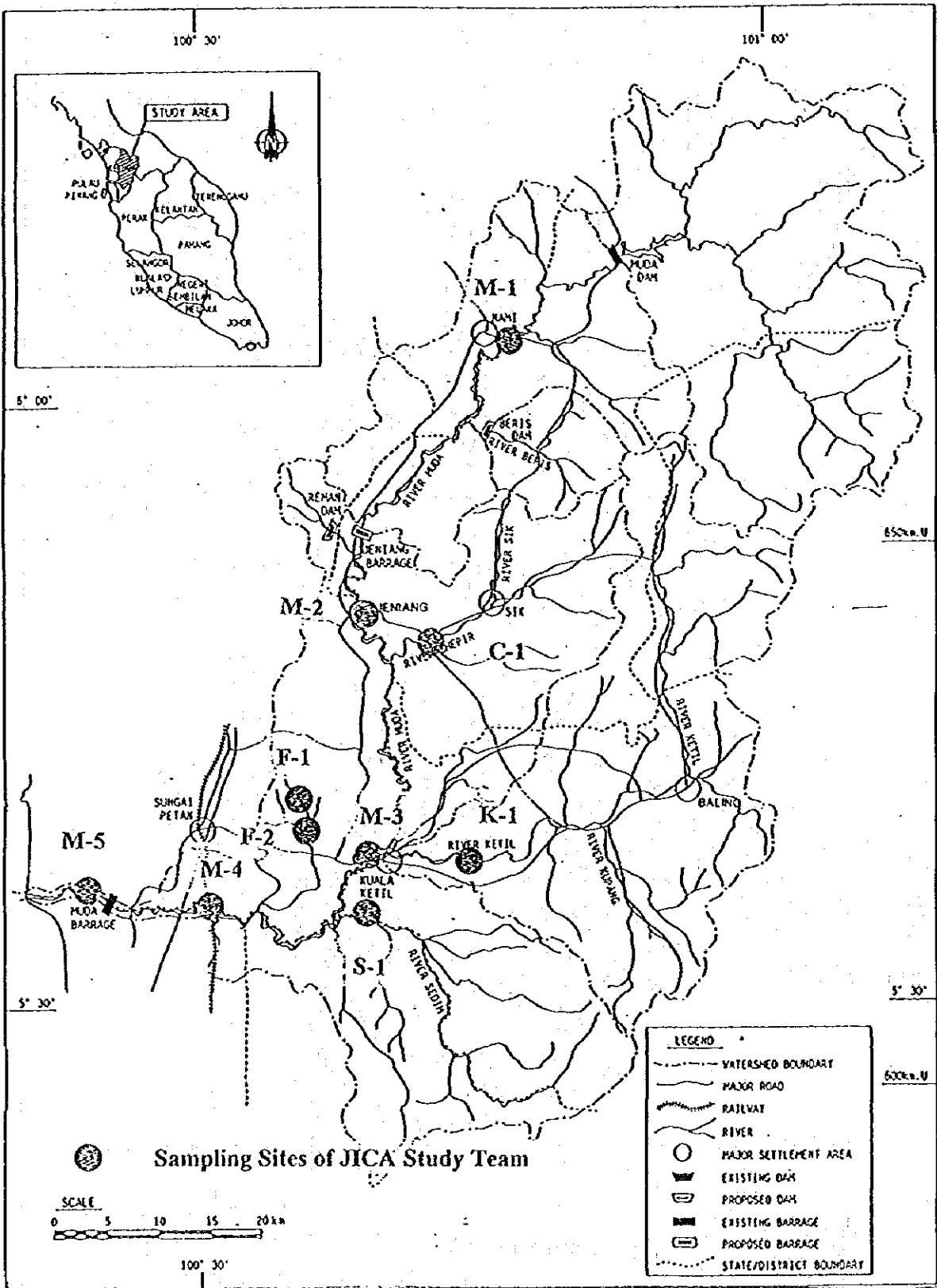
FIG. 2.3.5 (3/3)
FLOOD WATER PROFILE AND FLOW CAPACITY
(CHEPIR RIVER)



COMPREHENSIVE MANAGEMENT PLAN OF MUDA RIVER BASIN

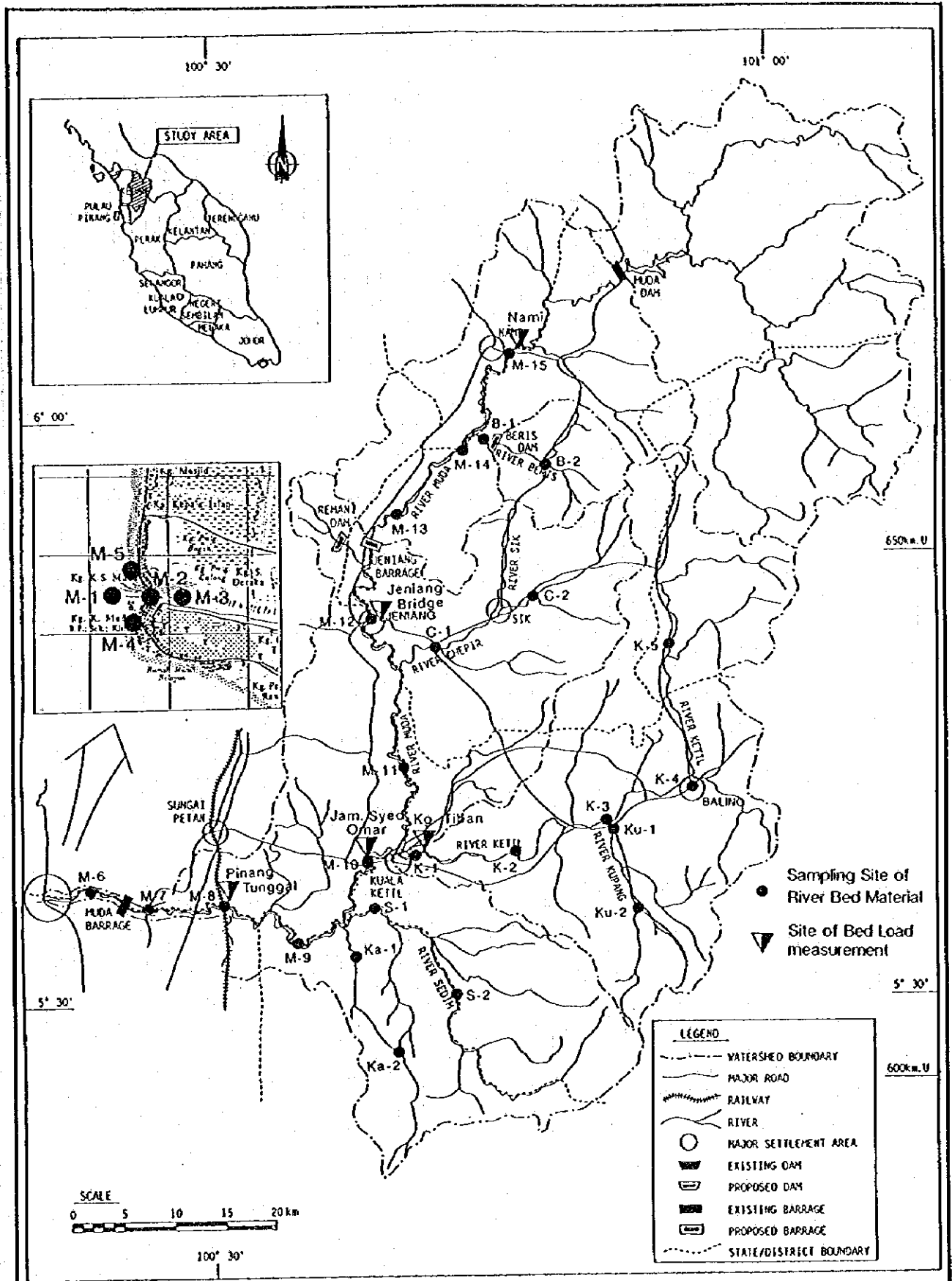
FIG. 2.3.6 WATER SAMPLING LOCATIONS OF DOE

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COMPREHENSIVE MANAGEMENT PLAN OF MUDA RIVER BASIN
 JAPAN INTERNATIONAL COOPERATION AGENCY

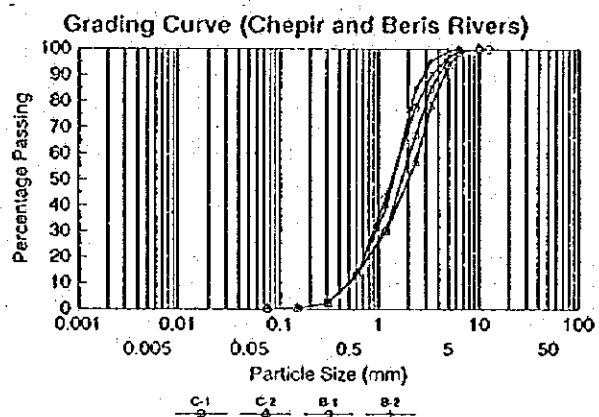
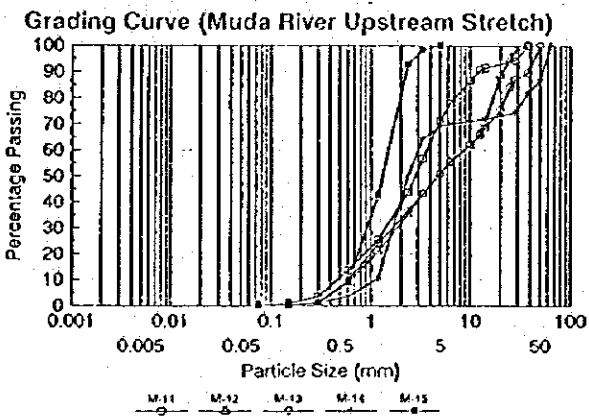
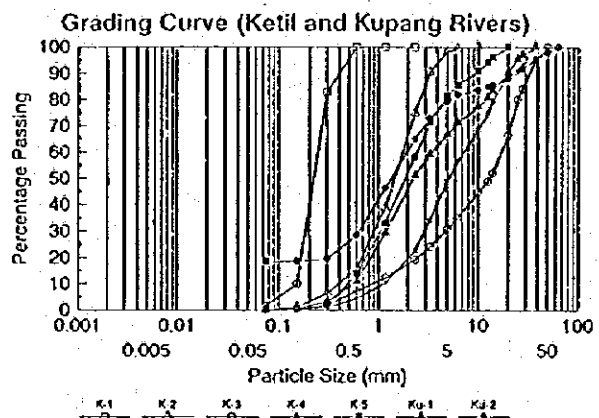
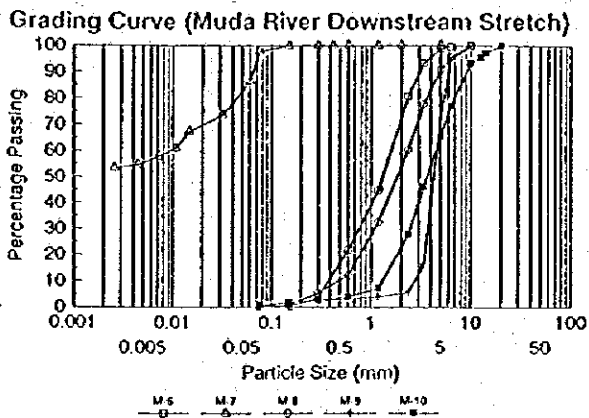
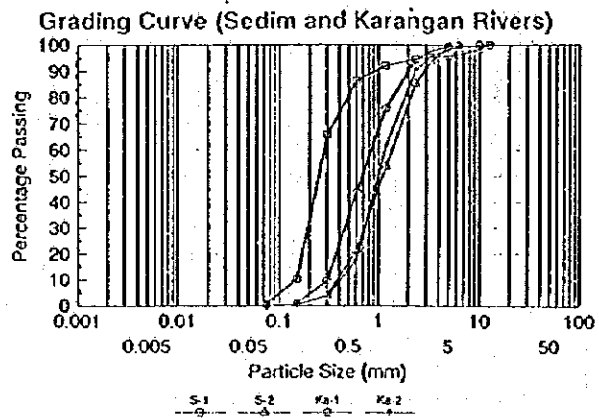
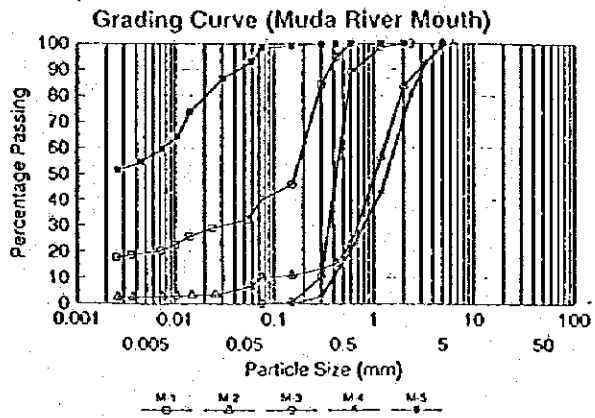
FIG. 2.3.7
 WATER SAMPLING LOCATIONS JICA STUDY TEAM



COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

FIG. 2.3.8
LOCATION OF RIVER SEDIMENT SURVEY

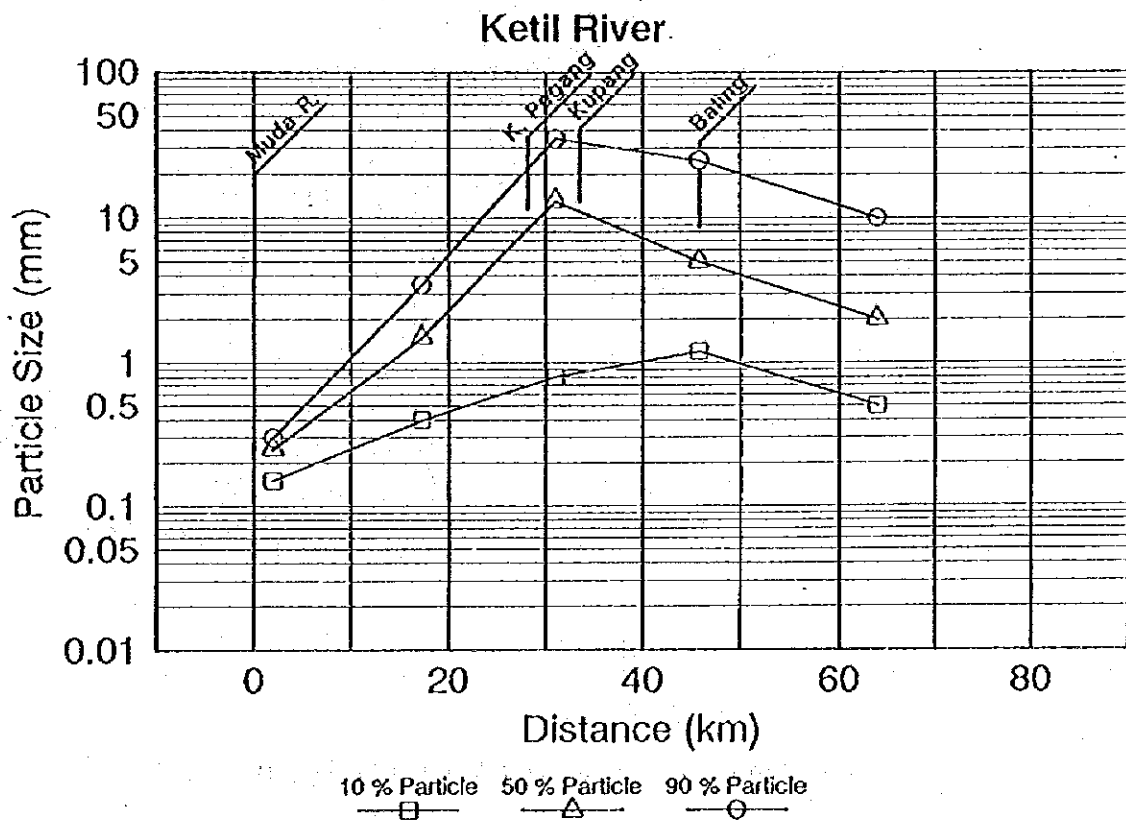
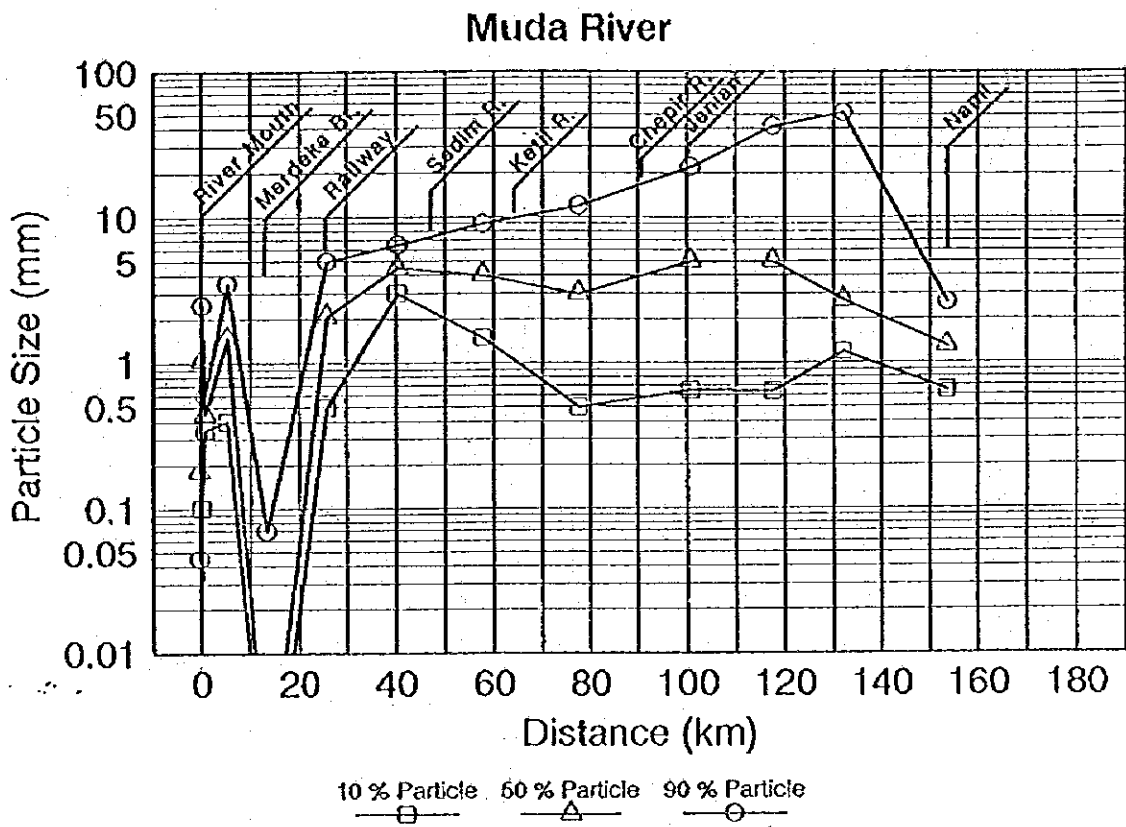


COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

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FIG. 2.3.9

GRADING CURVES OF RIVER BED MATERIAL IN
MUDA RIVER SYSTEM

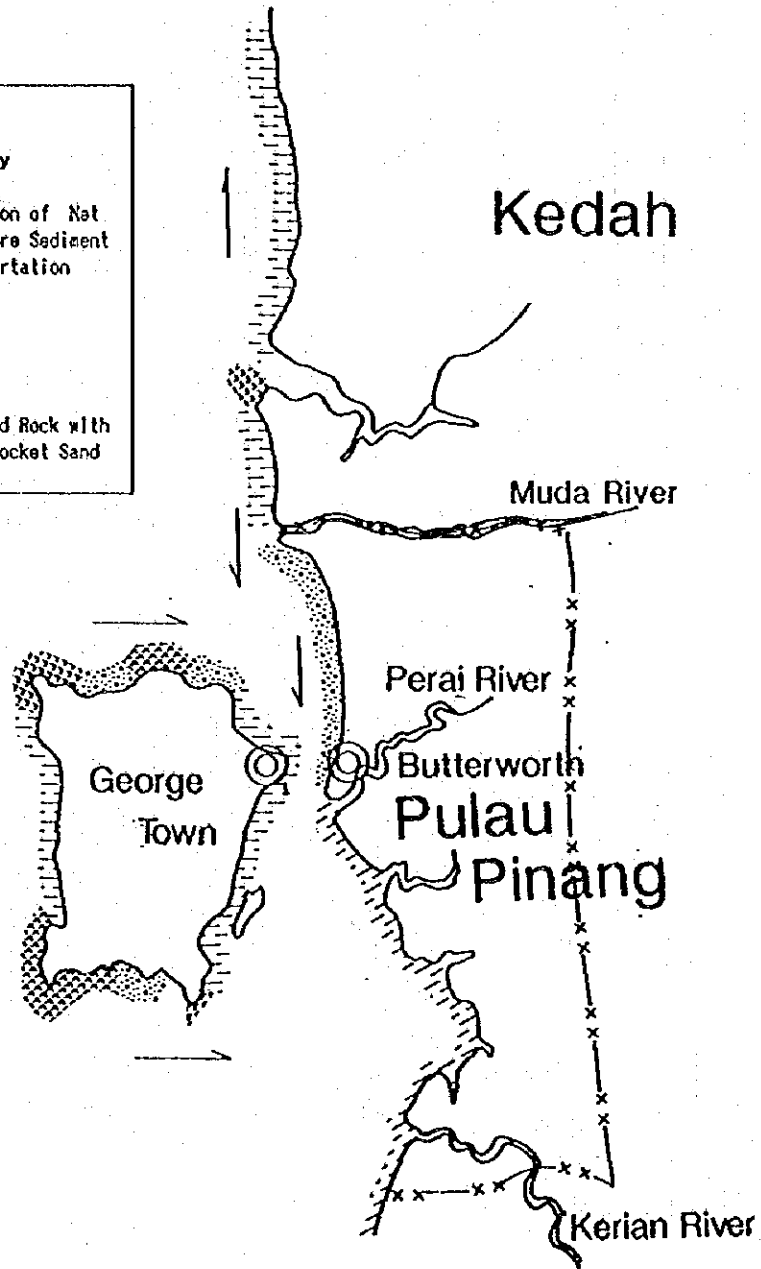
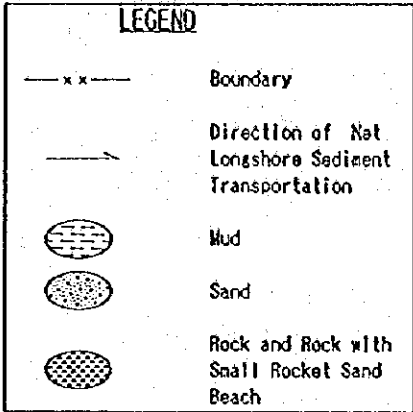
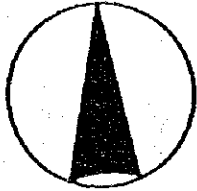


COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

FIG. 2.3.10

LONGITUDINAL DISTRIBUTION OF PARTICLE
SIZE ALONG MUDA AND KETIL RIVERS



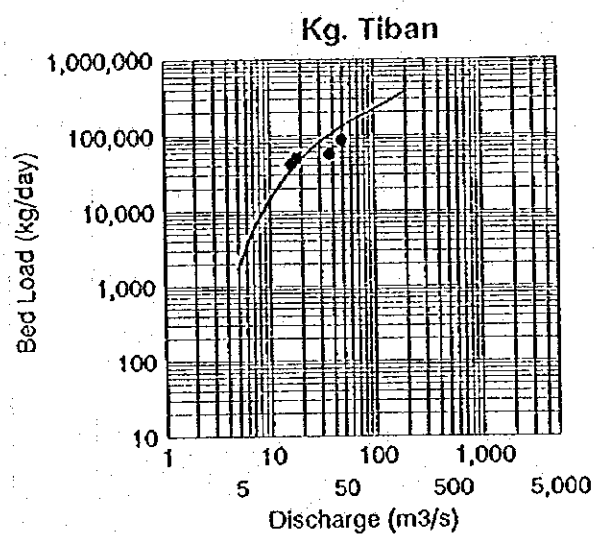
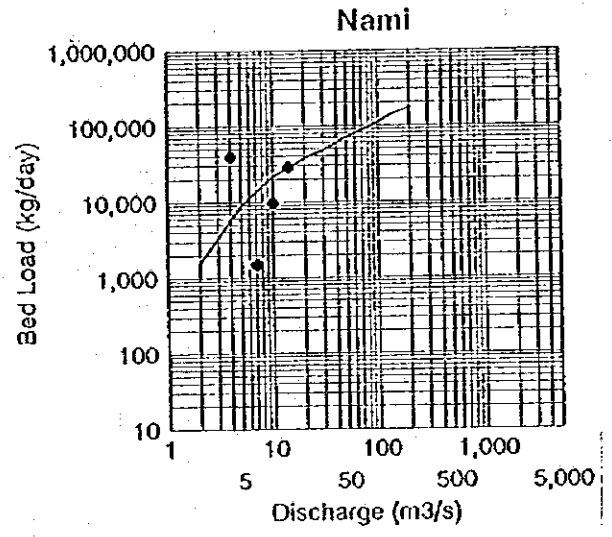
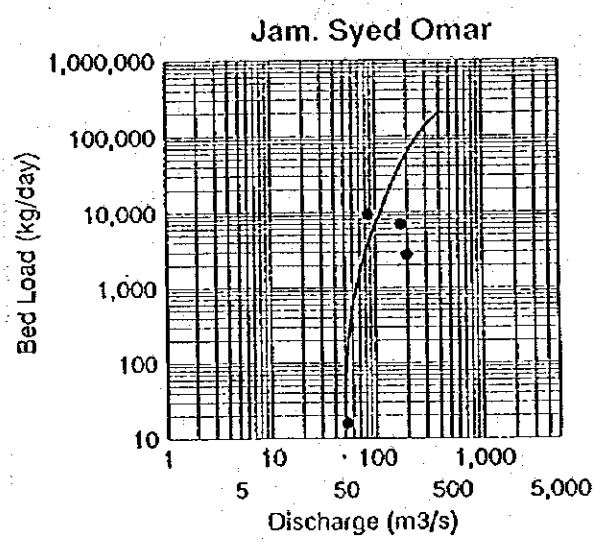
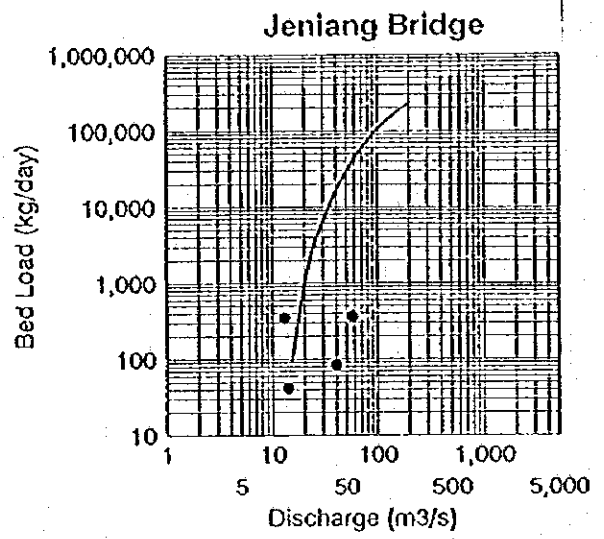
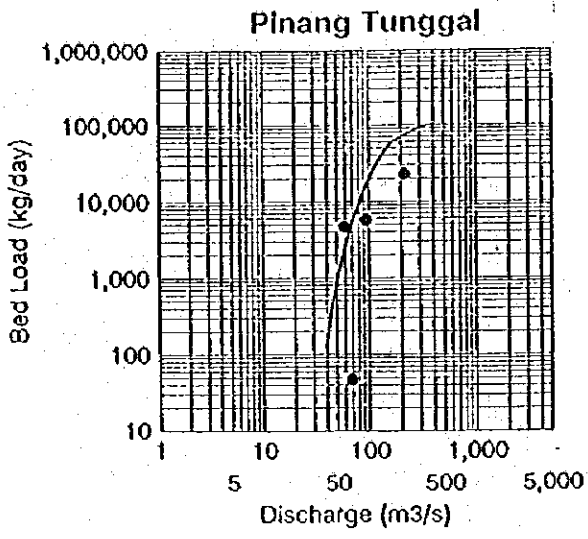
Data Source: National River Months Study, 1994. JICA

COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

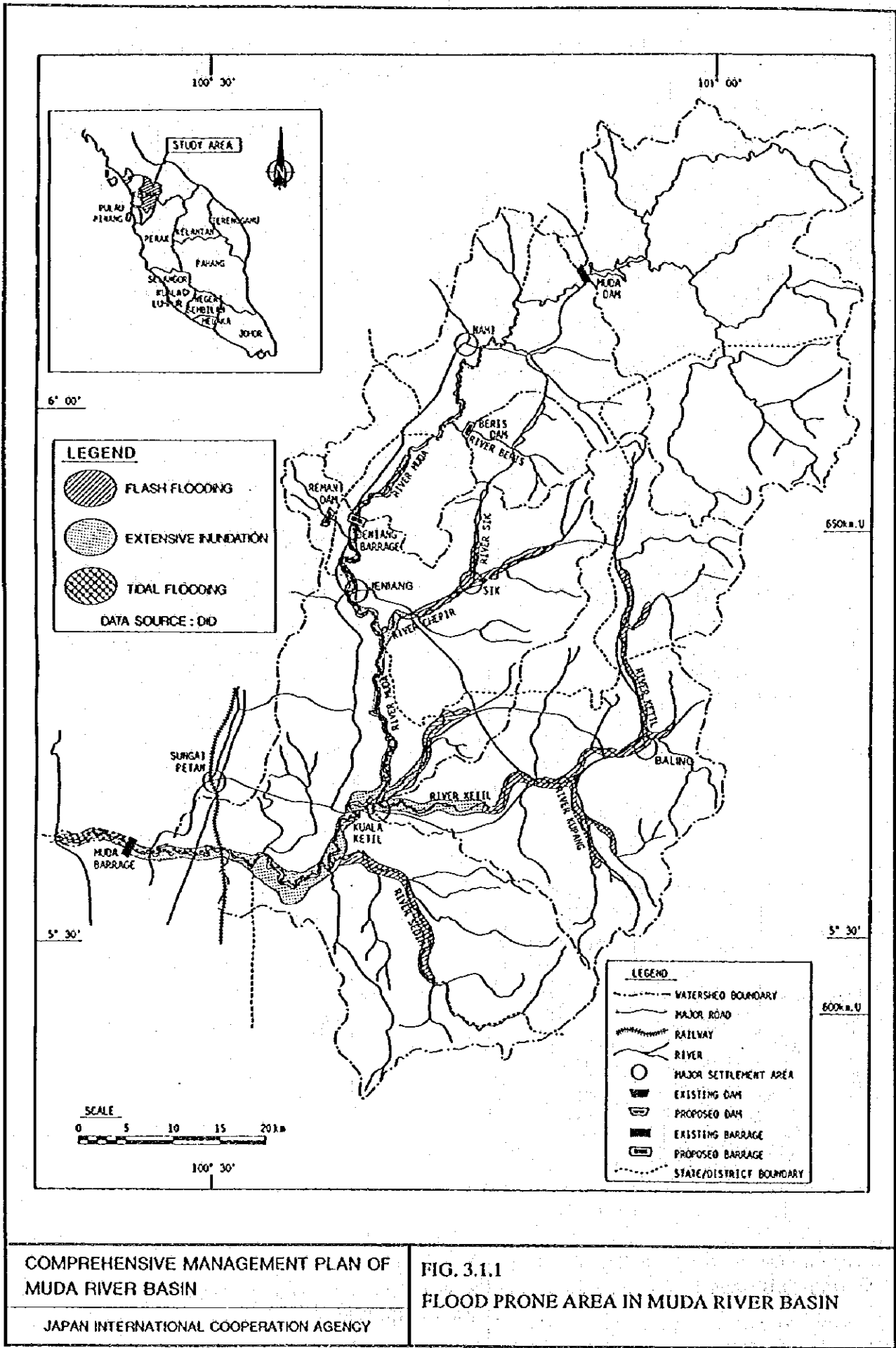
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FIG. 2.3.11

BEACH MATERIAL DISTRIBUTION AND DIRECTION
OF LONGSHORE SEDIMENT TRANSPORTATION



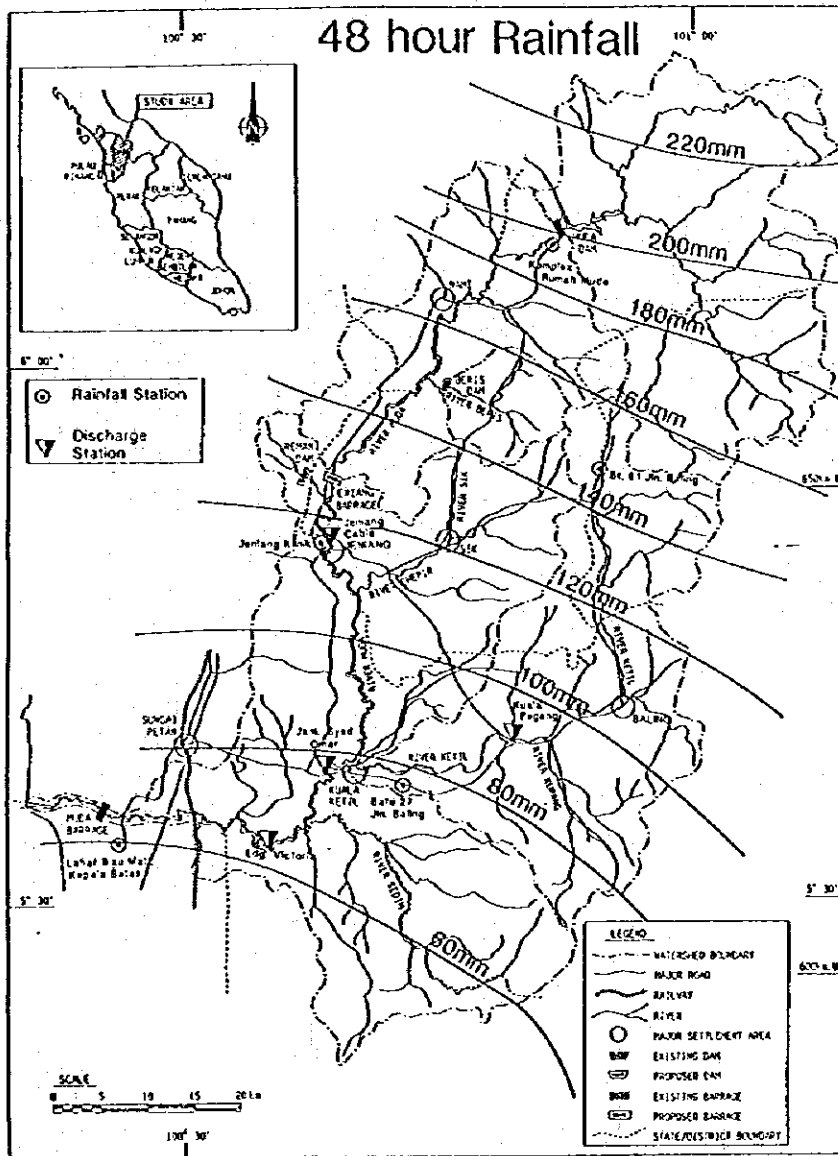
Observed Record
●
Sato-Kikkawa-Asida's
Formula



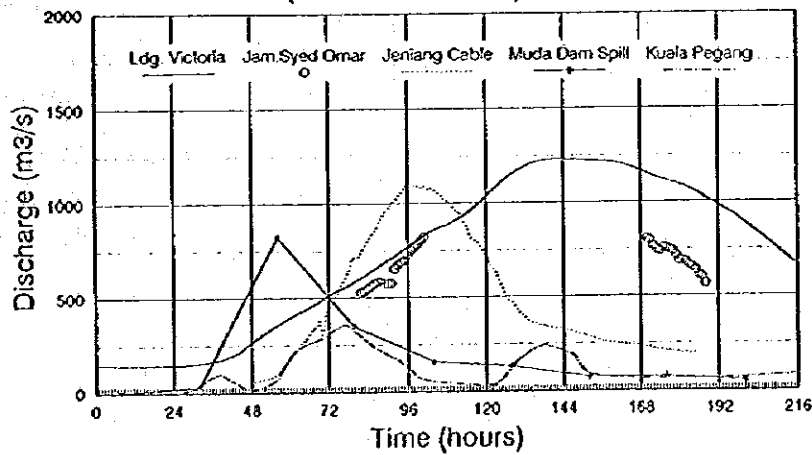
COMPREHENSIVE MANAGEMENT PLAN OF MUDA RIVER BASIN

FIG. 3.1.1 FLOOD PRONE AREA IN MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY



(19 Nov. - 27 Nov.)

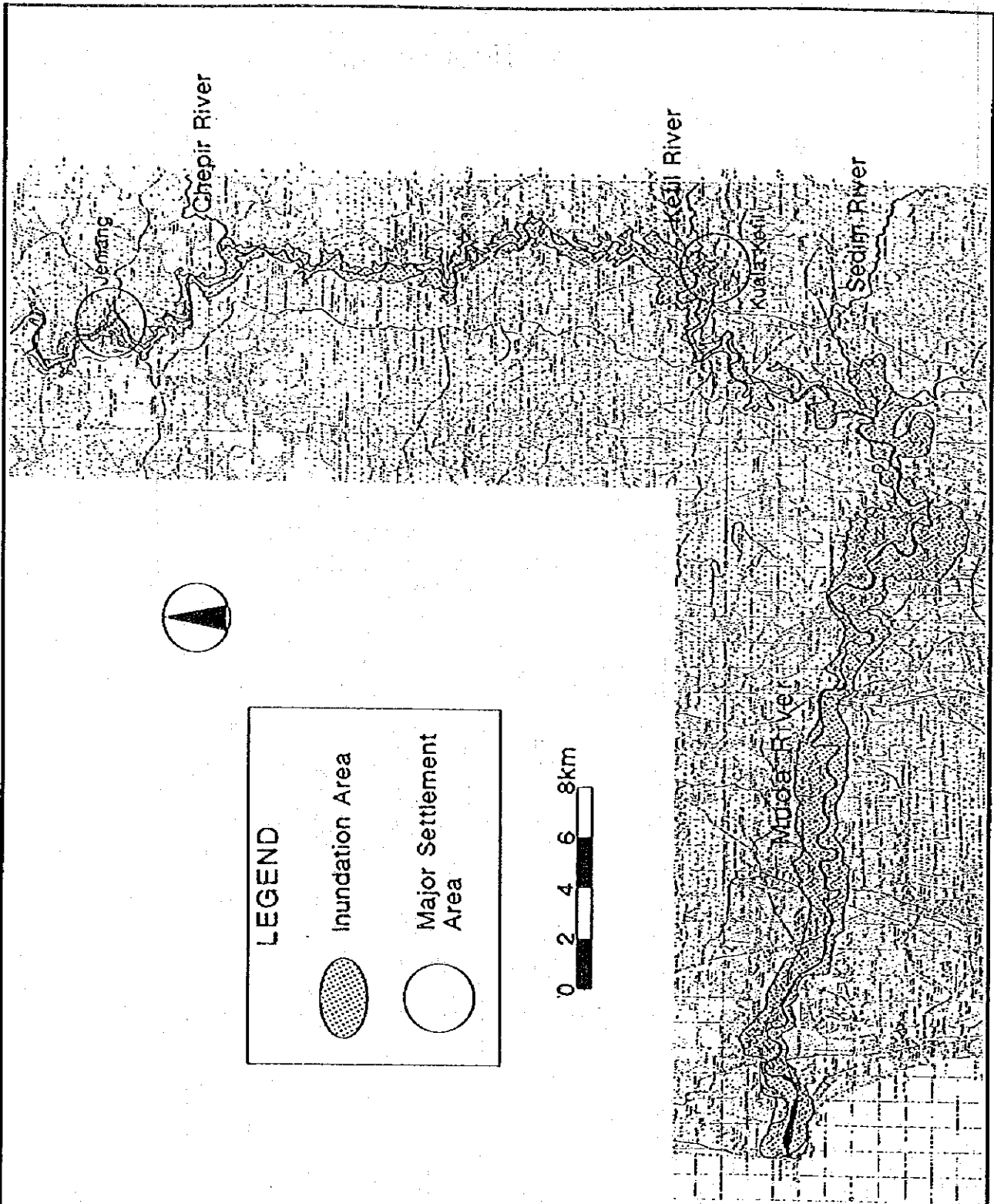


COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

FIG. 3.2.1

ISOHYETAL MAP OF 48-HOUR RAINFALL AND
FLOOD HYDROGRAPH DURING 1988 FLOOD

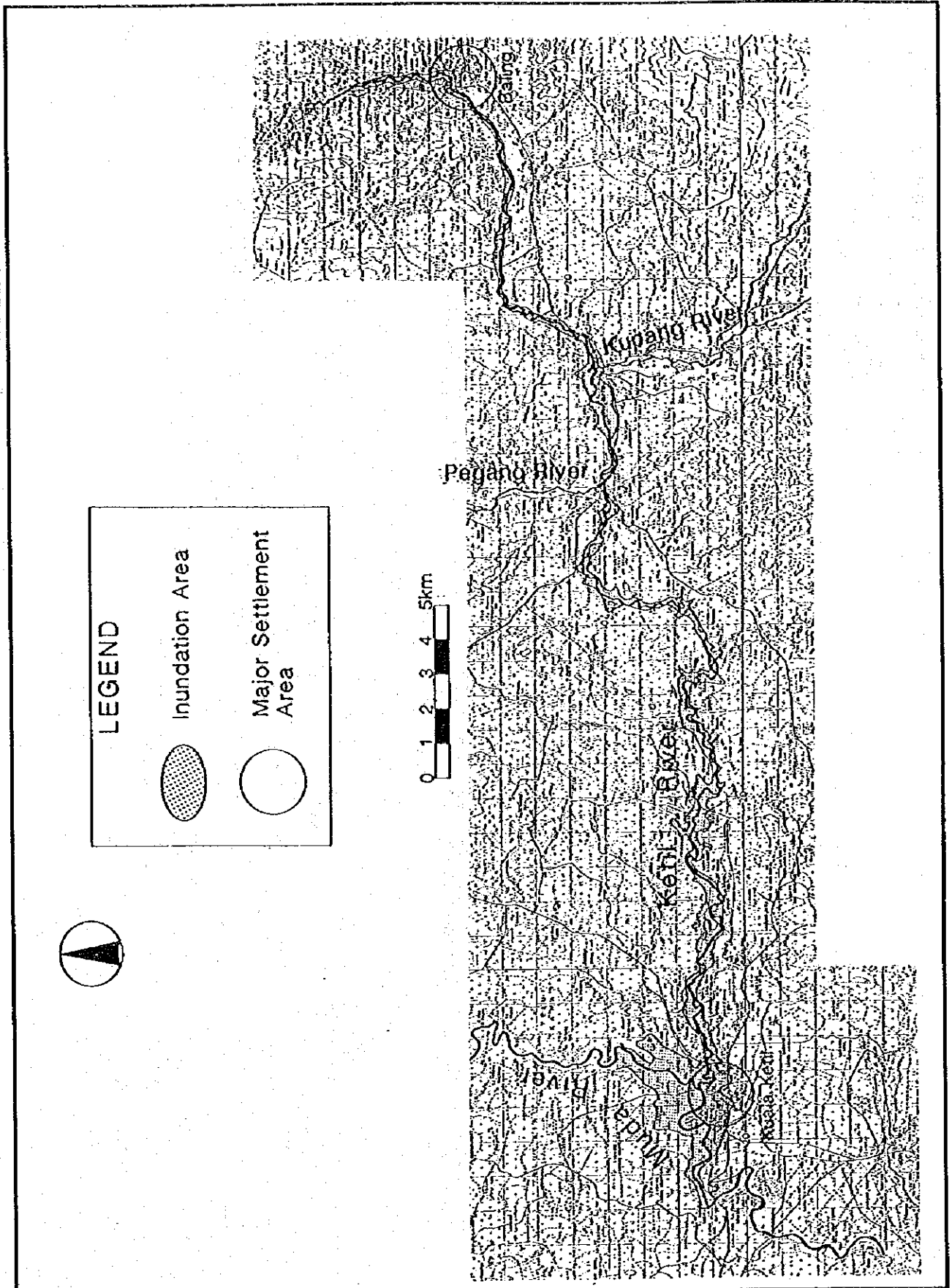


COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

FIG. 3.2.2

FLOOD INUNDATION AREA ALONG MUDA
RIVER DURING 1988 FLOOD

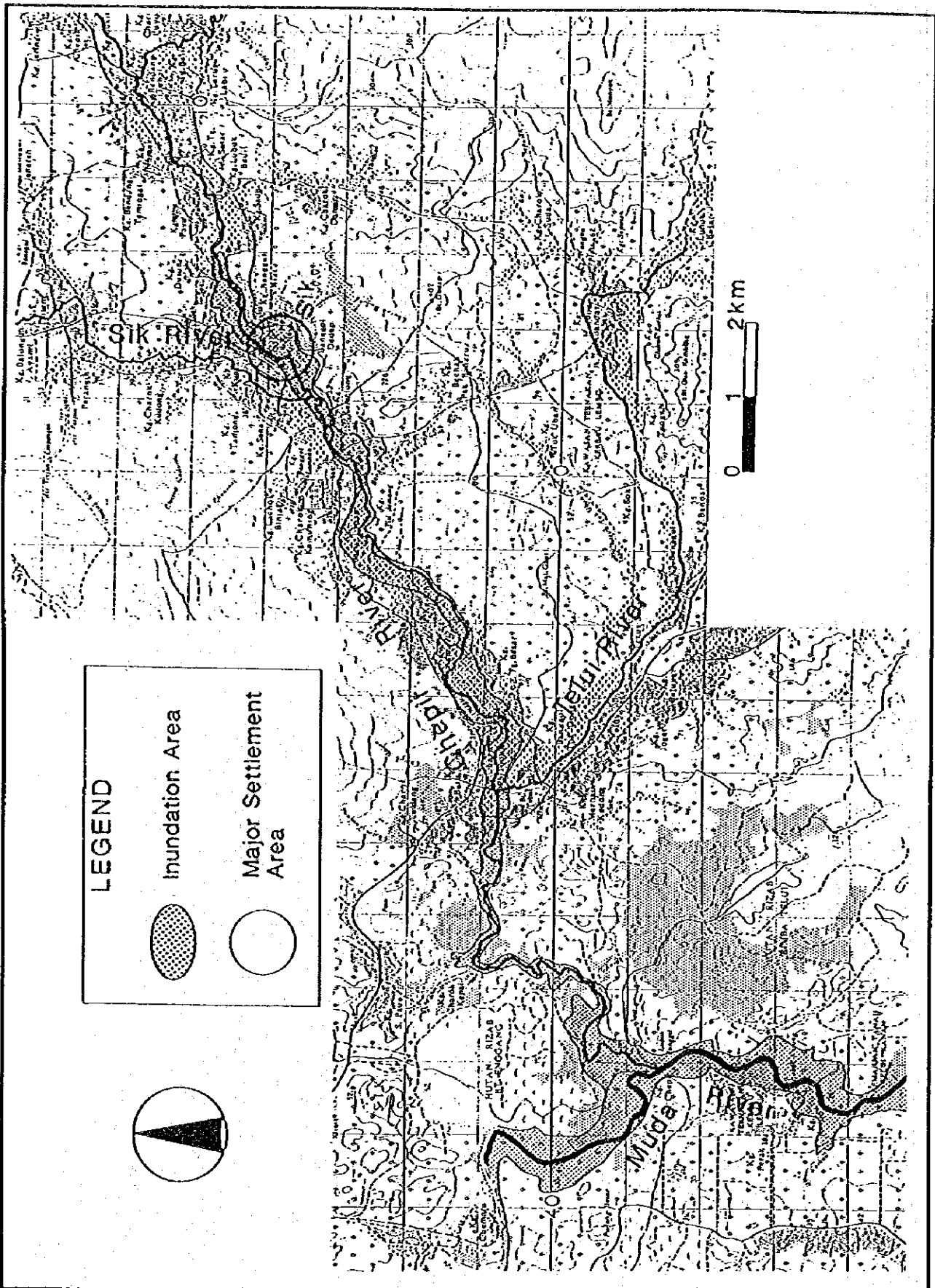


COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

FIG. 3.2.3

FLOOD INUNDATION AREA ALONG KETIL RIVER
DURING 1988 FLOOD

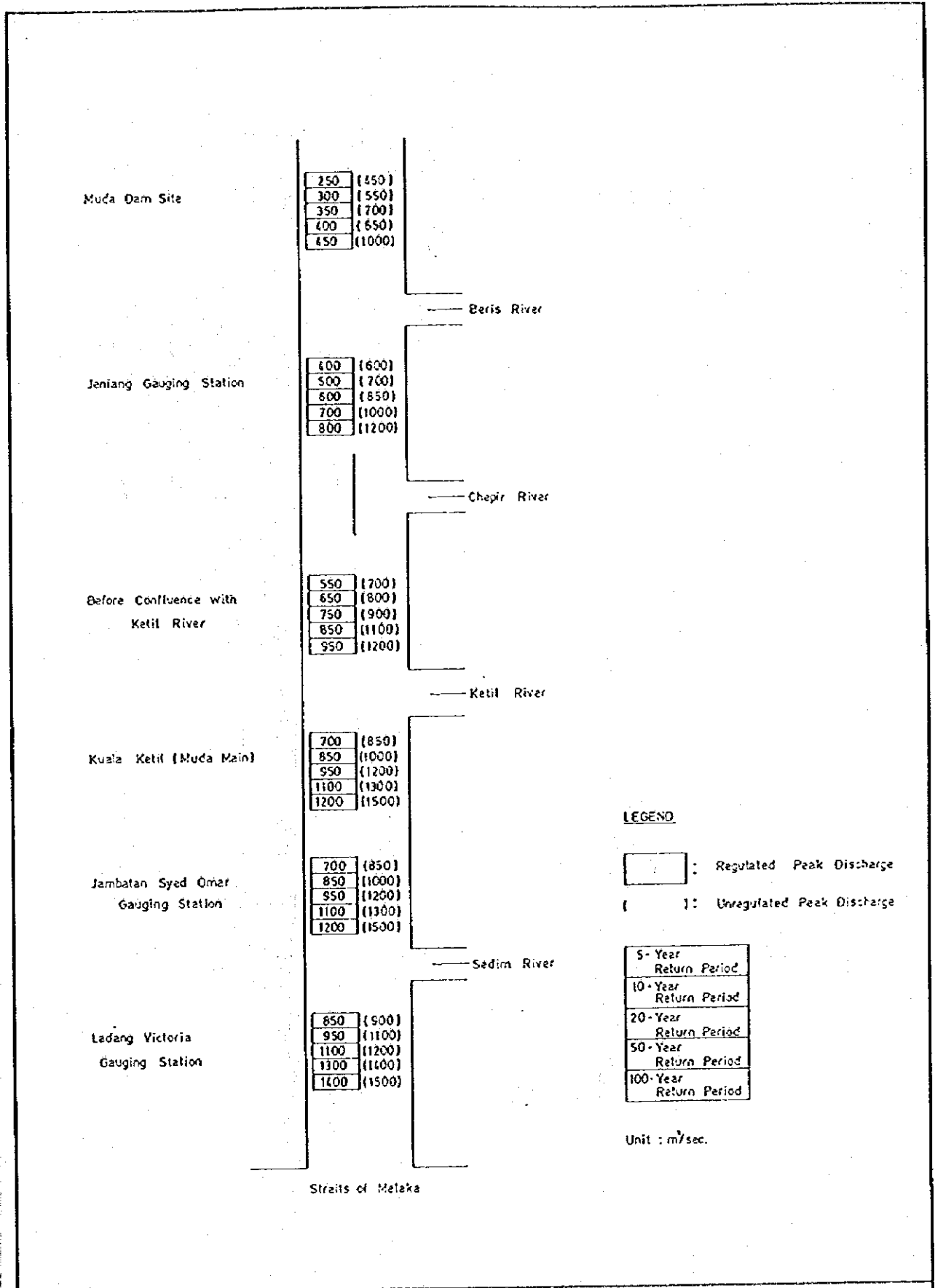


COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

FIG. 3.2.4

FLOOD INUNDATION AREA ALONG CHEPIR
RIVER DURING 1988 FLOOD

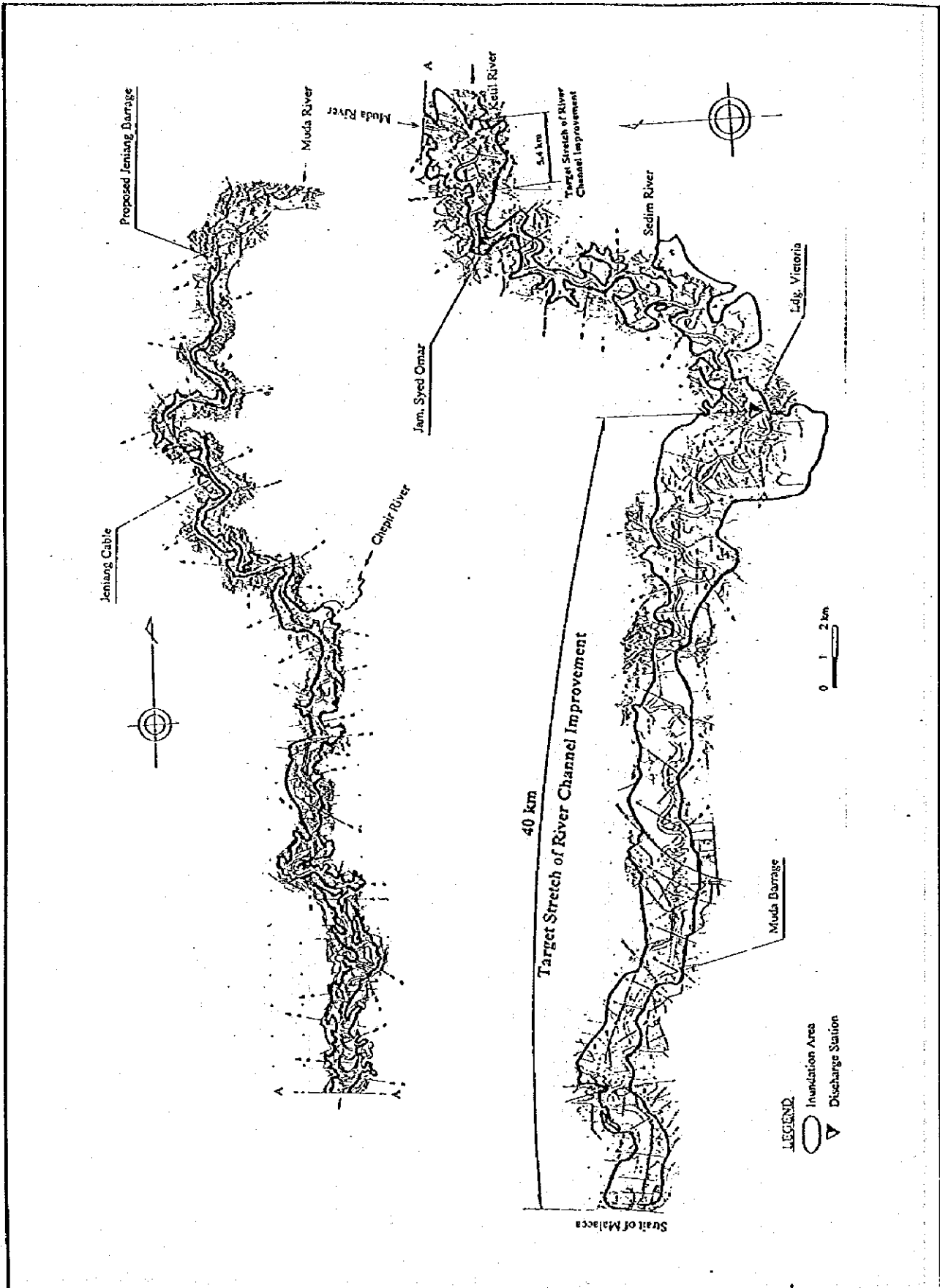


COMPREHENSIVE MANAGEMENT PLAN OF
 MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

FIG. 3.3.1

REGULATED PROBABLE FLOOD DISCHARGE
 DISTRIBUTION

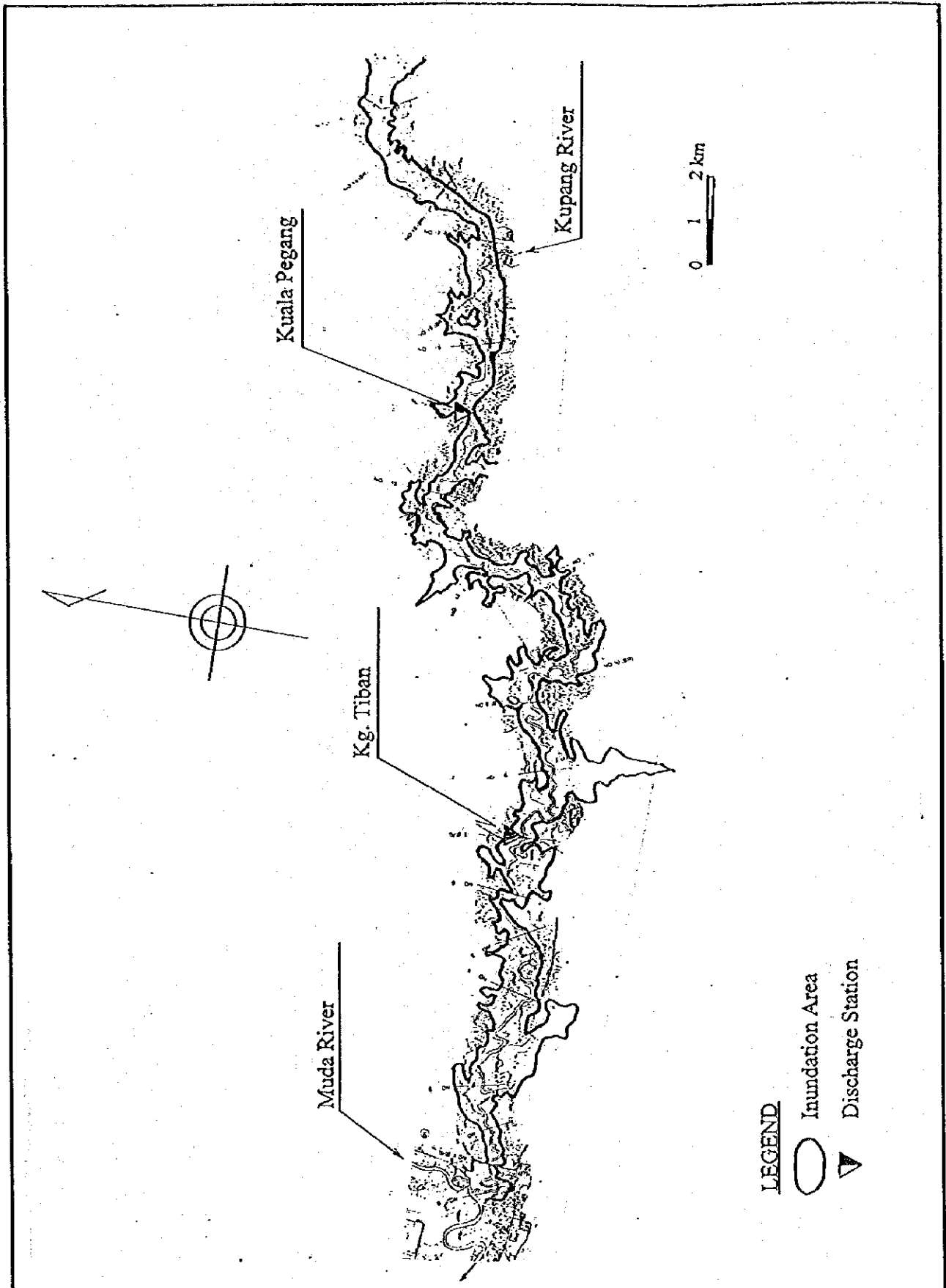


COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

FIG. 3.4.1 (1/2)

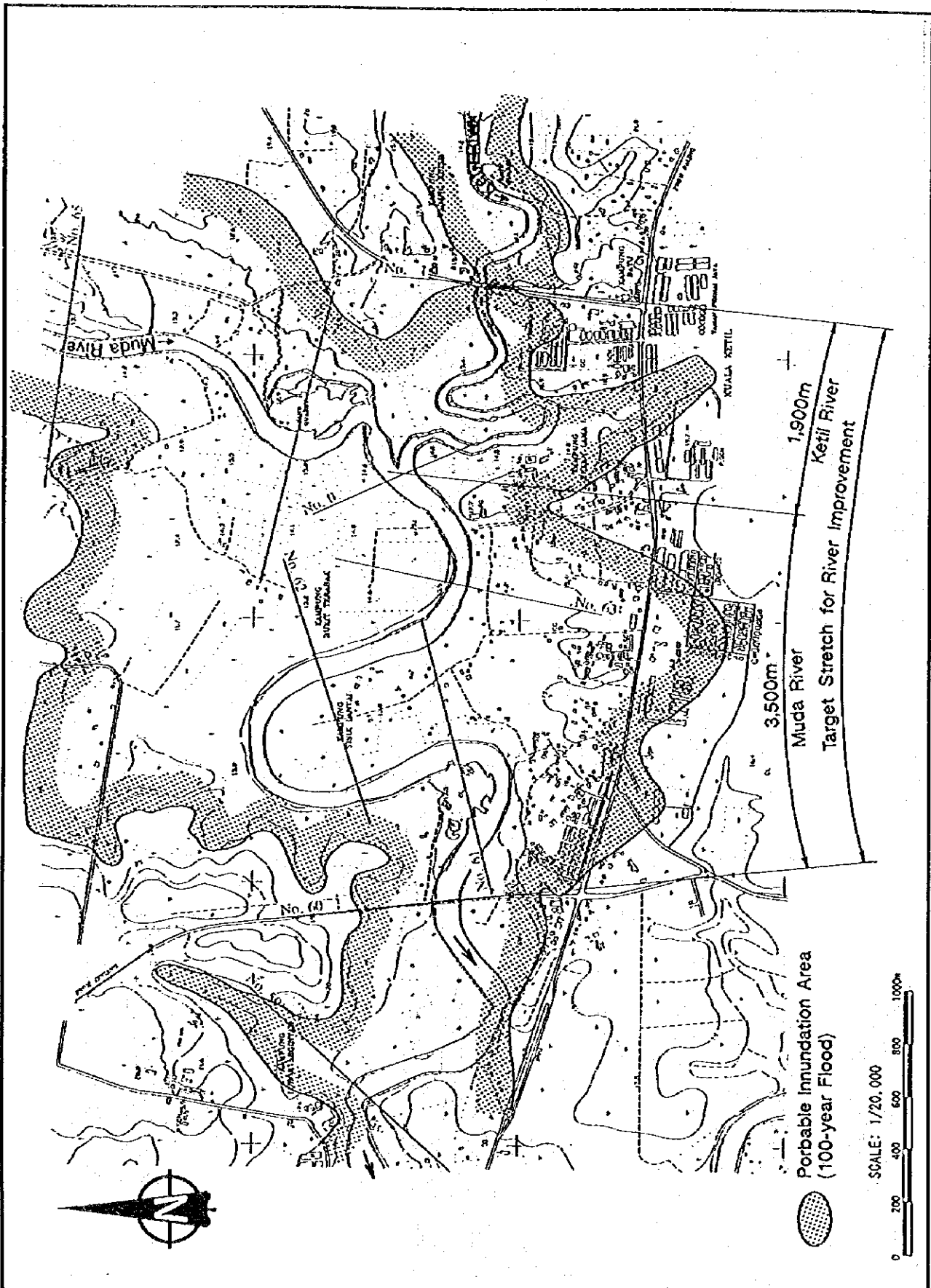
PROBABLE INUNDATION AREA BY 100-YEAR
FLOOD (MUDA RIVER)



COMPREHENSIVE MANAGEMENT PLAN OF
 MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

FIG. 3.4.1 (2/2)
 PROBABLE INUNDATION AREA BY 100-YEAR
 FLOOD (KETIL RIVER)

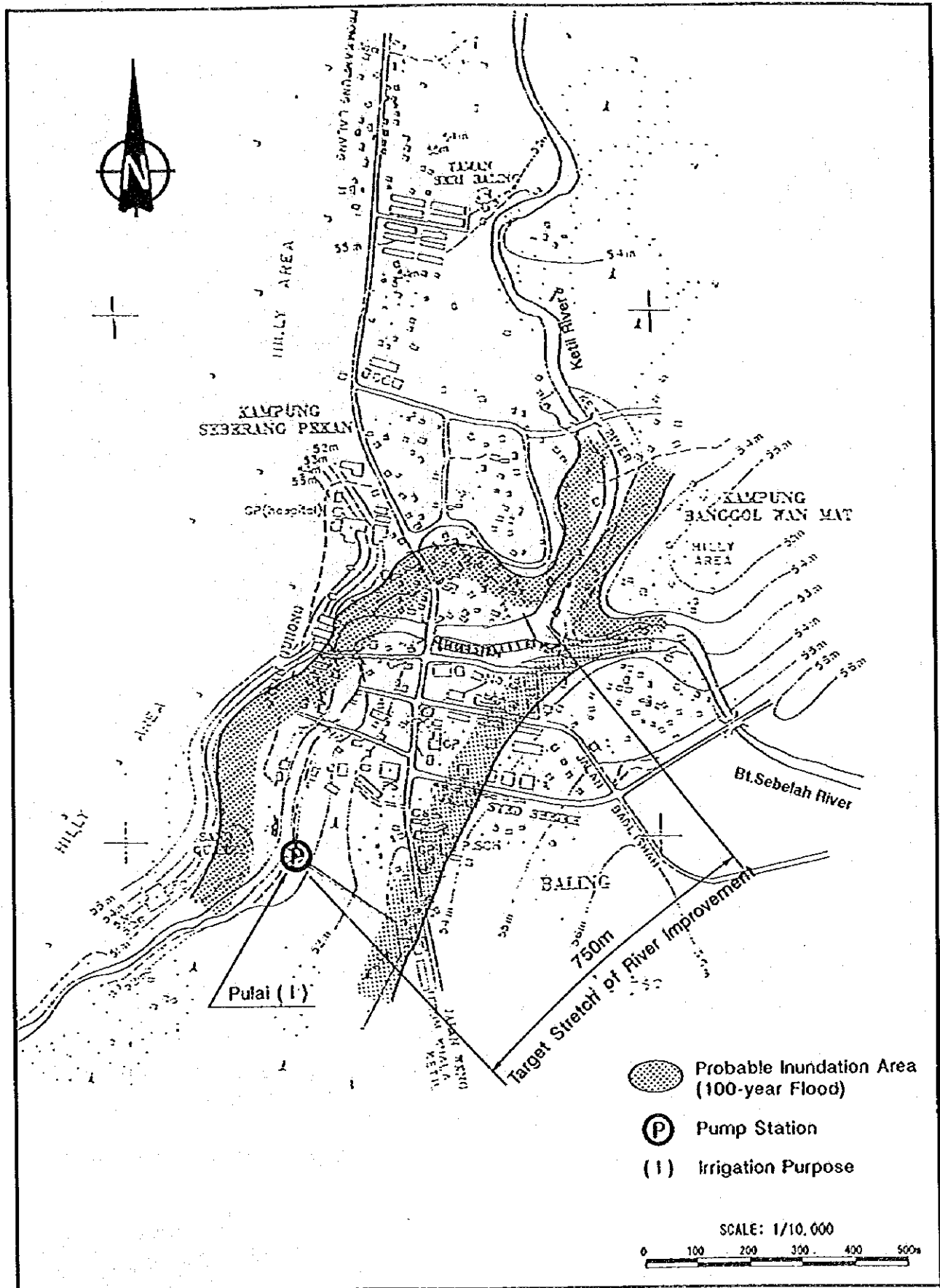


COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

FIG. 3.4.2 (1/3)

PROBABLE INUNDATION AREA BY 100-YEAR FLOOD
ALONG SHORT TARGET STRETCH (KUALA KETIL TOWN)

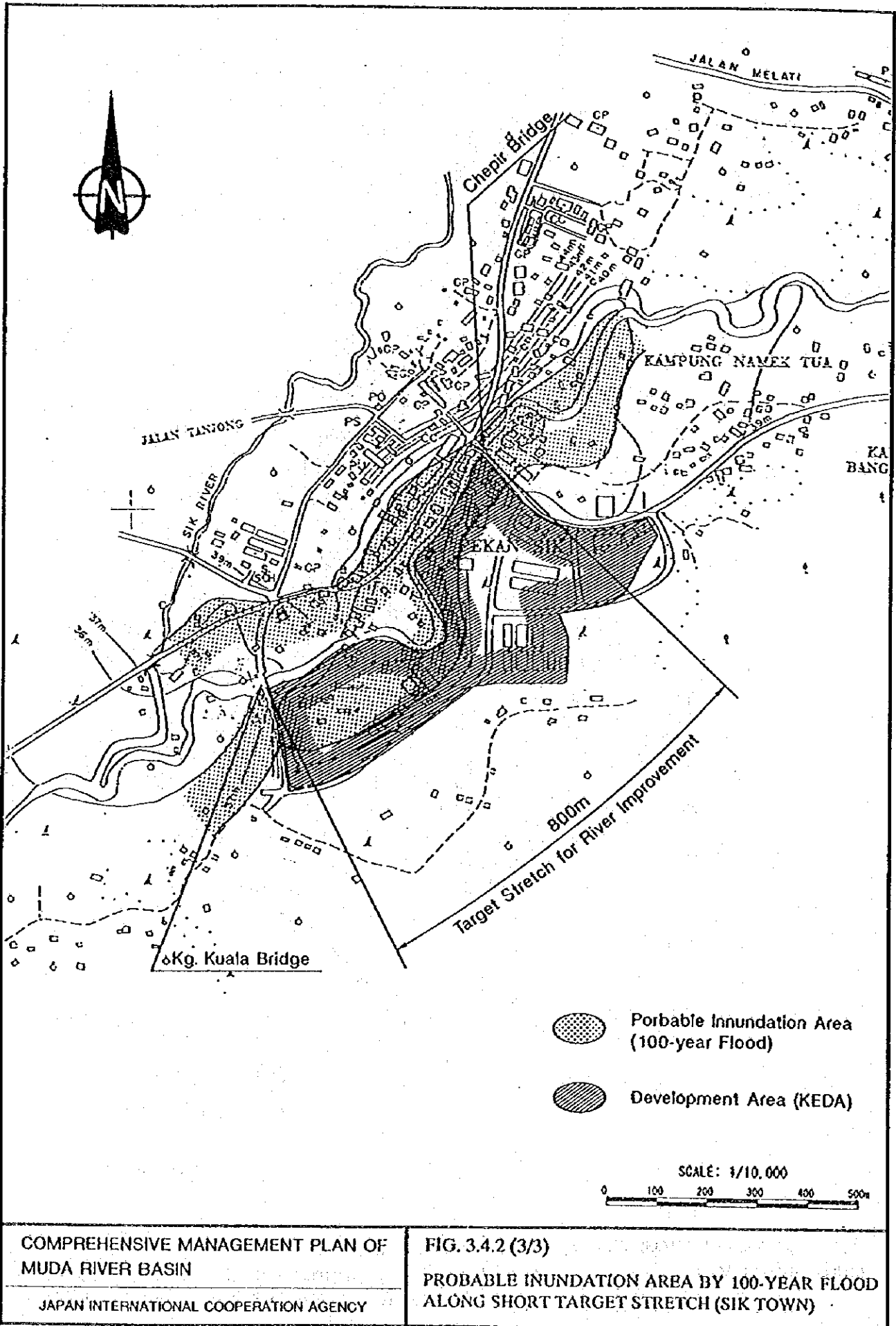


COMPREHENSIVE MANAGEMENT PLAN OF MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

FIG. 3.4.2 (2/3)

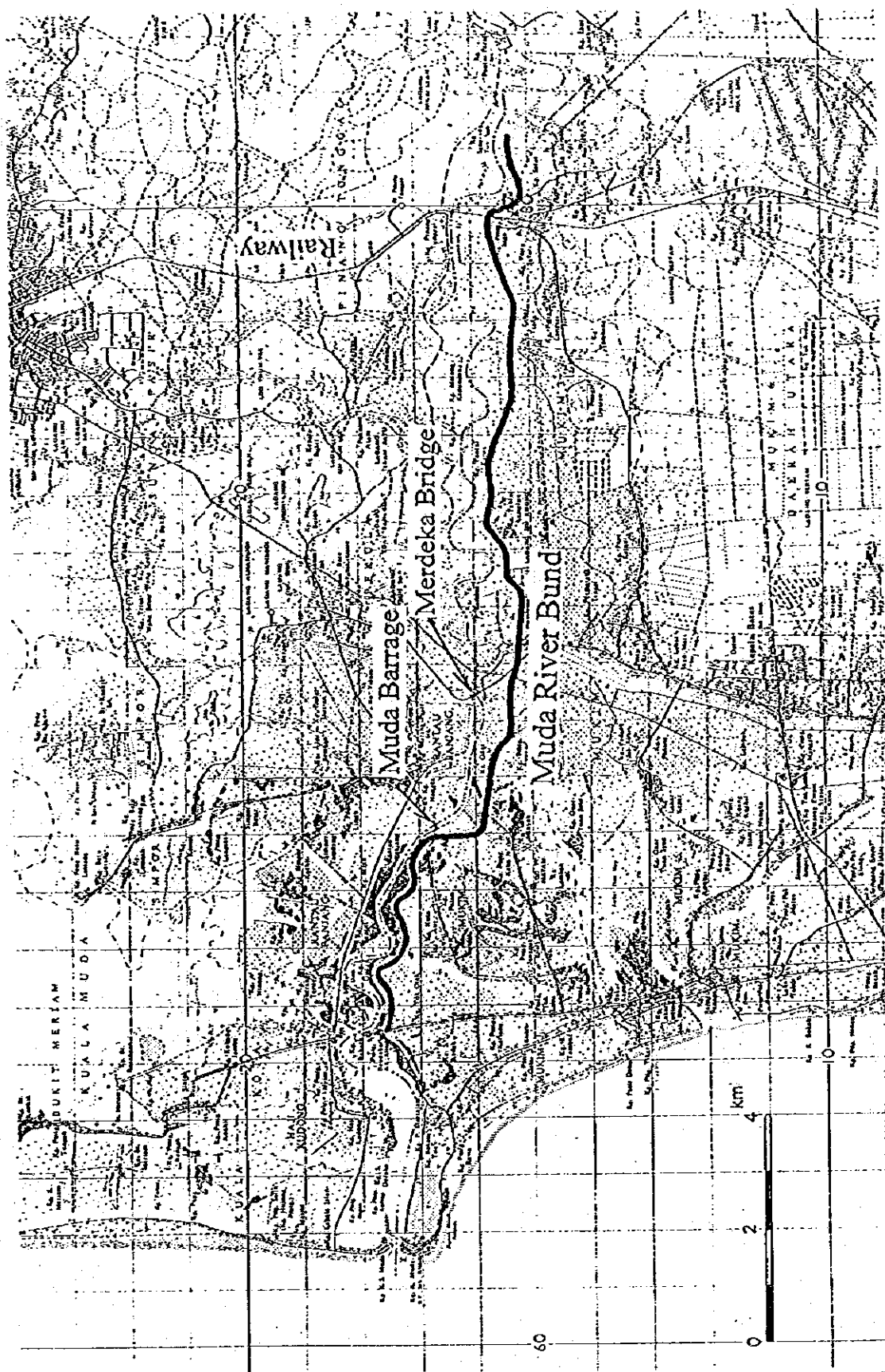
PROBABLE INUNDATION AREA BY 100-YEAR FLOOD ALONG SHORT TARGET STRETCH (BALING TOWN)



COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

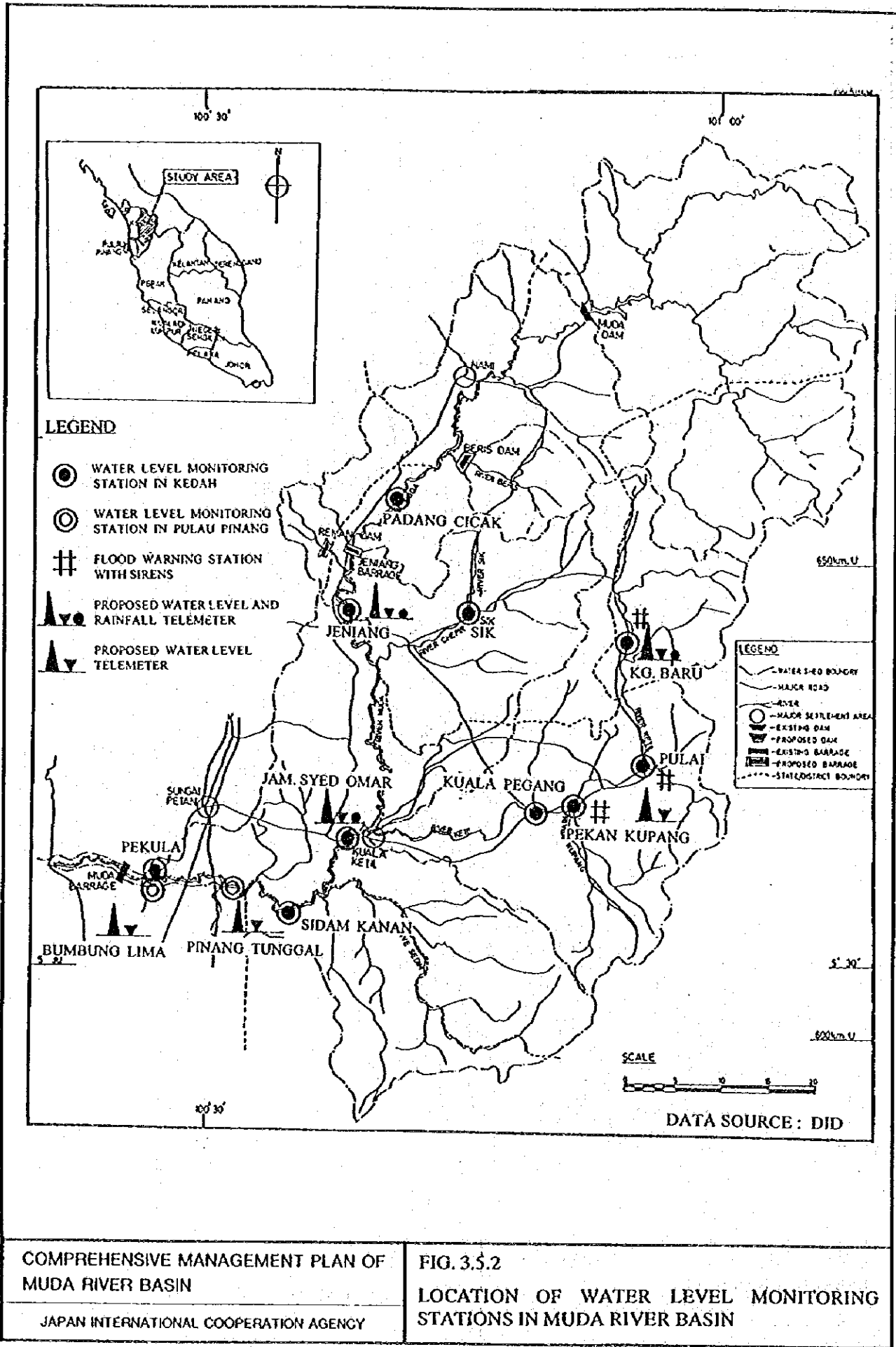
FIG. 3.4.2 (3/3)
PROBABLE INUNDATION AREA BY 100-YEAR FLOOD
ALONG SHORT TARGET STRETCH (SIK TOWN)



COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

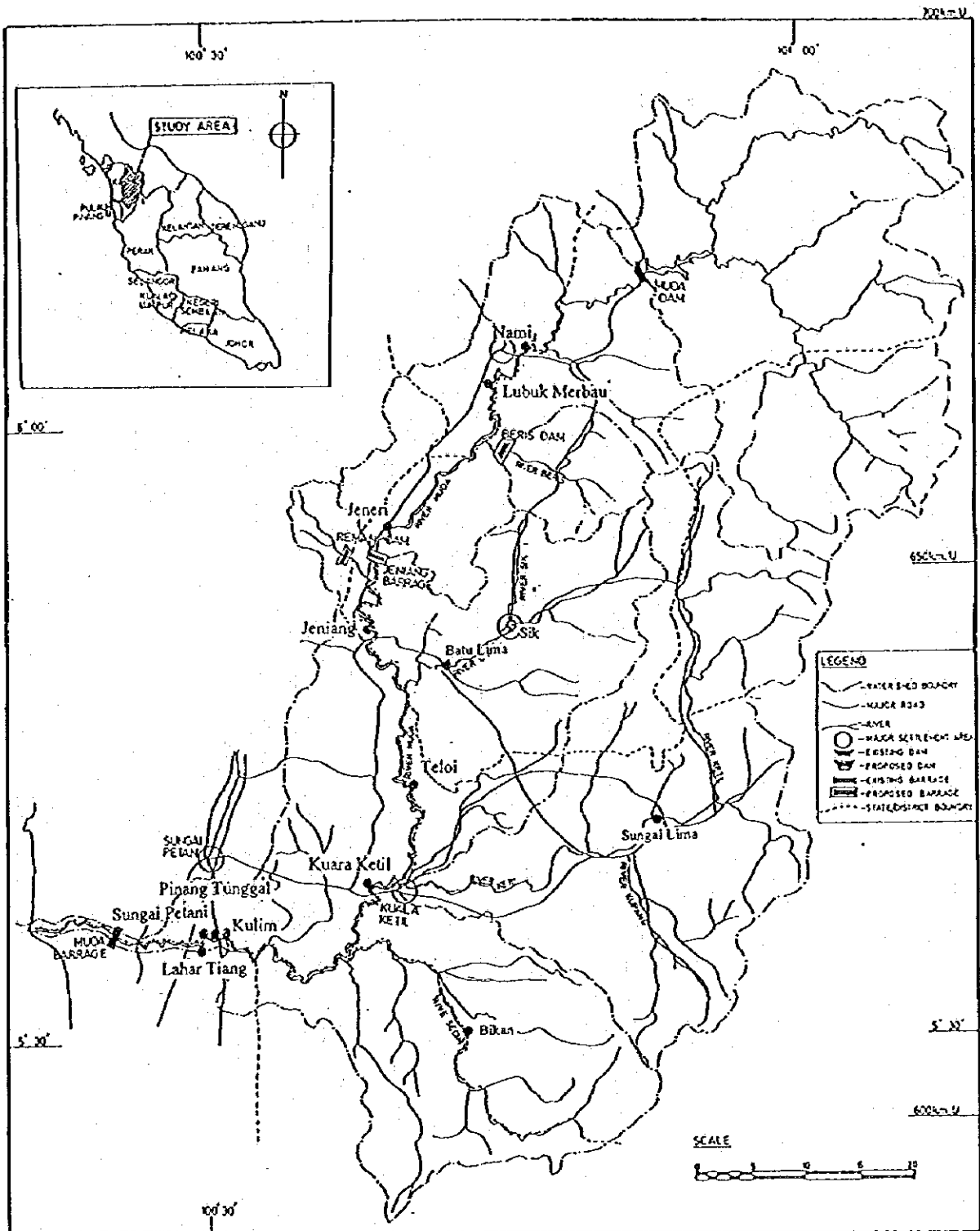
FIG. 3.5.1
LOCATION OF MUDA RIVER BUND

JAPAN INTERNATIONAL COOPERATION AGENCY



COMPREHENSIVE MANAGEMENT PLAN OF
 MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

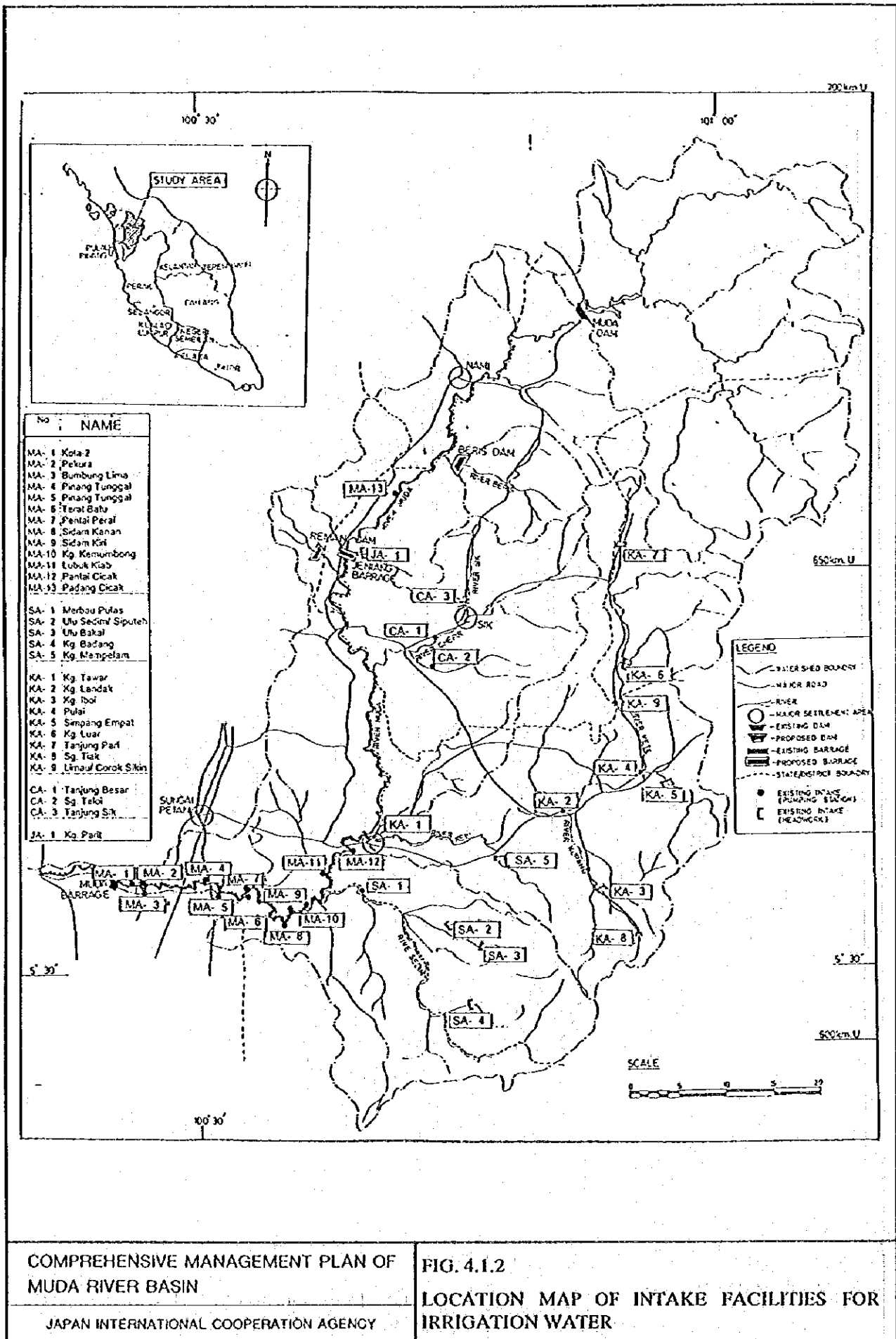


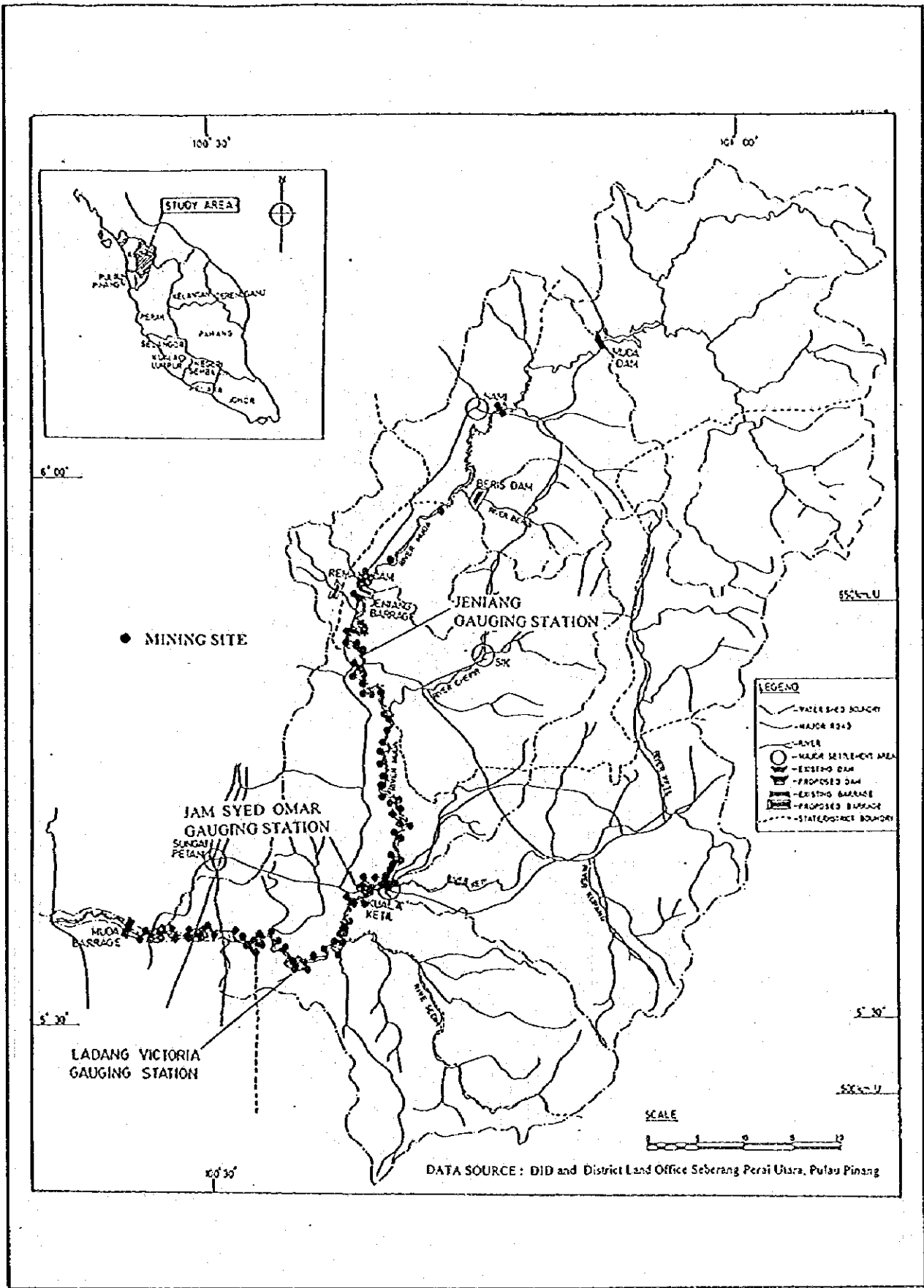
COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

FIG. 4.1.1

LOCATION MAP OF INTAKE FACILITIES FOR
DOMESTIC/INDUSTRIAL WATER





COMPREHENSIVE MANAGEMENT PLAN OF
MUDA RIVER BASIN

FIG. 4.2.1
LOCATION OF SAND MINING SITES

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