TABLE II.7 CATEGORIZATION AND SELECTION OF PROJECTS FROM HYDROLOGICAL VIEWPOINT (1/3)

CODE	PROJECT AREA	DISTRICT	ITEMS CONSIDERED FOR CATEGORIZATION								CATEGORIZATION				SPECIAL INTEREST	SELECTION
			Basin Number	General hydrological condition (1 - 10)	Water shortage (1 - 5)	Estimated runoff (ha meter /year)	Gross irrigation requirement (ha m/year)	Area (ha)	Catchment (km2)	Type of reservoir	Score for rainfall depth is less than 7	Water shortage (score is 3, 4, 5)	Water availability (sufficient or not)	Proposed area (30 ha - 400 ha)		
PERLIS																
PR 1	SIMPANG GETI	-	1	3	3	194	95	70	3	B	O	O	O	O	Water management combined with PR4	O
PR 2	PANGGAS-SMALL DAM P	-	1	3	3	981	162	120	15	A	O	O	O	O		O
PR 4	TASEK MELATI	-	1	3	5	168	314	232	3	B	O	O	X	O	Water management combined with PR1	O
PR 5	PAYA KELUBI MANGO PI	-	1	3	5	6	14	10	0	B	O	O	X	X		
PR 6	HUTAN LEMBAH MANGC	-	1	3	5	19	35	26	0	B	O	O	X	X		
~~PR 7~~	~~TASEK MELATI H~~	-	~~1~~	~~3~~	~~5~~	168	-	-	~~3~~	~~B~~	O	O	-	-	Dropped by State DID	
KEDAH																
~~KH 1~~	~~DURIAN PERAGIN~~	~~LANGKAWI~~	~~2~~	~~7~~	~~5~~		186	~~200~~		~~A~~	X	O	-	O	Dropped by State DID	
~~KH 2~~	~~AIR HANGAT~~	~~LANGKAWI~~	~~2~~	~~7~~	~~5~~		232	~~250~~		~~A~~	X	O	-	O	Dropped by State DID	
KH 3	AMPANGAN PDG SAGA	LANGKAWI	2	7	4	1189	452	486	12	A	X	O	O	X	Island	O
KH 4	KAWASAN PADI KEDAW	LANGKAWI	2	7	5	991	186	200	10	B	X	O	O	O	Island, Government policy for paddy	O
~~KH 5~~	~~KEDAWANG~~	~~LANGKAWI~~	~~2~~	~~7~~	~~5~~		177	~~190~~		~~B~~	X	O	-	O	Combined with KH4	
KH 6	P LIBALI BERKELOMPOK	KUBANG PAS	3	7	4	134	65	64	1	A	X	O	O	O		O
KH 13	KG PDG GELANGGANG	PDG TERAP	3	6	4	1199	101	100	13	A	O	O	O	O		O
KH 14	SKIM JANING	PDG TERAP	3	6	4	2768	78	77	30	A	O	O	O	O		O
KH 15	LUBUK MERBAU	PDG TERAP	3	6	5	277	81	80	3	A	O	O	O	O		O
KH 16	SEKIM TANDOP BESAR	PDG TERAP	3	6	4	1845	51	50	20	B	O	O	O	O		O
KH 19	KURONG HITAM IRRIGAT	PDG TERAP	3	6	4	2879	34	34	31	A	O	O	O	O		O
KH 31	KUBUR PANJANG	PENDANG	3	6	5	6458	122	120	70	A	O	O	O	O		O
KH 32	KG KAYU TIGA	PENDANG	3	6	5	369	72	71	4	A	O	O	O	O		O
~~KH 34~~	~~KG SAWA KECIK~~	~~PENDANG~~	3	6	5		51	~~50~~		~~A~~	O	O	-	O	Dropped by State DID	
KH 35	BK PERAK	PENDANG	4	7	5	606	43	48	6	A,D	X	O	O	O		
KH 40	SG AIR JERNIH	KUALA MUD	5	9	4	1120	93	120	10	A	X	O	O	O		
KH 41	SG BARU	KUALA MUD	5	9	4	1120	93	120	10	A	X	O	O	O		
KH 43	BENDANG DALAM	KUALA MUD	5	9	5	112	32	42	1	A,E	X	O	O	O		
PULAU PINANG																
PP 1	LUAR BAN PINANG TUNG	S PERAI UTAI	5	9	5	464240	8	10	4145	C	X	O	O	X		
~~PP 2~~		~~S PERAI UTAI~~	5	9	~~5~~		77	~~100~~		~~A~~	X	O	-	O	Dropped by State DID	
PP 3	TOK BEDU IRRIGATION A	S PERAI UTAI	5	9	5	2138	52	68	19	C	X	O	O	O	Good example of TYPE C	O
~~PP 4~~	~~KG TOK BEDU, AIR MELI~~	~~S PERAI UTAI~~	~~5~~	9	3		160	~~207~~		~~A~~	X	O	-	O	Dropped by State DID	
PP 5	PINANG TUNGGAL IRRIG	S PERAI UTAI	5	9	5	829	430	558	7	A	X	O	O	X		
PP 6	SG JARAK IRRIGATION A	S PERAI UTAI	5	9	5	2971	366	475	27	A	X	O	O	X		
~~PP 7~~	~~BK TOH ALLANG~~	~~S PERAI UTAI~~	5	9						~~D~~	X	-	-	-		
~~PP 8~~	~~SG BURUNG~~	~~BARAT DAYA~~	~~6~~	~~5~~	~~5~~		131	~~131~~		~~A~~	O	O	-	O	Island, Combined with PP9	
PP 9	SG BURUNG	BARAT DAYA	6	5	5	1289	202	202	14	B	O	O	O	O	Island	O
~~PP 10~~	~~MAK SULONG~~	~~S PERAI TENG~~	~~5~~	9						~~D~~	X	-	-	-	Dropped by State DID	
PP 11	SG KULIM IRRIGATION S	S PERAI TENG	5	9		17136	1116	1447	153	D	X	-	O	X		
PP 12	SKIM PENGAIRAN SG KU	S PERAI TENG	5	9		560	2	3	5	B	X	-	O	X		
PP 13	SKIM PENGAIRAN TASEK	S PERAI SELA	5	9			131	170		D	X	-	-	O		
PERAK																
PK 1	KG TASEK	HULU PERAK	4	7	5	949	36	40	9	A	X	O	O	O		
PK 2	PUSAT PERT TANAH TIN	HULU PERAK	27	7	4	1592	-	-	15	A	X	O	-	-		
PK 3	INDUSTRI BUAH-BUAHA	SELAMA	8	8	2	1808	Nil	57	10	D	X	X	O	O		
PK 4	BENDANG TEMELONG	HULU PERAK	7	7	5	1839	-	NA	21	A	X	O	-	-		
PK 5	P KELOMPOK BUAH-BUA	LARUT MATA	8	8	4	6039	Nil	30	33	B	X	O	O	O		
PK 6	P KELOMPOK BUAH-BUA	LARUT MATA	8	8	4	1537	Nil	292	9	A	X	O	O	O		
PK 7	SENOUK CHANGKAT NIN	LARUT MATA	8	8	5	5171	Nil	113	29	A	X	O	O	O		
PK 8	P KELOMPOK BUAH-BUA	LARUT MATA	8	8	3		Nil	-		B	X	O	-	-		
PK 9	BENDANG JENALIK	KUALA KANG	7	7	4	999	54	60	11	A	X	O	O	O		
PK 10	BENDANG KG LANEH	KUALA KANG	8	8	5	555	Nil	65	3	A	X	O	O	O		
PK 11	RANC TALIAIR BENDANG	KUALA KANG	8	8	5	470	Nil	52	3	A	X	O	O	O		
PK 12	RANC TALIAIR BENDANG	KUALA KANG	8	8	4	315	Nil	50	2	A	X	O	O	O		
PK 13	RANC TALIAIR PDG REN	KUALA KANG	8	8	4		Nil	100		A	X	O	-	O		
PK 15	DENDANG A	MANJUNG	10	6	4	1240	70	59	16	A	O	O	O	O		O
PK 16	DENDANG B	MANJUNG	10	6	4	1240	136	114	16	A	O	O	O	O		O
PK 17	BRUAS & TAMBAHAN	MANJUNG	10	6	4	1240	332	278	16	A	O	O	O	O		O
PK 19	KG LALAT BATU 7	HILIR PERAK	9	8						B	X	-	-	-		
PK 20	SG BATANG PDG MATI	HILIR PERAK	9	8		1329	112	142	12	A	X	-	O	O		
PK 21	SG MANIK,IRRIG SCHEM	HILIR PERAK	9	8	3	76411	5193	6600	690	D	X	O	O	X		

TABLE II.7 CATEGORIZATION AND SELECTION OF PROJECTS FROM HYDROLOGICAL VIEWPOINT (2/3)

CODE	PROJECT AREA	DISTRICT	ITEMS CONSIDERED FOR CATEGORIZATION								CATEGORIZATION				SPECIAL INTEREST	SELECTION
			Basin Number	General hydrological condition (1 - 10)	Water shortage (1 - 5)	Estimated runoff (ha meter/year)	Gross irrigation requirement (ha m/year)	Area (ha)	Catchment (km2)	Type of reservoir	Score for rainfall depth is less than 7	Water shortage (score is 3, 4, 5)	Water availability (sufficient or not)	Proposed area (30 ha - 400 ha)		
SELANGOR																
SG 1	TEBUK BERIHUN	SABAK BER	11	7	4		770	738		D	X	O		X		
SG 3	SG JANG	HULU SELA	12	6	3		208	200		A	O	O		O		
SG 4	BK TAMU	HULU SELA	12	6	3		208	200		A	O	O		O		
SG 5	KG KALONG TENGAH	HULU SELA	12	6	3		73	70		D	O	O		O		
SG 6	P SAYURAN SG YU	KUALA SEL	13	4	5		1340	1000		A	O	O		X		
SG 8	KUANG	GOMBAK	13	4	5	226286	3172	2368	3450	B	O	O	O	X		
SG 9	REKREASI SG CHONGKA	HULU LANC	14	8		12400	140	164	118	A	X	-	O	O		
SG 10	KG KANTAN	HULU LANC	14	8	5		21	25		A	X	O		X		
SG 11	KG PASIR	HULU LANC	14	8	5		51	60		A	X	O		O		
SG 12	MINANG KABAU	HULU LANC	17	4	5		137	100		A	O	O		O		
SG 13	JLN ENAM KAKI 1	HULU LANC	17	4	4	5569	79	58	88	A	O	O	O	O		O
SG 14	SAPAN BT MINANGKABA	HULU LANC	17	4		3713	109	80	59	A	O	-	O	O		
SG 15	SG JAI BK KEPONG	HULU LANC	17	4	5	4429	198	145	70	A	O	O	O	O		O
SG 16	MARDI RESEARCH STATI	KELANG	15	6	5					B	O	O				
SG 18	TAMAN PERT MALAYSIA	PETALING	13	4						A	O	-				
SG 24	P KELOMPOK SAYURAN	KUALA LAI	15	6	5		42	40		B	O	O		O		
SG 25	P KELOMPOK KONTAN K	KUALA LAI	15	6	5		48	45		B	O	O		O		
NEGERI SEMBILAN																
NS 1	STESEN MARDI JELEBU	JELEBU	16	3	5	131	383	220	4	A	O	O	X	O	MARDI, demonstration effect	O
NS 2	BUAH-BUAHAN LANJUT	KUALA PIL	17	4	3		18	13			O	O		X		
NS 3	SRI MENANTI	KUALA PIL	17	4	4	1736	194	142	53	B	O	O	O	O		O
NS 4	PEMBANGUNAN SAWAH	GEMAS	18	4	3	13076	258	200	400	D	O	O	O	O		O
NS 5	REMBAU	REMBAU	17	4		418			13	A	O	-				
NS 6	P TERNAKAN UDANG GA	KUALA PIL	17	4	5		274	200		A	O	O		O		
NS 7	KELOMPOK KG CHENGK	REMBAU	17	4	4	7	202	148	0.2	B	O	O	X	O		
NS 8	KG BK TEMBOK & SG RA	PORT DICK	17	4						A	O	-				
MELAKA																
~~MA 1~~	~~TEBONG~~	~~ALOR GAJA~~	~~19~~	~~5~~	~~4~~		~~31~~	~~25~~		~~B~~	O	O	-	X	Dropped by State DID	
MA 2	ULU SG BULOH	ALOR GAJA	19	5	5	30379	12	10	403	A	O	O	O	X		
~~MA 3~~	~~SOLOK BT ALANG~~	~~ALOR GAJA~~	~~19~~	~~5~~	~~4~~		~~18~~	~~15~~		~~B~~	O	O	-	X	Dropped by State DID	
~~MA 4~~	~~FELCRA RAMUAN CINA~~	~~ALOR GAJA~~	~~19~~	~~5~~						~~B~~	O	-	-	-	Dropped by State DID	
~~MA 5~~	~~MERJAM PATAH~~	~~ALOR GAJA~~	~~19~~	~~5~~						~~B~~	O	-	-	-	Dropped by State DID	
~~MA 6~~	~~SOLOK PUNGGAI~~	~~ALOR GAJA~~	~~19~~	~~5~~	~~4~~		~~15~~	~~12~~		~~B~~	O	O	-	-	Dropped by State DID	
~~MA 9~~	~~PDG KELADI~~	~~ALOR GAJA~~	~~19~~	~~5~~						~~B~~	O	-	-	-	Dropped by State DID	
MA 11	SG UDANG	MELAKA TI	19	5	5	29902	61	50	397	D	O	O	O	O		O
~~MA 12~~	~~FELDA BK KATIL~~	~~MELAKA TI~~	~~19~~	~~5~~						~~B~~	O	-	-	-	Dropped by State DID	
MA 14	KANDANG	MELAKA TI	19	5	4		9	7		B	O	O	-	-		
MA 15	SOLOK BK META	MELAKA TI	19	5	5		9	7		B	O	O	-	-		
MA 16	FELCRA BK SEDANAN	JASIN	19	5	3	156	118	97	2	A	O	O	O	O	FELCRA	O
~~MA 17~~	~~CINCIN LAKE~~	~~JASIN~~	~~19~~	~~5~~	~~5~~		~~121~~	~~100~~		~~B~~	O	O	-	-	Dropped by State DID	
~~MA 18~~	~~KG PULAI/SERKAM~~	~~JASIN~~	~~19~~	~~5~~						~~B~~	O	-	-	-	Dropped by State DID	
JOHOR																
JR 3	SAWAH KEBUN BARU	MUAR	19	5	3	2787	217	178	37	B	O	O	O	O		O
JR 8	LDG KELOMPOK KG SRI	KLUANG	21	7	5		110	120		B	X	O	-	O		
JR 9	LDG KELOMPOK BT SAM	BATU PAHA	20	4	5		164	114		B	O	O	-	O		
JR 10	LDG KELOMPOK KANGK	BATU PAHA	25	6	4	160	58	50	2		O	O	O	O	DOA	O
JR 12	TUNJOK LAUT	KOTA TING	23	7		273	59	60	3	D	X	-	O	O		
JR 14	SG CHEMARAN	KOTA TING	23	7			10	10			X	-	-	X		
KELANTAN																
KN 1	JUBAKAR PANTAI	TUMPAT	26	5	5	388	48	50	4	B	O	O	O	O		O
KN 4	KG BELIAN	TUMPAT	26	5	4	1163	38	40	12	B	O	O	O	O		O
KN 5	LUBOK SELEHONG	TUMPAT	26	5	4	1163	48	50	12	B	O	O	O	O		O
KN 8	BENDANG JELUTONG, K	KOTA BHAI	26	5	5	8	72	75	0	B	O	O	X	O		
KN 9	BENDANG BT TINGGI, BK	KOTA BHAI	26	5	5	7	29	30	0	B	O	O	X	O		
KN 10	BENDANG SOKOR, BK CH	KOTA BHAI	26	5	5	3	48	50	0	B	O	O	X	O		
KN 11	KUBANG TEBAKANG	PASIR MAS	26	5	4	872	96	100	9	C	O	O	O	O		O
KN 12	BENDANG TASEK BERAN	PASIR MAS	26	5	5		96	100		C	O	O	-	O		
KN 13	TASIK PUTERA	PASIR MAS	26	5	4	775	19	20	8	E	O	O	O	X		
KN 16	BENDANG PMTG SUNKA	PASIR PUTE	26	5	5	291	31	32	3	D	O	O	O	O		O
KN 24	RANC TALIAIR HILIR SA	MACHANG	27	7	2	1624	392	465	15	D	X	X	O	X		
KN 26	RANC PENGAIRAN TERA	TANAH MER	27	7	3	3353	124	147	32	C	X	O	O	O		
KN 27	RANC PANGAIRAN GUAL	TANAH MER	27	7	4	2229	71	84	21	A	X	O	O	O		
KN 35	RANC TALIAIR LEPAN A	KUALA KR/	27	7	4	1804	30	36	17	A	X	O	O	O		

TABLE II.7 CATEGORIZATION AND SELECTION OF PROJECTS FROM HYDROLOGICAL VIEWPOINT (3/3)

CODE	PROJECT AREA	DISTRICT	ITEMS CONSIDERED FOR CATEGORIZATION								CATEGORIZATION				SPECIAL INTEREST	SELECTION
			Basin Number	General hydrological condition (1 - 10)	Water shortage (1 - 5)	Estimated runoff (ha meter/year)	Gross irrigation requirement (ha m/year)	Area (ha)	Catchment (km2)	Type of reservoir	Score for rainfall depth is less than 7	Water shortage (score is 3, 4, 5)	Water availability (sufficient or not)	Proposed area (30 ha - 400 ha)		
TERENGGANU																
TR 1	TELABAK IRRIGATION S(	BESUT	27	7	4	590	98	116	6	A	X	O	O	O		
TR 3	SKIM TANAMAN PADI M/	KUALA TR(	28	5	5	139	435	420	2	E	O	O	X	X	Good example for TYPE E. Area to be reduce	O
TR 4	P KELOMPOK SAYURAN	KUALA TR(	28	5	4	181	8	8	2	B	O	O	O	X		
TR 7	SALIRAN TOK JIRING	KUALA TR(	28	5	5	76905	933	900	851	A	O	O	O	X		
TR 12	P KELOMPOK SAYURAN	KUALA TR(	28	5	4	181	21	20	2	B	O	O	O	X		
TR 14	P KELOMPOK SAYURAN	KUALA TR(	28	5	4		21	20		B	O	O	-	X		
TR 20	SKIM TANAM PADI DURI	MARANG	28	5	5	365	141	136	4	A	O	O	O	O		O
TR 24	P KELOMPOK SAYURAN	MARANG	28	5	4		10	10		B	O	O	-	X		
TR 28	P KELOMPOK SAYURAN	MARANG	28	5	4		6	6		B	O	O	-	X		
TR 34	LEMBAH MARANG II	MARANG	28	5	5	3615	622	600	40	A	O	O	O	X		
TR 38	P KELOMPOK SAYURAN	MARANG	29	5	4		10	10		B	O	O	-	X		
TR 42	P KELOMPOK SAYURAN	HULU TRG	28	5	4		17	16		B	O	O	-	X		
TR 44	P KELOMPOK SAYURAN	HULU TRG	28	5	4	181	41	40	2	B	O	O	O	O		O
TR 45	P KELOMPOK SAYURAN	HULU TRG	28	5	4	181	5	5	2	B	O	O	O	X		
TR 50	KOLAM ABANG	DUNGUN	29	5		18	-	-	0	E	O	-	-	-		
PAHANG																
PH 9	PAYA PAGAR SASAK	LIPIS	32	7	3	240	42	44	3	A	X	O	O	O		
PH 11	P.WAU,BETONG & GEMA	MARAN	35	4	4	696	86	59	7	A	O	O	O	O		O
PH 12	PAYA JELUTUNG	MARAN	35	4		197	73	50	2	A	O	-	O	O		
PH 13	PAYA NYAK BESAR	MARAN	35	4	3	987	309	212	10	A	O	O	O	O		O
PH 14	PAYA TING & BESAR KE	MARAN	35	4	3	432	102	70	5	A	O	O	O	O		O
PH 16	PAYA NYAK KECIL	MARAN	35	4	3	592	79	54	6	A	O	O	O	O		O
PH 17	PAYA PDG TENGGALA	MARAN	35	4	3	617	83	57	7	A	O	O	O	O		O
PH 19	PAYA SG LING	MARAN	35	4	3	237	262	180	3	A	O	O	X	O		
PH 20	PAYA LANTING	MARAN	35	4	3	3208	200	137	34	A	O	O	O	O	Inundation scheme	O
PH 23	PAYA PESAGI	MARAN	35	4	3		136	93		A	O	O	-	O	Inundation scheme, Fish pond	O
PH 24	PAYA KROT	MARAN	35	4	3	2468	92	63	26	A	O	O	O	O		O
PH 25	PAYA LDG	MARAN	35	4	3	494	232	159	5	A	O	O	O	O		O

Table II.8 METEOROLOGICAL CONDITIONS IN THE PROJECT AREAS

State	Station Number	Station Name	Duration
PERLIS	48604	Chuping	1980-1992
KEDAH	48600	Langkawi International Airport	1988-1992
MELAKA	48665	Melaka Airport (Batu Berendam)	1968-1992
JOHOR	48672	Kluang	1974-1992
TERENGGANU	48619	Kuala Terengganu	1968-1992

TEMPERATURE unit : °C

State		JAN	FEB	MAR	APR	JUN	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
PERLIS	MAX	32.9	34.8	34.9	34.2	32.7	32.3	31.8	31.7	31.4	31.5	31.4	31.1	32.6
	MEAN	26.8	27.6	28.0	27.9	27.4	27.2	26.7	26.7	26.4	26.2	26.1	26.1	26.9
	MIN	23.1	23.3	23.8	24.1	24.1	23.9	23.3	23.4	23.4	23.3	23.3	23.1	23.5
KEDAH	MAX	32.8	33.1	32.8	31.9	30.9	30.9	30.3	30.4	29.9	30.1	30.8	31.4	31.3
	MEAN	27.8	27.9	28.0	27.9	27.5	27.5	27.0	27.2	26.6	26.6	27.0	27.2	27.4
	MIN	24.0	24.0	24.3	24.6	24.8	24.6	24.2	24.6	24.1	24.0	24.2	24.0	24.3
MELAKA	MAX	31.7	33.0	33.0	32.5	32.0	31.6	31.1	31.1	31.1	31.5	31.1	31.0	31.7
	MEAN	26.4	27.0	27.2	27.2	27.2	27.0	26.6	26.6	26.5	26.6	26.2	26.1	26.7
	MIN	22.5	23.0	23.2	23.4	23.5	23.1	22.8	22.7	22.8	23.0	22.9	22.7	23.0
JOHOR	MAX	29.8	31.4	32.3	32.5	32.3	31.8	31.1	31.3	31.3	31.6	30.7	29.7	31.3
	MEAN	25.2	26.0	26.3	26.4	26.5	26.4	25.8	25.9	25.7	25.8	25.5	25.2	25.9
	MIN	22.3	22.6	22.9	23.0	23.2	23.0	22.5	22.6	22.4	22.6	22.6	22.5	22.7
TERENGGANU	MAX	28.3	29.3	30.5	31.6	32.1	31.8	31.3	31.3	30.9	30.5	29.0	28.1	30.4
	MEAN	25.3	25.8	26.6	27.2	27.4	27.1	26.6	26.5	26.3	26.2	25.6	25.4	26.3
	MIN	22.4	22.5	22.9	23.5	23.7	23.6	23.1	23.1	23.0	23.1	23.0	23.0	23.1

RELATIVE HUMIDITY unit : %

State		JAN	FEB	MAR	APR	JUN	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
PERLIS	MAX	97.4	98.5	99.8	99.8	99.9	100.0	99.9	99.9	100.0	100.0	99.9	98.8	99.5
	MEAN	75.6	73.5	76.7	81.9	86.5	86.3	86.5	86.7	87.8	88.4	86.8	82.0	83.2
	MIN	41.1	35.3	35.4	41.6	52.6	52.9	54.1	54.9	56.4	55.2	55.4	51.8	48.9
KEDAH	MAX	88.8	90.2	92.0	94.0	94.8	93.8	95.8	95.4	96.4	96.2	94.0	89.8	93.4
	MEAN	72.8	74.4	76.6	82.2	85.0	82.8	81.8	81.4	84.0	84.8	80.2	74.8	80.1
	MIN	54.4	54.0	57.0	65.2	70.8	68.4	66.6	67.0	68.6	70.0	64.8	58.6	63.8
MELAKA	MAX	93.9	94.0	95.7	97.6	97.8	98.1	98.1	98.1	98.1	98.0	97.8	96.0	96.9
	MEAN	78.4	77.4	80.5	84.0	84.7	84.7	84.6	84.8	84.8	84.5	85.7	82.8	83.1
	MIN	55.9	52.2	55.6	61.3	64.0	64.0	64.1	64.2	64.0	62.9	64.4	62.1	61.2
JOHOR	MAX	95.9	96.4	97.0	98.1	98.1	98.0	98.1	97.9	98.1	98.0	98.4	97.3	97.6
	MEAN	83.5	82.3	83.3	85.9	86.5	85.8	86.3	86.1	86.6	86.2	87.9	86.6	85.6
	MIN	65.3	60.3	59.6	62.5	64.1	64.5	65.3	64.3	64.0	63.5	67.1	69.1	64.1
TERENGGANU	MAX	95.4	96.1	96.2	96.7	96.7	96.6	96.5	96.7	97.0	97.4	97.4	95.4	96.5
	MEAN	83.1	82.7	82.6	83.1	83.6	84.1	84.0	84.6	85.0	86.3	88.2	85.4	84.4
	MIN	71.2	69.0	67.3	66.1	65.4	66.1	66.0	66.3	66.8	68.8	74.6	75.0	68.5

SUNSHINE HOURS unit : hours

State		JAN	FEB	MAR	APR	JUN	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
PERLIS	MEAN	8.5	8.7	8.2	7.8	6.8	6.5	6.8	6.6	5.7	5.7	6.0	7.0	7.0
KEDAH	MEAN	8.9	9.3	9.1	8.4	6.6	6.8	6.3	6.4	5.2	5.8	6.9	8.1	7.3
MELAKA	MEAN	6.7	7.6	7.1	7.0	6.9	6.6	6.7	6.3	5.8	5.9	5.3	5.7	6.4
JOHOR	MEAN	6.4	7.1	6.7	6.3	6.4	6.4	6.0	5.8	5.0	5.3	4.9	5.6	6.0
TERENGGANU	MEAN	6.6	7.9	8.2	8.6	7.9	7.1	7.2	6.8	6.5	6.1	5.4	4.9	6.9

WIND SPEED unit : m/sec

State		JAN	FEB	MAR	APR	JUN	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
PERLIS	MEAN	2.3	2.4	1.6	1.0	0.7	0.7	0.9	0.9	0.9	0.8	1.4	2.1	1.3
KEDAH	MEAN	3.4	2.7	2.2	1.9	1.6	1.7	1.7	2.3	1.9	1.9	2.4	3.5	2.3
MELAKA	MEAN	2.8	2.7	2.0	1.4	1.2	1.2	1.2	1.2	1.3	1.4	1.6	2.3	1.7
JOHOR	MEAN	3.7	3.2	2.2	1.3	1.3	1.5	1.7	1.9	1.5	1.3	1.7	3.0	2.0
TERENGGANU	MEAN	3.2	2.9	2.7	2.3	2.3	2.2	2.2	2.2	2.2	2.2	2.5	3.5	2.5

EVAPORATION unit : mm

State		JAN	FEB	MAR	APR	JUN	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
PERLIS	MEAN	4.8	5.5	5.1	4.6	3.7	3.2	3.2	3.2	3.1	2.8	2.9	3.4	3.8
KEDAH	MEAN	7.1	6.6	6.2	5.2	3.6	4.0	3.7	3.9	3.5	3.4	4.5	6.4	4.8
MELAKA	MEAN	5.0	5.5	5.2	4.5	4.1	4.0	3.9	4.0	4.2	4.2	3.8	4.3	4.4
JOHOR	MEAN	3.5	3.9	3.7	3.4	3.0	2.9	2.8	2.9	3.0	3.0	2.8	2.9	3.1
TERENGGANU	MEAN	3.7	4.2	4.7	4.7	4.4	4.0	4.0	4.0	3.9	3.5	3.1	3.3	4.0

Source: Provided by Malaysian Meteorological Services

Table II.9 FIELD OBSERVATIONS

Project Area		Instruments Installed	Discharge measurement	Other daily observation	Remarks
JICA AREA					
PERLIS					
PR1	Simpang Geti	-	-	-	
PR4	Tasik Melati	pressure-bulb, stickgauge	-	weather, stickgauge,	Recorded and maintained by DID
KEDAH					
KH4	Kedawang	stickgauge x 3	Streams for proposed reservoir sites	weather, stickgauge	Recorded and maintained by DID
MELAKA					
MA16	Bukit Sedanan	raingauge (manual)	Small stream in the area	weather, water depth/width of a stream	Recorded by FELCRA, Maintained by DID
JOHOR					
JR10	Kelompok Kangkar Merlimau	pressure-bulb, raingauge (automatic),	Parit Kangkar Merlimau	weather, stickgauge	Recorded by farmers, DOA, DID. Maintained by DID
TERENGGANU					
TR44	Pasir Nering	raingauge(automatic) ,stickgauge x 3, pressure-bulb	Sg. Peching, Sg. Por, Sg. Udang	weather, stickgauge	Recorded and maintained by DID
DID AREA					
P.PINANG					
PP3	Tok Bedu	raingauge(automatic) ,stickgauge, pressure-bulb	Sg. Kreh	weather, stickgauge	Recorded and maintained by DID
N.SEMBILAN					
NS1	MARDI Station	raingauge (automatic)	Sg. Jemenche	weather	Recorded and maintained by DID
KELANTAN					
KN16	Permatang Sungkai	raingauge(automatic) ,stickgauge, pressure-bulb	Sg. Linja, Sg Batu Balai	weather, stickgauge	Recorded and maintained by DID

Table II.10 LOWEST LOW FLOWS ESTIMATED BY HP12

PR1 SIMPANG GETI UNIT : CUMEC

RETURN PERIOD	9 in 10 1.1	4 in 5 1.3	2 in 3 1.5	1 in 2 2.0	3 in 7 2.3	1 in 5 5.0	1 in 10 10.0	1 in 20 20.0	1 in 50 50.0
MEAN ANNUAL LOW FLOW = 0.1724CUMEC (CA=55.0 SQ.KM)									
1 DAY	0.2694	0.2298	0.1957	0.1636	0.1513	0.1131	0.0940	0.0821	0.0725
4 DAYS	0.2881	0.2464	0.2104	0.1764	0.1635	0.1228	0.1024	0.0896	0.0792
7 DAYS	0.3033	0.2595	0.2220	0.1867	0.1733	0.1318	0.1112	0.0985	0.0884
30 DAYS	0.3954	0.3379	0.2894	0.2445	0.2277	0.1765	0.1520	0.1373	0.1259

PR4 TASIK MELATI UNIT : CUMEC

RETURN PERIOD	9 in 10 1.1	4 in 5 1.3	2 in 3 1.5	1 in 2 2.0	3 in 7 2.3	1 in 5 5.0	1 in 10 10.0	1 in 20 20.0	1 in 50 50.0
MEAN ANNUAL LOW FLOW = 0.0193 CUMEC (CA=5.7 SQ.KM)									
1 DAY	0.0302	0.0257	0.0219	0.0183	0.0170	0.0127	0.0105	0.0092	0.0081
4 DAYS	0.0323	0.0276	0.0236	0.0198	0.0183	0.0138	0.0115	0.0100	0.0089
7 DAYS	0.0340	0.0291	0.0249	0.0209	0.0194	0.0148	0.0125	0.0110	0.0099
30 DAYS	0.0443	0.0379	0.0324	0.0274	0.0255	0.0198	0.0170	0.0154	0.0141

KH 4 KEDAWANG, BUKIT LEMBU UNIT : CUMEC

RETURN PERIOD	9 in 10 1.1	4 in 5 1.3	2 in 3 1.5	1 in 2 2.0	3 in 7 2.3	1 in 5 5.0	1 in 10 10.0	1 in 20 20.0	1 in 50 50.0
MEAN ANNUAL LOW FLOW = 0.0204 CUMEC (CA=3.5 SQ.KM)									
1 DAY	0.0319	0.0272	0.0232	0.0194	0.0179	0.0134	0.0111	0.0097	0.0086
4 DAYS	0.0341	0.0292	0.0249	0.0209	0.0194	0.0146	0.0121	0.0106	0.0094
7 DAYS	0.0360	0.0308	0.0263	0.0221	0.0205	0.0156	0.0132	0.0117	0.0105
30 DAYS	0.0469	0.0401	0.0343	0.0290	0.0270	0.0209	0.0180	0.0163	0.0149

MA16 BUKIT SEDANAN, MELAKA UNIT : CUMEC

RETURN PERIOD	9 in 10 1.1	4 in 5 1.3	2 in 3 1.5	1 in 2 2.0	3 in 7 2.3	1 in 5 5.0	1 in 10 10.0	1 in 20 20.0	1 in 50 50.0
MEAN ANNUAL LOW FLOW = 0.0014 CUMEC (CA=2.35 SQ.KM)									
1 DAY	0.0023	0.0020	0.0017	0.0012	0.0009	0.0007	0.0006	0.0005	0.0081
4 DAYS	0.0025	0.0021	0.0018	0.0014	0.0010	0.0008	0.0006	0.0005	0.0089
7 DAYS	0.0026	0.0022	0.0019	0.0014	0.0010	0.0008	0.0007	0.0006	0.0099
30 DAYS	0.0036	0.0030	0.0026	0.0020	0.0014	0.0011	0.0009	0.0008	0.0141

JR10 KANGKAR MERLIMAU UNIT : CUMEC

RETURN PERIOD	9 in 10 1.1	4 in 5 1.3	2 in 3 1.5	1 in 2 2.0	3 in 7 2.3	1 in 5 5.0	1 in 10 10.0	1 in 20 20.0	1 in 50 50.0
MEAN ANNUAL LOW FLOW = 0.0024 CUMEC (CA=2.35 SQ.KM)									
1 DAY	0.0040	0.0034	0.0029	0.0022	0.0015	0.0012	0.0010	0.0008	0.0081
4 DAYS	0.0044	0.0037	0.0031	0.0024	0.0017	0.0013	0.0011	0.0009	0.0089
7 DAYS	0.0045	0.0039	0.0033	0.0025	0.0018	0.0014	0.0012	0.0010	0.0099
30 DAYS	0.0062	0.0053	0.0045	0.0035	0.0025	0.0020	0.0016	0.0014	0.0141

TR44 PASIR NERING, TERENGGANU UNIT : CUMEC

RETURN PERIOD	9 in 10 1.1	4 in 5 1.3	2 in 3 1.5	1 in 2 2.0	3 in 7 2.3	1 in 5 5.0	1 in 10 10.0	1 in 20 20.0	1 in 50 50.0
MEAN ANNUAL LOW FLOW = 0.0378 CUMEC (CA=4.85 SQ.KM)									
1 DAY	0.0591	0.0504	0.0429	0.0359	0.0332	0.0248	0.0206	0.0180	0.0159
4 DAYS	0.0632	0.0540	0.0462	0.0387	0.0359	0.0269	0.0225	0.0197	0.0174
7 DAYS	0.0665	0.0569	0.0487	0.0410	0.0380	0.0289	0.0244	0.0216	0.0194
30 DAYS	0.0867	0.0741	0.0635	0.0536	0.0499	0.0387	0.0333	0.0301	0.0276

Table II.11 PARAMETERS AND CONDITIONS OF CALCULATION FOR WRP12

	PR1	PR4	KH4	MA16	JR10	TR44
	Simpang Geti	Tasik Melati	Kedawang	Bkt.Sedanan	K.Merlimau	Pasir Nering
Catchment area (sq.km)	55.0	5.7	3.5, 0.35, 0.6	2.35, 0.47	1.4	4.85, 18.2, 2.4
Meteorological station	Chuping (MMS)	Chuping (MMS)	Langkawi Airport (MMS)	Melaka Airport (MMS)	Kluang (MMS)	K.Terengganu (MMS)
Potential evapotranspi-ration	ETo by PEN91 (HP17)	ETo by PEN91 (HP17)	ETo by PEN91 (HP17)	ETo by PEN91 (HP17)	ETo by PEN91 (HP17)	ETo by PEN91 (HP17)
Rainfall Station	6502001 Ldg. Perlis Utara	6502010 Bkt. Temiang	6397112 Ulu Melaka	2324032 Bkt. Senggeh	1929064 Parit Sulong	5029036 Paya Kemat
Years of calculation	1976-79, 1983, 1985-87	1969-1992	1955-1990	1960-1990	1952-1989	1958-1992
Water holding capacity	250 mm	250 mm	250 mm	250 mm	250 mm	250 mm
Soil moisture retention (a)	249.5	249.5	249.5	249.5	249.5	249.5
Soil moisture retention (a)	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004
Recession constant (K)	0.9143	0.9277	0.9443	0.9145	0.9629	0.9178
Surface runoff rate (fs)	0.05	0.00	0.05	0.01	0.01	0.10
Baseflow (Qb)	0.25 mm/day	0.29 mm/day	0.5 mm/day	0.054 mm/day	1.2 mm/day	0.35 mm/day

Table II.12 a ESTIMATED MONTHLY RUNOFF BY PROJECT

PR1 SIMPANG GETI

RAINFALL STATION : 6502001 LDG. PERLIS UTARA unit : mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Rainfall	f_runoff
1976	39.5	7.9	8.6	12.4	16.2	24.6	36.8	35.9	102.5	137.7	151.4	53.2	626.7	1694.5	37%
1977	8.8	7.5	7.8	8.2	16.4	10.7	10.4	18.2	115.4	93.1	29.6	8.4	334.5	1309.0	26%
1978	12.3	7.0	17.8	8.1	14.9	10.6	15.8	14.4	9.4	18.4	74.1	58.7	261.2	1556.0	17%
1979	8.9	7.0	10.0	19.1	46.7	10.4	89.5	40.9	9.7	26.9	254.4	95.3	618.7	1724.0	36%
1980															
1981				<---------- CONTINUOUS DATA ARE NOT AVAILABLE ---------->											
1982															
1983	10.7	7.0	9.5	9.4	13.6	10.0	12.5	68.0	94.4	137.4	66.3	108.6	547.3	1593.5	34%
1984				<---------- CONTINUOUS DATA ARE NOT AVAILABLE ---------->											
1985	7.8	12.2	8.0	11.8	38.7	12.1	9.6	14.1	9.6	9.9	16.3	25.5	175.5	1219.2	14%
1986	7.8	7.0	8.5	11.0	17.0	10.6	11.1	10.6	13.2	31.2	115.2	100.8	343.9	1437.3	24%
1987	9.6	7.0	12.4	9.4	14.0	13.9	8.7	30.6	99.4	163.1	122.1	122.0	612.1	1702.0	36%
1988															
1989				<---------- CONTINUOUS DATA ARE NOT AVAILABLE ---------->											
1990															
Average	13.2	7.8	10.3	11.2	22.2	12.9	24.3	29.1	56.7	77.2	103.7	71.6	440.0	1529.4	29%

Remarks : f_runoff; Percentage of the annual runoff to the annual rainfall

Table II.12 b ESTIMATED MONTHLY RUNOFF BY PROJECT

PR4 TASIK MELATI

RAINFALL STATION : 6502010 BUKIT TEMIANG, PERLIS unit : mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Rainfall	f_runoff
1969	102.1	15.1	9.0	8.7	66.2	53.1	41.6	36.9	92.1	132.1	265.9	117.5	940.4	2228.8	42%
1970	13.3	8.1	9.0	8.7	43.7	48.5	80.1	92.8	218.1	192.8	205.7	65.3	986.1	2317.7	43%
1971	124.8	14.2	51.8	33.8	12.4	75.7	58.4	17.3	49.1	168.2	123.7	130.8	860.3	2103.7	41%
1972	28.1	8.4	9.0	26.3	48.3	110.5	31.8	42.2	287.9	172.9	298.5	231.7	1295.6	2550.4	51%
1973	61.7	11.3	9.0	9.5	37.4	36.0	51.4	89.5	76.5	123.7	152.6	107.1	765.8	2058.1	37%
1974	17.5	8.1	9.0	8.7	18.6	58.5	13.4	9.0	15.8	44.1	78.3	55.8	336.8	1516.1	22%
1975	66.6	24.3	47.8	9.2	9.0	37.1	13.7	17.0	33.1	77.2	120.7	86.8	542.5	1899.5	29%
1976	47.1	8.6	9.0	8.7	31.7	25.2	53.2	74.5	151.3	142.5	90.8	53.3	695.7	1763.5	39%
1977	9.4	8.1	9.0	8.7	9.0	8.7	9.0	9.0	74.2	121.6	53.1	13.8	333.6	1694.5	20%
1978	9.0	8.1	9.0	8.7	9.0	8.7	33.4	83.7	87.3	46.1	39.4	10.9	353.4	1309.0	27%
1979	9.0	8.1	9.0	8.7	15.9	11.1	39.8	49.2	82.0	104.5	154.8	83.6	575.7	1556.0	37%
1980	10.9	8.4	9.0	8.7	9.0	11.4	9.0	19.7	31.3	161.2	142.4	130.4	551.4	1724.0	32%
1981	17.0	8.1	9.0	8.7	9.0	8.7	9.0	9.0	8.7	9.0	106.7	71.4	274.3	1373.0	20%
1982	10.5	8.1	9.0	8.7	9.0	17.6	113.3	91.6	137.2	203.4	128.9	240.9	978.3	2264.5	43%
1983	66.5	9.0	9.0	8.7	9.0	8.7	12.5	126.2	90.8	129.4	64.4	56.6	590.8	1559.3	38%
1984	12.0	8.4	9.0	8.7	9.0	8.7	46.8	12.3	34.7	55.0	68.7	33.9	307.2	1593.5	19%
1985	31.1	48.8	15.8	40.4	87.7	59.3	10.1	9.0	26.1	44.1	106.4	59.0	537.8	1705.0	32%
1986	9.7	8.1	9.0	8.7	126.7	112.9	20.1	27.5	65.1	173.9	176.0	89.6	827.2	1219.2	68%
1987	12.3	8.1	9.0	8.7	9.0	8.7	9.0	27.9	216.0	207.7	114.0	161.4	791.8	1437.3	55%
1988	27.0	9.6	9.0	55.2	62.4	14.0	9.0	16.2	96.4	219.3	126.0	119.1	763.2	1702.0	45%
1989	13.7	8.1	9.0	8.7	9.0	8.7	17.0	54.8	86.1	147.5	155.3	20.9	538.9	1600.0	34%
1990	9.0	8.1	9.0	8.7	9.0	8.7	9.0	9.0	8.7	91.5	303.4	38.1	512.2	1729.5	30%
1991	9.0	8.1	9.0	8.7	21.2	112.7	108.3	162.1	131.1	84.2	92.6	14.7	761.8	1924.5	40%
1992	9.0	8.4	9.0	8.7	9.0	8.7	9.0	9.0	8.7	9.0	109.3	31.1	228.9	1317.0	17%
Average	30.3	11.3	12.7	13.8	28.3	35.9	33.7	45.6	87.9	119.2	136.6	84.3	639.6	1745.3	37%

Remarks : f_runoff; Percentage of the annual runoff to the annual rainfall

Table II.12 c ESTIMATED MONTHLY RUNOFF BY PROJECT

KH4 KEDAWAN, LANGKAWI

RAINFALL STATION : 6397112 ULU MELAKA, LANGKAWI

unit : mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Rainfall	f_runoff
1955	15.8	14.1	15.5	15.0	15.5	18.0	17.0	25.9	19.3	135.5	189.6	58.9	540.0	1390.6	39%
1956	17.1	14.5	18.3	22.7	20.0	19.7	50.4	220.5	212.8	225.8	173.3	49.6	1044.6	2202.6	47%
1957	16.9	14.0	17.0	20.0	26.7	88.6	183.5	221.9	167.1	305.0	131.8	29.7	1222.2	2422.7	50%
1958	15.5	14.8	17.3	21.0	149.4	256.0	197.5	251.9	223.1	334.1	207.8	82.5	1771.0	2911.6	61%
1959	17.9	15.2	19.0	19.6	137.9	143.1	158.1	282.7	179.6	139.0	219.7	118.5	1450.3	2676.9	54%
1960	22.3	14.5	15.5	20.3	21.5	26.6	52.5	63.7	144.6	104.6	139.8	74.4	700.4	1855.5	38%
1961	20.2	14.2	19.5	24.6	49.3	110.3	100.3	72.2	160.9	331.6	158.9	37.3	1099.3	2380.0	46%
1962	15.5	14.0	16.2	18.5	51.5	106.7	171.3	79.5	116.3	217.3	173.5	32.3	1012.7	2117.0	48%
1963	16.4	14.0	17.6	15.6	18.9	20.2	22.1	54.4	214.4	314.2	276.7	62.1	1046.7	2145.4	49%
1964	16.0	14.9	15.5	16.6	32.7	42.3	82.6	111.5	313.6	215.7	257.5	79.4	1198.3	2340.0	51%
1965	17.2	15.5	18.2	15.0	18.6	20.0	105.7	221.6	329.1	261.6	219.9	50.8	1293.1	2428.6	53%
1966	16.0	17.0	57.1	97.6	237.6	272.4	248.5	283.4	187.5	176.3	112.0	81.7	1787.1	3133.6	57%
1967	23.5	14.0	15.5	25.0	138.1	149.8	258.8	211.0	201.0	272.0	109.5	21.6	1439.8	2571.5	56%
1968	15.5	14.5	17.7	22.7	42.5	192.9	256.0	159.9	129.3	224.1	119.7	28.0	1222.8	2418.3	51%
1969	18.4	14.5	20.9	21.3	73.5	137.6	158.9	155.1	306.5	481.5	377.0	81.6	1846.6	3133.5	59%
1970	19.3	14.0	17.6	18.0	34.8	89.3	56.1	89.7	313.7	305.6	153.0	103.1	1214.2	2458.4	49%
1971	31.3	21.1	19.8	19.7	136.5	210.3	162.5	182.5	340.5	208.7	126.5	51.5	1510.6	2760.1	55%
1972	15.7	15.3	16.1	20.4	17.3	66.6	35.2	40.6	417.4	311.1	158.0	124.6	1238.3	2481.1	50%
1973	35.5	14.0	15.7	22.6	31.8	117.9	174.4	86.1	227.2	256.6	286.1	155.3	1423.2	2634.8	54%
1974	28.8	14.6	15.7	18.2	106.1	126.0	105.2	174.5	315.4	270.8	171.4	38.9	1385.5	2496.3	56%
1975	21.4	16.3	16.5	22.8	104.9	277.4	231.7	197.3	349.6	358.5	214.5	68.5	1879.2	3282.5	57%
1976	17.3	16.9	25.3	16.9	26.8	89.5	220.0	203.8	231.1	266.4	180.0	42.7	1336.5	2564.5	52%
1977	16.0	14.0	15.5	18.4	20.9	17.8	51.4	171.7	245.3	437.1	162.7	30.4	1201.1	2197.0	55%
1978	15.9	14.0	16.5	23.2	99.7	97.0	285.9	174.5	213.6	172.0	78.3	18.6	1209.1	2344.5	52%
1979	15.5	14.0	15.9	21.3	21.9	46.4	266.3	273.4	343.3	243.9	86.3	21.1	1369.3	2435.5	56%
1980	15.5	14.5	20.5	23.1	44.5	297.4	196.9	399.0	192.8	345.7	259.3	135.8	1945.0	3249.8	60%
1981	29.5	17.1	16.0	40.0	230.0	149.7	155.4	120.7	167.2	93.2	281.3	94.2	1394.3	2586.3	54%
1982	19.0	14.5	20.7	62.4	335.1	237.4	232.9	251.9	267.8	451.1	267.4	144.5	2304.7	3580.5	64%
1983	26.2	14.2	17.0	16.0	50.5	145.1	452.8	439.0	394.0	479.1	257.2	70.1	2361.2	3425.5	69%
1984	17.3	14.8	22.2	45.5	117.8	78.6	85.3	99.1	98.1	112.5	54.5	18.4	764.0	2038.5	37%
1985	15.5	20.8	18.5	19.9	50.5	38.6	39.0	156.5	198.6	352.1	174.9	69.7	1154.5	2476.5	47%
1986	17.3	14.8	19.9	22.7	64.2	64.9	35.3	82.9	275.4	271.4	225.3	70.7	1164.9	2366.0	49%
1987	16.7	14.0	20.0	19.8	45.0	247.4	92.8	268.7	310.6	392.2	449.1	230.7	2107.0	3347.0	63%
1988	39.5	16.5	17.2	40.5	155.0	63.5	354.7	287.6	354.2	293.9	147.2	92.4	1862.2	3067.5	61%
1989	19.4	15.5	16.9	21.2	33.4	89.5	242.2	152.8	237.8	338.7	129.7	25.3	1322.3	2438.5	54%
1990	15.5	14.7	15.5	20.9	62.5	77.7	88.3	115.2	409.2	457.8	347.6	94.9	1719.8	2918.5	59%
Average	19.8	15.1	18.9	25.2	78.4	117.6	156.3	177.3	244.7	282.1	196.6	71.9	1403.9	2589.2	54%

Remarks : f_runoff; Percentage of the annual runoff to the annual rainfall

Table II.12 d ESTIMATED MONTHLY RUNOFF BY PROJECT

MA10 BUKIT SEDANAN, MELAKA

RAINFALL STATION : 2324032 BUKIT SENGGEH, MELAKA unit : mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Rainfall	f_runoff
1960	21.2	2.2	2.4	5.8	3.4	28.3	72.2	56.4	48.1	46.0	63.8	53.2	403.0	1537.2	26%
1961	29.0	3.9	2.5	78.1	178.0	66.3	23.9	26.1	4.0	1.8	2.4	2.4	418.5	1543.3	27%
1962	1.8	1.6	7.9	154.0	174.7	26.4	2.5	26.3	45.5	130.0	106.4	21.0	698.2	1899.2	37%
1963	2.2	1.7	2.1	1.8	32.4	29.6	3.8	2.2	3.5	81.0	88.9	126.4	375.4	1440.4	26%
1964	75.7	42.5	82.3	60.3	197.2	15.2	18.7	32.8	40.7	43.7	44.7	97.6	751.3	2008.9	37%
1965	123.8	16.2	3.3	29.1	5.8	2.0	2.4	1.9	1.9	2.7	55.7	126.9	371.6	1528.1	24%
1966	29.1	2.7	2.8	71.8	54.6	4.4	15.2	5.4	5.1	108.6	189.2	122.8	611.7	1828.9	33%
1967	180.5	66.7	61.8	5.4	49.7	51.5	4.3	2.4	31.9	18.3	193.0	97.0	762.5	1997.7	38%
1968	39.2	2.7	4.8	14.8	100.8	23.7	3.1	2.6	38.9	49.3	122.4	106.3	508.6	1613.3	32%
1969	32.7	8.6	3.4	37.1	130.6	66.7	7.3	2.3	2.5	60.3	84.4	114.2	550.1	1759.8	31%
1970	23.4	3.6	3.1	194.4	96.8	95.6	39.9	17.3	11.3	33.7	130.2	186.4	835.6	2095.7	40%
1971	269.1	22.1	30.1	14.7	4.3	49.7	21.3	10.8	45.4	29.1	181.6	240.5	918.9	2139.0	43%
1972	67.5	6.4	46.1	15.2	2.0	2.1	2.3	99.2	62.4	141.5	172.6	107.4	724.6	1780.0	41%
1973	16.9	2.8	2.1	52.1	85.8	9.4	1.7	2.4	2.5	2.8	11.4	2.4	192.4	1270.7	15%
1974	2.1	2.2	2.8	4.7	57.2	33.0	3.7	14.0	66.8	29.7	27.9	32.0	276.0	1449.7	19%
1975	116.6	20.5	3.7	71.6	34.4	6.6	2.7	13.6	74.0	17.8	64.1	62.8	488.4	1733.0	28%
1976	24.3	2.0	2.8	2.7	6.9	3.4	6.4	33.7	59.6	191.7	215.9	36.1	585.6	1681.0	35%
1977	2.8	13.3	4.6	2.2	30.7	5.5	21.7	25.8	6.3	24.4	40.0	13.9	191.4	1321.0	14%
1978	3.0	2.1	1.8	79.4	163.3	41.1	4.3	30.3	13.4	6.4	59.1	54.7	458.9	1686.0	27%
1979	19.2	2.5	9.4	152.1	69.0	5.8	14.8	23.0	2.7	2.4	81.6	77.5	460.0	1530.0	30%
1980	6.0	2.9	79.3	71.5	97.1	106.7	10.4	27.5	5.1	22.9	54.2	64.6	548.1	1770.0	31%
1981	5.9	2.6	2.4	99.8	81.8	6.3	2.3	2.0	49.9	57.4	85.5	31.6	427.5	1520.0	28%
1982	4.7	1.8	3.0	84.2	31.8	21.2	12.1	42.0	19.4	14.6	187.8	136.5	559.0	1820.0	31%
1983	53.9	3.7	1.7	2.3	2.3	2.0	20.7	26.1	6.2	47.3	73.7	26.5	266.4	1200.0	22%
1984	2.9	211.4	225.1	43.8	49.5	167.2	119.1	40.1	3.8	2.3	84.7	177.2	1127.1	2442.0	46%
1985	83.5	6.3	6.2	30.2	14.5	9.4	2.4	2.4	2.4	96.3	140.1	79.5	473.1	1558.5	30%
1986	11.8	13.7	157.4	248.1	141.3	17.2	2.7	2.1	22.6	194.3	137.0	12.1	960.4	2132.0	45%
1987	2.8	1.5	2.5	6.7	34.1	94.2	30.4	45.4	99.4	264.2	176.7	75.4	833.4	2014.0	41%
1988	6.4	6.8	23.8	59.6	42.2	144.8	20.8	3.3	76.2	85.2	123.7	47.1	639.9	1811.5	35%
1989	4.2	2.2	100.6	34.4	4.6	2.2	2.2	40.8	64.6	132.8	226.3	61.9	676.7	1917.5	35%
1990	17.1	5.7	2.7	2.5	2.4	1.9	2.0	1.7	2.0	20.1	46.1	78.1	182.3	1242.0	15%
Average	41.3	15.6	28.5	55.8	63.8	36.8	16.0	21.3	29.6	63.2	105.5	79.7	557.3	1718.4	32%

Remarks : f_runoff; Percentage of the annual runoff to the annual rainfall

Table II.12 e ESTIMATED MONTHLY RUNOFF BY PROJECT

JR10 KANGKAR MERLIMAU, JOHOR

RAINFALL STATION : 192964 PARIT SULONG, JOHOR

unit : mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Rainfall	f_runoff
1952	205.5	138.2	108.5	103.0	167.0	198.8	169.2	81.9	86.7	107.0	75.4	37.9	1479.0	2742.6	54%
1953	37.2	33.6	56.3	140.0	178.0	146.0	117.8	83.3	88.8	163.2	208.3	97.1	1349.5	2705.2	50%
1954	126.3	62.4	59.4	107.8	95.3	152.4	190.3	201.8	148.7	71.6	63.9	303.5	1583.5	3010.8	53%
1955	184.6	94.3	89.0	177.2	194.4	81.6	54.2	45.0	50.1	60.7	97.0	59.7	1187.8	2213.6	54%
1956	68.3	126.2	69.9	168.3	64.0	36.0	42.3	65.7	37.6	37.7	87.9	158.3	962.2	2272.4	42%
1957	81.3	52.8	37.5	37.9	59.1	69.2	48.5	130.3	108.1	72.0	230.3	238.8	1165.8	2489.5	47%
1958	132.4	99.7	67.4	95.2	131.1	88.1	43.9	37.2	36.0	37.2	70.9	50.1	889.1	1932.5	46%
1959	37.2	33.6	51.1	138.0	91.8	58.7	87.8	125.4	155.6	166.3	241.6	99.8	1287.0	2636.1	49%
1960	87.1	98.4	65.6	101.5	76.2	36.2	37.6	66.8	133.7	134.3	158.4	153.4	1149.1	2478.2	46%
1961	117.7	99.0	128.5	161.2	127.5	43.7	37.2	37.2	36.0	37.2	64.7	52.8	942.6	1929.4	49%
1962	37.2	33.6	37.7	60.9	68.4	38.0	37.2	37.2	49.3	95.0	215.0	134.2	843.7	2144.6	39%
1963	54.6	33.6	37.2	36.0	37.2	36.0	37.2	37.2	36.0	86.5	156.4	140.9	728.7	1945.1	37%
1964	108.3	69.9	185.0	150.3	180.1	67.7	69.2	89.1	55.5	47.7	57.4	112.5	1192.7	2489.1	48%
1965	111.2	37.8	37.7	98.4	170.3	119.7	49.8	53.9	43.2	68.9	172.8	143.7	1107.3	2213.5	50%
1966	69.5	38.1	37.2	68.3	100.1	75.6	45.7	53.7	36.7	60.3	69.4	107.3	761.8	2044.1	37%
1967	95.6	97.5	103.5	104.1	119.1	86.0	133.0	53.7	36.0	37.2	36.0	75.8	977.5	2360.5	41%
1968	214.0	63.9	58.1	98.2	115.3	73.1	39.5	37.2	36.0	81.5	158.0	131.6	1106.4	2005.7	55%
1969	67.6	39.3	37.6	37.4	71.6	63.9	89.8	88.2	106.5	176.4	114.4	257.4	1150.0	2496.7	46%
1970	128.6	45.5	37.2	64.3	172.6	120.4	143.5	148.2	165.7	243.7	121.3	91.6	1482.7	2675.6	55%
1971	214.0	68.9	37.6	36.0	37.2	36.0	37.2	64.9	87.6	43.8	92.7	141.7	897.5	2106.5	43%
1972	107.3	38.1	45.2	70.6	79.7	43.9	37.2	37.2	36.0	42.6	154.3	91.6	783.8	1816.7	43%
1973	80.1	61.8	137.7	188.2	179.5	120.1	109.3	153.5	117.6	100.9	169.0	94.4	1512.2	2757.8	55%
1974	44.2	33.6	37.2	68.4	141.6	95.3	106.6	109.3	115.4	106.0	80.6	70.2	1008.4	2162.8	47%
1975	55.3	33.6	62.8	71.1	62.3	82.0	81.5	83.4	75.5	75.4	136.1	137.5	956.6	2372.5	40%
1976	151.6	47.1	37.2	117.7	89.2	38.7	46.4	49.9	90.8	257.7	309.5	137.0	1372.6	2436.5	56%
1977	95.9	36.8	37.2	36.0	37.2	36.0	37.2	37.2	82.6	176.5	158.5	87.6	858.8	1949.5	44%
1978	72.8	46.6	83.1	65.9	75.3	40.2	39.3	42.7	87.3	75.5	97.4	114.2	840.3	2080.0	40%
1979	72.5	33.8	39.0	96.1	67.6	36.1	50.2	79.1	67.3	60.3	188.8	143.3	934.0	2006.5	47%
1980	48.6	35.5	116.2	100.9	101.6	38.9	37.2	39.4	57.4	164.6	175.4	159.6	1075.3	2373.0	45%
1981	62.8	33.6	37.2	86.9	169.5	56.6	81.0	67.2	61.7	75.2	96.0	61.2	888.8	2021.0	44%
1982	39.5	33.6	37.2	69.7	52.6	46.5	56.6	44.5	36.0	38.2	164.0	258.6	876.9	2198.6	40%
1983	144.1	44.7	37.2	36.0	37.2	73.0	135.1	125.5	45.3	37.7	84.6	69.9	870.1	1922.5	45%
1984	91.0	298.0	369.3	189.7	151.6	115.5	99.3	59.2	36.0	44.6	86.9	82.0	1623.1	2843.5	57%
1985	55.6	135.7	140.2	62.8	94.8	65.9	37.4	42.2	41.7	89.5	99.9	169.1	1034.7	2279.0	45%
1986	122.4	44.9	124.7	121.0	192.2	121.6	74.8	41.8	102.6	164.0	224.6	190.1	1524.8	2804.0	54%
1987	237.1	121.5	48.7	44.8	147.3	60.2	41.2	120.6	118.2	224.0	260.9	119.7	1544.1	2679.5	58%
1988	47.4	98.0	195.9	228.3	202.5	110.0	158.9	170.1	146.7	57.4	123.5	130.8	1669.6	2937.0	57%
1989	91.7	51.2	39.1	112.5	82.0	46.7	67.6	124.5	121.0	175.0	166.2	139.4	1217.1	2499.0	49%
1990															
Average	99.9	68.3	78.1	98.7	111.0	75.1	73.9	78.0	78.2	99.8	138.6	127.5	1127.2	2346.8	48%

Remarks : f_runoff; Percentage of the annual runoff to the annual rainfall

Table II.12 f ESTIMATED MONTHLY RUNOFF BY PROJECT

TR44 PASIR NERING, TERENGGANU

RAINFALL STATION : 5029036 PAM PAYA KEMAT, TERENGGANU unit : mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Rainfall	f_runoff
1958	341.2	173.0	41.9	14.1	20.8	63.5	70.4	118.7	72.4	140.6	421.8	295.8	1774.2	2837.8	63%
1959	201.7	52.0	41.3	73.2	67.7	20.1	99.3	53.1	24.3	140.3	265.3	238.9	1277.2	2643.9	48%
1960	412.6	226.3	45.4	27.8	74.9	50.5	46.9	71.6	144.0	64.9	236.2	319.2	1720.3	3174.6	54%
1961	373.1	116.1	91.8	83.8	89.7	22.1	19.3	34.8	98.9	132.7	312.4	502.6	1877.4	3277.3	57%
1962	420.8	82.4	42.7	13.0	18.4	19.3	27.8	32.6	90.8	102.2	223.8	449.6	1523.4	2691.6	57%
1963	334.5	179.2	76.4	16.2	19.4	13.8	15.7	32.6	60.0	107.3	220.8	380.0	1455.8	2609.6	56%
1964	84.4	245.5	87.0	15.5	14.7	23.2	16.2	27.8	46.4	118.7	206.1	291.9	1177.3	2569.6	46%
1965	101.3	35.6	15.5	19.4	21.8	15.8	21.3	20.4	26.5	40.3	206.8	604.1	1129.0	2437.8	46%
1966	497.7	182.3	91.4	12.3	28.1	25.2	37.0	53.5	76.7	239.2	265.2	417.8	1926.5	3225.5	60%
1967	407.8	165.7	117.3	24.4	42.3	19.0	43.8	54.2	65.8	140.6	314.3	436.4	1831.7	3064.7	60%
1968	72.4	13.0	19.9	30.5	75.2	20.0	21.3	23.2	24.8	189.9	254.0	385.8	1129.9	2524.1	45%
1969	199.2	22.9	12.4	17.5	18.0	16.1	18.7	15.2	19.6	20.7	170.3	437.1	967.7	2052.6	47%
1970	284.6	41.5	17.8	24.7	16.6	19.7	19.0	28.8	30.1	174.2	147.8	223.4	1028.0	2269.9	45%
1971	257.4	25.4	22.8	10.5	16.2	22.2	21.8	22.2	16.5	27.0	75.8	452.1	969.8	2028.3	48%
1972	114.7	11.7	11.3	13.2	15.5	17.9	17.9	16.6	29.1	44.3	121.0	323.1	736.3	1668.7	44%
1973	(118.2)	(20.0)	(24.4)	(14.1)	(25.7)	(37.0)	21.2	18.7	50.6	215.6	234.1	581.7	(1361.1)		
1974	139.4	30.0	16.1	47.4	32.1	25.8	21.3	15.4	52.4	53.6	255.1	220.0	908.7	2218.0	41%
1975	451.2	62.8	13.8	14.1	16.0	18.0	51.6	93.6	477.6	480.5	135.0	272.3	2086.4	3184.4	66%
1976	59.1	10.9	12.0	21.7	28.9	45.7	81.4	86.3	105.5	38.4	226.5	456.4	1172.5	2513.9	47%
1977	274.5	80.3	26.8	14.0	18.7	26.1	67.7	138.9	93.9	95.6	256.7	410.0	1503.2	2670.9	56%
1978	302.6	45.0	14.8	15.1	29.2	52.7	208.1	107.8	111.6	170.9	299.4	339.9	1697.0	2939.5	58%
1979	123.5	67.2	23.9	25.3	42.6	43.5	76.7	29.0	82.0	154.5	516.9	527.1	1712.2	3051.7	56%
1980	110.8	24.8	22.2	36.7	54.0	20.7	85.1	96.0	109.6	215.1	242.0	611.3	1628.4	3287.2	50%
1981	284.8	129.3	46.4	115.7	147.9	142.2	59.9	33.9	180.3	77.9	157.6	599.9	1975.7	3147.6	63%
1982	100.7	14.2	21.0	47.3	104.5	48.5	138.2	103.5	172.1	315.1	223.6	645.8	1934.5	3328.9	58%
1983	437.4	64.8	14.5	10.8	35.6	86.4	106.7	46.3	85.7	76.9	135.4	1770.8	2871.2	4180.0	69%
1984	555.2	700.8	376.9	199.5	280.2	268.9	110.9	110.3	138.0	168.6	297.4	649.1	3855.7	5237.9	74%
1985	329.8	205.6	346.8	130.7	262.5	116.9	30.6	24.9	228.7	304.1	330.8	401.1	2712.6	3922.5	69%
1986	323.2	38.6	24.1	20.6	20.9	126.4	35.4	19.0	118.9	278.2	367.7	686.5	2059.3	3380.1	61%
1987	307.9	77.7	28.8	16.4	20.9	38.5	28.3	20.9	143.8	160.2	238.7	758.9	1840.9	3216.0	57%
1988	338.1	169.8	245.8	65.5	205.8	88.1	182.2	299.9	199.2	60.3	465.3	670.3	2990.4	4333.5	69%
1989	486.8	112.6	42.4	149.4	211.7	162.5	155.4	97.1	171.2	312.8	352.7	352.6	2607.4	3955.5	66%
1990	283.1	97.2	19.4	49.7	101.1	75.0	86.7	63.2	50.8	146.2	323.2	567.5	1863.0	3188.5	58%
1991	332.5	229.0	28.3	20.2	26.0	19.7	24.5	108.7	160.6	189.9	533.7	706.1	2379.1	3868.5	61%
1992	454.9	107.7	153.7	21.2	28.1	20.0	53.7	87.7	167.7	193.8	738.1	948.9	2975.5	4316.0	69%
Average	(283.3)	(110.3)	(63.9)	(40.9)	(63.8)	(52.3)	60.6	63.0	106.5	154.0	279.2	512.4	(1790.3)	3088.7	58%

Remarks: f_runoff; Percentage of the annual runoff to the annual rainfall

Values within brackets are influenced by the absence of rainfall records

Table II.13 BASINWISE MEAN ANNUAL MINIMUM FLOW ESTIMATED BY HP12

Basin No.	RC	RE	Low Flow CA=1 sq.km		CA=2 sq.km		CA=5 sq.km		CA=10 sq.km		CA=20 sq.km		Mean	
			cumec	mm	cumec	mm	cumec	mm	cumec	mm	cumec	mm	cumec	mm
1	1	1	0.0027	0.2307	0.0057	0.2459	0.0155	0.2675	0.0330	0.2851	0.0703	0.3039	0.0254	0.2666
2	1	1	0.0055	0.4780	0.0118	0.5094	0.0321	0.5542	0.0684	0.5907	0.1457	0.6296	0.0527	0.5524
3 a	1	1	0.0036	0.3089	0.0076	0.3292	0.0207	0.3581	0.0442	0.3817	0.0942	0.4069	0.0341	0.3570
b	1	1	0.0033	0.2844	0.0070	0.3032	0.0191	0.3298	0.0407	0.3516	0.0867	0.3747	0.0314	0.3287
c	1	1	0.0040	0.3438	0.0085	0.3664	0.0231	0.3986	0.0492	0.4249	0.1048	0.4529	0.0379	0.3973
d	1	1	0.0040	0.3425	0.0085	0.3650	0.0230	0.3972	0.0490	0.4233	0.1044	0.4512	0.0378	0.3958
4	1	1	0.0051	0.4382	0.0108	0.4670	0.0294	0.5081	0.0627	0.5416	0.1336	0.5772	0.0483	0.5064
5 a	1	1	0.0048	0.4180	0.0103	0.4455	0.0280	0.4847	0.0598	0.5166	0.1275	0.5506	0.0461	0.4831
b	1	1	0.0051	0.4402	0.0109	0.4692	0.0295	0.5105	0.0630	0.5441	0.1342	0.5799	0.0485	0.5088
c	1	1	0.0051	0.4402	0.0109	0.4692	0.0295	0.5105	0.0630	0.5441	0.1342	0.5799	0.0485	0.5088
d	1	1	0.0050	0.4354	0.0107	0.4641	0.0292	0.5049	0.0623	0.5382	0.1328	0.5736	0.0480	0.5032
6	1	1	0.0050	0.4354	0.0107	0.4641	0.0292	0.5049	0.0623	0.5382	0.1328	0.5736	0.0480	0.5032
7	1	1	0.0049	0.4264	0.0105	0.4545	0.0286	0.4945	0.0610	0.5270	0.1300	0.5617	0.0470	0.4928
8	1	1	0.0043	0.3705	0.0091	0.3949	0.0249	0.4296	0.0530	0.4579	0.1130	0.4881	0.0409	0.4282
9	1	1	0.0022	0.1874	0.0046	0.1998	0.0126	0.2174	0.0268	0.2317	0.0572	0.2469	0.0207	0.2166
10 a	1	1	0.0044	0.3821	0.0094	0.4072	0.0256	0.4431	0.0547	0.4772	0.1165	0.5033	0.0421	0.4426
b	1	1	0.0029	0.2502	0.0062	0.2666	0.0168	0.2901	0.0358	0.3092	0.0763	0.3295	0.0276	0.2891
c	2	2	0.0251	2.1729	0.0476	2.0557	0.1106	1.9104	0.2092	1.8073	0.3958	1.7099	0.1577	1.9312
d	2	2	0.0282	2.4365	0.0534	2.3051	0.1240	2.1421	0.2346	2.0266	0.4438	1.9173	0.1768	2.1655
11	2	2	0.0176	1.5183	0.0333	1.4364	0.0773	1.3349	0.1462	1.2629	0.2766	1.1948	0.1102	1.3495
12	2	2	0.0103	0.8907	0.0195	0.8426	0.0453	0.7831	0.0857	0.7408	0.1622	0.7009	0.0646	0.7916
13	2	2	0.0120	1.0328	0.0226	0.9771	0.0525	0.9080	0.0994	0.8590	0.1881	0.8127	0.0749	0.9179
14	2	2	0.0103	0.8907	0.0195	0.8426	0.0453	0.7831	0.0857	0.7408	0.1622	0.7009	0.0646	0.7916
15	3	2	0.0180	1.5575	0.0341	1.4735	0.0792	1.3694	0.1499	1.2955	0.2837	1.2256	0.1130	1.3843
16	3	3	0.0010	0.0894	0.0024	0.1025	0.0071	0.1227	0.0163	0.1407	0.0373	0.1613	0.0128	0.1233
17	3	3	0.0006	0.0541	0.0014	0.0620	0.0043	0.0743	0.0099	0.0852	0.0226	0.0977	0.0078	0.0747
18	3	3	0.0006	0.0493	0.0013	0.0565	0.0039	0.0677	0.0090	0.0776	0.0206	0.0890	0.0071	0.0680
19	3	3	0.0009	0.0780	0.0021	0.0894	0.0062	0.1007	0.0142	0.1227	0.0326	0.1407	0.0112	0.1063
20	3	3	0.0009	0.0780	0.0021	0.0894	0.0062	0.1007	0.0142	0.1227	0.0326	0.1407	0.0112	0.1063
21 a	3	3	0.0007	0.0582	0.0015	0.0667	0.0046	0.0799	0.0106	0.0915	0.0243	0.1049	0.0083	0.0802
b	3	3	0.0008	0.0720	0.0019	0.0826	0.0057	0.0989	0.0131	0.1134	0.0301	0.1300	0.0103	0.0994
22	3	3	0.0011	0.0925	0.0025	0.1060	0.0073	0.1270	0.0168	0.1456	0.0386	0.1669	0.0133	0.1276
23	1	3	0.0010	0.0855	0.0023	0.0980	0.0068	0.1173	0.0156	0.1345	0.0357	0.1542	0.0123	0.1179
24	1	3	0.0018	0.1545	0.0041	0.1771	0.0123	0.2121	0.0281	0.2432	0.0645	0.2787	0.0222	0.2131
25	1	3	0.0034	0.2897	0.0077	0.3321	0.0230	0.3978	0.0528	0.4560	0.1210	0.5227	0.0416	0.3997
26	3	3	0.0028	0.2458	0.0065	0.2818	0.0195	0.3376	0.0448	0.3870	0.1027	0.4436	0.0353	0.3392
27	3	3	0.0014	0.1228	0.0033	0.1408	0.0098	0.1687	0.0224	0.1933	0.0513	0.2216	0.0176	0.1694
28	3	3	0.0010	0.0865	0.0023	0.0992	0.0069	0.1188	0.0158	0.1362	0.0361	0.1561	0.0124	0.1194
29	3	3	0.0028	0.2380	0.0063	0.2728	0.0189	0.3268	0.0434	0.3746	0.0994	0.4294	0.0342	0.3283
30 a	3	3	0.0020	0.1741	0.0046	0.1996	0.0138	0.2391	0.0317	0.2741	0.0727	0.3141	0.0250	0.2402
b	3	3	0.0014	0.1236	0.0033	0.1417	0.0098	0.1698	0.0225	0.1946	0.0516	0.2231	0.0177	0.1706
c	3	3	0.0010	0.0849	0.0023	0.0973	0.0067	0.1165	0.0155	0.1336	0.0354	0.1531	0.0122	0.1171
d	3	3	0.0007	0.0620	0.0016	0.0711	0.0049	0.0852	0.0113	0.0977	0.0259	0.1119	0.0089	0.0856
e	3	3	0.0007	0.0576	0.0015	0.0660	0.0046	0.0792	0.0105	0.0907	0.0241	0.1040	0.0083	0.0795
f	3	3	0.0007	0.0595	0.0016	0.0683	0.0047	0.0818	0.0108	0.0937	0.0249	0.1074	0.0085	0.0821
g	3	3	0.0025	0.2164	0.0057	0.2481	0.0172	0.2972	0.0394	0.3407	0.0904	0.3905	0.0310	0.2986
31	1	1	0.0034	0.2923	0.0072	0.3115	0.0196	0.3389	0.0418	0.3612	0.0891	0.3850	0.0322	0.3378
32	1	1	0.0039	0.3358	0.0083	0.3579	0.0225	0.3894	0.0480	0.4150	0.1024	0.4423	0.0370	0.3881
33	1	1	0.0045	0.3922	0.0097	0.4180	0.0263	0.4548	0.0561	0.4847	0.1196	0.5166	0.0432	0.4533
34	1	1	0.0045	0.3922	0.0097	0.4180	0.0263	0.4548	0.0561	0.4847	0.1196	0.5166	0.0432	0.4533
35	1	1	0.0046	0.3984	0.0098	0.4246	0.0267	0.4620	0.0570	0.4924	0.1215	0.5248	0.0439	0.4604
36 a	1	1	0.0041	0.3564	0.0088	0.3798	0.0239	0.4132	0.0510	0.4404	0.1087	0.4694	0.0393	0.4118
b	1	1	0.0047	0.4022	0.0099	0.4287	0.0270	0.4664	0.0575	0.4971	0.1226	0.5298	0.0443	0.4648
37	1	1	0.0047	0.4022	0.0099	0.4287	0.0270	0.4664	0.0575	0.4971	0.1226	0.5298	0.0443	0.4648
38	1	1	0.0058	0.4991	0.0123	0.5320	0.0335	0.5788	0.0714	0.6169	0.1522	0.6575	0.0550	0.5769
39	1	1	0.0055	0.4781	0.0118	0.5096	0.0321	0.5544	0.0684	0.5909	0.1458	0.6298	0.0527	0.5526
40 a	1	1	0.0045	0.3876	0.0096	0.4131	0.0260	0.4494	0.0554	0.4790	0.1182	0.5106	0.0427	0.4479
b	1	1	0.0047	0.4043	0.0100	0.4309	0.0271	0.4688	0.0578	0.4997	0.1233	0.5326	0.0446	0.4673
c	1	1	0.0058	0.4991	0.0123	0.5320	0.0335	0.5788	0.0714	0.6169	0.1522	0.6575	0.0550	0.5769
d	1	1	0.0055	0.4781	0.0118	0.5096	0.0321	0.5544	0.0684	0.5909	0.1458	0.6298	0.0527	0.5526
41	1	1	0.0055	0.4781	0.0118	0.5096	0.0321	0.5544	0.0684	0.5909	0.1458	0.6298	0.0527	0.5526

Remarks: RC; Low flow frequency regions (1 to 4) as illustrated in Map A of HP12.
RE; Mean annual minimum flow regions (1 to 3) as illustrated in Map B of HP12.
CA; Catchment area

Table II.14 ESTIMATED EVAPOTRANSPIRATION AT MMS PRINCIPAL STATIONS

Station No.	Station Name	Latitude	Longitude	Height Above MSL (m)		Anemometer	Evapotranspiration by month (mm)												
		° N	° E	Station	Anemometer	above ground (m)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
48679	Johor Bahru International Airport (Senai)	01° 38'	103° 40'	37.8	39.3	17.4	111	122	127	119	108	102	101	103	102	106	94	89	1284
48672	Kluang	02° 01'	103° 19'	88.1	85.7	15.5	111	117	125	111	109	103	100	104	105	110	100	104	1299
48674	Mersing	02° 27'	103° 50'	43.6	44.5	13.4	122	134	143	132	122	109	109	111	111	113	96	93	1395
48603	Alor Setar Airport (Kepala Batas)	06° 12'	100° 24'	3.9	4.2	12.4	119	120	143	138	128	135	141	138	132	112	90	106	1502
48600	Pulau Langkawi International Airport	06° 20'	99° 44'	6.4	15.2	10.0	133	125	147	140	120	121	118	127	120	117	113	127	1508
48615	Kota Bharu Airport (Pengkalan Chepa)	06° 10'	102° 17'	4.6	4.6	14.0	97	105	131	131	125	118	118	122	123	115	88	85	1358
48616	Kuala Krai	05° 32'	102° 12'	68.3	79.0	14.0	78	93	112	113	109	109	107	112	110	99	72	65	1179
48665	Melaka Airport (Batu Berendam)	02° 16'	102° 15'	8.5	8.5	14.2	113	115	125	118	110	107	108	109	113	112	100	106	1336
48642	Batu Embun	03° 58'	102° 21'	59.5	59.5	14.7	93	96	119	113	112	107	108	109	106	105	91	82	1241
48631	Cameron Highlands (Tanah Rata)	04° 28'	101° 22'	1545.0	1545.0	10.0	73	72	83	78	76	82	82	82	78	75	69	73	923
48657	Kuantan Airport	03° 47'	116° 50'	15.3	15.3	14.0	93	97	117	112	113	111	111	113	111	105	85	80	1248
48649	Muazam Shah	03° 03'	103° 05'	33.3	33.3	14.8	99	99	115	109	111	109	108	110	110	106	91	87	1254
48653	Temerloh	03° 28'	102° 23'	39.1	39.4	14.0	100	107	123	121	118	105	107	109	107	109	95	88	1289
48602	Butterworth Airport	05° 28'	100° 23'	2.8	13.0	10.0	<--- Data required for calculating ETo are not available --->												
48601	Penang International Airport (Bayan Lepas)	05° 28'	100° 16'	2.8	2.8	12.5	123	119	142	139	124	122	119	121	120	109	108	117	1463
48625	Ipoh Airport	04° 34'	101° 06'	40.1	39.0	17.4	111	115	138	132	130	126	126	126	119	113	100	108	1444
48620	Sitiawan	04° 13'	100° 42'	7.0	7.0	16.8	109	108	124	120	119	113	117	116	115	111	101	108	1361
48604	Chuping	06° 29'	100° 16'	21.7	21.7	12.6	116	120	140	132	122	130	138	135	125	107	85	104	1454
48647	Kuala Lumpur International Airport (Subang)	03° 07'	101° 33'	16.5	21.8	19.2	99	105	116	111	109	106	108	109	105	106	95	94	1263
48648	Petaling Jaya	03° 06'	101° 39'	45.7	56.4	29.0	108	107	120	115	113	108	109	111	109	112	97	99	1308
48619	Kuala Terengganu Airport	05° 23'	103° 06'	5.2	19.0	14.0	105	114	136	146	135	127	127	127	130	111	87	91	1436

NOTE: Evapotranspiration was calculated by the Penman method introduced in HP17, "Estimating Potential Evapotranspiration Using the Penman Procedure (DID 1991)

Table II.15 ESTIMATED RUNOFF BY RIVER BASIN

unit : mm

Basin	Period	Month												A	B	A/B
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Rainfall	%
1	1983-1992	14.6	12.2	8.9	17.4	37.4	33.1	26.8	48.0	81.6	119.4	131.9	54.7	586.1	1733.4	34%
2	1983-1992	18.5	19.4	24.5	33.8	64.7	105.4	192.5	202.9	271.6	322.1	192.7	56.4	1504.5	2686.3	56%
3a	1983-1992	12.9	11.2	13.9	20.7	44.4	45.0	72.8	135.6	162.8	174.6	116.8	53.2	863.8	2065.9	42%
3b	1983-1992	11.0	9.3	10.3	13.0	31.0	35.1	59.1	107.0	137.2	158.2	117.1	46.9	735.2	1966.1	37%
3c	1983-1992	14.9	12.3	14.9	20.3	51.1	47.9	72.6	125.3	166.4	193.1	148.1	69.3	936.2	2203.3	42%
3d	1983-1992	14.9	12.2	14.8	20.2	50.6	47.6	72.4	125.6	166.1	192.3	147.1	68.9	932.8	2198.4	42%
4	1983-1992	30.8	28.2	37.5	70.5	109.1	88.7	63.4	71.6	143.5	216.0	231.7	103.6	1194.7	2549.5	47%
5a	1983-1992	19.4	16.1	23.5	44.0	82.1	82.6	73.1	104.8	173.1	235.7	214.3	101.7	1170.5	2478.2	47%
5b	1983-1992	24.8	22.7	34.8	56.8	93.7	91.6	79.8	103.3	170.8	241.5	232.4	116.4	1268.5	2556.7	50%
5c	1983-1992	24.8	22.7	34.8	56.8	93.7	91.6	79.8	103.3	170.8	241.5	232.4	116.4	1268.5	2556.7	50%
5d	1983-1992	56.2	56.5	43.5	101.0	127.5	102.8	59.9	60.3	120.1	187.2	227.9	93.3	1236.1	2539.9	49%
6	1983-1992	56.2	56.5	43.5	101.0	127.5	102.8	59.9	60.3	120.1	187.2	227.9	93.3	1236.1	2539.9	49%
7	1983-1992	31.2	18.9	28.9	64.0	94.6	83.9	108.1	108.4	182.4	250.4	195.6	96.2	1262.6	2491.7	51%
8	1983-1992	46.5	46.7	31.1	79.3	97.9	76.7	41.2	39.2	96.5	156.4	197.2	76.8	985.3	2304.9	43%
9	1983-1992	37.8	37.4	32.6	35.6	17.7	13.4	11.1	7.4	36.2	28.8	43.8	49.9	351.8	1530.0	23%
10a	1983-1992	51.9	36.1	40.4	60.2	112.1	78.5	62.8	70.9	138.1	176.8	189.2	199.1	1216.1	2359.5	52%
10b	1983-1992	21.7	26.8	20.8	35.9	63.6	40.1	18.0	21.9	61.6	68.5	98.9	66.1	543.8	1818.4	30%
10c	1983-1992	99.3	88.0	91.6	120.5	141.9	98.9	79.6	73.2	105.9	108.0	151.2	130.9	1288.9	2654.0	49%
10d	1983-1992	114.0	99.3	104.4	150.2	164.7	114.8	87.5	84.0	114.0	120.4	176.5	150.9	1480.7	2794.3	53%
11	1983-1992	77.3	68.0	83.6	101.9	103.2	69.2	50.9	51.2	60.0	75.5	134.7	137.0	1012.5	2292.0	44%
12	1983-1992	84.9	46.4	47.0	55.4	39.1	40.1	30.5	39.7	57.4	53.5	76.7	99.7	670.3	1833.1	37%
13	1983-1992	69.0	46.5	48.2	60.2	58.0	50.2	29.4	34.0	60.5	62.1	94.2	111.9	724.3	1950.3	37%
14	1983-1992	84.9	46.4	47.0	55.4	39.1	40.1	30.5	39.7	57.4	53.5	76.7	99.7	670.3	1833.1	37%
15	1983-1992	58.1	49.5	76.4	98.6	100.9	68.8	53.5	46.0	66.8	141.3	203.4	162.0	1125.4	2319.8	49%
16	1983-1992	34.1	17.4	25.3	48.1	76.9	62.3	31.8	22.2	75.1	142.9	169.6	128.3	834.1	2089.6	40%
17	1983-1992	24.3	15.6	15.4	39.1	60.4	51.9	37.3	34.6	58.5	90.6	128.0	82.7	638.5	1822.2	35%
18	1983-1992	24.3	18.4	21.6	61.2	78.1	49.8	43.6	44.9	39.2	72.1	126.9	78.1	658.3	1776.9	37%
19	1983-1992	27.7	26.5	54.4	62.3	83.5	77.3	57.0	63.7	63.7	82.7	118.0	81.5	798.3	1999.9	40%
20	1983-1992	27.7	26.5	54.4	62.3	83.5	77.3	57.0	63.7	63.7	82.7	118.0	81.5	798.3	1999.9	40%
21a	1983-1992	57.2	34.0	49.0	31.4	49.5	34.3	20.6	28.3	36.2	57.7	103.5	111.0	612.5	1851.4	33%
21b	1983-1992	82.7	21.5	73.3	37.5	56.3	24.8	19.1	22.7	24.6	56.1	117.4	161.5	697.6	1965.0	35%
22	1983-1992	96.0	44.4	86.0	59.6	75.3	35.1	28.2	32.5	34.5	73.3	141.8	149.4	856.0	2099.3	41%
23	1983-1992	114.6	59.6	57.8	53.5	97.4	53.0	35.2	36.7	46.5	51.7	94.7	143.7	844.3	2051.3	41%
24	1983-1992	171.7	68.6	63.9	66.7	114.9	61.6	51.7	53.0	86.5	85.8	124.7	226.7	1175.8	2391.8	49%
25	1983-1992	254.4	88.2	65.1	69.9	109.4	66.4	68.2	67.2	118.4	117.3	163.6	350.8	1539.0	2815.5	55%
26	1983-1992	349.7	121.2	60.3	24.0	35.3	31.2	26.3	43.2	54.5	60.1	186.5	534.4	1526.9	2698.1	57%
27	1983-1992	201.3	44.7	62.2	32.7	38.8	26.8	23.1	33.0	38.4	57.9	140.4	320.7	1019.9	2259.9	45%
28	1983-1992	174.1	78.0	68.9	40.2	33.2	13.5	12.9	27.2	24.0	42.0	109.5	291.5	914.8	2057.9	44%
29	1983-1992	274.7	110.9	109.2	59.0	33.2	23.3	30.7	25.3	41.4	57.2	241.8	524.0	1530.6	2675.4	57%
30a	1983-1992	96.6	49.2	51.5	50.5	99.0	87.2	68.6	58.9	101.9	177.1	197.9	225.5	1263.7	2467.1	51%
30b	1977-1986	61.9	26.4	42.5	62.5	113.8	78.8	50.4	55.4	74.7	126.2	146.3	155.6	994.5	2123.6	47%
30c	1983-1992	54.2	43.7	51.0	56.8	89.2	50.3	18.5	23.3	55.2	120.4	145.5	121.1	829.2	2069.4	40%
30d	1983-1992	45.9	28.5	41.9	36.9	50.3	47.0	38.8	19.6	57.4	86.5	128.2	108.8	689.8	1921.0	36%
30e	1983-1992	68.5	41.8	48.0	26.6	48.2	30.4	15.5	25.4	35.3	63.9	104.2	134.2	641.9	1845.3	35%
30f	1977-1986	47.7	29.1	35.7	55.7	94.2	43.7	23.3	24.8	36.5	85.9	104.7	109.8	690.8	1876.1	37%
30g	1983-1992	222.9	92.7	109.6	53.9	31.2	27.3	23.7	20.5	29.6	66.2	268.2	550.5	1496.4	2610.4	57%
31	1983-1992	119.2	48.1	73.3	22.5	23.7	28.6	16.1	26.0	22.7	42.8	125.0	348.1	896.0	1998.5	45%
32	1983-1992	120.9	42.5	60.1	21.0	18.8	20.0	18.5	18.2	29.4	50.2	197.2	465.0	1061.7	2172.4	49%
33	1983-1992	130.7	46.3	41.1	20.0	18.6	17.3	18.8	21.0	31.4	52.7	280.9	592.1	1271.0	2385.0	53%
34	1983-1992	130.7	46.3	41.1	20.0	18.6	17.3	18.8	21.0	31.4	52.7	280.9	592.1	1271.0	2385.0	53%
35	1983-1992	113.0	31.1	41.9	24.0	16.7	15.9	16.1	16.7	18.7	34.7	334.2	596.2	1259.2	2407.6	52%
36a	1977-1986	85.2	21.4	37.9	16.3	14.4	14.0	20.9	22.1	21.8	53.7	225.2	529.1	1061.9	2269.9	47%
36b	1983-1992	110.7	24.6	43.7	32.9	17.7	16.9	16.6	18.2	19.5	41.3	360.0	599.8	1301.9	2421.5	54%
37	1983-1992	110.7	24.6	43.7	32.9	17.7	16.9	16.6	18.2	19.5	41.3	360.0	599.8	1301.9	2421.5	54%
38	1983-1992	175.5	50.1	48.7	33.6	42.8	40.3	53.3	55.5	107.1	153.5	227.6	529.5	1517.4	2759.0	55%
39	1983-1992	162.5	39.0	54.0	27.3	34.6	38.2	51.7	79.9	114.3	129.5	257.3	556.1	1544.4	2696.3	57%
40a	1977-1986	78.3	34.2	47.5	35.0	78.2	59.2	46.8	62.9	119.1	171.8	202.1	310.9	1246.1	2371.4	53%
40b	1983-1992	99.2	38.8	54.1	36.6	81.0	73.7	51.2	60.0	136.1	183.6	197.9	275.2	1287.4	2411.2	53%
40c	1983-1992	183.8	56.6	56.1	39.2	49.9	43.4	72.7	72.7	140.3	170.7	248.9	558.6	1692.9	2759.0	61%
40d	1983-1992	162.5	39.0	54.0	27.3	34.6	38.2	51.7	79.9	114.3	129.5	257.3	556.1	1544.4	2696.3	57%
41	1983-1992	162.5	39.0	54.0	27.3	34.6	38.2	51.7	79.9	114.3	129.5	257.3	556.1	1544.4	2696.3	57%

Note : River basin : 41 basins with 27 sub-basins which originate from "National Water Resources Study, Malaysia (JICA 1982)"

Table II.16 ESTIMATED FLOODS BY "HYDROLOGICAL PROCEDURES" (1/2)

PR4 TASIK MELATI

Catchment area: 5.7 sq.km — unit : cumec

	Hydrological Procedures		
Return Period	HP4	HP5 *	HP11
2 years	2.8	-	-
5 years	3.8	-	-
10 years	4.6	8.6	-
20 years	5.3	10.7	-
30 years	5.7	12.0	-
50 years	6.2	13.7	-
100 years	6.9	16.1	15.5
200 years	-	18.5	-

* : Maximum within the confidence limit

KH4 KEDAWAN, LANGKAWI

unit : cumec

	Bukit Lembu Reservoir (catchment area = 3.5 sq.km)		
Return Period	HP4	HP5 *	HP11
2 years	2.0	-	-
5 years	2.8	-	-
10 years	3.3	10.1	-
20 years	3.9	12.3	-
30 years	4.2	13.8	-
50 years	4.5	15.7	-
100 years	5.0	18.4	14.5
200 years	-	20.9	-

* : Maximum within the confidence limit

KH4 KEDAWAN, LANGKAWI

unit : cumec

	Bukit Lembu Upstream (catchment area = 0.34 sq.km)		
Return Period	HP4	HP5 *	HP11
2 years	0.32	-	-
5 years	0.45	-	-
10 years	0.53	1.46	-
20 years	0.61	1.79	-
30 years	0.66	2.00	-
50 years	0.71	2.27	-
100 years	0.80	2.61	4.00
200 years	-	3.00	-

* : Maximum within the confidence limit

KH4 KEDAWAN, LANGKAWI

unit : cumec

	Ketapang Reservoir (catchment area = 0.6 sq.km)		
Return Period	HP4	HP5 *	HP11
2 years	0.5	-	-
5 years	0.7	-	-
10 years	0.8	1.8	-
20 years	1.0	2.3	-
30 years	1.0	2.5	-
50 years	1.1	2.8	-
100 years	1.3	3.3	5.8
200 years	-	3.8	-

* : Maximum within the confidence limit

JR10 KANGKAR MERLIMAU

Catchment area: 1.4 sq.km — unit : cumec

	Hydrological Procedures		
Return Period	HP4	HP5 *	HP11
2 years	1.6	-	-
5 years	2.5	-	-
10 years	3.1	3.6	-
20 years	3.8	4.5	-
30 years	4.1	5.1	-
50 years	4.6	5.8	-
100 years	5.2	6.9	10.5
200 years	-	8.0	-

* : Maximum within the confidence limit

NOTE :

HP4 : Magnitude and Frequency of Floods in Peninsular Malaysia (DID,1982)
Results are applicable for the catchments with areas more than 20 sq.km.

HP5 : Rational Method of Flood Estimation for Rural Catchments in Peninsular Malaysia (DID, 1989)

HP11 : Design Flood Hydrograph Estimation for Rural Catchments in Peninsular Malaysia (DID, 1976)

Table II.16 ESTIMATED FLOODS BY "HYDROLOGICAL PROCEDURES" (2/2)

MA16 BUKIT SEDANAN, MELAKA

unit : cumec

	Ayer Mentangor (catchment area = 2.4 sq.km)		
Return Period	HP4	HP5 *	HP11
2 years	0.9	-	-
5 years	1.3	-	-
10 years	1.6	3.8	-
20 years	1.9	4.3	-
30 years	2.0	5.3	-
50 years	2.2	6.1	-
100 years	2.5	7.2	12.7
200 years	-	8.5	-

* : Maximum within the confidence limit

MA16 BUKIT SEDANAN, MELAKA

unit : cumec

	Durian area (catchment area = 0.47 sq.km)		
Return Period	HP4	HP5 *	HP11
2 years	0.30	-	-
5 years	0.42	-	-
10 years	0.51	1.0	-
20 years	0.59	1.3	-
30 years	0.64	1.4	-
50 years	0.70	1.7	-
100 years	0.78	2.0	3.3
200 years	-	2.3	-

* : Maximum within the confidence limit

TR44 PASIR NERING, TERENGGANU

unit : cumec

	Sg. Perching (catchment area = 4.9 sq.km)		
Return Period	HP4	HP5 *	HP11
2 years	5.0	-	-
5 years	9.4	-	-
10 years	12.3	29.2	-
20 years	15.1	37.2	-
30 years	16.7	43.5	-
50 years	18.8	50.5	-
100 years	21.4	61.3	43.0
200 years	-	73.8	-

* : Maximum within the confidence limit

TR44 PASIR NERING, TERENGGANU

unit : cumec

	Sg. Por (catchment area = 18.2 sq.km)		
Return Period	HP4	HP5 *	HP11
2 years	16.5	-	-
5 years	31.2	-	-
10 years	40.7	99.3	-
20 years	50.0	127.2	-
30 years	55.3	148.4	-
50 years	62.3	172.6	-
100 years	71.0	209.8	145.1
200 years	-	229.0	-

* : Maximum within the confidence limit

NOTE :

HP4 : Magnitude and Frequency of Floods in Peninsular Malaysia (DID,1982)
Results are applicable for the catchments with areas more than 20 sq.km.

HP5 : Rational Method of Flood Estimation for Rural Catchments in Peninsular Malaysia (DID, 1989)

HP11 : Design Flood Hydrograph Estimation for Rural Catchments in Peninsular Malaysia (DID, 1976)

Table II.17 SUMMARY OF SEDIMENT LOAD OBSERVATIONS

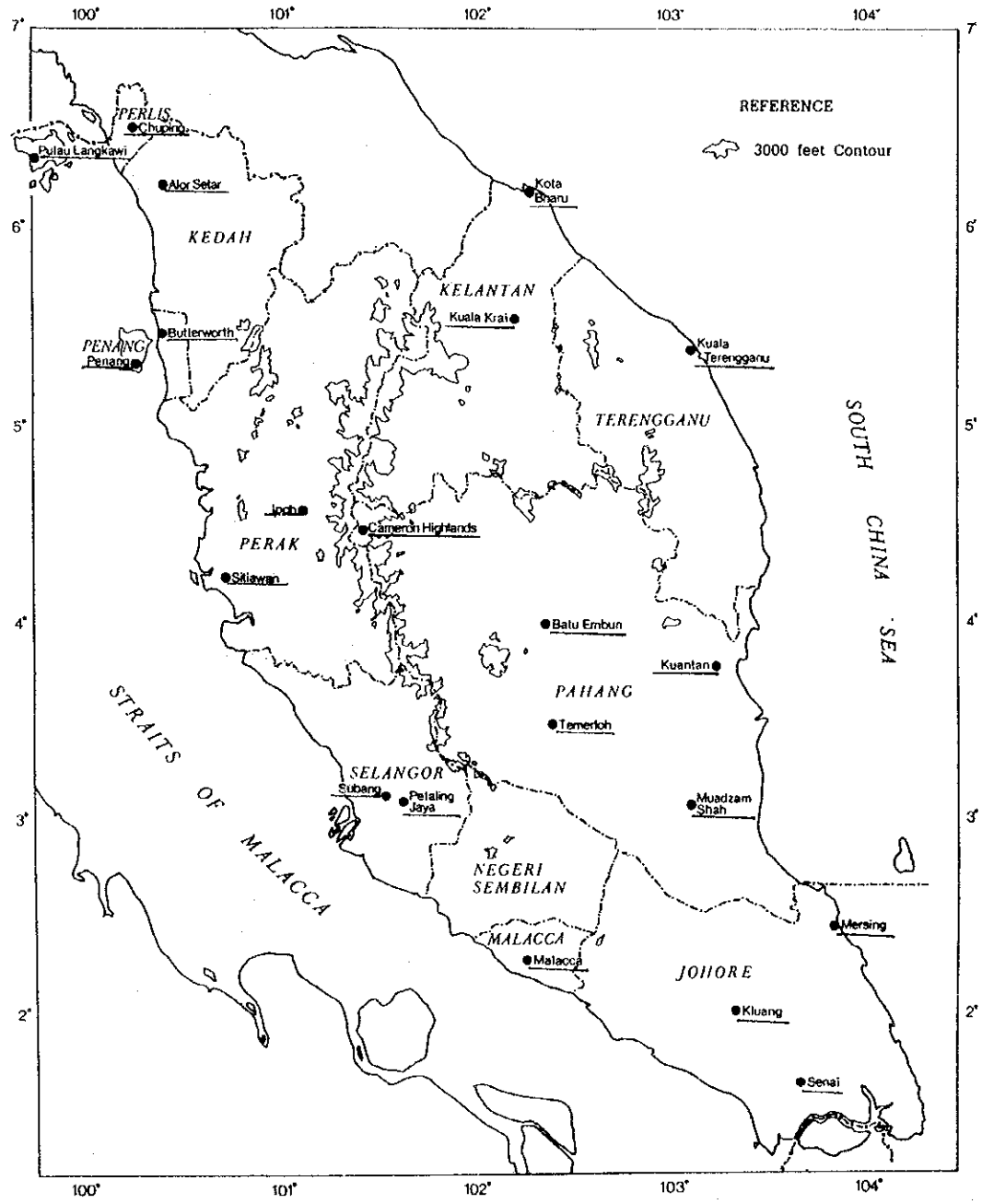
State	No.	Station Number	Catchment Area (km2)	River	Observed Suspended Load (tonnes/year)													
					1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Mean	qs_Sus	qs_Tot
PR	1	6502501	23.5	Sg.Jernih											300	300	13	16
	2	6502532	126	Sg.Tasoh											(2716)	2716	22	27
PK	3	3814516	455	Sg.Slim							39058					39058	86	107
	4	4012501	210	Sg.Bidor							30465	13221	12130	15993		17952	85	107
	5	4012552	339	Sg.Bidor					42344							42344	125	156
	6	4111555	445	Sg.Btg. Padang								84127	37379	206006	226245	138439	311	389
	7	4212567	119	Sg. Cenderiang								260147			599440	429793	3612	4515
	8	4511568	192	Sg.Raia								23467	21057	187705		77409	403	504
	9	4610566	245	Sg.Pari			(109202)	63783	79384	166846	271450	62100		123179	346064	152751	623	779
	10	4907522	80.3	Sg.Kurau			1724	1976	1483	4032	3410	5507	4189	4189	4547	3451	43	54
	11	5007521	337	Sg.Kurau				(13660)		(18567)						16114	48	60
	12	5007523	140	Sg.Ara			8386	43766	7549	11674	8250	3404				13838	99	124
	13	5206532	629	Sg.Krian			44358	58631					56464		68804	57064	91	113
SG	14	2917501	380	Sg.Langat				16494	16800	56605	499645		137370	176829		150624	396	495
	15	2918501	225	Sg.Semenyih				175127	316410	668996	921999	1323843	51007	222992	127025	475925	2115	2644
	16	3118545	68.1	Sg.Lui				2048	32360	17259	19290				7289	15649	230	287
	17	3516522	321	Sg.Selangor									102910			102910	321	401
	18	3615512	186	Sg.Bernam				(108279)	(112162)	(103739)		29910			56427	82103	441	552
WL	19	3116530	468	Sg.Klang			330731	225322								278027	594	743
	20	3116533	122	Sg.Gombak					(63879)							63879	524	654
	21	3216539	55.7	Sg.Batu			(7091)	2721	5547	3447						4701	84	106
	22	3116534	145	Sg.Batu								265447				265447	1831	2288
	23	3117502	160	Sg.Klang							75927	123411				99669	623	779
NS	24	2619501	230	Sg.Linggi							52688	55470	9929	37027		38778	169	211
	25	2723501	21	Sg.Kepis							1331		1590	6510		3144	150	187
MA	26	2224532	161	Sg.Kesang							(4114)					4114	26	32
	27	2322513	350	Sg.Melaka						15907	17524		10214	38386	41919	24790	71	89
JR	28	1836501	209	Sg.Linggui											8954	8954	43	54
	29	2130522	350	Sg.Bekok						(13379)	(10869)		(7011)	(17676)	23288	14445	41	52
PH	30	3024543	950	Sg.Serting	31993	14065	(6249)	(80292)	(41550)							34830	37	46
	31	3519526	241	Sg.Bentong	42011	21890	56688		43690	30060	(9685)	10385	9166			27947	116	145
	32	3629503	560	Sg.Lepar		1803181	1741468	1250593		36295	11544		48140	122080		716186	1279	1599
	33	3930501	582	Sg.Kuantan					(351158)	460067		235798	189815	305338		308435	530	662
	34	4320501	497	Sg.Kecau									(23644)			23644	48	59
TR	35	4232552	626	Sg.Kemaman					129000	207757	(66097)	68476	34521	87858		98951	158	198
	36	5428501	20.5	Sg.Chalok					2549	1243	1360	1441				1648	80	101
KN	37	6019511	761	Sg.Golok				17881				213792				115836	152	190
	38	6021501	305	Sg.Lemal								32524				32524	107	133
	39	6022521	47.9	Sg.Kemasin						(5829)						5829	122	152

Remarks: qs_Sus Mean specific suspended load (m3/km2/year). It is assumed that specific weight of sediment is 1 ton/m3.

qs_Tot Mean specific total sediment load (m3/km2/year). It is assumed that the bed load occupies 20% of the total sediment load.

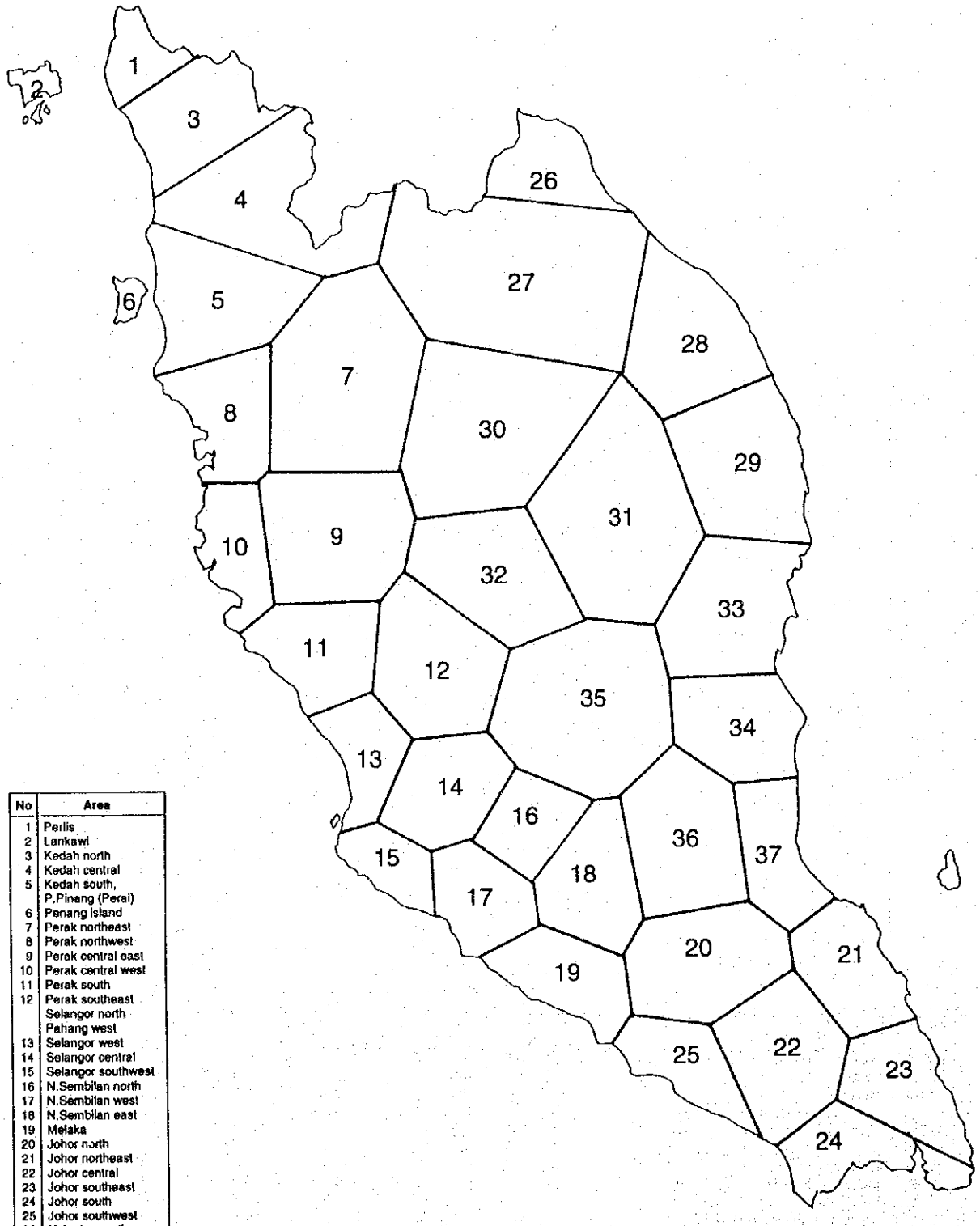
Figures

Fig. II.1 Principal Meteorological Stations



Station No.	Station Name	Latitude ° N	Longitude ° E	Height Above MSL (m) Station	Barometer	Anemometer	Anemometer above ground (m)
48679	Johor Bahru International Airport (Senai)	01° 38'	103° 40'	37.8	40.3	39.3	17.4
48672	Kluang	02° 01'	103° 19'	88.1	86.3	85.7	15.5
48674	Mersing	02° 27'	103° 50'	43.6	45.3	44.5	13.4
48603	Alor Setar Airport (Kepala Batas)	06° 12'	100° 24'	3.9	4.9	4.2	12.4
48600	Pulau Langkawi International Airport	06° 20'	99° 44'	6.4	7.4	15.2	10.0
48615	Kota Bharu Airport (Pengkalan Chepa)	06° 10'	102° 17'	4.6	5.5	4.6	14.0
48616	Kuala Krai	05° 32'	102° 12'	68.3	65.5	79.0	14.0
48665	Melaka Airport (Batu Berendam)	02° 16'	102° 15'	8.5	9.2	8.5	14.2
48642	Batu Embun	03° 58'	102° 21'	59.5	60.7	59.5	14.7
48631 &32	Cameron Highlands (Tanah Rata)	04° 28'	101° 22'	1545.0	1545.8	1545.0	10.0
48657	Kuantan Airport	03° 47'	116° 50'	15.3	15.9	15.3	14.0
48649	Muazam Shah	03° 03'	103° 05'	33.3	34.2	33.3	14.8
48653	Temerloh	03° 26'	102° 23'	39.1	39.9	39.4	14.0
48602	Butterworth Airport	05° 28'	100° 23'	2.8	4.2	13.0	10.0
48601	Penang International Airport (Bayan Lepas)	05° 28'	100° 16'	2.8	3.6	2.8	12.5
48625	Ipoh Airport	04° 34'	101° 06'	40.1	39.3	39.0	17.4
48620	Sitiawan	04° 13'	100° 42'	7.0	7.8	7.0	16.8
48604	Chuping	06° 29'	100° 16'	21.7	22.0	21.7	12.6
48647	Kuala Lumpur International Airport (Subang)	03° 07'	101° 33'	16.5	21.9	21.8	19.2
48648	Petaling Jaya	03° 06'	101° 39'	45.7	57.3	56.4	29.0
48619	Kuala Terengganu Airport	05° 23'	103° 06'	5.2	6.0	19.0	14.0

Fig. II.2 Thiessen Polygons



No	Area
1	Perlis
2	Lankawi
3	Kedah north
4	Kedah central
5	Kedah south, P.Pinang (Peral)
6	Penang island
7	Perak northeast
8	Perak northwest
9	Perak central east
10	Perak central west
11	Perak south
12	Perak southeast Selangor north Pahang west
13	Selangor west
14	Selangor central
15	Selangor southwest
16	N.Sembilan north
17	N.Sembilan west
18	N.Sembilan east
19	Melaka
20	Johor north
21	Johor northeast
22	Johor central
23	Johor southeast
24	Johor south
25	Johor southwest
26	Kelantan north
27	Kelantan central
28	Terengganu north
29	Terengganu south
30	Pahang north
31	Pahang northeast
32	Pahang Lipis
33	Pahang north coast
34	Pahang central coast
35	Pahang central
36	Pahang south
37	Pahang south coast

Fig. II.3 River Basins for Water Availability Evaluation

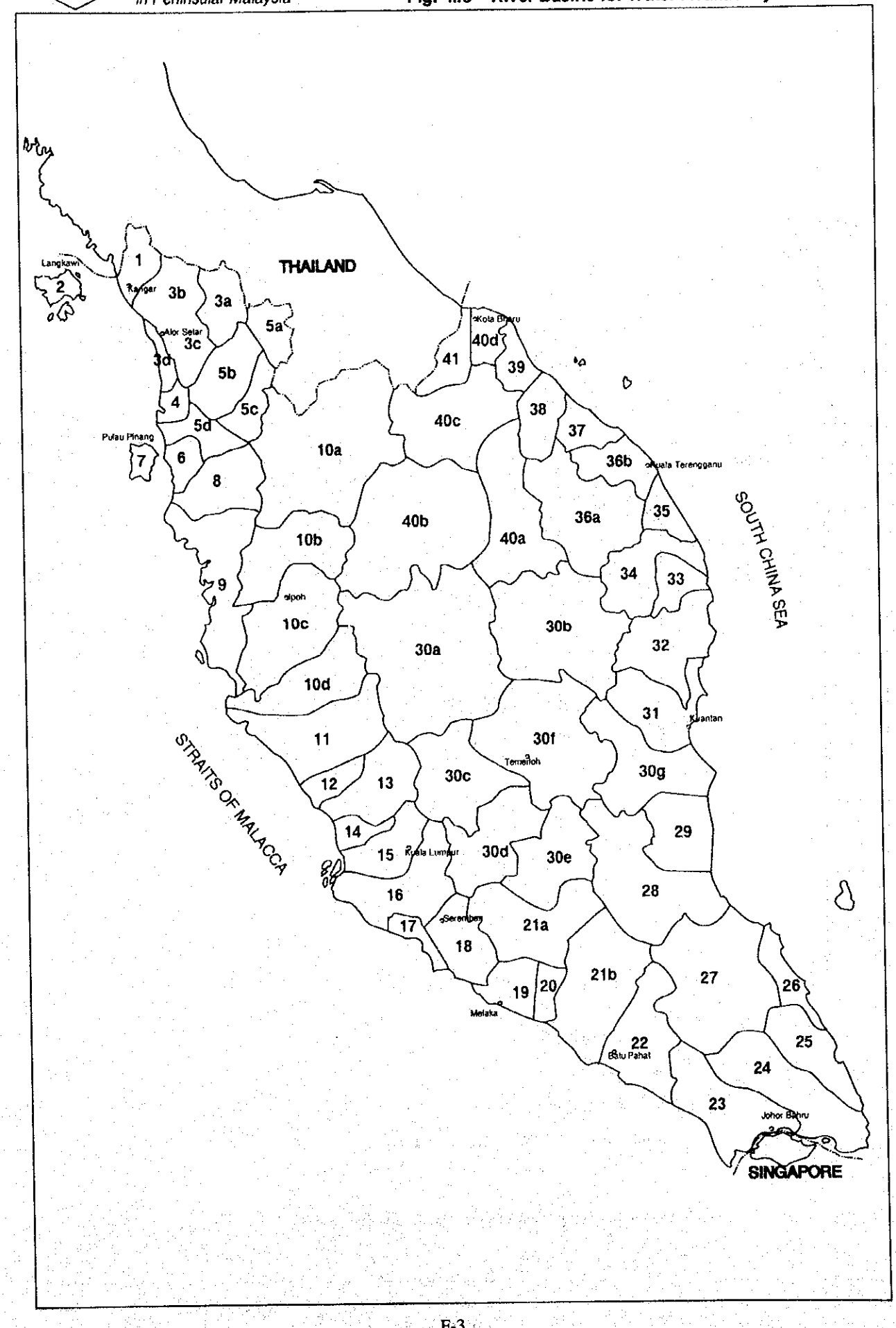
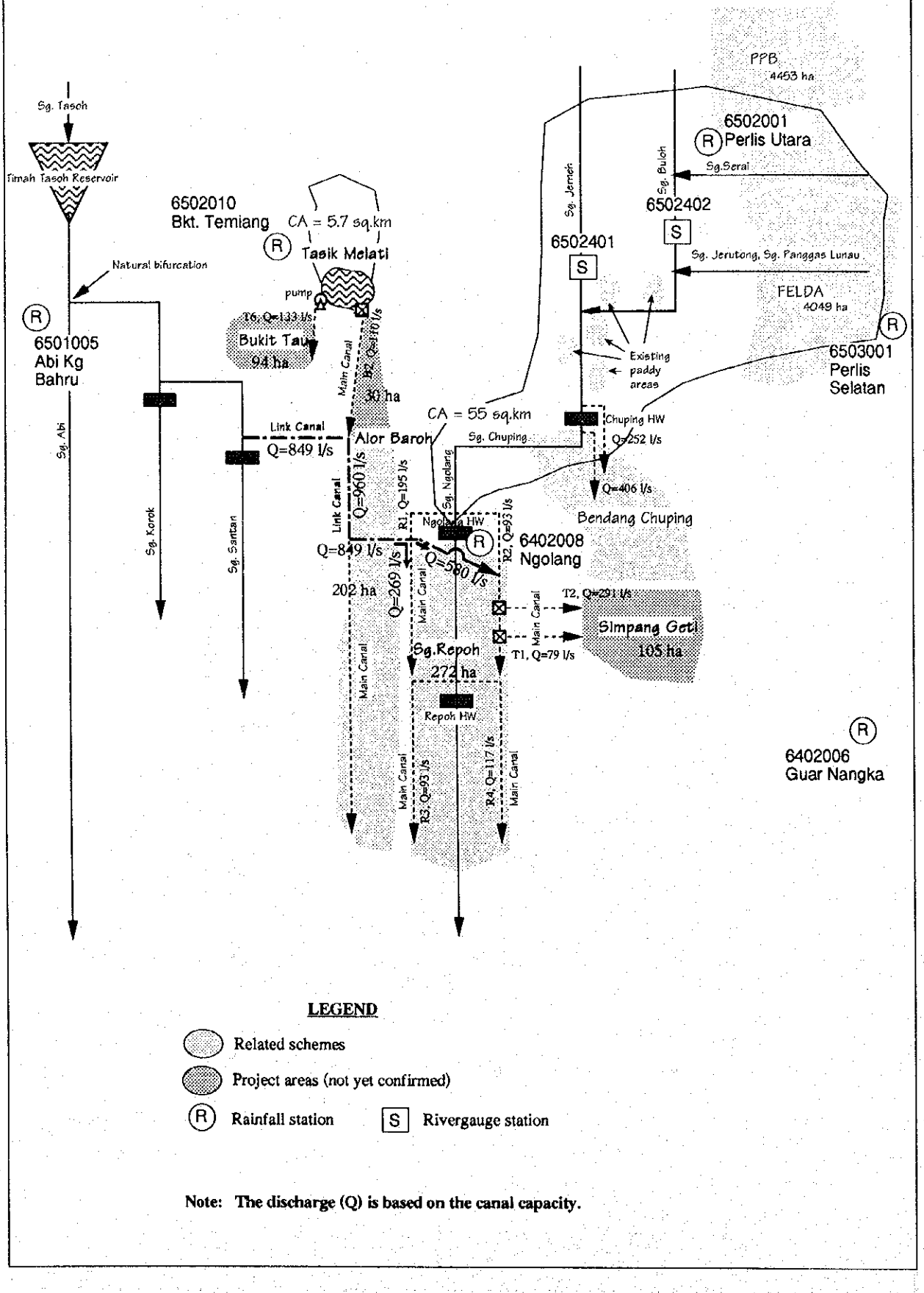


Fig. II.4 General Flow Diagram, Perlis



LEGEND

- Related schemes
- Project areas (not yet confirmed)
- (R) Rainfall station
- [S] Rivergauge station

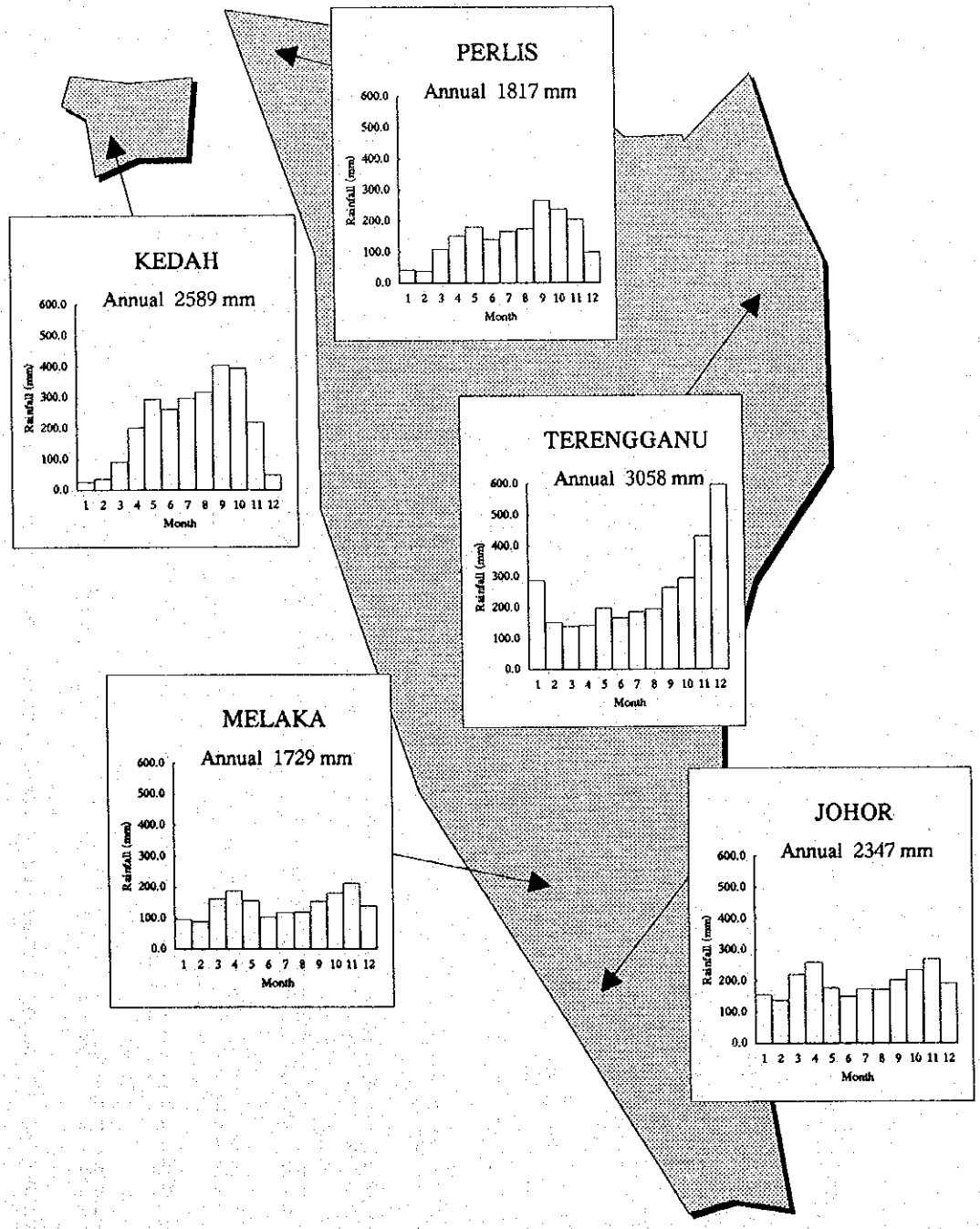
Note: The discharge (Q) is based on the canal capacity.

Fig. II.5 Mean Monthly Rainfall in/around the Project Area

unit : mm

		Jan	Feb	Mar	Apr	May	Jun	Nul	Aug	Sep	Oct	Nov	Dec	Ann
PERLIS	*1	41.9	38.7	109.0	151.7	180.5	141.7	167.0	175.5	266.5	237.9	206.4	100.4	1817.2
KEDAH	*2	26.4	35.3	90.5	202.0	293.7	260.9	298.2	316.6	404.0	394.5	218.2	48.9	2589.2
MELAKA	*3	97.1	90.3	163.3	189.2	156.7	104.0	119.3	121.2	153.9	182.3	212.2	139.8	1729.3
JOHOR	*4	155.9	137.9	219.8	259.4	177.3	151.2	174.8	171.3	202.4	234.7	270.4	191.6	2346.8
TERENGGANU	*5	287.8	152.9	140.3	144.2	199.1	166.9	186.6	195.4	263.8	293.9	429.6	597.6	3058.1

Remarks:
*1 Based on the records of Bukit Temiang (DID 6502010), average of 1967 to 1990
*2 Based on the records of Ulu Melaka (DID 6397112), average of 1953 to 1990
*3 Based on the records of Bukit Senggeh (DID 2324032), average of 1953 to 1990
*4 Based on the records of Parit Sulong (DID 1929064), average of 1951 to 1990
*5 Based on the records of Paya Kemat (DID 5029036), average of 1956 to 1990



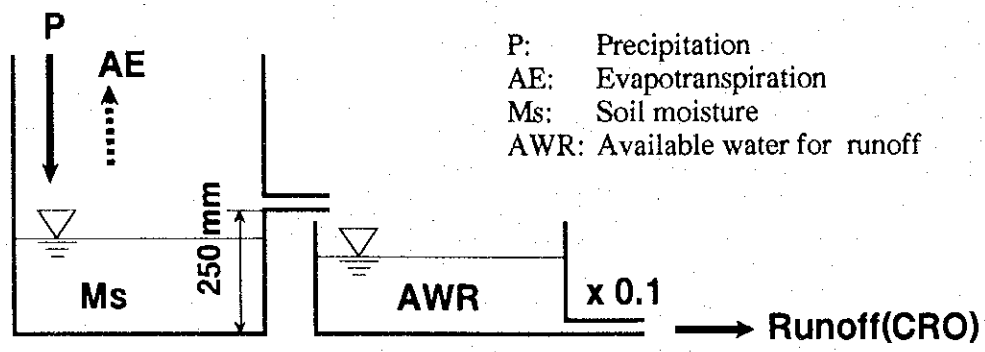


Fig. II.6 a Runoff Model for WRP No.12

Year	1960	Total rainfall (P year)	1537.2mm
Water holding capacity	250.0 mm	Actual evapotranspiration (AE)	1159.2mm
Initial soil moisture	250.0 mm	Rainfall - Actual Evapo. (P-AE)	378.0 mm
Initial available water for runoff	22.1 mm	Total water deficit (WD year)	176.8 mm
Soil moisture retention (a)	249.5	Total annual runoff (CRO year)	403.0 mm
Soil moisture retention (b)	-0.0040	Final soil moisture	242.8
Recession constant (K)	0.9000	Final available water for runoff	4.3
		Runoff coefficient	0.2622

CALCULATED RUNOFF (CRO) unit : mm

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total	21.3	0.8	0.0	6.8	4.2	30.4	74.8	55.3	48.5	43.1	65.5	52.4
f	45%	2%	0%	4%	6%	15%	49%	34%	26%	30%	64%	30%
1	2.2	0.1	0.0	0.0	0.4	0.0	2.8	1.7	2.0	4.2	3.3	0.5
2	2.0	0.1	0.0	0.0	0.4	0.0	2.6	1.6	1.8	3.7	3.0	0.5
3	1.8	0.1	0.0	0.0	0.4	0.0	2.3	1.4	1.6	3.4	2.7	0.4
4	1.6	0.1	0.0	0.0	0.3	0.0	2.1	1.3	1.4	3.0	2.4	0.4
5	1.4	0.1	0.0	0.0	0.3	0.0	1.9	1.1	1.3	2.7	2.2	0.3
6	1.3	0.0	0.0	0.0	0.3	0.0	1.7	1.0	1.2	2.5	2.0	0.7
7	1.2	0.0	0.0	0.0	0.2	0.0	1.5	1.6	1.0	2.2	1.9	0.6
8	1.1	0.0	0.0	0.0	0.2	0.0	1.4	1.7	0.9	2.0	5.1	5.3
9	1.0	0.0	0.0	0.0	0.2	0.0	1.2	3.0	0.8	1.8	4.6	4.8
10	0.9	0.0	0.0	0.0	0.2	0.0	1.1	2.7	0.8	1.6	4.1	4.3
11	0.8	0.0	0.0	0.0	0.2	0.0	1.0	2.4	0.7	1.5	3.7	3.9
12	0.7	0.0	0.0	0.0	0.1	0.0	0.9	2.2	0.8	1.3	3.3	3.5
13	0.6	0.0	0.0	0.0	0.1	0.0	1.1	2.0	0.7	1.2	3.0	3.2
14	0.6	0.0	0.0	0.0	0.1	0.0	1.0	1.8	0.6	1.1	2.7	2.8
15	0.5	0.0	0.0	0.0	0.1	0.0	1.5	1.6	0.6	1.0	2.4	2.6
16	0.5	0.0	0.0	0.0	0.1	0.0	3.0	1.4	0.5	0.9	2.2	2.3
17	0.4	0.0	0.0	0.0	0.1	0.0	3.3	1.3	0.5	0.8	2.2	2.1
18	0.4	0.0	0.0	0.0	0.1	0.0	3.2	1.2	0.4	0.7	2.0	1.9
19	0.3	0.0	0.0	0.0	0.1	0.0	2.9	1.1	0.4	0.6	1.8	1.7
20	0.3	0.0	0.0	0.0	0.1	0.0	3.5	0.9	0.3	0.6	1.6	1.5
21	0.3	0.0	0.0	0.0	0.1	4.1	3.4	0.9	0.3	0.5	1.4	1.4
22	0.2	0.0	0.0	1.1	0.0	3.7	4.3	0.8	0.3	0.5	1.3	1.2
23	0.2	0.0	0.0	1.0	0.0	3.4	4.4	0.7	0.2	0.4	1.2	1.1
24	0.2	0.0	0.0	0.9	0.0	3.0	4.0	0.6	0.2	0.4	1.1	1.0
25	0.2	0.0	0.0	0.8	0.0	2.7	3.6	1.9	4.2	0.3	0.9	0.9
26	0.2	0.0	0.0	0.7	0.0	2.4	3.2	3.7	3.7	0.3	0.9	0.8
27	0.1	0.0	0.0	0.7	0.0	2.2	2.9	3.3	5.7	0.3	0.8	0.7
28	0.1	0.0	0.0	0.6	0.0	2.0	2.6	3.0	5.7	0.2	0.7	0.6
29	0.1	0.0	0.0	0.5	0.0	3.5	2.4	2.7	5.1	0.2	0.6	0.6
30	0.1		0.0	0.5	0.0	3.2	2.1	2.4	4.6	0.2	0.6	0.5
31	0.1		0.0		0.0		1.9	2.2		3.3		0.5

Fig. II.6 b Sample Results of WRP No.12 Model

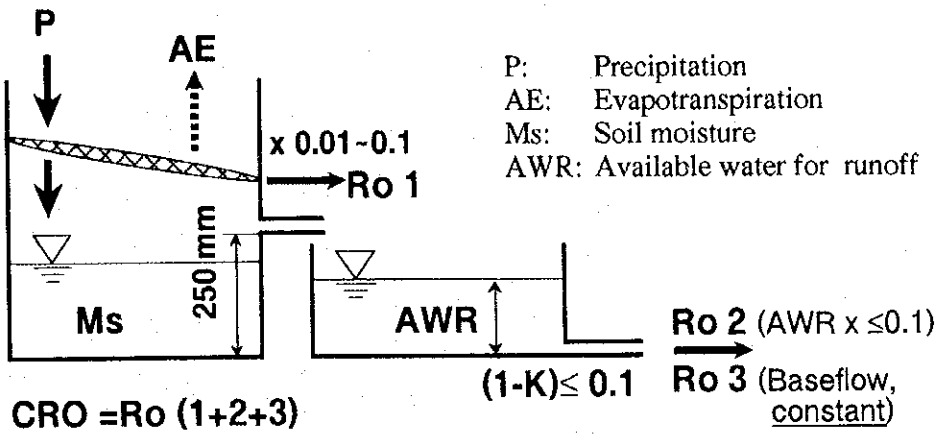


Fig. II.7 a Modified Runoff Model

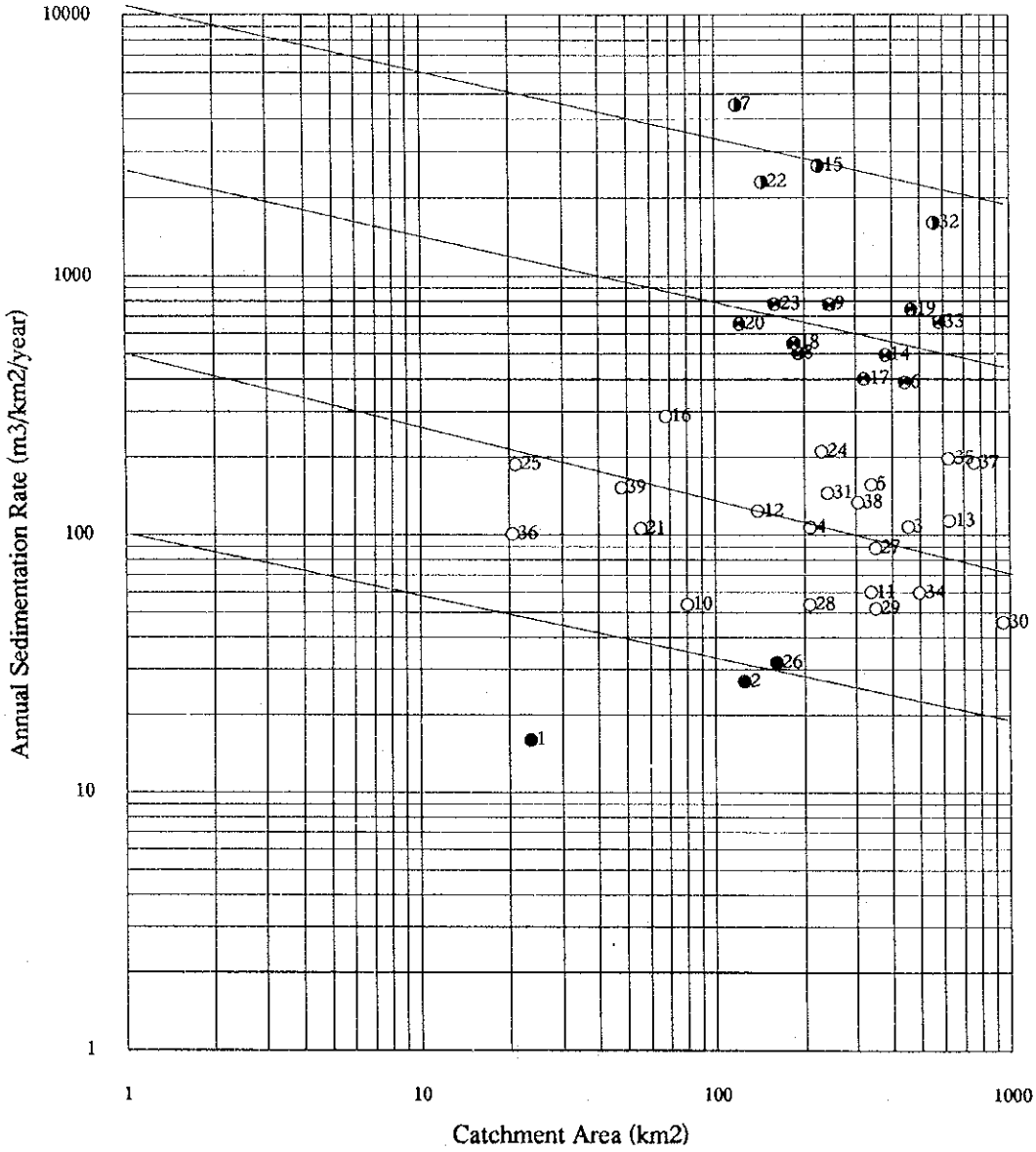
Year	1960	Total rainfall (P year)	1537.2mm
Water holding capacity	250.0mm	Actual evapotranspiration (AE)	1157.8mm
Initial soil moisture	250.0mm	Rainfall - Actual Evapo. (P-AE)	379.4mm
Initial available water for runoff	22.1mm	Total water deficit (WD year)	178.2mm
Soil moisture retention (a)	249.5	Total annual runoff (CRO year)	403.0mm
Soil moisture retention (b)	-0.0040	Final soil moisture	242.2
Recession constant (K)	0.9145	Final available water for runoff	6.3
Surface runoff rate (fs)	0.0100	Runoff coefficient	0.2622
Base flow (Qb)	0.0540mm/day		

CALCULATED RUNOFF (CRO) unit : mm

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total	21.2	2.2	2.4	5.8	3.4	28.3	72.2	56.4	48.1	46.0	63.8	53.2
f	45%	5%	3%	4%	5%	14%	47%	35%	26%	32%	63%	31%
1	1.89	0.12	0.05	0.05	0.23	0.05	2.58	1.82	1.93	3.83	2.88	0.81
2	1.73	0.11	0.05	0.19	0.33	0.05	2.33	1.66	1.76	3.51	2.64	0.57
3	1.58	0.10	0.05	0.05	0.19	0.05	2.13	1.52	1.61	3.21	2.41	0.52
4	1.45	0.09	0.08	0.05	0.18	0.16	1.95	1.39	1.47	2.93	2.21	0.47
5	1.32	0.08	0.05	0.05	0.16	0.05	1.78	1.50	1.48	2.68	2.02	0.75
6	1.21	0.08	0.05	0.05	0.15	0.05	1.63	1.40	1.23	2.45	2.05	0.65
7	1.11	0.07	0.05	0.05	0.14	0.05	1.49	1.70	1.13	2.24	2.15	1.15
8	1.01	0.06	0.05	0.05	0.17	0.06	1.36	1.89	1.03	2.05	4.46	4.61
9	0.92	0.06	0.05	0.21	0.11	0.05	1.45	2.79	0.94	1.88	4.08	4.22
10	0.85	0.05	0.05	0.50	0.10	0.05	1.14	2.55	1.18	1.71	3.73	3.85
11	0.83	0.05	0.05	0.05	0.09	0.05	1.12	2.33	0.94	1.57	3.41	3.53
12	0.71	0.05	0.05	0.05	0.09	0.05	1.09	2.13	0.82	1.43	3.12	3.22
13	0.65	0.05	0.05	0.05	0.08	0.05	1.05	1.95	0.75	1.38	2.85	2.95
14	0.59	0.05	0.05	0.05	0.07	0.05	1.09	1.78	0.69	1.20	2.61	2.70
15	0.54	0.31	0.05	0.25	0.07	0.05	1.59	1.63	0.63	1.10	2.49	2.47
16	0.56	0.05	0.05	0.05	0.06	0.05	2.81	1.49	0.75	1.00	2.39	2.25
17	0.49	0.11	0.05	0.16	0.14	0.05	3.06	1.36	0.53	0.92	2.17	2.06
18	0.41	0.05	0.05	0.05	0.05	0.55	2.92	1.25	0.48	0.84	1.98	1.89
19	0.38	0.05	0.05	0.05	0.05	0.05	2.83	1.14	0.44	0.77	1.82	1.72
20	0.35	0.10	0.05	0.05	0.05	0.70	3.28	1.04	0.47	0.70	1.66	1.58
21	0.32	0.05	0.05	0.28	0.05	3.29	3.27	1.09	0.37	0.64	1.52	1.44
22	0.60	0.05	0.05	0.52	0.20	3.01	4.02	1.09	0.34	0.59	1.39	1.32
23	0.26	0.05	0.05	0.47	0.07	2.79	4.03	0.89	0.31	0.54	1.27	1.27
24	0.24	0.05	0.05	0.43	0.05	2.52	3.71	0.95	0.91	1.23	1.16	1.25
25	0.22	0.05	0.05	0.40	0.05	2.30	3.40	1.99	3.56	0.45	1.06	1.01
26	0.20	0.05	0.05	0.36	0.22	2.27	3.11	3.30	3.56	0.41	0.97	0.92
27	0.18	0.05	0.05	0.33	0.05	1.92	2.91	3.01	5.03	0.38	0.89	0.84
28	0.17	0.05	0.46	0.30	0.05	2.01	2.60	2.76	5.01	0.34	0.81	0.77
29	0.15	0.05	0.05	0.28	0.05	3.04	2.37	2.52	4.58	0.31	0.74	0.80
30	0.14		0.36	0.33	0.05	2.82	2.17	2.31	4.19	0.83	0.81	1.02
31	0.13		0.05		0.05		1.99	2.11		2.88		0.59

Fig. II.7 b Sample Results of Modified Model

Fig. II.8 Sedimentation Rates



Legend			
	ⓘ	Group 1	Very High (part of Selangor, Perak)
	◒	Group 2	High (Selangor, Lower Sg. Pahang basin)
	○	Group 3	Intermediate
	●	Group 4	Low (Perlis, Melaka)

ATTACHMENTS

Iwai Method

This method is derived from lognormal distribution by applying the experimental distribution.

$$F(x) = \frac{1}{\sqrt{\pi}} \int_{-\infty}^{\xi} e^{-\xi^2} d\xi$$

$$\xi = a \log_{10} \frac{x+b}{x_0+b}, \quad (-b < x < \infty)$$

Relation between N and ξ

$$\frac{100}{W(\%)} = N \rightarrow \xi$$

N	ξ	N	ξ	N	ξ	N	ξ	N	ξ
2	0.0000	37	1.3622	72	1.5560	107	1.6629	260	1.8847
3	0.3045	38	1.3702	73	1.5597	108	1.6654	270	1.8936
4	0.4769	39	1.3782	74	1.5635	109	1.6678	280	1.9022
5	0.5951	40	1.3860	75	1.5672	110	1.6701	290	1.9105
6	0.6858	41	1.3932	76	1.5709	111	1.6725	300	1.9184
7	0.7547	42	1.4008	77	1.5745	112	1.6749	310	1.9260
8	0.8134	43	1.4079	78	1.5780	113	1.6772	320	1.9335
9	0.8634	44	1.4145	79	1.5815	114	1.6795	330	1.9407
10	0.9062	45	1.4213	80	1.5849	115	1.6818	340	1.9476
11	0.9442	46	1.4276	81	1.5883	116	1.6841	350	1.9542
12	0.9780	47	1.4342	82	1.5917	117	1.6863	360	1.9606
13	1.0084	48	1.4404	83	1.5950	118	1.6885	370	1.9672
14	1.0361	49	1.4464	84	1.5982	119	1.6907	380	1.9733
15	1.0614	50	1.4520	85	1.6014	120	1.6929	390	1.9792
16	1.0848	51	1.4578	86	1.6046	125	1.7034	400	1.9850
17	1.1065	52	1.4634	87	1.6077	130	1.7135	410	1.9906
18	1.1263	53	1.4693	88	1.6108	135	1.7232	420	1.9961
19	1.1455	54	1.4746	89	1.6138	140	1.7324	430	2.0014
20	1.1630	55	1.4798	90	1.6168	145	1.7414	440	2.0067
21	1.1798	56	1.4849	91	1.6198	150	1.7499	450	2.0118
22	1.1955	57	1.4901	92	1.6228	155	1.7582	460	2.0166
23	1.2102	58	1.4952	93	1.6257	160	1.7663	470	2.0213
24	1.2246	59	1.4999	94	1.6285	165	1.7739	480	2.0260
25	1.2380	60	1.5047	95	1.6314	170	1.7814	490	2.0305
26	1.2509	61	1.5094	96	1.6342	175	1.7885	500	2.0350
27	1.2639	62	1.5141	97	1.6369	180	1.7955	550	2.0565
28	1.2749	63	1.5180	98	1.6396	185	1.8023	600	2.0757
29	1.2861	64	1.5231	99	1.6423	190	1.8089	650	2.0931
30	1.2967	65	1.5274	100	1.6450	195	1.8153	700	2.1094
31	1.3069	66	1.5317	101	1.6476	200	1.8215	750	2.1242
32	1.3170	67	1.5359	102	1.6502	210	1.8332	800	2.1375
33	1.3270	68	1.5400	103	1.6528	220	1.8446	850	2.1506
34	1.3359	69	1.5441	104	1.6554	230	1.8554	900	2.1630
35	1.3453	70	1.5481	105	1.6579	240	1.8656	950	2.1750
36	1.3537	71	1.5521	106	1.6604	250	1.8753	1000	2.1850

Foundamental equation:

$$\log_{10}(x+b) = \log_{10}(x_0+b) + \frac{1}{a}\xi$$

where, a, b, x_0 are constants.

Estimation of the constants:

$$b = \frac{1}{m}\sum_{i=1}^{N} b_s \quad , \quad (m = \frac{N}{10})$$

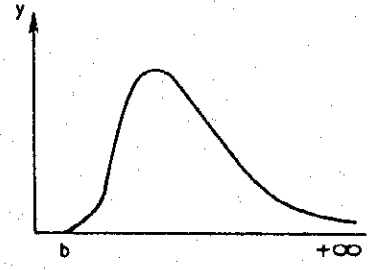
$$b_s \approx \frac{x_1 x_s - x_q^{\,2}}{2x - (x_1 + x_s)} \quad , \quad (1+s = N+1)$$

$$\log_{10} x_g = \frac{1}{N}\sum_{i=1}^{N} \log_{10} x_i$$

$$\log_{10}(x_0+b) = \frac{1}{N}\sum_{i=1}^{N} \log_{10}(x_i+b) = \overline{Y}$$

$$\frac{1}{a} = \sqrt{\frac{2}{N-1}\sum_{i=1}^{N}(\log_{10}\frac{x_i+b}{x_0+b})^2} = \sqrt{\frac{2N}{N-1}} \cdot S_x$$

$$S_x = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\{\log_{10}(x_i+b)\}^2 - \{\log_{10}(x_0+b)\}^2} = \sqrt{\overline{Y^2} - \overline{Y}^2}$$



ANNEX III

IRRIGATION AND DRAINAGE

ANNEX III
IRRIGATION AND DRAINAGE

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1 Simpang Geti and Tasik Melati Project (PR-1 & 4)

1.1 Present Condition

1.1.1 Project Area

The Project areas are located in the flat plain about 8 to 10 km Northwest from Arou town. Both schemes have existing irrigation canals and related structures. The main crops of both the shemes are rice in main season and vegetable and tobacco in dry season. The scheme areas sometimes suffer from flood in the main season,from October to November. The scheme area has partial inundation ranging from 20 ha to 50 ha during flood. The inundation period of these floods ranges from a couple of days to 10 days.

Agriculture water shortages caused by insufficient regional water management occure in the off-season. For the last 4 years from 1990 to 1993, an irrigation area ranging from 10 ha to 220 ha suffered from water shortage, every November to March.

Inspection roads of the main canals and farm roads which total about 15 km in and around the project areas have been constructed and are well maintained the appreciated condition.

1.1.2 Irrigation and Drainage Facilities

Irrigation areas for both the schemes are 105 ha for the Simpang Gati scheme and 232 ha for the Tasik Melati scheme. The main water resources for the existing 2 scheme areas are small river streams and existing ponds located near the project areas, The Tasik Melati reservoir, and the Timah Tasoh reservoir. Futhermore, link canals of approximately 4 km in length constructed in 1993, are located along both the areas to supply irrigation water to Simpang Geti scheme area from the Ngolang river.

The Tasik Melati scheme area is irrigated by water of the Tasik Melatih reservoir. Water is conveyed through several natural streams and main canals. The reservoir capacity of the Tasik Melati is about 45,000 m3,

The Simpang Geti scheme area is located downstream of the link canals, and its water resources are stored in the 8 existing ponds near the scheme area and in the Timah Tasoh reservoir. Irrigation water is mainly supplied to the area from the 8 existing ponds in the main season and from the Timah Tasoh reservoir in off-season. The reservoir capacities of the 8 existing ponds are estimated at 60,000 m3.

Natural rivers such as the Santan river and the Ngolang river also function as main drains. Ngolang river and its tributary located near the Simpang Geti scheme area are able to evacuate drainage water, but the tributary of Santan river located around the Tasik Melati scheme must be rehabilitated, especially the lower stream reaches.

Irrigation and drainage facilities of both the schemes are in the operation and maintenance stage of the projects under the State DID's supervision, and are being well maintained.

1.2 The Projects

1.2.1 Background of the Project

The State DID intends to improve the regional water management by the implementation of pilot projects for small reservoir development. The current water resources for both schemes are water stored in 8 existing ponds, and the Tasik Melati and Timah Tasoh reservoirs. Water from the Timah Tasoh is supplied to both schemes through the link canals designed to cope with water shortage constraints in the off-season. However, due to inregular water absorption of sugar cane plantations and paddy fields located upstream, water allocation in the region is not stable, and the off-taking discharge for both schemes is limited and insufficient.

In the Tamah Tasoh scheme area, irrigation water is insufficient for paddy cultivation even in the main season based on a calculation of water balance involving the current storage capacity of the Timah Tasoh reservoir. An additional storage reservoir of about 450,000 m3 will be required to irrigate the overall paddy field of 232 ha as shown in Tables 3.1.1.to 3.1.2.

The main purpose of the link canals is to provide supplemental irrigation water to the Simpang Gati scheme area in the off-season.

The link canals also have the capacity to supply additional irrigation water to the Timah Tasoh scheme area. If the water allocation of the Timah Tasoh reservoir is adjusted in the future, the constraints on irrigation in both schemes will be solved.

Therefore, future development of both schemes would ensure sufficient discharge of irrigation water through the link canals under the optimisation of the regional water management.

1.2.2 Proposed irrigation area

Tobacco plantations in both Project area are proposed for 100 ha in Tasik Melati area and 50 ha in Simpang Geti.

1.2.3 Irrigation Water Requirement

According to the field information, both areas obtain irrigation water for main season paddy cultivation from existing reservoirs such as the Timah Tasoh, Tasik Melati, Simpang Geti, and other small ponds. However, it is considered that both scheme areas have insufficient water to irrigate the overall scheme areas.

The irrigation water requirement for the main season paddy is calculated as shown in Table 3.1.1 based on Section 3.4.3.2. of MADA report No. 86014.

The peak irrigation water requirement for the main season paddy is estimated at 2.5 lit./sec, and the design discharge of the link canals is 0.85 m3/sec for both areas.

On the other hand, tobacco plantations cover about 10 ha of both areas in the off season and do not suffer from water shortages by using water from the existing reservoirs and ponds in and around the schemes.

According to the present cropping pattern and practical irrigation for tobacco plantations in both scheme areas, irrigation water supply are carried out 3 times for one (1) crop season, consisting of (i) the first irrigation in the end of January, (ii) the second irrigation in February and (iii) the third irrigation in the beginning of

April. The water supply for the 3 times is carried out for about one (1) week each. Based on this practical irrigation, practical water supply for the current tobacco plantations could be estimated at about 300 m3/ha/day.

Therefore, the irrigation water amount for the extension of tobacco plantation area i.e 140 ha during each one (1) week, could be estimated at about 42,300 m3/day, equivalent to an irrigation water discharge of about 0.5 m3/sec.

The link canals have sufficient sections to convey these respective design discharges.

1.2.4 Drainage Water Requirement

Drainage water requirement is computed under the condition of 3 consecutive days rainfall and 3 days of drainage period.

The 3 consecutive days rainfall is adopted to calculate the probable rainfall with a return period of 5 years by the Gumbel method based on the rainfall data of the past 25 years at the BKT Temiang hydrological station for Tasik Melati and the rainfall data of 8 years at the LDG Perlis Utara hydrological station for Simpang Geti.

The probable 3 consecutive days rainfall in the respective Project areas are estimated at 154 mm and 169 mm, and the design discharge of the drainage canals are estimated at 6.5 lit/sec/ha for the Tasik Melati and at 5.9 lit/sec/ha for the Simpang Geti.

1.2.5 Irrigation and Drainage Facilities

The general lay out of the irrigation and drainage development is shown in DWG.1001.

(1) Drainage area

Proposed tobacco plantations in Tasik Mulati is 100 ha and plantation area is concentrated in the central area of the scheme which has agriculture land of 232 ha. In the Simpang Geti scheme. tobacco plantation is spread in the overall scheme area, and plantation area is 50 ha

The catchment area of the drainage plots per one (1) main drain is designed to range from 20 ha to 40 ha in the Tasik Melati area, and 10 ha to 20 ha in Sinpamg Geti area.

Main drains are laid out at intervals of about 500 m in Tasik Melati and every 250 m in Simpang Geti. Drains are designed to have a gradient of 1/3,000 in both the scheme areas and a design discharge of 0.13 m3/sec to 0.26 m3/sec in Tasik Melati area and 0.06 m3/sec to 0.12 m3/sec in Simpang Geti.

(2) Related structures to main drains

In accordance with the layout of the main drains, 3 culvert are designed at the crossing points with the existing roads.

(3) Rehabilitation of the tributary of the Santan river

Since the downstream reaches of the Santan river tributary which are located just down stream of the Tasik Melati scheme area, meander out of the river course

and have much sedimentation, rehabilitation of the tributary, such as short cut in the meandering sections of the existing river course, and widening of the river bottom, and dredging of the sedimentation, are designed for a section of about 4 km.

(4) Farm road

Farm roads located along the main drains are laid out with a total width of 5 m and laterite pavement of 3 m wide.

(5) Salient features of the Project facilities

Salient features of the facilities are as follows:

Tasik Melati Project	
Irrigation area	232 ha (paddy 232 ha in the main season and tobacco 100 ha in the off season)
Drainage canal	1.6 km of 3 new drains
Rehabilitation of the Santan river tributary	1 km
Culvert	2 nos.
Farm road & Inspection road	1.6 km
Simpang Geti Project	
Irrigation area	105 ha (paddy 105 ha in the main season and tobacco 50 ha in the off season)
Drainage canal	1.6 km of 3 new drains
Culvert	1 no.
Farm road & Inspection road	1.6 km

1.2.6 Construction Plan

Mechanical construction methods will be applied for the excavation of the river and new drains.

Main construction works will be the embankment of the farm road, and inspection road and excavation of the main drain, and rehabilitation of the river. The construction volume of these works is estimated at about 6,900 m3 of embankment and about 12,700 m3 of excavation.

Taking into consideration the construction volume, the construction schedule is assumed at 4 months, consisting of 1 month for mobilisation, preparatory work, and demobilisation periods, and 3 months for construction.

1.3 Estimate of Project Cost

1.3.1 Unit price Analysis

Unit prices of the respective works of the project are estimated by reviewing the Government price schedule issued in 1993, using an annual inflation rate of commodity issued by the Central Bank of Malaysia. The unit prices of these works are estimated at 1994 price levels.

The updated unit prices of the respective works are shown in Table 3.1.3.

1.3.2 Estimate of Quantity

Based on the design mentioned above, the quantities shown in Tables 3.1.4 to 3.1.5.are estimated.

1.3.2 Estimate of Construction Cost

The total construction cost, consisting of direct construction cost, land acquisition cost, and physical contingency is estimated at about RM 400, 900 for the Tasik Melati Project and at about RM 261, 000 for the Simpang Geti Project at 1994 price levels, shown below.

Physical contingency is estimated at 15 % of the direct construction cost.

	Description	Cost (RM)	
		T. Melati	S. Geti
1	Direct construction cost	180,973	82,618
2	Land acquisition	165,600	153,600
3	Physical contingency	27,147	12,392
4	Engineering cost	18,100	8,270
5	Administration cost	9,050	4,120
	Total	400,870	261,000

The estimate of detailed costs are shown in Tables 3.1.3 to 3.1.5.

Table 3.1.1 Water Requirements for Paddy Cultivation (Direct Sowing Culture of 120 days variety)

Off season	March	April	May	June	July	Total
Duration of time (days)	20	30	31	30	24	135
Soil soaking and flooding (mm)	180					180
Evaporation (mm)	146	199	205	199	159	908
Seepage and percolation (mm)	110	114	118	114	91	547
Total (mm)	436	313	323	313	250	1635
unit requirements (l/sec/ha)	2.52	1.21	1.21	1.21	1.21	

Main season	August	September	October	November	December	Total
Duration of time (days)	33	28	31	30	11	133
Soil soaking and flooding (mm)	80					80
Evaporation (mm)	155	161	178	173	63	730
Seepage and percolation (mm)	125	76	84	81	30	396
Total (mm)	360	237	262	254	93	1206
unit requirements (l/sec/ha)	1.26	0.98	0.98	0.98	0.98	
Total of two seasons						2841

Note : Computed based on MADA report NO. 86014, 3.4.3.2 Direct Sowing Culture

Table 3.1.2 Simulation of Tasik Melati Reservoir Operation (Reservoir Capacity 45,000 m3) for Main Season Paddy Cultivation only (232 ha)

unit : 1000 m3

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
Water Requirement (mm)								360.0	237.0	262.0	254.0	93.0	1206.0
													(Required Reservoir
Reservoir Storage												45	Capacity)
1969	45	45	45	45	45	45	45	-16	45	45	45	45	16
1970	45	45	45	45	45	45	45	45	45	45	45	45	0
1971	45	45	45	45	45	45	45	-390	-171	45	45	45	390
1972	45	45	45	45	45	45	45	-169	45	45	45	45	169
1973	45	45	45	45	45	45	45	45	45	45	45	45	0
1974	45	45	45	45	45	45	45	-513	-423	-513	-205	45	513
1975	45	45	45	45	45	45	45	-451	-262	-92	45	45	451
1976	45	45	45	45	45	45	45	-94	45	45	45	45	94
1977	45	45	45	45	45	45	45	38	45	45	45	-92	92
1978	-41	6	45	45	45	45	45	45	45	45	-156	-94	156
1979	-43	3	45	45	45	45	45	-241	45	45	45	45	241
1980	45	45	45	45	45	45	45	-102	-90	45	45	45	102
1981	45	45	45	45	45	45	45	-434	-586	-762	-265	45	762
1982	45	45	45	45	45	45	45	45	45	45	45	45	0
1983	45	45	45	45	45	45	45	45	45	45	45	45	0
1984	45	45	45	45	45	45	45	-632	-485	-330	-293	-99	632
1985	45	45	45	45	45	45	45	-397	-330	-197	45	45	397
1986	45	45	45	45	45	45	45	-260	45	45	45	45	260
1987	45	45	45	45	45	45	45	45	45	45	45	45	0
1988	45	45	45	45	45	45	45	-270	45	45	45	45	270
1989	45	45	45	45	45	45	45	-14	45	45	45	45	14
1990	45	45	45	45	45	45	45	-702	-692	-170	45	45	702

Table 3.1.3 Unit Price Analysis (PR-1&4)

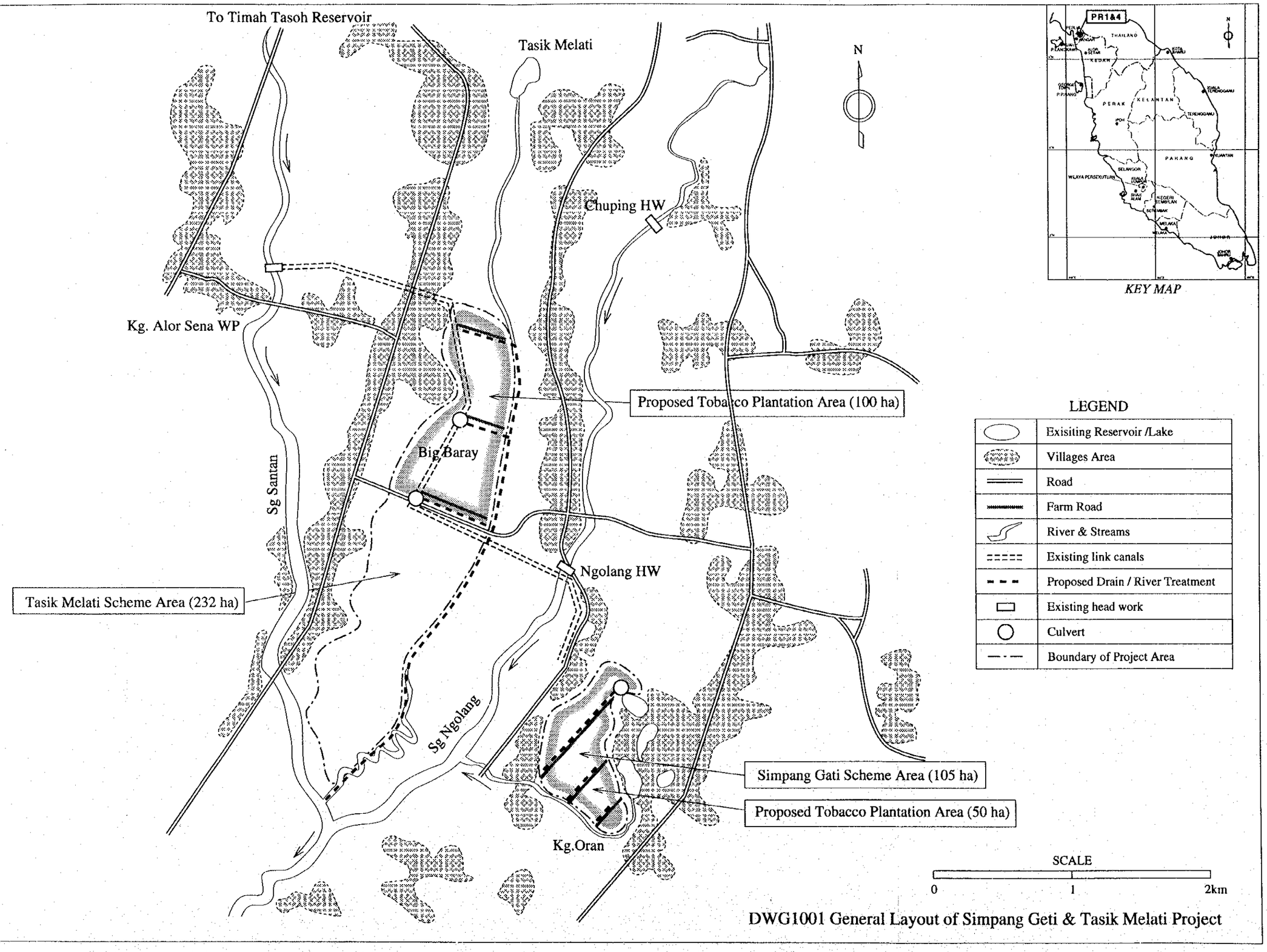
Description	Unit	Tender Price	Tender Year	Infration Rate (%)	Up-dated Price (RM)	Adopted Price (RM)	Remarks Data sources
Canal & Related Structures							
Reinforced Concrete	m3	471.0	1991	1.131	532.7		JPS Price List 1993
		481.0	1993	1.035	497.8	515.3	JPS Schedule of Rate 1993
Concrete Pipe dia. 300	m	60.0	1991	1.131	67.9	67.9	JPS Price List 1993
Inspection and Farm Road							
Stripping	m3	2.7	1991	1.131	3.1	3.1	JPS Price List 1993 Average price
Embankment	m3	15.0	1991	1.131	17.0	17.0	JPS Price List 1993
Laterite	m3	14.4	1993	1.035	14.9	15.0	JPS Price List 1993 Average price
Drainage & River Treatment							
Excavation	m3	9.3	1993	1.035	9.6	9.6	JPS Schedule of Rate 1993
Land Acquisition	ha	100,000.0	1994	1	100,000.0	100,000.0	

Table 3.1.4 Estimate of Construction Cost (Tasik Melati)

Work Item	Unit	Quantity	Unit Price(RM)	Amount(RM)
Canal & Related Structures				
Reinforced Concrete	m3	2.6	515.3	1,360.3
Concrete Pipe dia. 300	m	13.2	67.9	896.3
Subtotal				2,256.6
Inspection and Farm Road				
Stripping	m3	852.5	3.1	2,642.8
Embamkment	m3	3,410.0	17.0	57,970.0
Raterite	m3	511.5	15.0	7,672.5
Subtotal				68,285.3
Drainage & River Treatment				
Excavation	m3	11,503.2	9.6	110,430.7
Subtotal				110,430.7
SUBTOTAL				180,972.6
Land Acquisition	ha	1.7	100,000.0	165,600.0
Physical Contingency (15 % of Subtotal)				27,145.9
Engineering Cost (10 % of Subtotal)				18,097.3
Administration cost (5 % of Subtotal)				9,048.6
TOTAL				400,864.3

Table 3.1.5 **Estimate of Construction Cost (Simpang Geti)**

Work Item	Unit	Quantity	Unit Price(RM)	Amount(RM)
Canal & Related Structures				
Reinforced Concrete	m3	1.3	515.3	680.2
Concrete Pipe dia. 300	m	6.6	67.9	448.1
Subtotal				1,128.3
Inspection and Farm Road				
Stripping	m3	880.0	3.1	2,728.0
Embamkment	m3	3,520.0	17.0	59,840.0
Raterite	m3	528.0	15.0	7,920.0
Subtotal				70,488.0
Drainage & River Treatment				
Excavation	m3	1,146.0	9.6	11,001.6
Subtotal				11,001.6
SUBTOTAL				82,617.9
Land Acquisition	ha	1.5	100,000.0	153,600.0
Physical Contingency (15 % of Subtotal)				12,392.7
Engineering Cost (10 % of Subtotal)				8,261.8
Administration cost (5 % of Subtotal)				4,130.9
TOTAL				261,003.3



DWG1001 General Layout of Simpang Geti & Tasik Melati Project

2 Kedawang Project (KH 4 & 5)

2.1 Present Condition

2.1.1 Project Area

Both schemes are located in the Lembu and Ketapang river basins about 3 km South from Langkawi airport. The Project area extends from the small hilly area to the coastal area. Agriculture land in the Project areas are substantially covered by rainfed paddy fields totalling more than 200 ha in the Lembu Project area and more than 100 ha in the Ketapang Project area. In the Lembu Project area, less than 50 ha of paddy field are irrigated using return flow from other paddy fields located at a higher elevation. The main water resources for the Projects are small rivers and their tributaries.

For 2 years from 1991 to 1992, 200 ha of paddy fields suffered from water shortages in the off-season, especially from October to November.

2.1.2 Irrigation and Drainage Facilities

The Lembu Project area has a simple irrigation canal system consisting of a small excavated pond, 3 off-take gate structures, and about 3 km of earth canals. Existing earth canals are functioning as irrigation canals and drains. Irrigation water is currently collected as return flow from paddy fields in the upper reachses of the Lembu stream area. The Lembu Project area is in the operation and maintenance stage under the State DID's supervision and the State DOA's agriculture extension work. The DOA intends to promote a crop diversification program in the Project areas.

The Ketapang Project area have no existing irrigation facilities.

Access roads to both scheme areas are well maintained with asphalt pavement, but farm roads are few and the majority are not paved.

2.1.3 Construction Materials

According to local information and the survey results on construction materials and equipment, local market prices of basic construction materials such as cement, reinforcement bars, PVC & steel pipes, etc. and heavy construction equipment are rather expensive, compared with those in the Peninsular area, mainly because of transportation and the market scale of the islands.

2.2 The Projects

2.2.1 Background of the Project

The Government intends to develop agro-tourism on the island. In line with this, the Project area is being promoted by the DOA's crop diversification program. To assist the DOA's crop diversification program and reinforce the agro-tourism development program, and improve water supply, the State DID, also endorses the Project.

2.2.2 Proposed irrigation area

At present, the majority of both areas are rainfed paddy fields, and the planted areas of paddy cultivation in the main season are always varied depending on the availability of water resources.

The total proposed irrigation areas of both the Projects are 180 ha which are 110 ha in the Lembu Project and 70 ha in the Ketapang project.

In this planning, the Lembu Project has 100 ha of paddy fields and 10 ha of vegetable cultivation lands, and the Ketapang Project has 60 ha of paddy fields and 10 ha of vegetable cultivations under the conditions of the drought year with a return period of 5 years

The general layouts of the Projects are shown in DGW 2001.

2.2.3 Irrigation Water Requirement

(1) Seasonal irrigation requirement of the main season paddy

Irrigation water requirement for the main season paddy is calculated under the conditions of the direct sowing planting method following the procedure of MADA report No. 86014, as shown in Fig. 3.2.1. Irrigation methods are designed as basin irrigation. The seasonal irrigation water requirement for paddy field is estimated at 1,206 mm/4.5 months.

(2) Seasonal irrigation requirement of vegetables

The irrigation water requirement for vegetables is calculated based on the FAO Irrigation and Drainage Paper No. 24 and MARDI' s information on irrigation water for vegetable cultivation using rain shelter and drip/micro jet sprinkler irrigation facilities.

Potential evapo transpiration (ETo) is estimated at 1,345 mm/year by the modified Penman method, using meteorological data from the Langkawi airport station. Potential evapo transpiration for vegetable cultivation is estimated at 90 % of the above, because of the a rain shelter uses.

Since it will be difficult to forecast selective type and kind of vegetables and cropping pattern, rather higher crop coefficients are assumed, and the cropping pattern is for all seasons.

Effective rainfall for vegetable cultivation is also disregarded because of the use of rain shelter facilities.

Irrigation methods designed are drip and/or micro jet sprinkler systems, and overall irrigation efficiency for vegetable cultivation is adopted at 85 %.

Seasonal irrigation water requirements for vegetables are 1,210 mm/year. A detailed calculation of irrigation water requirements is described in Table. 3.2.1.

(3) Design irrigation water requirement for facilities.

Design irrigation water requirement for facilities are calculated as the peak irrigation water requirement. Peak irrigation water requirements for both Projects are calculated at 1.34 lit / sec / ha for the main season paddy and 0.43 lit./ sec / ha for vegetables as shown in Table 3.2.1.

Design irrigation water requirements for the irrigation facilities are calculated as follows, taking into consideration the irrigation method, the rotation of the irrigation water supply, and design conditions of the facilities.