Fig. 6-16 SEISMIC RIPPABILITY CHART

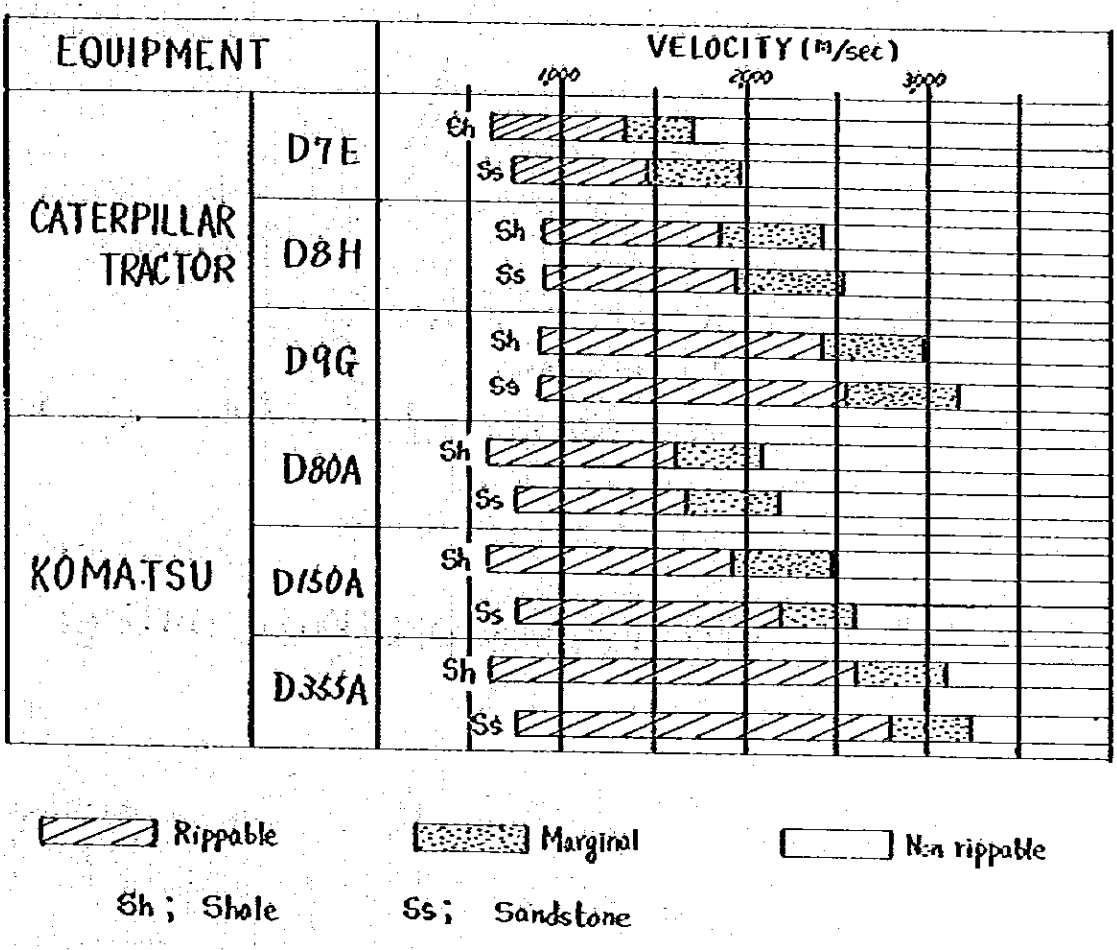


Fig. 6-17(a) PARTICLE SIZE DISTRIBUTION CURVES OF TERRACE DEPOSITS

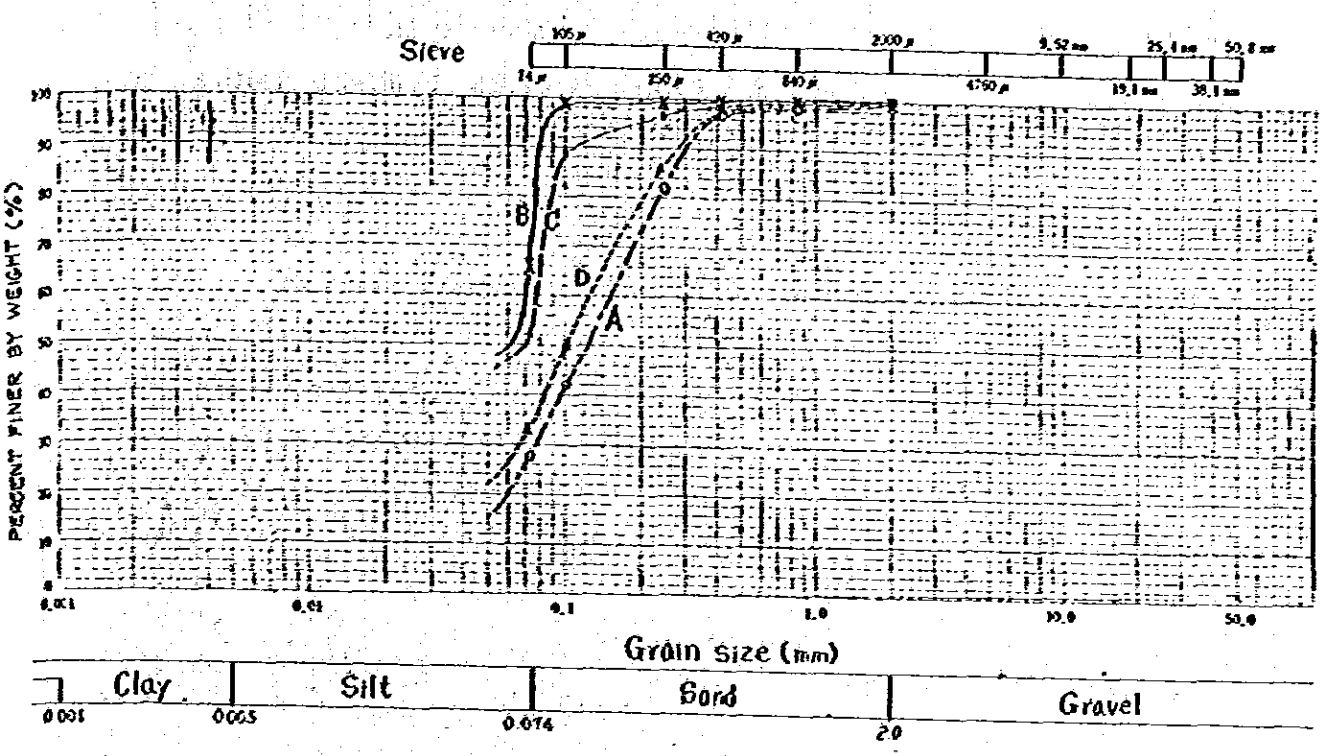


Fig. 6-17(b) PARTICLE SIZE DISTRIBUTION CURVES OF RIVER SAND

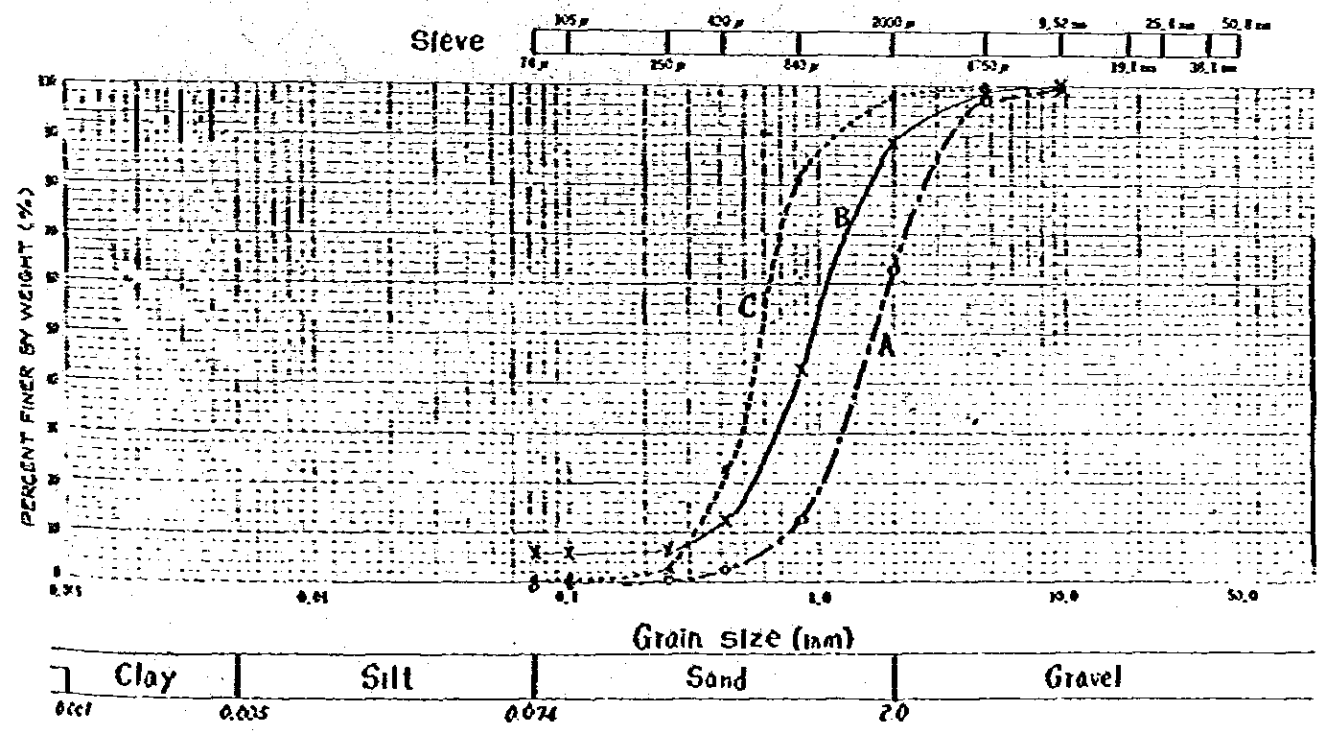


Fig. 6-18 DISTRIBUTION OF EPICENTER IN SOUTHEAST ASIA

(after Bulletin of the seismological society of America
Vol. 59, No.1, pp. 369-380. February, 1969)

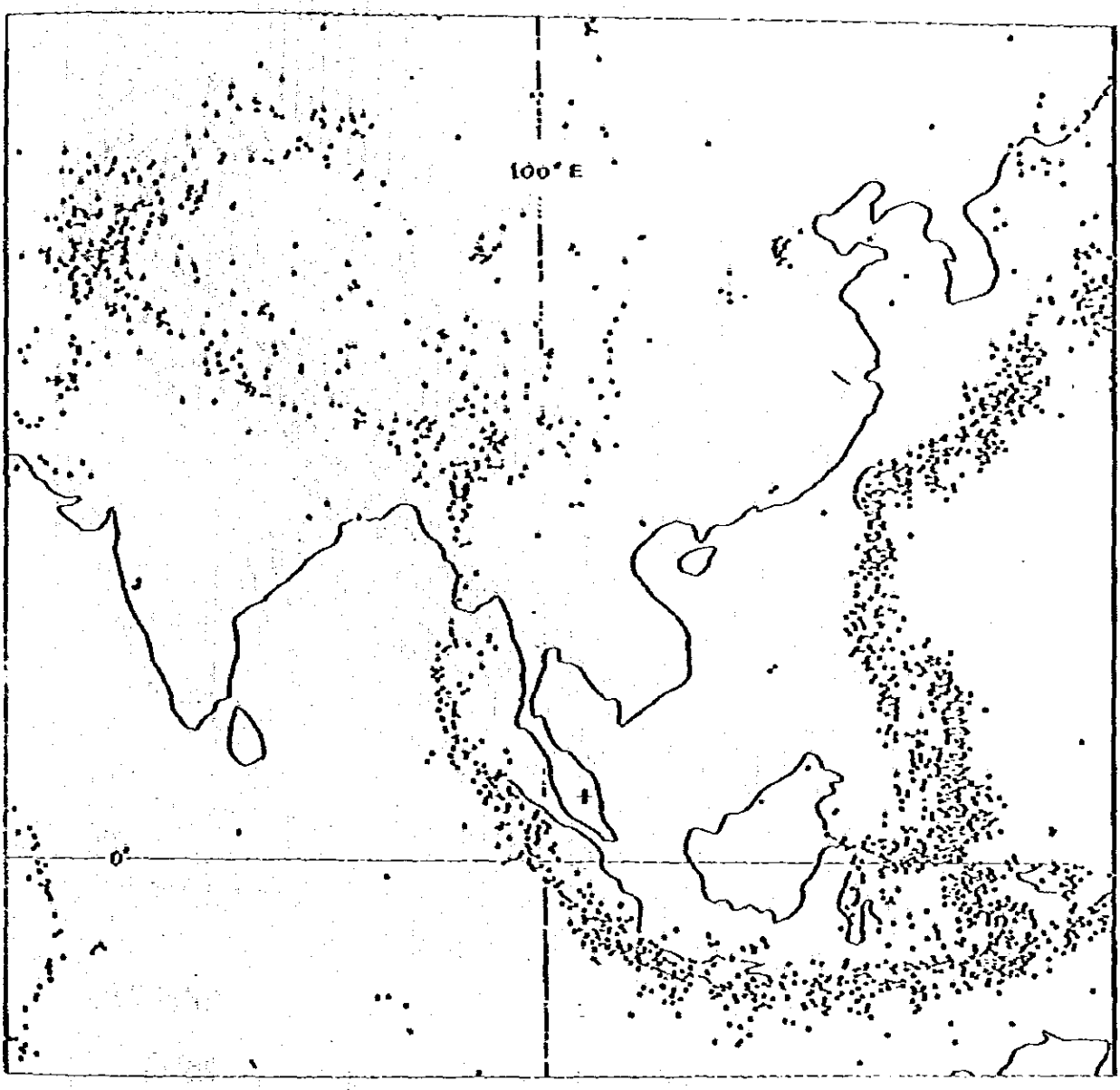
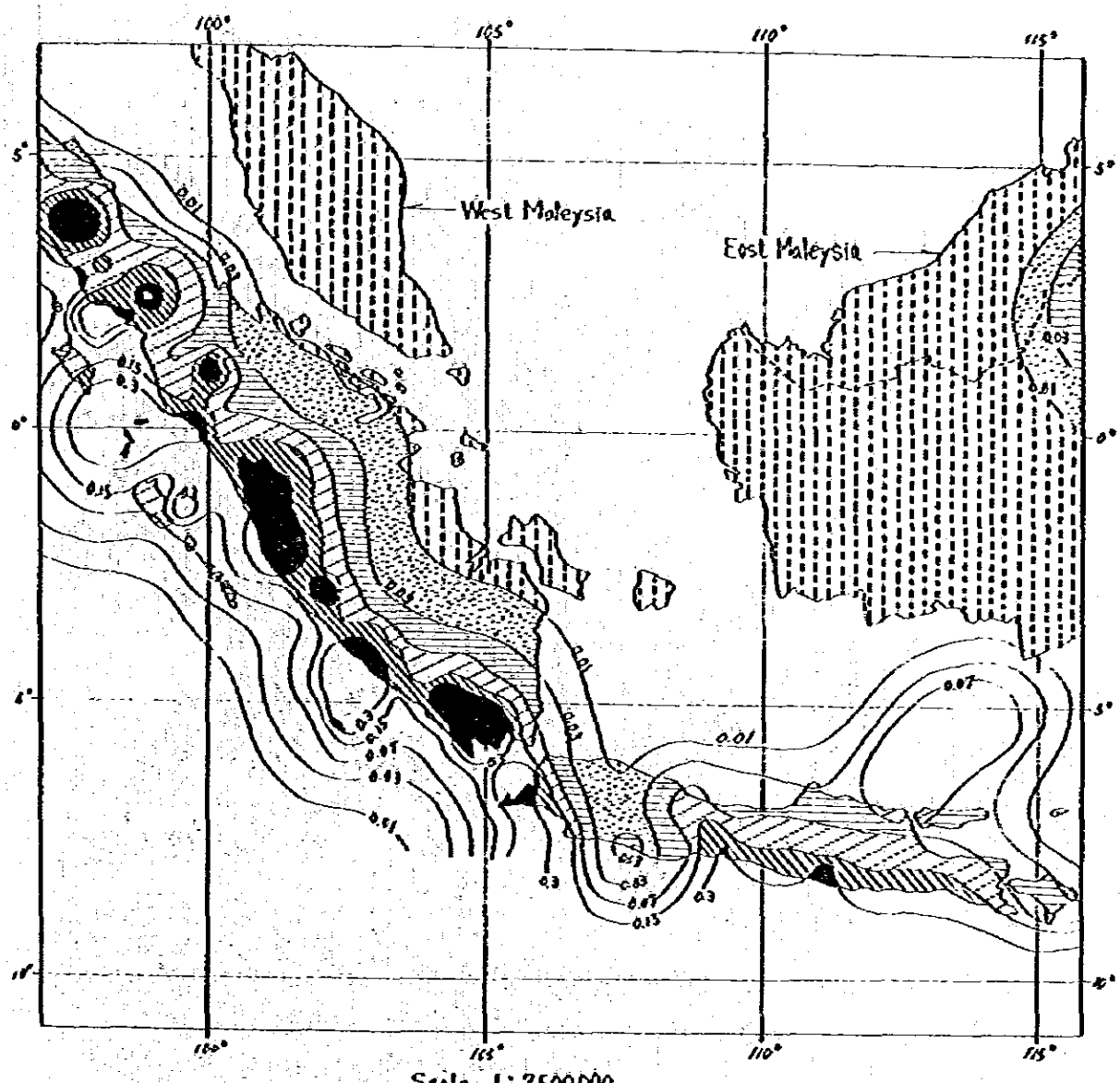


Fig. 6-19 ISOSEISMAL MAP OF SOUTHEAST ASIA

(after Peta Iso Seisma Indonesia, Hiroshi Kawasumi)



Scale 1: 7500,000

LEGEND

- α = 0.3g
- α = 0.15 - 0.3g
- α = 0.07 - 0.15g
- α = 0.03 - 0.07g
- α = 0.01 - 0.03g
- α < 0.01g

α = Maximum acceleration g = Gravity (9.8 m/sec²)

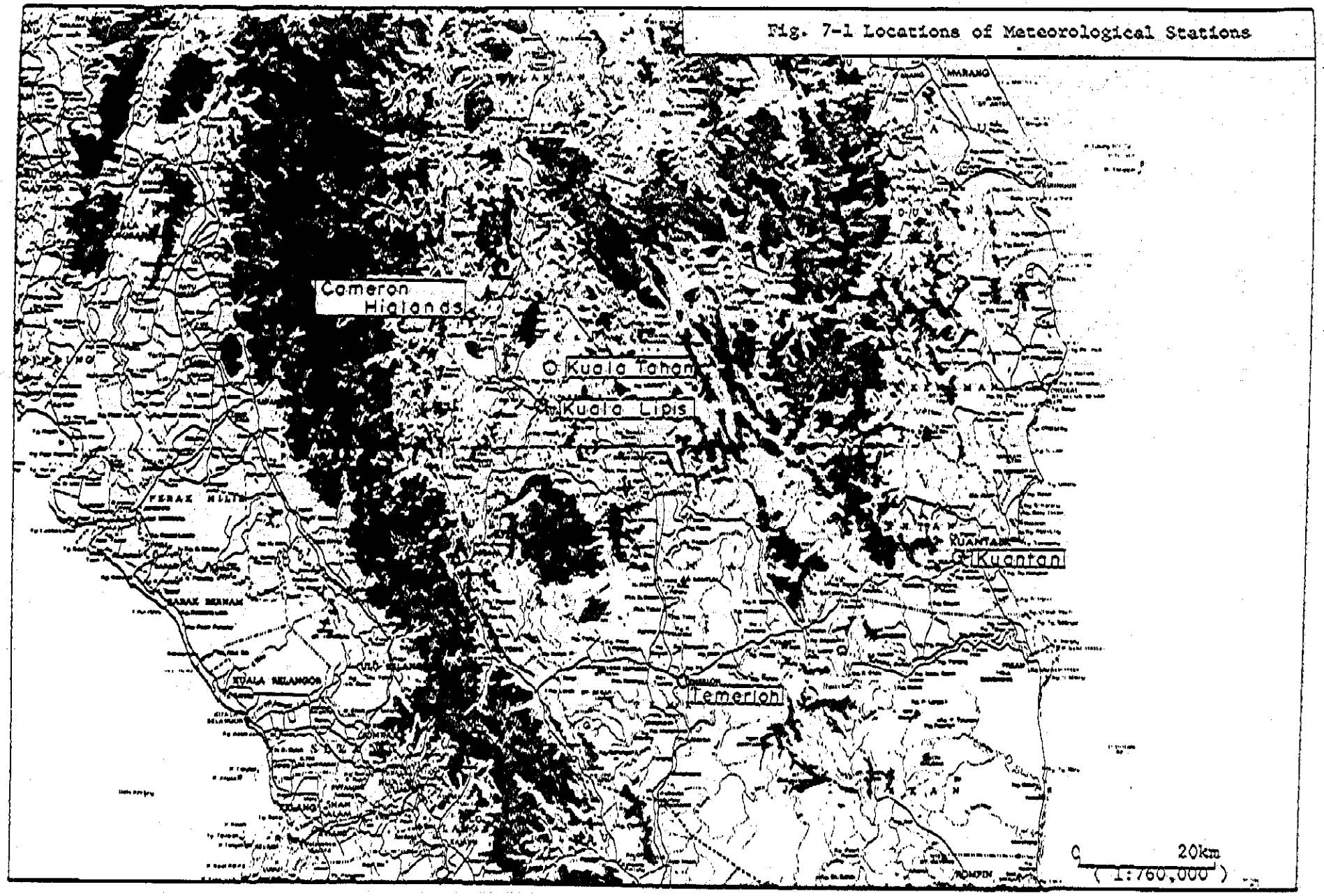
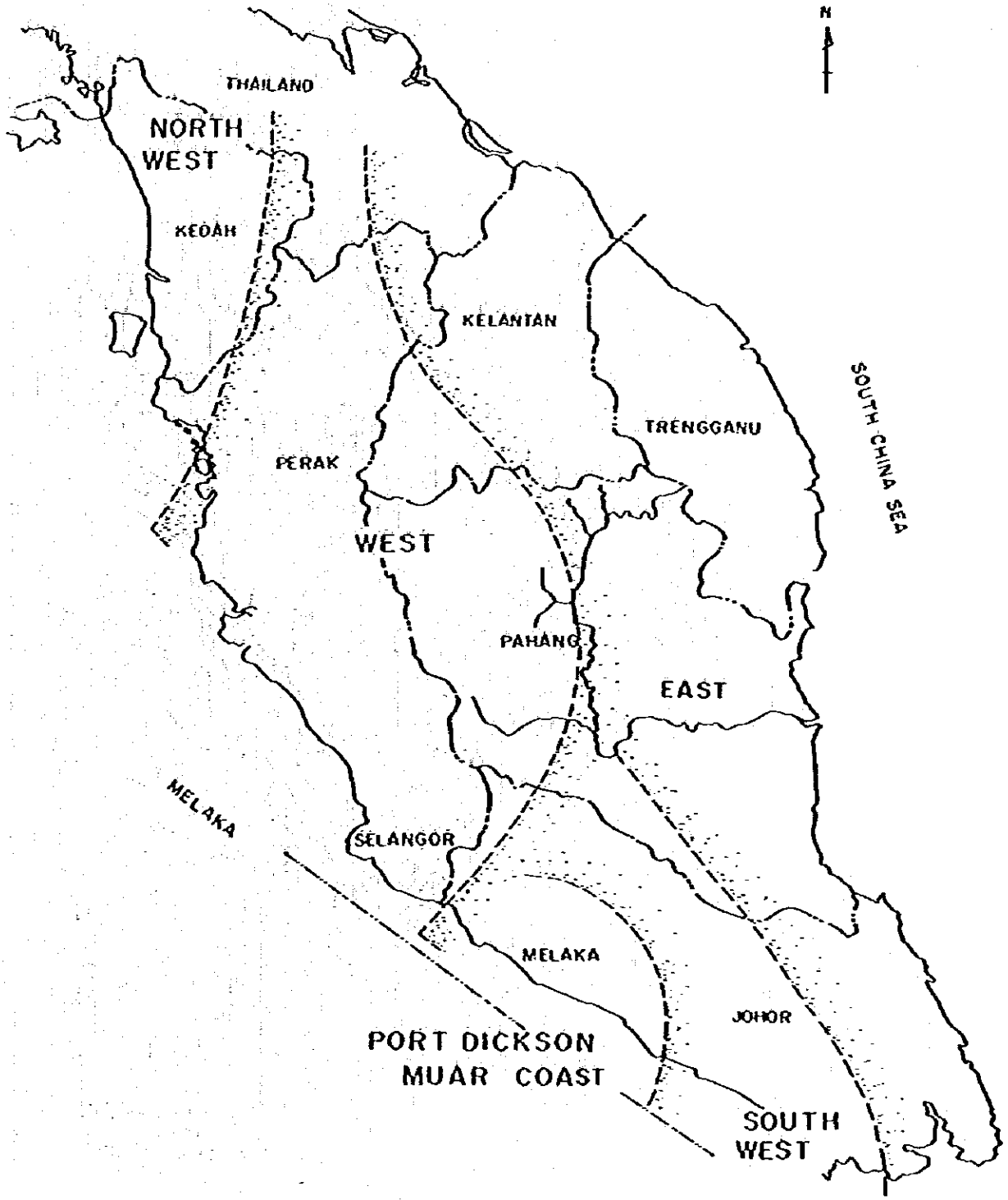


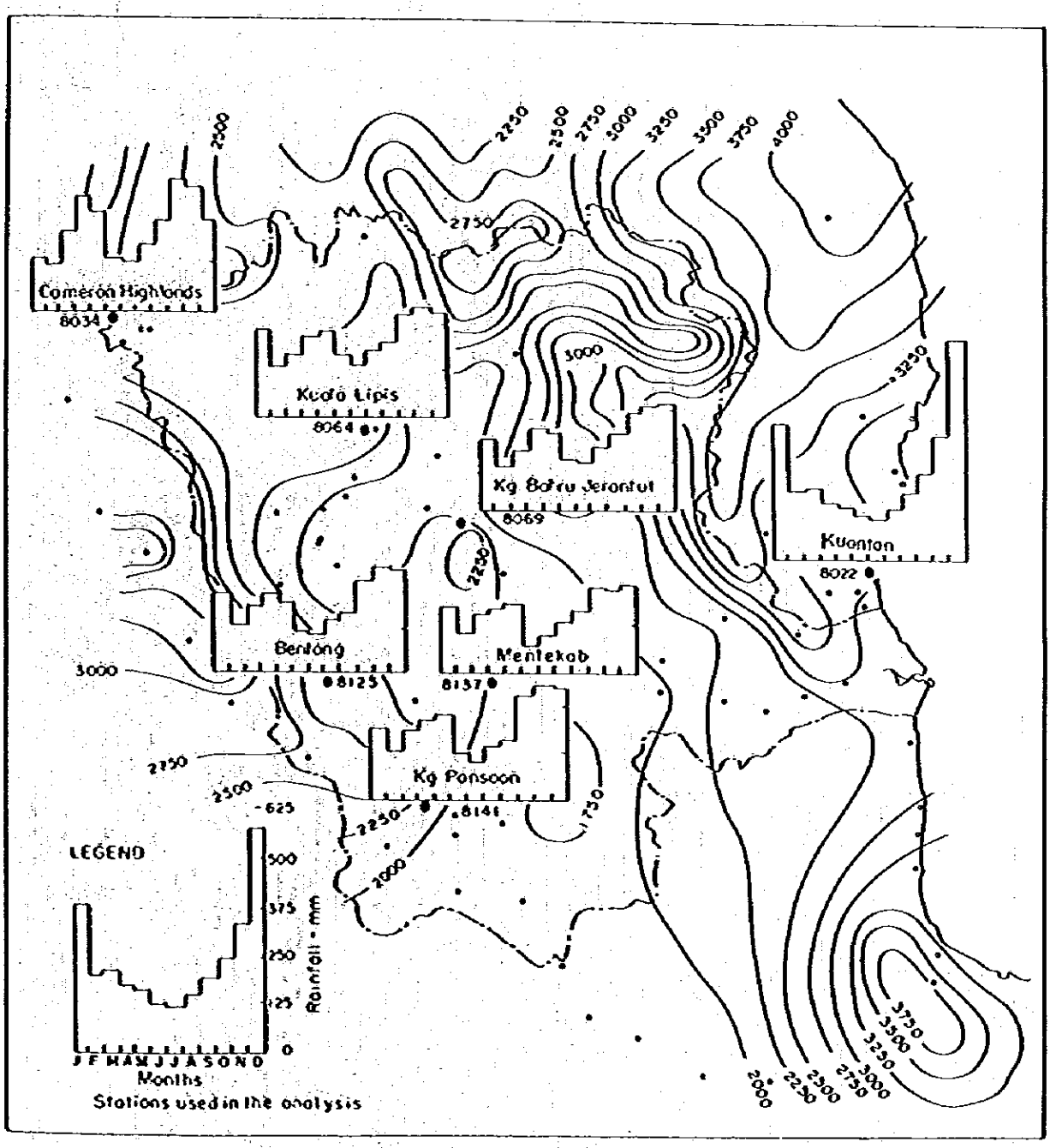
Fig. 7-1 Locations of Meteorological Stations

Fig. 7-2 Typical Seasonal Rainfall Pattern of Each Region



(Source Dale W. L, the Rainfall of Malaya, 1959)

Fig. 7-3 Average Annual Rainfall Distribution for the Pahang River Basin, and Distributions at Typical Stations



(Source; 3.2.2, Vol.3, Pahang River Basin Study)

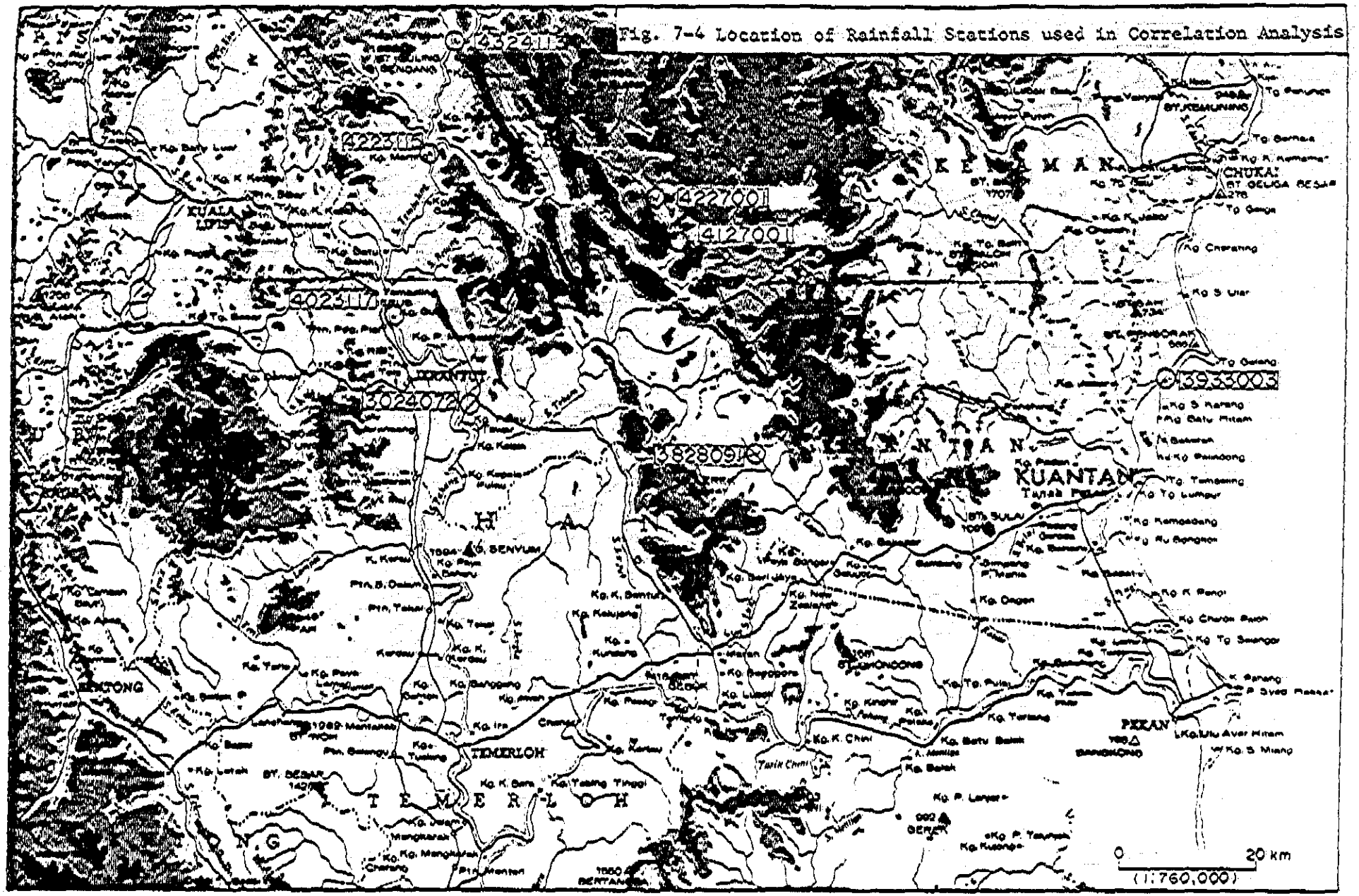
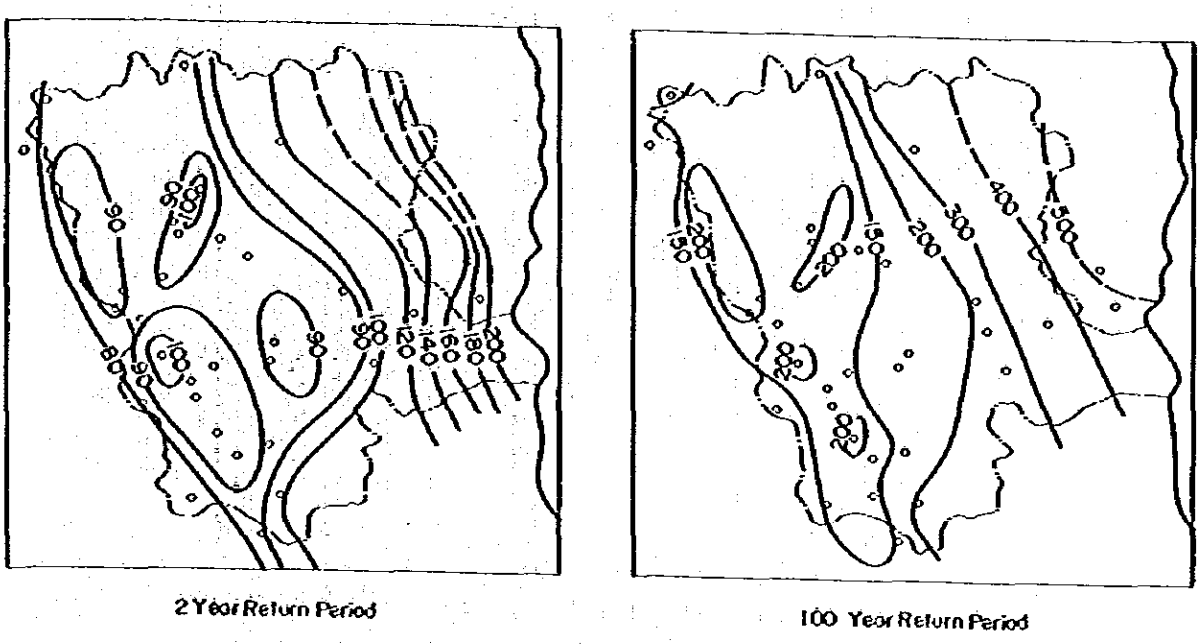
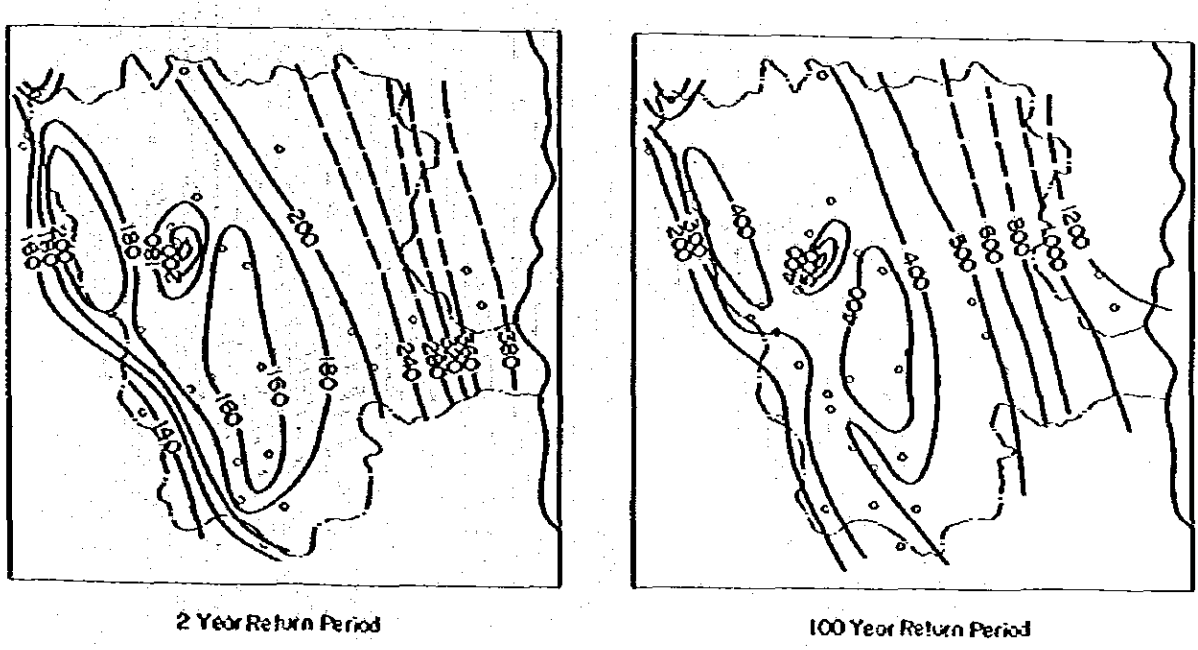


Fig. 7-4 Location of Rainfall Stations used in Correlation Analysis

Fig. 7-5 Spatial Distribution of Rainfall



1 Day Maximum Rainfall



5 Day Maximum Rainfall

LEGEND

——— Isohyet in millimetres

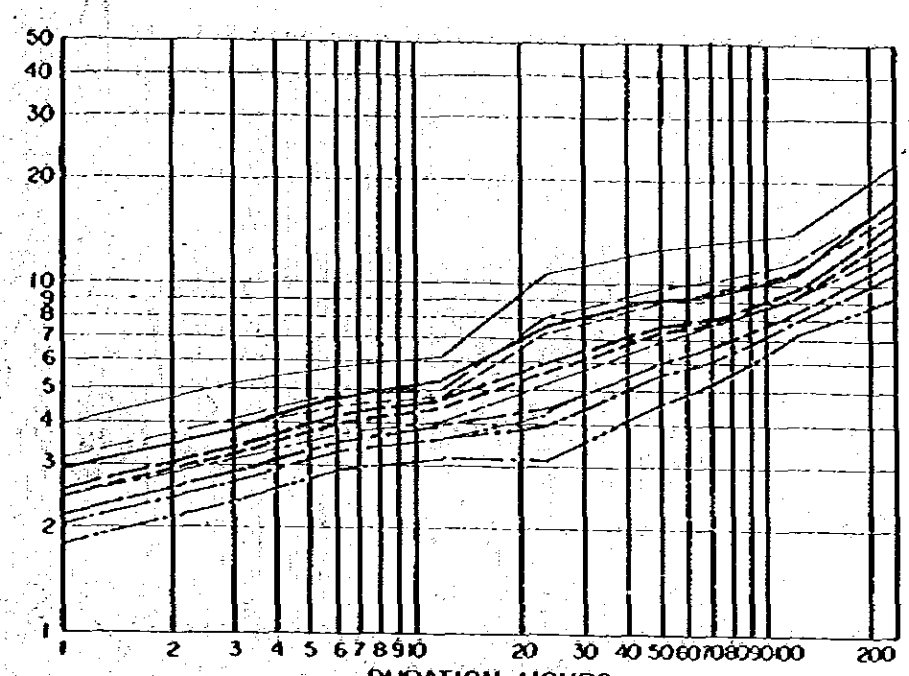
– – – Approximate isohyet

° Position of stations used in analysis

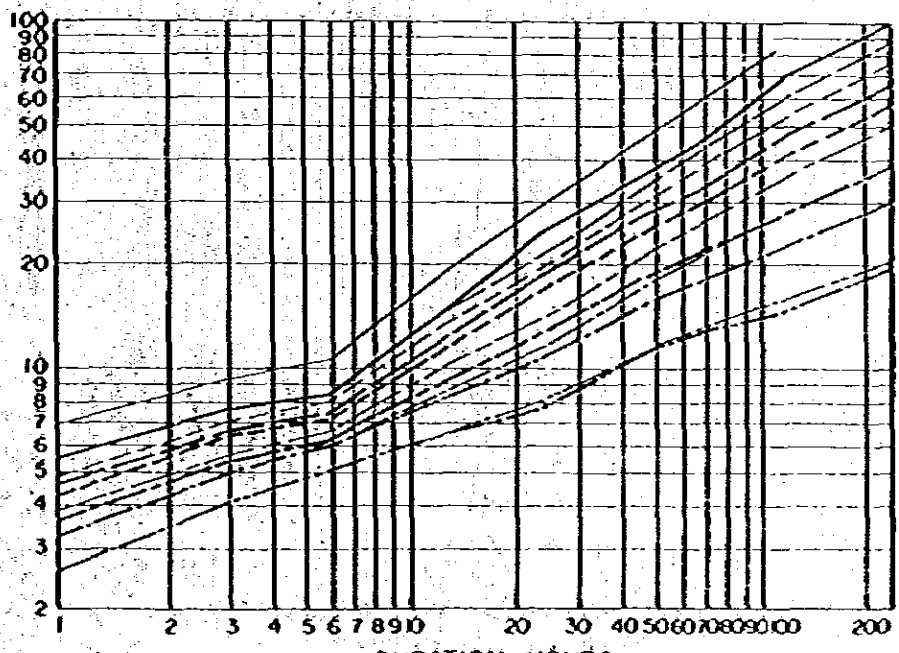
—·— Pahang River Basin Boundary

(Source; 3.2.6, Vol.3, Pahang River Basin Study)

Fig. 7-6 Rainfall Depth-Duration Frequency Curves



CAMERON HIGHLANDS



KUANTAN

LEGEND

RETURN PERIOD (Years)	LOG NORMAL DISTRIBUTION	GUMBEL DISTRIBUTION
10000	———	———
1000	— — —	— — —
100	- - - - -	- - - - -
50	— - — -	— - — -
10	— · — ·	— · — ·
5	— · · — · ·	— · · — · ·

Source; Ex.8, Vol.3, Pahang River Basin Study

Fig. 7-7 Gauging Stations used in checking the Rating Curves

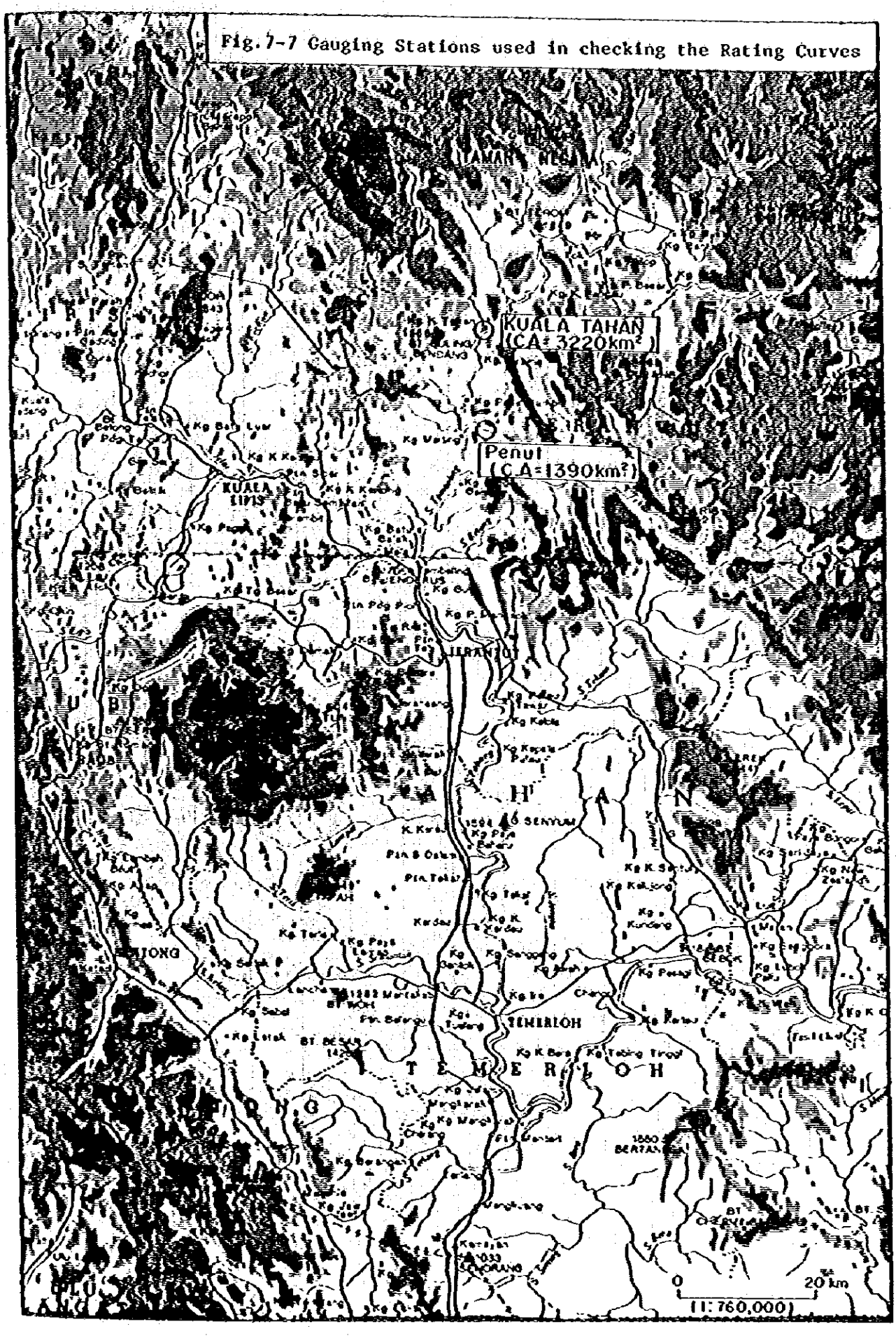


Fig. 7-8 Streamflow Record at Penut and Kuala Tahan

Streamflow Records at Penut

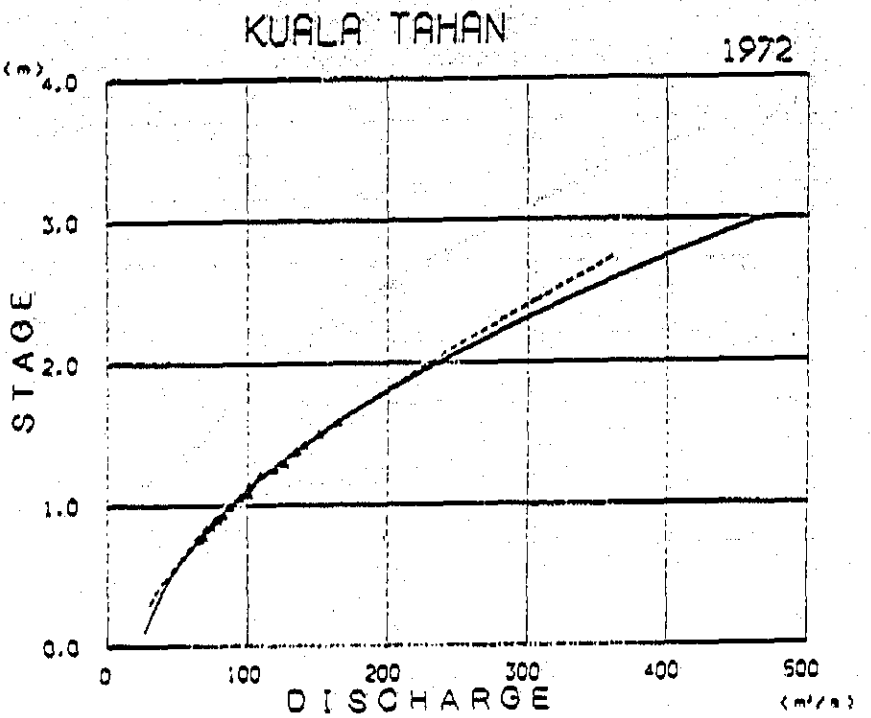
(C.A=1390km²)

Year \ Month	1	2	3	4	5	6	7	8	9	10	11	12
1972												
1973												
1974												
1975												
1976												
1977												
1978												
1979												
1980												

Streamflow Records at Kuala Tahan

(C.A=3220km²)

Year \ Month	1	2	3	4	5	6	7	8	9	10	11	12
1972												
1973												
1974												
1975												
1976												
1977												
1978												
1979												
1980												



KUALA YAHAN YEAR : 1972

(1) OBSERVATION

H	Q	H	Q
1.50	151.00	0.86	74.70
1.21	109.00	0.79	68.90
1.29	126.00	1.37	134.00
1.38	135.00	0.90	79.30
1.58	165.00	1.13	101.00
1.42	140.00	1.08	101.00
0.99	87.80	0.91	77.50
0.93	83.00	0.84	70.80
1.25	119.00	0.76	66.30
1.06	95.10		

(2) H-Q TABLE

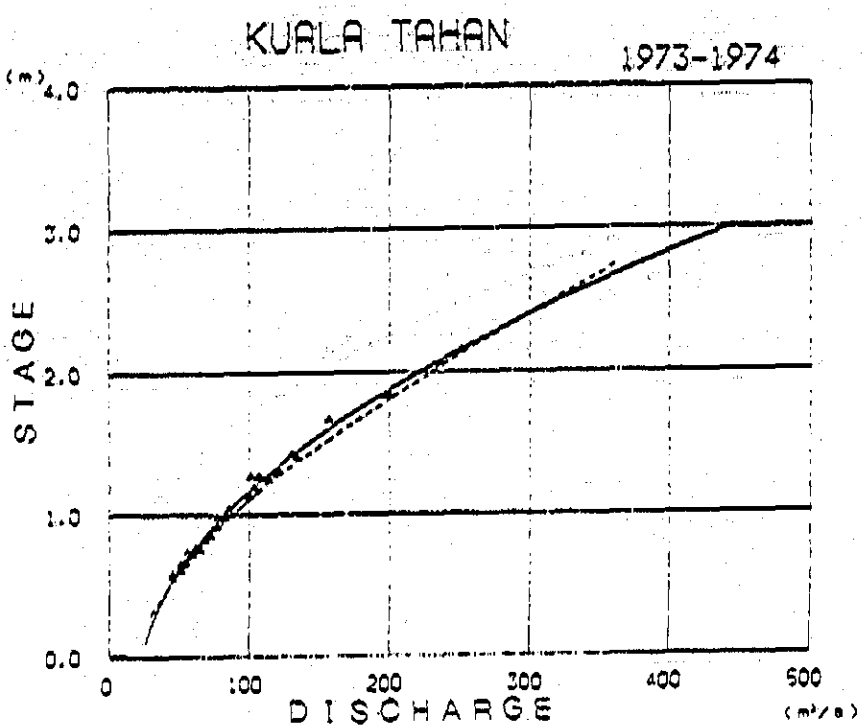
H	Q	H	Q
0.30	30.16	1.28	120.64
0.46	40.36	1.37	133.67
0.61	51.68	1.46	147.26
0.76	63.44	1.52	155.76
0.91	78.30	1.83	202.49
0.98	84.96	2.13	252.05
1.07	95.16	2.44	305.86
1.16	105.35	2.74	362.50
1.22	112.71		

(3) H-Q EQUATION

Q= 41.660*H*H+ 22.773*H+ 24.306

H	Q	H	Q
0.20	30.53	1.50	152.20
0.40	40.08	2.00	236.49
0.60	52.97	2.50	341.61
0.80	69.19	3.00	467.57
1.00	88.74	3.50	614.35
1.20	111.62		

Fig. 7-9 Rating Curve (Kuala Tahan 1972)



KUALA TAHAN YEAR : 1973-1974

(1) OBSERVATION

H	Q	H	Q
0.66	53.40	0.83	68.40
0.65	50.40	0.73	59.60
0.61	51.50	0.86	72.70
0.76	64.30	1.31	121.00
1.85	199.00	0.77	61.10
1.20	103.00	0.56	45.20
2.07	236.00	1.14	99.70
1.68	157.00	0.98	82.70
1.05	85.00	0.99	77.00
0.74	55.40	1.00	82.60
1.28	107.00	1.30	120.00
0.58	44.90	1.26	114.00
1.43	131.00	1.28	101.00
1.43	130.00	2.16	251.00
1.31	120.00	1.41	134.00
1.85	197.00	0.92	77.00
0.67	54.40		

(2) H-Q TABLE

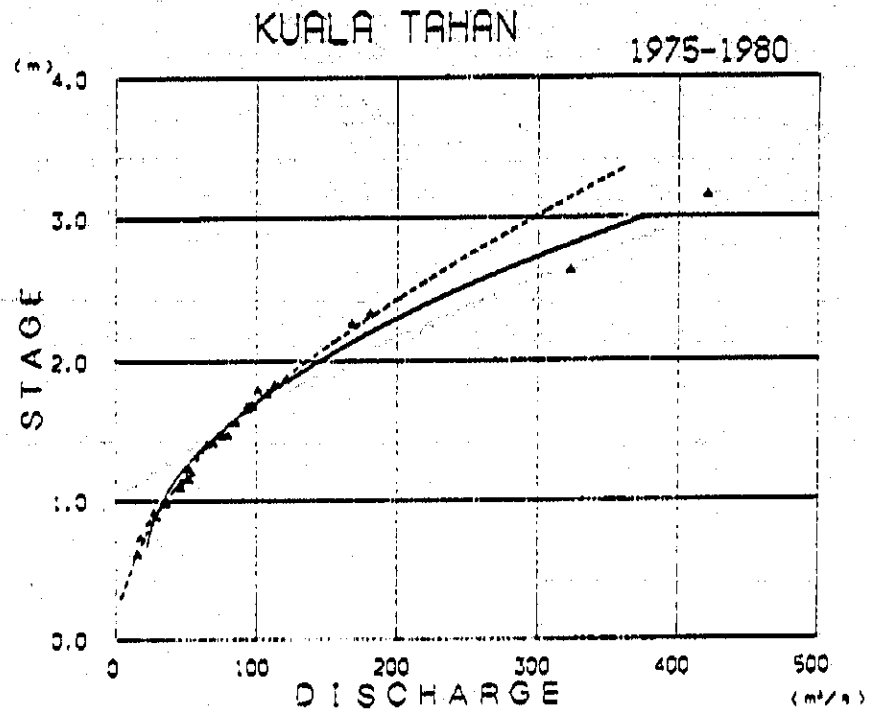
H	Q	H	Q
0.30	30.16	1.28	120.64
0.46	40.36	1.37	133.67
0.61	51.68	1.46	147.26
0.76	63.44	1.52	155.76
0.91	78.30	1.83	202.49
0.98	84.96	2.13	252.05
1.07	95.16	2.44	305.86
1.16	105.35	2.74	362.50
1.22	112.71		

(3) H-Q EQUATION

$Q = 40.911*H*H + 16.683*H + 24.45$

H	Q	H	Q
0.20	29.42	1.50	141.52
0.40	37.67	2.00	221.46
0.60	49.19	2.50	321.85
0.80	63.98	3.00	442.70
1.00	82.04	3.50	584.00
1.20	103.38		

Fig. 7-10 Rating Curve (Kuala Tahan 1973-1974)



KUALA TAHAN YEAR : 1975-1980

(1) OBSERVATION

H	Q	H	Q
2.63	323.00	1.80	101.00
3.16	421.00	1.69	93.50
1.66	94.60	1.14	46.40
1.47	75.80	0.74	17.70
1.57	85.40	0.92	27.30
1.42	69.40	0.92	26.70
1.42	64.80	0.85	24.20
1.88	121.00	1.23	51.80
1.49	76.20	1.17	51.00
2.33	181.00	1.00	35.40
2.26	168.00	1.16	52.10
1.77	108.00	1.10	46.30
1.68	95.80	1.78	108.00
0.89	28.70	1.21	53.00
0.62	15.50	1.48	79.50
0.62	14.90	0.98	35.90
1.43	69.30	1.69	97.30
1.84	113.00		

(2) H-Q TABLE

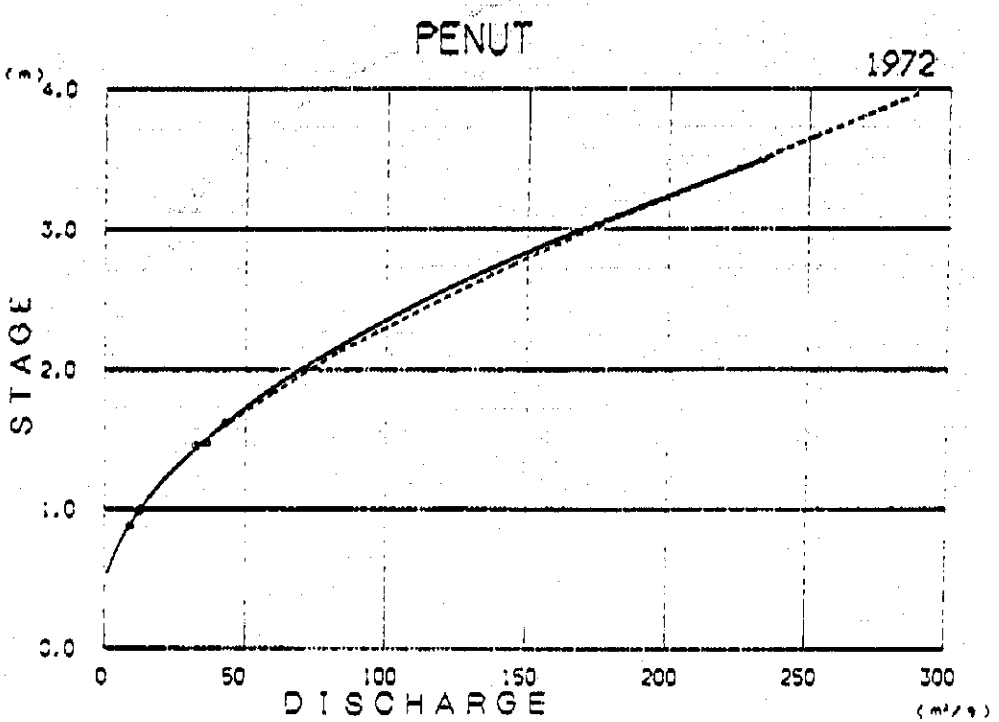
H	Q	H	Q
0.30	4.25	1.68	95.16
0.61	14.73	1.83	112.71
0.76	21.81	1.98	133.67
0.91	30.16	2.13	155.76
1.07	40.36	2.44	202.49
1.22	51.68	2.74	252.05
1.37	63.44	3.05	305.86
1.52	78.30	3.35	362.50

(3) H-Q EQUATION

$Q = 60.004*H*H - 68.296*H + 41.597$

H	Q	H	Q
0.20	30.34	1.50	74.16
0.40	23.88	2.00	145.02
0.60	22.22	2.50	245.88
0.80	25.36	3.00	376.74
1.00	33.30	3.50	537.60
1.20	46.05		

Fig. 7-11 Rating Curve (Kuala Tahan 1975-1980)



PENUT YEAR = 1972

(1) OBSERVATION

H	Q	H	Q
1.00	13.00	0.99	12.30
1.00	12.70	0.98	12.00
1.48	36.20	0.88	9.10
1.46	32.40	1.62	42.70
0.98	12.20		

(2) H-Q TABLE

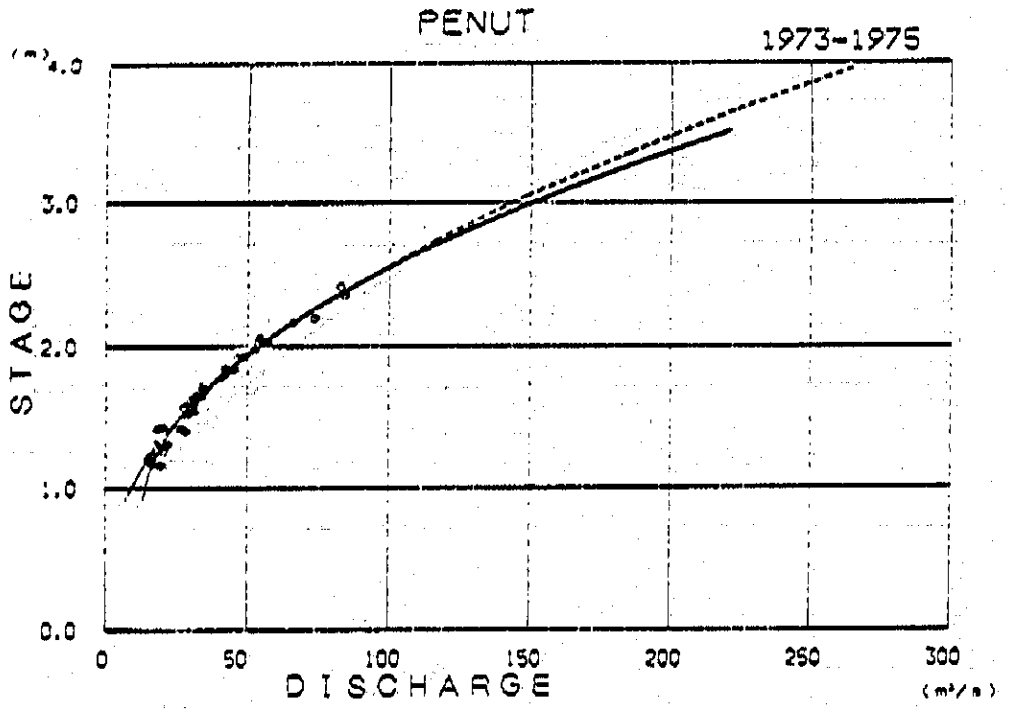
H	Q	H	Q
0.88	9.35	1.34	27.19
0.91	10.20	1.37	28.89
0.94	11.04	1.40	30.59
0.98	12.04	1.43	32.28
1.01	13.03	1.46	33.98
1.04	14.16	1.49	35.68
1.07	15.29	1.52	37.38
1.10	16.43	1.83	59.47
1.13	17.56	2.13	83.54
1.16	18.69	2.44	113.28
1.19	19.82	2.74	144.43
1.22	21.10	3.05	178.42
1.25	22.37	3.35	215.23
1.28	24.07	3.66	252.05
1.31	25.49	3.96	288.86

(3) H-Q EQUATION

$Q = 21.597*H**H** - 8.010*H** - 0.752$

H	Q	H	Q
0.20	-1.49	1.50	35.83
0.40	-0.50	2.00	69.62
0.60	2.22	2.50	114.20
0.80	6.66	3.00	169.59
1.00	12.84	3.50	235.77
1.20	20.74		

Fig. 7-12 Rating Curve (Penut 1972)



PENUT YEAR : 1973-1975

(1) OBSERVATION

H	Q	H	Q
1.311	21.801	1.311	17.901
1.161	19.401	1.651	34.001
1.261	20.501	1.811	42.401
1.401	28.201	1.681	33.401
1.171	16.401	1.701	35.601
1.421	26.701	1.981	52.901
1.521	28.801	1.721	33.901
1.541	31.201	2.031	53.901
1.211	15.001	2.061	54.401
1.241	16.501	2.421	82.901
2.361	84.401	1.921	46.801
2.171	66.201	1.571	27.601
2.031	57.401	1.431	20.401
1.931	48.901	1.621	30.001
2.201	73.701	1.551	30.401
1.841	45.501	1.841	42.601
1.601	31.401	1.421	18.501
1.781	40.901	1.651	31.701
1.571	30.701	1.851	42.201

(2) H-Q TABLE

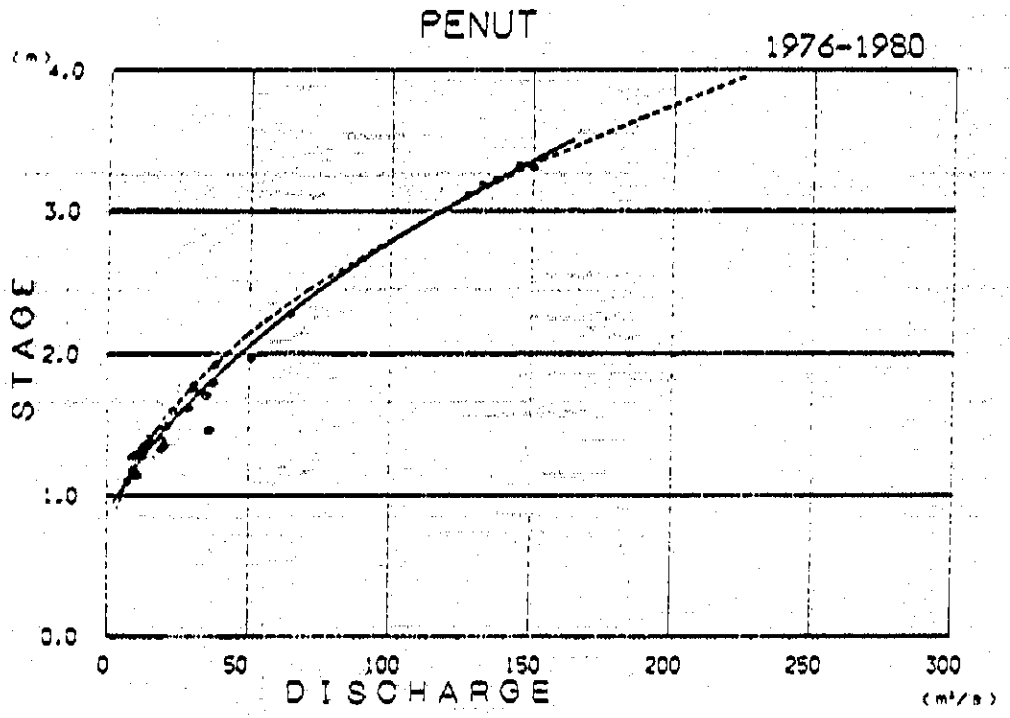
H	Q	H	Q
0.911	7.361	1.371	20.871
0.941	8.011	1.401	22.121
0.981	8.671	1.431	23.361
1.011	9.401	1.461	24.641
1.041	10.201	1.491	25.911
1.071	11.021	1.521	27.191
1.101	11.841	1.831	43.051
1.131	12.691	2.131	63.441
1.161	13.541	2.441	89.211
1.191	14.411	2.741	116.401
1.221	15.351	3.051	148.681
1.251	16.341	3.351	185.501
1.281	17.391	3.661	225.731
1.311	18.491	3.961	266.211
1.341	19.651		

(3) H-Q EQUATION

Q= 28.896*H*H*H-47.408*H* 32.708

H	Q	H	Q
0.201	24.381	1.501	26.611
0.401	18.371	2.001	53.481
0.601	14.671	2.501	94.791
0.801	13.281	3.001	150.551
1.001	14.201	3.501	220.761
1.201	17.431		

Fig. 7-13 Rating Curve (Penut 1973-1975)



PENUT YEAR : 1976-1980

(1) OBSERVATION

H	Q	H	Q
1.46	35.90	1.18	8.90
1.14	9.80	1.28	11.00
1.14	10.60	1.92	38.00
1.33	19.30	1.78	30.40
1.35	19.90	1.33	12.70
1.39	19.70	1.60	23.20
1.17	10.00	1.30	11.40
1.97	50.60	1.27	8.90
1.62	28.50	1.35	13.50
1.71	34.70	1.29	10.30
1.80	37.40	1.75	30.40
3.22	137.00	1.35	12.70
3.11	127.00	2.28	64.60
3.31	150.00	1.40	14.90
3.32	145.00	1.46	18.50
3.18	132.00	1.29	12.70
1.28	12.60	1.49	20.80
1.10	7.10		

(2) H-Q TABLE

H	Q	H	Q
0.91	3.96	1.37	14.30
0.94	4.39	1.40	15.29
0.98	4.81	1.43	16.28
1.01	5.32	1.46	17.28
1.04	5.86	1.49	18.27
1.07	6.43	1.52	19.26
1.10	7.00	1.83	32.57
1.13	7.59	2.13	49.28
1.16	8.21	2.44	70.80
1.19	8.98	2.74	95.16
1.22	9.74	3.05	122.34
1.25	10.54	3.35	152.93
1.28	11.33	3.66	188.33
1.31	12.32	3.96	226.56
1.34	13.31		

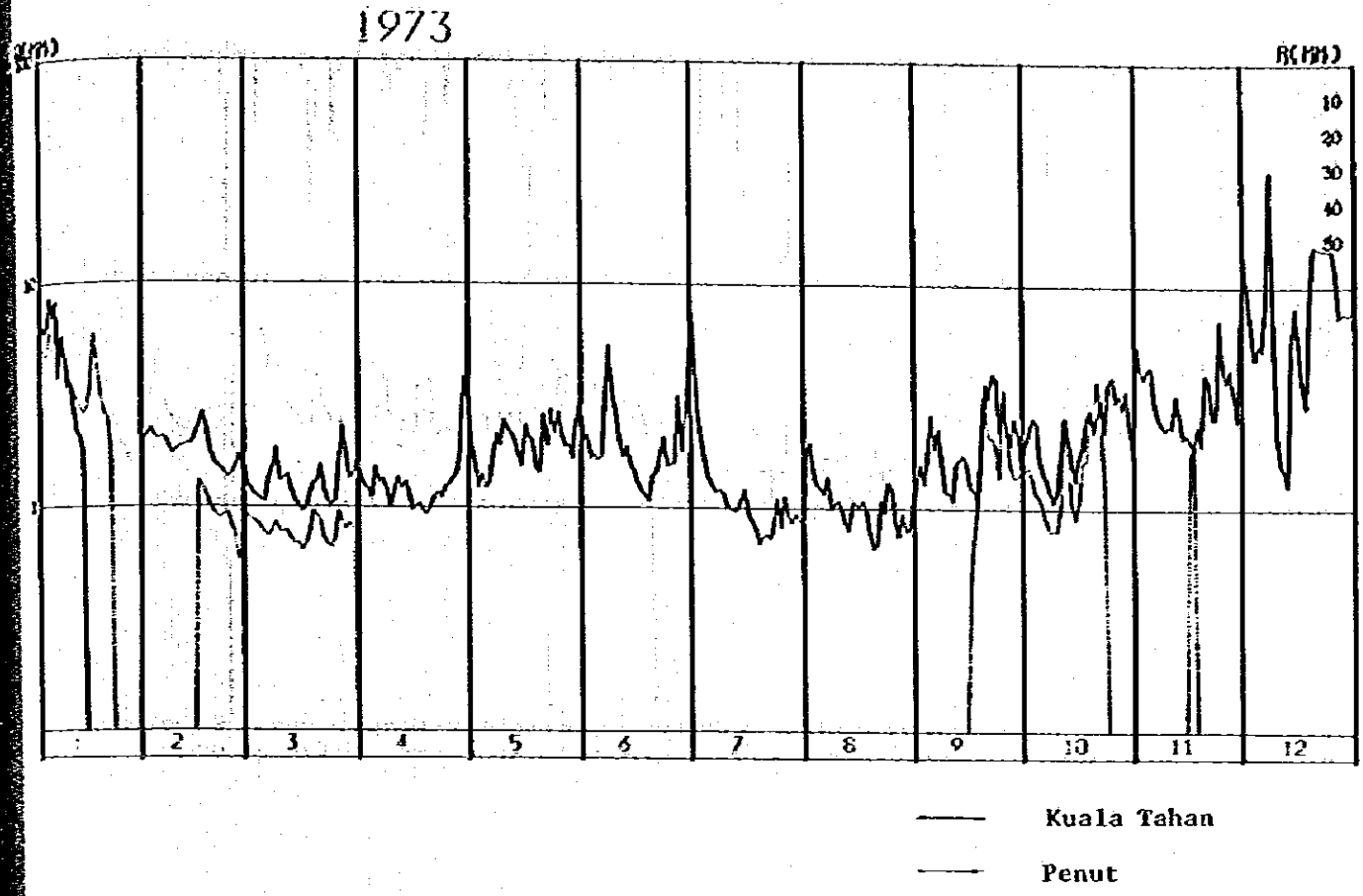
(3) H-Q EQUATION

Q= 14.059*H*H+ 0.831*H-10.955

H	Q	H	Q
0.20	-10.23	1.50	21.92
0.40	-8.37	2.00	46.94
0.60	-5.40	2.50	78.99
0.80	-1.29	3.00	118.07
1.00	3.93	3.50	164.17
1.20	10.29		

Fig. 7-14 Rating Curve (Penut 1976-1980)

Fig. 7-15 Discharge Comparison in Kuala Tahan and Penut (1973/74)



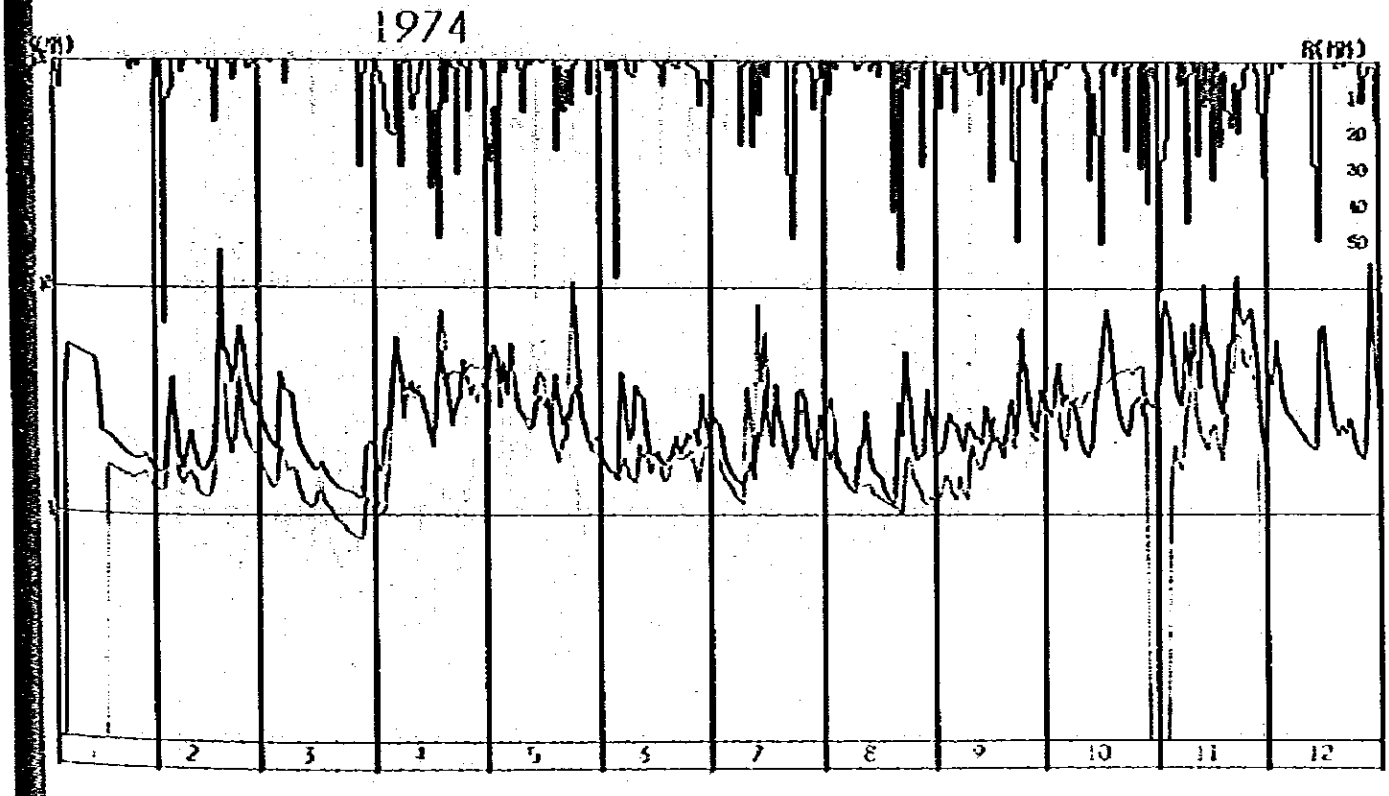


Fig. 7-16 Discharge Comparison in Kuala Tahan and Penut (1975/76)

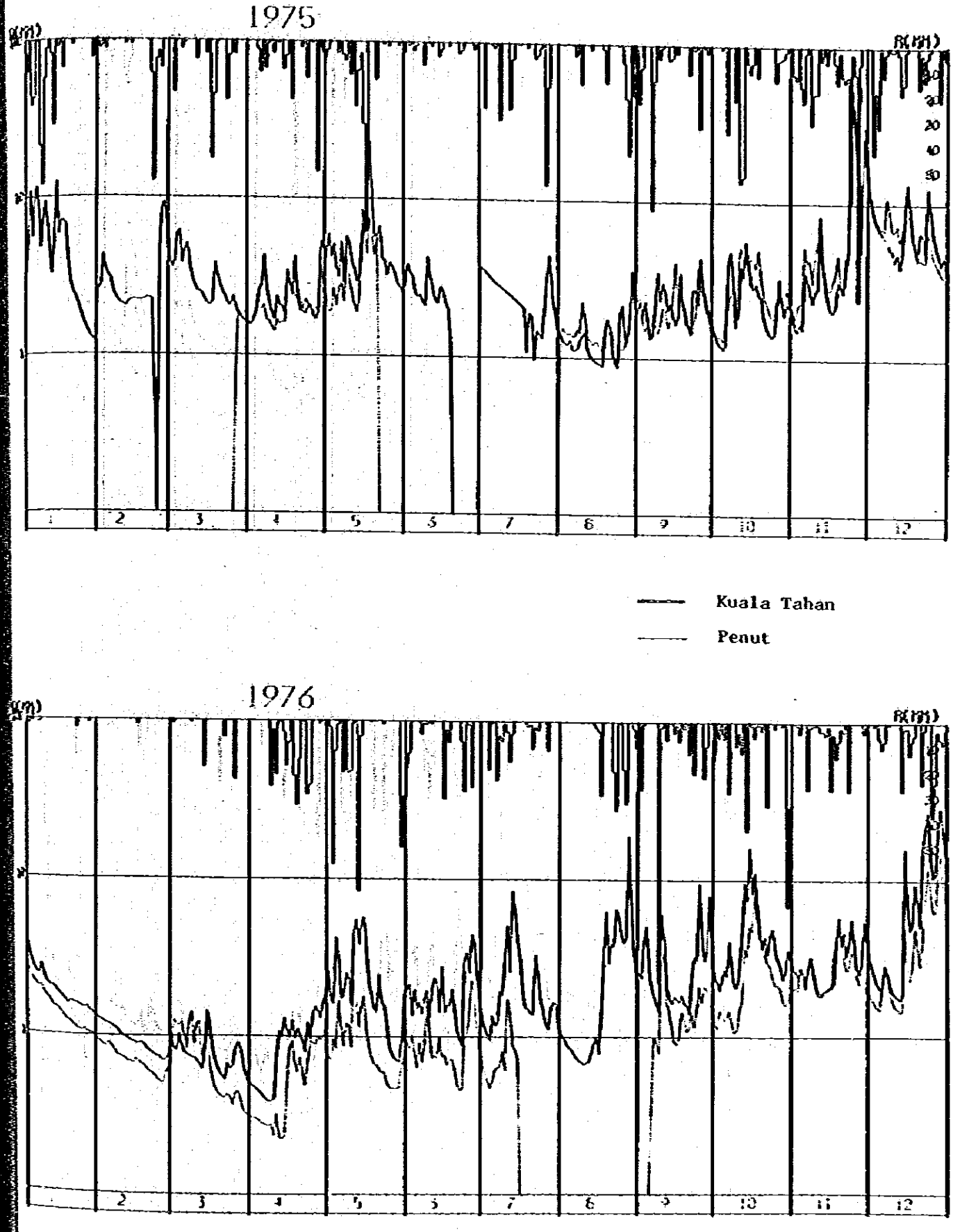


Fig. 7-17 Discharge Comparison in Kuala Tahan and Penut (1977/78)

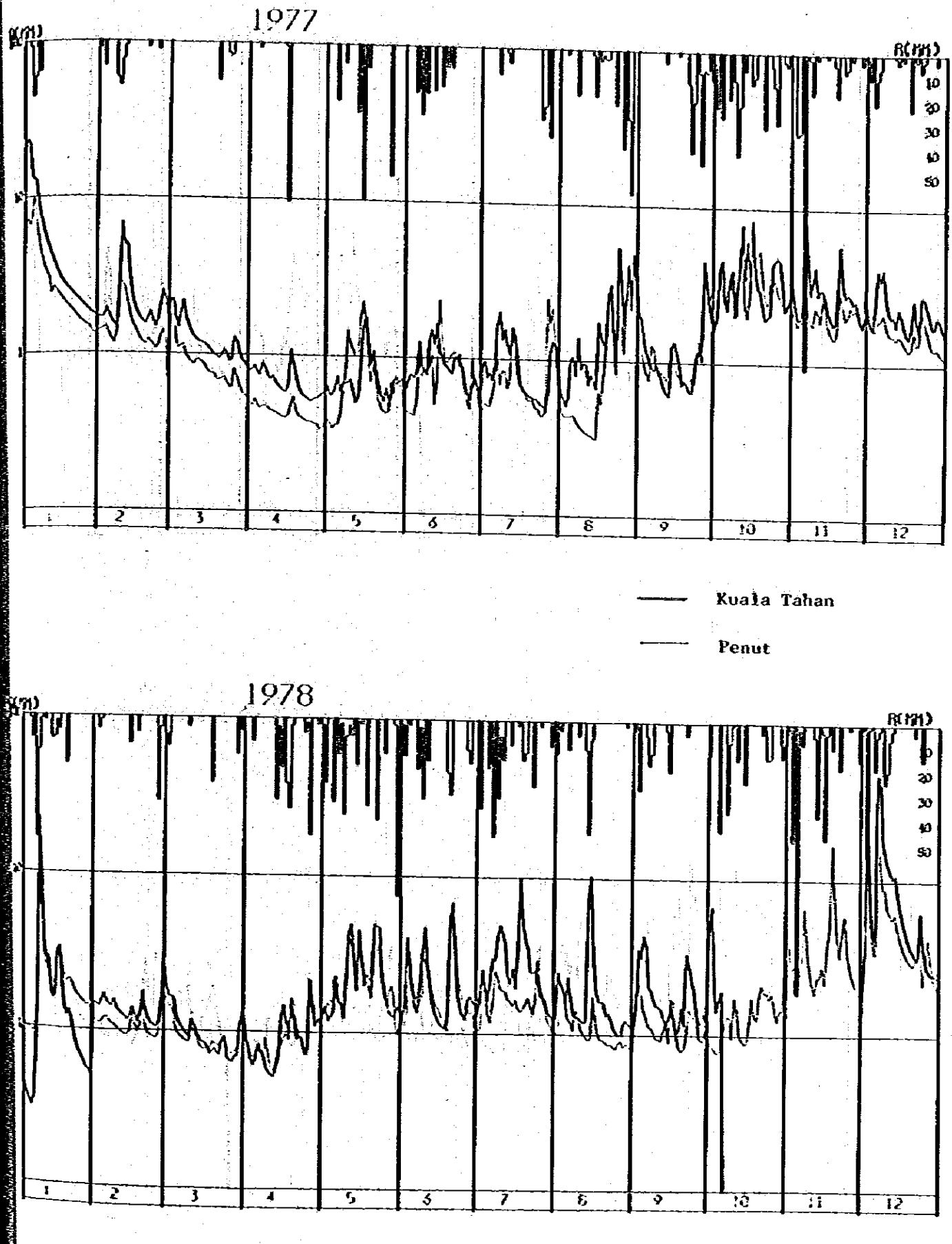


Fig. 7-18 Discharge Comparison in Kuala Tahan and Penut (1979/80)

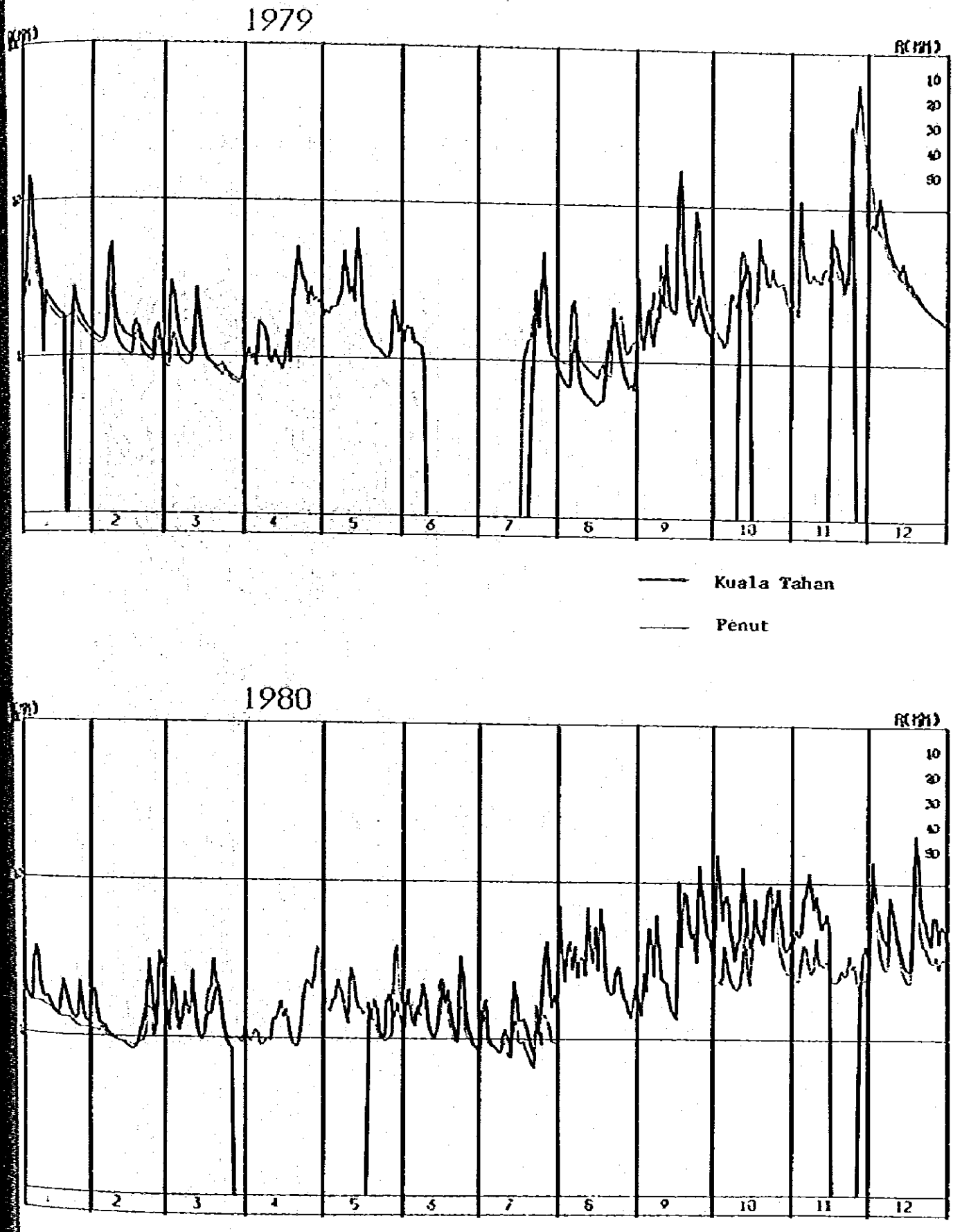
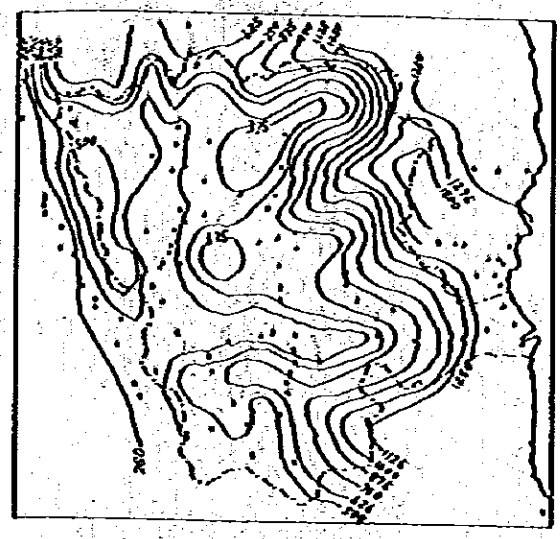


Fig. 7-19 Storm Rainfall Distribution



20 December - 5January
1971

11 December - 23 December
1972

Note:All Isohyetsare in Millimeters

(Source; 3.2.6, Vol.3, Pahang River Basin Study)

Fig. 7-20 Discharge Stations used in Derivation and Checking the Regional Flood Frequency Procedure

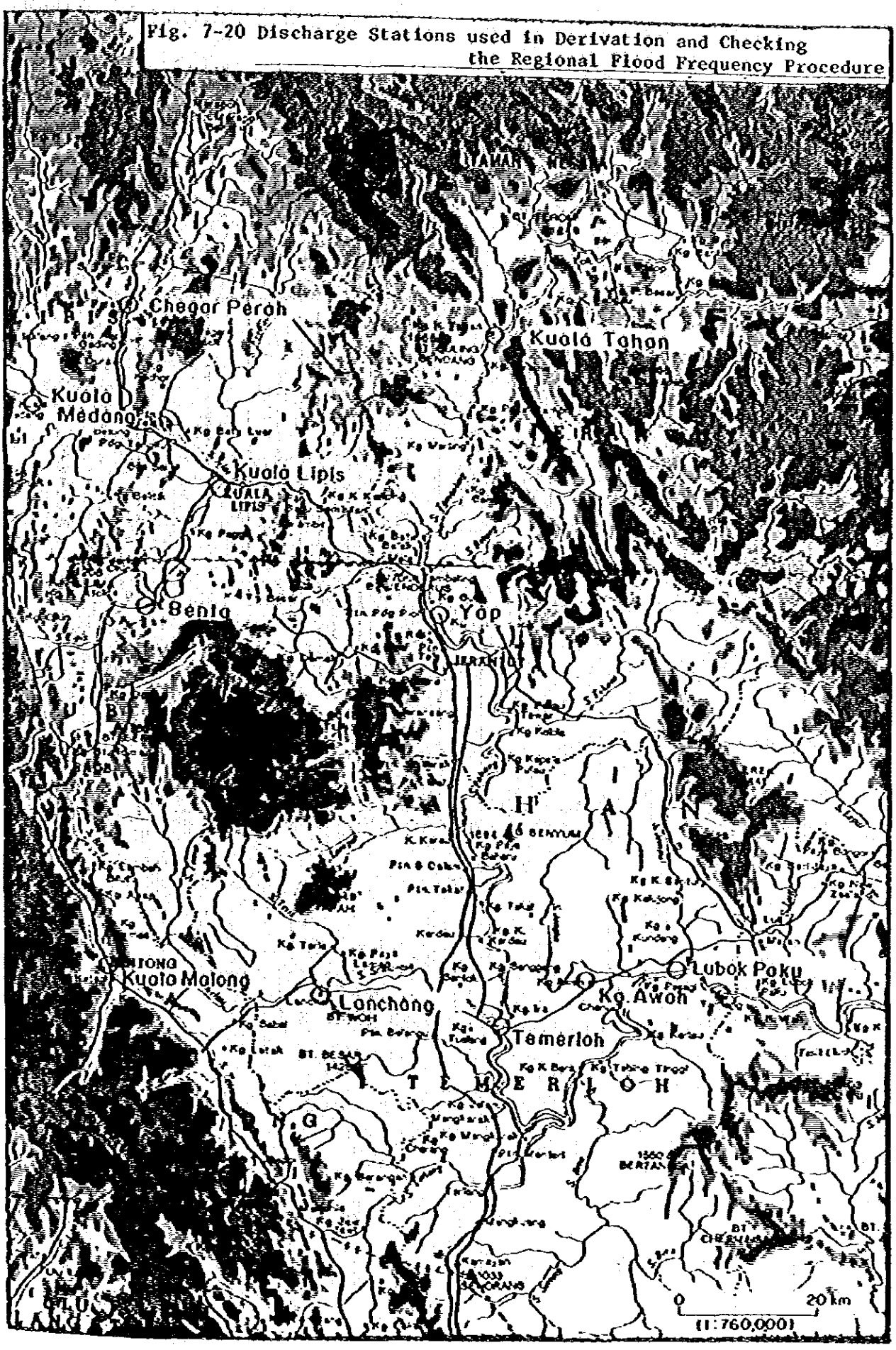
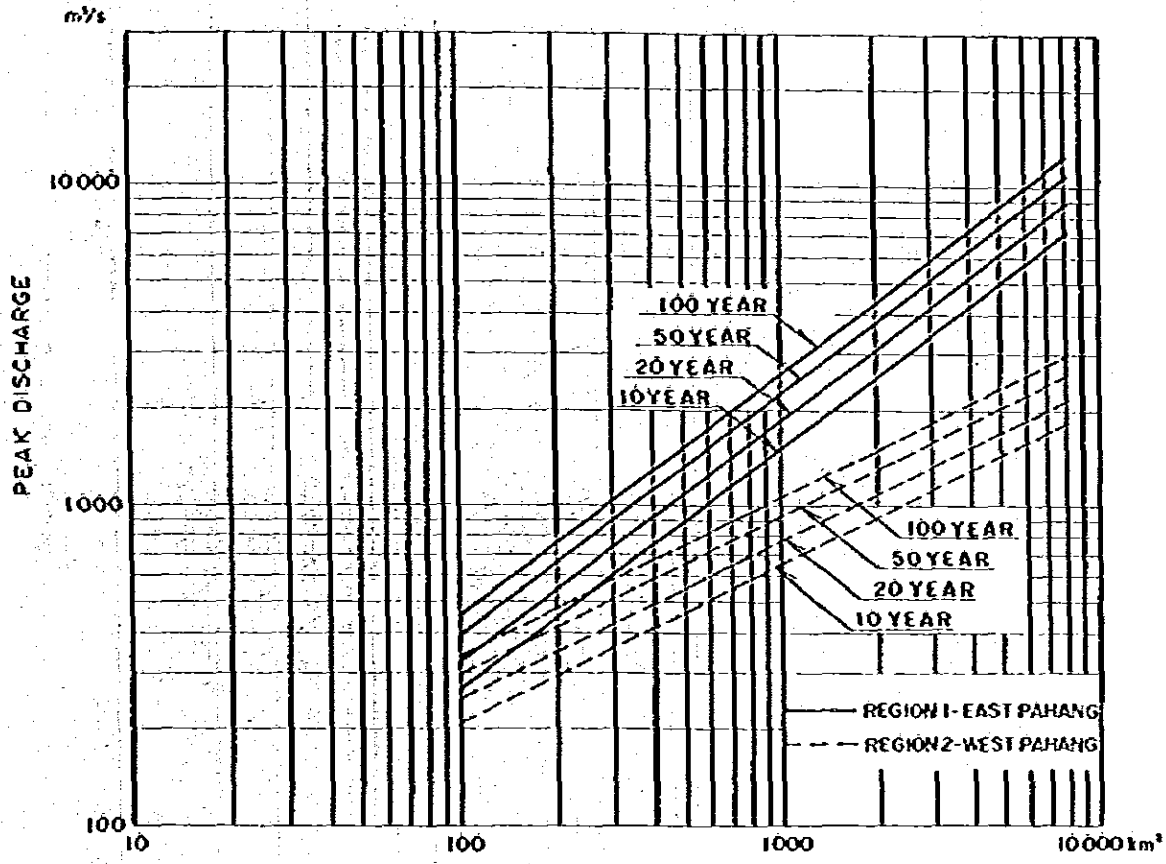
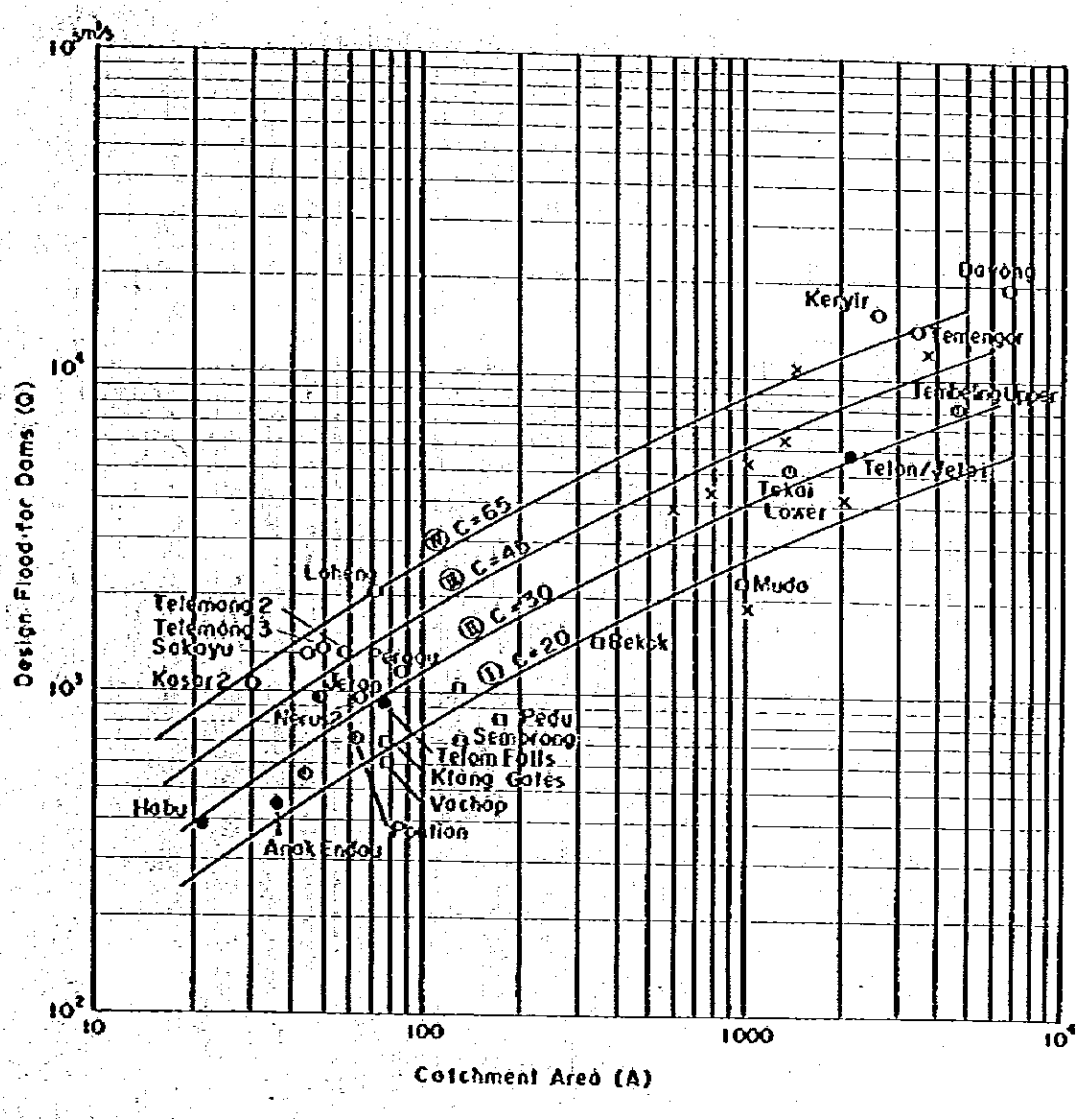


Fig. 7-21 Resional Flood Frequency Curves



(Source; Ex.12, Vol.3, Pahang River Basin Study)

Fig. 7-22 Design Flood Envelope Curves



① o West coast
Ⓑ • Johor of Pahang - West
Ⓔ o Pahang - East
Ⓦ o Kelantan, Trenggoru, Perak-North
× Projects in other S.E. Asia countries
C Creager's value

(Source; 3.5.13, Vol.3, Pahang River Basin Study)

Fig. 7-23 gauging Stations with Sediment Data

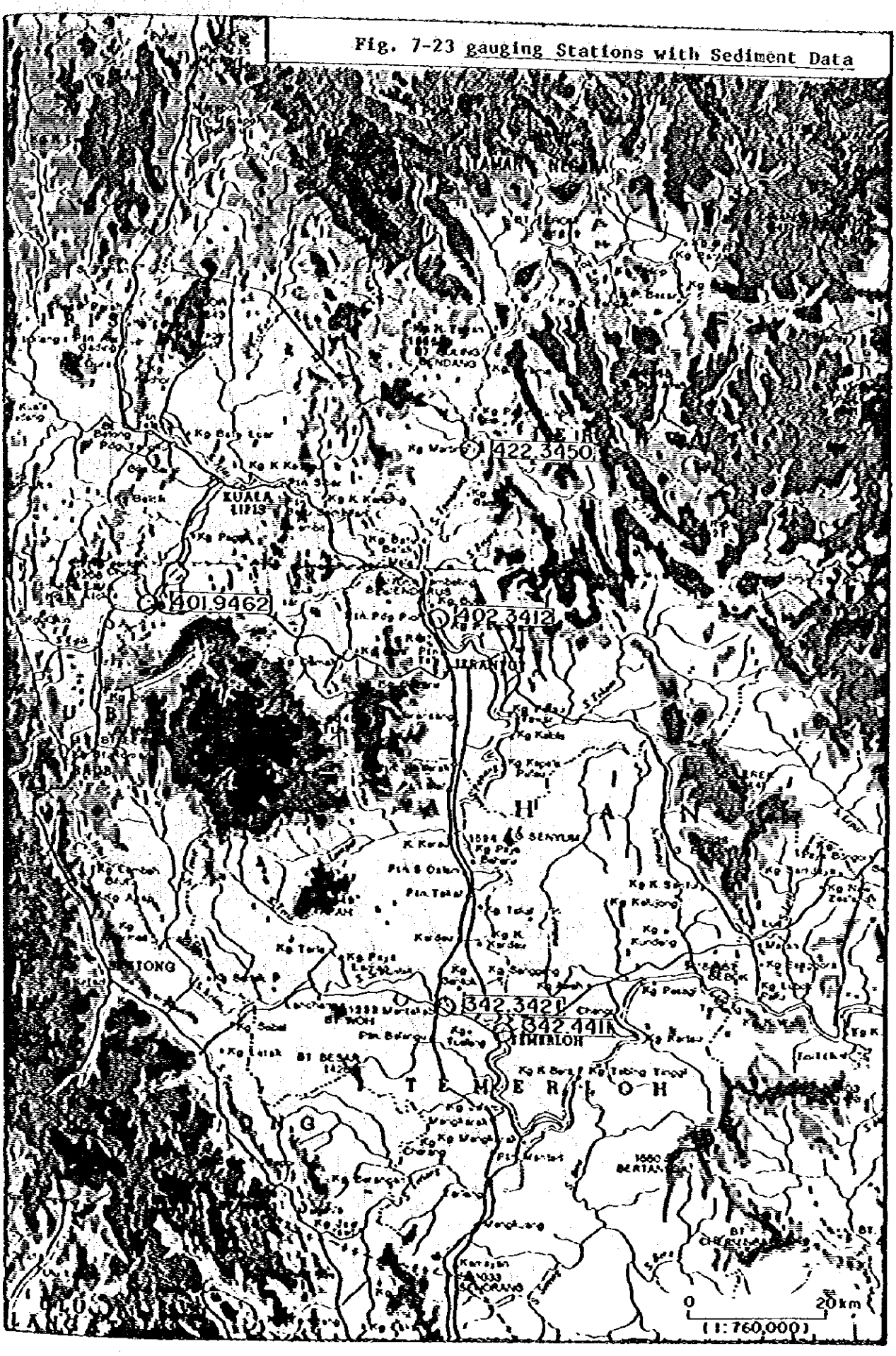
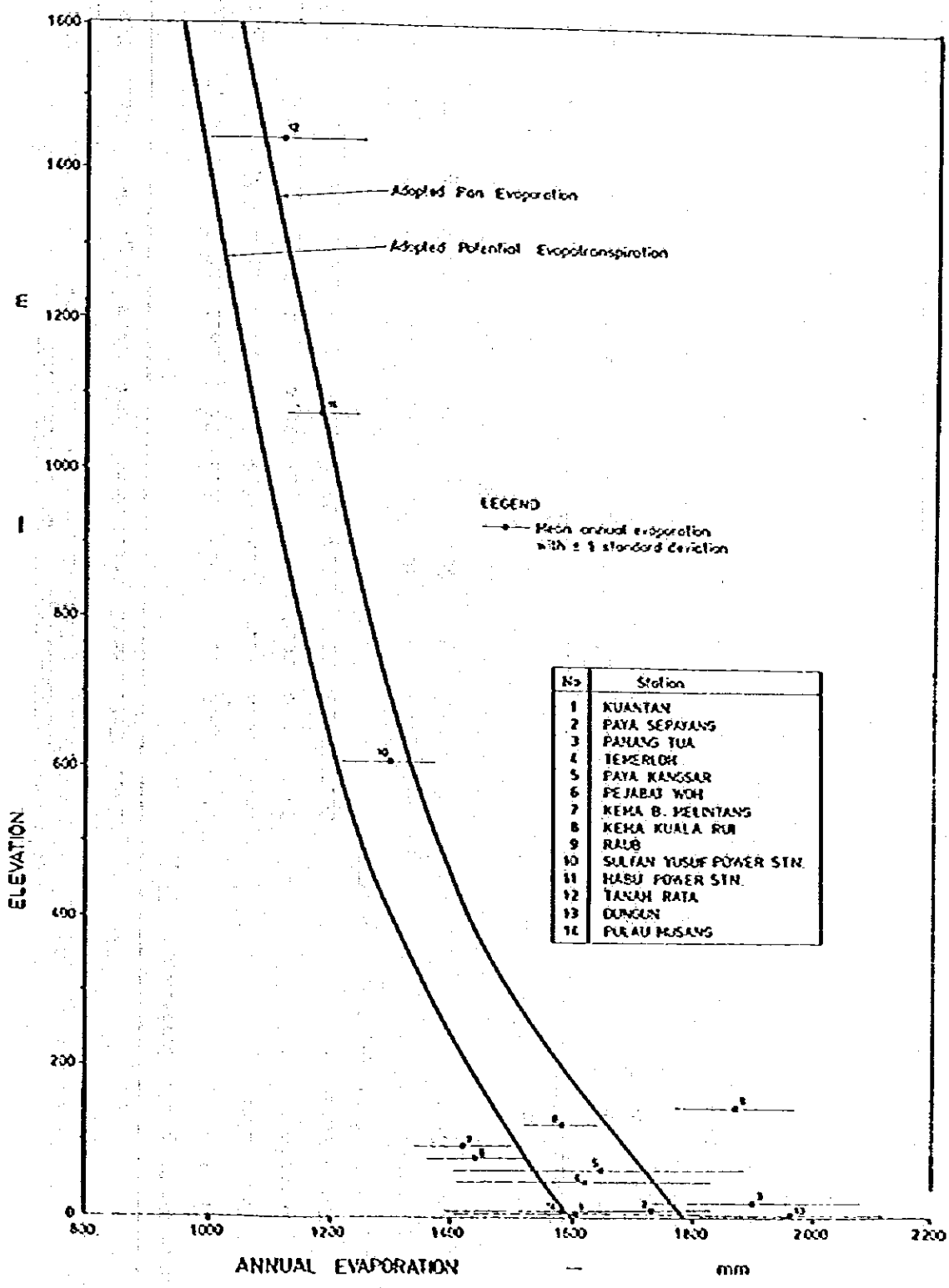


Fig. 7-24 Evaporation Elevation Relationship



(Source; 3.3.1, Vol.3, Pahang River Basin Study)

Table 7-1 General Meteorological Condition

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean Monthly Air Temperature (°C)												
Kuantan	24.5	25.0	25.7	26.4	26.6	26.5	26.1	26.0	26.0	25.7	25.0	24.4
Kuala Lipis	24.0	24.8	25.6	26.2	25.9	25.6	25.6	25.4	25.5	25.4	25.2	24.6
Temerloh	24.6	25.0	26.0	26.9	26.8	26.4	26.4	26.3	26.2	26.2	26.0	25.4
Kuala Tahan	24.1	24.9	25.7	27.0	27.1	27.0	26.6	26.4	26.2	26.1	25.8	25.1
Man Monthly Relative Humidity (%)												
Kuantan	88	87	86	86	87	86	86	86	86	87	90	90
Kuala Lipis	89	88	86	86	88	86	87	86	88	89	90	88
Temerloh	87	86	85	85	86	85	85	85	86	87	89	88
Mean Daily Sunshine Hours (Unit: h)												
Cameron Highlands	5.38	5.70	5.78	5.21	4.86	5.03	4.96	4.61	3.86	3.69	3.41	3.54
Kuantan	5.49	6.45	6.90	7.15	6.67	6.11	6.59	6.20	5.60	5.20	3.67	3.41
Mean Daily Wind Velocity (Unit: m/sec.)												
Kuantan	2.5	2.3	1.9	1.4	1.3	1.4	1.6	1.6	1.5	1.3	1.4	2.1
Kuala Tahan	0.41	0.42	0.46	0.41	0.38	0.33	0.39	0.37	0.34	0.33	0.28	0.30
Monthly Open Water Evaporation (Unit: mm)												
Cameron Highlands	101	102	118	110	102	102	104	101	101	97	90	87
Kuala Tahan	100	99	121	125	116	108	110	104	104	100	90	96
Kuantan	130	134	156	156	147	141	144	146	147	136	116	106

(Source; N.W.R.S. and NEB)

Table 7-2 Rainfall in the Pahang Basin in Period 1926 to 1973

Month	Rainfall (mm)															
	Kuantan				Mentekab				Cameron Highlands				Kuala Tahan			
	Mean	Min	Max	SD	Mean	Min	Max	SD	Mean	Min	Max	SD	Mean	Min	Max	SD
January	388	15.7	986	242	173	19.3	448	116	145	23.1	410	87	117.75	1.00	332.00	89.24
February	217	10.2	1,269	225	105	6.9	418	87	121	22.9	255	55	72.27	0.00	227.00	52.63
March	221	27.4	596	166	146	13.7	344	83	204	46.5	514	105	92.26	3.00	180.00	54.29
April	174	19.8	469	101	182	28.2	350	74	294	51.6	539	92	171.15	65.90	482.00	96.22
May	152	43.2	307	70	196	76.2	404	84	261	115.8	447	76	217.58	77.00	369.00	80.04
June	124	28.4	295	58	119	6.1	254	54	133	55.9	258	57	162.99	39.30	301.00	71.25
July	121	18.8	330	76	115	23.9	220	49	138	17.0	424	75	160.77	34.00	301.00	64.02
August	145	40.9	330	77	131	46.0	253	55	174	36.6	362	79	177.90	49.00	352.00	75.06
September	210	101.1	398	82	179	73.9	323	58	248	95.5	520	101	255.45	91.70	334.90	70.61
October	243	57.7	526	105	224	79.2	373	70	335	125.2	608	98	235.39	93.20	477.00	91.99
November	333	138.7	804	149	233	51.6	503	100	312	113.0	511	86	249.16	38.00	446.30	92.70
December	646	62.7	1,962	432	237	15.9	765	127	231	41.7	672	131	222.00	26.90	540.00	128.39
Annual	2,974	1,737	4,529	600	2,040	1,382	2,713	349	2,596	2,098	3,233	296	2,105	1,506	2,808	382
Statistics of Mean Monthly Values																
Mean			247.8				170.0				216.3				175.39	
Standard Deviation			149.3				46.9				74.9				57.81	
Coeff. of Variation			0.60				0.28				0.35				0.33	

Note: SD = Standard Deviation
Kuala Tahan, period 1960 to 1979

Table 7-4 Correlation Table

Y / X	3828001	3924072	3933003	4023117	4223115	4023001	4127001	4227001
4324113								
COR.COE.	0.552	0.717	0.508	0.651	0.735	0.558	0.455	0.623
REG. (A)	0.761	0.924	0.241	0.759	0.906	0.977	1.283	0.689
REG. (B)	49.09	1.46	114.33	49.31	20.94	19.12	-22.51	29.35
SAMPLE	120	120	117	119	119	67	23	31
4227001								
COR.COE.	0.643	0.712	0.351	0.671	0.562	0.708	0.945	
REG. (A)	1.222	1.395	1.762	1.242	1.431	1.134	2.638	
REG. (B)	9.69	-20.85	-90.20	10.75	-45.52	4.52	-198.33	
SAMPLE	31	31	30	30	31	28	7	
4127001								
COR.COE.	0.554	0.479	0.323	0.392	0.477	0.259		
REG. (A)	0.506	0.800	0.128	0.303	0.630	0.414		
REG. (B)	68.80	13.80	126.27	97.16	41.71	90.59		
SAMPLE	23	23	22	23	23	23		
4023001								
COR.COE.	0.564	0.633	0.354	0.557	0.515			
REG. (A)	0.771	1.079	0.219	0.739	0.883			
REG. (B)	27.96	-35.14	111.43	33.25	-3.95			
SAMPLE	67	67	65	66	67			
4223115								
COR.COE.	0.608	0.646	0.515	0.632				
REG. (A)	0.866	1.020	0.267	0.842				
REG. (B)	28.08	-21.50	103.35	30.85				
SAMPLE	119	119	116	118				
4023117								
COR.COE.	0.524	0.649	0.569					
REG. (A)	1.053	1.209	0.336					
REG. (B)	-7.73	-61.68	81.66					
SAMPLE	119	119	116					
3933003								
COR.COE.	0.535	0.534						
REG. (A)	3.225	3.681						
REG. (B)	-278.42	-440.18						
SAMPLE	117	117						
3924072								
COR.COE.	0.628							
REG. (A)	0.860							
REG. (B)	46.07							
SAMPLE	120							

Correlation Formula; Y = (A)X + (B)

Where,

Y; Rainfall at Y Station

X; Rainfall at X Station

COR.CORD; Correlation Coefficient

REG.(A); Variable (A)

REG.(B): Variable (B)

SAMPLE: Sample No.

Table 7-5 Correlation Table

CRDEP	1	2	3	4	5	6	7	8
4324113	4223115	3924072	4023117	4227001	4023001	3828091	3933003	4127001
COR.COE.	0.735	0.717	0.651	0.623	0.558	0.552	0.508	0.455
REG. (A)	0.906	0.924	0.759	0.689	0.977	0.761	0.241	1.283
REG. (B)	20.94	1.46	49.31	29.35	19.12	49.09	114.33	-22.51
SAMPLE	119	120	116	118	117	120	7	31
4227001	4127001	3924072	4023001	4023117	3828091	4324113	4223115	3933003
COR.COE.	0.945	0.712	0.708	0.671	0.643	0.623	0.562	0.351
REG. (A)	2.638	1.395	1.134	1.242	1.222	1.451	1.431	1.762
REG. (B)	-198.33	-20.85	4.52	10.75	9.69	-42.60	-45.52	-90.20
SAMPLE	7	31	30	31	31	30	7	31
4127001	4227001	3828091	3924072	4223115	4324113	4023117	3933003	4023001
COR.COE.	0.945	0.554	0.479	0.477	0.455	0.392	0.323	0.259
REG. (A)	0.379	0.506	0.800	0.630	0.779	0.303	0.128	0.414
REG. (B)	75.19	68.80	13.80	41.71	17.54	97.16	126.27	90.59
SAMPLE	7	23	23	23	22	30	7	31
4023001	4227001	3924072	3828091	4324113	4023117	4223115	3933003	4127001
COR.COE.	0.708	0.634	0.564	0.558	0.557	0.515	0.354	0.259
REG. (A)	0.882	1.079	0.771	1.023	0.739	0.883	0.219	2.418
REG. (B)	-3.98	-35.14	27.86	-19.56	33.25	-3.95	111.43	-219.04
SAMPLE	28	67	67	23	65	30	7	31
4223115	4324113	3924072	4023117	3828091	4227001	3933003	4023001	4127001
COR.COE.	0.735	0.646	0.632	0.608	0.562	0.515	0.515	0.477
REG. (A)	1.103	1.020	0.842	0.866	0.699	0.267	1.133	1.586
REG. (B)	-23.10	-21.50	30.85	28.08	31.82	103.35	4.47	-66.17
SAMPLE	119	119	67	119	65	30	7	31
4023117	4227001	4324113	3924072	4223115	3933003	4023001	3828091	4127001
COR.COE.	0.671	0.651	0.649	0.632	0.569	0.557	0.524	0.392
REG. (A)	0.805	1.317	1.209	1.188	0.336	1.354	1.053	3.300
REG. (B)	-8.66	-64.94	-61.68	-36.65	81.66	-45.00	-7.73	-320.60
SAMPLE	30	119	119	116	65	30	119	31
3933003	4023117	3828091	3924072	4223115	4324113	4023001	4227001	4127001
COR.COE.	0.569	0.535	0.534	0.515	0.508	0.354	0.351	0.323
REG. (A)	2.974	3.225	3.681	3.740	4.142	4.557	0.568	7.814
REG. (B)	-242.85	-278.42	-440.18	-386.51	-473.60	-507.72	51.20	-986.65
SAMPLE	116	117	22	116	65	30	119	31
3924072	4324113	4227001	4023117	4223115	4023001	3828091	3933003	4127001
COR.COE.	0.717	0.712	0.649	0.646	0.633	0.628	0.534	0.479
REG. (A)	1.093	0.717	0.827	0.980	0.927	0.860	0.272	1.250
REG. (B)	-1.58	14.95	51.02	21.08	32.58	46.07	119.60	-17.25
SAMPLE	120	31	119	116	65	120	119	31
3828091	4227001	3924072	4223115	4023001	4127001	4324113	3933003	4023117
COR.COE.	0.643	0.628	0.608	0.564	0.554	0.552	0.535	0.524
REG. (A)	0.818	1.163	1.155	1.298	1.975	1.313	0.310	0.950
REG. (B)	-7.93	-53.56	-32.43	-36.16	-135.87	-64.46	86.32	7.34
SAMPLE	31	120	119	116	65	117	119	31

Table 7-6 Monthly Rainfall at Kuala Tahan

(Unit: mm)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
134.0	98.0	143.0	145.0	307.0	67.0	94.0	240.0	323.0	125.0	294.0	123.0	1960
223.0	61.0	95.0	234.0	152.0	228.0	141.0	215.0	256.0	251.0	268.0	216.0	1961
102.0	118.0	161.0	154.0	134.0	283.0	111.0	142.0	319.0	205.0	194.0	239.0	1962
170.0	23.0	80.0	66.0	165.0	120.0	235.0	238.0	145.0	208.0	236.0	143.0	1963
115.0	69.0	120.0	88.0	294.0	150.0	301.0	103.0	229.0	245.0	247.0	146.0	1964
1.0	64.0	90.0	482.0	335.0	142.0	230.0	138.0	308.0	477.0	256.0	285.0	1965
174.0	81.0	137.0	111.0	77.0	113.0	182.0	243.0	258.0	410.0	243.0	377.0	1966
332.0	227.0	180.0	215.0	369.0	129.0	217.0	150.0	285.0	237.0	295.0	142.0	1967
33.0	0.0	32.0	116.0	165.0	234.0	151.0	194.0	191.0	238.0	38.0	114.0	1968
66.0	40.0	26.0	135.0	226.0	301.0	108.0	281.0	209.0	319.0	168.0	230.0	1969
102.0	21.0	150.0	137.0	166.0	253.0	34.0	161.0	187.0	312.0	223.0	427.0	1970
258.0	76.0	167.0	87.0	274.0	205.0	141.0	352.0	172.0	188.0	179.0	540.0	1971
37.0	109.0	3.0	100.0	139.0	114.0	88.0	244.0	301.0	135.0	159.0	212.0	1972
93.0	17.0	80.0	196.0	231.0	223.0	192.0	49.0	334.9	195.1	277.5	388.9	1973
14.4	129.4	65.7	281.0	196.2	110.9	184.2	158.4	196.8	243.7	375.8	126.4	1974
218.0	106.0	140.2	151.2	209.3	39.3	179.7	133.0	184.9	230.6	387.6	274.9	1975
8.4	1.8	50.7	230.3	287.8	146.5	113.5	154.2	219.8	144.8	137.6	189.9	1976
49.2	57.2	23.8	65.9	179.8	114.0	104.1	198.5	158.6	258.2	252.0	89.6	1977
119.1	61.0	66.4	183.9	310.0	167.0	228.8	96.8	91.7	192.3	306.4	149.4	1978
105.0	86.0	44.4	244.1	134.6	120.1	180.1	67.1	134.4	93.2	446.3	26.9	1979

(Source; N.W.R.S. AND NEB)

Table 7-7 Comparison of 1 and 5 Days Rainfall at Mentekab Estimated with Various Frequency Distributions

Period of Record 1930-72 (30 full years)

Duration (Days)	Return Period (Year)	Rainfall Estimated by Each Distributions				
		Normal		Extreme Value		Log Pearson III
		Arithmetic	Log-normal	Gumbel	Chow	
One Day	2	98	94	94	94	93
	5	123	120	124	123	119
	10	136	136	144	142	137
	50	159	170	188	184	167
	100	167	183	207	202	195
	1000	190	228	268	261	257
	10000	209	273	330	319	329
Five Days	2	176	168	168	168	169
	5	221	218	223	221	218
	10	245	250	259	256	249
	50	286	317	338	334	311
	100	301	344	372	366	369
	1000	342	435	483	474	417
	10000	376	530	594	582	498

(Source; 3.2.6, Vol.3, Pahang River Basin Study)

Table 7-8 Maximum Rainfalls Recorded at Climatological Stations

Duration	Rainfall (mm)			
	Mersing	Kuala Trengganu	Kuantan	Cameron Highlands
15 mins	45.7 (182.9)	45.2 (180.9)	42.9 (171.7)	27.2 (108.7)
30 mins	58.7 (117.3)	66.5 (133.1)	67.1 (134.1)	41.7 (83.3)
45 mins	74.9 (99.8)	75.9 (101.1)	94.0 (125.2)	50.8 (67.8)
1 hour	87.4 (87.4)	98.5 (98.5)	106.7 (106.7)	59.7 (59.7)
3 hours	186.9 (62.2)	170.2 (56.6)	142.5 (47.5)	81.3 (27.2)
6 hours	287.8 (48.0)	251.0 (41.9)	206.0 (34.3)	85.3 (14.2)
12 hours	353.8 (29.5)	343.2 (28.7)	273.6 (22.9)	91.2 (7.4)
1 day	433.1 (18.0)	481.3 (20.1)	345.7 (14.5)	119.4 (5.1)
2 days	547.6 (11.4)	658.6 (13.7)	535.4 (11.2)	163.8 (3.3)
3 days	677.4 (9.4)	892.8 (11.4)	691.1 (9.7)	169.4 (2.3)
5 days	707.7 (5.8)	934.7 (7.9)	944.4 (7.9)	221.7 (1.8)
10 days	1,242.1 (5.1)	1,114.3 (4.6)	1,391.2 (5.8)	248.4 (1.0)

Notes: ( ) The figures in brackets are the average rainfall intensities in millimeters per hour.
Mersing is 160 kilometers south from Kuantan.
Kuala Trengganu is 170 kilometers north from Kuantan.

(Source; 3.2.6, Vol.3, Pahang River Basin Study)

Table 7-9 Flow Regime at Upper Damsite (C.A = 1,200 km^2)

	Q max	Q-95	Q-185	Q-275	Q-355	Q min	Q average	Annual Flow
1973	457.83	35.76	24.26	16.99	11.21	9.24	36.59	13,355.2
1974	203.23	51.29	35.08	26.72	17.81	15.59	42.93	15,668.5
1975	748.74	56.43	34.85	26.07	13.41	11.93	51.63	18,844.9
1976	398.75	40.33	25.10	14.33	7.48	5.43	39.00	14,273.7
1977	325.07	31.13	20.67	11.07	7.41	6.85	28.79	10,509.1
1978	665.53	41.26	22.99	16.66	7.70	4.33	39.23	14,319.4
1979	552.36	41.67	29.90	17.64	9.31	6.52	41.00	14,963.3
1980	283.35	54.60	28.32	18.66	12.11	11.06	42.28	15,476.0

Flow Regime at Lower Damsite (C.A = 1,390 km^2)

	Q max	Q-95	Q-185	Q-275	Q-355	Q min	Q average	Annual Flow
1973	530.32	41.42	28.10	19.68	12.98	10.71	42.38	15,469.8
1974	235.41	59.41	40.63	30.95	20.63	18.06	49.72	18,149.4
1975	867.29	65.36	40.37	30.20	15.53	13.81	59.80	21,828.7
1976	461.89	46.71	29.07	16.60	8.66	6.29	45.17	16,553.7
1977	376.54	36.06	23.95	12.82	8.58	7.93	33.35	12,173.1
1978	770.90	47.79	26.63	19.30	8.92	5.02	45.44	16,586.6
1979	639.82	48.27	34.63	20.44	10.78	7.55	47.49	17,332.5
1980	328.21	63.25	32.81	21.62	14.03	12.82	48.98	17,926.4

(Source NEB)

Table 7-10 Discharge Stations Used in Derivation and Checking the Regional Flood Frequency Procedure

Station Name	Area (km^2)	Type of Record	Length of Record	Location
S. Pahang at Lubok Paku	25,600	Staff Gauge	1948-72	North of Temerloh
S. Pahang at Temerloh	19,000	Staff Gauge	1948-72	Temerloh
S. Pahang at Yap	13,200	Staff Gauge	1948-72	East of Temerloh
S. Tembeling at K. Tahan	3,300	Staff Gauge	1948-72	North-East of Temerloh
S. Lipis at Benta	1,670	Staff Gauge and Chart	1948-72	North-West of Temerloh
S. Bentong at K. Marong	240	Chart	1948-72	West of Temerloh
S. Jelai at K. Lipis	6,280	Staff Guage	1948-72	North-West of Temerloh
S. Jelai at K. Medang	2,630	Staff Gauge	1961-72	North-West of Temerloh
S. Semantan at Lanchang	2,230	Staff Gauge	1965-72	West of Temerloh
S. Tanum at Chegar Perah	732	Staff Gauge	1962-72	North-West of Temerloh
S. Jengka at Kg. Awah	490	Staff Gauge	1965-72	East of Temerloh

(Source; 3.7.1, Vol.3, Pahang River Basin Study)

Table 7-13 Pan Evaporation Data in Pahang River Basin

Period	Evaporation (mm)							
	Pahang Tua		Temerloh		Cameron Highlands		Kuala Tahan	
	US Class Pan		US Class Pan		US Class Pan		US Class Pan	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
January	148	16.4	130	19.1	94	11.2	100	9.6
February	144	15.0	136	21.5	99	18.7	99	20.5
March	175	21.5	148	16.0	107	19.2	121	14.2
April	172	19.9	147	29.7	93	15.2	125	15.1
May	175	27.7	149	28.9	96	14.8	116	6.2
June	167	26.6	138	31.0	90	15.2	108	9.0
July	166	16.0	135	28.1	92	14.4	110	6.1
August	170	26.2	134	19.4	90	13.5	104	10.5
September	163	21.2	129	18.6	90	9.8	104	12.0
October	157	17.9	129	17.4	82	23.8	100	17.3
November	133	15.4	124	17.2	78	20.6	90	20.9
December	136	14.0	119	25.4	74	21.5	96	20.6
Annual	1,910	187.7	1,620	215.4	1,090	133.5	1,280	88.6
Mean	158.8		134.8		90.42		106.8	
S.V.	15.03		9.50		9.03		10.56	
C.V.	0.095		0.070		0.10		0.10	
EL	5 m		49 m		1,450 m			

Note: SD - Standard Deviation, CV - Coefficient of Variation

(Source; 3.3.4, Vol.3, Pahang River Basin Study)

Table 7-14 Actual Evapotranspiration Computed from Rainfall and Runoff

Catchment	Period of Record*	Catchment Area (km^2)	Average Annual Values (mm)		
			Rainfall	Runoff	Evapo-Transpiration
S. Tekai at Penu	1973-80 (8 years)	1,390	2,340	1,060	1,280
S. Lipis at Benta	1966-72 (7 years)	1,670	2,240	890	1,350
S. Pahang at Temerloh	1959-72 (14 years)	19,000	2,630	1,160	1,470
S. Kelang	1961-69 (9 years)	464	2,460	1,100	1,360
S. Selangor at Randau Panjang	1950-70 (14 years)	1,450	2,720	1,420	1,300
S. Kelantan at Guillemard Bridge	1961-70 (10 years)	11,900	2,760	1,420	1,340

* The number of complete years used are shown in brackets.

(Source; 3.3.4,Vol.3, Pahang River Basin Study)

Table 7-15 Evaporation

- Kuala Tahan -

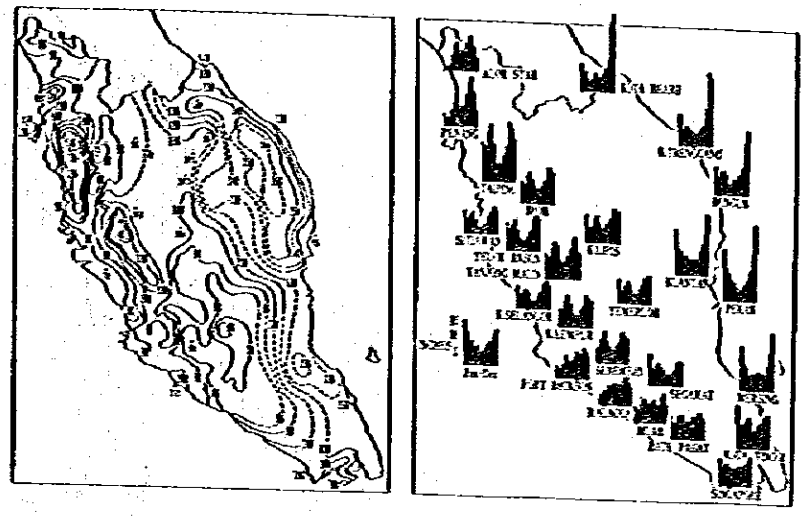
(Unit: mm)

	1974	1975	1976	1977	1978	1979	1980
1	95.0	83.6	96.5	99.8	100.6	111.0	111.3
2	77.5	94.5	124.0	86.6	77.0	126.7	103.4
3	127.0	116.3	149.9	114.0	115.1	105.7	118.4
4	103.1	106.4	138.2	142.5	127.0	132.3	128.3
5	108.7	109.2	121.7	118.6	116.1	125.0	112.8
6	104.9	93.7	101.1	106.4	112.3	114.8	120.4
7	105.7	100.6	107.7	106.9	112.0	117.9	115.8
8	110.2	116.1	108.7	86.1	94.0	110.2	104.4
9	90.4	94.2	107.2	95.0	121.2	104.6	118.1
10	103.9	93.4	65.8	98.8	115.1	114.3	111.8
11	73.7	78.5	63.8	82.6	94.5	113.5	120.1
12	99.1	75.4	65.9	96.3	93.5	111.8	126.9
Total	1,199.2	1,161.9	1,250.5	1,233.6	1,278.4	1,387.8	1,391.7

Note: US Class A Pan Observation

(Source; NEB)

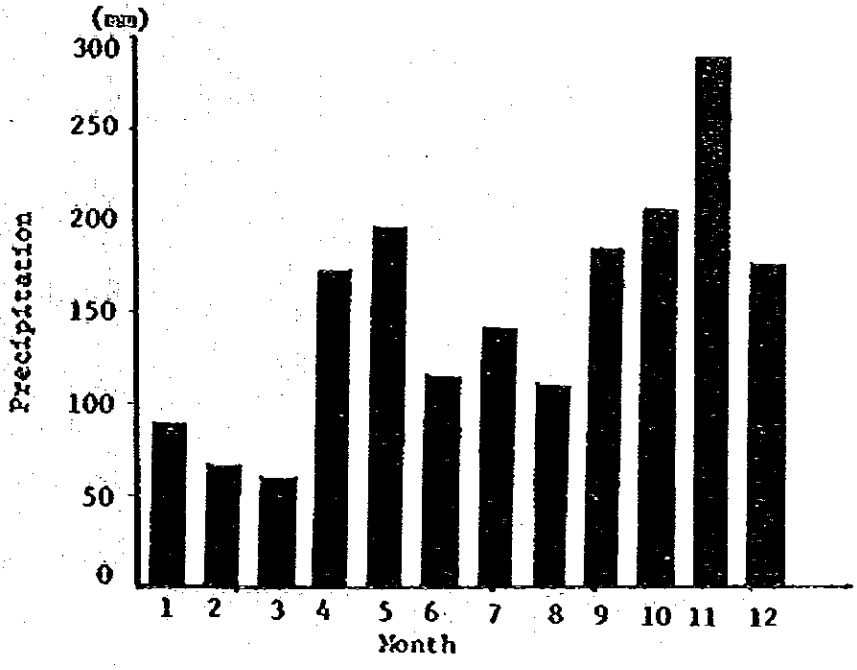
Fig. 8-1 Annual Rainfall in West Malaysia



(Source; Wyatt-Smith,Malay Forest Rec.23,1963)

Fig. 8-2 Annual Rainfall in Kuala Tahan

(Average 1973 - 1981)



(Source; NEB)

Fig. 8-3 Location of Water Test Sampling in 1981

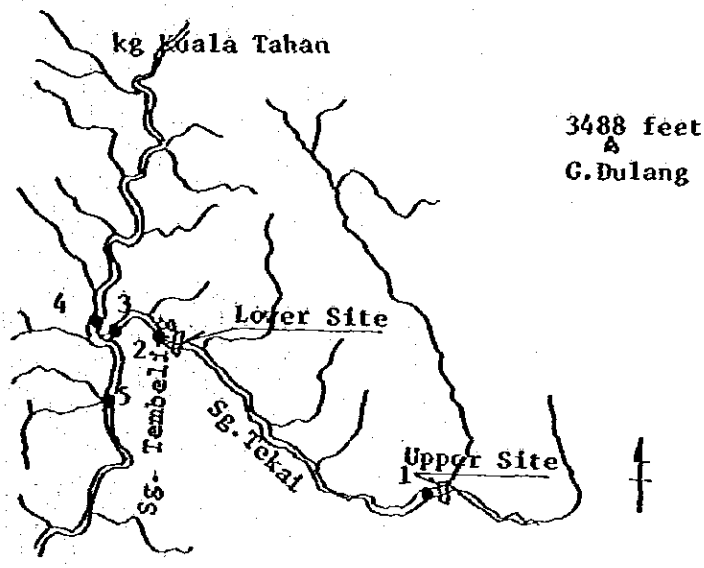
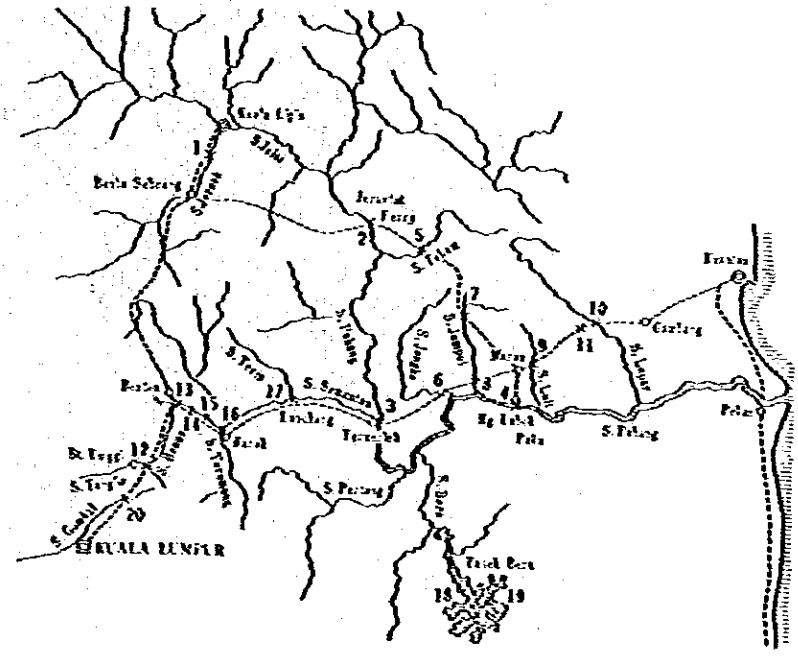
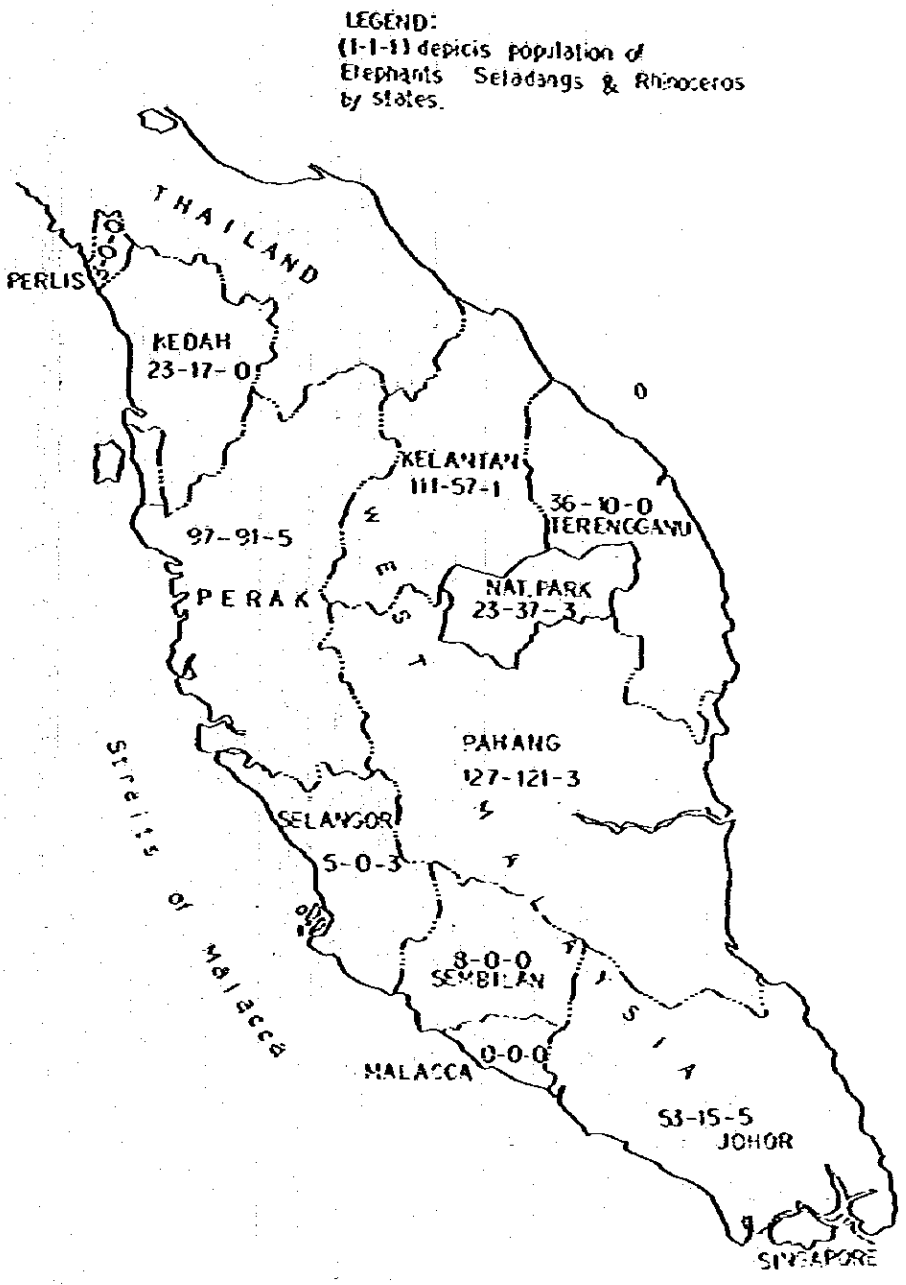


Fig. 8-4 Location of Water Quality Sampling in Pahang



(Source; Mizuno and Mori, University Report of Ohsaka Educational Univ., 1969)

Fig. 8-5 Estimated Population of Elephant, Seladang, Rhinoceros (West Malayis)



(Source; Environmental Overview, Temengor Hydro-electric Development Project)

Table. 8-1 Results of Water Quality Tests at Tekai River

Item \ Date of Test	July 28, 1981	September 1, 1981					September 22, 1981					October 14, 1981				
	No.2	No.1	No.2	No.3	No.4	No.5	No.1	No.2	No.3	No.4	No.5	No.1	No.2	No.3	No.4	No.5
Turbidity (APHA Formazin Units)	24	<5	5	5	5	5	2	4	5	1	2	74	114	33	26	24
pH Value	7.8	7.2	7.2	7.2	7.3	7.5	7.3	7.1	7.3	7.2	7.3	7.1	7.2	6.8	6.9	7.1
Total Suspended Solids	20	5	10	10	10	10	5	10	5	5	15	300	285	50	35	25
Chemical Oxygen Demand	7	35	15	<5	<5	10	8	6	8	6	4	50	30	15	40	35
Biochemical Oxygen Demand @ 20°C for 5 days	2	9	5	2	2	3	2	1	3	2	1	5	5	5	5	5
Nitrate Nitrogen as N	0.91	0.91	0.82	0.74	0.91	0.78	0.62	0.66	0.58	0.54	0.54	0.91	0.62	0.91	0.82	0.54
Ammoniacal Nitrogen as N	0.98	3.13	1.44	1.40	2.55	1.48	1.40	1.48	1.56	1.19	0.91	1.77	1.69	1.89	1.36	1.61
Hydrolysable Phosphate as PO_4	2.32	<0.01	<0.01	<0.01	0.04	<0.01	0.08	0.09	0.11	0.23	0.08	0.19	0.01	0.24	<0.01	0.32

Table 8-2 Water Quality in the Pahang River

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. S. Jurnch	22-VI	17:00	32.0	28.5	6.9	-	B	
2. S. Jelai	23-VI	12:00	31.0	28.0	6.8	-	B	
3. S. Pahang	25-VI	13:10	30.8	30.5	6.8	14	RB	
4. S. Pahang	25-VI	12:10	29.0	26.5	5.7	20	RB	
5. S. Tekan	25-VI	12:45	31.0	27.0	6.7	18	B	
6. S. Jengka	25-VI	14:00	34.0	29.0	6.6	50	B	
7. S. Jampol	23-VI	14:00	34.0	29.0	6.6	50	B	
8. S. Jampol	25-VI	12:30	29.0	27.0	6.6	19	YB	
9. S. Luit	25-VI	10:25	27.0	26.5	7.0	30	YB	
10. S. Lepar	23-VI	15:40	33.0	29.0	6.2	18	RB	
11. S. Lepar	23-VI	16:00	33.0	33.0	6.2	45	RB	
12. S. Tanglir	22-VI	10:25	27.2	23.0	6.9	-	YB	
13. S. Benus	25-VI	14:25	29.5	28.3	6.8	29	YB	
14. S. Benus	25-VI	14:10	30.0	28.0	6.8	14	YB	
15. S. Benus	25-VI	15:35	30.5	27.0	6.8	60<	T	Insects
16. S. Telemony	25-VI	15:00	32.5	27.0	6.6	25	Y	
17. S. Teris	25-VI	14:00	32.0	27.0	6.2	5	YB	
18. Tasek Bera	16-V	9:00	27.0	26.5	4.7	-	DB	
19. Tasek Bera	16-V	14:00	30.2	27.8	4.6	-	DB	
20. S. Gombak	22-VI	9:00	-	23.0	6.9	60<	T	Insects, Shrimp

(1) Name of River
(2) Date
(3) Time
(4) Atmosphic Temperature (°C)
(5) Water Temperature (°C)
(6) PH
(7) Depth (m)
(8) Colour of Water
(9) Insect, etc.

B : Brown
RB : Red Brown
YB : Yellow Brown
Y : Yellow
T : Transparency
DB : Dark Brown

(Source; Mizuno and Mori, University Report of Ohsaka Educational Univ., 1969)

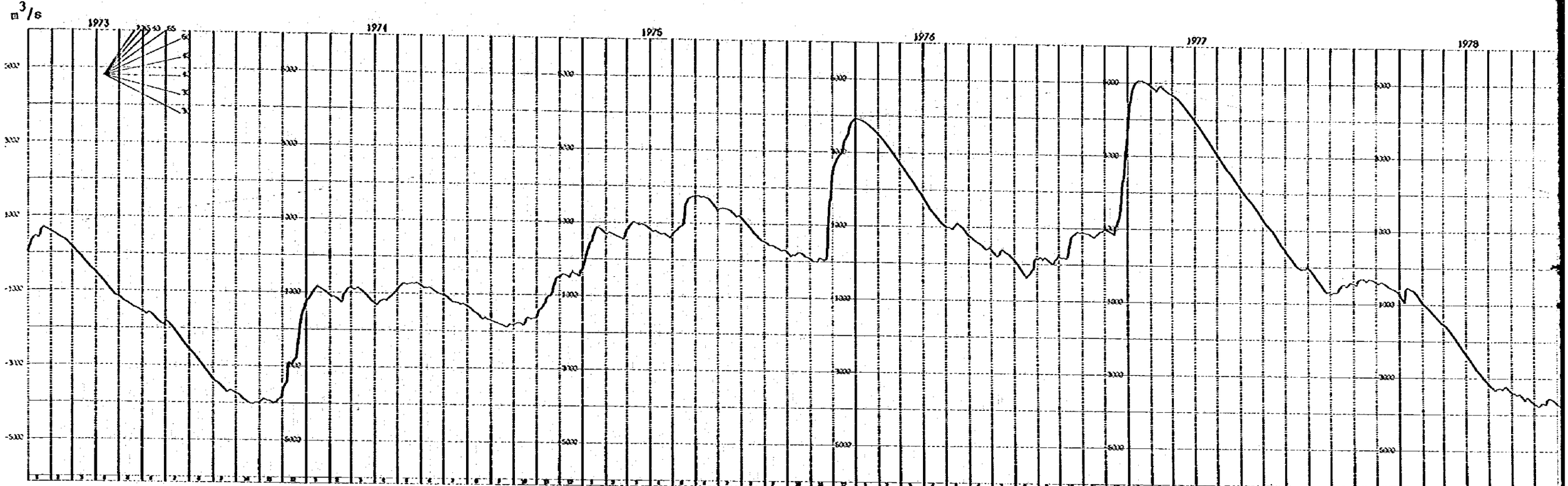
Table 8-3 Major Species of Trees consisting Lowland Deterocarp Forest

(Effective Lumber)

Common Name	Botanical (scientific) name	No . & area of lumber group		
		JT 6/78 650ac	JT 03/79 1000ac	JT 7/79 670ac
Balau	Shorea, Shorea	8,691	1,796	117,820
Resak	Vitica	6,758	24,994	14,549
Keruing	Dipterocarpus	17,771	44,156	37,754
Kempas	Leguminorae (Pulse family) Koompassia, K.malaccensis	10,215	29,570	32,308
Kelal, Keleday	Moraceae (Mulberry family) Artocarpus	3,568	16,615	30,210
M. Pipit	Shorea, Rubroshorea (Red Meanti)	85,185	66,039	464,629
Meranti Kuusing	Shorea, Richetoides (Yellow Meanti)	4,617	4,175	32,810
M. Puteh	Shorea, Anthoshorea (White Meranti)	149	6,321	2,140
Mengkulang	Sterculiaceae (Firmiana platanofolia) Heritiea, H.simplicifolta	2,583	5,126	1,916
Kasai	Sapindaceae (Sapindus mukurossi) Sapindaceae, Pometia Pinnata Forster	4,676	22,706	43,530
Mersawa	Anisoptera	2,786	9,161	38,201
Jelutong	Apocynaceae, Dyera D.costulata	1,540	4,091	9,026
Nyatoh	Sapotaceae	400	911	2,369
Total (Sg.feet)		149,244 cu.ft.	235,661 cu.ft.	827.262 cu.ft.

(Source; Malayan Forest Records No.23, Manual of Malayan silviculture for Inland Forests Vol.II)

Mass Curve at Upper Site



Mass Curve at Lower Site

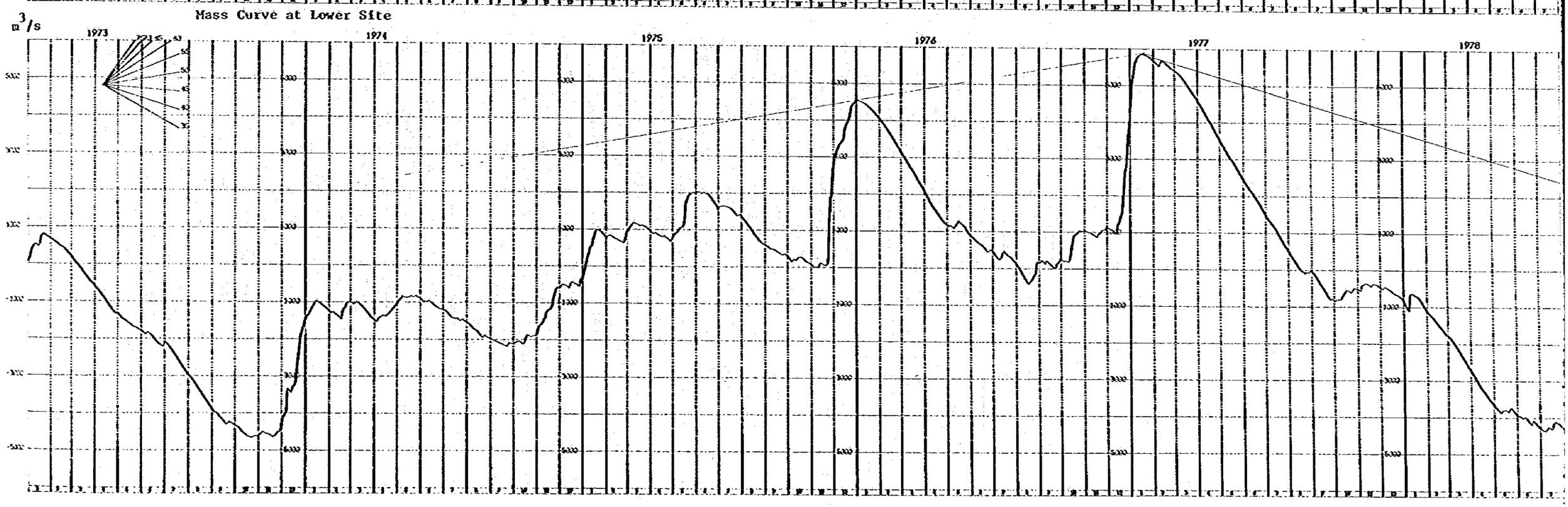
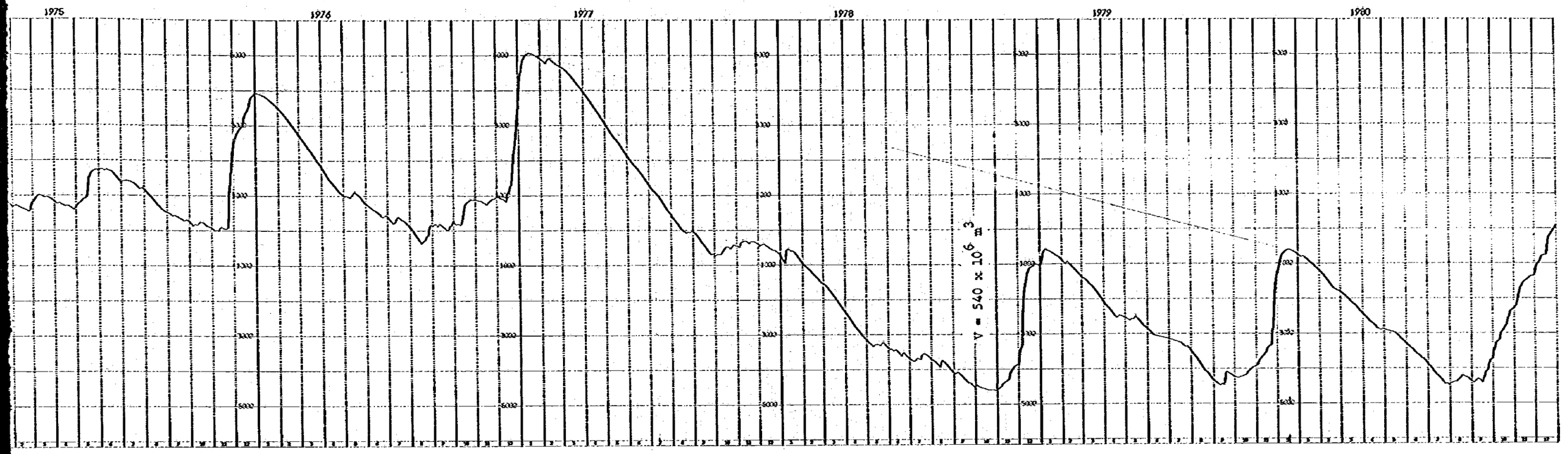


Fig 9-3


1975
1976
1977
1978
1979
1980
V = 540 x 10^6 m^3

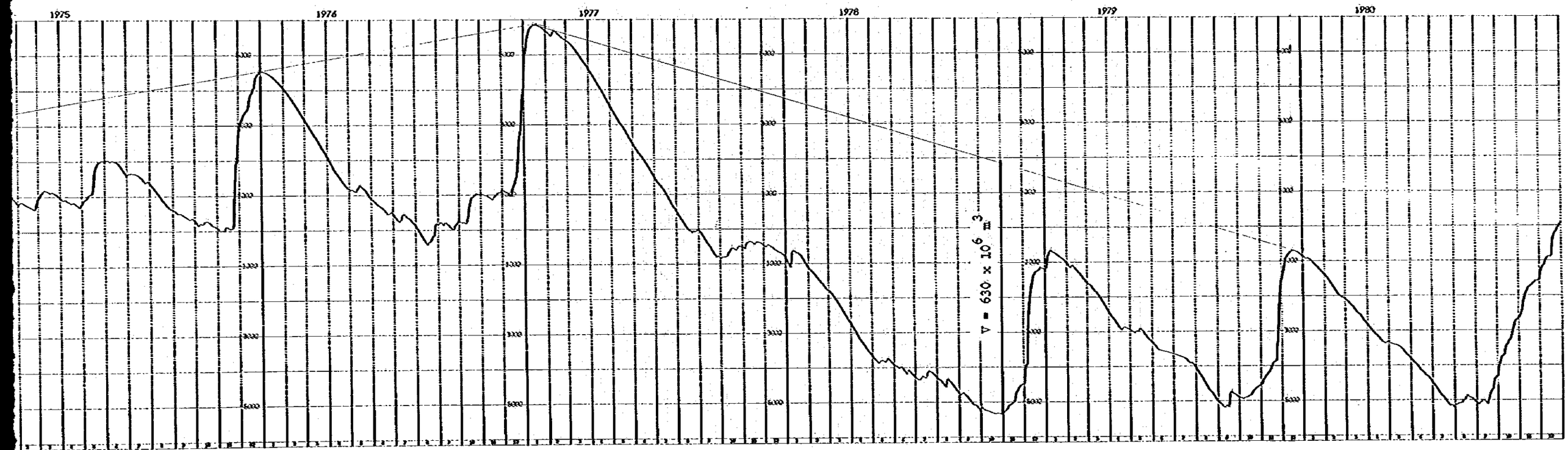
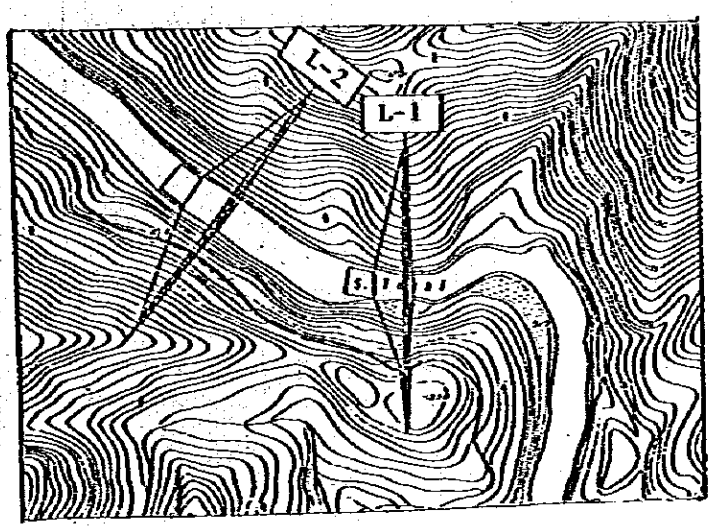

1975
1976
1977
1978
1979
1980
V = 630 x 10^6 m^3

Fig. 9-4 Selection of Dam Sites

(1) Upper Dam Sites

(2) Lower Dam Sites



0 100 250 500m

Fig. 9-5 RESERVOIR SURFACE AREA AND STORAGE CAPACITY CURVES FOR UPPER SITE

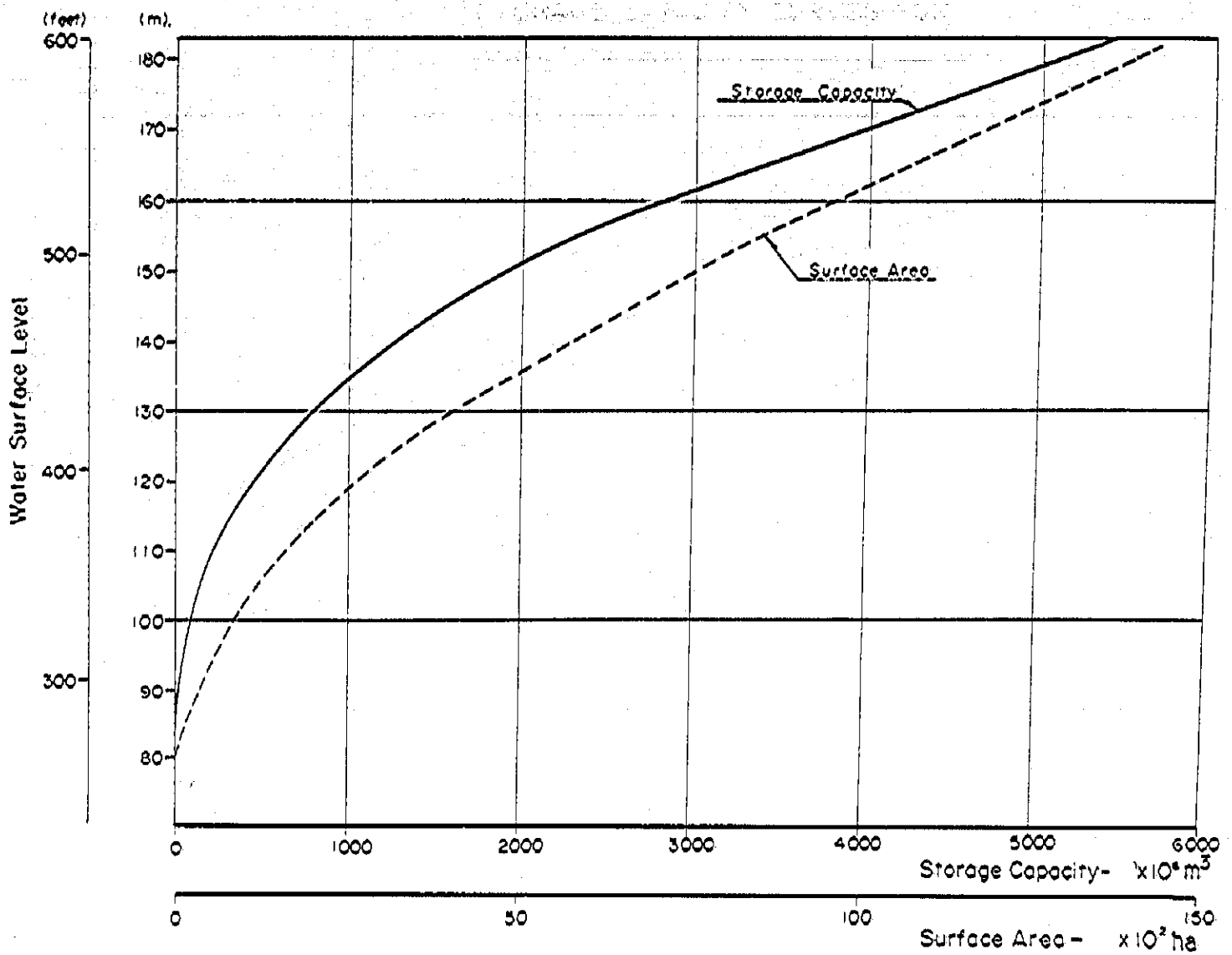


Fig. 9-6 RESERVOIR SURFACE AREA AND STORAGE CAPACITY CURVES FOR LOWER SITE

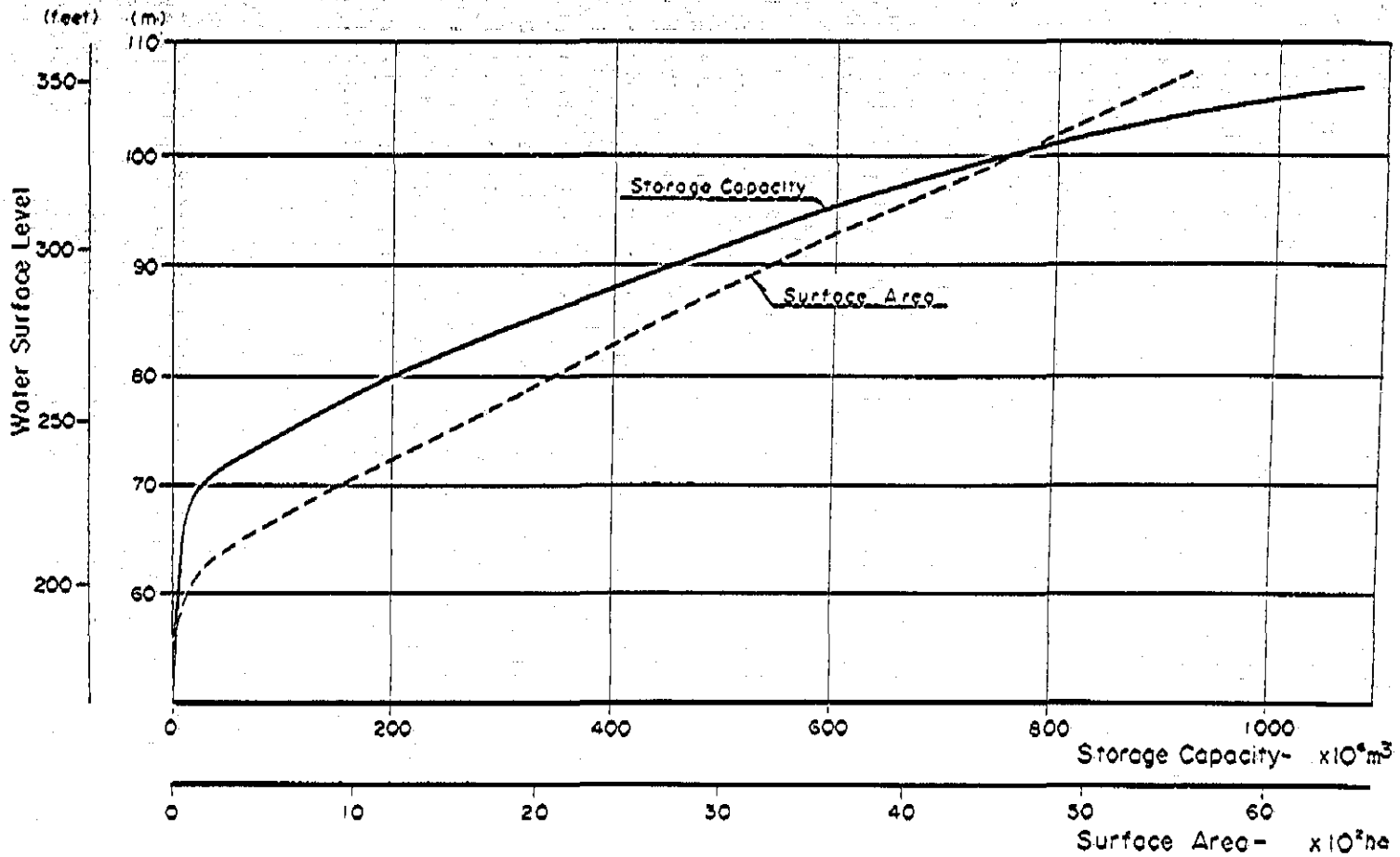


Table 9-3 Upper Single (One Dam) Development (1)

Dam Height; 90 m, Operation Time; 6hours, Effective Depth; 10m

H--E.L.M	98.5	111.0	118.0	125.0	142.5	147.9	150.0	155.5	162.5	165.0
V-10**6M3	70.	240.	400.	610.	1420.	1760.	1900.	2320.	3100.	3400.

F.S.L- 165.0 M.O.L- 155.0 B-- 82.0 PPMAX-- 104000. HD-- 161.7

(*1000KW)

	1973	1974	1975	1976	1977	1978	1979	1980
1	3224.	3224.	3224.	3224.	3224.	3180.	3192.	3195.
2	2912.	2912.	2912.	3016.	2912.	2851.	2870.	2963.
3	3224.	3224.	3224.	3224.	3224.	3127.	3150.	3142.
4	3120.	3120.	3120.	3120.	3120.	2988.	3017.	3013.
5	3224.	3224.	3224.	3224.	3224.	3064.	3107.	3100.
6	3120.	3120.	3120.	3120.	3120.	2956.	2989.	2977.
7	3224.	3224.	3224.	3224.	3224.	3049.	3079.	3047.
8	3224.	3224.	3224.	3224.	3216.	3042.	3051.	3042.
9	3120.	3120.	3120.	3120.	3091.	2926.	2936.	2950.
10	3224.	3224.	3224.	3224.	3135.	3012.	3042.	3109.
11	3120.	3120.	3120.	3120.	3093.	2929.	2981.	3066.
12	3224.	3224.	3224.	3224.	3190.	3141.	3201.	3212.

(L.S...KW)

	1973	1974	1975	1976	1977	1978	1979	1980
1	104000.	104000.	104000.	104000.	104000.	102232.	102583.	102691.
2	104000.	104000.	104000.	104000.	104000.	101393.	102110.	101786.
3	104000.	104000.	104000.	104000.	104000.	100236.	101035.	100876.
4	104000.	104000.	104000.	104000.	104000.	99055.	100335.	100153.
5	104000.	104000.	104000.	104000.	104000.	98735.	99935.	99647.
6	104000.	104000.	104000.	104000.	104000.	98328.	99597.	98815.
7	104000.	104000.	104000.	104000.	104000.	98188.	99089.	97906.
8	104000.	104000.	104000.	104000.	103473.	97818.	97838.	97955.
9	104000.	104000.	104000.	104000.	102559.	97213.	97601.	98043.
10	104000.	104000.	104000.	104000.	102531.	97093.	97959.	99315.
11	104000.	104000.	104000.	104000.	102909.	97157.	98537.	101343.
12	104000.	104000.	104000.	104000.	102646.	98479.	102565.	102939.

FIRM-Q = 40.00 (M3/S) QMAX = 160.00 6.

YEAR	ENERY-GENER (KWH)	GENERATION-B (1000 M$)	LS-ENERGY (KW)	LS-B (1000 M$)	TOTA-BENEFIT (1000 M$)
1973	227758080.	34163.7	103999.8	7809.3	41973.0
1974	227758080.	34163.7	103999.8	7809.3	41973.0
1975	227758080.	34163.7	103999.8	7809.3	41973.0
1976	228382080.	34257.3	103999.8	7809.3	42066.6
1977	226932192.	34039.8	103508.8	7772.5	41812.3
1978	217533136.	32637.5	98827.3	7420.9	40059.4
1979	219696096.	32954.4	99924.5	7503.3	40457.7
1980	220398224.	33133.2	100122.1	7518.2	40651.4
8 AVERAGE	224594400.	33689.1	102297.7	7681.5	41370.7

INSTALLED CAPACITY (KW)= 104003.0

(Please refer to Table 9-4 for Legend)

Table 9-4 Legend for Tables 9-3, 9-6, 9-8

H: Dam Height (m)

T: Operation Time (hrs)

h: Effective Depth (m)

H--E.L.H; Water Level (EL. m)

V-10x6M3; Storage Volmume (10^6 m^3)

F.S.L; Full Supply Level (EL. m)

M.O.L; Minimum Operating Level (EL. m)

B; Tailrace Water Level (EL. m)

PPMAX; Maximum Output (kW)

ND; Normal Operating Level (EL. m)

Monthly Total Output (10^3 kW); 1973 - 1980

Monthly L5 Output (kW); 1973 - 1980

Firm Q; Firm Discharge (m^3/s)

QMAX; Maximum Effective Discharge (m^3/s)

ENERY-GENER; Annual Generating Energy (kWH)

GENERATION-B; Annual Energy Genration Benefit (10^3 M$)

L5-ENERGY; Annual L5 Output (kW)

L5-B; Annual L5 Output Benefit (10^3 M$)

TOTA-BENEFIT; Annual Total Benefit (10^3 M$)

Table 9-5 Upper Single (One Dam) Development (2)

Dam Height; 90 m, Operation Time; 6 hours, Effective Depth; 10 m

Benefit/Cost Analysis

Item	Unit	
Maximum Output	GW	0.102
Annual Generated Energy	GWH	225.0
Construction Cost	10^6 M$	299.757
Capital Value with IDC (IDC = 16%)	M$/kW	3409.0
Capital Cost (1) (CRF = 0.0817)	M$/kWH	0.1265
Fixed Cost with Overhead	M$/kW	8.82
Insurance (0.1%)	M$/kW	3.41
Inclusive Fixed Cost	M$/kW	12.23
O & M Costs (2)	M$/kWH	0.0056
Total Operating Cost (1+2)	M$/kWH	0.1320
Cost for Power Generating	10^6 M$	29.66
Reservoir Clearing Cost	10^6 M$	4.50
Annual Cost (C)	10^6 M$	34.15
Annual Benefit (B)	10^6 M$	41.37
(B) / (C)		1.21
(B) - (C)	10^6 M$	7.22

Table 9-6 Lower Single (One Dam) Development (1)

Dam Height; 60m, Operation Time; 12hours, Effective Depth; 10m

H--E.L.M	69.5	80.0	85.0	89.5	90.0	95.0	97.0	100.0	102.5	105.0
V-10**6M3	20.	195.	320.	440.	450.	590.	650.	760.	875.	1000.

F.S.L- 105.0 M.O.L- 95.0 B-- 50.0 PMAX-- 38700. HD-- 101.7

(*1000KW)

	1973	1974	1975	1976	1977	1978	1979	1980
1	1200.	1200.	1200.	1200.	1200.	1003.	1200.	1200.
2	1084.	1084.	1084.	1122.	1084.	548.	1084.	1122.
3	1200.	1200.	1200.	1198.	1200.	374.	1200.	1200.
4	1161.	1161.	1161.	1111.	1161.	334.	1159.	1145.
5	1187.	1200.	1200.	1116.	1159.	847.	1187.	1161.
6	1125.	1161.	1161.	1047.	1051.	785.	1120.	1083.
7	1129.	1200.	1200.	1062.	930.	937.	1142.	1063.
8	1061.	1200.	1200.	1027.	565.	851.	1083.	1058.
9	959.	1161.	1161.	1025.	514.	655.	1022.	1039.
10	990.	1200.	1200.	1101.	990.	956.	1076.	1173.
11	961.	1161.	1161.	1099.	997.	933.	1106.	1161.
12	1116.	1200.	1200.	1164.	1023.	1174.	1200.	1200.

(L5...KW)

	1973	1974	1975	1976	1977	1978	1979	1980
1	38700.	38700.	38700.	38700.	38700.	31657.	38700.	38700.
2	38700.	38700.	38700.	38700.	38700.	12540.	38700.	38700.
3	38700.	38700.	38700.	38184.	38700.	7539.	38700.	38700.
4	38700.	38700.	38700.	36072.	38537.	6165.	38473.	37724.
5	37878.	38700.	38700.	35483.	36230.	14303.	37825.	36923.
6	37048.	38700.	38700.	34430.	33919.	12731.	37146.	35307.
7	35296.	38700.	38700.	33945.	9141.	18684.	36391.	33598.
8	33046.	38700.	38700.	32365.	6569.	13298.	33972.	33712.
9	31900.	38700.	38700.	33903.	7170.	12158.	33527.	34003.
10	14389.	38700.	38700.	34456.	23155.	25925.	34337.	36612.
11	31810.	38700.	38700.	36362.	32714.	31759.	35563.	38700.
12	33320.	38700.	38700.	36695.	32544.	34335.	33700.	38700.

FIRM-Q = 46.00 (M3/S) QMAX = 92.00 12.

YEAR - - - - - -

	ENERY-GENER (KWH)	GENERATION-B (10^3 M$)	LS-ENERGY (KW)	LS-B (10^3 M$)	TOTA-BENEFIT (10^3 M$)
1973	156936096.	23547.9	34124.0	2552.4	26110.3
1974	169505360.	25425.8	38699.9	2906.0	28331.9
1975	169505369.	25425.8	38699.9	2906.0	28331.8
1976	159281616.	23989.2	35774.7	2686.3	26575.5
1977	142456720.	21370.0	28423.2	2134.3	23504.3
1978	113612320.	17041.8	13474.9	1387.3	18429.1
1979	163006176.	24450.9	35935.5	2766.1	27217.0
1980	163311808.	24496.7	36731.5	2761.9	27258.7
8 AVERAGE	154705916.	23206.0	33476.3	2513.8	25719.8

INSTALLED CAPACITY (KW)= 38700.0

(Please refer to Table 9-4 for Legend)

Table 9-7 Lower Single (One Dam) Development (2)

Dam Height; 60 m, Operation Time; 12 hours, Effective Depth; 10 m

Benefit/Cost Analysis

Item	Unit	
Maximum Output	GW	0.033
Annual Generated Energy	GWH	155.0
Construction Cost	10^6 M$	161.102
Capital Value with IDC (IDC = 16%)	M$/kW	5663.0
Capital Cost (1) (CRF = 0.0817)	M$/kWH	0.0985
Fixed Cost with Overhead	M$/kW	14.65
Insurance (0.1%)	M$/kW	5.66
Inclusive Fixed Cost	M$/kW	20.31
O & M Costs (2)	M$/kWH	0.0043
Total Operating Cost (1+2)	M$/kWH	0.1028
Cost for Power Generating	10^6 M$	15.94
Reservoir Clearing Cost	10^6 M$	2.42
Annual Cost (C)	10^6 M$	18.35
Annual Benefit (B)	10^6 M$	25.72
(B) / (C)		1.40
(B) - (C)	10^6 M$	7.37

Table 9-6 Series (Two Dams) Development (1), Lower Development

Dam Height; 38m, Operation Time; 24hours, Effective Depth; 4m

H--F.L.L	69.5	79.0	80.0	82.0	83.0	95.0	97.0	100.0	102.5	105.0
V-10**3	20.	175.	195.	240.	255.	590.	650.	760.	975.	1000.

F.S.L- 83.0 M.O.L- 79.0 B-- 50.0 PMAX-- 12000. HD-- 82.0

(*1000KW)

	1973	1974	1975	1976	1977	1978	1979	1980
1	372.	372.	372.	372.	372.	347.	372.	372.
2	336.	336.	336.	343.	336.	311.	334.	343.
3	372.	372.	372.	372.	372.	339.	363.	371.
4	360.	360.	360.	354.	360.	321.	346.	353.
5	370.	372.	372.	361.	367.	329.	355.	361.
6	354.	360.	360.	345.	346.	313.	340.	345.
7	360.	370.	372.	355.	360.	331.	350.	350.
8	353.	364.	372.	352.	344.	331.	344.	349.
9	336.	349.	360.	344.	339.	313.	330.	349.
10	345.	361.	372.	360.	342.	323.	344.	365.
11	337.	355.	360.	352.	335.	323.	342.	360.
12	362.	371.	372.	367.	347.	361.	372.	372.

(L.F.KW)

	1973	1974	1975	1976	1977	1978	1979	1980
1	12000.	12000.	11985.	12000.	12000.	11122.	11942.	12000.
2	12000.	12000.	12000.	12000.	12000.	11033.	11346.	12000.
3	12000.	12000.	12000.	11993.	12000.	10340.	11513.	11832.
4	12000.	12000.	12000.	11573.	12000.	10525.	11457.	11693.
5	11876.	12000.	12000.	11599.	11690.	10573.	11397.	11592.
6	11717.	12000.	12000.	11462.	11420.	10502.	11315.	11414.
7	11503.	11866.	12000.	11415.	11484.	10502.	11255.	11300.
8	11273.	11691.	12000.	11277.	11043.	10533.	11012.	11219.
9	11176.	11607.	12000.	11440.	10933.	10564.	10955.	11259.
10	11142.	11612.	12000.	11505.	10947.	10564.	11052.	11551.
11	11193.	11691.	12000.	11705.	11117.	10521.	11215.	11997.
12	11372.	11931.	12000.	11727.	11137.	11005.	12000.	12000.

E100-0 = 46.30 (M3/S) Q*** = 46.30 24.

YEAR - - - - - -

	ENERGY-GROSS (KWH)	GENERATION-P (1000 K)	LS-ENERGY (KW)	LS-P (1000 K)	FIRM-BENEFIT (1000 K)
1973	102833104.	15329.0	11504.7	871.4	16200.4
1974	105833280.	15623.0	11865.5	891.1	16520.0
1975	105817696.	15757.6	11993.7	901.0	16669.5
1976	103759120.	15413.0	11649.9	874.3	16283.6
1977	100322320.	15123.3	11461.0	869.6	15983.9
1978	94953696.0	14244.6	10732.4	805.3	15050.4
1979	100513960.	15091.9	11423.0	957.3	15949.7
1980	102342880.	15426.4	11551.9	976.2	16301.4
AVERAGE	101633032.	15253.2	11569.5	867.2	16123.4

INSTALLED CAPACITY (KW)= 12000.0

(Please refer to Table 9-4 for Legend)

Table 9-9 Series (Two Dams) Development (2), Lower Development

Dam Height; 38 m, Operation Time; 24 hours, Effective Depth; 4 m

Benefit/Cost Analysis

Item	Unit	
Maximum Output	GW	0.011
Annual Generated Energy	GWH	102.0
Construction Cost	10^6 M$	96.144
Capital Value with IDC (IDC = 16%)	M$/kW	10138.8
Capital Cost (1) (CRF = 0.0817)	M$/kWH	0.0896
Fixed Cost with Overhead	M$/kW	26.22
Insurance (0.1%)	M$/kW	10.14
Inclusive Fixed Cost	M$/kW	36.36
O & M Costs (2)	M$/kWH	0.0039
Total Operating Cost (1+2)	M$/kWH	0.0935
Cost for Power Generating	10^6 M$	9.51
Reservoir Clearing Cost	10^6 M$	1.44
Annual Cost (C)	10^6 M$	10.95
Annual Benefit (B)	10^6 M$	16.12
(B) / (C)		1.47
(B) - (C)	10^6 M$	5.17

Table 9-10 Series (Two Dams) Development (3), Upper and Lower Development

	Dam Hight	Operation Time	Effective Depth
Upper Dam	90 m	6 hours	10 m
Lower Dam	38 m	24 hours	4 m

Benefit/Cost Analysis

Item	Unit	
Maximum Output	GW	0.114
Annual Generated Energy	GWH	327.0
Construction Cost	10^6 M$	396.000
Capital Value with IDC (IDC = 16%)	M$/kW	4029.5
Capital Cost (1) (CRF = 0.0817)	M$/kWH	0.1148
Fixed Cost with Overhead	M$/kW	10.42
Insurance (0.1%)	M$/kW	4.03
Inclusive Fixed Cost	M$/kW	14.45
O & M Costs (2)	M$/kWH	0.0050
Total Operating Cost (1+2)	M$/kWH	0.1198
Cost for Power Generating	10^6 M$	39.18
Reservoir Clearing Cost	10^6 M$	5.94
Annual Cost (C)	10^6 M$	45.12
Annual Benefit (B)	10^6 M$	57.49
(B) / (C)		1.27
(B) - (C)	10^6 M$	12.37

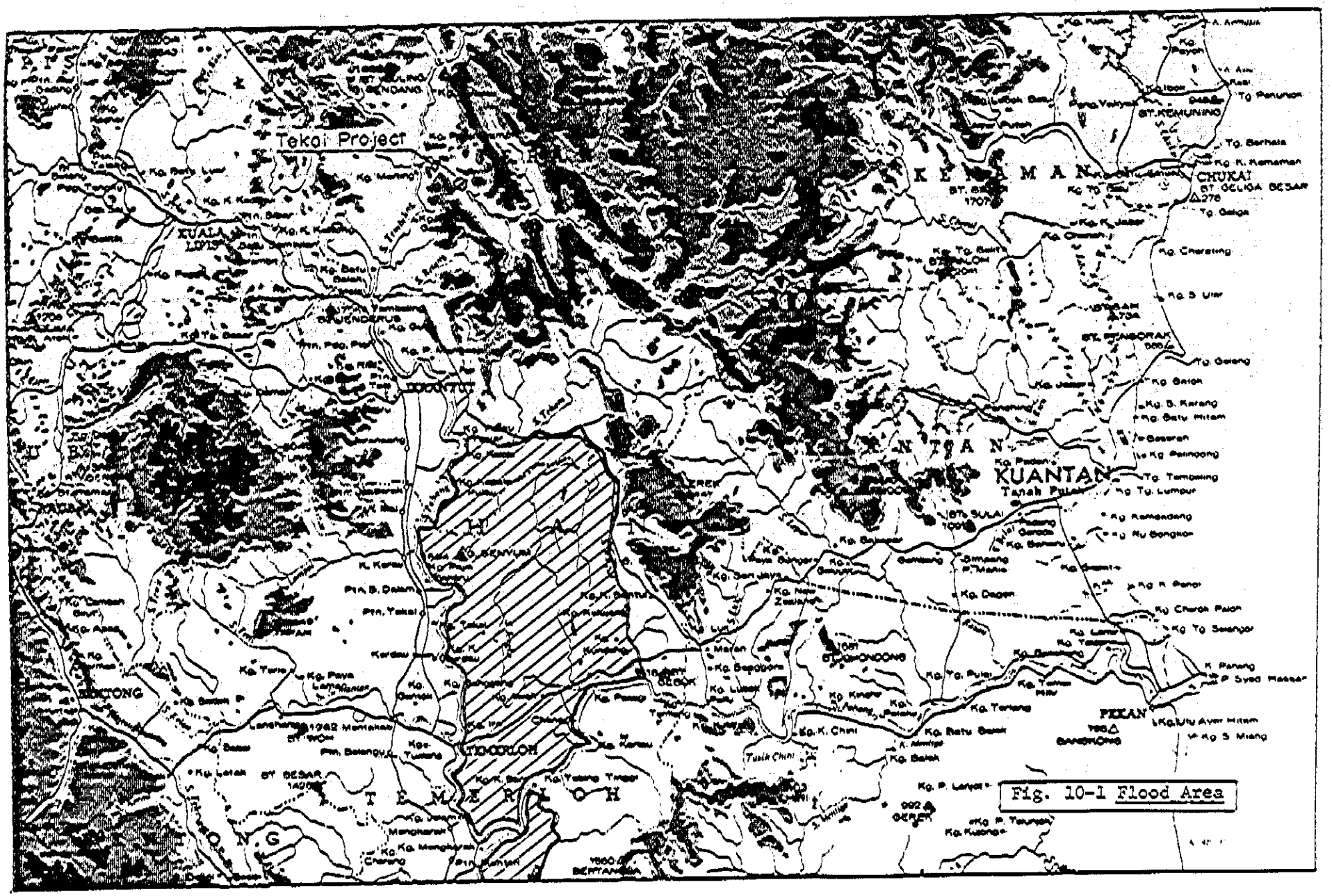


Fig. 10-1 Flood Area

Fig. 10-2 DESIGN FLOOD AND THE WATER STAGE OF RESERVOIR

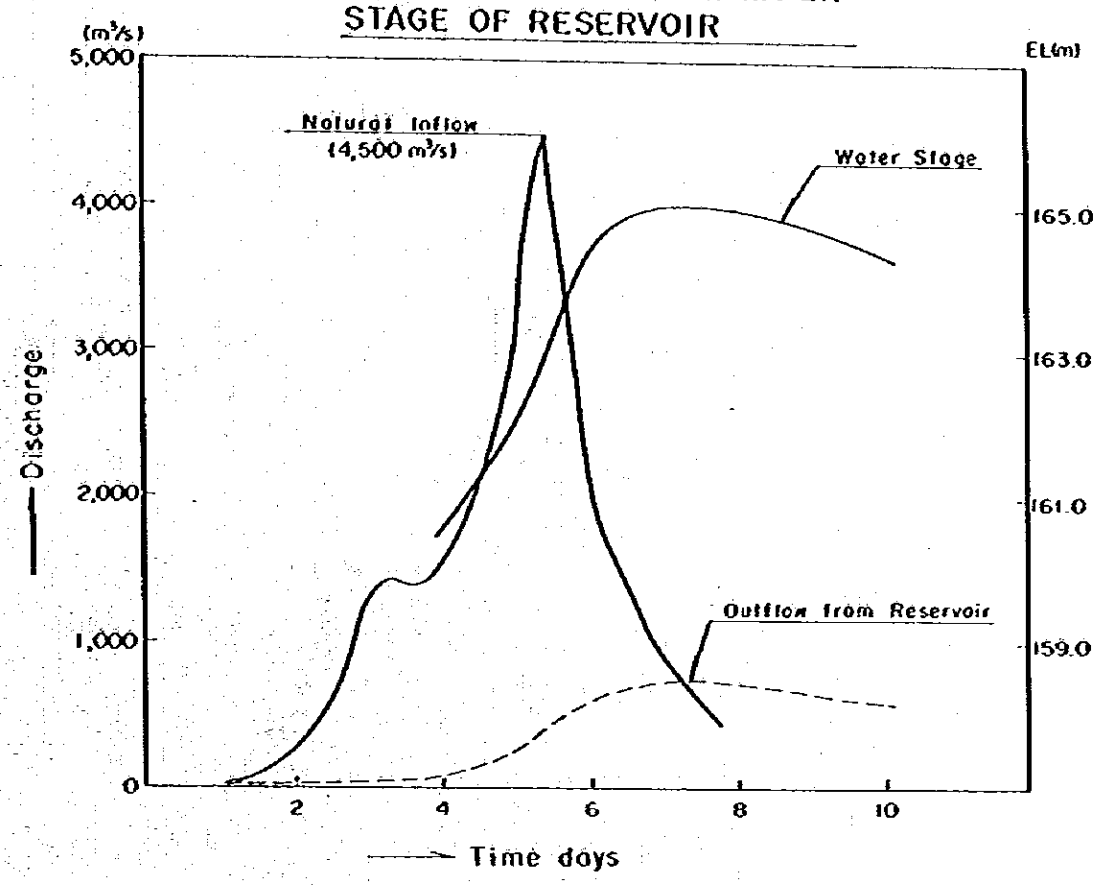
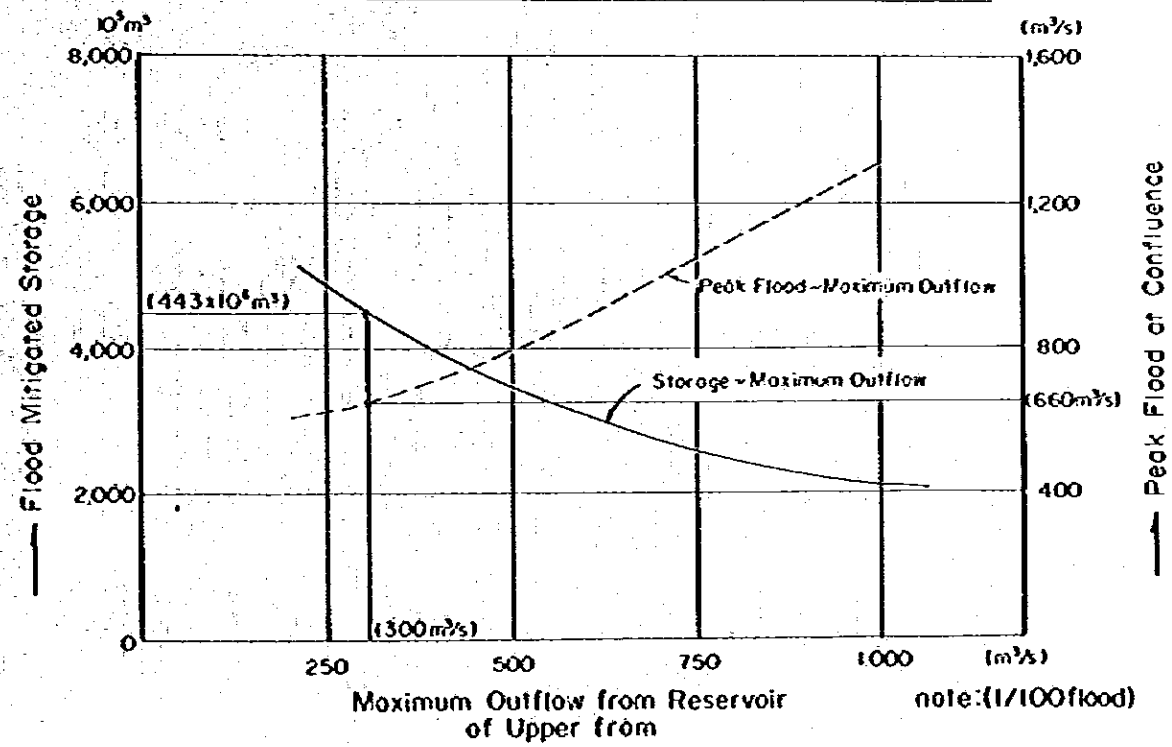
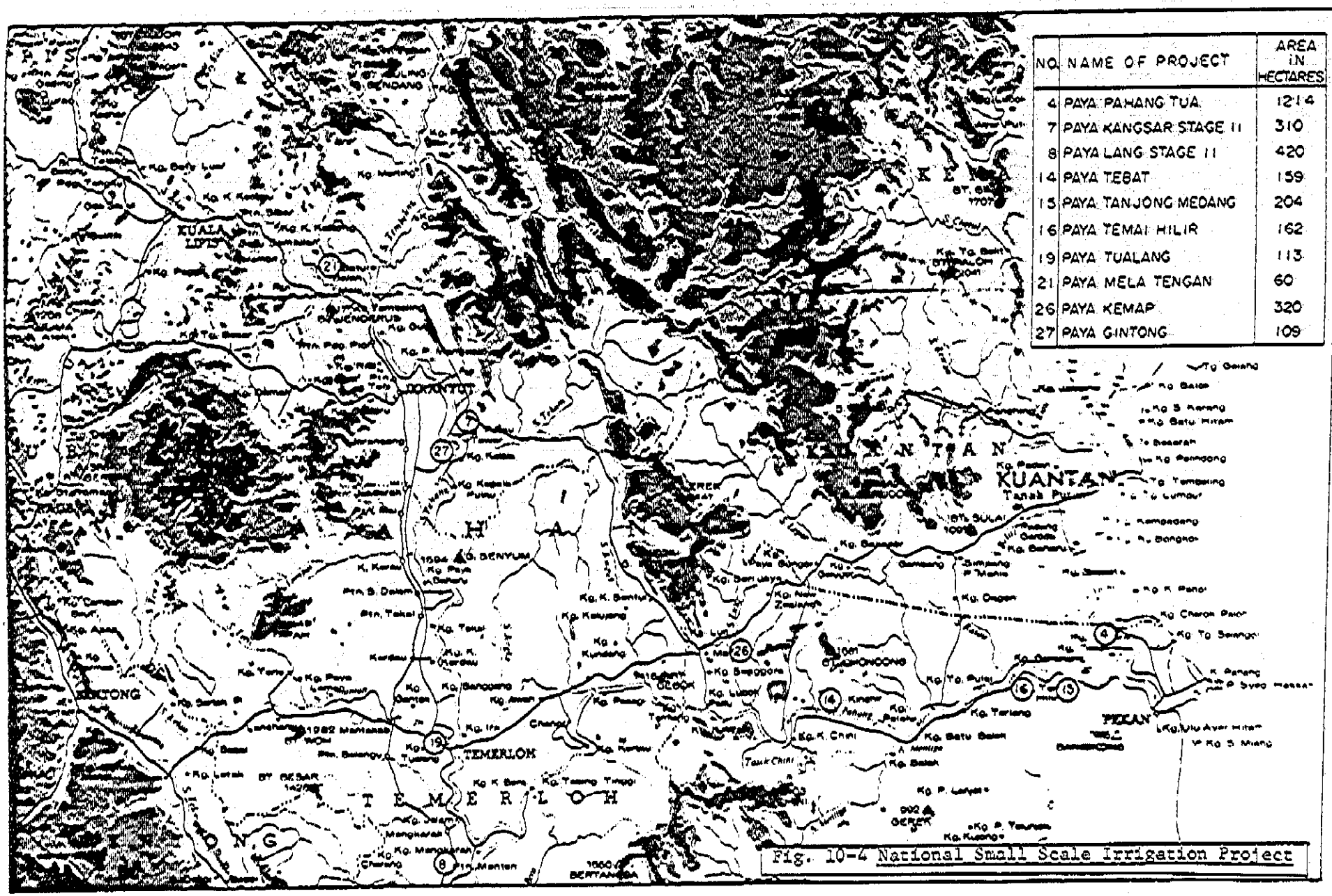


Fig. 10-3 MITIGATED STORAGE CAPACITY AND MAXIMUM OUTFLOW FROM RESERVOIR





NO.	NAME OF PROJECT	AREA IN HECTARES
4	PAYA PAHANG TUA	1214
7	PAYA KANGSAR STAGE II	310
8	PAYA LANG STAGE II	420
14	PAYA TEBAT	159
15	PAYA TANJONG MEDANG	204
16	PAYA TEMAI HILIR	162
19	PAYA TUALANG	113
21	PAYA MELA TENGAN	60
26	PAYA KEMAP	320
27	PAYA GINTONG	109

Fig. 10-4 National Small Scale Irrigation Project

Fig. 10-5 Diversion Scheme

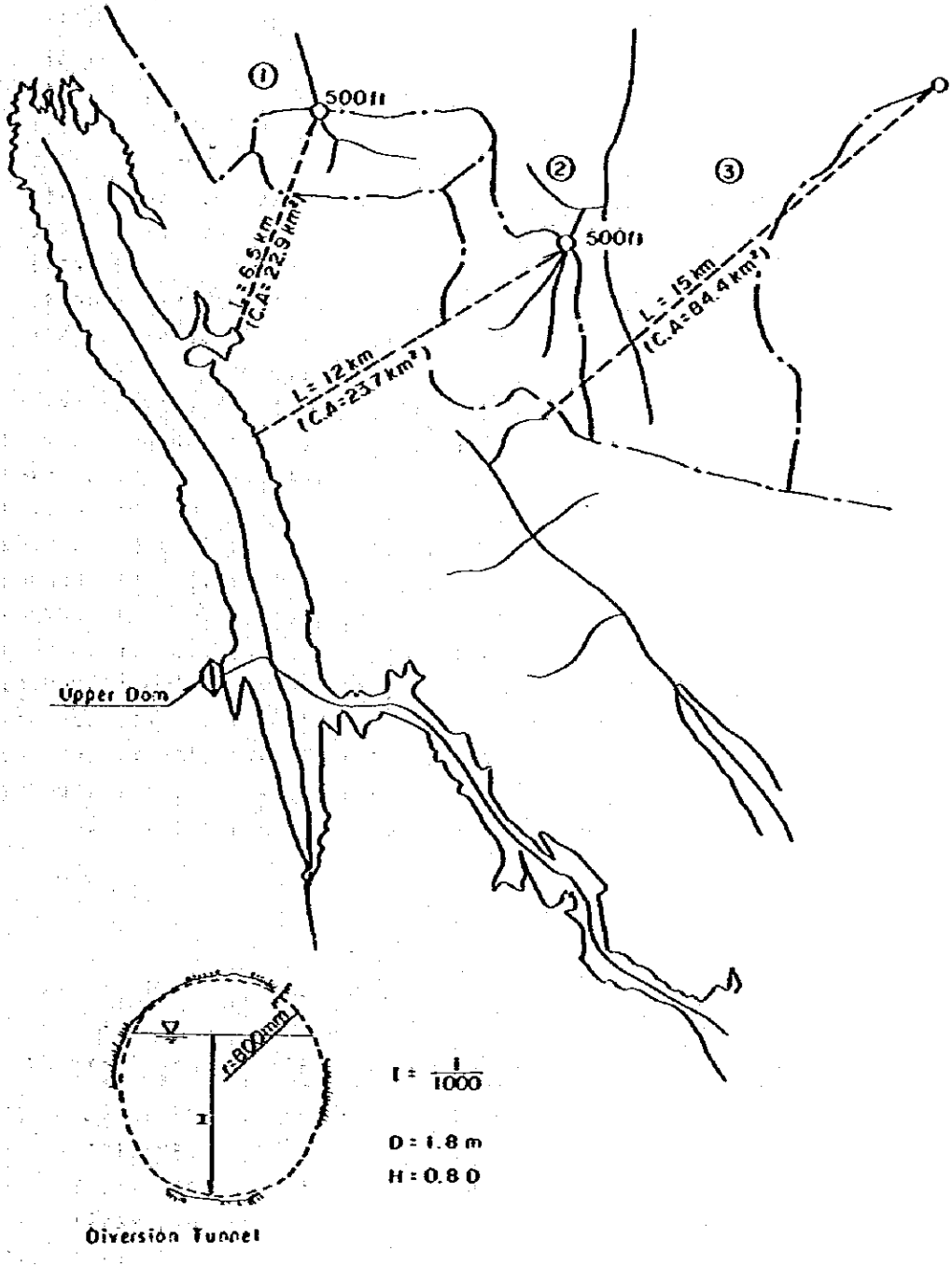


Table 10-1 Diversion Scheme (1)

H--E.L.M	98.5	111.0	118.0	125.0	142.5	147.9	150.0	155.5	162.5	165.0
V-10**6M3	70.	240.	400.	610.	1420.	1760.	1900.	2320.	3100.	3400.

F.S.L- 155.0 M.O.L- 155.0 B-- 82.0 PPAK(-- 104000). HD-- 151.7

(*1000Kw)

	1973	1974	1975	1976	1977	1978	1979	1980
1	3224.	3224.	3224.	3224.	3224.	3206.	3224.	3224.
2	2912.	2912.	2912.	3016.	2912.	2876.	2912.	3016.
3	3224.	3224.	3224.	3224.	3224.	3156.	3212.	3224.
4	3120.	3120.	3120.	3120.	3120.	3017.	3073.	3105.
5	3224.	3224.	3224.	3224.	3224.	3096.	3172.	3197.
6	3120.	3120.	3120.	3120.	3120.	2989.	3054.	3072.
7	3224.	3224.	3224.	3224.	3224.	3086.	3149.	3146.
8	3224.	3224.	3224.	3224.	3223.	3031.	3123.	3145.
9	3120.	3120.	3120.	3120.	3104.	2967.	3006.	3052.
10	3224.	3224.	3224.	3224.	3202.	3056.	3113.	3212.
11	3120.	3120.	3120.	3120.	3112.	2976.	3058.	3120.
12	3224.	3224.	3224.	3224.	3213.	3190.	3224.	3224.

(L.F...Kw)

	1973	1974	1975	1976	1977	1978	1979	1980
1	104000.	104000.	104000.	104000.	104000.	103939.	104000.	104000.
2	104000.	104000.	104000.	104000.	104000.	102303.	104000.	104000.
3	104000.	104000.	104000.	104000.	104000.	101136.	103033.	103924.
4	104000.	104000.	104000.	104000.	104000.	100338.	102355.	103243.
5	104000.	104000.	104000.	104000.	104000.	99753.	102069.	102313.
6	104000.	104000.	104000.	104000.	104000.	99473.	101719.	102021.
7	104000.	104000.	104000.	104000.	104000.	99351.	101332.	101145.
8	104000.	104000.	104000.	104000.	103957.	99131.	100147.	101204.
9	104000.	104000.	104000.	104000.	103912.	93594.	99936.	101395.
10	104000.	104000.	104000.	104000.	103939.	98544.	100373.	102725.
11	104000.	104000.	104000.	104000.	103915.	93655.	100174.	104000.
12	104000.	104000.	104000.	104000.	103967.	100122.	104000.	104000.

FIRM-Q = 43.00 (2975) QMAX = 150.00 6.

YEAR - - - - - -

	ENERGY-SEVER (KWH)	GENERATION-B (100) M)	LS-ENERGY (Kw)	LS-3 (100) M)	FDIA-BENEFIT (100) M)
1973	227758030.	34163.7	103939.3	7809.3	41973.0
1974	227758030.	34163.7	103999.3	7809.3	41973.0
1975	227758080.	34163.7	103999.3	7809.3	41973.0
1976	223332080.	34257.3	103999.3	7809.3	42066.6
1977	227412576.	34111.9	103736.6	7739.6	41931.4
1978	223174752.	33026.2	100015.5	7513.2	41535.4
1979	223977792.	33590.7	102037.1	7653.7	41256.4
1980	226422046.	33963.3	102377.3	7725.1	41635.3
8 AVERAGE	225233376.	33837.3	103079.4	7753.2	41871.)

INSTALLED CAPACITY (Kw)= 104000.)

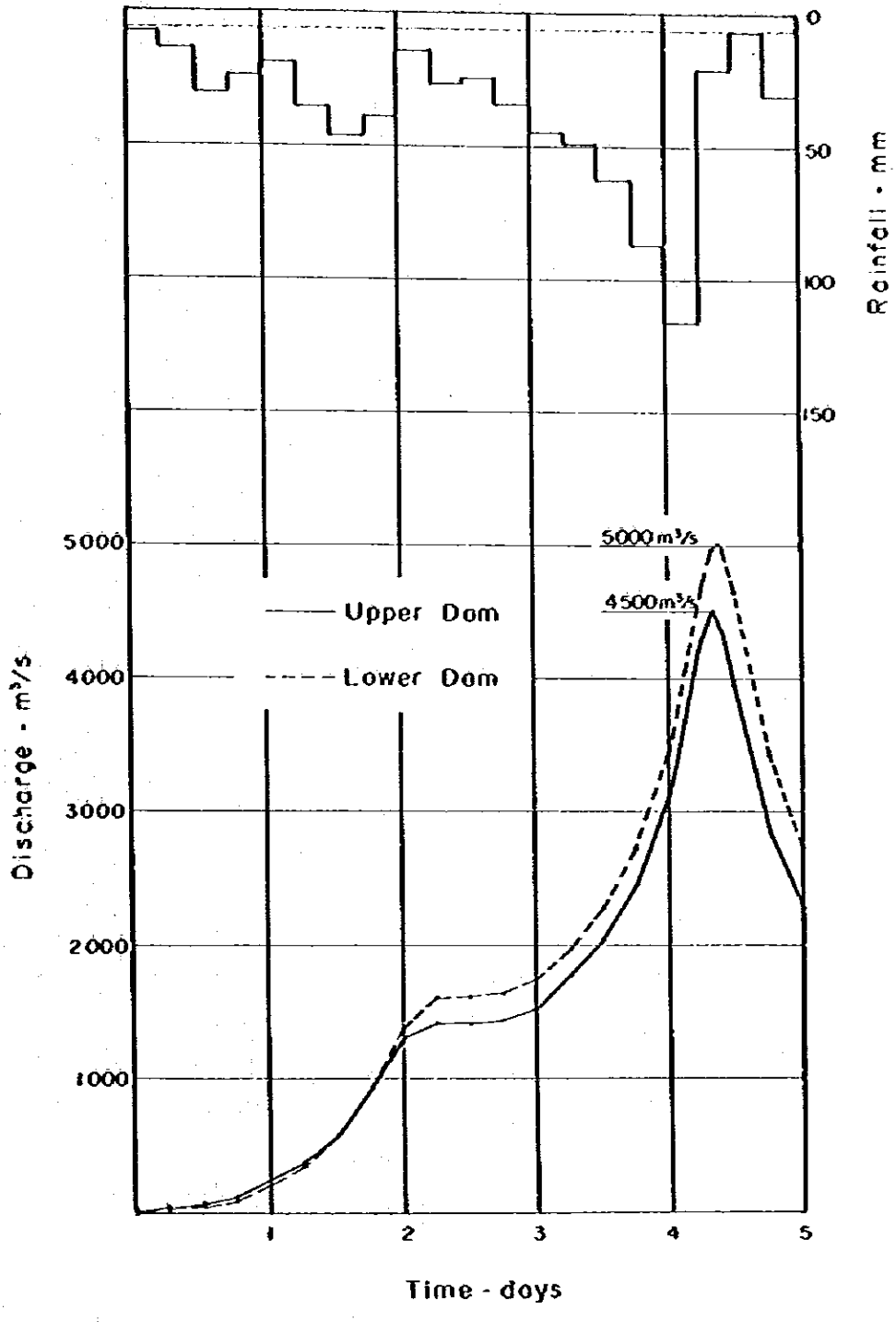
(Please refer to Table 9-5 for Legend)

Table 10-2 Diversion Sheme (2)

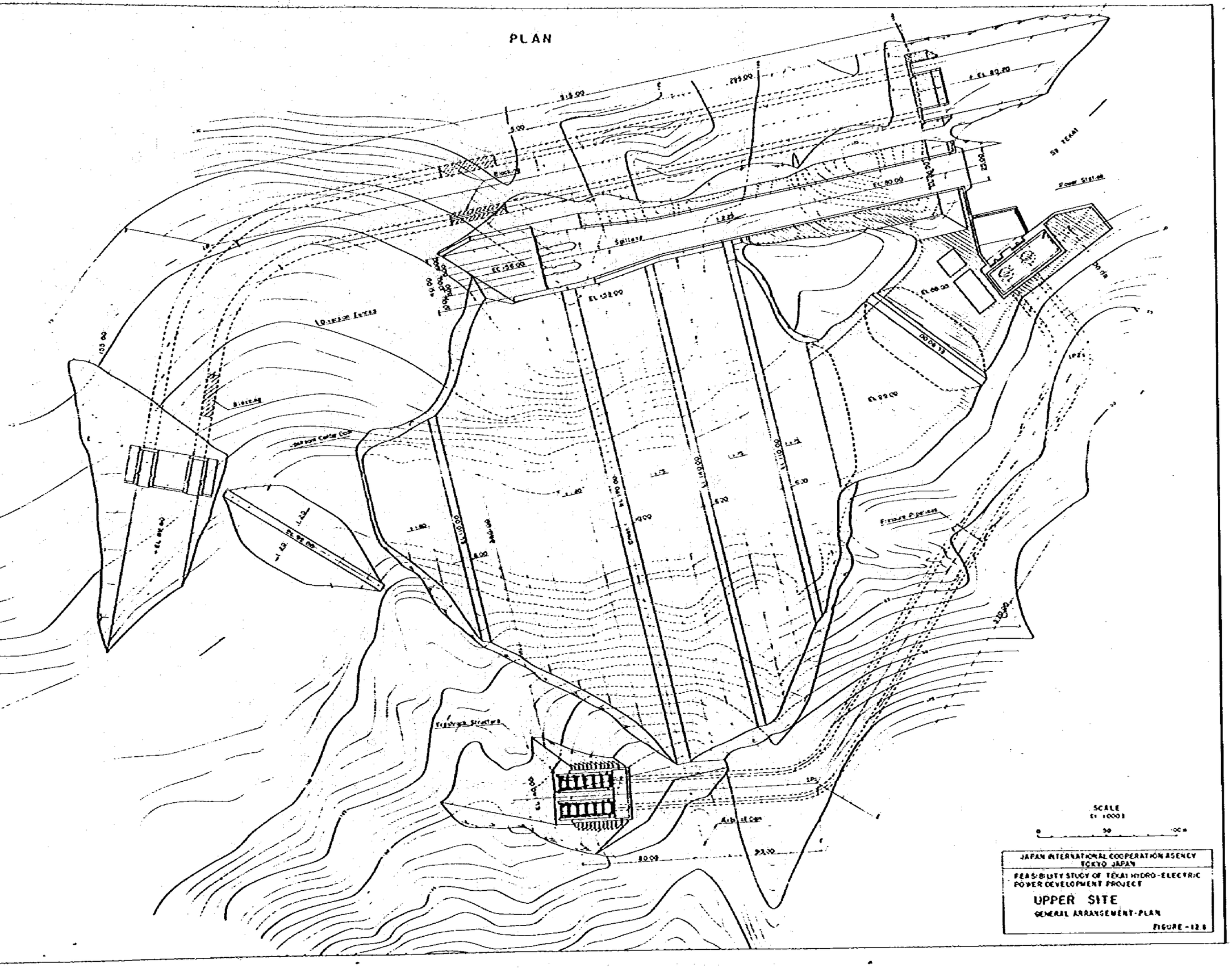
Benefit/Cost Analysis

Item	Unit	
Maximum Output	GW	0.103
Annual Generated Energy	GWH	226.0
Construction Cost	10^6 M$	378.290
Capital Value with IDC (IDC = 16%)	M$/kW	4260.4
Capital Cost (1) (CRF = 0.0817)	M$/kWH	0.1585
Fixed Cost with Overhead	M$/kW	11.02
Insurance (0.1%)	M$/kW	4.26
Inclusive Fixed Cost	M$/kW	15.28
O & M Costs (2)	M$/kWH	0.0070
Total Operating Cost (1+2)	M$/kWH	0.1655
Cost for Power Generating	10^6 M$	37.42
Reservoir Clearing Cost	10^6 M$	5.67
Annual Cost (C)	10^6 M$	43.10
Annual Benefit (B)	10^6 M$	41.67
(B) / (C)		0.97
(B) - (C)	10^6 M$	-1.43

Figuer II-1 Design Flood at the Damsite



PLAN



JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO JAPAN

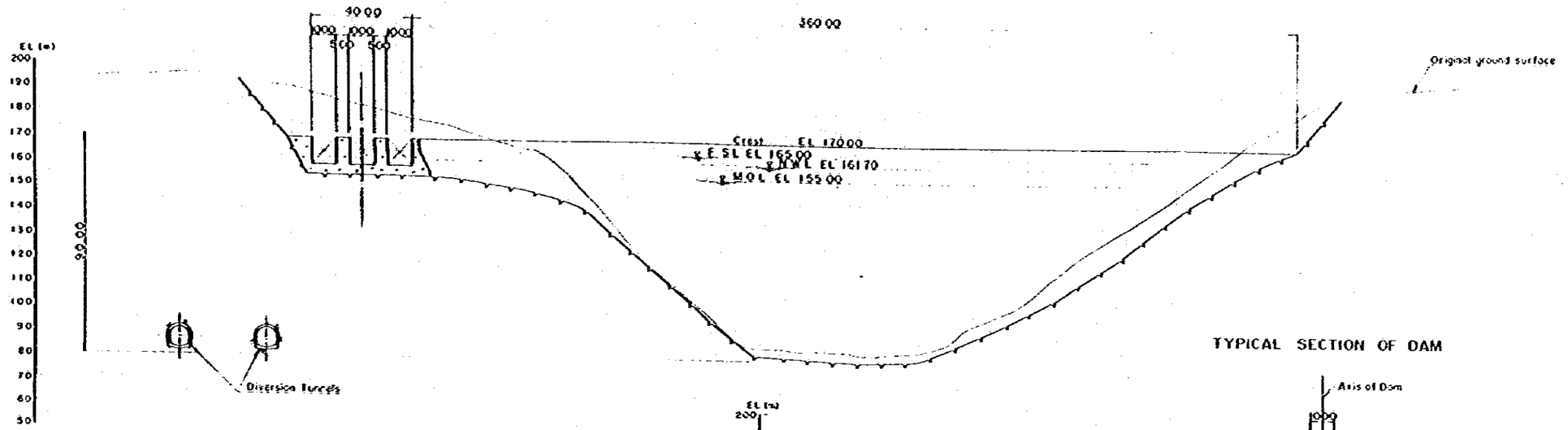
FEASIBILITY STUDY OF TEKAI HYDRO-ELECTRIC POWER DEVELOPMENT PROJECT

UPPER SITE

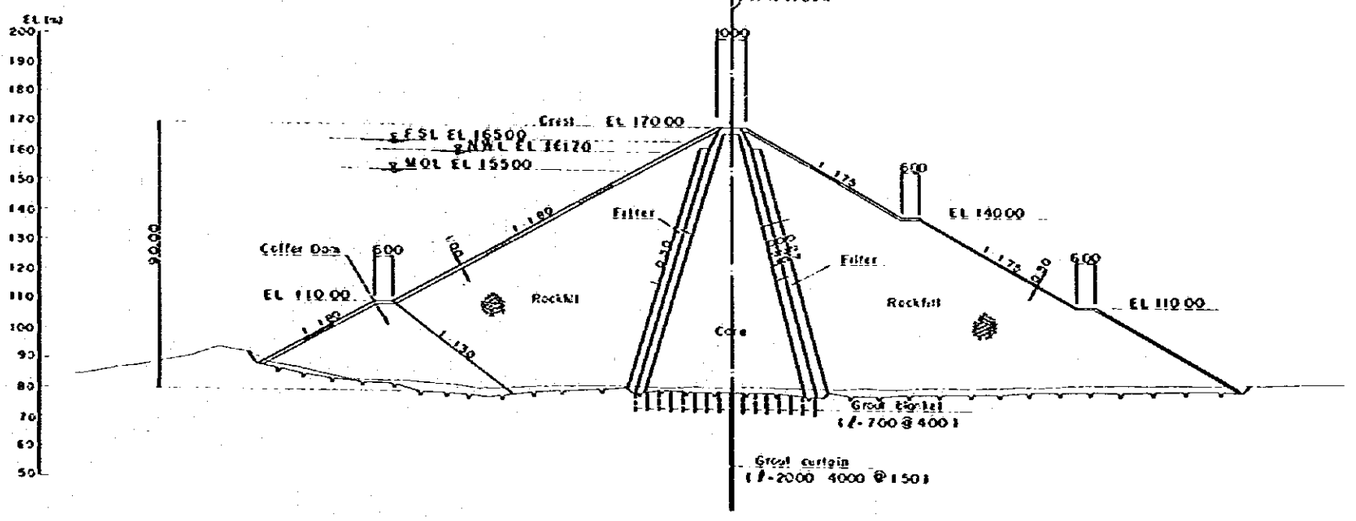
GENERAL ARRANGEMENT-PLAN

FIGURE-12.8

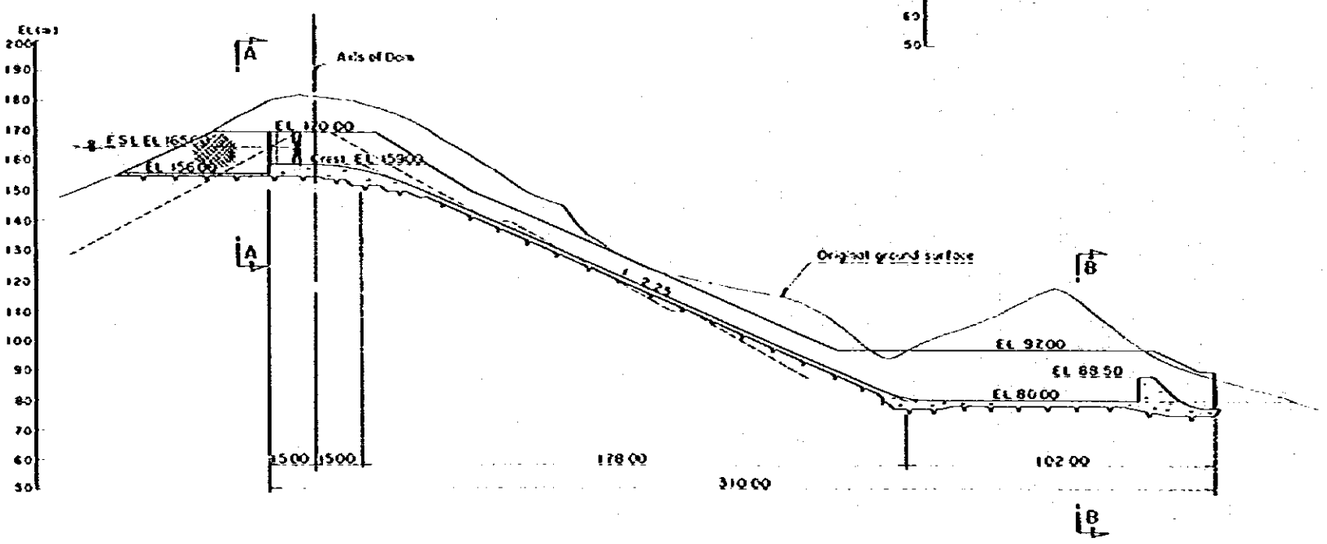
LONGITUDINAL SECTION



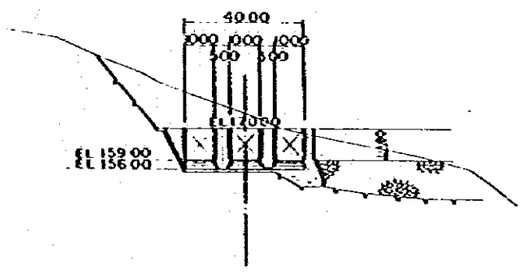
TYPICAL SECTION OF DAM



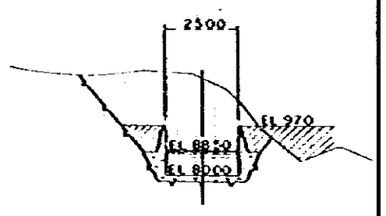
LONGITUDINAL SECTION OF SPILLWAY



A - A



B - B



SCALE
(1:1000)

0 50 100 m

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO JAPAN

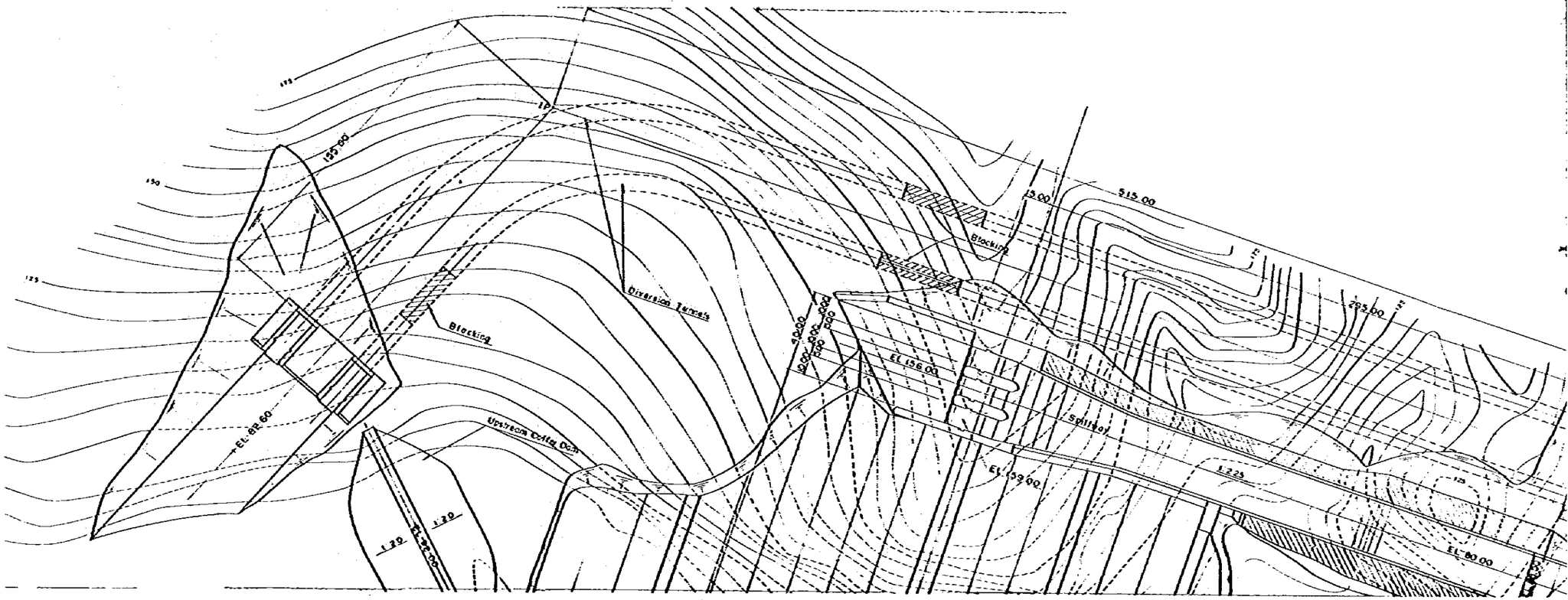
FEASIBILITY STUDY OF TEKAI HYDRO-ELECTRIC POWER DEVELOPMENT PROJECT

UPPER SITE

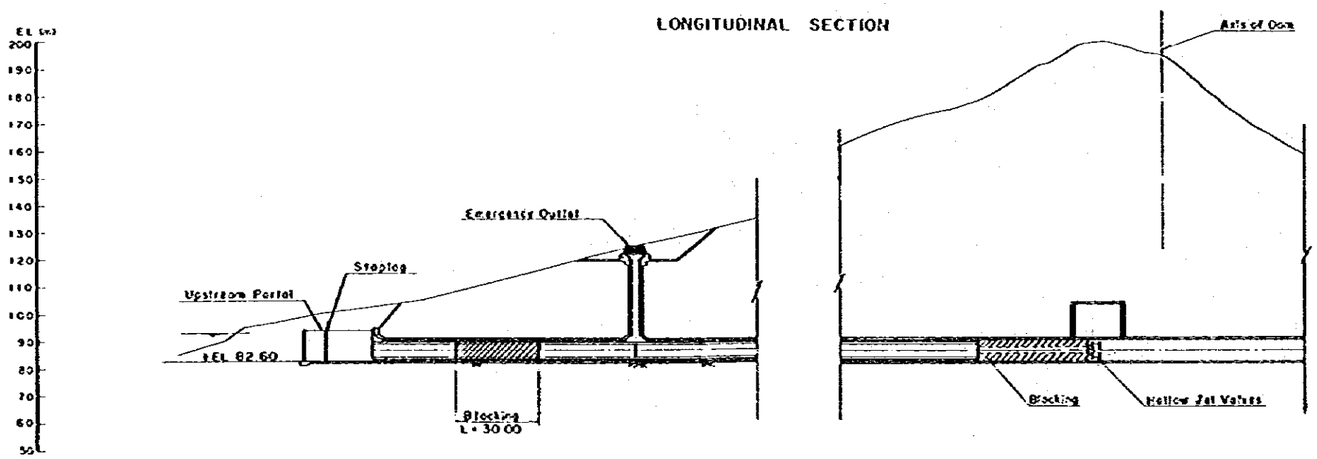
SPILLWAY AND SECTIONS

FIGURE - 12.2

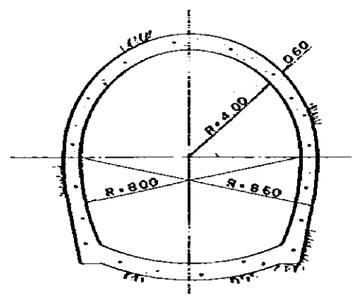
PLAN



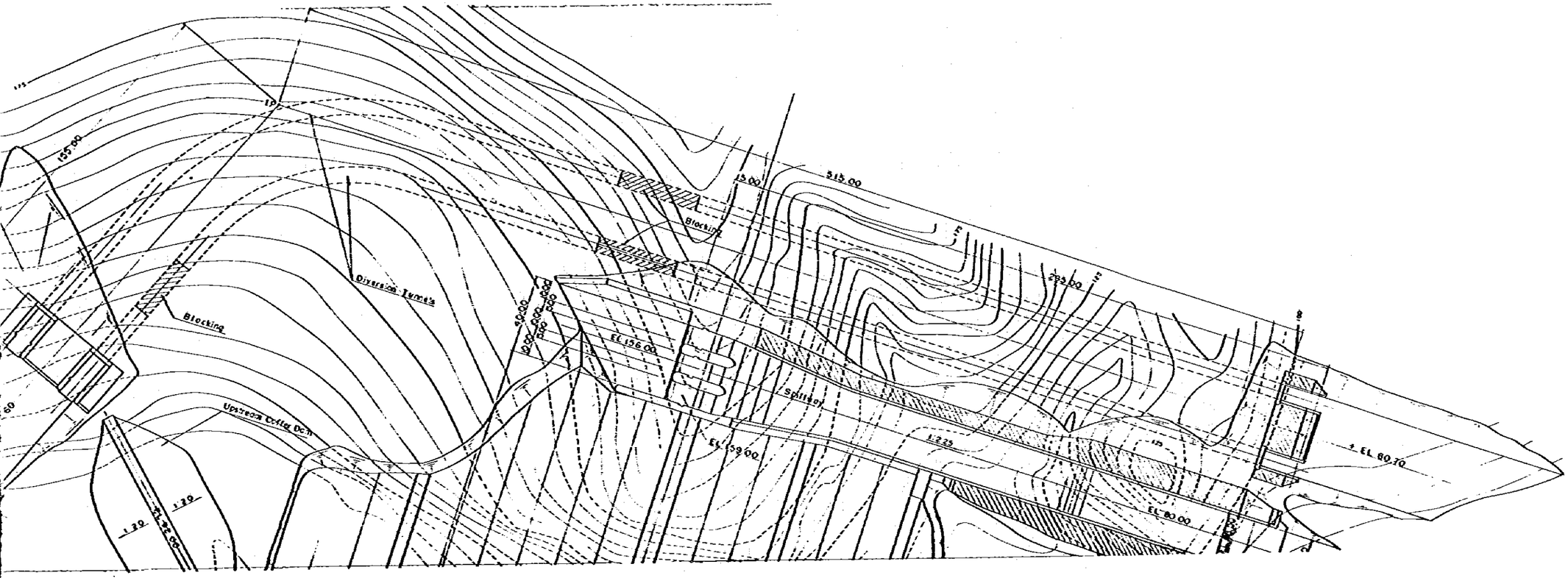
LONGITUDINAL SECTION



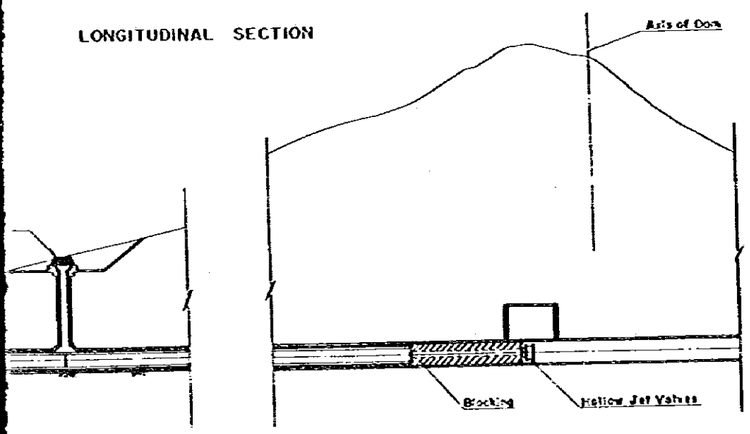
TYPICAL SECTION OF DIVERSION TUNNEL
(1:100)

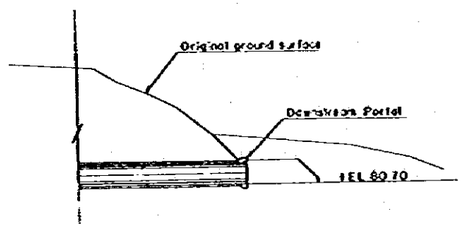


PLAN

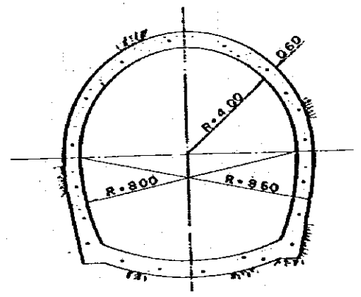


LONGITUDINAL SECTION





TYPICAL SECTION OF DIVERSION TUNNEL
(1:100)



SCALE
(1:1000)

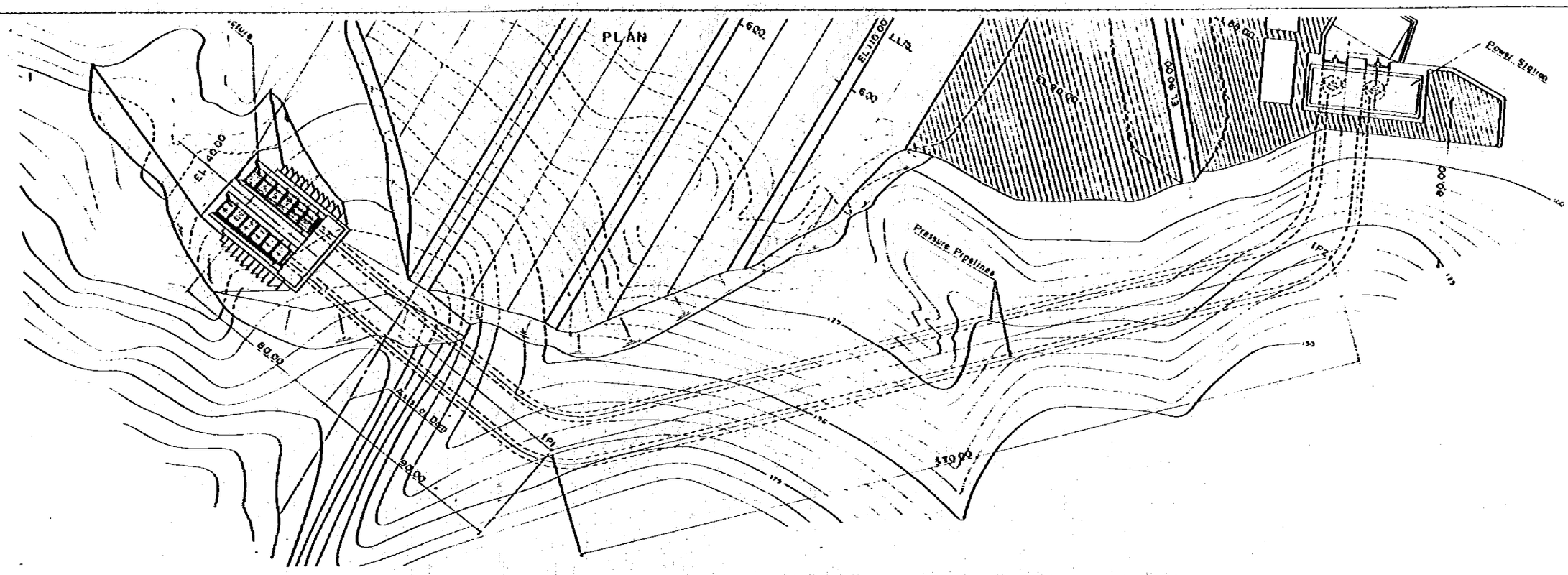
0 50 100 m

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO JAPAN

FEASIBILITY STUDY OF TEKAI HYDRO-ELECTRIC POWER DEVELOPMENT PROJECT

UPPER SITE
DIVERSION TUNNELS

FIGURE - 12.3



JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO JAPAN

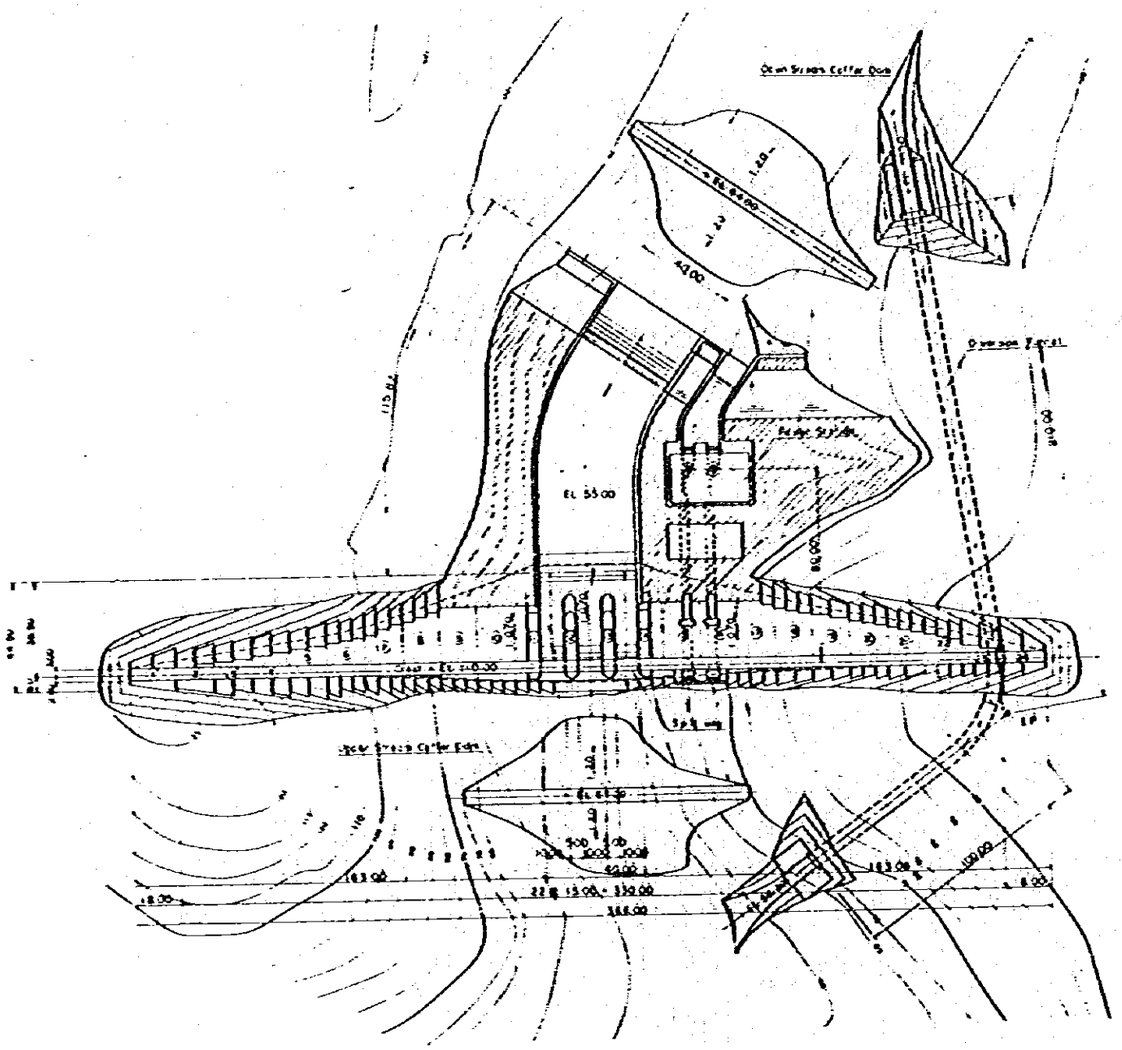
FEASIBILITY STUDY OF TEKAI HYDRO-ELECTRIC POWER DEVELOPMENT PROJECT

UPPER SITE

PIPELINES AND POWER STATION

FIGURE - 12.4

PLAN



SCALE
1 : 1000

0 50 100 m

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO JAPAN

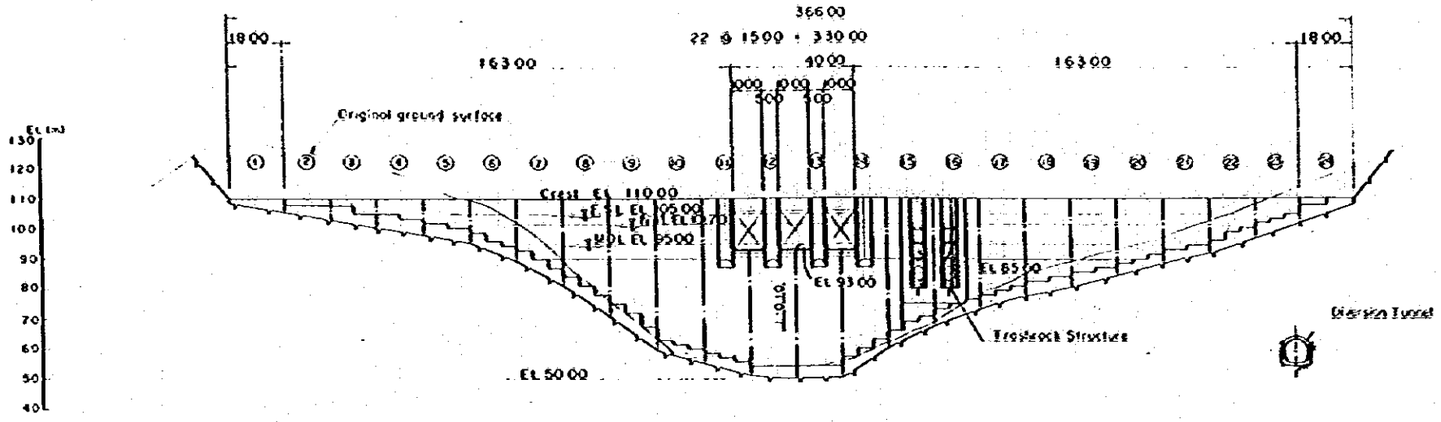
FEASIBILITY STUDY OF TEKAI HYDRO-ELECTRIC POWER DEVELOPMENT PROJECT

LOWER SINGLE DEVELOPMENT

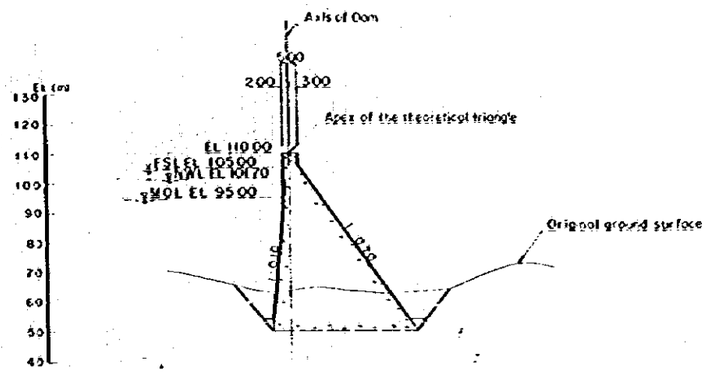
GENERAL ARRANGEMENT - PLAN

FIGURE - 12.5

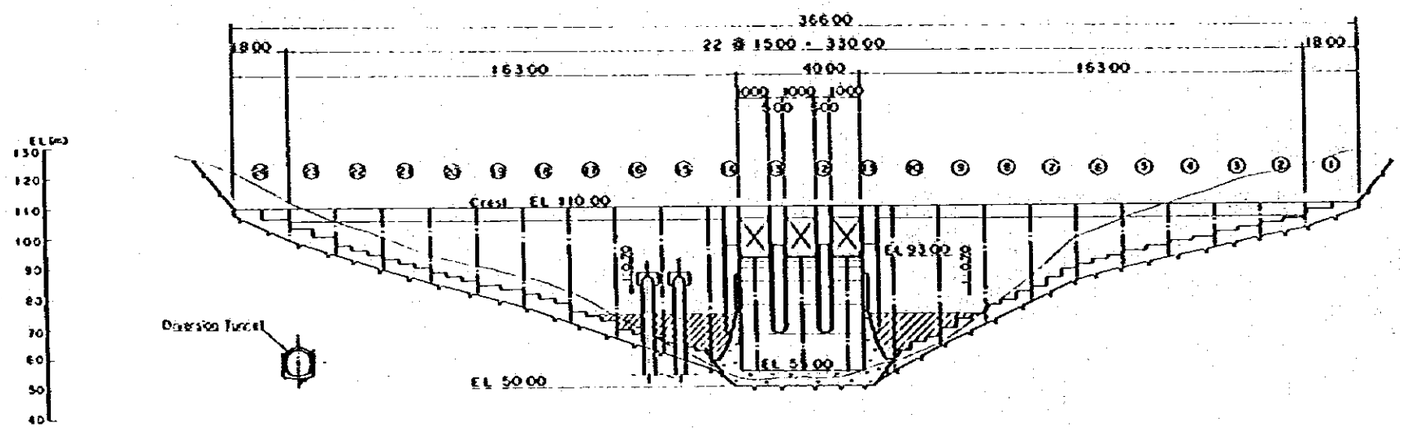
UPSTREAM ELEVATION



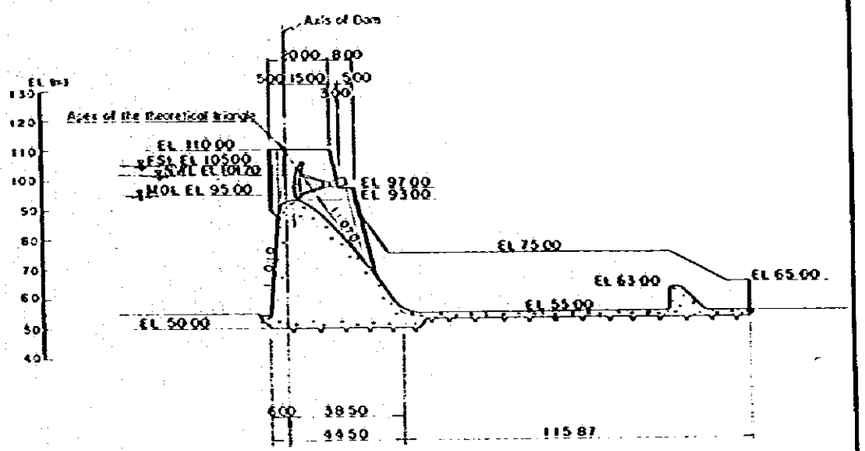
NON-OVERFLOW SECTION



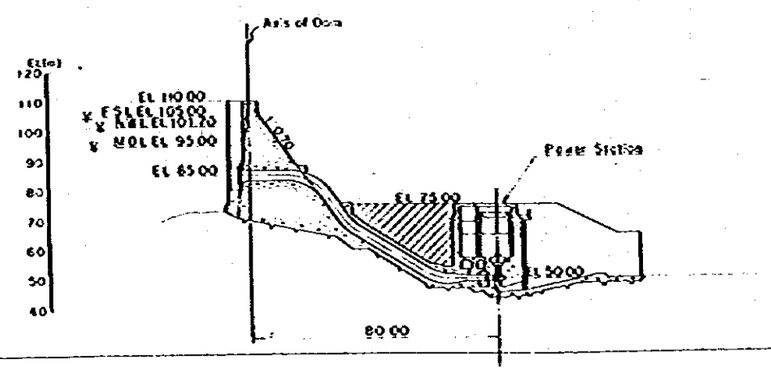
DOWNSTREAM ELEVATION



OVERFLOW SECTION



LONGITUDINAL SECTION OF PRESSURE PIPELINE



SCALE
(1:1000)

0 50 100m

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO JAPAN

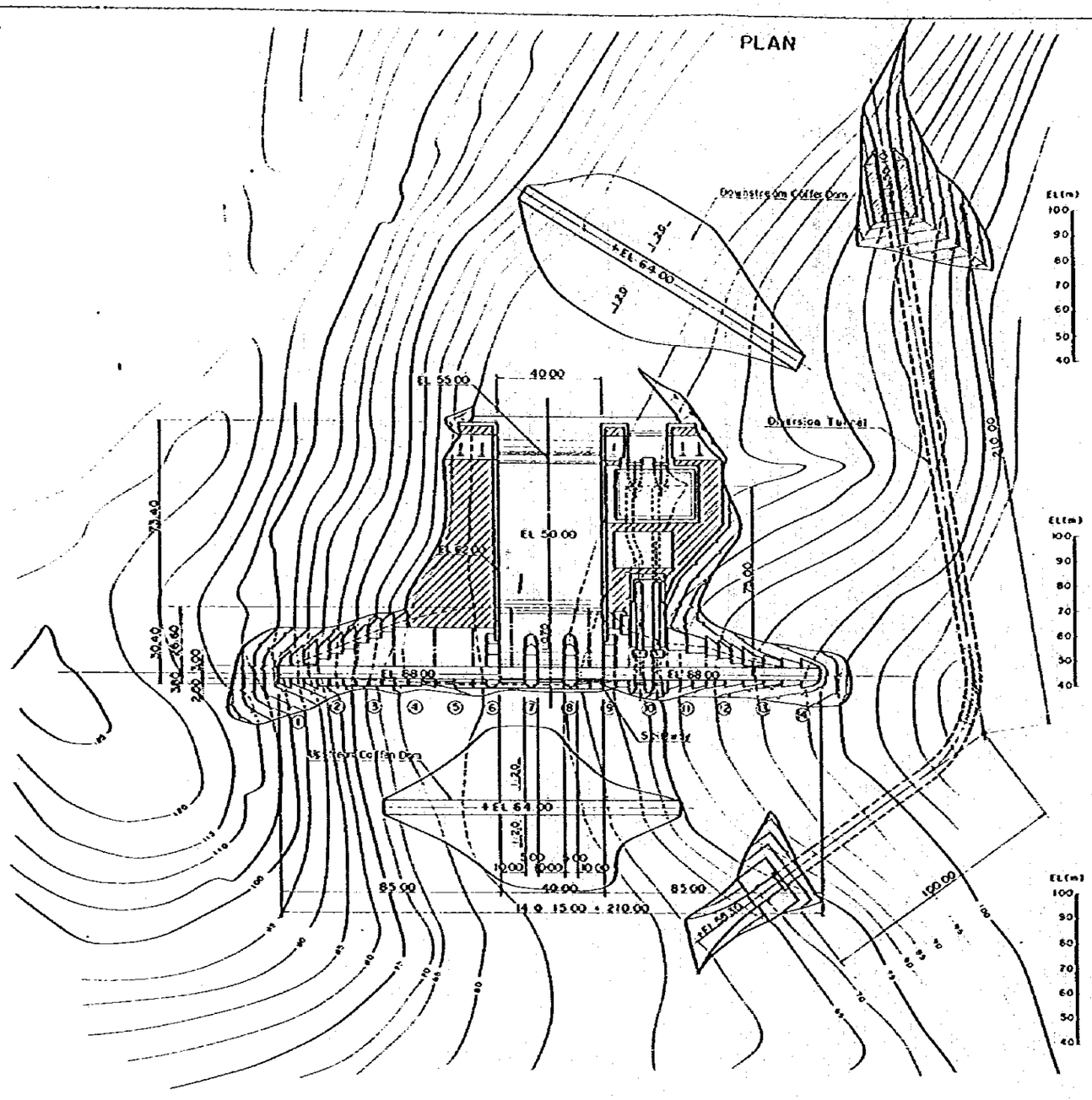
FEASIBILITY STUDY OF TEKAI HYDRO-ELECTRIC POWER DEVELOPMENT PROJECT

LOWER SINGLE DEVELOPMENT

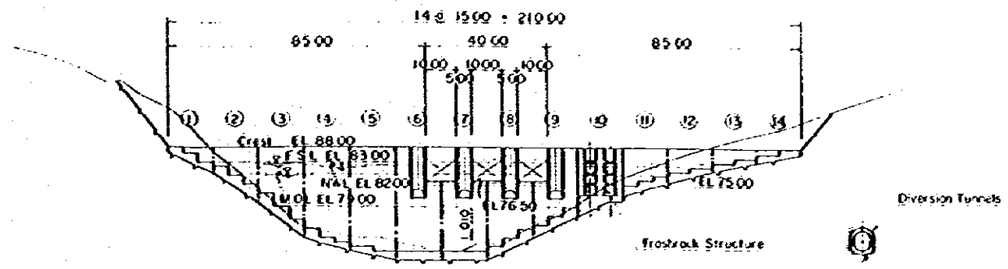
POWERSTATION AND SECTIONS

FIGURE - 12.6

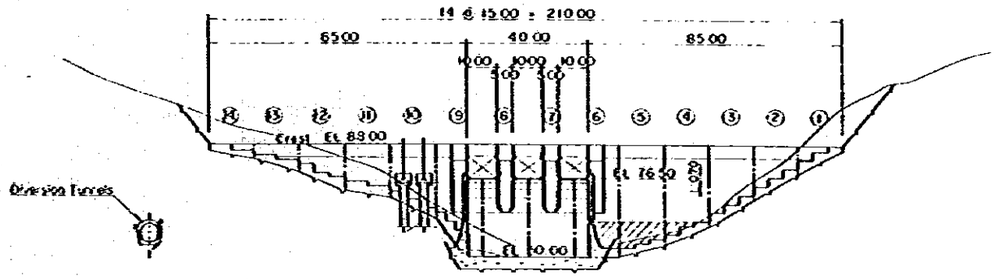
PLAN



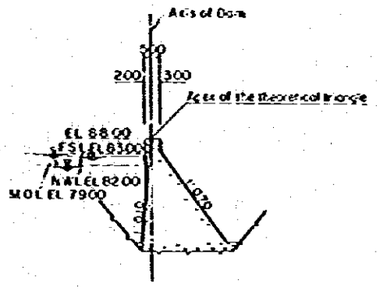
UPSTREAM ELEVATION



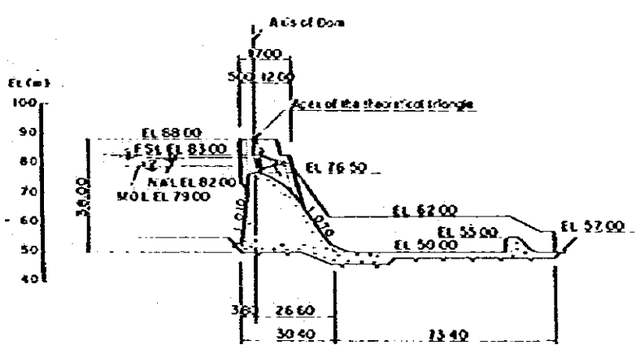
DOWNSTREAM ELEVATION



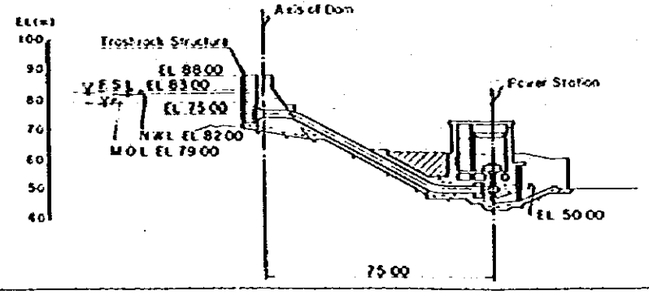
NON-OVEVFLOW SECTION



OVERFLOW SECTION



LONGITUDINAL SECTION OF PRESSURE PIPELINE



SCALE

(1:1000)

0 50 100m

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO JAPAN

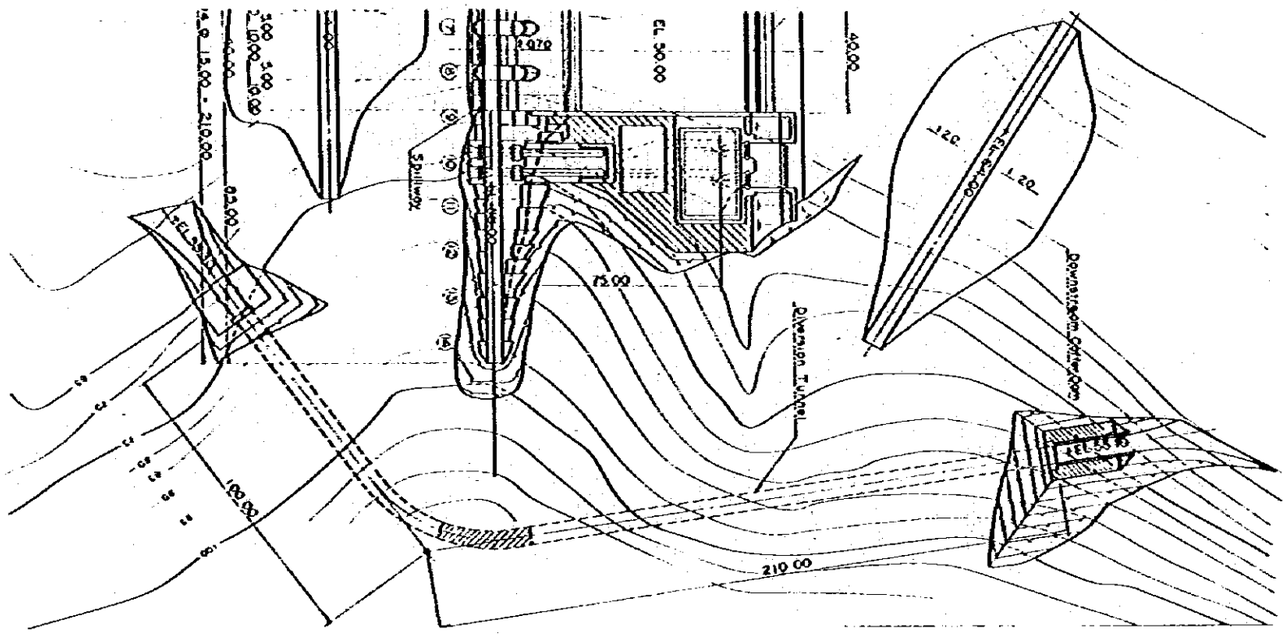
FEASIBILITY STUDY OF TEKAI HYDRO-ELECTRIC POWER DEVELOPMENT PROJECT

LOWER SERIES DEVELOPMENT

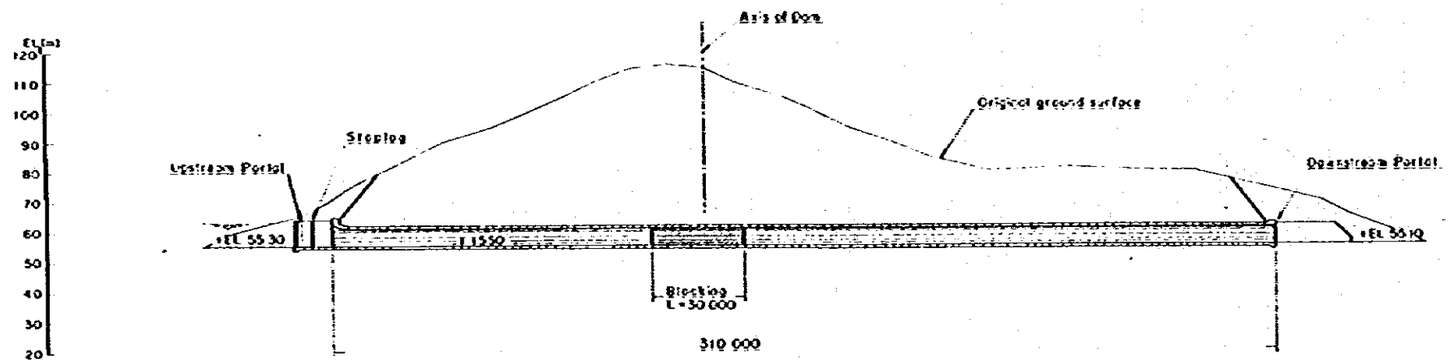
GENERAL ARRANGEMENT - PLAN, POWER STATION AND SECTIONS

FIGURE - 12.7

PLAN

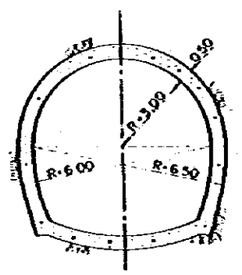


LONGITUDINAL SECTION



TYPICAL SECTION OF DIVERSION TUNNEL

(1:100)



SCALE
(1:1000)

0 50 100m

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO JAPAN

FEASIBILITY STUDY OF TEKAI HYDRO-ELECTRIC

LOWER SERIES DEVELOPMENT

DIVERSION TUNNEL

FIGURE - 12 8

Table 12-1 Unit Rate of Estimation (1)

Item	Quantity	Unit	Unit Cost	Construction Cost	Remarks
1. Civil Works			(M$)	(M$)	
1-1. Preparatory Works					
1) Access Road		Km	400,000		
2) Temporary Facilities					{(1-2)+(1-3)} x 10%
1-2. Diversion Tunnel					
1) Common Excavation		m^3	7.0		
2) Rock Excavation		"	22.0		
3) Concrete		"	.0		
4) Tunnel Excavation		"	300		
5) Coffer Dam		"	14.0		
6) Others					5%
Sub Total					
1-3. Dam					
1) Common Excavation		m^3	8.0		
2) Rock Excavation		"	25.0		
3) Embankment Construction					
a) Concrete		m^3	200		
4) Pressure Grouting					
a) Drilling Grout Holes		m	120		
b) Grout Cement		t	1,300		
5) Others					10%
Sub Total					
1-4. Mechanical Equipment					
1) Gate		t	10,000		

Unit Rate of Estimation (2)

Item	Quantity	Unit	Unit Cost	Construction Cost	Remarks
1-5. Intake Structure and Penstock			(M$)	(M$)	
1-6. Power House and Switch Yard					
1-7. Tailrace					
2. Generating Equipment					
3. Engineering Service					(1+2)x13%
4. Government Administration					(1+2)x5%
5. Contingency					(1+2+3+4)x 10%
6. Grand Total					

Table 12-2 Summary of Costs for Tekai Development

	Single (Upper One Dam Development) M$ x 10^6	Single (Lower One Dam Development) M$ x 10^6	Series (Two Dams Development) M$ x 10^6
1. Contract Construction Cost			
1.1 Civil	194.2	100.8	254.4
1.2 Generating Equipment	36.8	23.4	50.6
2. Engineering Service and General Expense	30.0	16.1	39.7
3. Government Administration	11.5	6.2	15.2
4. Contingency	27.3	14.6	36.0
5. Grand Total	299.8	161.1	395.9

Table 12-3 Construction Cost Estimates (1)

Upper Single (One Dam) Development

[Fill, H=90
6 hr, Mol=155.0]

Item	Quantity	Unit	Unit Cost	Construction Cost	Remarks
1. Civil Works			(M$)	(M$)	
1-1. Preparatory Works					
1) Access Road	20	Km	400,000	8,000,000	
2) Temporary Facilities				13,675,000	[(1-2)+(1-3) +(1-4)]x10%
1-2. Diversion Tunnel					
1) Common Excavation	26,050	m^3	7.0	182,000	
2) Rock Excavation	94,950	"	22.0	2,089,000	
3) Concrete	21,600	"	450	9,720,000	
4) Tunnel Excavation	120,000	"	300	36,000,000	
5) Coffer Dam	47,200	"	14.0	661,000	
6) Others				2,433,000	5%
Sub Total				51,085,000	
1-3. Dam					
1) Common Excavation	169,700	m^3	8.0	1,358,000	
2) Rock Excavation	169,700	"	25.0	4,243,000	
3) Embankment Construction					
a) Core	417,000	m^3	10.0	4,170,000	
b) Filter	226,200	"	30.0	6,786,000	
c) Rock-fill	1,898,800	"	15.0	28,482,000	
d) Riprap	68,000	"	30.0	2,040,000	
4) Pressure Grouting					
a) Drilling Grout Holes	12,300	m	120	1,476,000	
b) Grout Cement	980	t	1,300	1,274,000	
5) Others				4,983,000	10%
Sub Total				54,812,000	

Construction Cost Estimates (2)

Item	Quantity	Unit	Unit Cost	Construction Cost	Remarks
1-4. Spillway			(M$)	(M$)	
1) Common Excavation	106,100	m^3	8.0	849,000	
2) Rock Excavation	247,600	"	25.0	6,190,000	
3) Concrete	57,500	"	350	20,125,000	
4) Reinforcing Steel Bars	520	t	1,700	884,000	
5) Others				2,805,000	10%
Sub Total				30,853,000	
1-5. Mechanical Equipment					
1) Gate	500	t	10,000	5,000,000	
1-6. Intake Structure and Penstock				25,692,000	
1-7. Power House and Switch Yard				4,500,000	
1-8. Tailrace				520,000	
2. Generating Equipment				36,800,000	
3. Engineering Service and General Expense				30,022,000	(1+2)× 13%
4. Government Administration				11,547,000	(1+2) × 5%
5. Contingency				27,251,000	(1+2+3+4)×10%
6. Grand Total				299,757,000	

Table 12-4 Construction Cost Estimates (1)

Lower Single (One Dam) Development

[Conc. H=60
12 hr, MOL=95.0]

Item	Quantity	Unit	Unit Cost	Construction Cost	Remarks
			(M$)	(M$)	
1. Civil Works					
1-1. Preparatory Works					
1) Access Road	20	Km	400,000	8,000,000	
2) Temporary Facilities				6,289,000	[(1-2)+(1-3)] x 10%
1-2. Diversion Tunnel					
1) Common Excavation		m^3	7.0		
2) Rock Excavation		"	22.0		
3) Concrete		"	45.0		
4) Tunnel Excavation		"	300		
5) Coffer Dam		"	14.0		
6) Others				12,713,000	5%
Sub Total					
1-3. Dam					
1) Common Excavation		m^3	8.0		
2) Rock Excavation		"	25.0		
3) Embankment Construction					
a) Concrete		m^3	200		
4) Pressure Grouting					
a) Drilling Grout Holes		m	120		
b) Grout Cement		t	1,300		
5) Others					10%
Sub Total				50,173,000	
1-4. Mechanical Equipment					
1) Gate		t	10,000	5,000,000	(82,175,000)

Construction Cost Estimates (2)

Item	Quantity	Unit	Unit Cost	Construction Cost	Remarks
			(M$)	(M$)	
1-5. Intake Structure and Penstock				14,900,000	
1-6. Power House and Switch Yard				3,200,000	
1-7. Tailrace				440,000	
2. Generating Equipment				23,400,000	
3. Engineering Service and General Expense				16,135,000	(1+2)x13%
4. Government Administration				6,206,000	(1+2)x5%
5. Contingency				14,646,000	(1+2+3+4) x 10%
6. Grand Total				161,102,000	

Table 12-5 Construction Cost Estimates (1)

Lower Dam in Series (Two Dams) Development

[Conc., H=38
24 hr. Q max.=46.3]

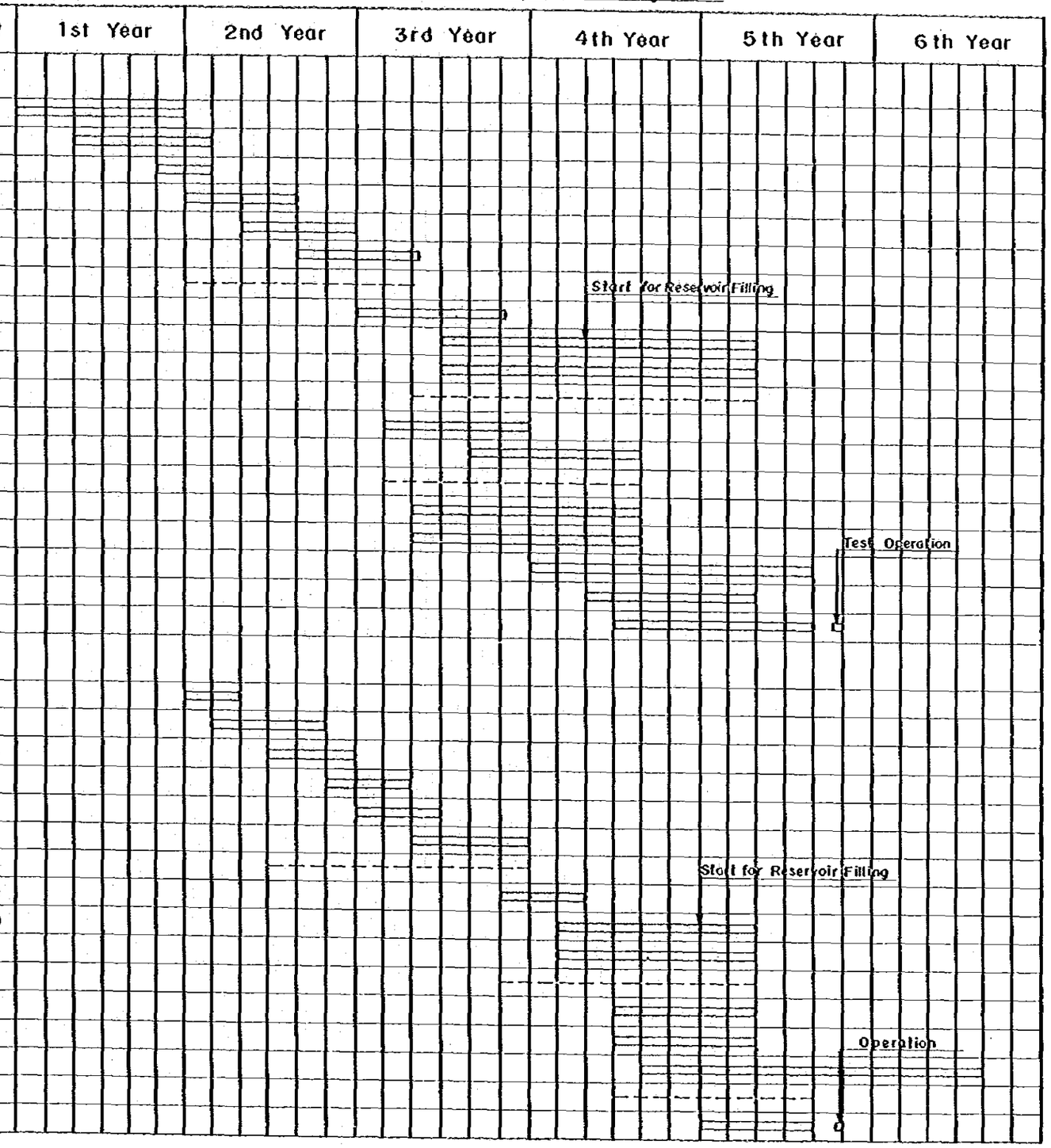
Item	Quantity	Unit	Unit Cost	Construction Cost	Remarks
1. Civil Works			(M$)	(M$)	
1-1. Preparatory Works					
1) Access Road	20	Km	400,000	8,000,000	
2) Temporary Facilities				3,969,000	[(1-2)+(1-3)] x 10%
1-2. Diversion Tunnel					
1) Common Excavation		m^3	7.0		
2) Rock Excavation		"	22.0		
3) Concrete		"	45.0		
4) Tunnel Excavation		"	300		
5) Coffer Dam		"	14.0		
6) Others				12,713,000	5%
Sub Total					
1-3. Dam					
1) Common Excavation	39,360	m^3	8.0	315,000	Vo=65,600
2) Rock Excavation	26,240	"	25.0	656,000	
3) Embankment Construction					
a) Concrete	74,000	m^3	200	14,800,000	
4) Pressure Grouting					
a) Drilling Grout Holes	6,600	m	120	792,000	
b) Grout Cement	530	t	1,300	689,000	
5) Others				1,725,000	10%
Sub Total				18,977,000	
1-4. Mechanical Equipment					
1) Gate	500	t	10,000	5,000,000	(48,659,000)

Construction Cost Estimates (2)

Item	Quantity	Unit	Unit Cost	Construction Cost	Remarks
			(M$)	(M$)	
1-5. Intake Structure and Penstock				9,152,000	
1-6. Power House and Switch Yard				2,100,000	
1-7. Tailrace				360,000	
2. Generating Equipment		Kw	870	13,800,000	
3. Engineering Service and General Expense				9,629,000	(1+2)x13%
4. Government Administration				3,704,000	(1+2)x5%
5. Contingency				8,740,000	{(1+2+3+4) x 10%
6. Grand Total				96,144,000	

Fig.14-1 Construction Schedule, Tekai Hydro-electric Power Development Project

Description of Works		Unit	Quantity	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
(Upper Dam)									
Preparation	Access Rord	L.S	1						
	Temporary-Facilities	L.S	1						
Diversion	Excavation	m3	121.000						
	Tunnel Excavation	m3	120.000						
	Linning Concrete	m3	21.600						
	Coffer Dam	m3	47.200						
	Others	L.S	1						
Dam	Excavation	m	339.400						
	Embankment	m	2.610.000						
	Grouting	L.S	1						
	Others	L.S	1						
Spillway	Excavation	m3	353.700						
	Concrete	m3	57.500						
	Others	L.S	1						
Other Structures	Intake	L.S	1						
	Penstock	L.S	1						
	Power House, Switch Yard	L.S	1						
	Tailrace	L.S	1						
Generating Equipment		L.S	1						
(Lower Dam)									
Preparation	Access Rord	L.S	1						
	Temporary Facilities	L.S	1						
Diversion	Excavation	m3	45.500						
	Tunnel Excavation	m3	27.700						
	Linning Concrete	m3	4.800						
	Coffer Dam	m3	59.700						
	Others	L.S	1						
Dam	Excavation	m3	65.600						
	Concrete	m3	74.000						
	Grouting	L.S	1						
	Others	L.S	1						
Other Structures	Intake	L.S	1						
	Penstock	L.S	1						
	Power House, Switch Yard	L.S	1						
	Others	L.S	1						
Generating Equipment		L.S	1						



3-1 Unit Cost of Construction

Equipment Proposal (Kenyir Dam Project)

3-2 Environmental Aspects

The Environmental Impact Assessment Handbook
Procedure and Guidlines.

Appendix 2.1 to Part II, E.I.A. Handbook

Malaysia Environment and Development a Report to The Government of Malaysia by a World Bank Environmental Mission Dec. 1975 (Draft for Discussion)

Environmental, Health and Human Ecologic Considerations in Economic Development Projects (World Bank/May 1974)

Manual of NEB Guidlines for Preparation of Environmental Impact Evaluations.

3-3 Fishery

Prices of Freshwater Fish (at Jerantut)

Ecological Drawing of Fish Classification

The Influence of Environmental Degradation on Riverine Fisheries in Peninsular Malaysia

3-4 Forestry

Price List of Wood

Foresters' Manual of Depterocarps

Forestry and Forest Industries Development Malaysia

Forestry in Peninsular Malaysia

Forest Resource Base, Policy and Legislation of Peninsular Malaysia

MASKAYA (Monthly Timber Bulletin) Vol. 4, Apr. 1980

3-5 Archaecological

Report on the Archaecological Potentialities of the Tekai Valley, Pahang

3-6 Animals

Save Our Wildlife (The Sunday Star, July 19, 1981)

3-7 Seismic

Seismic Design of Mtera Dam

Advisory Services Report. Suggestions regarding measuring equipment for a small seismological observatory in Malaysia

3-8 Hydrology and Meteorology

Hourly Water Stage

Station Number	Period of Observation
(Kuala Tahan) 4324454	Oct. 1972 - Jun. 1981
(Penut) 4224453	Apr. 1972 - Feb. 1981

Daily Discharge

Station Number	Period of Observation
3224433	Nov. 1972 - Dec. 1979

Monthly Discharge

Station Number	Period of Observation
4324454	Sep. 1972 - June 1981
4224453	Nar. 1972 - Dec. 1981

Daily Rainfall

Station Number	Period of Observation
4324401	Aug. 1973 - Dec. 1980
4227001	Sep. 1975 - May 1979
4127001	Jan. 1974 - July 1979
4023001	Nov. 1973 - Dec. 1979
(Lower Tekai Damsite) Rt. 1	Nov. 1971 - Mar. 1981

Hydrology

Title
Stage- Discharge Curves (Kuala Tahan, Penut)
River Discharge Measurement by Current Meter (Kuala Tahan, Penut)
Hydrological Station, Numbering System
National Water Quality Monitoring Programme 1981

Meteorology

Title
Meteorological Data (Aug. 1973 - Dec. 1980) (Kuala Tahan)

Water Quality Records

Station Number	Period of Observation
4223450	1977 - 1979
4121413	1977
3925401	1975 - 1979
3925402	1975 - 1979
3925403	1975 - 1979
3525405	1977 - 1979
3225441	1977 - 1978
3224433	1977 - 1979

3-9 Topography

Title
Map 1/25000, 1/63360 (JERANTUT, PAHANG MALAYSIA)

3-10 Geology

Title	Pablisher or Writer
Geological Sketch Map Upper Takai Gorge	Geological Survey, Malaysia
Batang Padang Southern Works	National Electricity Board
Batang Padang Northern Works	"
Sultan Yussuf Power Station	"
Cameron Highlands Upper Works	"

Title	Publisher or Writer
Sultan Abu Bakar Dam	National Electricity Board
The Geology of the Gunung Tahan Area	Geological Survey, Malaysia
The Geology of Sungai Tekai Area	"

3-11 Power Transmission

Title	Publisher or Writer
28th Annual Report	National Electricity Board
29th Annual Report	"
30th Annual Report	"
Statistical Bulletin 1979	"
Graph of Generation Development 1980-2000 Current Development Plan and Future Aspect Historical Data for Energy	"
Principal Generating Stations and Transmission	"
Generating Stations and Transmission Network	"
Review of System Development Programme	"
Transmission Studies	"

3-12 Economics

Mid-term Review of the Third Malaysia Plan

Preliminary Field Count Summary

Annual Statistical Bulletin Malaysia

Consumer Price for Peninsula Malaysia

Tariff

Economic Report 1980 - 1981

3-13 Report

Tembeling Hydro-Electric Project

- Summary Report
- Volume 1 - General Report
- Volume 2 - Hydrology and Meteorology
- Volume 3 - Geology and Topography
- Volume 4 - Geology
- Volume 5 - Water and Power Engineering Parameters of Hydro-electric Project
- Volume 7 - Cost Estimate and Economic Analysis

Trengganu River Basin Study
Feasibility Report on Multi-purpose Dam Project

- Volume 1 - General Report
- Volume 2 - Survey
- Volume 3 - Hydrology
- Volume 4 - Geology
- Volume 5 - Construction Materials
- Volume 6 - Hydropower Development
- Volume 7 - Irrigation and Agriculture
- Volume 8 - Other Associated Aspects
- Volume 9 - Economic Evaluation
- Executive Summary
- Environmental Appraisal Report
- Interim Report on Kenyir Multi-purpose Dam Project

Pahang River Basin Study

- Volume 1 - Study Summary and Action Plan
- Volume 2 - Basin Development and Flood Effects
- Volume 3 - Basin Hydrology and River Behaviour
- Volume 4 - Flood Mitigation Measures Flow Regulation Works
- Volume 5 - Flood Mitigation Measures Planning and Design Strategies
- Volume 6 - Water Resources Development

National Water Resources Study, Malaysia

- Sectoral Report — PG Irrigation Water Demand
- " — PC Power Market
- " — PD Domestic and Industrial Water Supply
- " — PK Water Quality
- " — PN Meteorology and Hydrology
- " — PL Ecology

3-14 Others

Investment Opportunities (Pahang Malaysia)

Pahang Basic Investment

Rancangan Malaysia Keempat (1989 - 1985)

Peringkat II

Fourth Malaysia Plan (1981 - 1985)

Monthly Statistical Bulletin (Peninsular Malaysia)

Annual Statistical Bulletin Malaysia 1979

Consumer Price Index for Peninsular Malaysia (July 1981)

The Producer Price Index for Peninsular Malaysia (1978)

MIZUNO TOSHIHIKO: Lakes and Marshes for East-South Asia

OGAWA FUSATO: Ecology I for the Tropics - Forest -

MIZUNO TOSHIHIKO: Ecology II for The Tropics - Freshwater -