Fig. 11-1 Annual Cost of Thermal Plant

(Interest rate at 8%)

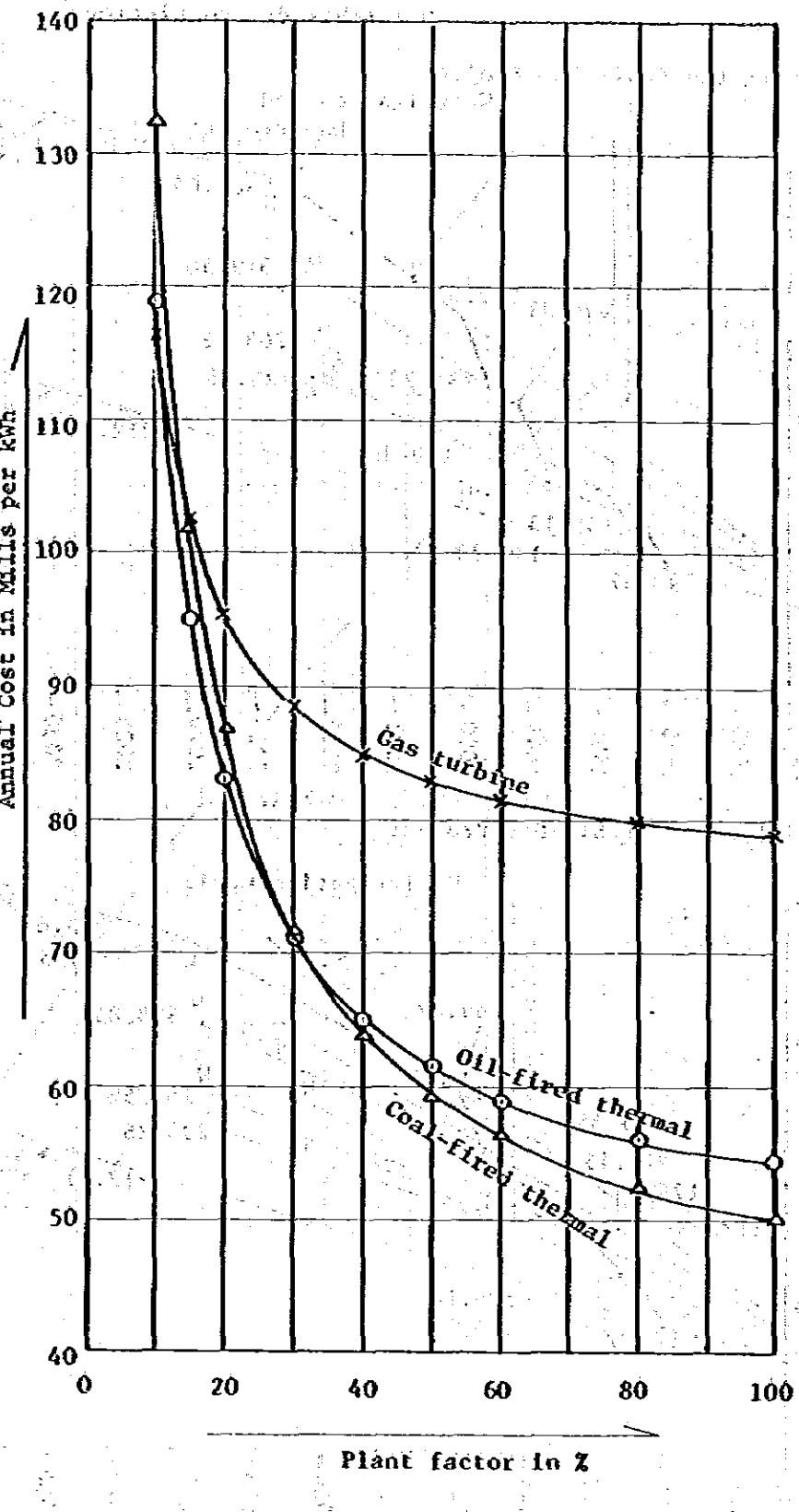

Fig. 11-2 Agricultural Net Production Value

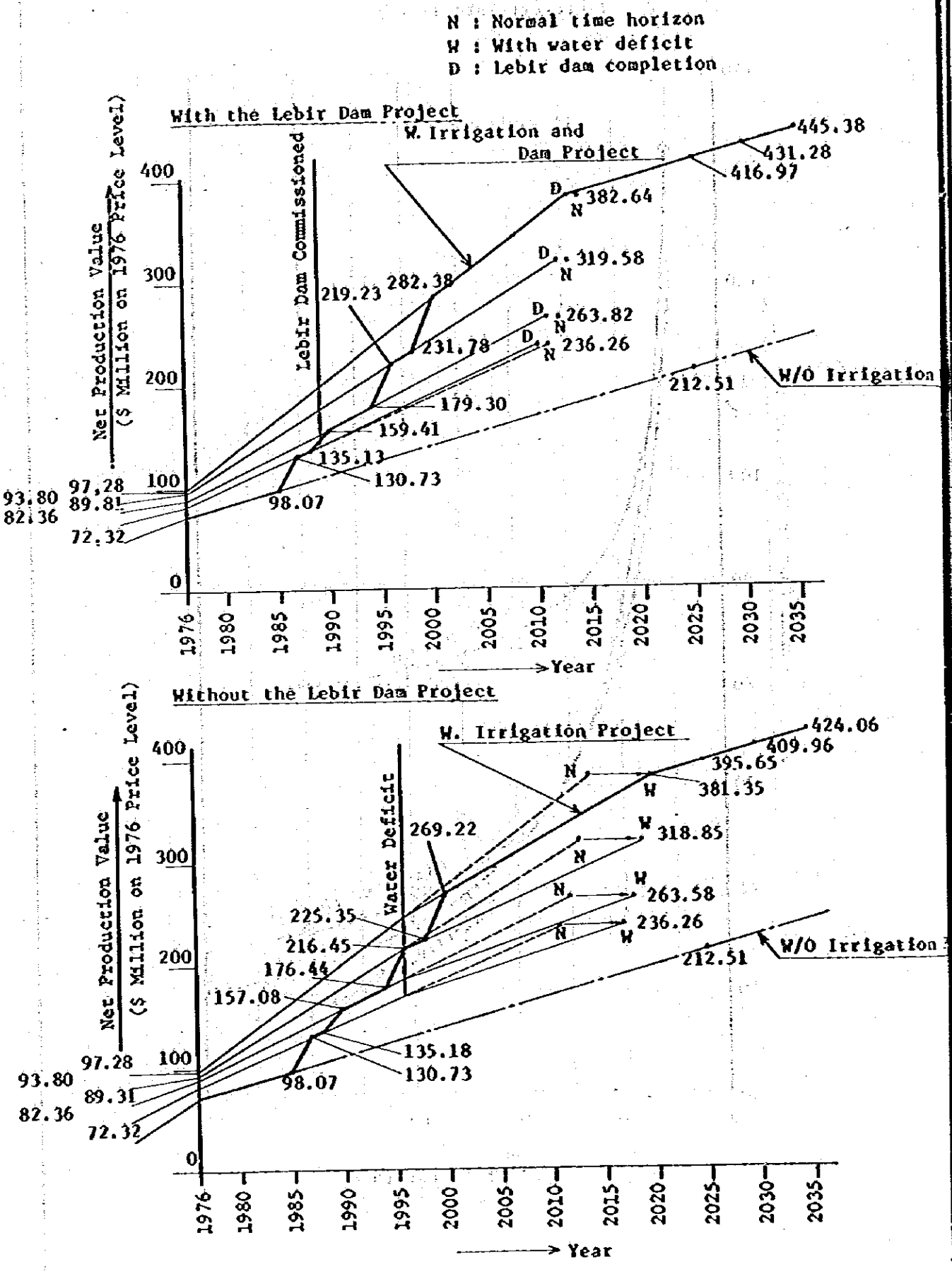

Fig. 11-3 Relation between Peak Discharge and Damage

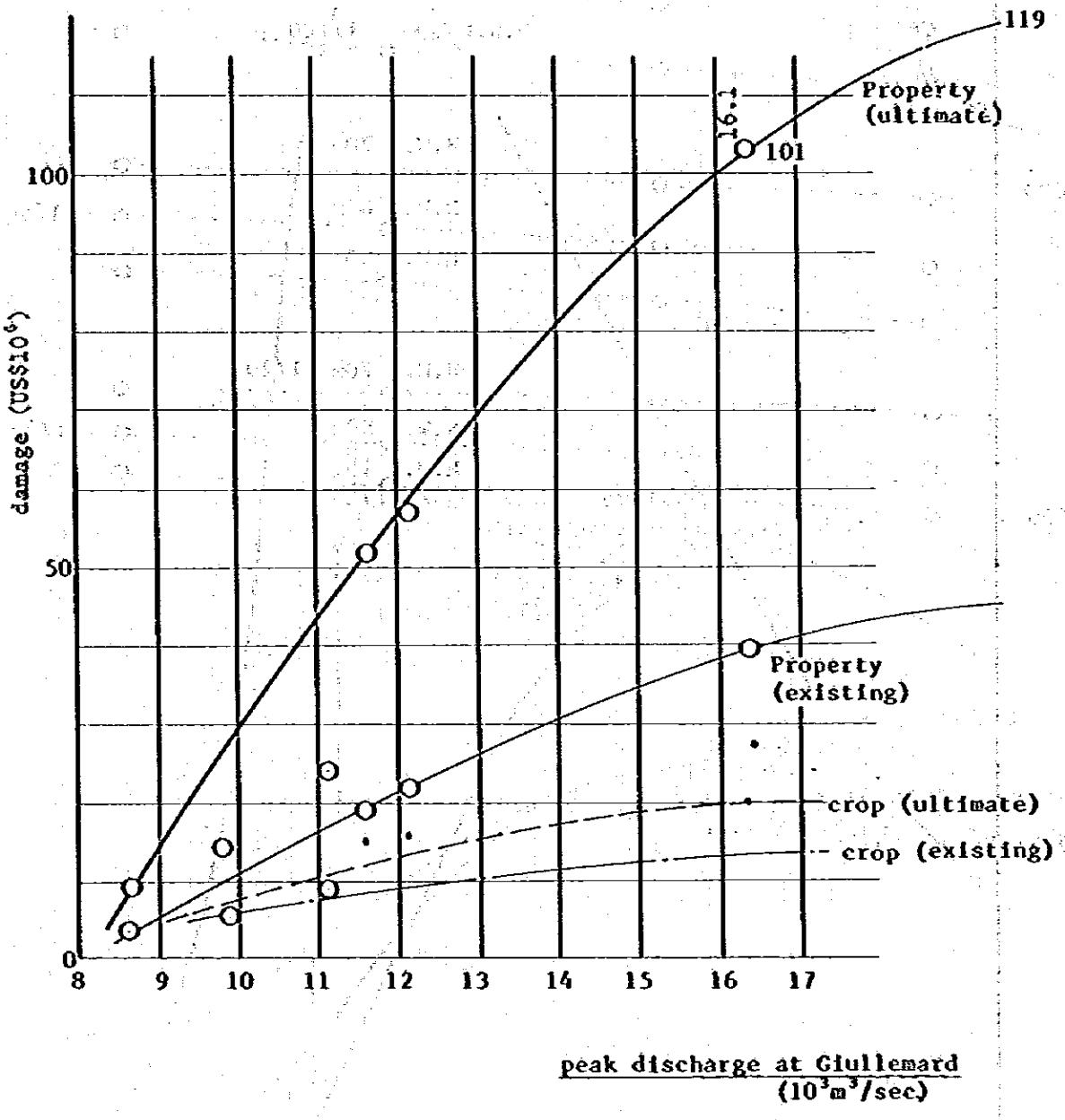

Fig. 11-4 Discharge at Guillemard Bridge

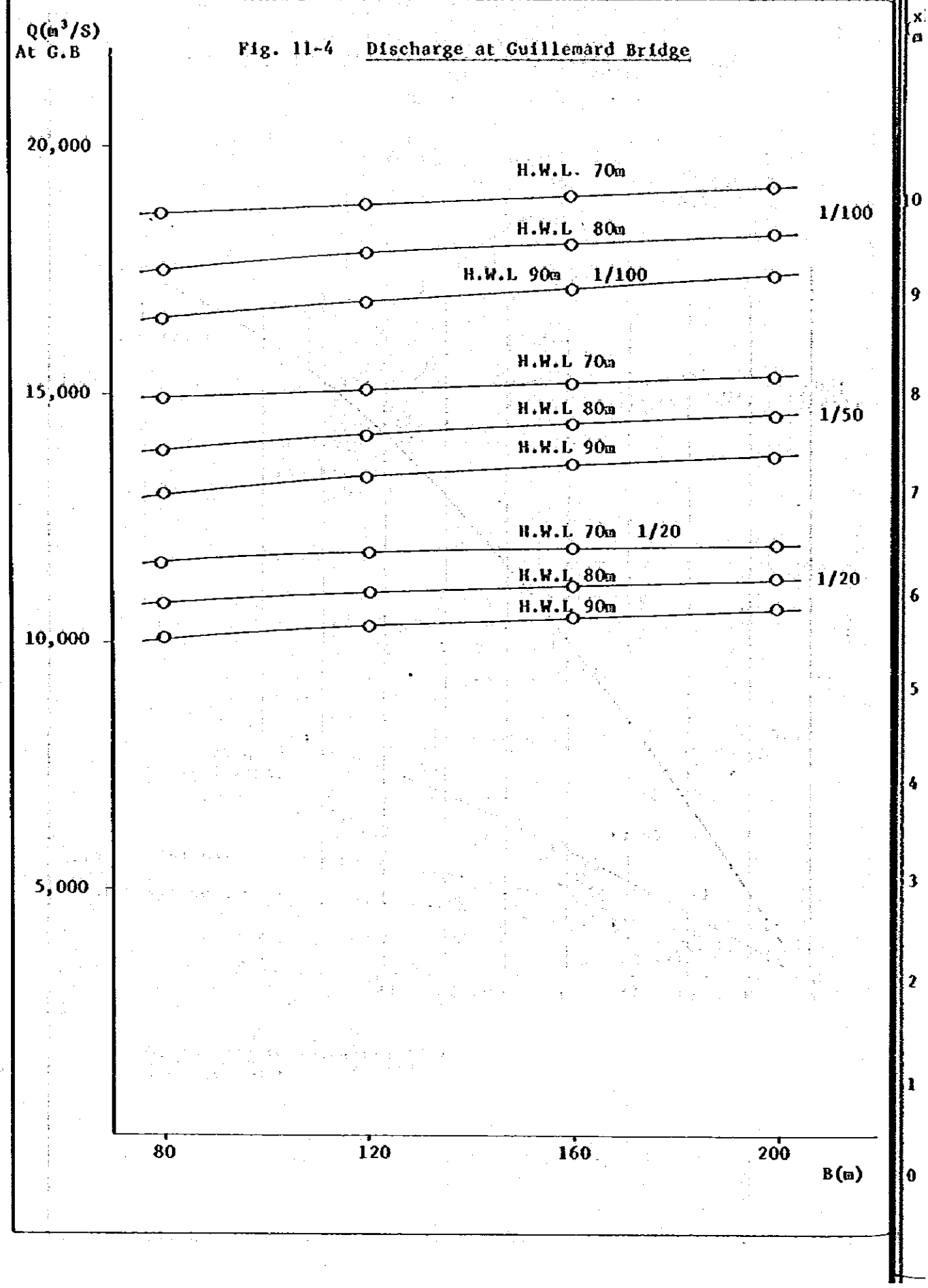

Fig. 11-5 Design Flood and the Water Stage of Lebir Reservoir

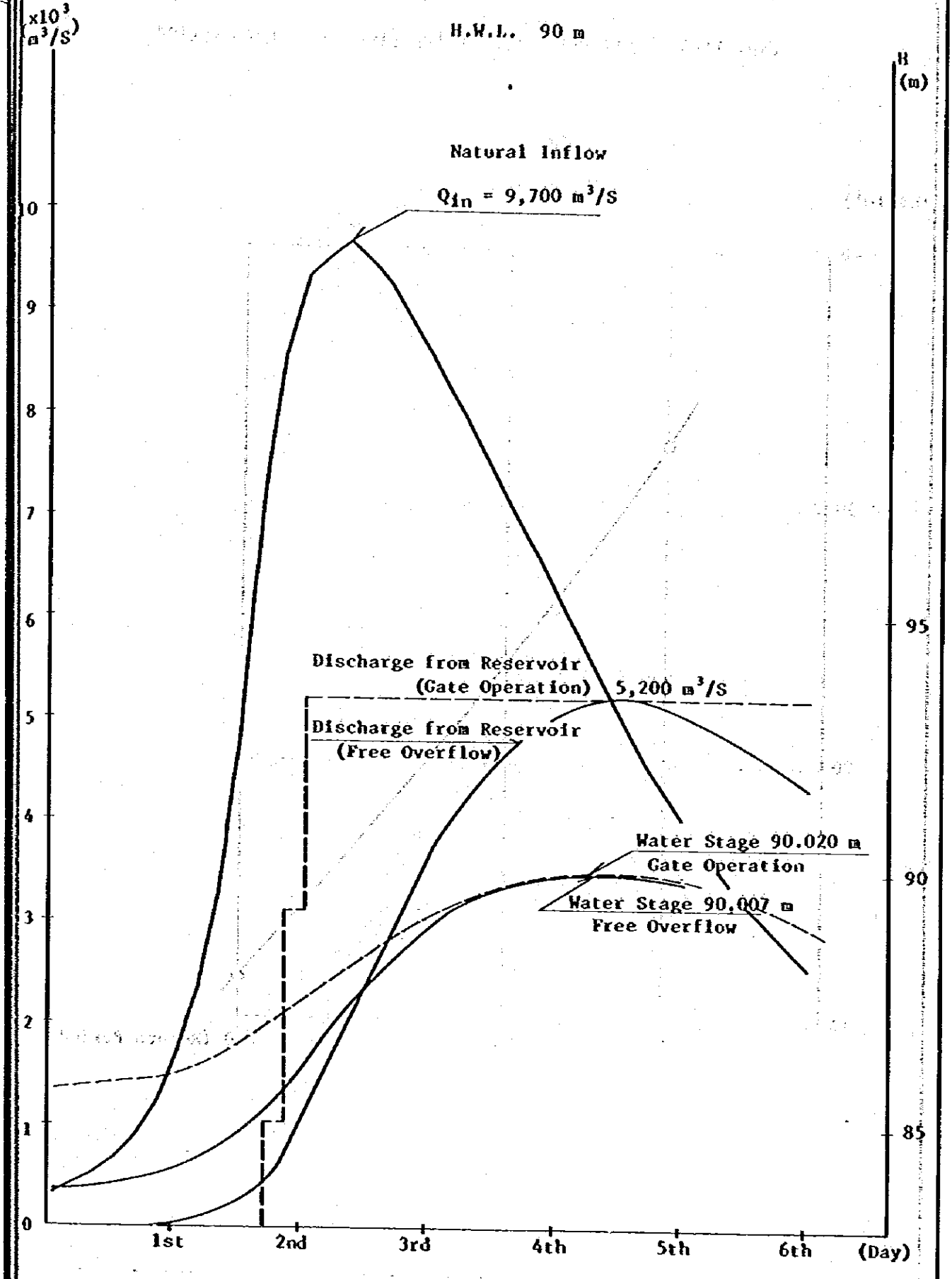

Fig. 11-6 Incremental Damage for Flood of Return Period

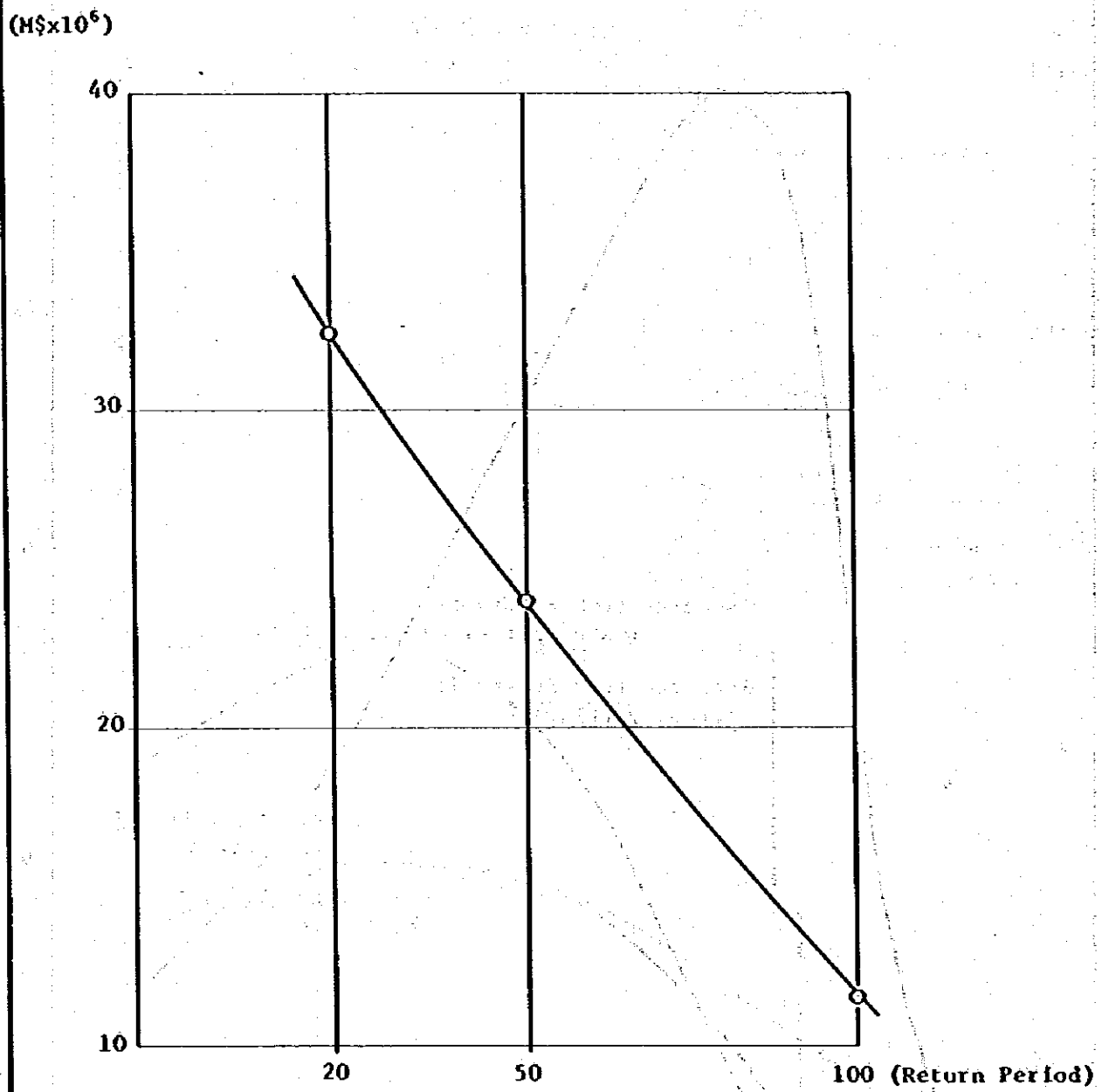

Fig. 11-5 Design Flood and the Water Stage of Lebir Reservoir

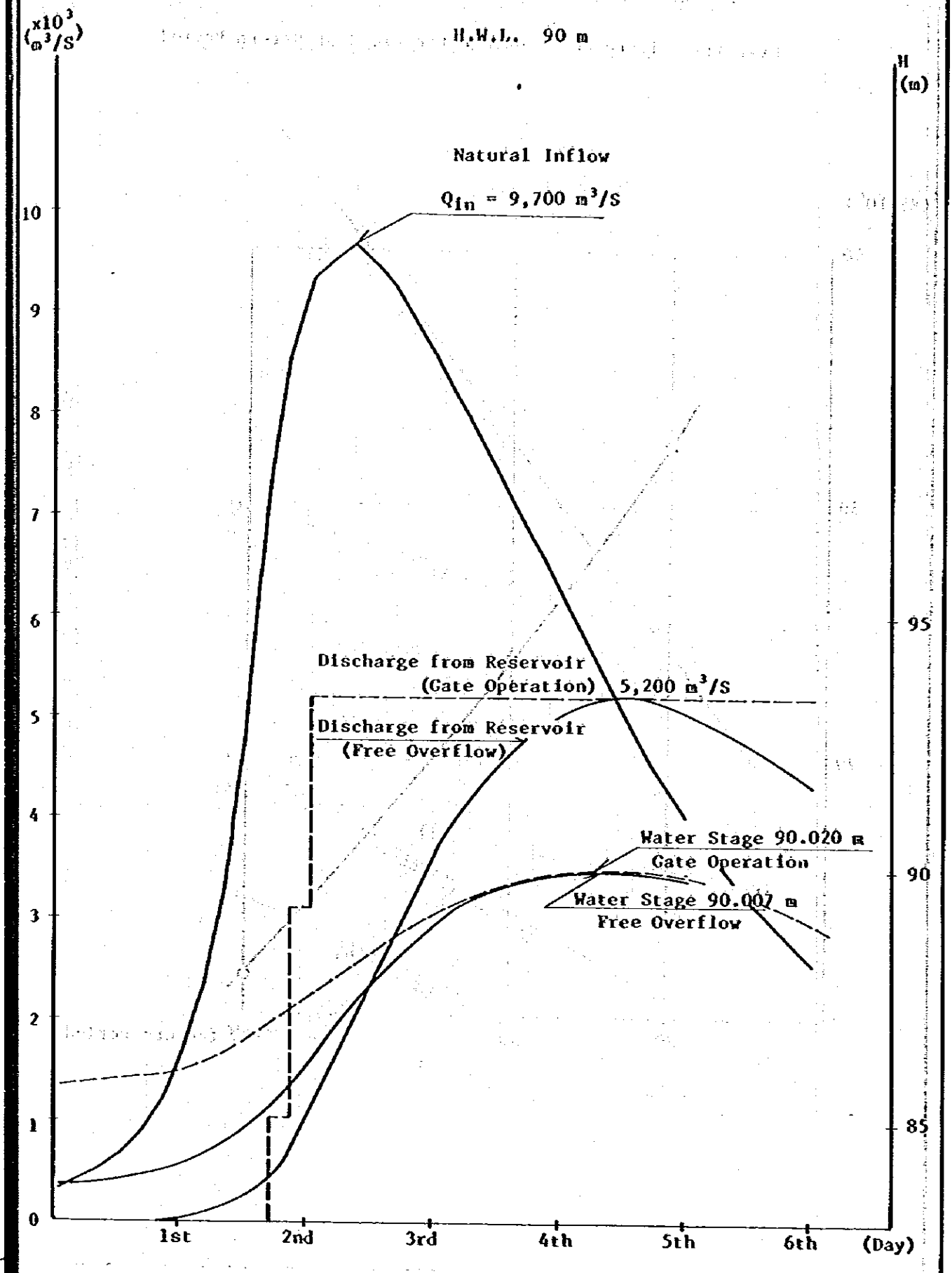

Fig. 11-6 Incremental Damage for Flood of Return Period

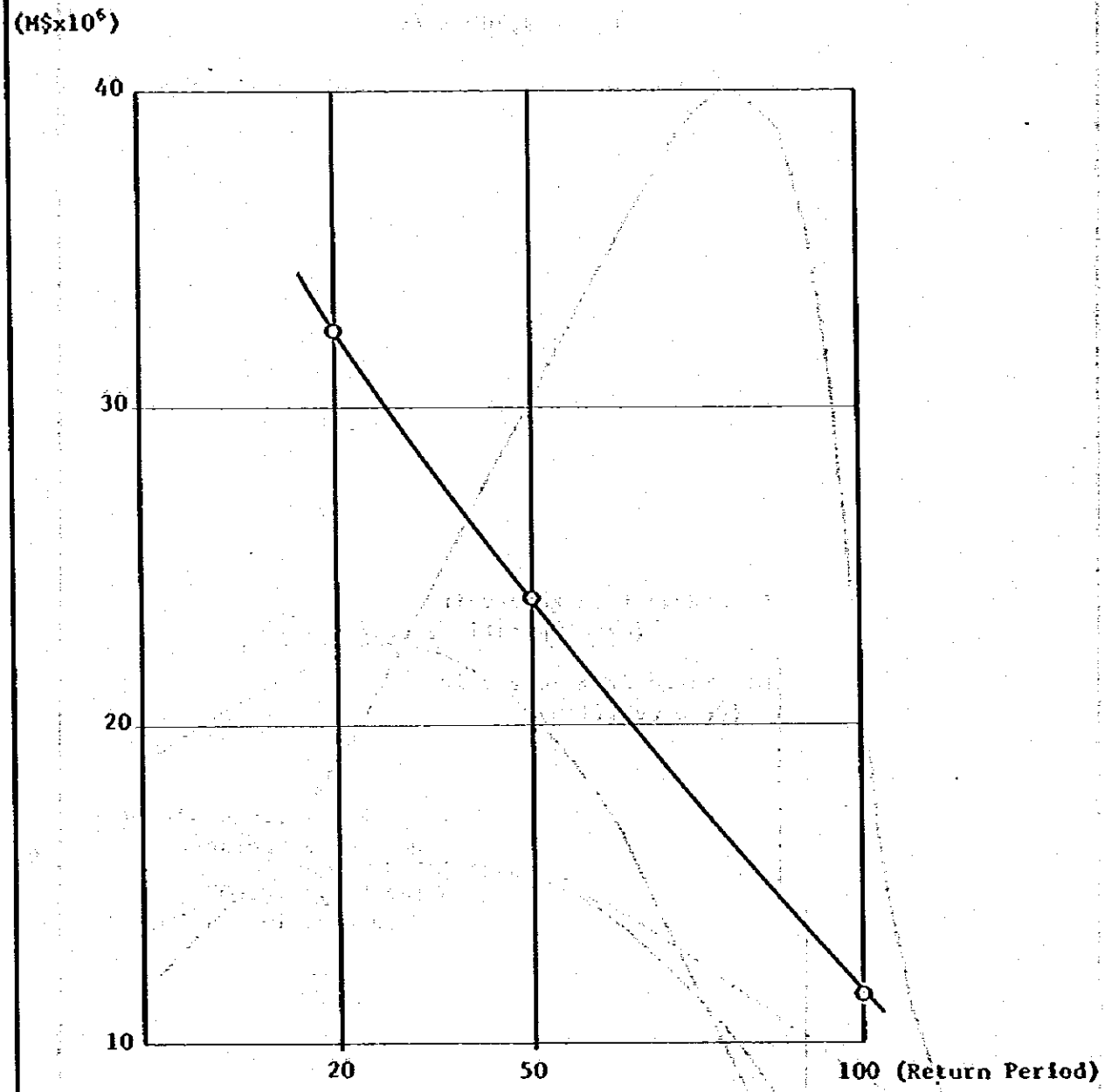

Fig. 12-1 Comparison of Dam Construction Costs

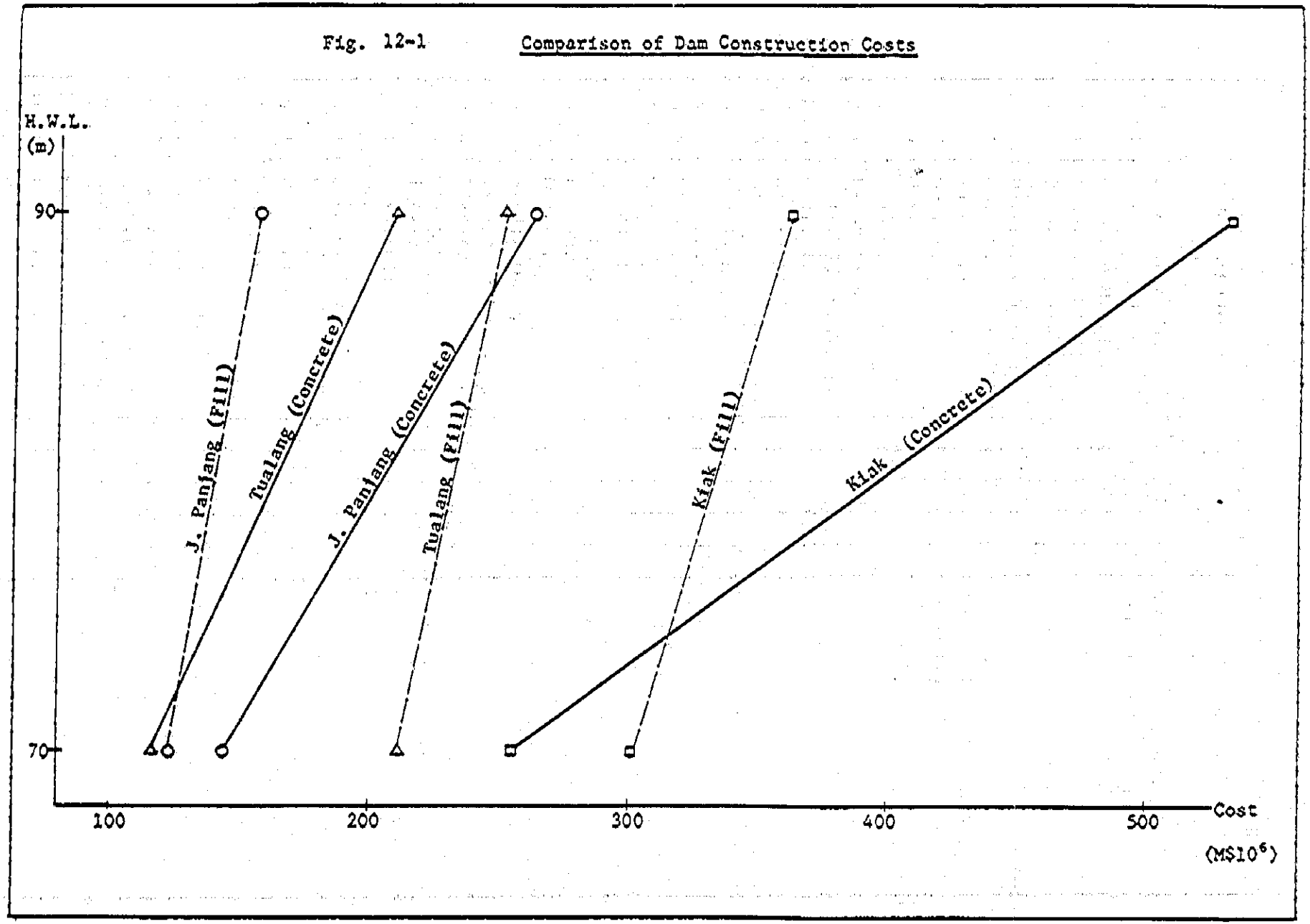

Fig. 13－1 Construction Schedule of Lebir Hydroelectric Power Development Project

	Description of Works	Unit	Quantity	1st Year 1986	2nd Year 1987	3rd Year 1988	4th Year 1989	5th Year 1990	Remarks
1.	Preparatory Works			Start			Reservoir Filling	Commissioning	
1.1	Access Road	km	3.					Completion	Tualang Site H.W.L. 90m
1.2	Camp and Housing	Lump Sum	1.						(Concrete Gravity)
1.3	Power and Communication	〃	1.						
1.4	Plant and Equipment	〃	1.						
2.	Diversion Tunnel								
2.1	Open Excavation	m^3	57,000.		Diversion of the River		Tunnel Blocking		
2.2	Tunnel Excavation	〃	97,000.						Tunnel Length 635m×2
2.3	Concrete	〃	34,500.						Diameter 8m
2.4	Gate	ton	80.						
3.	Main Dam								
3.1	Excavation	m^3	293,000.						
3.2	Cofferdam Concrete	〃	21,400.						
3.3	Concrete	〃	495,000.						
3.4	Grouting	Lump Sum	1.						
3.5	Gate	ton	850.						
4.	Saddle Dam 1								
4.1	Stripping	m^3	393,000.						
4.2	Placing Fill	〃	990,000.						
4.3	Grauting	Lump Sum	1.						
5.	Saddle Dam 2								
5.1	Stripping	m^3	147,000.						
5.2	Placing	〃	119,000.						
5.3	Grouting	Lump Sum	1.						
6.	Saddle Dam 3								
6.1	Stripping	m^3	872,000.						
6.2	Placing	〃	2524,000.						
6.3	Grauting	Lump Sum	1.						
7.	Intake								
7.1	Excavation	m^3	13,900.						
7.2	Concrete	〃	19,200.						
7.3	Gate Screen	ton	410.						
8.	Penstock								
8.1	Excavation	m^3	128,600.						
8.2	Concrete	〃	14,600.						
8.3	Steel Pipe	ton	940.						
9.	Powerhouse Including Outlet								
9.1	Excavation	m^3	180,700.						
9.2	Concrete	〃	56,900.						
9.3	Architectural Finish	Lump Sum	1.					Test Operation	
9.4	Electrical and Mechanicalworks	〃	1.						
10.	Switchyard and Transformers								
10.1	Faundation	Lump Sum	1.						
10.2	Electrical Equipment	〃	1.						

Fig. 13－2　　Construction Schedule of Lebir Hydroelectric Power Development Project

	Description of Works	Unit	Quantity	Remarks
1	Preparatory Works			
1.1	Access Road	km	63	Jeram Panjang Site H.W.L. 90m (Rock Fill, Free Overflow)
1.2	Camp and Housing	Lump Sum	1	
1.3	Power and Communication	〃	1	
1.4	Plant and Equipment	〃	1	
2	Diversion Tunnel			
2.1	Open Excavation	m³	283,000.	
2.2	Tunnel Excavation	〃	150,000.	Tunnel Length 460m×2 Diameter 12m
2.3	Concrete	〃	53900.	
2.4	Gate	ton	160.	
3	Spillway			
3.1	Excavation	m³	872,000.	
3.2	Concrete	〃	100,000.	
4	Main Dam			
4.1	Stripping	m³	929,000.	
4.2	Placing Fill	〃	5203,000.	
4.3	Grouting	Lump Sum	1.	
5	Saddle Dam 1			
5.1	Stripping	m³	393,000.	
5.2	Placing Fill	〃	990,000.	
5.3	Grouting	Lump Sum	1.	
6	Saddle Dam 2			
6.1	Stripping	m³	147,000.	
6.2	Placing Fill	〃	119,000.	
6.3	Grouting	Lump Sum	1.	
7	Intake			
7.1	Excavation	m³	75300.	
7.2	Concrete	〃	10200.	
7.3	Gate Screen	ton	440.	
8	Penstock			
8.1	Open Excavation	m³	101,400.	
8.2	Concrete	〃	16400.	
8.3	Tunnel Excavation	〃	16400.	Tunnel Length 151m×2
8.4	Tunnel Concrete	〃	7200.	
8.5	Steel Pipe	ton	1,150.	
9	Powerhouse Including Outlet			
9.1	Excavation	m³	135000.	
9.2	Concrete	〃	56200.	
9.3	Architectural Finish	Lump Sum	1.	
9.4	Electrical and Mechanicalworks	〃	1	
10	Switchyard and Transformers			
10.1	Faundation	Lump Sum	1.	
10.2	Electrical Equipment	〃	1.	

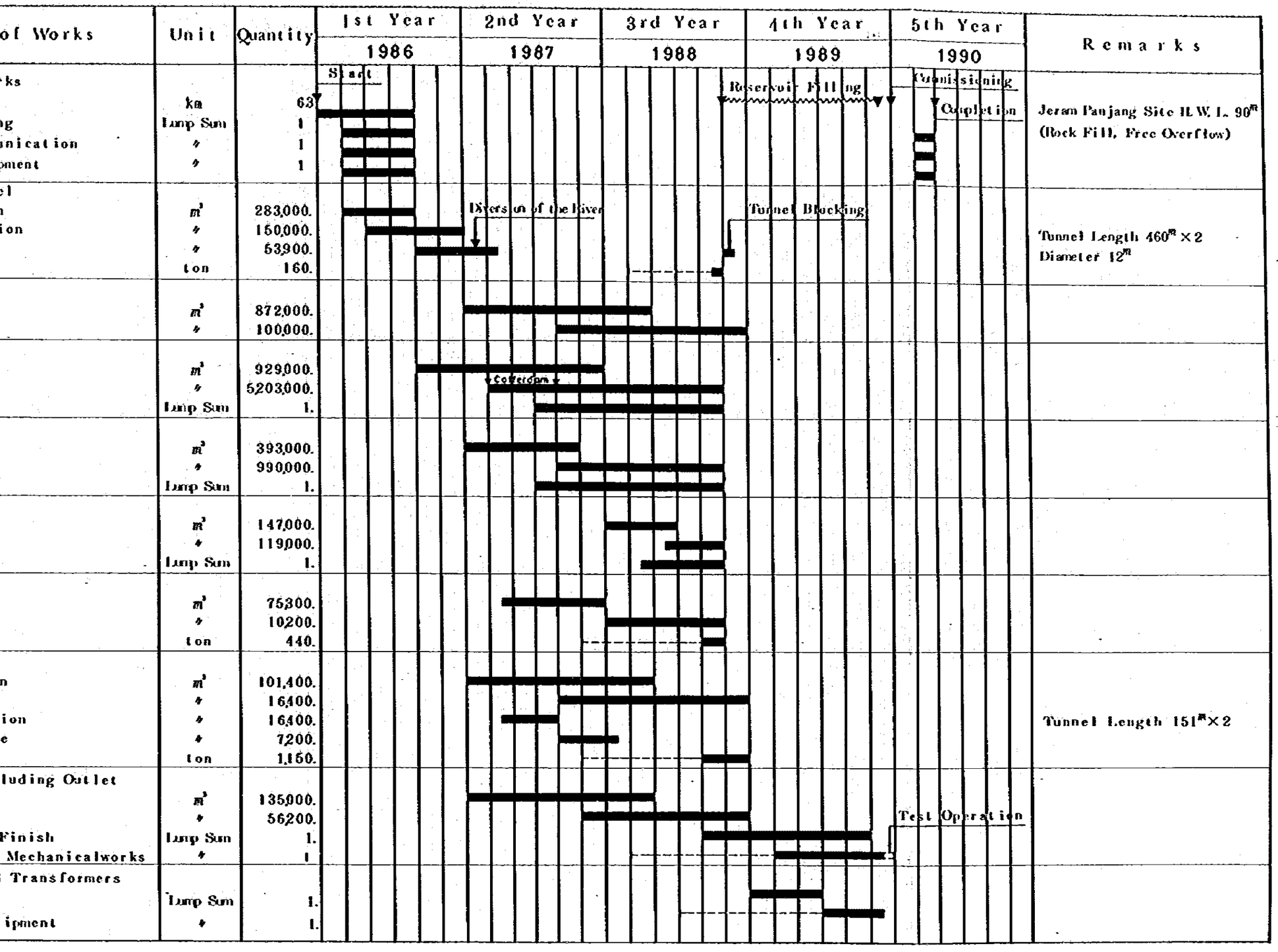

Table 2-1-1

Estimated Construction Costs of Alternative Dams (H.W.L. 70m)

(M10^6)

Item	Kiak		J. Panjang		Tualang	
	Case 1	Case 2	Case 1	Case 2	Case 1	Case 2
1. Main Dam	98.3	236.1	24.0	117.6	8.6	73.0
2. Spillway	107.6		56.7		127.1	
3. Diversion	85.9	11.5	33.2	16.7	50.2	21.4
Sub-total (1 ∿ 3)	291.8	247.6	113.9	134.3	185.9	94.4
4. Saddle Dam 1			5.3	5.3	5.3	5.3
5. Saddle Dam 2						
6. Saddle Dam 3					13.6	13.6
7. Miscellaneous	8.7	7.4	3.6	4.2	6.2	3.4
Grand Total (1 ∿ 7)	300.5	255.0	122.8	143.8	211.0	116.7

Note : Case 1 ----- All rockfill dams

Case 2 ----- Main dam : Concrete-gravity dam

Saddle dam : Rock-fill dam

Table 2-1-2

Estimated Construction Costs of Alternative Dams (H.W.L. 90m)

(M10^6)

Item	Kiak		J. Panjang		Tualang	
	Case 1	Case 2	Case 1	Case 2	Case 1	Case 2
1. Main Dam	157.4	506.8	65.8	221.3	13.2	128.8
2. Spillway	107.6		36.8		127.1	
3. Diversion	85.9	11.5	33.2	16.7	50.2	21.4
Sub-total (1 ∿ 3)	350.9	518.3	135.8	238.0	190.5	150.2
4. Saddle Dam 1			14.9	14.9	14.9	14.9
5. Saddle Dam 2			2.6	2.6	2.6	2.6
6. Saddle Dam 3					35.9	35.9
7. Miscellaneous	10.5	15.6	4.5	7.7	7.3	6.1
Grand Total (1 ∿ 7)	361.4	533.9	157.8	263.2	251.3	209.7

Note : Case 1 ----- All rockfill dams

Case 2 ----- Main dam : Concrete-gravity dam

Saddle dam : Rock-fill dam

Table 2-2-1 Benefit/Cost Analysis

At the J. Panjang Site - H.W.L. 90 m Rockfill

Item	Unit	Crest Length			
		80 m	120 m	160 m	200 m
N.W.L.	m	81.9	83.0	83.8	84.3
Peak Flood Discharge	m^3/S	3,900	4,700	5,200	5,600
Maximum Output	MW	145	149	151	153
Annual Generated Energy	GWH	412	420	426	429
Capacity Factor	%	32.44	32.18	32.21	32.01
Construction Cost	$M\$10^6$	432.948	437.417	441.875	446.249
Capital Value with IDC (IDC = 16%)	M$/kW	3463.6	3405.4	3394.5	3383.3
Capital Costs (1) (CRF = 0.0817)	M$/kWH	0.0996	0.0987	0.0983	0.0986
Fixed Cost with Overhead	M$/kW	9.37	9.37	9.37	9.37
Insurance (0.1%)	M$/kW	3.46	3.41	3.39	3.38
Inclusive Fixed Cost	M$/kW	12.83	12.78	12.76	12.75
O&M Costs (2)	M$/kWH	0.0045	0.0045	0.0045	0.0045
Total Operating Cost (1 + 2)	M$/kWH	0.1041	0.1032	0.1028	0.1031
Cost for Power Generation	$M\$10^6$	42.89	43.34	43.79	44.23
Reservoir Clearing Cost	$M\$10^6$	2.25	2.25	2.25	2.25
Annual Cost (C)	$M\$10^6$	45.14	45.59	46.04	46.48
Power Benefit	$M\$10^6$	56.85	58.08	58.90	59.41
Flood Mitigation Benefit	$M\$10^6$	2.72	2.30	2.07	1.89
Annual Benefit (B)	$M\$10^6$	59.57	60.38	60.97	61.30
B/C	-	1.320	1.324	1.324	1.319
B-C	$M\$10^6$	14.43	14.79	14.93	14.82

(Interest rate 8%)

Table 2-2-2 Benefit/Cost Analysis

At the J. Panjang Site - Spillway Crest Length 160 m

Item	Unit	Free Overflow			Gate Operation		
		H.W.L. 70 m	H.W.L. 80 m	H.W.L. 90 m	H.W.L. 70 m	H.W.L. 80 m	H.W.L. 90 m
N.W.L.	m	61.7	72.7	83.8	66.4	75.6	85.8
Peak Flood Discharge	m^3/S	8,300	6,800	5,200	8,300	6,800	5,200
Maxiumu Output	MW	69	109	151	84	122	158
Annual Generated Energy	GWH	268	350	426	303	372	440
Capacity Factor	%	44.34	36.66	32.21	41.18	34.81	31.79
Construction Cost	$M\$10^6$	334.378	393.891	441.875	357.631	406.874	442.938
Capital Value with IDC (IDC=16%)	M$/kW	5,621.4	4,191.9	3,394.5	4,938.7	3,868.6	3,251.9
Capital Costs (1) (CRF = 0.0817)	M$/kW	0.1182	0.1066	0.0983	0.1119	0.1036	0.0954
Fixed Cost with Overhead	M$/kW	9.37	9.37	9.37	9.37	9.37	9.37
Insurance (0.1%)	M$/kW	5.62	4.19	3.39	4.94	3.87	3.25
Inclusive Fixed Cost	M$/kW	14.99	13.59	12.76	14.31	13.24	12.62
O&M Costs (2)	M$/kWH	0.0039	0.0042	0.0045	0.0040	0.0043	0.0045
Total Operating Cost (1 + 2)	M$/kWH	0.1221	0.1108	0.1028	0.1159	0.1079	0.0999
Cost for Power Generation	$M\$10^6$	32.72	38.78	43.79	35.12	40.14	43.96
Reservoir Clearing Cost	$M\$10^6$	0.81	1.41	2.25	0.81	1.41	2.25
Annual Cost (C)	$M\$10^6$	33.53	40.19	46.04	35.93	41.55	46.21
Power Benefit	$M\$10^6$	34.32	46.81	58.90	39.43	50.39	61.05
Flood Mitigation Benefit	$M\$10^6$	0.51	1.29	2.07	0.85	1.45	2.38
Annual Benefit(B)	$M\$10^6$	34.83	48.10	60.97	40.28	51.84	63.43
B/C	-	1.039	1.197	1.324	1.121	1.248	1.373
B-C	$M\$10^6$	1.30	7.91	14.93	4.35	10.29	17.22
Agricultural Benefit	$M\$10^6$	14.26	14.26	14.26	14.26	14.26	14.26
Annual Benefit(B')	$M\$10^6$	49.09	62.36	75.23	54.54	66.10	77.69
B'/C	-	1.464	1.552	1.634	1.518	1.591	1.681
B'-C	$M\$10^6$	15.56	22.17	29.19	18.61	24.55	31.48

(Interest rate 8%)

Table 2-2-3 Benefit/Cost Analysis

At the Tualang Site - Concrete Gravity

Item	Unit	H.W.L.		
		70 m	80 m	90 m
N.W.L.	m	66.6	76.0	85.8
Peak Flood Discharge	m^3/S	8,300	6,800	5,200
Maximum Output	MW	88	128	162
Annual Generated Energy	GWH	321	392	455
Capacity Factor	%	41.64	34.96	32.06
Construction Cost	$M\$10^6$	342.271	428,383	509,788
Capital Value with IDC (IDC = 14%)	M$/kW	4,434.0	3,815.3	3,587.4
Capital Costs (1) (CRF = 0.0817)	M$/kWH	0.0993	0.1018	0.1044
Fixed Cost with Overhead	M$/kW	9.37	9.37	9.37
Insurance (0.1%)	M$/kW	4.43	3.82	3.59
Inclusive Fixed Cost	M$/kW	13.80	13.19	12.96
O&M Costs (2)	M$/kWH	0.0038	0.0043	0.0046
Total Operating Cost (1 + 2)	M$/kWH	0.1031	0.1061	0.1090
Cost for Power Generation	$M\$10^6$	33.10	41.59	49.60
Reservoir Clearing Cost	$M\$10^6$	0.83	1.42	2.28
Reconstruction Cost for Highway	$M\$10^6$	3.39	3.39	3.39
Annual Cost (C)	$M\$10^6$	37.32	46.40	55.27
Power Benefit	$M\$10^6$	41.67	53.04	62.98
Flood Mitigation Benefit	$M\$10^6$	0.85	1.45	2.38
Annual Benefit (B)	$M\$10^6$	42.52	54.49	65.36
B/C	-	1.139	1.174	1.183
B-C	$M\$10^6$	5.20	8.09	10.09

(Interest rate 8%)

Table 4.1 Agricultural Production: Existing and Proposed

No.	Crop	In 1976 Cropped Area (Ha)	In 1976 Production (Ton)	In 1976 Gross Value ($'000)	In 2010 (Ultimate Status) Cropped Area (Ha)	In 2010 (Ultimate Status) Production (Ton)	In 2010 (Ultimate Status) Gross Value ($'000)
1.	Short-term Padi	35,369	99,399	39,759	88,793	353,049	141,220
2.	Long-term Padi	41,803	76,232	30,493	259	656	262
3.	Tobacco	7,268	5,088	38,157	13,863	16,430	123,242
4.	Groundnut	2,104	844	1,704	27,089	107,004	48,162
5.	Maize	625	0	278	4,360	10,874	3,588
6.	Soyabean	0	0	0	39,915	87,954	17,170
7.	Sorghum	0	19,299	0	11,683	36,847	11,054
8.	Vegetables	1,184	0	2,316	4,713	46,218	25,313
9.	Pasture	0	0	0	16,117	398,543	44,637
10.	Sugarcane	0		0	11,663	128,289	63,503
11.	Fruits	4,232		2,714	17,496		31,074
12.	Rubber	50,028	20,487	30,730	49,331	42,848	64,272
13.	Coconut	9,846	5,907	3,544	7,168	12,900	7,740
14.	Oil Palm	2,021	21,225	2,123	2,021	47,302	4,730
	Total	154,480		151,818	294,469		625,968
		(100.0%)			(190.6%)		
				(100.0%)			(412.3%)

* ..... on 1976 price level

(Source: KBRS, 1977)

Table 4-2-1 Flood Mitigations (without and with Development)

($ Million on Constant 1976 Price Level)

	Crop Production		1) Properties		2) Disruption		Total	
	Value	%	Value	%	Value	%	Value	%
Direct Damage Without Development								
Existing = 1976 level	8.76	42.9	11.68	57.1			20.44	100.0
Future = 2005 level	18.60	45.1	22.60	54.9			41.20	100.0
3) Benefits with Irrigation Project								
	2.44	19.7	5.72	46.2	4.23	34.1	12.39	100.0
Benefits with Irrigation and Dabong Dam Projects								
	3.64	21.4	8.45	49.8	4.87	28.7	16.97	100.0
Benefits with Irrigation, Dabong Dam, Lebir Dam, and River Band Projects								
	4.54	22.6	10.28	51.1	5.28	26.3	20.10	100.0

1)..... Reduction in damages to road, railway, house, public utility, irrigation structure and livestock

2)..... Reduction in damages due to disruption of commercial activity, evacuation cost and loss of human life

3)..... Includes the installation of bulk drainage systems in association with the irrigation project

Table 4-2-2 Flood Mitigations: Incremental Benefits

($ Million on Constant 1976 Price Level)

Project	Crops			Non-crops			Total		
	Each	%	Cumulated	Each	%	Cumulated	Each	%	Cumulat
(1) With Irrigation	2.44	53.7	2.44	9.95	63.9	9.95	12.39	61.6	12.39
(2) With Irrigation and Dabong Dam	1.20	26.4	3.64	3.37	21.7	13.32	4.57	22.7	16.96
(3) With Irrigation, Dabong Dam, Lebir Dam, and River Band	0.90	19.8	4.54	2.24	14.4	15.56	3.14	15.6	20.10

(2) + (3) : (4)	2.10	5.61	7.71
(1) / (4)	1.16	1.77	1.61
(2) / (4)	0.57	0.60	0.59
(3) / (4)	0.43	0.40	0.41
(2) / (1)	0.49	0.34	0.37
(3) / (1)	0.36	0.23	0.25

(Source: KBRS, 1977)

Table 4-3 Present Main Power Stations Owned by NEB
(Except Diesel Plant)

Name	Classification of Hydro or Thermal	Installed Capacity (MW)	
		August, 1977	August, 1978
Jor	Hydro	100	100
Woh	"	150	150
Temengor	"	-	87
Prai	Steam	90	90
Glugor	"	40	40
Power Dickson	"	600	600
Connaught Bridge	"	80	80
Malacca	"	40	40
Glugor	Gas Turbine	-	20
Total		1,220	1,327

Table 4 - 4 NEB's Generation Expansion Plan

Name of Project		Classification	Installed Capacity	Commissioning Date
Temengor		Hydro		
	Nos.2-4		3 x 85 "	Feb. 1979
Gas turbine		Gas turbine	4 x 20 "	Feb. 1979
			1 x 20 "	May 1979
Prai	No.4	Steam	1 x 120 "	Aug. 1979
	No.5		1 x 120 "	Feb. 1980
	No.6		1 x 120 "	Aug. 1980
Pasir Gudang	No.1	Steam	1 x 120 "	Feb. 1981
	No.2		1 x 120 "	Aug. 1981
		Hydro	3 x 24 "	Aug. 1982
Kenering		Hydro	3 x 40 "	Feb. 1983
Trengganu	Nos.1-2	Hydro	2 x 100 "	Feb. 1984
	Nos.3-4	"	2 x 100 "	Aug. 1984
Port Klang	No.1	Steam	1 x 300 "	May 1985
	No.2		1 x 300 "	Feb. 1986
	No.3		1 x 300 "	Aug. 1987
	No.4		1 x 300 "	May 1989
Gas turbine	No.1		1 x 20 "	
	No.2		1 x 20 "	Nov. 1978
	No.3		1 x 20 "	Dec. 1978
	No.4		1 x 20 "	Jan. 1979
	No.5		1 x 20 "	April 1979
	No.6		1 x 70	March 1983

Table 6 - 1 Temperature (average of 24 hours)

Month	1968	1969	1970	1971	1972	Average
1	26.6	26.3	26.0	25.3	25.1	25.9
2	27.3	26.4	26.0	25.6	26.3	26.3
3	28.0	27.2	27.1	26.2	26.6	27.2
4	27.8	28.4	27.6	27.8	27.3	27.8
5	27.5	28.8	28.5	27.6	28.3	28.1
6	27.4	27.7	27.7	27.4	27.9	27.6
7	27.2	27.3	27.1	27.3	27.9	27.4
8	26.9	27.1	27.1	26.5	27.1	26.9
9	26.6	27.1	26.9	27.2	26.8	26.9
10	26.4	26.8	26.5	26.4	27.0	26.6
11	26.8	25.7	25.8	25.2	26.4	26.0
12	26.5	25.9	25.9	25.6	26.4	26.1
Maximum	36.7	35.0	34.6	34.2	34.6	36.7
Minimum	18.6	19.5	20.4	19.7	18.3	18.3
Average	27.1	27.1	26.8	26.5	26.9	26.9

Table 6 - 2 Humidity (average of 24 hours)

Month	1968	1969	1970	1971	1972	Average
1	78.2%	82.2%	78.8%	77.5%	79.8%	79.3%
2	79.3	79.1	78.8	78.1	81.2	79.3
3	75.8	77.2	80.8	79.2	82.4	79.1
4	82.1	77.5	81.6	82.0	82.1	81.1
5	80.1	77.6	83.3	81.6	81.5	80.8
6	81.8	79.6	81.9	81.3	81.4	81.2
7	80.7	80.3	80.8	81.2	81.0	80.8
8	83.6	80.9	80.7	79.7	80.5	81.1
9	86.0	80.0	80.4	80.9	79.9	81.4
10	84.3	83.4	79.7	79.6	79.5	81.3
11	87.3	87.8	78.5	77.3	80.3	82.2
12	86.3	83.4	78.7	78.0	79.7	81.2
Average	82.1	80.7	80.3	79.7	80.8	80.7

Table 6 - 3 Time from Sunrise to Sunset (average of day)

Month	1968	1969	1970	1971	1972	Average
1	8.02	5.29	7.08	8.06	7.71	7.23
2	9.64	7.17	8.25	9.04	8.91	8.60
3	8.52	7.88	8.37	9.65	9.22	8.73
4	8.10	10.18	7.81	9.91	7.44	8.69
5	7.38	7.60	8.82	8.25	9.39	8.29
6	6.32	7.23	5.91	7.11	6.22	6.56
7	5.33	7.89	6.10	7.26	6.88	6.69
8	6.07	7.54	6.95	8.01	7.43	7.20
9	5.11	7.84	7.11	6.49	7.14	6.74
10	5.75	4.10	5.09	7.19	6.68	5.76
11	8.86	4.31	4.45	2.44	5.13	5.04
12	6.14	3.37	4.77	4.07	6.11	4.89
Average	7.10	6.70	6.73	7.29	7.35	7.03

Table 6 - 4 Number of Days of Rainfall

Month	1968	1969	1970	1971	1972	Average
1	-	6	25	8	25	16
2	6	5	6	23	25	13
3	22	11	22	16	26	24.3
4	11	6	22	30	26	19
5	19	29	5	3	11	13.4
6	24	3	12	12	5	11.2
7	23	8	26	13	21	18.2
8	6	23	25	10	16	16
9	16	4	27	20	4	14.2
10	23	11	5	22	25	17.2
11	6	29	2	30	10	15.4
12	18	12	7	1	15	10.6
Average	-	147	184	188	209	182

Table 6 - 5 Mean Monthly Rainfall in the Kelantan Basin River

Tributary Station: Name of Tributary	Location	1	2	3	4	5	6	7	8	9	10	11	12	Yearly Rainfall
S. Galas	Gua Musang	172	72	97	128	192	162	168	275	335	345	278	278	2,502
S. Galas	Bertang	170	90	118	108	179	159	141	177	228	312	283	245	2,210
S. Galas	Dabong	193	82	95	131	192	191	164	208	244	311	347	392	2,550
S. Pergau	Bongor	189	125	131	121	212	203	193	215	243	365	439	629	3,065
S. Lebir	Kg. Lalok	128	56	82	139	191	173	158	238	270	237	249	454	2,375
S. Kelantan	Kota Bharu	225	78	114	82	102	142	148	157	212	292	597	606	2,755

Table 6 - 6 Correlative Coefficients of Monthly Rainfalls at Rainfall Gauging Stations in the State of Kelantan

Correlative Coefficient

(y)		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
(x)	NO. / NAME	6121067 TUMPAT	6121066 KG BERANGAN	6121063 WAKAF BHARU	6121064 KOTA BHARU	6021062 CHABANG TIGA PENDEK	6021080 PENGKALAN KUBOR	6021090 PUKAN PAK REPEK	6018004 PANTAI PANJANG	6021076 BALAI POLIS BACHOK	6023072 TERATAR PULAI	5821009 IBU BEKALAH	5824080 CHERANG RUKU	5834099 PASIR PUTEH	5823077 CHERANG TULI	5821007 KELETAPI BT	5821059 LADANG SG	5723056 TELUSAN	5723057 BALAI POLIS KG	5720055 GUALIPOH ULU KUSIAL	5718001 KG GEMANG BAHRU	5718033 KG JELI	5621052 LADANG KERILA	5621051 LADANG KENNETH	5622048 KUALA PERSANG	5518035 KUBOR BUNGOR	5621050 KUALA MAL	5522047 KUALA KRAI	5419035 KUALA BALAH	5320008 STN TELE DABONG	5320037 KUALA BERGAU	5322044 STN TELE KG LALOK	5120025 POLIS BERSAH	4823001 STN TELE KG ARANG	4819027 STN TELE GUA MUSANG	4813001 GUA MUSANG	4720026 LADANG MENTARA
1	TUMPAT		275	170	328	213	263	315	276	211	169	287	228	214	348	207	344	215	257	231	——	180	216	189	301	211	298	269	265	239	309	44	286	——	213	——	50
2	KG BERANGAN	0.878		251	284	218	283	284	256	215	274	269	178	217	284	188	280	220	257	219	——	166	222	195	283	217	280	257	237	238	282	43	240	——	184	——	54
3	WAKAF BHARU	0.903	0.860		286	200	259	286	255	200	157	276	180	200	286	199	282	202	253	222	——	151	203	176	285	199	282	246	235	236	264	43	236	——	176	——	48
4	KOTA BHARU	0.930	0.939	0.838		226	282	335	287	219	177	305	268	221	367	224	356	224	277	270	——	168	225	198	339	219	324	277	289	258	307	45	286	——	205	——	54
5	CHABANG TIGA PENDEK	0.828	0.874	0.793	0.882		220	221	197	213	173	211	156	215	221	142	218	218	217	158	——	161	219	192	321	214	317	199	202	208	200	45	202	——	182	——	54
6	PENGKALAN KUBOR	0.873	0.881	0.846	0.922	0.904		283	247	217	176	268	170	220	282	186	278	222	276	220	——	168	223	196	282	218	279	241	254	257	282	46	258	——	190	——	56
7	PUKAN PAK REPEK	0.783	0.824	0.749	0.828	0.878	0.925		287	219	137	306	274	221	354	224	343	234	278	270	——	188	225	196	340	219	325	277	269	258	315	45	273	——	205	——	54
8	PANTAI PANJANG	0.723	0.721	0.696	0.729	0.801	0.822	0.813		198	158	278	176	197	287	192	263	200	242	226	——	150	202	176	285	198	282	253	223	236	268	33	236	——	163	——	43
9	BALAI POLIS BACHOK	0.884	0.916	0.864	0.933	0.862	0.912	0.880	0.783		170	212	156	212	219	139	215	216	215	155	——	162	217	190	218	213	214	156	200	202	197	45	198	——	156	——	48
10	TERATAR PULAI	0.883	0.923	0.870	0.929	0.911	0.937	0.908	0.795	0.829		188	116	175	197	108	175	177	136	118	——	136	176	150	175	134	173	162	164	182	158	31	158	——	124	——	26
11	IBU BEKALAH	0.725	0.785	0.717	0.796	0.836	0.853	0.840	0.771	0.805	0.822		198	211	305	209	301	213	262	241	——	158	214	187	305	211	302	261	240	243	282	45	244	——	179	——	46
12	CHERANG RUKU	0.812	0.838	0.718	0.862	0.900	0.868	0.796	0.723	0.887	0.888	0.788		157	258	177	248	158	164	236	——	106	180	157	225	154	208	187	180	151	215	45	182	——	146	——	56
13	PASIR PUTEH	0.835	0.861	0.786	0.885	0.822	0.867	0.822	0.726	0.846	0.872	0.776	0.838		221	142	217	217	217	158	——	163	218	192	221	214	218	191	202	204	200	45	201	——	157	——	49
14	CHERANG TULI	0.805	0.868	0.754	0.884	0.865	0.888	0.863	0.782	0.893	0.882	0.829	0.864	0.865		224	276	224	277	290	——	168	225	198	339	219	324	277	295	258	327	45	306	——	225	——	56
15	KELETAPI BT	0.713	0.715	0.670	0.780	0.738	0.820	0.818	0.739	0.782	0.796	0.824	0.760	0.872	0.797		221	144	180	202	——	108	165	164	223	160	220	182	187	187	203	37	188	——	122	——	51
16	LADANG SG	0.721	0.763	0.709	0.805	0.810	0.862	0.837	0.809	0.815	0.864	0.812	0.790	0.788	0.855	0.858		220	273	287	——	166	221	194	328	215	320	273	281	256	323	45	302	——	224	——	53
17	TELUSAN	0.776	0.776	0.788	0.835	0.817	0.891	0.849	0.758	0.830	0.805	0.828	0.833	0.883	0.891	0.795	0.813		220	161	——	185	222	195	223	217	219	201	205	207	202	45	206	——	160	——	52
18	BALAI POLIS KG	0.879	0.885	0.688	0.748	0.896	0.754	0.752	0.880	0.885	0.700	0.726	0.730	0.783	0.750	0.682	0.759	0.853		214	——	184	221	194	276	215	273	236	252	255	258	41	256	——	192	——	54
19	GUALIPOH ULU KUSIAL	0.806	0.706	0.516	0.894	0.708	0.706	0.705	0.898	0.622	0.867	0.898	0.893	0.890	0.767	0.762	0.788	0.617	0.513		——	107	182	159	256	156	253	225	224	195	269	45	234	——	187	——	56
20	KG GEMANG BAHRU	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——		——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
21	KG JELI	0.592	0.651	0.610	0.670	0.647	0.894	0.680	0.658	0.672	0.742	0.711	0.701	0.559	0.757	0.710	0.714	0.725	0.633	0.595	——		187	143	188	162	165	152	155	166	154	26	151	——	137	——	49
22	LADANG KERILA	0.877	0.913	0.663	0.769	0.773	0.808	0.812	0.749	0.759	0.787	0.810	0.778	0.768	0.846	0.765	0.864	0.838	0.830	0.724	——	0.808		198	224	218	220	202	226	208	203	45	205	——	162	——	54
23	LADANG KENNETH	0.683	0.724	0.879	0.786	0.771	0.819	0.798	0.729	0.769	0.799	0.802	0.782	0.735	0.823	0.761	0.802	0.819	0.806	0.679	——	0.803	0.329		197	151	193	176	180	183	177	45	179	——	141	——	53
24	KUALA PERSANG	0.672	0.723	0.630	0.744	0.795	0.805	0.760	0.738	0.775	0.793	0.782	0.732	0.752	0.815	0.785	0.845	0.828	0.796	0.780	——	0.780	0.908	0.879		219	324	276	254	257	297	45	258	——	190	——	54
25	LUBOK BUNGOR	0.578	0.566	0.555	0.615	0.621	0.625	0.572	0.625	0.642	0.620	0.658	0.809	0.808	0.678	0.544	0.808	0.728	0.688	0.698	——	0.659	0.742	0.741	0.760		215	197	200	202	196	45	199	——	158	——	48
26	KUALA MAL	0.658	0.709	0.586	0.734	0.798	0.802	0.777	0.760	0.768	0.808	0.780	0.782	0.780	0.813	0.731	0.829	0.823	0.758	0.747	——	0.773	0.912	0.902	0.917	0.764		273	251	254	294	45	295	——	187	——	50
27	KUALA KRAU	0.549	0.581	0.533	0.618	0.676	0.678	0.669	0.633	0.664	0.648	0.658	0.587	0.686	0.687	0.581	0.686	0.755	0.707	0.623	——	0.806	0.779	0.802	0.826	0.751	0.824		216	216	260	41	220	——	186	——	49
28	KUALA BALAH	0.866	0.871	0.617	0.699	0.672	0.886	0.839	0.824	0.707	0.708	0.623	0.882	0.872	0.776	0.581	0.679	0.702	0.610	0.583	——	0.741	0.719	0.733	0.735	0.707	0.768	0.673		239	266	28	246	——	204	——	54
29	STN TELE DABONG	0.819	0.850	0.629	0.709	0.700	0.712	0.723	0.667	0.720	0.701	0.888	0.738	0.884	0.713	0.581	0.895	0.734	0.670	0.529	——	0.686	0.778	0.811	0.725	0.864	0.798	0.672	0.789		239	43	238	——	185	——	54
30	KUALA BERGAU	0.831	0.872	0.834	0.871	0.777	0.723	0.885	0.703	0.726	0.746	0.877	0.845	0.708	0.877	0.578	0.884	0.782	0.885	0.607	——	0.715	0.808	0.837	0.798	0.736	0.755	0.892	0.903	0.859		28	273	——	208	——	54
31	STN TELE KG LALOK	0.617	0.744	0.675	0.729	0.897	0.880	0.709	0.878	0.890	0.783	0.804	0.761	0.732	0.799	0.364	0.886	0.785	0.645	0.890	——	0.804	0.826	0.821	0.847	0.802	0.846	0.771	0.739	0.813	0.807		35	——	25	——	——
32	POLIS BERSAH	0.651	0.695	0.675	0.527	0.696	0.538	0.544	0.951	0.570	0.517	0.528	0.562	0.504	0.551	0.486	0.523	0.585	0.457	0.682	——	0.397	0.545	0.546	0.516	0.580	0.523	0.511	0.516	0.580	0.584	0.788		——	211	——	49
33	STN TELE KG ARANG	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——		——	——	——
34	STN TELE GUA MUSANG	0.218	0.250	0.270	0.277	0.387	0.364	0.376	0.501	0.384	0.303	0.488	0.608	0.327	0.601	0.275	0.388	0.604	0.387	0.380	——	0.508	0.687	0.512	0.622	0.691	0.657	0.662	0.686	0.688	0.511	0.782	0.691	——		——	49
35	GUA MUSANG	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——	——
36	LADANG MENTARA	0.964	0.918	0.294	0.288	0.400	0.385	0.479	0.542	0.548	0.506	0.643	0.379	0.298	0.385	0.385	0.388	0.648	0.302	0.618	——	0.524	0.508	0.478	0.524	0.389	0.584	0.612	0.538	0.637	0.647	——	0.421	——	0.805	——	

Table 6 - 7 Probable Rainfalls at the Lalok Gauging Station

(unit: mm/day)

Return Period	24 hrs.	48 hrs.	72 hrs.	120 hrs.
100	457	348	266	165
50	404	306	235	147
20	334	251	193	122
10	279	208	161	103

Table 6 - 8 Constants of Rainfall Intensity

Return Period	a	b
100	24,791	30.25
50	22,180	30.90
20	18,455	31.26
10	15,674	32.18

$$I = a/(t+b)$$

where: I is precipitation intensity (mm/day), and t is continuing hour of rainfall (hr.).

Table 6-9-1 Discharge at Tualang Estimated by Water Level Record and Water Level - Discharge Curve (m^3/sec/day)

Year 1976

Day \ Month	Jan.	Feb.	Mar.	Apr.	May	Jun.
1	162	63	45	32	78	100
2	154	62	43	31	73	80
3	136	62	62	30	57	85
4	122	68	41	29	143	80
5	116	64	42	29	81	79
6	106	64	41	27	58	77
7	103	60	40	-	86	71
8	107	58	41	-	133	71
9	99	56	43	-	75	80
10	93	55	45	-	69	61
11	91	54	45	-	148	63
12	87	53	42	-	102	82
13	88	51	40	-	103	72
14	95	51	39	-	95	79
15	100	50	43	-	106	159
16	94	49	58	-	96	130
17	90	48	47	-	163	113
18	87	48	41	-	77	164
19	85	47	38	-	62	130
20	82	45	37	-	98	102
21	80	45	36	-	310	74
22	78	45	36	-	154	62
23	77	44	35	-	97	58
24	73	43	35	-	76	80
25	73	42	37	-	62	77
26	72	42	37	-	54	69
27	70	42	39	-	50	88
28	68	43	45	-	48	277
29	66	44	45	83	77	171
30	65	-	39	83	87	87
31	64	-	35	-	177	-

Table 6-9-2

Year 1976

Day \ Month	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1	69	58	135	104	174	183
2	61	52	115	95	154	157
3	56	48	147	90	121	135
4	52	45	173	83	111	121
5	50	44	112	97	105	104
6	53	43	88	100	89	104
7	55	42	77	115	96	120
8	54	41	86	104	151	113
9	54	40	78	94	101	101
10	103	41	130	91	86	94
11	102	45	158	90	85	91
12	101	44	111	120	94	93
13	151	47	95	184	106	107
14	207	42	82	274	102	287
15	136	43	73	325	97	241
16	89	42	80	218	168	173
17	71	39	79	193	203	206
18	62	65	85	142	195	-
19	57	152	71	113	302	-
20	56	177	77	105	200	-
21	69	76	69	102	279	-
22	143	179	68	116	176	-
23	98	165	94	104	274	-
24	74	152	108	170	282	-
25	61	141	136	120	184	-
26	60	279	163	97	206	-
27	60	141	125	120	160	-
28	56	466	98	167	270	-
29	78	280	228	99	447	-
30	59	130	212	104	256	409
31	53	113	-	100	-	312

Table 6-9-3

Year 1977

Day \ Month	Jan.	Feb.	Mar.	Apr.	May	Jun.
1	324.4	59.8	50.0	29	25	23
2	586.9	58.3	53.0	28	20	21
3	404.5	59.0	50.0	32	17	22
4	277.9	69.8	49.3	33	18	40
5	246.5	70.6	42.3	29	18	32
6	272.4	70.6	53.8	30	19	30
7	224.5	70.6	53.8	31	18	30
8	186.4	72.9	53.0	28	17	25
9	163.4	88.1	53.0	26	18	22
10	149.5	85.6	53.8	25	18	16
11	139.5	55.3	53.8	23	16	16
12	126.1	51.5	53.8	22	16	21
13	117.4	50.8	53.8	22	18	31
14	109.7	51.5	54	21	41	33
15	104.6	52.3	54	20	46	23
16	99.6	51.5	54	20	39	22
17	95.5	51.5	51	24	30	33
18	91.3	51.5	47	24	25	32
19	87.3	51.5	47	22	24	29
20	84.0	51.5	41	20	23	26
21	81.6	51.5	32	18	22	24
22	79.2	50.8	36	18	21	22
23	76.1	50.0	36	17	19	31
24	72.9	50.8	32	18	18	40
25	70.6	64.4	34	17	25	20
26	69.0	63.6	52	15	22	20
27	66.7	50.8	43	15	19	17
28	64.4	50.0	36	14	36	22
29	62.8		34	15	31	29
30	61.3		32	14	24	22
31	59.0		30		26	

Table 6-10 Monthly Discharge at Tualang Estimated for Rainy Season and Dry Season from Monthly Discharge at the Cullemard Bridge

Year \ Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	(Oct. - Mar.)			(Apr. - Sept.)								
	Tualang (m^3/s/month) y = 0.1805x - 22,741 (r = 0.9817)			y = 0.288x - 627.398 (r - 0.9951)								
1948	6924*	3748*	2871*	4629*	6956*	3526*	3722*	3944*	3143*	3498*	3462*	2164*
49	1654	2900	1558*	2850*	4315*	2941*	1943	1943	2975	3505	5127	7777
1950	4620	4599	2623	3008	5002	3458	3013	2688	4157	3680	3928	4489
51	9985	3506	2062	2187	2338	2063	2024	1873	4224	4198	5423	5510
52	6260	3339	3257	2794	4874	2839	2257	2117	2491	4066	4435	3156
53	4249	2690	2682	2547	4862	3740	3211	1746	3199	3389	4252	5036
54	8222	2486	1880	2265	2978	3222	3269	3815	3627	4314	3455	9956
55	5496	2486	1727	2119	2420	2467	2943	3304	2198	3680	4471	3338
56	2426	2221	1974	3526	3188	3774	2908	3222	5991	6859	8061	8470
57	6305	2624	3236	4719	7119	6407	3921	5270	7308	4526	4803	12026
58	5728	3816	2703	1477	2896	2727	908	3583	2321	3520	4654	2492
59	1778	1037	794	836	2188	1533	1943	2001	2975	3345	5000	5648
1960	4249	2487	1384	1061	2164	1173	1373	978	2963	1952	3603	5138
61	6742	2716	1697	2637	2618	1612	1096	885	2029	2828	4062	5546
62	6224	2038	2448	1984	2653	1646	2117	2199*	2265*	3119	3187	5284
63	5277	1880	1566	644	803	847	920	1640	1815	2849	4929	5976
64	2740	2869	2332	1444	3048	2670	3001	2257	3357	2208	2461	3840
65	1792	1261	903	1399	2350	1511	1815	2501	3897	4176	4633	9796
66	7339	2979	2754	2480	2571	2670	2827*	3106	3188	9330*	7758*	8302*
67	17143*	5040*	6844	3954	4537	2400	3001	2466	2355	2572	7356	6217*
68	2529*	1157	998	588	1780	2310	2408	1152	3042	3644	2207	3563
69	3440	1182	772	273	1222	1376	1047	1489	1343	2325	5353	8681
1970	6064	2216	1668*	2480*	2071	2006	2676	3033	4297	4733	4363	6412
71	13854	2858	4454	2137	2319	2224	2397*	2481*	4038	2327	3432	16255
72	2271	1841	1035	1403	3147*	2527*	1069	1605	4729	2887	4255	12064
73	4342	1948	1432	1273	2140	2915	2497	2765	4297	3502	4309	22191
74	3838	2555	1824	3865	4551	2569	3721	2747	4081	3654	4840	4678
75	8594	3242	2462	2526	4194	2855	3078	2515	4971	3189	7715	8617
76	3295	1563	1270	1515	2908	2898	2310	3310	3321	3754	5560	6351
77	4739	2231	1438	902	970	1162	1926	2756	1681	3978	5132	3698
78	4152	1514	1192	1152	2230	2258	2962	1524	3071	-	-	-

Table 6-11 Discharge Calculation by Storage Function

Observation discharge volume and analytical discharge volume

Rainfall Period	Observation Peak (m^3/sec.)	Analytical Peak (m^3/sec.)
Dec. 12 to Dec. 15, 1975	860	945
Dec. 18 to Dec. 21, 1975	897	663
Nov. 25 to Nov. 27, 1979	3,300	3,200

Table 6-12 Probable Flood Discharge at Tualang Site

Regression Year	Probable Flood Discharge	
	Storage Function	Simple Correlation with Peak Discharge at the Guillemard Bridge
200	-	5,800
100	5,100	4,900
50	4,400	4,000
20	3,500	3,000
10	2,800	2,300
5	-	1,700

Table 6-13 Synthetical Storage Function

(m^3/s)

Date		Tualang	Dabong	Guillemard	Remarks
Dec.16,1975	Observation Value	860	1,428	2,593	
	Analytical Value	946	1,406	2,713	
Dec.18,1972	"	-	-	13,604	
	"	1,605	8,802	13,460	
Dec.10,1973	"	-	-	15,138	
	"	2,643	9,424	15,465	

Table 6-14 Synthetical Storage Function

(m³/S)

Regression Year	Guillemard	Analytical Valve	Tualang	Analytical Valve
1/100	19600	19600	4870	4200
1/50	16100	15800	4000	3400
1/20	12000	12400	3000	2600

Fluctuation of Flood Discharge

(m³/S)

Regression Year	Guillemard	Tualang Cut Volume	Max Discharge	Incremental
	19400	500	3680	200
	18900	1000	3180	700
1/100	18400	1500	2680	1200
19600	17900	2000	2180	1700
	17400	2500	1680	2200
	16900	3000	1180	2700
	16400	3500	680	3200
	15500	500	2900	300
	15000	1000	2400	800
1/50	14500	1500	1900	1300
15800	14000	2000	1400	1800
	13500	2500	900	2300
	13000	3000	400	2800
	12000	500	2100	400
1/20	11500	1000	1600	900
12400	11000	1500	1100	1400
	10500	2000	600	1900

Table 6-15 Monthly Evaporation

(millimetres)

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	De.
Kota Bharu	144	148	177	185	167	155	155	157	158	143	122	11
Cameron Highlands	101	102	118	110	102	102	104	101	101	97	90	8

Table 7-1 Water Quality Record (No. 642)

Station 5721642 SG. Kelantan @ Jam. Guillemard 76/01/01 to 76/08/31

Sampling Date	Discharge (Litre/$)	Total Solids (Residue at 105C) (MG/L)	Suspended Solids (Non-Filterable Residue) (MG/L)	Specific Conductance (Micromhos /CM)	Alkalinity (MG/L) Calcium Carbonate	PH (Units)	Silica (MG/L)	Calcium (MG/L)	Magnesium (MG/L)	Sodium (MG/L)	Potassium (MG/L)	Chloride (MG/L)	Sulphate (MG/L)
76/ 1/13	487200	70	35	50	25	7.5	20	5.6	1.3	4.0	1.2	4	6.0
76/ 2/ 3	264000	55	5	50	30	7.5	14	6.4	2.6	4.1	1.4	5	3.0
76/ 2/24	228000	75	10	58	30	7.5	18	6.0	2.2	88.2	3.6	3	2.0
76/ 3/16	294000	130	50	57	30	7.6	14	6.0	1.2	4.8	1.7	3	2.0
76/ 5/11	366000	95	60	45	20	7.4	18	3.2	1.0	2.9	1.7	8	7.0
76/ 6/21	298800	95	40	52	30	7.3	32	7.2	0.7	2.7	1.0	3	4.0
76/ 8/30	660000	70	45	39	25	7.2	14	4.4	1.8	2.1	1.2	2	7.0

Dashes indicate laboratory analysis was not performed.
NIL indicates a value below the lowest limits of detection.
The lowest limits of detection are : Magnesium less than 0.4 (MG/L)
Chloride less than 1 (MG/L)
Sulphate less than 0.3 (MG/L)

Sampling Date	Colour (Hazen Units)	Turbidity (Fullers Earth)	Temperature (Degree C)	Dissolved Oxygen (% Sat)	Biological Oxygen Demand (MG/L)	Chemical Oxygen Demand (MG/L)	Nitrate (MG/L)	Ammonia (MG/L)	Phosphate (Hydrolyzable) (MG/L)	Iron (MG/L)	Manganese (MG/L)	Fluoride (MG/L)
76/ 1/13	5	10	24.5	-	-	-	NIL	NIL	-	-	-	-
76/ 2/ 3	5	5	28.5	-	-	-	0.1	NIL	-	-	-	-
76/ 2/24	5	5	30.0	-	-	-	NIL	NIL	-	-	-	-
76/ 3/16	10	5	30.5	-	-	-	0.0	NIL	-	-	-	-
76/ 5/11	30	15	29.0	-	-	-	NIL	NIL	-	-	-	-
76/ 6/21	30	5	29.0	-	--	-	NIL	NIL	-	-	-	-
76/ 8/30	10	10	27.0	-	-	-	NIL	NIL	-	-	-	-

Dashes indicate laboratory analysis was not performed.
NIL indicates a value below the lowest limits of detection.
The lowest limits of detection are : Colour less than 5 units
Nitrate less than 0.1 (MG/L)
Ammonia less than 0.01 (MG/L)
Phosphate less than 0.01 (MG/L)
Iron less than 0.01 (MG/L)
Manganese less than 0.01 (MG/L)
Fluoride less than 0.01 (MG/L)

Resource : Hydrological Data
Water Quality Records 1976

Table 7-2 Water Quality Record (No. 652)

Station 5222652 Sg. Lebir @ Stn. Tele Kg. Tualang 76/02/01 to 76/09/30

Sampling Date	Discharge (Litre/$)	Total Solids (Residue at 105C) (MG/L)	Suspended Solids (Non-Filterable Residue) (MG/L)	Specific Conductance (Micromhos /CM)	Alkalinity (MG/L) Calcium Carbonate	PH (Units)	Silica (MG/L)	Calcium (MG/L)	Magnesium (MG/L)	Sodium (MG/L)	Potassium (MG/L)	Chloride (MG/L)	Sulphate (MG/L)
76/ 2/26	-	80	10	82	45	7.6	19	10.0	6.5	3.8	0.8	4	11.0
76/ 3/30	-	90	30	87	35	6.9	18	14.8	0.7	3.9	0.8	5	2.0
76/ 4/13	-	135	50	55	25	7.0	20	8.0	1.7	4.1	1.4	3	10.0
76/ 5/22	-	15	10	36	20	7.4	18	4.0	0.7	1.9	1.0	3	11.0
76/ 8/16	-	105	25	82	40	7.3	16	4.0	0.8	4.4	1.1	3	NIL
76/ 9/11	-	125	75	45	25	6.8	20	6.8	0.6	1.5	0.7	2	7.0

Dashes indicate laboratory analysis was not performed.
NIL indicates a value below the lowest limits of detection.
The lowest limits of detection are : Magnesium less than 0.4 (MG/L)
Chloride less than 1 (MG/L)
Sulphate less than 0.3 (MG/L)

Sampling Date	Colour (Hazen Units)	Turbidity (Fullers Earth	Temperature (Degree C)	Dissolved Oxygen (% Sat)	Biological Oxygen Demand (MG/L)	Chemical Oxygen Demand (MG/L)	Nitrate (MG/L)	Ammonia (MG/L)	Phosphate (Hydrolyzable (MG/L)	Iron (MG/L)	Manganese (MG/L)	Fluoride (MG/L)
76/ 2/26	10	5	29.0	-	-	-	NIL	NIL	-	-	-	-
76/ 3/30	5	5	29.0	-	-	-	NIL	NIL	-	-	-	-
76/ 4/13	10	20	29.5	-	-	-	NIL	0.01	-	-	-	-
76/ 5/22	50	5	27.0	-	-	-	NIL	NIL	-	-	-	-
76/ 8/16	5	5	30.5	-	-	-	NIL	NIL	-	-	-	-
76/ 9/11	5	10	28.0	-	-	-	NIL	NIL	-	-	-	-

Dashes indicate laboratory analysis was not performed.
NIL indicates a value below the lowest limits of detection.
The lowest limits of detection are : Colour less than 5 units
Nitrate less than 0.1 (MG/L)
Ammonia less than 0.01 (MG/L)
Phosphate less than 0.01 (MG/L)
Iron less than 0.01 (MG/L)
Manganese less than 0.01 (MG/L)
Fluoride less than 0.01 (MG/L)

Resource : Hydrological Data
Water Quality Records 1976

Table 7-3 Water Quality Record (No. 643)

Station 4809643 Sq. Perak @ Iskandar Bridge 76/01/01 to 76/12/31

Sampling Date	Discharge (Litre/S)	Total Solids (Residue at 105C (MG/L)	Suspended Solids (Non-Filterable Residue) (MG/L)	Specific Conductance (Micromhos /CM)	Alkalinity (MG/L) Calcium Carbonate	PH (Units)	Silica (MG/L)	Calcium (MG/L)	Magnesium (MG/L)	Sodium (MG/L)	Potassium (MG/L)	Chloride (MG/L)	Sulphate (MG/L)
76/ 1/ 6	-	80	20	45	-	7.1	16	4.0	0.9	14.6	3.0	1	-
76/ 1/19	55000	50	5	53	23	6.9	20	4.8	0.7	1.2	0.3	1	NIL
76/ 3/ 2	40000	85	10	4	21	7.6	18	4.4	3.4	6.0	0.8	1	1.6
76/ 4/26	265000	415	330	48	17	7.7	20	4.0	1.2	3.9	2.7	1	3.0
76/ 6/15	105000	82	20	56	20	7.4	6	5.6	0.7	5.1	2.2	1	0.3
76/ 7/27	65000	70	14	52	22	6.7	20	6.0	1.0	3.1	1.9	NIL	0.6
76/ 9/21	130000	186	129	47	20	7.5	22	5.2	1.0	2.6	3.6	NIL	3.6
76/11/ 9	-	240	170	49	14	7.6	16	4.8	1.2	2.5	2.5	1	0.8
76/12/20	95000	75	55	51	17	6.4	12	5.2	0.7	2.0	2.0	NIL	0.8

Dashes indicate laboratory analysis was not performed
NIL indicates a value below the lowest limits of detection.
The lowest limits of detection are : Magnesium less than 0.4 (MG/L)
Chloride less than 1 (MG/L)
Sulphate less than 0.3 (MG/L)

Sampling Date	Colour (Hazen Units)	Turbidity (Fullers Earth)	Temperature (Degree C)	Dissolved Oxygen (% Sat)	Biological Oxygen Demand (MG/L)	Chemical Oxygen Demand (MG/L)	Nitrate (MG/L)	Ammonia (MG/L)	Phosphate (Hydrolyzable) (MG/L)	Iron (MG/L)	Manganese (MG/L)	Fluoride (MG/L)
76/ 1/ 6	-	-	-	-	-	-	-	-	0.33	0.38	0.03	-
76/ 1/19	30	5	27.0	-	-	-	0.5	0.02	0.05	0.36	0.01	NIL
76/ 3/ 2	5	20	27.0	-	-	-	1.5	0.04	0.88	0.30	NIL	0.14
76/ 4/26	350	420	26.9	-	-	-	1.4	0.04	0.40	15.20	0.15	0.23
76/ 6/15	70	25	28.9	-	-	-	2.3	0.01	0.30	0.40	NIL	0.23
76/ 7/27	30	15	27.8	-	0.1	-	0.9	0.02	4.70	0.40	0.35	0.10
76/ 9/21	160	140	27.5	-	0.4	-	0.9	0.03	0.30	0.60	0.09	0.50
76/11/ 9	160	255	27.8	-	0.9	-	0.4	0.10	0.20	1.44	0.04	0.40
76/12/20	40	25	24.4	-	0.1	-	0.5	0.09	1.00	0.80	0.02	0.20

Dashes indicate laboratory analysis was not performed
NIL indicates a value below the lowest limits of detection.
The lowest limits of detection are : Colour less than 5 units
Nitrate less than 0.1 (MG/L)
Ammonia less than 0.01 (MG/L)
Phosphate less than 0.01 (MG/L)
Iron less than 0.01 (MG/L)
Manganese less than 0.01 (MG/L)
Fluoride less than 0.01 (MG/L)

Resource : Hydrological Data
Water Quality Records 1976

Table 7-4 Numbers of Sighted Wild Animals in Kelantan

Species \ Year	1975	1976	1977	1978	
Elephant	46	39	66	69	*
Gaur	11	27	10	11	*
Tiger	17	29	20	14	*
Sambar Deer	32	25	26	32	*
Malayan Honey Bear	21	30	2	10	*
Wild Pig	20	10	19	11	*
Tapir	-	-	10	22	**

* Protected Wild Animals

** Totally Protected Wild Animals

Resource: Games Dept. of Kelantan

Table 7-5 Density of Primates in Forest

Species		Density of Species (Animal/km^2)	
		Secondary Forest	Primary Forest
Macaca fascicularis (Long-tailed Macaque)	*	1.54	0.37
Macaca nemestrina (Pig-tailed Macaque)	*	0.13	-
Presbytis cristana (Silvered-leaf Monkey)	*	0.26	-
Presbytis melalophos (Banded-leaf Monkey)	*	2.95	2.22
Presbytis obscura (Spectacled or Duskey-leaf Monkey)	**	0.64	0.74
Hylobates lar (White-handed Gibbon)	*	0.89	1.11
Hylobates syndactylus (Siamang)	*	0.51	1.11

* protected animals

** totally protected animals

Resource: Man's Impact on the Primates of Peninsula Malaysia

Table 7-6 Vector Borne Disease

	1970	1977
1. Gastro-enteritis and colitis, ages 4 weeks and over	941	7,305
2. Typhoid fever	85	523
3. Dysentery all types	181	149
4. Measles	88	456
5. Dengue	not available	15
6. Acute infections encephalitis	same	0
7. Other and unspecified typhus	3	4
8. Malaria all types	3,084	1,531
9. Leptospirosis	4	4
10. Filariasis	3	1

Resource: Health Dep. of Kelantan

Table 7-7 Present Land Use (1966)

Land Use Category	Ule Kelantan District		Kelantan State	
	km^2	%	km^2	%
Urban and Associated areas	6	0.1	32	0.2
Horticulture	17	0.2	323	2.2
Tree, Palm and Permanent Crops	286	2.6	977	6.6
Cropland	27	0.2	779	5.2
Grassland	89	0.8	270	1.8
Forest and Scrubland	10,422	94.5	11,917	80.3
Recently Cleared Land	68	0.6	105	0.7
Swamp	2	0.0	259	1.7
Unused Land	45	0.4	63	0.4
Unclassified	59	0.5	121	0.8
Total	11,023	100.0	14,846	100.0

Resource: I.P.T. Wong
The Present Land Use of Kelantan
July 1970
Present Land Use Report No.7

Table 8-1

Reservoir Areas for 3 Sites

(km^2)

Elevation (m) \ Name	Tualang	Jeram Panjang	Kiak
90	250	247	217
80	156	154	129
70	91	89	70

Storage Capacity for 3 Sites

($\times 10^6 m^3$)

Elevation (m) \ Name	Tualang	Jeram Panjang	Kiak
90	4495	4397	3565
80	2465	2392	1835
70	1230	1177	840

Table 10 - 1 Estimated Construction Cost - J. Panjang Site

(Rockfill, H.W.L. 90 m, Free Overflow)

Item	Unit	Unit Price (M$)	Crest Length 80 m		Crest Length 120 m	
			Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
1. Civil Works				241,134.		245,689.
1-1. Buildings				8,600.		8,600.
Powerhouse	m^3	300	22,000	6,600		
Others	lot		1	2,000		
1-2. Waterway				32,604.		32,604.
Intake				7,817.		7,817.
earth excavation	m^3	4.5	18,100	81		
rock excavation	m^3	15	57,200	858		
concrete	m^3	250	10,200	2,550		
steel bar	ton	1,500	510	765		
gate	ton	9,200	180	1,656		
screen	ton	4,600	260	1,196		
others	lot		1	711		
Penstock				19,012.		19,012.
earth excavation	m^3	4.5	40,900	184		
rock excavation	m^3	15	60,500	908		
tunnel driving	m^3	64	16,400	1,050		
steel rib support	ton	3,000	40	120		
concrete	m^3	270	16,400	4,428		
tunnel concrete	m^3	270	7,200	1,944		

Item	Unit	Unit Price (M$)	Crest Length 80 m		Crest Length 120 m	
			Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
steel bar	ton	1,500	170	255		
steel pipe	ton	7,300	1,150	8,395		
others	lot		1	1,728		
Tailrace				4,521.		4,521.
earth excavation	m^3	4.5	20,600	93		
rock excavation	m^3	15	64,500	968		
concrete	m^3	270	6,600	1,782		
steel bar	ton	1,500	170	255		
gate	ton	9,200	110	1,012		
others	lot		1	411		
Miscellaneous Works				1,254.		1,254.
1-3. Reservoir				150,145.		154,133.
Main Dam				66,370.		66,098.
stripping	m^3	3.5	929,000	3,252	929,000	3,252
rock-filling	m^3	11	4,435,000	48,785	4,409,000	48,499
rock-filling (appropriate)	m^3	1.5	144,000	216	170,000	255
earth-filling	m^3	8.5	624,000	5,304	624,000	5,304
grout hole drilling	m	140	11,400	1,596	11,400	1,596
grout cement	ton	1,220	970	1,183	970	1,183
others	lot		1	6,034	1	6,009

Item	Unit	Unit Price (M$)	Crest Length 80 m		Crest Length 120 m	
			Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
Spillway				28,773.		32,918
earth excavation	m^3	4.5	477,000	2,147	540,000	2,430
rock excavation	m^3	15	205,000	3,075	243,000	3,645
concrete	m^3	250	79,000	19,750	90,000	22,500
steel bar	ton	1,500	790	1,185	900	1,350
others	lot		1	2,616	1	2,993
Diversion				33,208.		33,208.
earth excavation	m^3	4.5	240,000	1,080		
rock excavation	m^3	15	43,000	645		
concrete	m^3	250	1,100	275		
tunnel driving	m^3	64	150,000	9,600		
steel rib support	ton	3,000	70	210		
tunnel concrete	m^3	270	46,000	12,420		
blocking concrete	m^3	220	6,800	1,496		
steel bar	ton	1,500	1,400	2,100		
gate	ton	9,200	160	1,472		
grout hole drilling	m	140	3,400	476		
grout cement	ton	1,220	340	415		
others	lot		1	3,019		
Saddle Dam 1				14,865.		14,865.
stripping	m^3	3.5	393,000	1,376		
rock-filling	m^3	11	852,000	9,372		
earth-filling	m^3	8.5	138,000	1,173		

Item	Unit	Unit Price (M$)	Crest Length 80 m		Crest Length 120 m	
			Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
grout hole drilling	m	140	6,500	910		
grout cement	ton	1,220	560	683		
others	lot		1	1,351		
Saddle Dam 2				2,556.		2,556.

Item	Unit	Unit Price (M$)	Crest Length 80 m		Crest Length 120 m	
			Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
stripping	m^3	3.5	147,000	515		
rock-filling	m^3	11	99,000	1,089		
earth-filling	m^3	8.5	20,000	170		
grout hole drilling	m	140	2,100	294		
grout cement	ton	1,220	210	256		
others	lot		1	232		
Miscellaneous Works				4,373.		4,489.
1-4. Mechanical Equipment				23,949.		24,028.
Foundation				19,727.		19,727.
earth excavation	m^3	4.5	8,700	39		
rock excavation	m^3	15	41,200	618		
concrete	m^3	270	49,600	13,392		
steel bar	ton	1,500	2,590	3,885		
others	lot		1	1,793		
Mechanical Equipment				4,222.		4,301.
1-5. Temporary Facilities				25,836.		26,324.
2. Electro-Mechanical Equipment	kW		@870 145,000	126,150.	@840 149,000	125,160.
Sub-total (1~2)				367,284.		370,849.

Item	Unit	Unit Price (M$)	Crest Length 80 m		Crest Length 120 m	
			Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
3. Contingency				36,728.		37,085.
4. Engineering				24,113.		24,569.
5. Government Administration				4,823.		4,914.
Grand Total(1 ~ 5)				432,948.		437,417.

Item	Unit	Unit Price (M$)	Crest Length 160 m		Crest Length 200 m	
			Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
1. Civil Works				249,871.		254,037.
1-1. Buildings				8,600.		8,600.
1-2. Waterway				32,604.		32,604.
1-3. Reservoir				157,794.		161,441.
Main Dam				65,764.		65,419.
stripping	m^3	3.5	929,000	3,252	929,000	3,252
rock-filling	m^3	11	4,377,000	48,147	4,344,000	47,784
rock-filling (appropriate)	m^3	1.5	202,000	303	235,000	353
earth-filling	m^3	8.5	624,000	5,304	624,000	5,304
grout hole drilling	m	140	11,400	1,596	11,400	1,596
grout cement	ton	1,220	970	1,183	970	1,183
others	lot		1	5,979	1	5,947
Spillway				36,805.		40,691.
earth excavation	m^3	4.5	583,000	2,624	626,000	2,817
rock excavation	m^3	15	289,000	4,335	335,000	5,025
concrete	m^3	250	100,000	25,000	110,000	27,500
steel bar	ton	1,500	1,000	1,500	1,100	1,650
others			1	3,346	1	3,699
Diversion				33,208.		33,208.
Saddle Dam 1				14,865.		14,865.
Saddle Dam 2				2,556.		2,556.

Item	Unit	Unit Price (M$)	Crest Length 160 m		Crest Length 200 m	
			Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
Miscellaneous Works				4,596.		4,702.
1-4. Mechanical Equipment				24,101.		24,174.
Foundation				19,727.		19,727.
Mechanical Equipment				4,374.		4,447.
1-5. Temporary Facilities				26,772.		27,218.
2. Electro-Mechanical Equipment	kW		@825 151,000	124,575.	@810 153,000	123,930.
Sub-total (1~2)				374,446.		377,967.
3. Contingency				37,445.		37,797.
4. Engineering				24,987.		25,404.
5. Government Administration				4,997.		5,081.
Grand Total (1 ~ 5)				441,875.		446,249.

Estimated Construction Cost - J. Pnajang Site

(Rockfill, Free Overflow)

Item	Unit	Unit Price (M$)	H.W.L. 70 m		H.W.L. 80 m		H.W.L. 90 m	
			Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
1. Civil Works				193,204		220,652		249,871
1-1. Buildings				8,600		8,600		8,600
1-2. Waterway				25,279		29,018		32,604
Intake				6,168		7,006		7,817
earth excavation	m^3	4.5	13,600	61	15,900	72	18,100	81
rock excavation	m^3	15	42,900	644	50,000	750	57,200	858
concrete	m^3	250	7,700	1,925	9,000	2,250	10,200	2,550
steel bar	ton	1,500	390	585	450	675	510	765
gate	ton	9,200	140	1,288	160	1,472	180	1,656
screen	ton	4,600	240	1,104	250	1,150	260	1,196
others	lot		1	561	1	637	1	711
Penstock				14,336		16,686		19,012
earth excavation	m^3	4.5	32,700	147	36,800	166	40,900	184
rock excavation	m^3	15	48,400	726	54,500	818	60,500	908
tunnel driving	m^3	64	13,100	838	14,800	947	16,400	1,050
steel rib support	ton	3,000	32	96	36	108	40	120

Item	Unit	Unit Price (M$)	H.W.L. 70 m		H.W.L. 80 m		H.W.L. 90 m	
			Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
concrete	m^3	270	13,100	3,537	14,800	3,996	16,400	4,428
tunnel concrete	m^3	270	5,800	1,566	6,500	1,755	7,200	1,944
steel bar	ton	1,500	140	210	150	225	170	255
steel pipe	ton	7,300	810	5,913	980	7,154	1,150	8,395
others	lot		1	1,303	1	1,517	1	1,728
Tailrace				3,851		4,210		4,521
earth excavation	m^3	4.5	16,400	74	18,500	83	20,600	93
rock excavation	m^3	15	51,600	774	58,100	872	64,500	968
concrete	m^3	270	5,300	1,431	6,000	1,620	6,600	1,782
steel bar	ton	1,500	140	210	160	240	170	255
gate	ton	9,200	110	1,012	110	1,012	110	1,012
others	lot		1	350	1	383	1	411
Miscellaneous Works				924		1,116		1,254
1-3. Reservoir				122,777		139,433		157,794
Main Dam				24,012		44,867		65,764
stripping	m^3	3.5	514,000	1,799	722,000	2,527	929,000	3,252
rock-filling	m^3	11	1,183,000	13,013	2,779,000	30,569	4,377,000	48,147
rock-filling (Appropriate)	m^3	1.5	948,000	1,422	575,000	863	202,000	303
earth-filling	m^3	8.5	451,000	3,834	537,000	4,565	624,000	5,304
grout hole drilling	m	140	7,000	980	9,200	1,288	11,400	1,596

Item	Unit	Unit Price (M$)	H.W.L. 70 m		H.W.L. 80 m		H.W.L. 90 m	
			Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
grout cement	ton	1,220	640	781	800	976	970	1,183
others	lot		1	2,183	1	4,079	1	5,979
Spillway				56,692		46,905		36,805
earth excavation	m^3	4.5	874,000	3,933	729,000	3,281	583,000	2,624
rock excavation	m^3	15	1,354,000	20,310	822,000	12,330	289,000	4,335
concrete	m^3	250	103,000	25,750	102,000	25,500	100,000	25,000
steel bar	ton	1,500	1,030	1,545	1,020	1,530	1,000	1,500
others	lot		1	5,154	1	4,264	1	3,346
Diversion				33,208		33,208		33,208

Item		Unit	Unit Price (M$)	H.W.L. 70 m		H.W.L. 80 m		H.W.L. 90 m	
				Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
	Saddle Dam 1				5,289		10,086		14,865
	stripping	m^3	3.5	204,000	714	299,000	1,047	393,000	1,376
	rock-filling	m^3	11	276,000	3,036	564,000	6,204	852,000	9,372
	earth-filling	m^3	8.5	38,000	323	88,000	748	138,000	1,173
	grout hole drilling	m	140	2,900	406	4,700	658	6,500	910
	grout cement	ton	1,220	270	329	420	512	560	683
	others	lot		1	481	1	917	1	1,351
	Saddle Dam 2				0		306		2,556
	stripping	m^3	3.5					147,000	515
	rock-filling	m^3	11					99,000	1,089
	earth-filling	m^3	8.5					20,000	170
	grout hole drilling	m	140			1,200	168	2,100	294
	grout cement	ton	1,220			90	110	210	256
	others	lot				1	28	1	232
	Miscellaneous Works				3,576		4,061		4,596
1-4.	Mechanical Equipment				15,848		19,960		24,101
	Foundation				12,466		16,097		19,727
	earth excavation	m^3	4.5	7,200	32	7,900	36	8,700	39

Item	Unit	Unit Price (M$)	H.W.L. 70 m		H.W.L. 80 m		H.W.L. 90 m	
			Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
rock excavation	m^3	15	34,400	516	37,800	567	41,200	618
concrete	m^3	270	31,000	8,370	40,300	10,881	49,600	13,392
steel bar	ton	1,500	1,610	2,415	2,100	3,150	2,590	3,885
others	lot		1	1,133	1	1,463	1	1,793
Mechanical Equipment				3,382		3,863		4,374
1-5. Temporary Facilities				20,700		23,641		26,772
2. Electro-Mechanical Equipment	kW		@1,300 69,000	89,700	@1,040 109,000	113,360	@825 151,000	124,575
Sub-total (1~2)				282,904		334,012		374,446
3. Contingency				28,290		33,401		37,445
4. Engineering				19,320		22,065		24,987
5. Government Administration				3,864		4,413		4,997
Grand Total (1 ~ 5)				334,378		393,891		441,875

Estimated Construction Cost - J. Panjang Site

(Rockfill, Gate Operation)

Item	Unit	Unit Price (M$)	H.W.L. 70 m		H.W.L. 80 m		H.W.L. 90 m	
			Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
1. Civil Works				201,497.		225,704.		251,945.
1-1. Buildings				8,600.		8,600.		8,600.
1-2. Waterway				25,279.		29,018.		32,604.
1-3. Reservoir				130,035.		143,855.		159,609.
Main dam				25,872.		46,016.		66,202.
stripping	m^3	3.5	514,000	1,799	722,000	2,527	929,000	3,252
rock-filling	m^3	11	1,361,000	14,971	2,889,000	31,779	4,419,000	48,609
rock-filling (Appropriate)	m^3	1.5	770,000	1,155	465,000	698	160,000	240
earth-filling	m^3	8.5	451,000	3,834	537,000	4,565	624,000	5,304
grout hole drilling	m	140	7,000	980	9,200	1,288	11,400	1,596
grout cement	ton	1,220	640	781	800	976	970	1,183
others	lot		1	2,352	1	4,183	1	6,018
Spillway				61,878		50,049.		38,129.
earth excavation	m^3	4.5	756,000	3,402	625,000	2,813	494,000	2,223
rock excavation	m^3	15	1,100,000	16,500	664,000	9,960	228,000	3,420
Concrete	m^3	250	91,000	22,750	86,000	21,500	80,000	20,000
Steel bar	ton	1,500	910	1,365	860	1,290	800	1,200
gate	ton	9,200	1,330	12,236	1,080	9,936	850	7,820
others	lot		1	5,625	1	4,550	1	3,466
Diversion				33,208.		33,208.		33,208.

Item	Unit	Unit Price (M$)	H.W.L. 70 m		H.W.L. 80 m		H.W.L. 90 m	
			Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
Saddle Dam 1				5,289.		10,086.		14,865.
Saddle Dam 2				0		306.		2,556.
Miscellaneous Works				3,788.		4,190.		4,649.
1-4. Mechanical Equipment				15,994.		20,048.		24,138.
Foundation				12,466.		16,097.		19,727.
Mechanical Equipment				3,528.		3,951.		4,411.
1-5. Temporary Facilities				21,589.		24,183.		26,994.
2. Electro-Mechanical Equipment	kW		@1,210 84,000	101,640	@980 122,000	119,560	@780 158,000	123,240
Sub-total (1~2)				303,137.		345,264.		375,185.
3. Contingency				30,314.		34,526.		37,519.
4. Engineering				20,150.		22,570.		25,195.
5. Government Administration				4,030.		4,514.		5,039.
Grand Total (1~5)				357,631.		406,874.		442,938.

Estimated Construction Cost - Tualang Site

(Concrete Gravity)

Item	Unit	Unit Price (M$)	H.W.L. 70 m		H.W.L. 80 m		H.W.L. 90 m	
			Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
1. Civil Works				185,335.		244,956.		306,849.
1-1. Buildings				8,600.		8,600.		8,600.
1-2. Waterway				23,888.		27,160.		30,349.
Intake				7,829.		9,044.		10,260.
earth excavation	m^3	4.5	8,700	39	8,700	39	8,700	39
rock excavation	m^3	15	5,200	78	5,200	78	5,200	78
concrete	m^3	250	14,000	3,500	16,600	4,150	19,200	4,800
steel bar	ton	1,500	800	1,200	950	1,425	1,100	1,650
gate	ton	9,200	150	1,380	170	1,564	190	1,748
screen	ton	4,600	200	920	210	966	220	1,012
others	lot		1	712	1	822	1	933
Penstock				10,307		12,075		13,812
earth excavation	m^3	4.5	38,200	172	40,400	182	42,600	192
rock excavation	m^3	15	71,000	1,065	78,500	1,178	86,000	1,290
concrete	m^3	270	11,500	3,105	13,100	3,537	14,600	3,942
steel bar	ton	1,500	140	210	160	240	180	270
steel pipe	ton	7,300	660	4,818	800	5,840	940	6,862
others	lot		1	937	1	1,098	1	1,256
Tailrace				4,833		4,996		5,110
earth excavation	m^3	4.5	22,300	100	23,300	105	24,300	109

Item	Unit	Unit Price (M$)	H.W.L. 70 m		H.W.L. 80 m		H.W.L. 90 m	
			Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
rock excavation	m^3	15	85,800	1,287	84,300	1,265	82,800	1,242
concrete	m^3	270	6,500	1,755	7,000	1,890	7,400	1,998
steel bar	ton	1,500	160	240	180	270	190	285
gate	ton	9,200	110	1,012	110	1,012	110	1,012
others	lot		1	439	1	454	1	464
Miscellaneous Works				919		1,045		1,167
1-3. Reservoir				116,683		62,118		209,671
Main Dam				72,994		00,846		28,869
earth excavation	m^3	4.5	69,000	311	96,500	434	124,000	558
rock excavation	m^3	15	123,000	1,845	146,000	2,190	169,000	2,535
concrete	m^3	200	227,000	45,400	361,000	72,200	495,000	99,000
steel bar	ton	1,500	640	960	680	1,020	710	1,065
gate	ton	9,200	1,330	12,236	1,080	9,936	850	7,820
grout hole drilling	m	140	3,800	532	5,100	714	6,300	882
grout cement	ton	1,220	300	366	390	476	480	586
cofferdam concrete	m^3	220	21,400	4,708	21,400	4,708	21,400	4,708
others	lot			6,636		9,168		11,715
Diversion				21,362		21,362		21,362
earth excavation	m^3	4.5	27,000	122				
rock excavation	m^3	15	30,000	450				
concrete	m^3	250	1,500	375				

Item	Unit	Unit Price (H$)	H.W.L. 70 m		H.W.L. 80 m		H.W.L. 90 m	
			Quantity	Amount (H$10^3)	Quantity	Amount (H$10^3)	Quantity	Amount (H$10^3)
tunnel driving	m^3	64	97,000	6,208				
steel rib support	ton	3,000	240	720				
tunnel concrete	m^3	270	29,600	7,992				
blocking concrete	m^3	220	3,400	748				
steel bar	ton	1,500	890	1,335				
gate	ton	9,200	80	736				
grout hole drilling	m	140	2,800	392				
grout cement	ton	1,220	280	342				
others	lot		1	1,942				
Saddle Dam 1				5,289		10,086		14,865
Saddle Dam 2				0		306		2,556
Saddle Dam 3				13,639		24,796		35,912
stripping	m^3	3.5	632,000	2,212	752,000	2,632	872,000	3,052
rock-filling	m^3	11	650,000	7,150	1,388,000	15,268	2,125,000	23,375
earth-filling	m^3	8.5	155,000	1,318	277,000	2,355	399,000	3,392
grout hole drilling	m	140	6,700	938	9,100	1,274	11,400	1,592
grout cement	ton	1,220	640	781	830	1,013	1,010	1,232
others	lot		1	1,240	1	2,254	1	3,265
Miscellaneous Works				3,399		4,722		6,107

Item	Unit	Unit Price (M$)	H.W.L. 70 m		H.W.L. 80 m		H.W.L. 90 m	
			Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)	Quantity	Amount (M$10^3)
1-4. Mechanical Equipment				16,308		20,833		25,352
Foundation				13,063		16,545		19,980
earth excavation	m^3	4.5	17,600	79	17,200	77	16,700	75
rock excavation	m^3	15	67,400	1,011	62,200	933	56,900	854
concrete	m^3	270	31,000	8,370	40,300	10,881	49,500	13,365
steel bar	ton	1,500	1,610	2,415	2,100	3,150	2,580	3,870
others	lot		1	1,188	1	1,504	1	1,816
Mechanical Equipment				3,245		4,288		5,372
1-5. Temporary Facilities				19,857		26,245		32,877
2. Electro Mechanical Equipment	kW		91,200	88,000 105,600	93,920	128,000 117,760	97,750	162,000 123,120
Sub-total (1~2)				290,936		362,716		429,969
3. Contingency				29,094		36,272		42,997
4. Engineering				18,534		24,496		30,685
5. Government Administration				3,707		4,899		6,137
Grand Total (1 ~ 5)				342,271		428,383		509,788

Table 10-2 Unit Costs of Civil Works

(M$)

Item	Unit	Rockfill Dam	Concrete Dam	Spill-way	Diver-sion	Intake	Pen-stock	Power Plant Tail-race
earth ex-cavation	m^3		4.5	4.5	4.5	4.5	4.5	4.5
rock ex-cavation	m^3		15.0	15.0	15.0	15.0	15.0	15.0
stripping	m^3	3.5						
rock filling	m^3	11.0						
rock filling (appropri-ate)	m^3	1.5						
earth filling	m^3	8.5						
tunnel driving	m^3				64		64	
steel rib support	ton				3,000		3,000	
concrete	m^3		200	250	250	250	270	270
secondary coffering concrete	m^3		220					
tunnel concrete	m^3				270		270	
blocking concrete	m^3				220			
steel bar	ton		1,500	1,500	1,500	1,500	1,500	1,500
grout hole drilling	m	140	140		140			
grout cement	ton	1,220	1,220		1,220			

Table 11-1

Present Land Use in the Coastal Region, Kelantan

-Without the KRBS-Irrigation Projects-

No.	Category	Kelantan Ha (A)	Coastal Ha (B)	%	%	B/A (%)
Agriculture		256,569.1	164,221.6	100.0	69.8	64.0
1	Padi	75,226.2	71,356.6	43.4	30.3	94.9
2	Rubber	129,603.4	53,221.6	32.4	22.6	41.1
3	Mixed Horticulture	34,350.9	27,534.0	16.8	11.7	80.2
4	CoConut	7,662.9	7,544.9	4.6	3.2	98.5
5	Oil Palm	5,258.6	2,150.5	1.3	0.9	40.9
6	Diversified Crops	2,269.1	1,401.9	0.9	0.6	61.8
7	Orchards	1,040.1	1,012.1	0.6	0.4	97.3
8	Shifting Cultivation	1,157.9	0	0	0	0
Other Land Use		1,247,623.5	71,165.8	100.0	30.2	5.7
9	Urban	3,065.9	2,497.6	3.5	1.1	81.5
10	Grass Land	17,986.6	12,065.9	17.0	5.1	67.1
11	Forest	1,104,339.9	15,313.6	21.5	6.5	1.4
12	Scrub Forest	55,690.4	13,305.4	18.7	5.7	23.9
13	Swamp	25,951.4	22,892.4	32.2	9.7	88.2
14	Unclassified	40,589.3	5,090.9	7.2	2.2	12.5
	Total	1,504,192.6	235,387.4		100.0	15.6

(Source = KRBS, 1977)

Note: KBRS means "Kelantan River Basin Study".

Table 11-2 Annual Cost of Alternative Thermal Power Plant

I) Capital Cost of Notional Thermal

	M Dol./kW (1978.1 Est.)	Escala-tion (78.1 - 79.12)	M Dol./kW (1979.12)	IDC (8-0/0)	Cap. Value M Dol./kW	Stn. Loss Factor	Cap. Value M Dol./kW
Steam Plant	834.0	10-0/0	917.4	12.7-0/0	1033.9	1.15	1189.0
Gas Turbine	469.0	10/0/0	515.9	4-0/0	536.5	1.15	617.0

II) Operation and Maintenance Cost

A) Fixed cost

	Fixed Cost (1978.1) M Dol./kW	Escalation (78.1 - 79.12)	Fixed Cost (1979.12) M Dol./kW	Over-head	Insurance M Dol./kW	Fixed Cost M Dol./kW
Steam Plant	12.08	10-0/0	13.29	39-0/0	2.58	21.05
Gas Turbine	4.41	10-0/0	4.85	39-0/0	1.34	8.08

B) Variable Cost

	Variable Cost (1978.1) M Dol./kWh	Escalation (1978.1 - 1979.12)	Variable Cost (1979.12) M Dol./kWh
Steam Plant	0.00124	89 %	0.00234
Gas Turbine	0.00195	89 %	0.00369

III) Fuel Cost for Notilnal Thermal Plant

	Fuel Cons. kg/kWh	Fuel Price (1978.1) M Dol./L.Ton	Escalation (1978.1 - 1979.12)	Fuel Price (1979.12) M Dol./L.Ton	Fuel Cost M Dol./kWh
Steam Plant	0.256	199	89 %	376.1	0.0948
Gas Turbine	0.320	314	89 %	593.5	0.1869

Annual cost of the notional thermal alternatives is obtained as describing in the following formulas.

Formula I

$$P = PS + PG \quad \text{..... (1)}$$

$$E = 8760\ (PS \times 0.80 + PG \times 0.05) \quad \text{..... (2)}$$

From the above formulas,

$$PS = (F/0.75 - 0.05/0.75)P$$

$$PG = (0.8/0.75 - F/0.75)P$$

Where

P : Max. output of hydro project (kW)

E : Annual energy product of hydro project (kWh)

F : Plant factor of hydro project (E/PX8760)

PS : Output of steam plant

PG : Output of gas turbine

If the kW value and the kWh value of steam plant and gas turbine are shown as follows,

Steam Plant :

VS1 : 1189 x C·R·F + 21.05 (M Dol./kW, C·R·F = 0.0937)

VS2 : 0.0023 + 0.0948 (M Dol./kWh)

Gas Turbine :

VG1 : 617 x C·R·F + 8.08 (M Dol./kW, C·R·F = 0.0937)

VG2 : 0.0037 + 0.1869 (M Dol./kWh)

B (hydro power benefit) = Annual cost of the alternative thermal, which can be written in the following formula,

$$B = PS(VS1 + VS2 \times 8760 \times 0.8) + PG\ (VG1 + VG2 \times 8760 \times 0.05)$$

Therefore,

$$B = 105.1P + 0.1010E$$

Note : B : (M Dol.)

Table 11-3 Basic Factors in Agricultural Net Production Value

($Million on Constant 1976 Price Level)

No.	Irrigation Project	Year Commissioned	Base Year (1976)	Ultimate Status N.P.V.	Ultimate Status Year Achieved	Future (2025)
(A)	Without the Lebir Dam Project					
	W/O Irrigation Project		72.32			
4.	ADB:Kemasin-Semerak	1986	82.36	236.26	N. 2011 W. 2017	
5.	KBRS-Lemal, Alor Pasir & Pasir Mas Ext					
6.	KBRS-North Lemal KBRS-Rantau Panjang					
7.	KBRS-Ulu Lemal					
8.	KBRS-Upper Ulu Lemal					
9.	KBRS-Sa Baan	1989	89.81	263.58	N. 2012 W. 2018	
10.	KBRS-Tasek Garu	1995	93.80	318.85	N. 20.13 W. 20.19	
11.	KBRS-Kemubu & Salor Ext					
12.	KBRS-Sg. Sat					
13.	KBRS-Pertok & Putat Ext	1999	97.28	281.35	N. 2014 W. 2020	395.65
	(Water shortage will occur in 1996)					
(B)	With the Lebir Dam Project					
	W/O Irrigation Project		72.32			
4.	ADB: Kemasin-Semerak	1986	82.32	236.26	N. 2011 D. 2010	
5.	KBRS-Lemal,Alar Pasir & Mas Ext					
6.	KBRS-North Lemal KBRS-Rantan Panjang					
7.	KBRS-Ulu Lemal					
8.	KBRS-Upper Ulu Lemal					
9.	KBRS-Sg. Bagar	1989	89.81	263.82	D. 2011	
10.	KBRS-Tasek Garu	1995	93.80	319.58	D. 2012	
11.	KBRS-Kemubu & Salor Ext					
12.	KBRS-Sg. Sat					
13.	KBRS-Pertak & Putat Ext	1999	97.28	282.64	D. 2013	416.97

*/..... N=Normal time horizon, W=Water shortage

D=After completion of Lebir Dam, less 1 year from N.

N.P.V.= Net production value

Table 11-4 Agricultural Benefit with the Lebix Dam

($ Million on Constant 1976 Price Level)

Project Year	Benefits w/o-NPV (A)	Benefits w - NPV (B)	Benefits (B)-(A)	Direct Water Deficit Costs w/o-Dam (C)	Direct Water Deficit Costs w/Dam (D)	Direct Water Deficit Costs Increment (D)-(C)
1979	80.90	80.90	0	0	0	0
1980	83.76	83.76	0	0	0	0
1	86.63	86.63	0	0	0	0
2	89.49	89.49	0	0	0	0
3	92.35	92.35	0	0	0	0
4	95.21	95.21	0	0	0	0
85	98.07	98.07	0	0	0	0
6	114.40	114.40	0	0	0	0
7	130.73	130.73	0	0	0	0
8	135.13	135.13	0	0	0	0
9	146.11	147.27	1.16	0	0	0
1990	157.08	159.41	2.33	0	0	0
1	161.92	164.39	2.47	0	0	0
2	166.76	169.36	2.60	0	0	0
3	171.60	174.33	2.73	0	0	0
4	176.44	179.30	2.86	0	0	0
95	169.45	199.27	2.82	0	0	0
6	216.45	219.23	2.78	2.00	0	-2.00
7	220.90	225.50	4.60	2.50	0	-2.50
8	225.35	231.78	6.43	3.00	0	-3.00
9	247.29	257.08	9.79	3.50	0	-3.50
2000	269.22	282.38	13.16	4.00	0	-4.00
1	274.83	290.08	15.26	4.00	0	-4.00
2	280.43	297.80	17.37	4.00	0	-4.00
3	286.04	305.52	19.48	4.00	0	-4.00
4	291.65	313.23	21.58	4.00	0	-4.00
05	297.26	320.94	23.68	4.00	0	-4.00
6	302.86	328.65	25.79	4.00	0	-4.00
7	308.47	336.36	27.89	4.00	0	-4.00
8	314.08	344.08	30.00	4.00	0	-4.00
9	318.68	351.79	32.11	4.00	0	-4.00
2010	325.29	359.50	34.21	4.00	0	-4.00
1	330.90	367.21	36.31	4.00	0	-4.00
2	336.50	374.92	38.42	4.00	0	-4.00
3	342.11	382.64	40.53	4.00	0	-4.00
4	347.72	385.50	37.78	4.00	0	-4.00
15	353.33	388.36	35.03	4.00	0	-4.00
6	358.93	391.22	32.29	4.00	0	-4.00
7	364.54	394.08	29.54	4.00	0	-4.00
8	370.15	396.95	26.80	4.00	0	-4.00
9	375.75	399.81	24.06	4.00	0	-4.00
2020	381.35	402.67	21.32	4.00	0	-4.00
1	384.21	405.53	21.32	4.00	0	-4.00
2	387.07	408.39	21.32	4.00	0	-4.00
3	389.93	411.25	21.32	4.00	0	-4.00
4	392.79	414.11	21.32	4.00	0	-4.00
25	395.65	416.97	21.32	4.00	0	-4.00
6	398.52	419.83	21.32	4.00	0	-4.00
7	401.38	422.69	21.32	4.00	0	-4.00
8	402.24	425.56	21.32	4.00	0	-4.00
9	407.10	428.42	21.32	4.00	0	-4.00
2030	409.96	431.28	21.32	4.00	0	-4.00
1	412.82	434.14	21.32	4.00	0	-4.00
2	415.68	436.99	21.32	4.00	0	-4.00
3	418.54	439.86	21.32	4.00	0	-4.00
4	421.20	442.52	21.32	4.00	0	-4.00
2035	424.06	445.38	21.32	4.00	0	-4.00

Table 11-5 Comparison of Flood Damage Amount for Each Year and Case on the Basis of ENEX Report

(No. 1 Agricultural Damage) (10^3 M$)

Year	Condition as of 1976			Future Condition			Remarks
	A	B	C	A	B	C	
1				1,595	1,557	1,542	
2				3,991	3,610	3,306	
3				3,903	3,003	2,851	
4				917	915	908	
5				2,189	2,198	2,189	
6				1,657	1,587	1,555	
7				2,101	1,776	1,758	
8				1,538	1,549	1,549	
9				2,806	2,743	2,716	
10				1,871	1,638	1,603	
11				3,652	3,657	3,657	
12				3,108	3,082	3,072	
13				2,716	2,652	2,630	
14				3,285	3,266	3,266	
15				2,488	2,452	2,437	
16				2,004	1,994	1,989	
17				358	348	346	
18				4,928	4,687	4,562	
19				19,971	16,097	15,204	1967
20				2,773	2,235	1,950	
21				2,304	2,318	2,318	
22				3,464	3,044	3,013	
23				4,220	3,484	3,468	
24				3,111	2,510	2,475	
25				6,131	3,093	2,161	1973
26				9,494	6,233	5,094	
27				3,277	3,208	3,191	
Total				99,852	84,935	83,882	
Average				3,698	3,146	3,107	

A: Without Dam Construction
B: Dabong Dam
C: Dabong and Lebir Dams

Table 11-6 Comparison of Flood Damage Amount for Each Year and Case on the Basis of ENEX Report

(No. 2 Social Damage) (10^3 H$)

Year	A	B	C	A	B	C	Remarks
1	366	354	347	1,089	1,051	1,033	
2	1,387	629	520	3,828	1,846	1,555	
3	1,920	840	586	5,089	2,365	1,635	
4	110	109	108	329	327	324	
5	365	340	337	1,101	1,039	1,031	
6	367	336	327	1,091	1,000	974	
7	460	403	304	1,366	1,200	908	
8	186	146	145	552	435	432	
9	308	311	305	915	923	906	
10	516	404	361	1,424	1,165	1,059	
11	225	226	212	670	671	631	
12	724	629	623	2,164	1,881	1,863	
13	323	300	289	970	902	879	
14	205	242	238	610	721	708	
15	234	186	180	696	554	536	
16	196	191	187	586	573	560	
17	37	35	33	109	103	97	
18	1,591	1,051	975	4,601	3,108	2,898	
19	39,068	21,489	19,359	102,773	57,386	51,698	1967
20	1,700	364	217	4,302	1,038	645	
21	274	262	267	821	784	800	
22	1,590	928	884	4,509	2,759	2,627	
23	2,778	1,688	1,689	7,120	4,446	4,443	
24	498	369	328	1,419	1,064	956	
25	6,094	1,465	601	15,506	3,993	1,742	1973
26	9,390	5,483	3,781	24,202	14,115	9,832	
27	697	610	595	2,072	1,820	1,776	
Total	71,609	39,390	33,798	189,914	107,269	92,548	
Average	2,652	1,459	1,252	7,034	3,973	3,428	

Table 11-7 Flood Mitigation at Guillemard Bridge

Return Period (Years)	Fluctuation (m^3/S)	Remarks
100	17,100	
50	13,600	
20	10,500	

Mitigated Amount of the Flood Damage

(M$ x 10^6)

Discharge	Property	Crop	Total
19,600	119	22	141
17,100	108.5	21	129.5
			11.5
15,800	99	19.5	118.5
13,600	77.5	17	94.5
			24
12,400	63	14	77
10,500	36	8.5	44.5
			32.5

Flood Mitigation Benefit

Return Period (Years)	Occurrence Probability	Flood Mitigation	Expectation
20	0.0267	32.5	0.867
30	0.0114	29.6	0.337
40	0.0063	26.8	0.169
50	0.0040	24	0.096
60	0.0028	21.4	0.060
70	0.0021	18.9	0.040
80	0.0016	16.4	0.026
90	0.0012	14.0	0.017
100	0.0010	11.5	0.012
Total			1.624
After Escalation			2.072

Escalation = $(1.05)^5 = 1.276$

Table 11-8 Flood Control Benefit

I) Free Overflow

(El.M) H.W.L.	(M) Crest Length	N.W.L.	Damage Mitigation in Each Scale 10^6M$			Expected Flood Control Benefit 10^6M$
			1/20	1/50	1/100	
90	80	81.9	41.5	30.0	18.2	2.72
90	120	83.0	35.7	27.5	14.0	2.30
90	160	83.8	31.2	25.3	12.3	2.07
90	200	84.3	28.0	23.5	11.5	1.89
80	80	70.0	28.0	23.5	10.5	1.86
80	120	71.6	23.0	18.0	7.0	1.49
80	160	72.7	20.0	15.2	5.6	1.29
80	200	73.4	18.0	13.5	5.0	1.15
70	80	58.2	13.0	9.5	4.0	0.83
70	120	60.4	10.0	7.5	3.0	0.64
70	160	61.7	7.9	6.3	2.7	0.51
70	200	62.7	6.5	5.5	2.5	0.44

II) Gate Operation

H.W.L. (L.L.M)	N.W.L. (E.L.M)	Damage Mitigation in Each Scale (10^6 M$)			Expected Floor Control Benefit (10^6 M$)
		1/20	1/50	1/100	
90	85.8	39.0	25.0	15.0	2.38
80	75.9	23.5	16.0	6.5	1.45
70	66.4	15.0	8.0	4.5	0.85

3.1.1. Hourly Discharge

Station Number	Period of Observation	Remarks
(Cullemard) 5721442	1965 - 1977	Only in Nov., Dec. and Jan.

3.1.2. Hourly Water Stage

Station Number	Period of Observation	Remarks
(Tualang) 5222452	25 Nov., 1975 - Nov. 1977	
(Bertam) 5120401	Nov., 1975 - Jan., 1977	
(Dabong) 5320443	Nov., 1973 - Jan., 1977	

3.1.3. Daily Discharge

Station Number	Period of Observation	Remarks
5221442	1965 - 1978	

3.1.4. Daily Rainfall

Station Number	Period of Observation	Remarks
6019004	1967	
6021010	"	
6021060	"	
6022062	"	
6023072	"	
6024074	"	
6021063	"	
6121066	"	
6121067	"	
6122064	"	
4620045	"	
4819001	"	
5419036	1972 - 1973	
5718033	1972	
5721002	1971 - 1976	
5120401	July 1970 - Aug. 1974	
5522047	July 1970 - Jan. 1977	
5718001	July 1970 - May 1978	
5721001	Dec. 1970 - April 1978	

Station Number	Period of Observation	Remarks
5322044	Oct. 1971 - Feb. 1978	
4819027	Nov. 1971 - Feb. 1978	
5521050	July 1970 - May 1978	
5419036	July 1970 - Feb. 1978	
5622048	July 1970 - May 1978	
5320443	Oct. 1971 - Feb. 1978	
5422046	July 1970 - May 1978	
5721001	Jan. 1971 - May 1978	
5722057	July 1970 - Aug. 1978	
5320039	June 1970 - April 1978	
5718033	Sept.1972 - Feb. 1978	
5720055	July 1970 - May 1977	
5621052	July 1970 - March 1978	
5621051	Sept.1970 - March 1978	
5518035	July 1970 - May 1978	
4923001	July 1977 - Feb. 1978	

3.1.5. Daily Water Stage

Station Number	Period of Observation	Remarks
5120401	1975 - 1977	
522452	1975 - 1977	
5320443	1972 - 1977	

3.1.6. List of Books on Hydrology

Title	Publisher or Writer
Estimation of the Design Rainstorm	Agriculture and Fisheries Dept.
Magnitude and Frequency of Floods in Peninsular Malaysia	"
Rational Method of Flood Estimation for Rural Catchments in Peninsular Malaysia	"
Hydrological Station Numbering System	"
Hydrological Station Registeres	"
Field Installation and Maintenance of Capricoder 1598 Digital Event Water Level Recorder	Agriculture and Rural Development
Stage-Discharge Curves	Agriculture
Design Flood Hydrograph Estimation for Rural Catchments in Peninsular Malaysia	"
Magnitude and Frequency of Low Flows in Peninsular Malaysia	"
The Estimation of Storage-Draft Rate Characteristics for Rivers in Peninsular Malaysia	"
Graphical Recorders Instructions for Chart Changing and Annotation	"
River Discharge Measurement by Current Meter	"
Estimating Potential Evapotranspiration using the Penman Procedure	"
Hydrological Design of Agricultural Drainage Systems	"
The Determination of Suspended Sediment Discharge	"
Hydrological Aspects of Agricultural Planning and Irrigation Design	"
Rainfall Records (1879 - 1975)	Drainage & Irrigation Department
Streamflow Records (1971 - 1970)	"
Enex Reports Volume 1 Hydrology	ENEX
Rating-Curve (Batu, Lembu, Bertan, Dabong)	"
Stage-Discharge Curve (Tualang, Guillemard)	"
Enex Reports Volume 2, Drainage and Irrigation	ENEX
Enex Reports Volume 3, Flood Mitigation Project	ENEX
Water Quality Records (1974 - 1976)	Ministry of Agriculture and Rural Development

3.2. Meteorology

Title	Publisher
Meteorological Data (1948 - 1972)	Malaysia Meteorological Service

3.3. Topography

Title	Publisher or Writer
Detailed and Locality Plan of Cross-section	ENEX
Kota Bharu (Sg. Kelantan) Dabong (Sg. Galas) of Cross-Section	"
Master Cross Section Guillemard, Batu Lembu, Tualang, Bertan, Dabong	"
1/25000, 1/63360 (Western Malaysia)	Government of Malaysia

3.4. Geology

Title	Publisher or Writer
Geology and Mineral Resources of North Kelantan and North Trengganu	S. Mac Donald, Ministry of Lands and Mines, Malaysia
South-east Asia: A Systematic Geography	Chia Lin Sien & Others, Oxford University Press
Field Record Vol.III South Kelantan	Che Mohd. Sanibin Abnan.
Geological Map of West Malaysia (1/500,000)	Geological Survey, Malaysia
Hydrogeological Map of Peninsular Malaysia (1/500,000)	"
Geological Map of Peninsular Malaysia (1/2,000,000)	Geological Survey, Malaysia

Title	Publisher or Writer
Sungai Aring (46-58) Geological Map (1/63,360)	Geological Survey, Malaysia
Mineral Distribution Map of Peninsular Malaysia (1/500,000)	Geological Survey, Malaysia
Reconnaissance Soil Map Peninsular Malaysia (1/500,000)	Ministry of Agriculture & Fisheries, Malaysia
Semenanjung Malaysia (1/760,000)	National Mapping, Malaysia
Semenanjung Malaysia Kelantan (1/190,080)	National Mapping, Malaysia

3.5. Land Development

Title	Publisher
VLV Kelantan Land Settlement Project, Loan No. 4/8 as revised on March 15, 1979	Federal Land Development Authority (FELDA)
21 years of land development by Tunku Shansul	FELDA
Penyata Tahunan 1978 Jabatan, Hutan, Kelantan	State Ministry of Forestry Annual Report
Development and rehabilitation project E.P.U. Kelantan	State Land Development Board, Kelantan
Potensi Perhutanan Di Wilayah Pembangunan Kelantan Selatan	Mimeo State Ministry of Forestry
Enex Reports Volume 5: Land Use Effects Enex Reports Volume 6: Basin Development Plan	ENEX

3.6. Power Transmission

Title	Publisher or Writer
Lightning Performance of N.E.B's 275 kV Transmission Line	A. Maglmay (Dec. 1977)
Drawings of Tanah Merah S/S	N.E.B. (Aug. 1978)
How to Estimate Construction Costs of Electrical Power Substations	J.M. Bifulco (1973)
Single Line Diagram of National Power System	N.E.B.
Semenanjung Malaysia at a Scale 1/260,000 SY/I	National Mapping
Kelantan at a Scale of 1/190,000 SY/I	"
Topographical Maps at a Scale of 1/25,000 and 1/63,690 for Proposed Transmission Lines Routes Area	"
Three Dimensional Monte Carlo Determination of the Performance of Overhead Lightning Shield Systems	Thun Peng Chew Liew Ah Choy (Dec. 1977)
Trengganu River Basin Study Feasibility Report on Multi-Purpose Dam Project, Vol. 6 Hydro Power Development, Volume 7 Power Stations and Power System	Snowy Mountain Engineering Corp. (July, 1976)
Transmission Developments Temengor-Tanah Merah, K.L. North Kampong-Awah, P.C.R. Project	P.C.R.

3.7. Finance and Economics

3.7.1. Socio-Economic Aspect

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Trade Classification and Customs Tariffs 1978
Annual Reports of the Ministry of Labour and Manpower for 1976
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1970 Input - Output Tables, Peninsular Malaysia Dept. of Statistics
Monthly Statistical Bulletin Malaysia Peninsular Malaysia 1979
Annual Statistical Bulletin Malaysia 1977
1970 Population and Housing of Malaysia Vol. 1
Kelantan Urban Development and Industrial Priority Study (Draft Final Report) Technical Appendix A Economic Strategy by Consult Limited Canada
Draft Report on Economic Survey of Kelantan Development Bank of Malaysia 1st Aug. 1978
Report on Socio - Economic Survey of Kelantan Kelantan Irrigation District Federal Land Consolidation and Rehabilitation Authority Oct., 1977
District Data Bank VLV Kelantan State E.P.U.
Survey of Payment Scheme for Jobs in Kelantan (Draft)
Kelantan, an Advantageous Location for International Industrial Investment in Eighties State E.P.U.
Malaysia Builder Directory (1976 - 1977) (List of Government Organization)

National Parameters for Project Appraisal in Malaysia
Vol. I, II, III
U.N.D.P., World Bank Study
State and Rural Development Project

Information Malaysia
Malaysian Yearbook 1978/1979

Pattern of Labour Utilization in Peninsular Malaysia
Research Paper No. 14
Dept. of Statistics

Rubber Institute of Malaysia
Annual Report (1977)

3.7.2. Hydroelectric Aspects

NEB Trengganu Hydro-electric Project Economic Review
by Th'ng Yong Huat April, 1978

Hydro-power Potential and Development in Malaysia
by Th'ng Yong Huat
I.E.S./I.E.M. Engineering Convention

N.E.B. Trengganu Hydro-electric Project Supplement to "Economic Review"
Internal Economic Rate of Return 6/1978
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Tariff Booklet
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N.E.B. 1964

Tembeling Multi-purpose Dam Project
An Appraisal of Project Proposals and Implementation Issues
by Th'ng Yong Huat

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Water Resources of the Basin. Vol.4. Multi-purpose Dam Project
April, 1978
by Snowy Mountain Engineering Corp.

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The Kelantan River Basin Study
ENEX 1978

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Vol. 7 Irrigation and Drainage 1976

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N.E.B. Capital Assets Classification

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