

Table 4-2-2 Flood Mitigations: Incremental Benefits

(\$ Million on Constant 1976 Price Level)

Project	Crops			Non-crops			Total		
	Each	%	Cumulated	Each	%	Cumulated	Each	%	Cumulated
(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: KBRIS, 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
Joroh	Hydro	100	100
Woh	"	150	150
Tenengor	"	87	87
Prai	Steam	90	90
Glugor	"	40	40
Power Dickson	"	600	600
Connaught Bridge	"	80	80
Malacca	"	40	40
Glugor	Gas Turbine	20	20
<b>Total</b>		<b>1,220</b>	<b>1,327</b>

Table 4.4 NEB's Generation Expansion Plan

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

Table 6 - 1: Temperature (average of 24 hours)

Month	1968	1969	1970	1971	1972	Average
1	26.6	26.3	26.0	25.8	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	7	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	15.9	147.5	184.5	188.5	209	182

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

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



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

(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)	N.O. NO. 2	021067 TUMPAI	021068 EG. BERANGAN	021063 MAYANG BHARU	021064 KOTA BHARU	022062 CHABANG MAG. PENCEK	024080 MENDALAM RUBOR	021090 RUKAT PUN REPEN	020004 RANTAU PANGANG	024074 BALAI PULS BODE	023072 TAMBAK PULAI	027008 RIBU BEKALAN	024080 CHERANG RURU	024079 PASIR PUTEK	023077 CHERANG FULLI	027007 KELEKAP B1	022053 LADANG S5	022066 TELUSAR	022051 BALAI PULS RG	022056 GULUPON ULU RUSA	027004 MS. BUNANG BAERU	027033 AG. JELI	021052 LADANG KERRALA	021051 LADANG KEMETH	022048 KUALA PERTANG	055005 LUBA BUNGOR	021050 KUALA KRAI	055201 KUALA KRAI	041036 KUALA BALAH	030008 STM TELE DABONG	032003 KUALA BERGAU	032044 STM TELE EG. LALOK	022025 POLIS BERTAM	023001 STM TELE AG. ARANG	021027 STM TELE GUA MUSANG	021001 GUA MUSANG	022026 LADANG MENTARA			
1																																								
2	0.878																																							
3	0.803	0.850																																						
4	0.910	0.939	0.838																																					
5	0.828	0.874	0.793	0.882																																				
6	0.873	0.881	0.846	0.822	0.904																																			
7	0.781	0.824	0.743	0.828	0.870	0.925																																		
8	0.723	0.721	0.836	0.728	0.801	0.822	0.813																																	
9	0.884	0.874	0.864	0.833	0.882	0.812	0.880	0.783																																
10	0.883	0.823	0.870	0.829	0.811	0.839	0.808	0.795	0.829																															
11	0.778	0.785	0.737	0.796	0.838	0.853	0.840	0.871	0.805	0.822																														
12	0.812	0.830	0.738	0.862	0.800	0.868	0.795	0.723	0.897	0.949	0.788																													
13	0.835	0.861	0.785	0.885	0.822	0.867	0.822	0.726	0.845	0.872	0.778	0.808																												
14	0.801	0.848	0.754	0.884	0.865	0.898	0.853	0.782	0.893	0.892	0.829	0.864	0.865																											
15	0.713	0.715	0.670	0.760	0.738	0.820	0.818	0.739	0.782	0.796	0.824	0.780	0.872	0.797																										
16	0.721	0.763	0.709	0.835	0.810	0.882	0.837	0.809	0.815	0.864	0.812	0.790	0.788	0.855	0.858																									
17	0.774	0.774	0.788	0.835	0.817	0.851	0.843	0.758	0.830	0.805	0.828	0.833	0.823	0.851	0.795	0.813																								
18	0.879	0.865	0.868	0.743	0.836	0.754	0.752	0.880	0.785	0.700	0.726	0.730	0.783	0.750	0.682	0.757	0.853																							
19	0.604	0.706	0.518	0.684	0.708	0.706	0.706	0.698	0.622	0.867	0.698	0.833	0.810	0.747	0.762	0.788	0.617	0.513																						
20	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---																					
21	0.592	0.651	0.630	0.670	0.647	0.634	0.630	0.658	0.672	0.742	0.711	0.701	0.558	0.757	0.710	0.714	0.721	0.623	0.595																					
22	0.877	0.713	0.663	0.753	0.773	0.808	0.812	0.743	0.798	0.787	0.810	0.778	0.748	0.845	0.785	0.864	0.838	0.830	0.724																					
23	0.643	0.724	0.679	0.785	0.771	0.819	0.798	0.729	0.759	0.763	0.802	0.782	0.735	0.823	0.761	0.802	0.819	0.806	0.679																					
24	0.872	0.723	0.630	0.744	0.795	0.809	0.780	0.738	0.775	0.793	0.782	0.732	0.752	0.815	0.786	0.845	0.828	0.795	0.760																					
25	0.578	0.566	0.585	0.615	0.621	0.625	0.572	0.625	0.642	0.620	0.658	0.809	0.808	0.678	0.944	0.808	0.728	0.688	0.498																					
26	0.668	0.709	0.584	0.734	0.798	0.802	0.777	0.760	0.768	0.808	0.780	0.762	0.780	0.813	0.731	0.828	0.823	0.798	0.747																					
27	0.543	0.541	0.533	0.618	0.678	0.678	0.669	0.633	0.664	0.646	0.858	0.587	0.886	0.887	0.581	0.886	0.795	0.707	0.623																					
28	0.866	0.671	0.617	0.699	0.672	0.686	0.679	0.624	0.707	0.708	0.623	0.882	0.672	0.716	0.581	0.679	0.702	0.610	0.583																					
29	0.615	0.890	0.829	0.709	0.700	0.712	0.723	0.687	0.720	0.701	0.899	0.738	0.884	0.713	0.581	0.695	0.734	0.670	0.529																					
30	0.621	0.672	0.834	0.671	0.727	0.723	0.685	0.703	0.726	0.746	0.677	0.645	0.708	0.677	0.578	0.884	0.782	0.885	0.607																					
31	0.617	0.744	0.475	0.723	0.887	0.880	0.709	0.678	0.850	0.783	0.804	0.761	0.732	0.799	0.744	0.888	0.785	0.645	0.890																					
32	0.451	0.495	0.475	0.527	0.484	0.538	0.544	0.561	0.570	0.517	0.528	0.562	0.504	0.551	0.486	0.523	0.585	0.457	0.482																					
33	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---																					
34	0.218	0.250	0.270	0.277	0.387	0.384	0.374	0.501	0.384	0.303	0.488	0.409	0.327	0.401	0.275	0.388	0.404	0.287	0.280																					
35	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---																					
36	0.164	0.118	0.294	0.289	0.400	0.385	0.479	0.542	0.148	0.506	0.443	0.379	0.299	0.385	0.285	0.398	0.448	0.302	0.418																					

Correlative Coefficient





Table 6 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.).

100	24	30
50	22	31
20	18	31
10	15	32
5	12	33
2	8	34
1	5	35
0.5	3	36
0.2	2	37
0.1	1	38
0.05	0.5	39
0.02	0.2	40
0.01	0.1	41

**Table 6-9-1. Discharge at Tualang Estimated by Water Levels  
Record and Water Level - Discharge Curve (m<sup>3</sup>/sec/day)**

Year 1976							
Day	Jan.	Feb.	Mar.	Apr.	May	Jun.	
1	162	63	45	32	78	100	
2	154	62	43	31	73	80	
3	136	62	42	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	65	55	45	-	69	61	
11	91	54	45	-	148	63	
12	87	53	42	-	102	82	
13	88	51	40	-	101	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		Year 1977				
Month	Jan	Feb	Mar	Apr	May	June
Day	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	91
20	56	177	77	105	200	95
21	69	76	69	102	279	18
22	143	179	68	116	176	55
23	98	165	94	104	274	55
24	74	152	108	170	282	55
25	61	141	136	120	184	55
26	60	279	163	97	206	55
27	60	141	125	120	160	55
28	56	466	98	167	270	55
29	78	280	228	99	447	55
30	59	130	212	104	256	409
31	53	113	-	100	-	312

Table 6-9-3

1977-8-8 added

Year 1977

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	26

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

Year	Month	(Oct. - Mar.) Tualang (m <sup>3</sup> /s/month) $y = 0.1805x - 22,741$ ( $r = 0.9817$ )						(Apr. - Sept.) $y = 0.288x - 627.398$ ( $r = 0.9951$ )					
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
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	analytical discharge volume	Rate
Remarks	Remarks	Remarks
Rainfall Period	Observation Peak	Analytical Peak
	(m <sup>3</sup> /sec.)	(m <sup>3</sup> /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<sup>3</sup>/s)

Date	Tualang	Dabong	Guillemard	Remarks
Dec. 16, 1975	860	1,428	2,593	Observation Value
"	946	1,406	2,713	Analytical Value
Dec. 18, 1972	807	1,351	2,604	Observation Value
"	1,605	8,802	13,440	Analytical Value
Dec. 10, 1973	-	-	15,138	Observation Value
"	2,643	9,424	15,465	Analytical Value

Regression Year	Storage Function	Probable Flood Discharge
5	-	1,700
10	2,800	2,300
20	3,200	3,000
50	4,400	4,000
100	5,100	4,900
200	-	5,800

Table 6-14 Synthetical Storage Function (m<sup>3</sup>/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 (m<sup>3</sup>/S)

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

Table 6-15 Monthly Evaporation at various Stations

Station	(millimetres)											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Kota	340		200		1280			1610		1220		
Bharu	144	148	177	185	167	155	155	157	158	143	122	119
Cameron Highlands	101	102	118	110	102	102	104	101	101	97	96	87

Fluctuation of Flood Discharge

Incremental	Max Discharge	Cut Volume	Coefficient	Regression
				Year
200	3680	200	12400	
400	3180	1000	18000	
600	2680	1200	18100	11100
800	2180	2000	12000	12600
1000	1680	3200	11400	
1200	1180	3000	16000	
1400	680	3200	16400	
1600	2200	200	12200	
1800	2400	1000	12000	
2000	1900	1200	14200	1120
2200	1400	2000	14000	12800
2400	900	2200	13200	
2600	400	3000	13000	
2800	2100	200	15000	
3000	1600	1000	11200	1120
3200	1100	1200	11000	12400
3400	600	2000	10200	

Table 7-1

## Water Quality Record (No. 642)

Sampling Date	Discharge (Litre/s)	Station 5721642					SG. Kelantan @ Jam. Guillemard						
		Total Solids (Residue at 105C) (MG/L)	Suspended Solids (Non-Filtrable Residue) (MG/L)	Specific Conductance (Microhm/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)

Sampling Date	Discharge (Litre/§)	Station 5222652		Sg. Lebir @ Stn. Tele Kg. Tualang		76/02/01 to 76/09/30							
		Total Solids (Residue at 105C) (MG/L)	Suspended Solids (Non-Filtrable 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 (Litres/S)	Total Solids (Residue at 105°C (MG/L))	Suspended Solids (Non-Filtrable 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

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 <sup>2</sup> )	
	Secondary Forest	Primary Forest
<i>Macaca fascicularis</i> (Long-tailed Macaque)	1.54	0.37
<i>Macaca nemestrina</i> (Pig-tailed Macaque)	0.13	-
<i>Presbytis cristana</i> (Silvered-leaf Monkey)	0.26	-
<i>Presbytis melalophis</i> (Banded-leaf Monkey)	2.95	2.22
<i>Presbytis obscura</i> (Spectacled or Dusky-leaf Monkey)	0.64	0.74
<i>Hylobates lar</i> (White-handed Gibbon)	0.89	1.11
<i>Hylobates syndactylus</i> (Siamang)	0.51	1.11

\* protected animals

\*\* totally protected animals

\*\* Totally Protected Wild Animals

Resource: Gamba Dept. of Kelantan

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

Table 7-6 Vector Borne Disease

	<u>1970</u>	<u>1977</u>
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 infectious 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	Ulu Kelantan District		Kelantan State	
	km <sup>2</sup>	%	km <sup>2</sup>	%
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	168	1.6	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
<b>Total</b>	<b>11,023</b>	<b>100.0</b>	<b>14,846</b>	<b>100.0</b>

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

Elevation (m)	Name	(km <sup>2</sup> )		
		Tualang	Jeram Panjang	Kiak
90		250	247	217
80		156	154	129
70		91	89	70

Storage Capacity for 3 Sites

Elevation (m)	Name	(x 10 <sup>6</sup> m <sup>3</sup> )		
		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 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )
<b>1. Civil Works</b>				241,134.		245,689.
<b>1-1. Buildings</b>				8,600.		8,600.
Powerhouse	m <sup>3</sup>	300	22,000	6,600		
Others	lot		1	2,000		
<b>1-2. Waterway</b>				32,604.		32,604.
<b>Intake</b>				7,817.		7,817.
earth excavation	m <sup>3</sup>	4.5	18,100	81		
rock excavation	m <sup>3</sup>	15	57,200	858		
concrete	m <sup>3</sup>	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		
<b>Penstock</b>				19,012.		19,012.
earth excavation	m <sup>3</sup>	4.5	40,900	184		
rock excavation	m <sup>3</sup>	15	60,500	908		
tunnel driving	m <sup>3</sup>	64	16,400	1,050		
steel rib support	ton	3,000	40	120		
concrete	m <sup>3</sup>	270	16,400	4,428		
tunnel concrete	m <sup>3</sup>	270	7,200	1,944		

Item	Unit	Unit Price (M\$)	Crest Length 80 m		Crest Length 120 m	
			Quantity	Amount (M\$10 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )
steel bar	ton	1,500	170	255		
steel pipe	ton	7,300	1,150	8,395		
others	lot		1	1,728		
<b>Tailrace</b>				<b>4,521</b>		<b>4,521</b>
earth excavation	m <sup>3</sup>	4.5	20,600	93		
rock excavation	m <sup>3</sup>	15	64,500	968		
concrete	m <sup>3</sup>	270	6,600	1,782		
steel bar	ton	1,500	170	255		
gate	ton	9,200	110	1,012		
others	lot		1	411		
<b>Miscellaneous Works</b>				<b>1,254</b>		<b>1,254</b>
<b>1-3. Reservoir</b>				<b>150,145</b>		<b>154,133</b>
<b>Main Dam</b>				<b>66,370</b>		<b>66,098</b>
stripping	m <sup>3</sup>	3.5	929,000	3,252	929,000	3,252
rock-filling	m <sup>3</sup>	11	4,435,000	48,785	4,409,000	48,499
rock-filling (appropriate)	m <sup>3</sup>	1.5	144,000	216	170,000	255
earth-filling	m <sup>3</sup>	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 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )
<b>Spillway</b>				28,773.		32,918.
earth excavation	m <sup>3</sup>	4.5	477,000	2,147	540,000	2,430
rock excavation	m <sup>3</sup>	15	205,000	3,075	243,000	3,645
concrete	m <sup>3</sup>	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
<b>Diversion</b>				33,208.		33,208.
earth excavation	m <sup>3</sup>	4.5	240,000	1,080		
rock excavation	m <sup>3</sup>	15	43,000	845		
concrete	m <sup>3</sup>	250	1,100	275		
tunnel driving	m <sup>3</sup>	64	150,000	9,600		
steel rib support	ton	3,000	70	210		
tunnel concrete	m <sup>3</sup>	270	46,000	12,420		
blocking concrete	m <sup>3</sup>	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		
<b>Saddle Dam 1</b>				14,865.		14,865.
stripping	m <sup>3</sup>	3.5	393,000	1,376		
rock filling	m <sup>3</sup>	11	852,000	9,372		
earth filling	m <sup>3</sup>	8.5	138,000	1,173		







Item	Unit	Unit Price (M\$)	Crest Length 80 m		Crest Length 120 m	
			Quantity	Amount (M\$10 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )
stripping	m <sup>3</sup>	3.5	147,000	515		
rock-filling	m <sup>3</sup>	11	99,000	1,089		
earth-filling	m <sup>3</sup>	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 <sup>3</sup>	4.5	8,700	39		
rock excavation	m <sup>3</sup>	15	41,200	618		
concrete	m <sup>3</sup>	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 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )
3. Contingency				36,728.		37,085.
4. Engineering				24,113.		24,569.
5. Government Administration				4,823.		4,914.
<b>Grand Total (1 to 5)</b>				<b>432,948.</b>		<b>437,417.</b>

Item	Unit	Unit Price (M\$)	Crest Length 160 m		Crest Length 200 m	
			Quantity	Amount (M\$10 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )
<b>1. Civil Works</b>				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.
<b>Main Dam</b>				65,764.		65,419.
stripping	m <sup>3</sup>	3.5	929,000	3,252	929,000	3,252
rock-filling	m <sup>3</sup>	11	4,377,000	48,147	4,344,000	47,784
rock-filling (appropriate)	m <sup>3</sup>	1.5	202,000	303	235,000	353
earth-filling	m <sup>3</sup>	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
<b>Spillway</b>				36,805.		40,691.
earth excavation	m <sup>3</sup>	4.5	583,000	2,624	626,000	2,817
rock excavation	m <sup>3</sup>	15	289,000	4,335	335,000	5,025
concrete	m <sup>3</sup>	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
<b>Diversion</b>				33,208.		33,208.
<b>Saddle Dam 1</b>				14,865.		14,865.
<b>Saddle Dam 2</b>				2,556.		2,556.

Item	Unit	Unit Price (M\$)	Crest Length 160 m		Crest Length 200 m	
			Quantity	Amount (M\$10 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )
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 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )
<b>1. Civil Works</b>				193,204		220,652		249,871
<b>1-1. Buildings</b>				8,600		8,600		8,600
<b>1-2. Waterway</b>				25,279		29,018		32,604
<b>Intake</b>				6,168		7,006		7,817
earth excavation	m <sup>3</sup>	4.5	13,600	61	15,900	72	18,100	81
rock excavation	m <sup>3</sup>	15	42,900	644	50,000	750	57,200	858
concrete	m <sup>3</sup>	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
<b>Penstock</b>				14,336		16,686		19,012
earth excavation	m <sup>3</sup>	4.5	32,700	147	36,800	166	40,900	184
rock excavation	m <sup>3</sup>	15	48,400	726	54,500	818	60,500	908
tunnel driving	m <sup>3</sup>	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 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )
concrete	m <sup>3</sup>	270	13,100	3,537	14,800	3,996	16,400	4,428
tunnel concrete	m <sup>3</sup>	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
fallrace				3,851		4,210		4,521
earth excavation	m <sup>3</sup>	475	16,400	7,740	18,500	8,830	20,600	9,830
rock excavation	m <sup>3</sup>	15	51,600	774	58,100	872	64,500	968
concrete	m <sup>3</sup>	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
<b>1-3. Reservoir</b>				<b>122,777</b>		<b>139,433</b>		<b>157,794</b>
<b>Main Dam</b>				<b>24,012</b>		<b>44,867</b>		<b>65,764</b>
stripping	m <sup>3</sup>	3.5	514,000	1,799	722,000	2,527	929,000	3,252
rock-filling	m <sup>3</sup>	11	1,183,000	13,013	2,779,000	30,569	3,377,000	48,147
rock-filling (Appropriate)	m <sup>3</sup>	1.5	948,000	1,422	575,000	863	202,000	303
earth-filling	m <sup>3</sup>	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 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )
grout	ton	1,220	640	781	800	976	970	1,183
cement	lot		1	2,183	1	4,079	1	5,979
others								
<b>Spillway</b>				<b>56,692</b>		<b>46,905</b>		<b>36,805</b>
earth excavation	m <sup>3</sup>	4.5	874,000	3,933	729,000	3,281	583,000	2,624
rock excavation	m <sup>3</sup>	15	354,000	20,310	822,000	12,330	289,000	4,335
concrete	m <sup>3</sup>	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
<b>Diversion</b>				<b>33,208</b>		<b>33,208</b>		<b>33,208</b>

Item	Unit	Unit Price (M\$)	H.W.L. 70 m		H.W.L. 80 m		H.W.L. 90 m	
			Quantity	Amount (M\$10 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )
Saddle Dam 1				5,289		10,086		14,865
stripping	m <sup>3</sup>	3.5	204,000	714	299,000	1,047	393,000	1,376
rock-filling	m <sup>3</sup>	11	276,000	3,036	564,000	6,204	852,000	9,372
earth-filling	m <sup>3</sup>	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						306		2,556
stripping	m <sup>3</sup>	3.5				147,000		515
rock-filling	m <sup>3</sup>	11				99,000		1,089
earth-filling	m <sup>3</sup>	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 <sup>3</sup>	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 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )	
rock excavation	m <sup>3</sup>	15	34,400	516	37,800	567	41,200	618	
concrete	m <sup>3</sup>	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	@1,040	109,000	@825	151,000	24,575
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+3+4+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 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )
<b>1. Civil Works</b>				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 <sup>3</sup>	3.5	514,000	1,799	722,000	2,527	929,000	3,252
rock-filling	m <sup>3</sup>	11	361,000	14,971	289,000	31,779	419,000	48,609
rock-filling (Appropriate)	m <sup>3</sup>	1.5	770,000	1,155	465,000	698	160,000	240
earth-filling	m <sup>3</sup>	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 <sup>3</sup>	4.5	756,000	3,402	625,000	2,813	494,000	2,223
rock excavation	m <sup>3</sup>	15	1,100,000	16,500	664,000	9,960	228,000	3,420
Concrete	m <sup>3</sup>	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 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )
Saddle Dam 1				5,289		10,086		14,865
Saddle Dam 2				110		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		84,000	101,640	122,000	119,560	158,000	123,240
Sub-total (1-5)				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 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )
<b>1. Civil Works</b>				<b>185,335</b>		<b>244,956</b>		<b>306,849</b>
<b>1-1. Buildings</b>				<b>8,600</b>		<b>8,600</b>		<b>8,600</b>
<b>1-2. Waterway</b>				<b>23,888</b>		<b>27,160</b>		<b>30,349</b>
<b>Intake</b>				<b>7,829</b>		<b>9,044</b>		<b>10,260</b>
earth excavation	m <sup>3</sup>	4.5	8,700	39	8,700	39	8,700	39
rock excavation	m <sup>3</sup>	15	5,200	78	5,200	78	5,200	78
concrete	m <sup>3</sup>	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
<b>Penstock</b>				<b>10,307</b>		<b>12,075</b>		<b>13,812</b>
earth excavation	m <sup>3</sup>	4.5	38,200	172	40,400	182	42,600	192
rock excavation	m <sup>3</sup>	15	71,000	1,065	78,500	1,178	86,000	1,290
concrete	m <sup>3</sup>	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
<b>Tailrace</b>				<b>4,833</b>		<b>4,996</b>		<b>5,110</b>
earth excavation	m <sup>3</sup>	4.5	22,300	100	23,300	105	24,300	109

Item	Unit	Unit Price (H\$)	H.W.L. 70 m		H.W.L. 80 m		H.W.L. 90 m	
			Quantity	Amount (H\$10 <sup>3</sup> )	Quantity	Amount (H\$10 <sup>3</sup> )	Quantity	Amount (H\$10 <sup>3</sup> )
rock excavation	m <sup>3</sup>	15	85,800	1,287	84,300	1,265	82,800	1,242
concrete	m <sup>3</sup>	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
<b>1-3. Reservoir</b>				<b>16,683</b>		<b>62,118</b>		<b>69,671</b>
<b>Main Dam</b>				<b>72,994</b>		<b>60,846</b>		<b>28,869</b>
earth excavation	m <sup>3</sup>	4.5	69,000	311	96,500	434	124,000	558
rock excavation	m <sup>3</sup>	15	123,000	1,845	146,000	2,190	169,000	2,535
concrete	m <sup>3</sup>	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 <sup>3</sup>	220	21,400	4,708	21,400	4,708	21,400	4,708
others	lot			6,636		9,168		11,715
<b>Diversion</b>				<b>21,362</b>		<b>21,362</b>		<b>21,362</b>
earth excavation	m <sup>3</sup>	4.5	27,000	122				
rock excavation	m <sup>3</sup>	15	30,000	450				
concrete	m <sup>3</sup>	250	1,500	375				



Item	Unit	Unit Price (M\$)	H.W.L. 70 m		H.W.L. 80 m		H.W.L. 90 m	
			Quantity	Amount (M\$10 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )
tunnel driving	m <sup>3</sup>	64	97,000	6,208				
steel rib support	ton	3,000	240	720				
tunnel concrete	m <sup>3</sup>	270	29,600	7,992				
blocking concrete	m <sup>3</sup>	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 <sup>3</sup>	3.5	632,000	2,212	752,000	2,632	872,000	3,052
rock-filling	m <sup>3</sup>	11	650,000	7,150	388,000	15,268	2125,000	23,375
earth-filling	m <sup>3</sup>	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 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )	Quantity	Amount (M\$10 <sup>3</sup> )
1-4. Mechanical Equipment				16,308		20,833		25,352
Foundation				13,063		16,545		19,980
earth excavation	m <sup>3</sup>	4.5	17,600	79	17,200	77	16,700	75
rock excavation	m <sup>3</sup>	15	67,400	1,011	62,200	933	56,900	854
concrete	m <sup>3</sup>	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	920	920	9750		
			88,000	105,600	128,000	17,760	162,000	23,120
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+3+4+5)				342,271		428,383		509,788