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

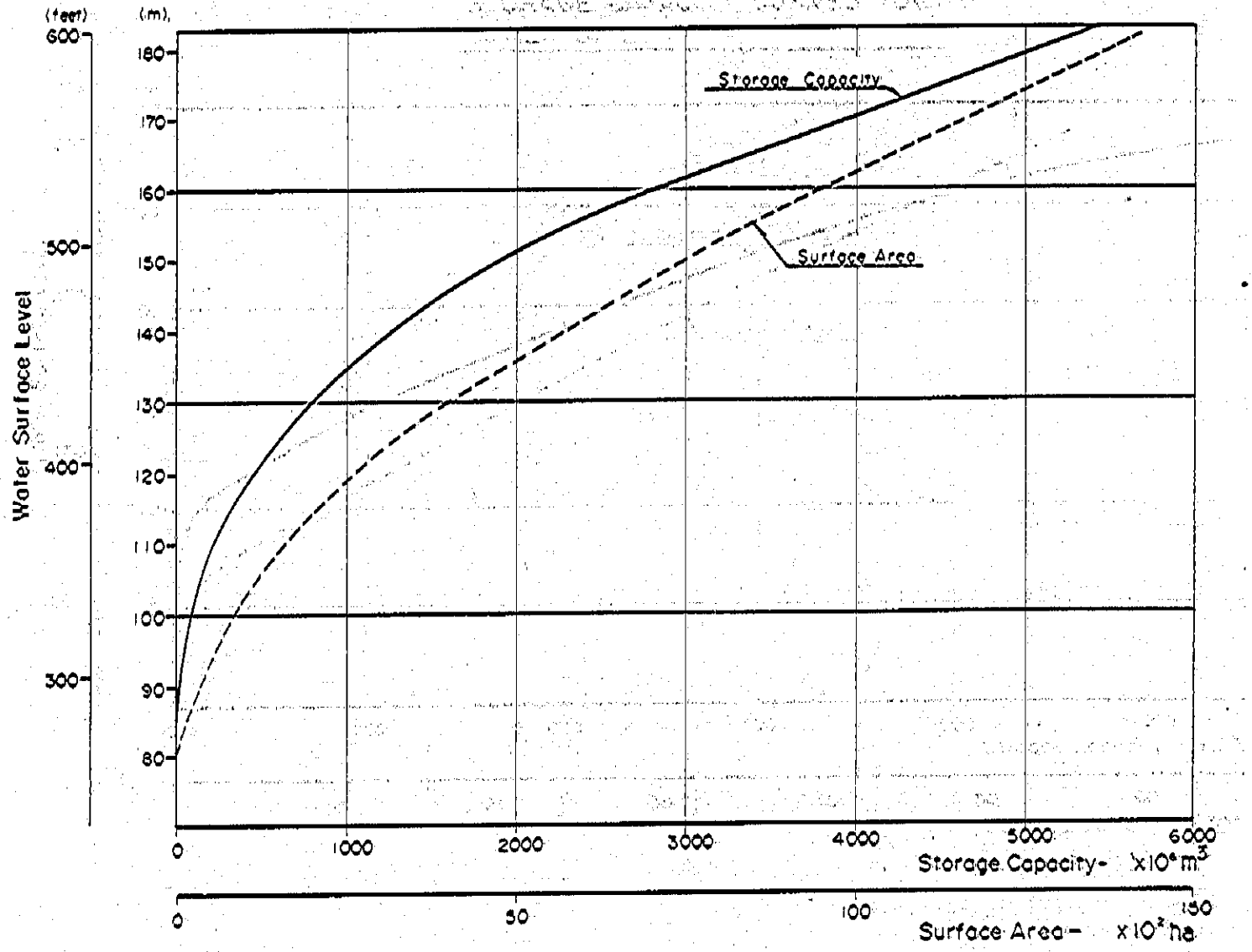


Fig. 9-6 RESERVOIR SURFACE AREA AND STORAGE CAPACITY CURVES FOR LOWER SITE

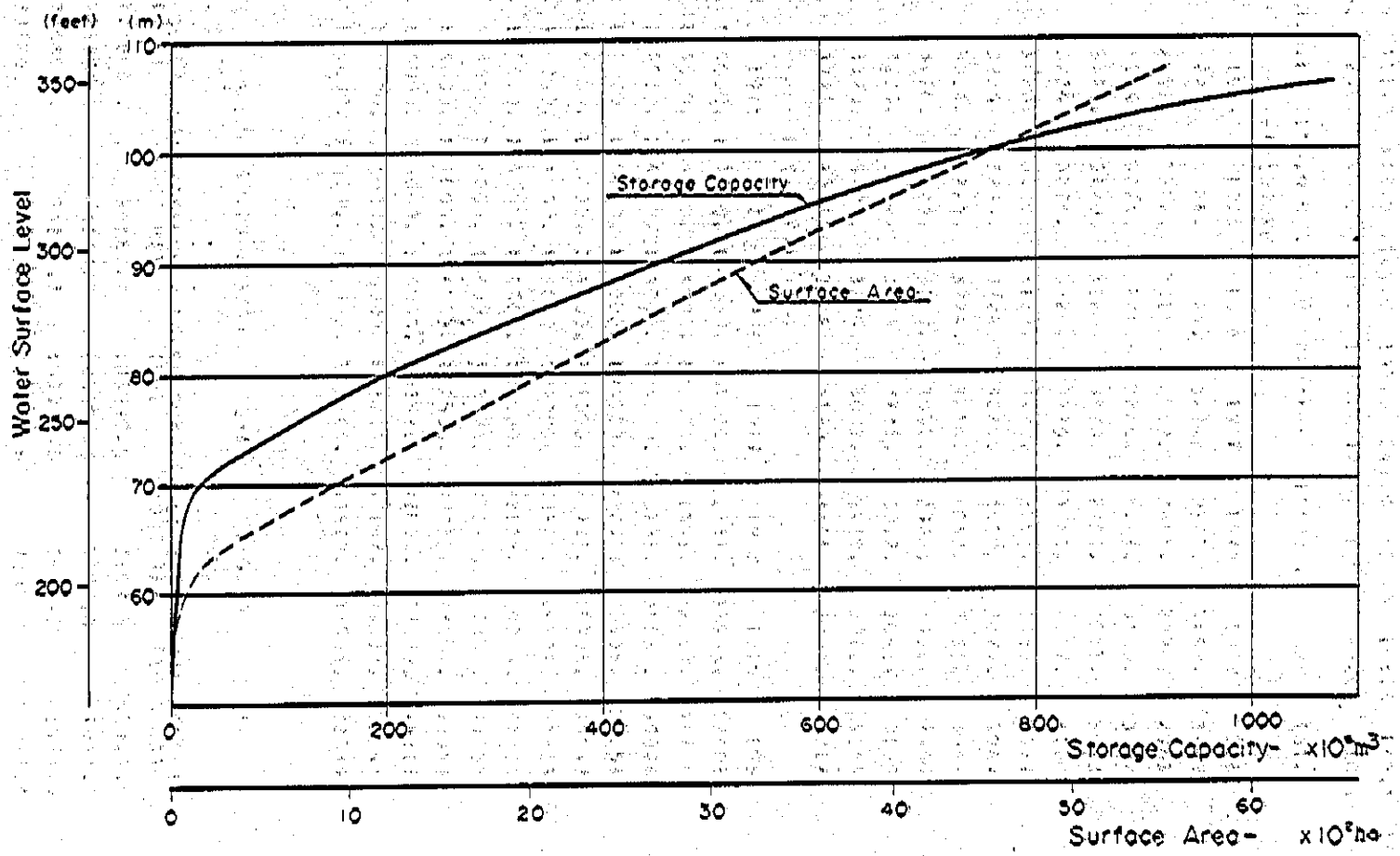


Table 9-3 Upper Single (One Dam) Development (1)

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

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

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

(*1000KWH)

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

(KW)

	1973	1974	1975	1976	1977	1978	1979	1980
1	104000.	104000.	104000.	104000.	104000.	102232.	102583.	102691.
2	104000.	104000.	104000.	104000.	104000.	101393.	102110.	101786.
3	104000.	104000.	104000.	104000.	104000.	100236.	101035.	100876.
4	104000.	104000.	104000.	104000.	104000.	99056.	100335.	100153.
5	104000.	104000.	104000.	104000.	104000.	98735.	99935.	99647.
6	104000.	104000.	104000.	104000.	104000.	98328.	99597.	98815.
7	104000.	104000.	104000.	104000.	104000.	98188.	99089.	97906.
8	104000.	104000.	104000.	104000.	103473.	97818.	97838.	97955.
9	104000.	104000.	104000.	104000.	102559.	97213.	97601.	98043.
10	104000.	104000.	104000.	104000.	102531.	97093.	97959.	99315.
11	104000.	104000.	104000.	104000.	102900.	97157.	98537.	101343.
12	104000.	104000.	104000.	104000.	102646.	98479.	102565.	102939.

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

YEAR	ENERY-GENER (KWH)	GENERATION-B (1000 M$)	LS-ENERGY (KW)	LS-B (1000 M$)	TOTA-BENEFIT (1000 M$)
1973	227758080.	34163.7	103999.8	7809.3	41973.0
1974	227758080.	34163.7	103999.8	7809.3	41973.0
1975	227758080.	34163.7	103999.8	7809.3	41973.0
1976	228332080.	34257.3	103999.8	7809.3	42066.6
1977	226932192.	34039.8	103508.8	7772.5	41812.3
1978	217533136.	32637.5	98827.3	7420.9	40059.4
1979	219696096.	32954.4	99924.5	7503.3	40457.7
1980	220398224.	33133.2	100122.1	7518.2	40651.4
8 AVERAGE	224594400.	33689.1	102297.7	7681.5	41370.7

INSTALLED CAPACITY (KW)= 104000.0

(Please refer to Table 9-4 for Legend)

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

H: Dam Height (m)

T: Operation Time (hrs)

h: Effective Depth (m)

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

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

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

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

B; Tailrace Water Level (EL. m)

PPMAX; Maximum Output (kW)

HD; Normal Operating Level (EL. m)

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

Monthly L5 Output (kW); 1973 - 1980

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

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

ENERY-GENER; Annual Generating Energy (kWH)

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

L5-ENERGY; Annual L5 Output (kW)

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

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

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

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

Benefit/Cost Analysis

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

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

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

H--E.L.M	69.5	80.0	85.0	89.5	90.0	95.0	97.0	100.0	102.5	105.0
V-1000M3	20.	195.	320.	449.	459.	590.	659.	760.	875.	1000.

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

(*1000KW)

	1973	1974	1975	1976	1977	1978	1979	1980
1	1200.	1200.	1200.	1200.	1200.	1003.	1200.	1200.
2	1084.	1084.	1084.	1122.	1084.	548.	1084.	1122.
3	1200.	1200.	1200.	1198.	1200.	374.	1200.	1200.
4	1161.	1161.	1161.	1111.	1161.	334.	1159.	1145.
5	1187.	1200.	1200.	1116.	1159.	847.	1187.	1161.
6	1125.	1161.	1161.	1047.	1051.	786.	1120.	1083.
7	1129.	1200.	1200.	1062.	930.	937.	1142.	1063.
8	1061.	1200.	1200.	1027.	565.	851.	1083.	1058.
9	959.	1161.	1161.	1025.	514.	655.	1022.	1039.
10	890.	1200.	1200.	1101.	990.	966.	1076.	1178.
11	961.	1161.	1161.	1099.	997.	933.	1105.	1161.
12	1116.	1200.	1200.	1164.	1023.	1174.	1200.	1200.

(L.S.,KW)

	1973	1974	1975	1976	1977	1978	1979	1980
1	38700.	38700.	38700.	38700.	38700.	31657.	38700.	38700.
2	38700.	38700.	38700.	38700.	38700.	12540.	38700.	38700.
3	38700.	38700.	38700.	38184.	38700.	7639.	38700.	38700.
4	38700.	38700.	38700.	36072.	38537.	6165.	38478.	37724.
5	37878.	38700.	38700.	35483.	35230.	14303.	37825.	36923.
6	37048.	38700.	38700.	34430.	33919.	12731.	37146.	35307.
7	35296.	38700.	38700.	33945.	9141.	18684.	36391.	33598.
8	33046.	38700.	38700.	32365.	6569.	13298.	33972.	33712.
9	31900.	38700.	38700.	33903.	7170.	12158.	33527.	34003.
10	14389.	38700.	38700.	34456.	23155.	25925.	34337.	36612.
11	31810.	38700.	38700.	36362.	32714.	31759.	35563.	38700.
12	33320.	38700.	38700.	36695.	32544.	34335.	38700.	38709.

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

YEAR	ENERY-GENER (KWH)	GENERATION-B (1000 M$)	LS-ENERGY (KW)	LS-B (1000 M$)	TOTA-BENEFIT (1000 M$)
1973	156936096.	23547.9	34124.0	2552.4	26110.3
1974	169505360.	25425.8	38699.9	2906.0	28331.9
1975	169505360.	25425.8	38699.9	2906.0	28331.8
1976	159261616.	23889.2	35774.7	2686.3	26575.5
1977	142466720.	21370.0	28423.2	2134.3	23504.3
1978	113612320.	17041.8	13474.9	1397.3	18429.1
1979	163006176.	24450.9	35935.5	2766.1	27217.9
1980	163311808.	24496.7	36781.5	2761.9	27258.7
8 AVERAGE	154705816.	23206.9	33476.3	2513.8	25719.8

INSTALLED CAPACITY (KW)= 38700.0

(Please refer to Table 9-4 for Legend)

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

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

Benefit/Cost Analysis

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

Table 9-8 Series (Two Dams) Development (1), Lower Development

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

H--E.L.M	69.5	79.0	89.0	82.0	33.0	95.0	97.0	100.0	102.5	105.0
V-10**6M3	20.	175.	195.	240.	255.	590.	650.	760.	875.	1000.

F.S.L- 93.0 M.O.L- 79.0 9-- 50.0 P*4X-- 12000. HD-- 82.0

(*1000KW)

	1973	1974	1975	1976	1977	1978	1979	1980
1	372.	372.	372.	372.	372.	347.	372.	372.
2	336.	336.	336.	343.	336.	311.	334.	343.
3	372.	372.	372.	372.	372.	339.	363.	371.
4	350.	360.	350.	354.	350.	321.	346.	353.
5	370.	372.	372.	351.	357.	329.	355.	361.
6	354.	360.	350.	345.	346.	313.	340.	345.
7	350.	370.	372.	355.	350.	331.	350.	350.
8	353.	364.	372.	352.	344.	331.	344.	349.
9	336.	349.	350.	344.	330.	313.	330.	340.
10	345.	361.	372.	360.	342.	323.	344.	365.
11	337.	355.	350.	352.	335.	323.	342.	360.
12	362.	371.	372.	367.	347.	361.	372.	372.

(LS...KW)

	1973	1974	1975	1976	1977	1978	1979	1980
1	12000.	12000.	11985.	12000.	12000.	11122.	11942.	12000.
2	12000.	12000.	12000.	12000.	12000.	11033.	11845.	12000.
3	12000.	12000.	12000.	11993.	12000.	10969.	11513.	11932.
4	12000.	12000.	12000.	11573.	12000.	10525.	11457.	11699.
5	11876.	12000.	12000.	11599.	11690.	10573.	11397.	11592.
6	11717.	12000.	12000.	11462.	11420.	10502.	11315.	11414.
7	11593.	11865.	12000.	11414.	11184.	10592.	11255.	11209.
8	11273.	11691.	12000.	11277.	11043.	10633.	11012.	11219.
9	11176.	11607.	12000.	11440.	10939.	10564.	10956.	11259.
10	11142.	11612.	12000.	11505.	10947.	10564.	11052.	11551.
11	11193.	11691.	12000.	11705.	11117.	10621.	11215.	11997.
12	11372.	11931.	12000.	11727.	11137.	11005.	12000.	12000.

F1ST-O = 46.30 (M3/S) Q*4X = 46.30 24.

YEAR

	ENERGY-GENER (KWH)	GENERATION-B (1000 Y)	LS-ENERGY (KW)	LS-B (1000 Y)	TOTL-BENEFIT (1000 Y)
1973	102133104.	15329.0	11504.7	871.4	16200.4
1974	104103280.	15629.0	11965.5	891.1	16520.0
1975	105117696.	15767.6	11993.7	901.0	16663.6
1976	102759120.	15413.9	11649.8	874.3	16288.6
1977	100822320.	15123.3	11481.0	860.6	15983.9
1978	94953696.0	14244.6	10732.4	805.9	15050.4
1979	100612960.	15091.9	11423.0	857.3	15949.7
1980	102342980.	15426.4	11551.9	974.9	16301.4
* AVERAGE	101633332.	15253.2	11549.5	867.2	16121.4

INSTALLED CAPACITY (KW)= 12000.0

(Please refer to Table 9-4 for Legend)

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

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

Benefit/Cost Analysis

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

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

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

Benefit/Cost Analysis

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

Fig. 10-1 Flood Area

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

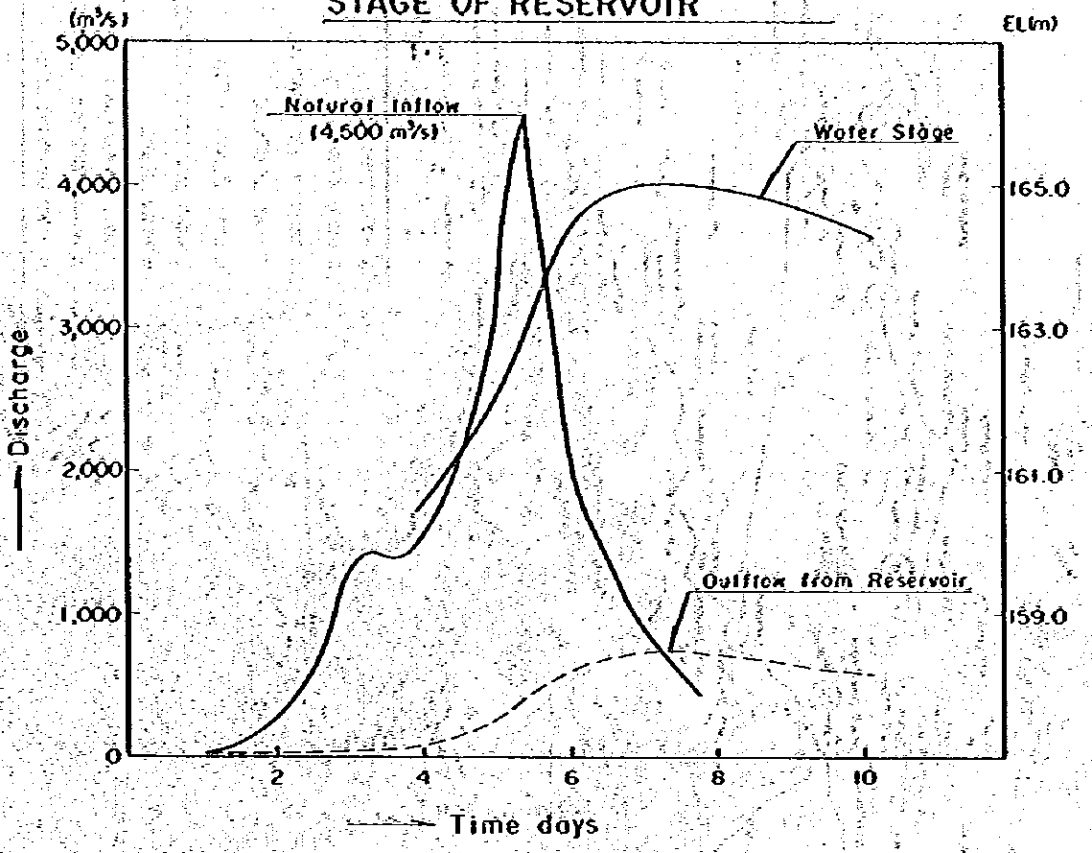
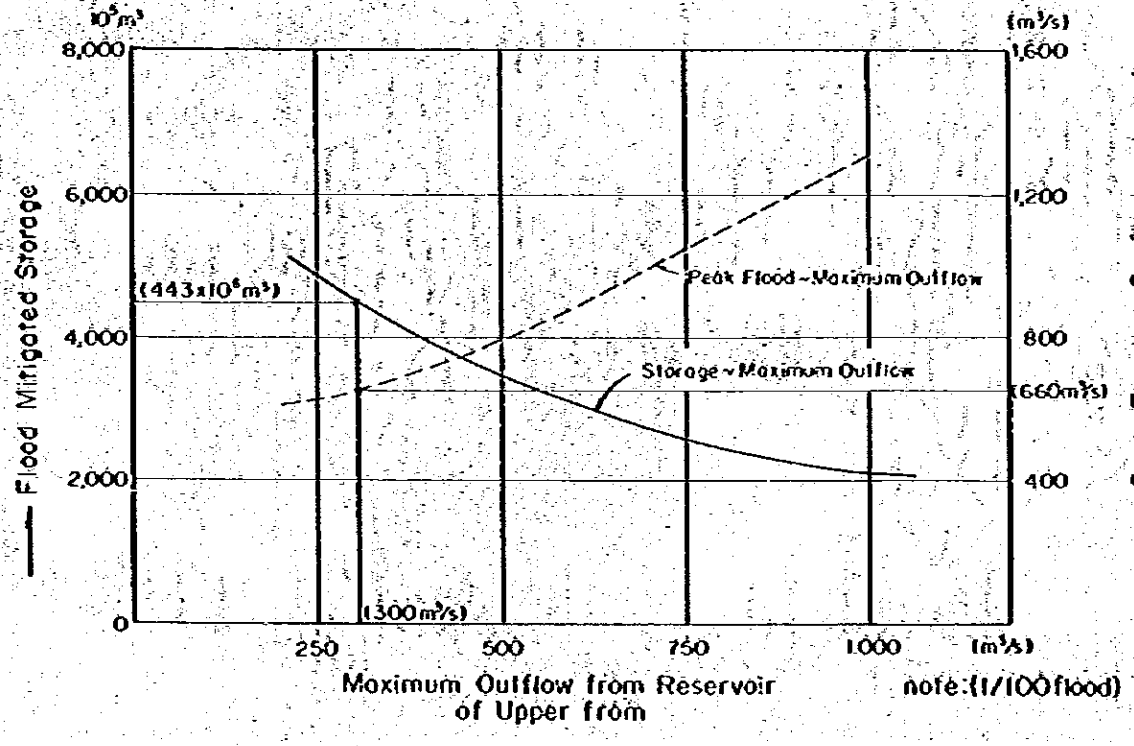
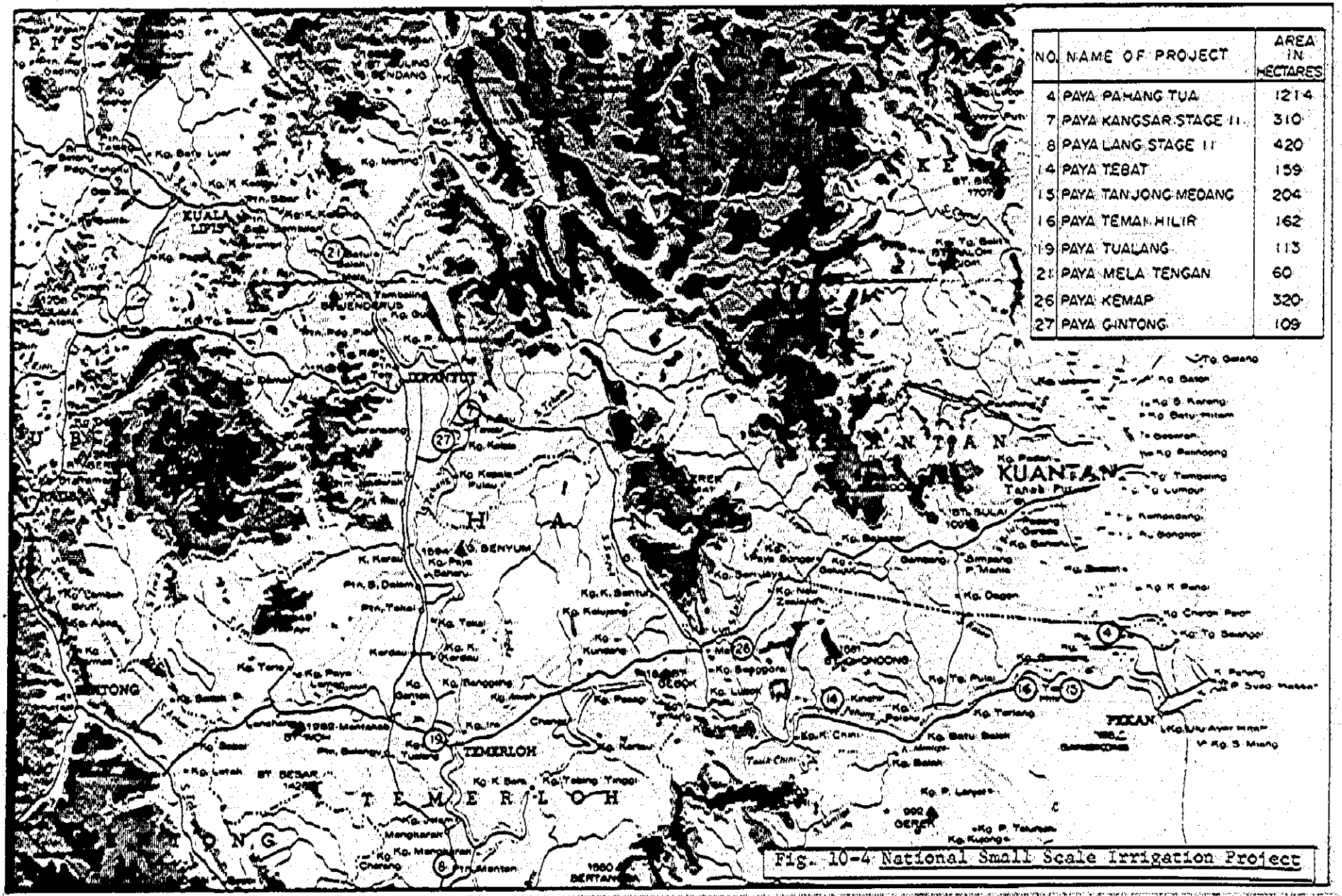


Fig. 10-3 MITIGATED STORAGE CAPACITY AND MAXIMUM OUTFLOW FROM RESERVOIR





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

Fig. 10-4 National Small Scale Irrigation Project

Fig. 10-5 Diversion Scheme

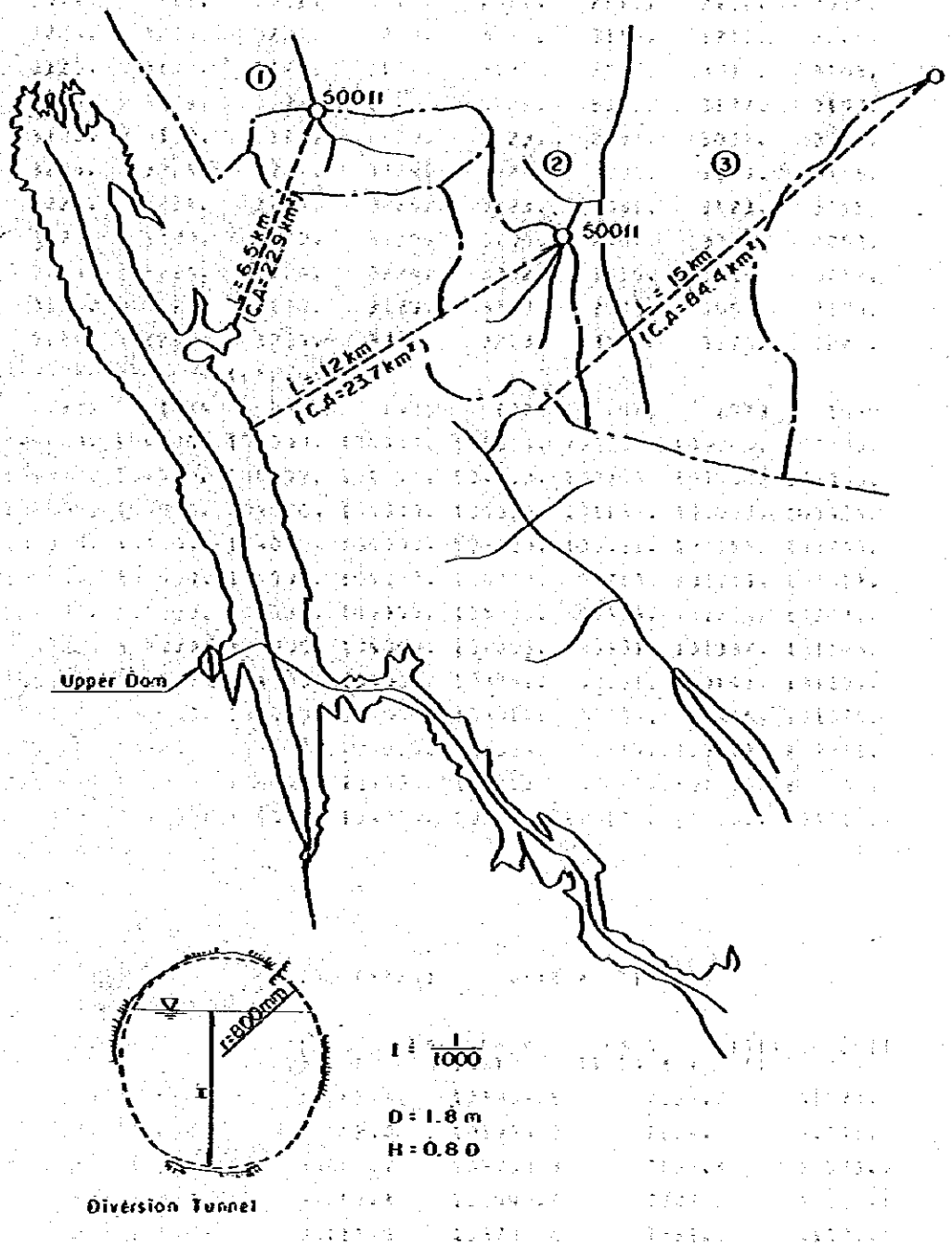


Table 10-1 Diversion Scheme (1)

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

F.S.L- 165.0 M.O.L- 155.0 Q-- 82.0 PP**(-- 104000. HD-- 161.7

(*1000Kw)

	1973	1974	1975	1976	1977	1978	1979	1980
1	3224.	3224.	3224.	3224.	3224.	3206.	3224.	3224.
2	2912.	2912.	2912.	3016.	2912.	2876.	2912.	3016.
3	3224.	3224.	3224.	3224.	3224.	3156.	3212.	3224.
4	3120.	3120.	3120.	3120.	3120.	3017.	3073.	3105.
5	3224.	3224.	3224.	3224.	3224.	3096.	3172.	3197.
6	3120.	3120.	3120.	3120.	3120.	2933.	3054.	3072.
7	3224.	3224.	3224.	3224.	3224.	3085.	3143.	3146.
8	3224.	3224.	3224.	3224.	3223.	3031.	3123.	3145.
9	3120.	3120.	3120.	3120.	3104.	2967.	3036.	3052.
10	3224.	3224.	3224.	3224.	3202.	3056.	3113.	3212.
11	3120.	3120.	3120.	3120.	3112.	2976.	3058.	3120.
12	3224.	3224.	3224.	3224.	3213.	3190.	3224.	3224.

(L**,Kw)

	1973	1974	1975	1976	1977	1978	1979	1980
1	104000.	104000.	104000.	104000.	104000.	103039.	104000.	104000.
2	104000.	104000.	104000.	104000.	104000.	102393.	104000.	104000.
3	104000.	104000.	104000.	104000.	104000.	101186.	103033.	103524.
4	104000.	104000.	104000.	104000.	104000.	100033.	102355.	103243.
5	104000.	104000.	104000.	104000.	104000.	99753.	102069.	102313.
6	104000.	104000.	104000.	104000.	104000.	99473.	101719.	102021.
7	104000.	104000.	104000.	104000.	104000.	95351.	101332.	101145.
8	104000.	104000.	104000.	104000.	103357.	99131.	100147.	101204.
9	104000.	104000.	104000.	104000.	103012.	98594.	99935.	101395.
10	104000.	104000.	104000.	104000.	103009.	98544.	100373.	102725.
11	104000.	104000.	104000.	104000.	103515.	98655.	101974.	104000.
12	104000.	104000.	104000.	104000.	103447.	100122.	104000.	104000.

FIRM-E = 43.00 (M3/S) QMAX = 150.00 6.

YEAR - - - - - -

	ENERY-GENER (KWH)	GENERATION-B (100 M)	LS-ENERGY (KW)	LS-B (100 M)	IDEA-BENEFIT (100 M)
1973	227758030.	34163.7	103999.3	7809.3	41973.0
1974	227758030.	34163.7	103999.3	7809.3	41973.0
1975	227758080.	34163.7	103999.3	7809.3	41973.0
1976	223332080.	34257.3	103999.8	7309.3	42066.6
1977	227412576.	34111.9	103736.6	7739.6	41931.4
1978	220174752.	33026.2	100015.5	7519.2	40535.4
1979	223977792.	33598.7	102337.1	7659.7	41256.4
1980	226422048.	33963.3	102377.3	7725.1	41633.3
8 AVERAGE	225205376.	33930.3	103077.4	7713.2	41571.0

INSTALLED CAPACITY (Kw)= 104000.0

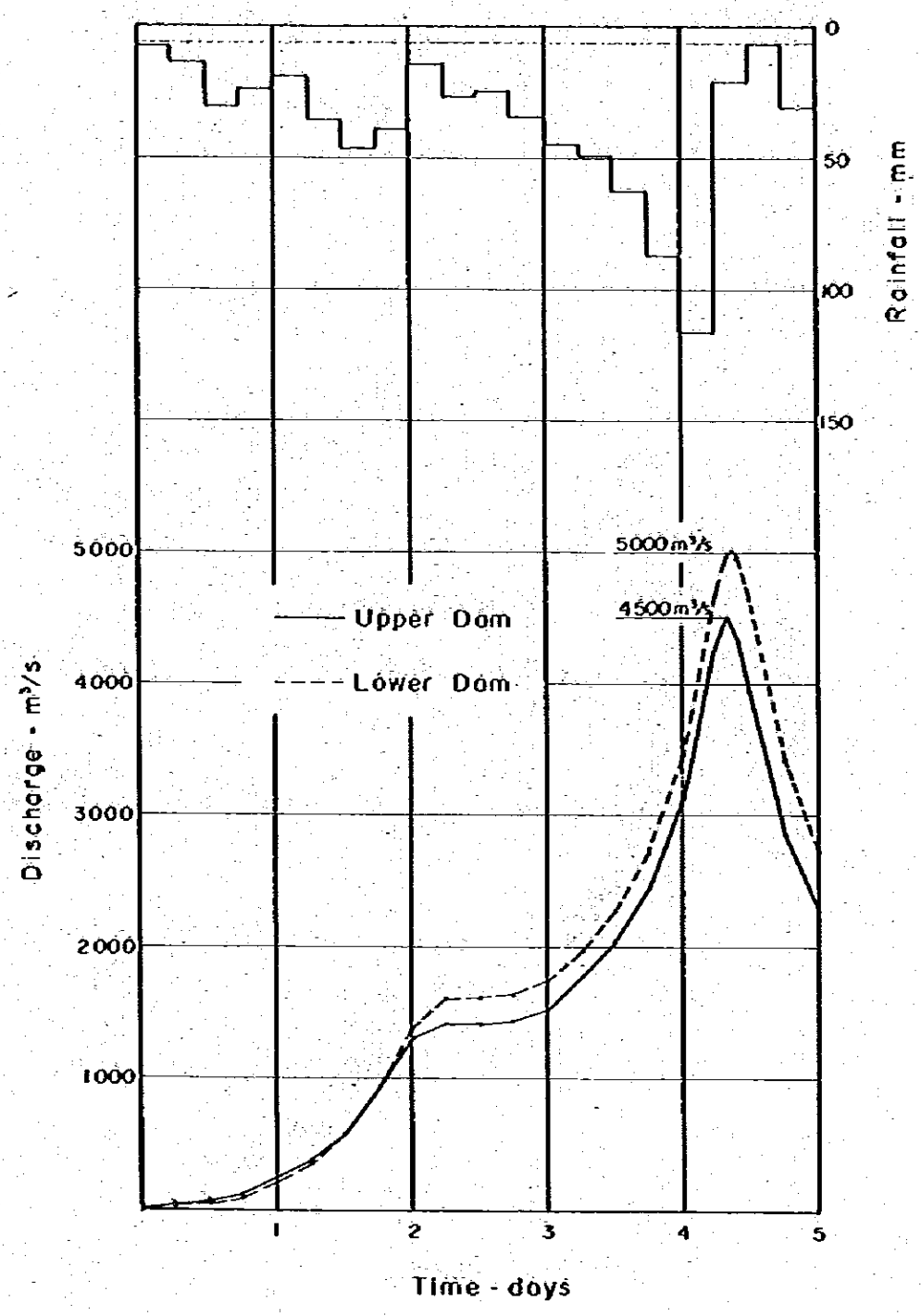
(Please refer to Table 9-5 for Legend)

Table 10-2 Diversion Sheme (2)

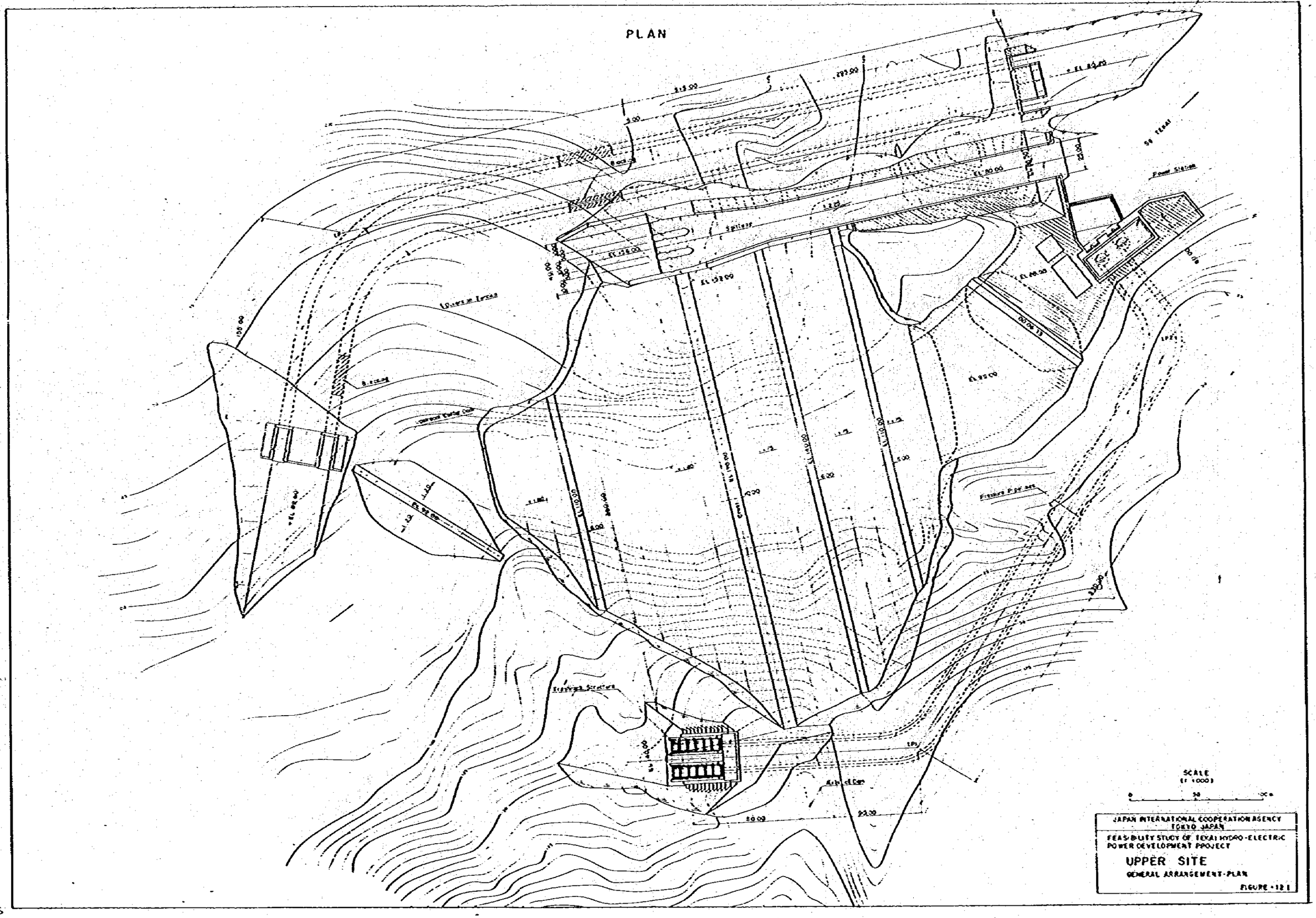
Benefit/Cost Analysis

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

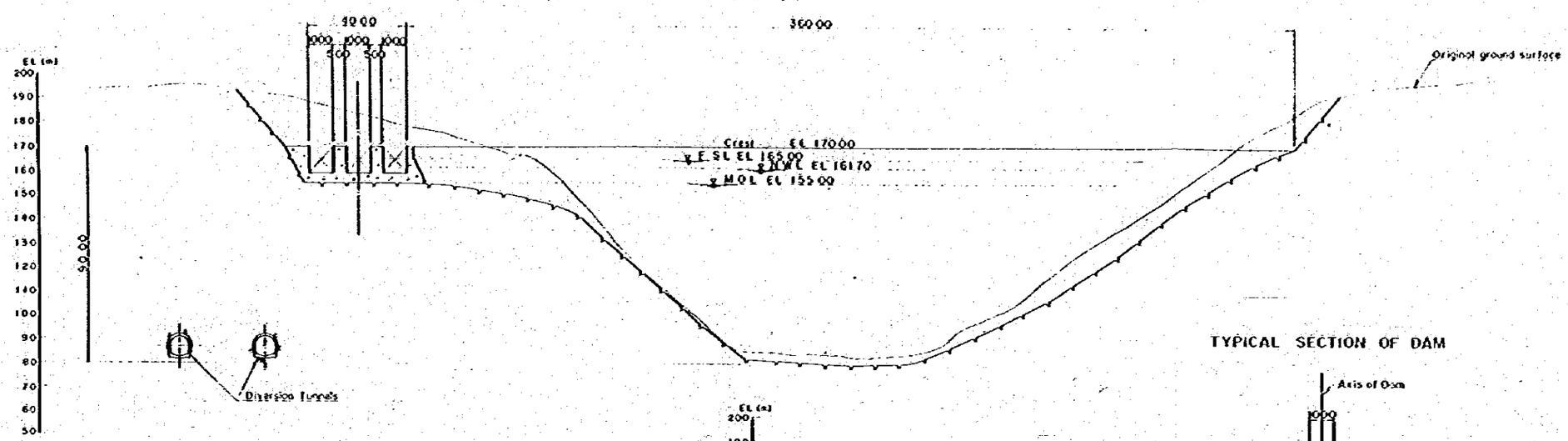
Figuer 11-1 Design Flood of the Damsite



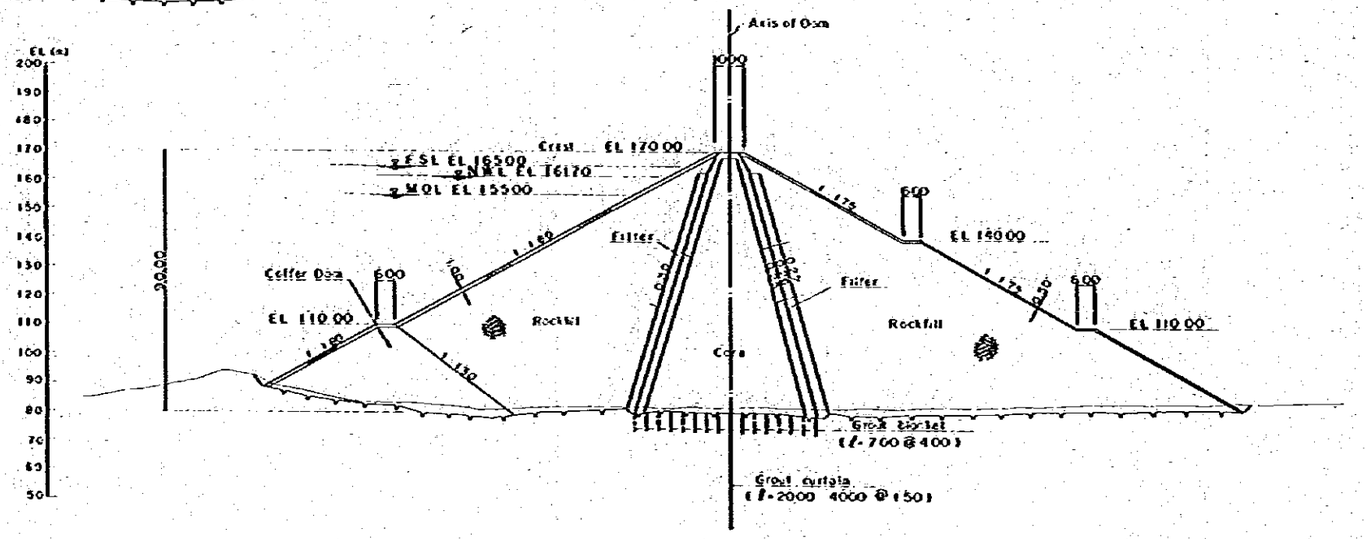
PLAN


Spillway
Power Station
Pressure Pipe line
Diversion Tunnel
Diversion Structure
SCALE
(1:1000)
JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO JAPAN
FEASIBILITY STUDY OF TEXAI HYDRO-ELECTRIC POWER DEVELOPMENT PROJECT
UPPER SITE
GENERAL ARRANGEMENT-PLAN
FIGURE-12.1

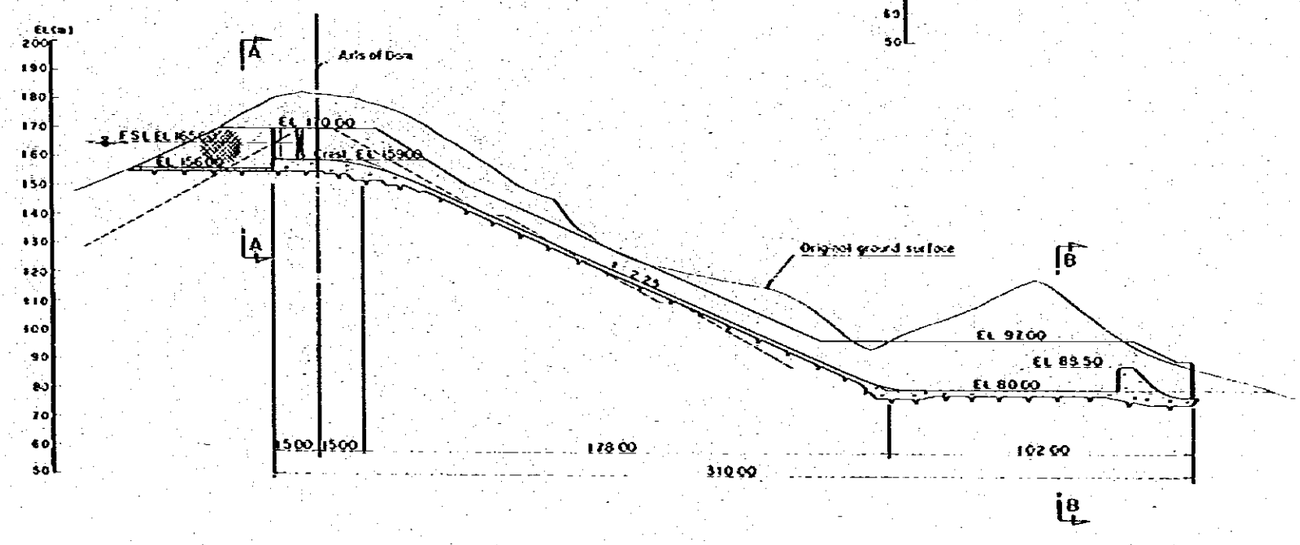
LONGITUDINAL SECTION



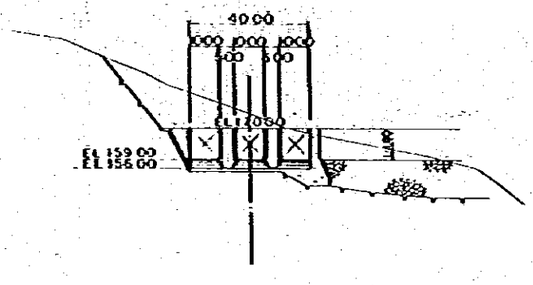
TYPICAL SECTION OF DAM



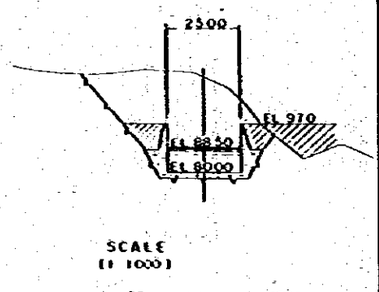
LONGITUDINAL SECTION OF SPILLWAY



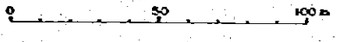
A – A



B – B



SCALE
(1:1000)



JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO JAPAN

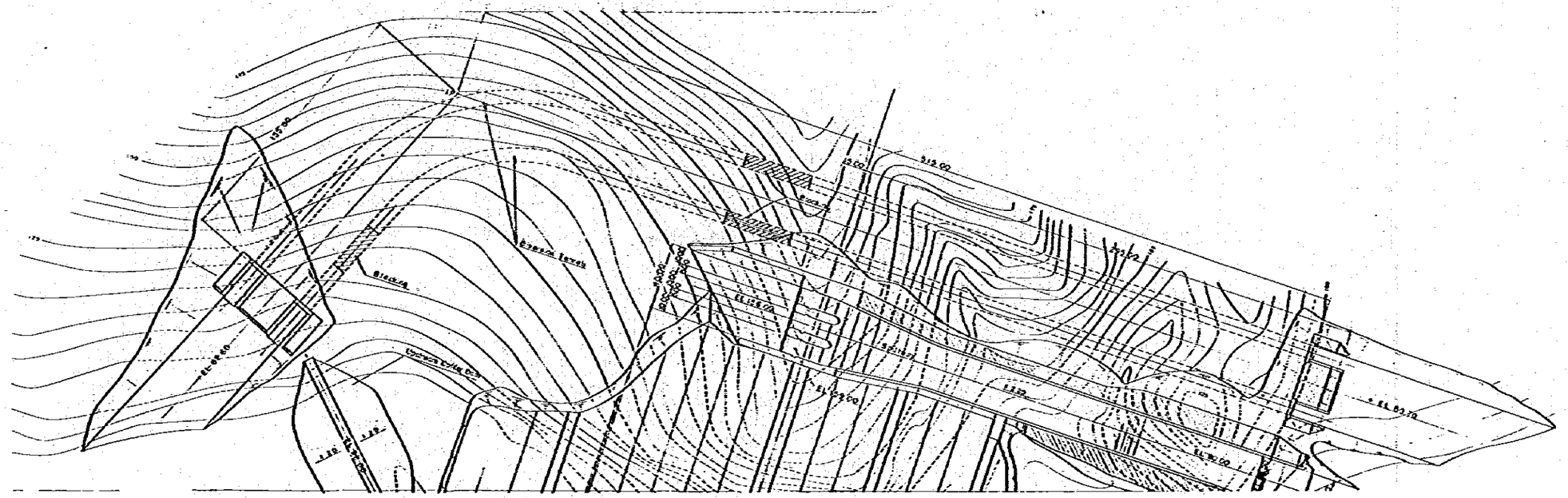
FEASIBILITY STUDY OF TEKAI HYDRO-ELECTRIC POWER DEVELOPMENT PROJECT

UPPER SITE

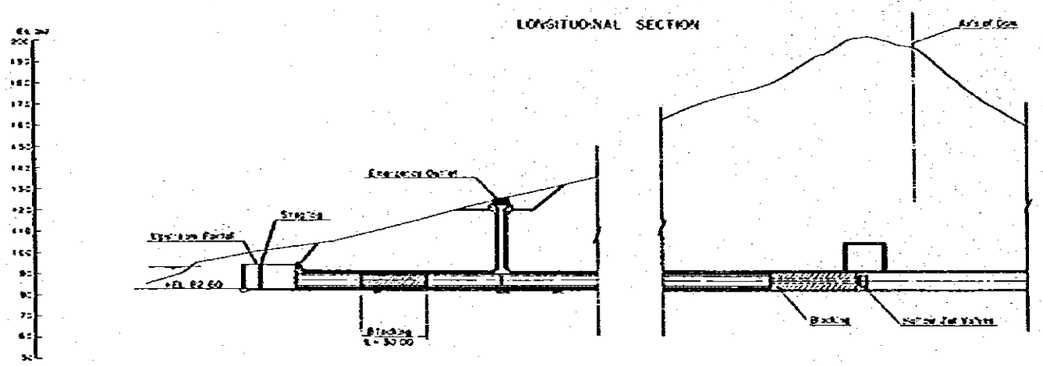
SPILLWAY AND SECTIONS

FIGURE - 12.2

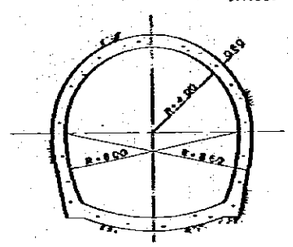
PLAN



LONGITUDINAL SECTION



TYPICAL SECTION OF DIVERSION TUNNEL



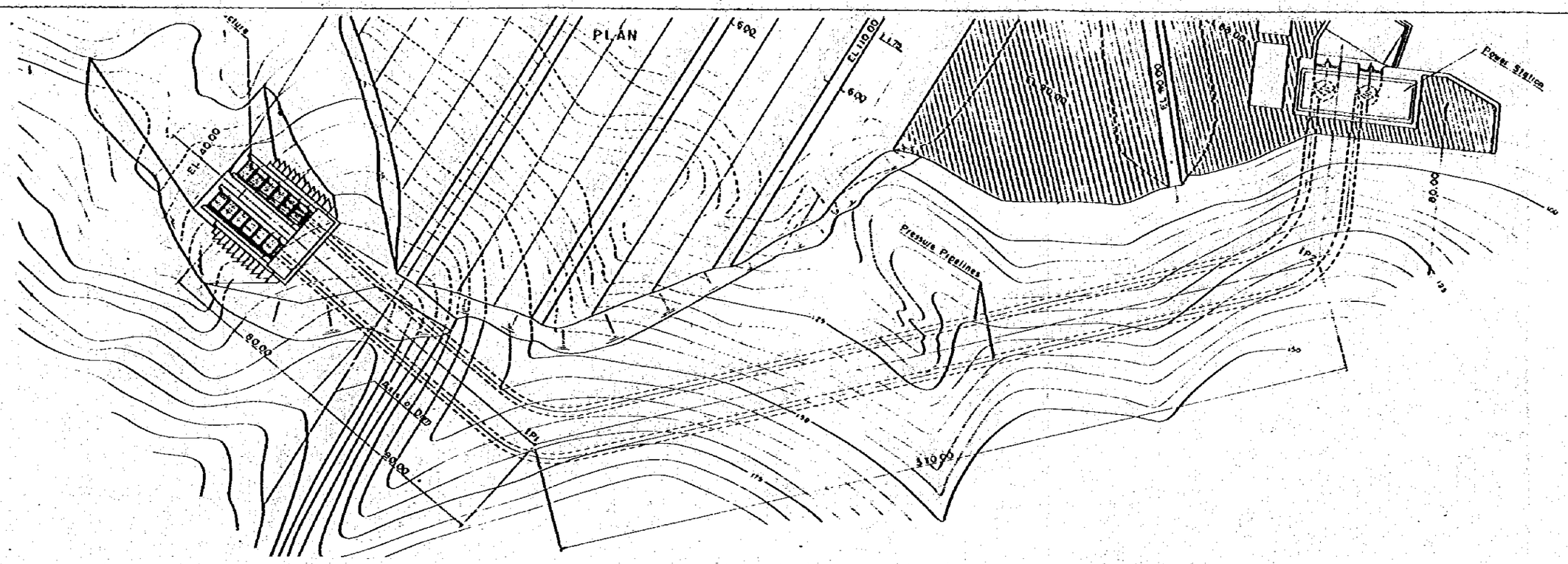
SCALE

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO JAPAN

FEASIBILITY STUDY OF TEKAI HYDRO-ELECTRIC POWER DEVELOPMENT PROJECT

UPPER SITE
DIVERSION TUNNELS

FIGURE-12.3



JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO JAPAN

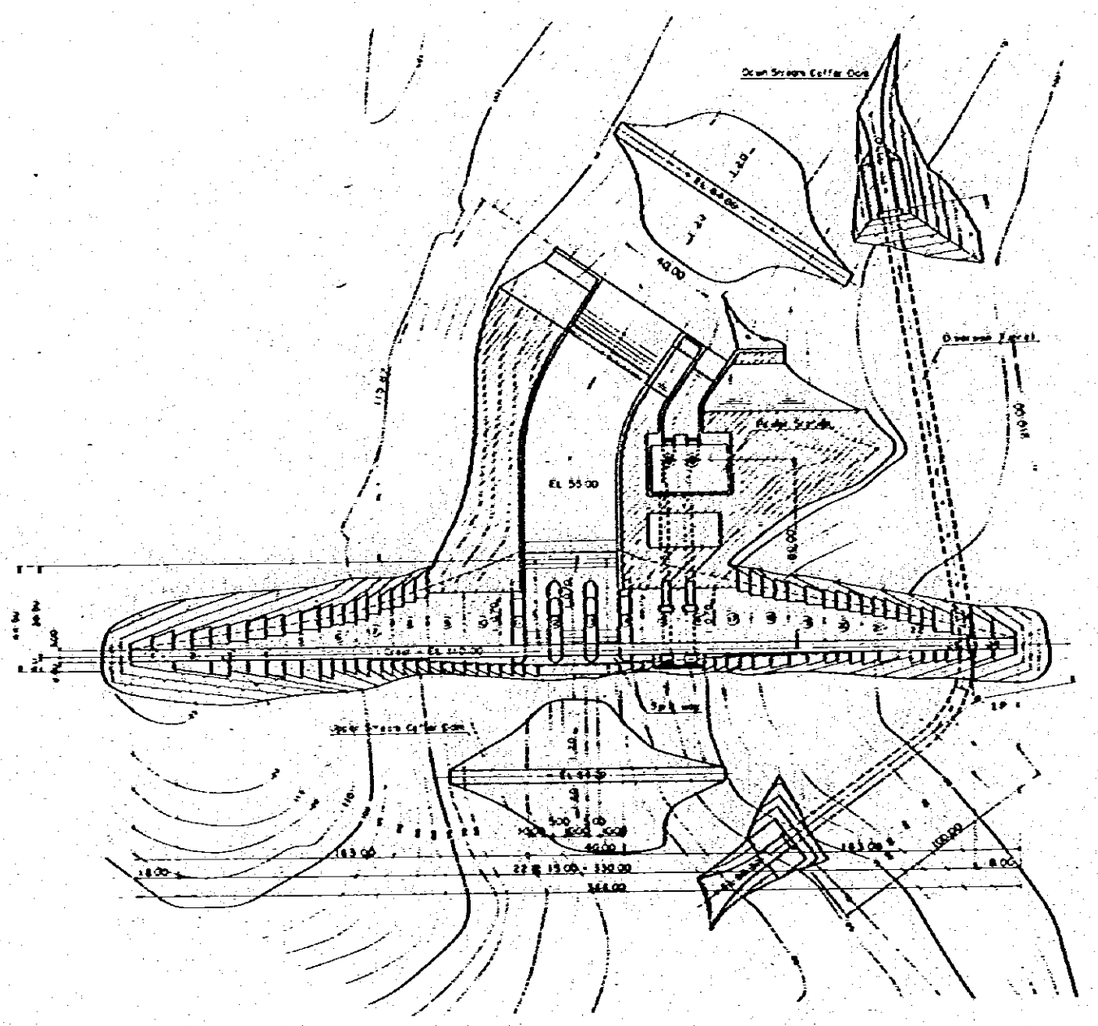
FEASIBILITY STUDY OF TEKAI HYDRO-ELECTRIC POWER DEVELOPMENT PROJECT

UPPER SITE

PIPELINES AND POWER STATION

FIGURE - 12.4

PLAN



SCALE
(1:1000)
0 50 100m

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO JAPAN

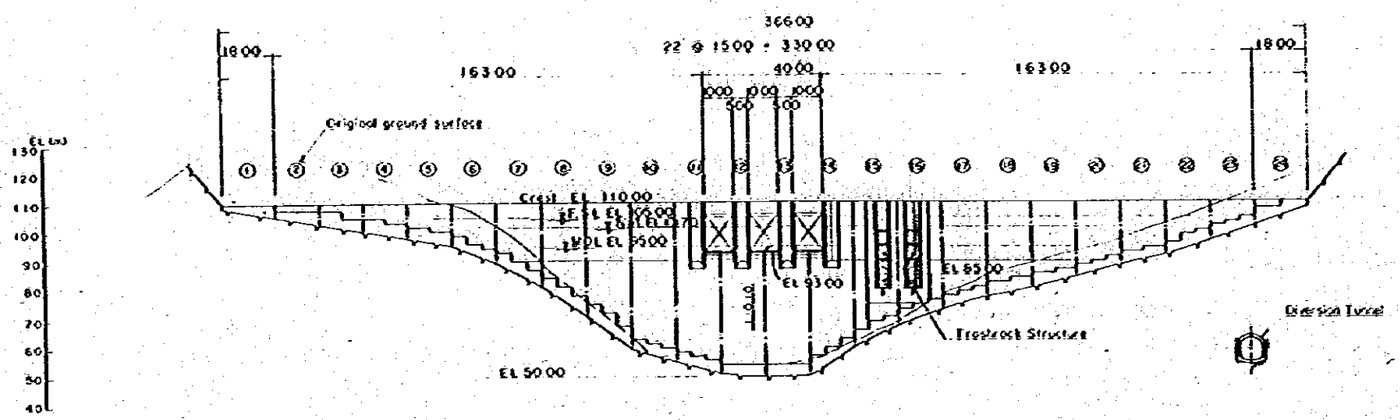
FEASIBILITY STUDY OF TEKAI HYDRO-ELECTRIC POWER DEVELOPMENT PROJECT

LOWER SINGLE DEVELOPMENT

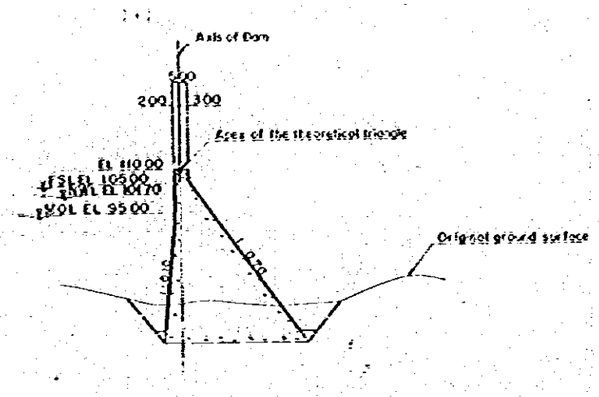
GENERAL ARRANGEMENT PLAN

FIGURE - 12.5

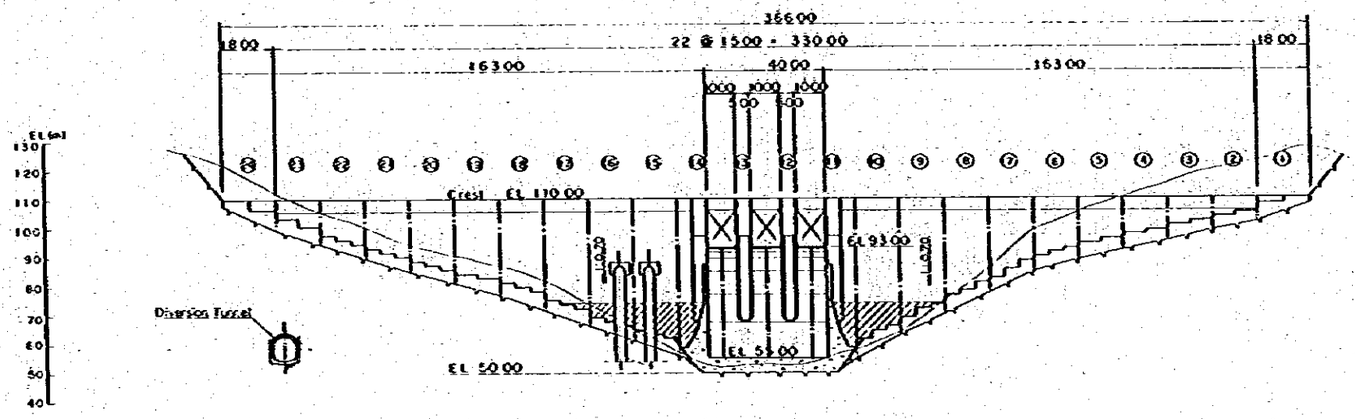
UPSTREAM ELEVATION



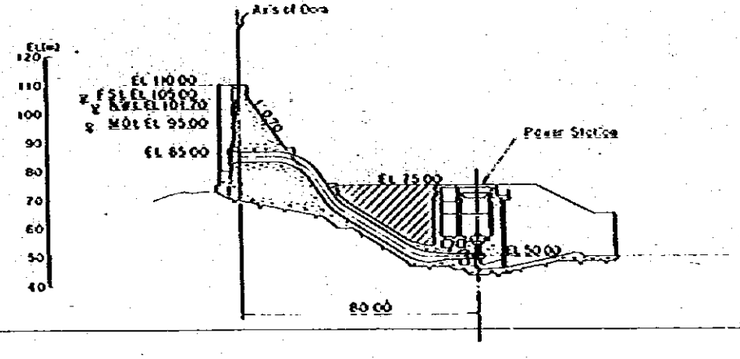
NON-OVERFLOW SECTION



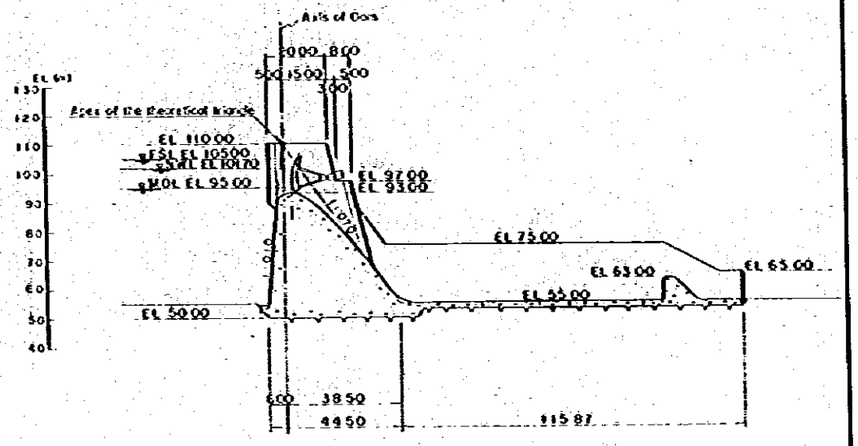
DOWNSTREAM ELEVATION



LONGITUDINAL SECTION OF PRESSURE PIPELINE



OVERFLOW SECTION



SCALE
(1:1000)

0 50 100m

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO JAPAN

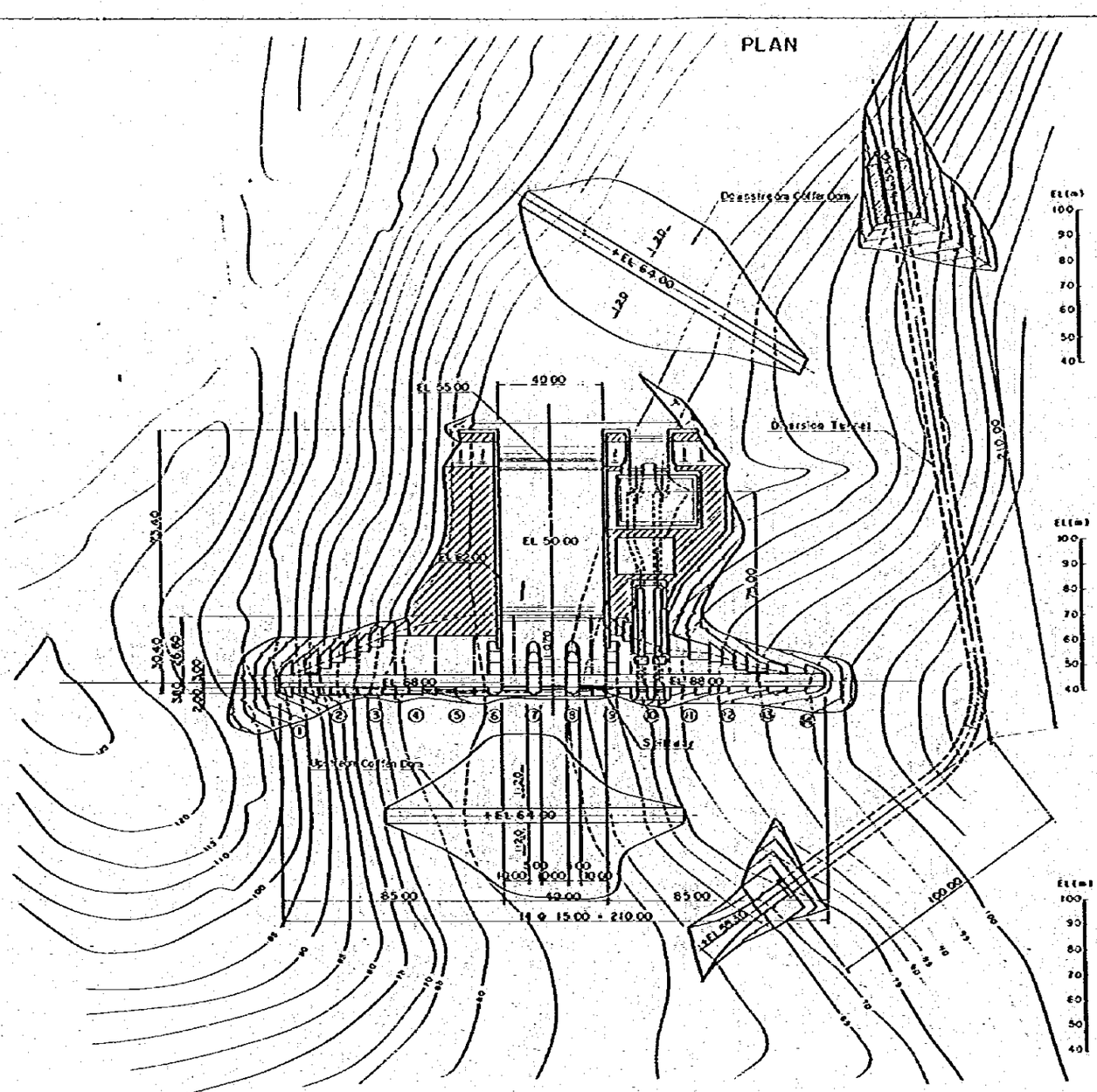
FEASIBILITY STUDY OF TEKAI HYDRO-ELECTRIC POWER DEVELOPMENT PROJECT

LOWER SINGLE DEVELOPMENT

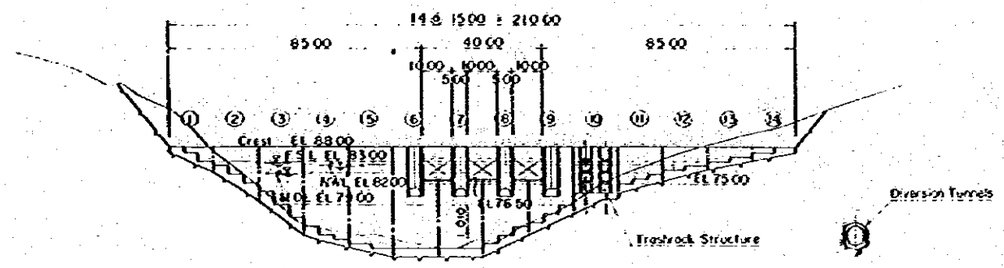
POWERSTATION AND SECTIONS

FIGURE - 12.6

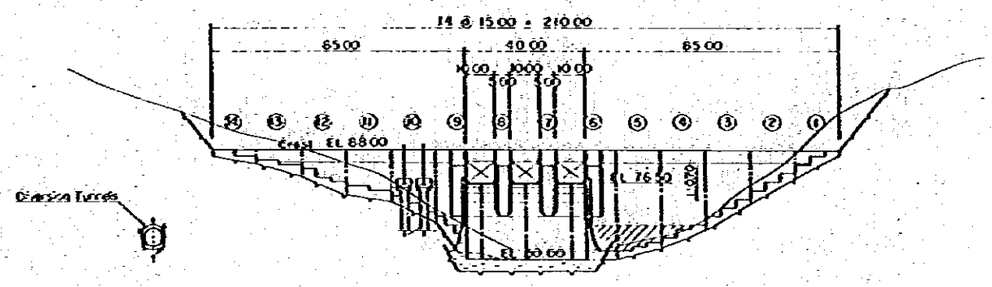
PLAN



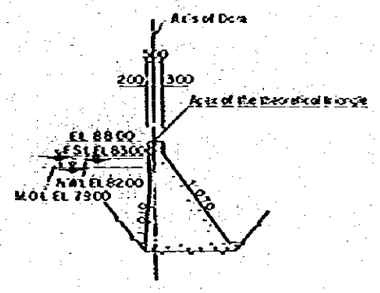
UPSTREAM ELEVATION



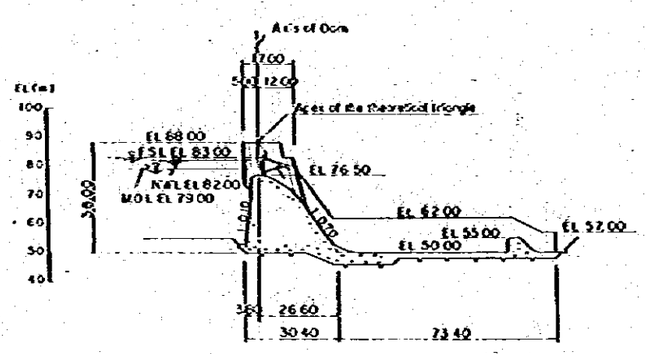
DOWNSTREAM ELEVATION



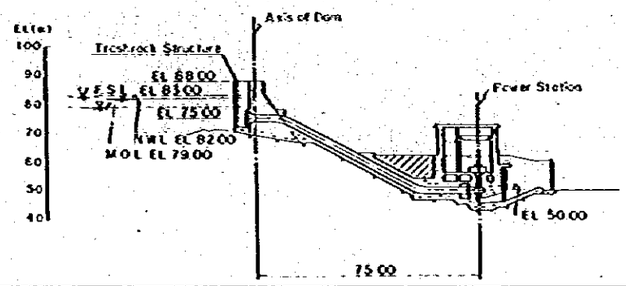
NON-OVEVFLOW SECTION



OVERFLOW SECTION



LONGITUDINAL SECTION OF PRESSURE PIPELINE



SCALE
(1: 1000)

0 50 100m

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO JAPAN

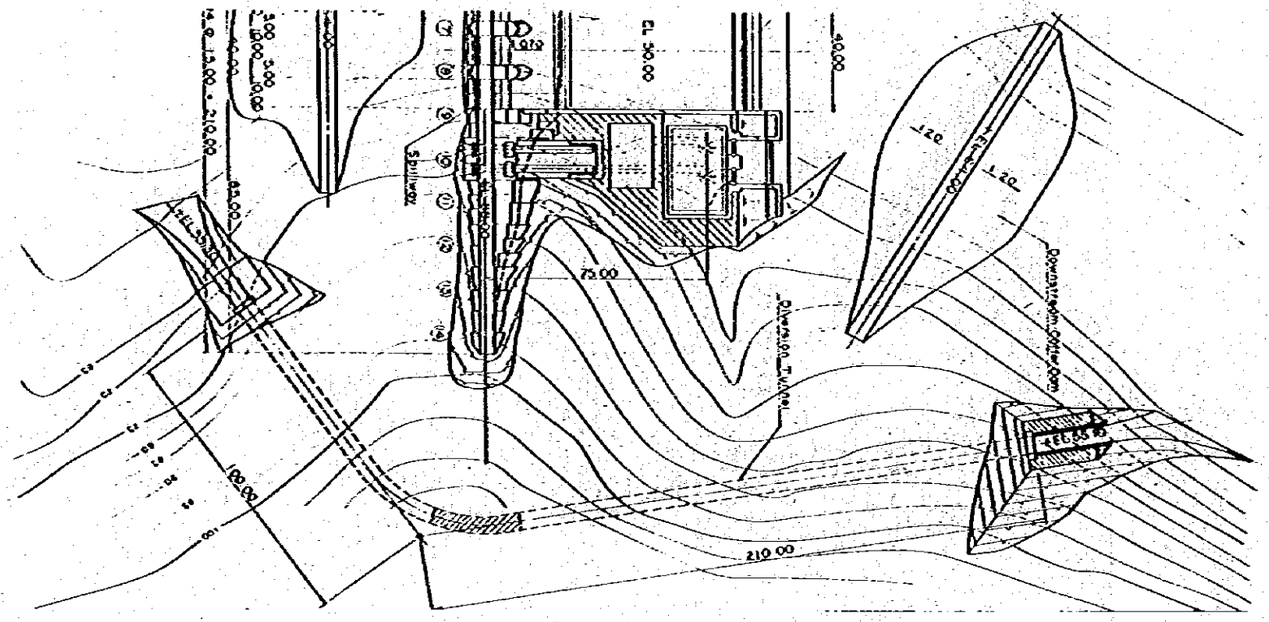
FEASIBILITY STUDY OF TEKAI HYDRO-ELECTRIC POWER DEVELOPMENT PROJECT

LOWER SERIES DEVELOPMENT

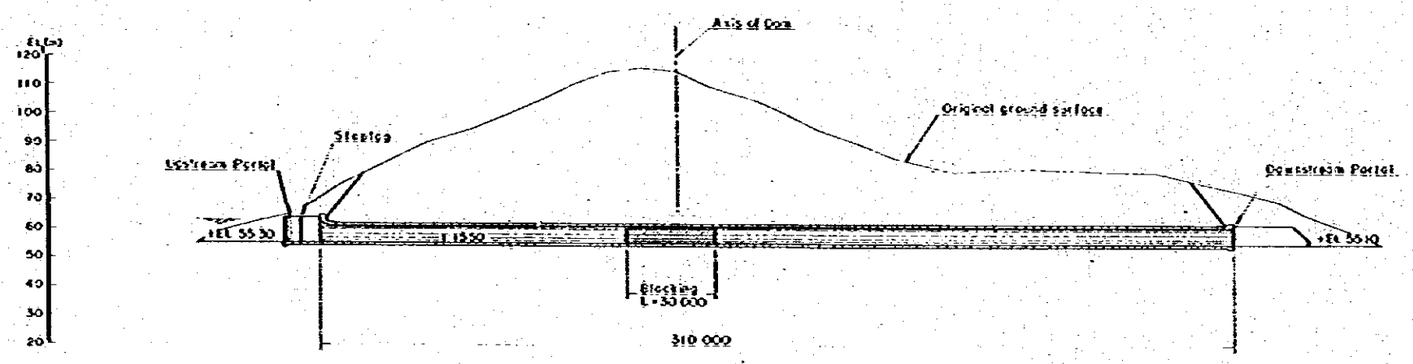
GENERAL ARRANGEMENT - PLAN, POWER STATION AND SECTIONS

FIGURE - 12.7

PLAN

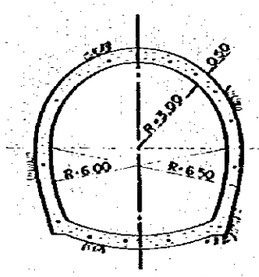


LONGITUDINAL SECTION



TYPICAL SECTION OF DIVERSION TUNNEL

(1:100)



SCALE
(1:1000)

0 50 100m

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO JAPAN

FEASIBILITY STUDY OF TEKAI HYDRO-ELECTRIC

LOWER SERIES DEVELOPMENT

DIVERSION TUNNEL

FIGURE - 12.8

Table 12-1 Unit Rate of Estimation (1)

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

Unit Rate of Estimation (2)

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

Table 12-2 Summary of Costs for Tekai Development

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

Table 12-3 Construction Cost Estimates (1)

Upper Single (One Dam) Development

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

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

Construction Cost Estimates (2)

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

Table 12-4 Construction Cost Estimates (1)

Lower Single (One Dam) Development [Conc. H=60 12 hr, MOL=95.0]

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

Construction Cost Estimates (2)

Item	Quantity	Unit	Unit Cost	Construction Cost	Remarks
			(M$)	(M$)	
1-5. Intake Structure and Penstock				14,900,000	
1-6. Power House and Switch Yard				3,200,000	
1-7. Tailrace				440,000	
2. Generating Equipment				23,400,000	
3. Engineering Service and General Expense				16,135,000	(1+2)×13%
4. Government Administration				6,206,000	(1+2)×5%
5. Contingency				14,646,000	(1+2+3+4) x 10%
6. Grand Total				161,102,000	

Table 12-5 Construction Cost Estimates (1)

Lower Dam in Series (Two Dams) Development

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

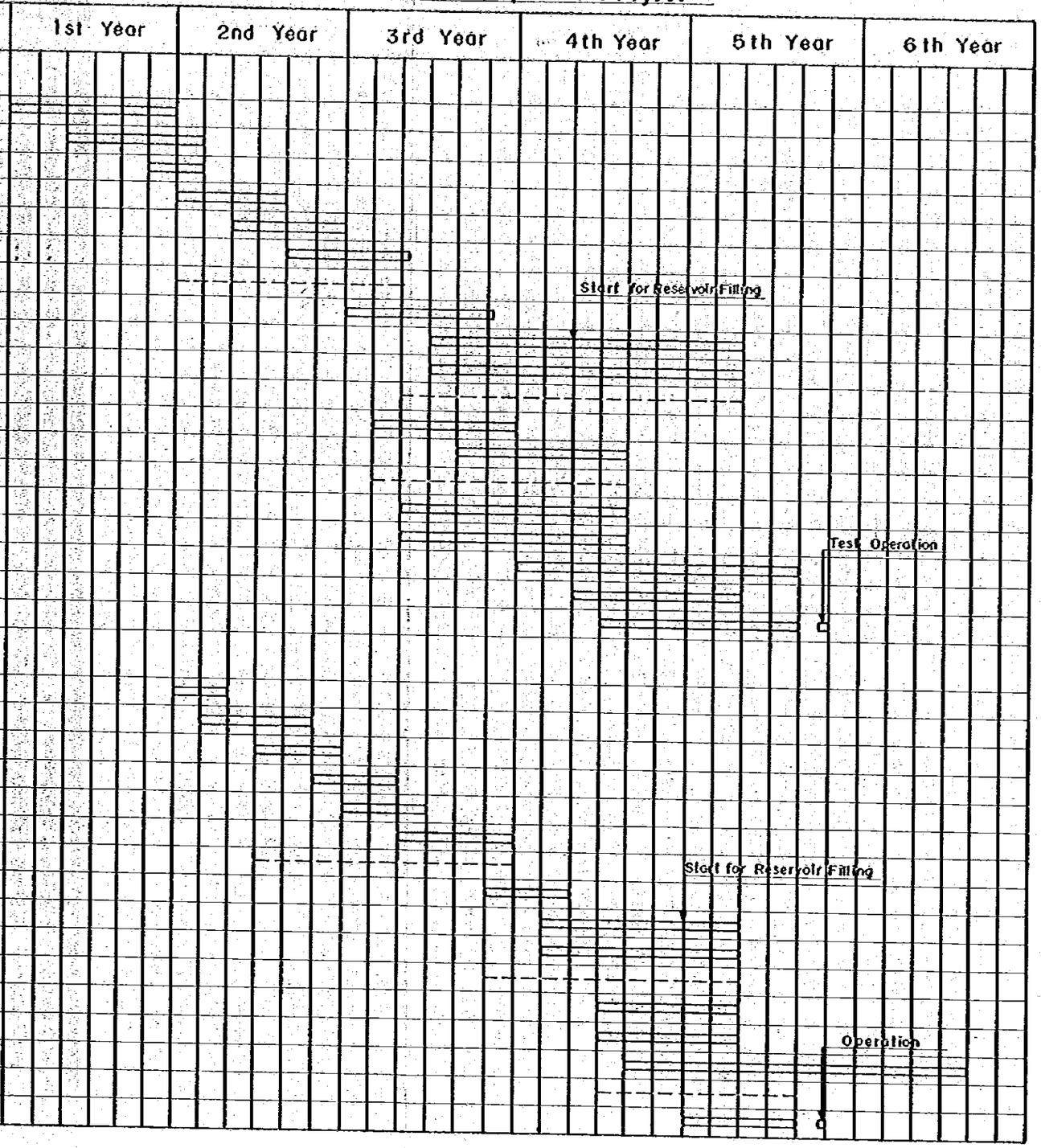
Item	Quantity	Unit	Unit Cost	Construction Cost	Remarks
			(M$)	(M$)	
1. Civil Works					
1-1. Preparatory Works					
1) Access Road	20	Km	400,000	8,000,000	
2) Temporary Facilities				3,969,000	[(1-2)+(1-3)] x 10%
1-2. Diversion Tunnel					
1) Common Excavation		m^3	7.0		
2) Rock Excavation		"	22.0	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

Construction Cost Estimates (2)

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

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

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



3-1 Unit Cost of Construction

Equipment Proposal (Kenyir Dam Project)

3-2 Environmental Aspects

The Environmental Impact Assessment Handbook
Procedure and Guidlines.

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

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

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

Manual of NEB Guidlines for Preparation of Environmental Impact Evaluations.

3-3 Fishery

Prices of Freshwater Fish (at Jerantut)

Ecological Draving of Fish Classification

The Influence of Environmental Degradation on Riverine Fisheries in Peninsular Malaysia

3-4 Forestry

Price List of Wood

Foresters' Manual of Dipterocarps

Forestry and Forest Industries Development Malaysia

Forestry in Peninsular Malaysia

Forest Resource Base, Policy and Legislation of Peninsular Malaysia

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

3-5 Archaecological

Report on the Archaecological Potentialities of the Tekai Valley, Pahang

3-6 Animals

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

3-7 Seismic

Seismic Design of Mtera Dam

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

3-8 Hydrology and Meteorology

Hourly Water Stage

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

Daily Discharge

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

Monthly Discharge

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

Daily Rainfall

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

Hydrology

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

Meteorology

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

Water Quality Records

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

3-9 Topography

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

3-10 Geology

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

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

3-11 Power Transmission

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

3-12 Economics

Mid-term Review of the Third Malaysia Plan

Preliminary Field Count Summary

Annual Statistical Bulletin Malaysia

Consumer Price for Peninsula Malaysia

Tariff

Economic Report 1980 - 1981

3-13 Report

Tembeling Hydro-Electric Project

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

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

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

Pahang River Basin Study

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

National Water Resources Study, Malaysia

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

3-14 Others

Investment Opportunities (Pahang Malaysia)

Pahang Basic Investment

Rancangan Malaysia Keempat (1989 - 1985)

Peringkat II

Fourth Malaysia Plan (1981 - 1985)

Monthly Statistical Bulletin (Peninsular Malaysia)

Annual Statistical Bulletin Malaysia 1979

Consumer Price Index for Peninsular Malaysia (July 1981)

The Producer Price Index for Peninsular Malaysia (1978)

MIZUNO TOSHIHIKO: Lakes and Marshes for East-South Asia

OGAWA FUSATO: Ecology I for the Tropics - Forest -

MIZUNO TOSHIHIKO: Ecology II for The Tropics - Freshwater -