Table 1.6 Summary of Geological Survey

*: no reconnaissance

No.	Dam Name	Geology	Geological Age	Strike/Dip	Hardness/Weathering	Fault, Fracture Zone	Remarks	Contents
(1) 1	Durmon *	sandstone, conglomerate	Pliocene	Strike: E-W dip : S	Soft/partly highly weathered to red clay.	fault (E-W) exists in southern area	satisfactory	small collapse and landslide.
(2) 4	Chico No.4	sandstone, mudstone conglomerate	Upper Miocene	N60°E/70°NE	hard-medium/moderately weathered (upland)	fault is present at the abutment	highly recommended.	bed rock is fairy good.
(3) 6	Chico No.2	basic volcanics (basalt-spilite, diabase)	Cretaceous-Paleogene	-	generally very hard	-	excellent site	-
(4) 8	Chico-Mallig	sandstone alternation with shale	Upper Miocene	N25°E/54°NW (right bank)	soft/moderately-highly weathered	-	satisfactory, excavation will be large.	extended river gravel, terrace deposit.
(5) 10	Mataleg	conglomerate, sandstone	Upper Miocene	N60°E/35~45°SE	soft, partly hard/moderately weathered	-	very satisfactory.	remarkable cuesta.
(6) 12	Pinukpuk	conglomerate, sandstone	Upper Miocene	N30°E/30°SE	soft-partly hard	-	very satisfactory.	remarkable cuesta. landslides upstream right slope.
(7) 14	Bahaca *	conglomerate, sandstone	Upper Miocene	Strike:NNE-SSW, dip:W	hard-medium	strike fault is estimated on E-area.	very satisfactory.	little problem about fault.
(8) 15	Bitag	sandstone	Upper Miocene	N45°E/10°W	very soft/highly	-	satisfactory	wide riverbed. extended sandy river deposit.
(9) 19	Agguyadan	limestone	Upper Miocene	strike: N-S dip:5°W	very hard/weathering is proceeding	-	satisfactory	well-layered, cracky rocks. Callao Cave at downstream.
(10) 24	Shiffu No.1 (A)	pebble-conglomerate	Pliocene	strike:N-S dip: 30°E	soft/moderately to highly weathered	active structure infered may be no problem.	very satisfactory.	remarkable cuesta. wide collapse zone to be investigated.
(11) 24	Shiffu No.1 (B)	sandstone, shale, conglomerate	Upper Miocene	N25°W/40°E	soft-medium/moderately weathered	-	very satisfactory.	collapse existing upstream. may be no problem.
(12) 25	Shiffu No.2 *	volcanic rocks (basalt, andesite)	Cretaceous-Paleogene	-	generally hard/slightly -moderately weathered	-	highly recommended.	-
(13) 26	Mallig No.1	conglomerate, sandstone	Upper Miocene	N15~30°E/20~30°E	hard (river bed), soft (upland)/highly-moderately weathered	active structure is inferred.	very satisfactory.	wide collapse zone at down-stream may be no problem. abutment excabation large.
(14) 27	Mallig No.2	sandstone, shale	Upper Miocene	Strike: N-S dip: E	soft-med./moderately weathered	wide fracture zone estimated (upstream)	very satisfactory.	fracture zone (estimated upstream should be confirmed.
(15) 28	Ilagan No.1	meta-andesite, diorite	Cretaceous-Paleogene	-	very hard-med./slightly altered.	-	highly recommended.	slight pyrite dissemination. sufficient river gravel.
(16) 29	Ilagan No.2	meta-andesite, agglomerate, diorite	Cretaceous-Paleogene	-	very hard-medium/highly weathered to red clay.	-	highly recommended.	
(17) 33	Dinabungan	sandstone, andesite granodiorite	Cretaceous-Paleogene/Pliocene	Almost horizontal (sandstone)	very soft, highly (upland)/hard (river bank)	-	very satisfactory	hardrock only river bed level. right abutment should be excabated.
(18) 34	Catalangan *	andesite, pyroclastics, agglomerate	Cretaceous-Paleogene	-	hard-med.	-	highly recommended.	many outcrops on the river bed.
(19) 37	Alinit No.1 (A)	agglomerate, andesite	Cretaceous-Paleogene	N50-60°W/50°NE	generally hard/slightly -moderately weathered	-	highly recommended.	many outcrops on the river bed.
(20) 41	Matuno No.1	conglomerate	Middle Miocene	strike: E-W, dip : 30-40°N	hard/moderately weathered	-	satisfactory, foundation treatment necessary.	so high bedrock permeability.
(21) 47	Cagayan No.1	limestone (Callao-)	Upper Miocene	strike: N-S dip : 7 ~ 8°W	hard/slightly-moderately with solutive texture.	-	satisfactory.	many opened cracks in places.
(22) 48	Cagayan No.2	limestone (Sicalao-	Middle Miocene	strike: NE-SW dip : 10°NW	hard-med./moderately weathered.	-	satisfactory.	many cracks. progressive weathering.
(23) 49	Casecnan (conwap)	agglomerate	Upper Oligocene	strike: NE-SW dip : 20-30°N	hard, massive	sheared zone, consolidated.	very satisfactory	no special problem.
(24) 50	Addalam (A)	agglomerate	Oligocene	N60°W/10°SW	med.-very hard/slightly -highly weathered (right	-	very satisfactory	-
(25) 51	Diduyon	agglomerate, andesite	Oligocene	N35-50°NE/25-35°E	hard/generally fresh	fault right bank	satisfactory. foundation treatment necessary.	weak zone in the right bank.
(26) 52	Dibuluan	metasediments	Cretaceous-paleogene	strike: NE-SW dip : NW	medium hard/moderately weathered	-	very satisfactory.	-

Table 1.7 Irrigation Efficiency for Second Screening

	NO.	NAME OF DAM	C.A. (sq.km)	DAM CREST ELEVATION (EL.m)	HWL (m)	LWL (m)	GROSS STORAGE (Mcm)	ACTIVE STORAGE (Mcm)	SEDIMENT STORAGE (Mcm)	AVERAGE DISCHARGE (cms)	IRRIGATION BENEFIT /1 (million US$/y)	DAM VOLUME (Mcm)	IRRIGATION EFFICIENCY (US$/y/cu.m)	CLASS /2
1	1	Dummon	112	143	138	122	80	63	17	5.6	1.26	0.8	1.58	B
2	4	Chico No.4	1410	456	451	396	740	529	211	118.9	10.58	18.2	0.58	C
3	6	Chico No.2	720	832	827	756	560	452	108	72.9	9.04	10.2	0.89	C
4	8	Chico-Mallig	1990	292	287	236	1669	1371	298	156.6	27.42	29.9	0.92	C
5	10	Matalag	655	74	69	47	454	354	100	40.5	7.08	1.2	5.90	A
6	12	Pinukpuk	856	146	141	106	675	547	128	62.6	10.94	3.6	3.04	A
7	14	Babaca	253	220	215	160	225	187	38	21.3	3.74	2.2	1.70	B
8	15	Bitag	695	53	48	38	497	393	104	34.6	7.86	0.7	11.20	A
9	19	Aggugaddan	441	81	76	52	370	304	66	26.9	6.08	1.0	6.08	A
10	24	Siffu No.1(A)	656	119	114	91	400	302	98	27.9	6.04	1.4	4.31	A
11	24'	Siffu No.1(B)	626	130	125	108	335	241	94	26.6	4.82	1.8	2.68	A
12	25	Siffu No.2	367	253	248	210	243	188	55	17.3	3.76	2.7	1.39	B
13	26	Mallig No.1	436	136	131	101	243	178	65	16.5	3.56	1.5	2.37	B
14	27	Mallig No.2	362	151	146	131	221	167	54	15.4	3.34	0.5	6.68	A
15	28	Ilagan No.1	1350	160	155	137	628	425	203	83.5	8.50	3.6	2.36	B
16	29	Ilagan No.2	876	240	235	178	648	517	131	59.1	10.34	6.6	1.57	B
17	33	Disabungan	652	98	93	72	419	321	98	36.7	6.42	3.4	1.89	B
18	34	Catalangan	235	193	188	155	162	127	35	14.5	2.54	2.5	1.02	C
19	37	Alimit No.1(A)	559	289	284	243	370	286	84	26.4	5.72	4.1	1.40	B
20	41	Matuno No.1	550	530	525	502	157	75	82	36.4	1.50	8.1	0.19	C
21	47	CagayanNo.1	1214	165	160	139	956	774	182	73.9	15.48	1.2	12.90	A
22	48	Cagayan No.2	481	245	240	208	383	311	72	29.3	6.22	3.1	2.01	B
23	49	Casecnan	1150	388	383	310	1039	866	173	76.4	17.32	14.6	1.18	C
24	50	Addalam(A)	864	167	162	137	240	182	58	52.6	3.64	2.9	1.26	B
25	51	Diduyon	477	646	642	619	431	359	72	31.7	7.18	5.3	1.35	B
26	52	Dibuluan	159	369	364	295	134	110	24	9.7	2.20	7.7	0.29	C

NOTES : /1 ; Unit value of irrigation water --- 0.02 US $/cu.m.
/2 ; Class 'A'>=2.4 , 2.4 > Class 'B'>= 1.2 , 1.2 > Class 'C'

Table 1.8 Power Generation Efficiency for Second Screening

	NO.	NAME OF DAM	C.A. (sq.km)	DAM CREST ELEVATION (EL.m)	HWL (EL.m)	LWL (EL.m)	TWL (EL.m)	GROSS STORAGE (Mcm)	ACTIVE STORAGE (Mcm)	SEDIMENT STORAGE (Mcm)	AVERAGE DIS-CHARGE (cms)	GROSS HEAD (Hg) (m)	NET HEAD (He) (m)	ANNUAL ENERGY OUTPUT /3 (Gwh/y)	ENERGY BENEFIT/1 (Milli-on US$ /y)	DAM VOLUME (Mcm)	POWER GENERA-TION EFFICIENCY (US$/y/cu.m)	CLASS /2
1	1	Dummon	112	153	148	138	104	145	63	82	5.6	39.0	35.0	14	0.84	1.4	0.60	C
2	4	Chico No.4	1410	456	451	411	300	740	430	310	118.9	131.0	118.0	1023 (955)	61.38	18.2	3.37	A
3	6	Chico No.2	720	832	827	756	566	560	452	108	72.9	226.0	203.0	1080	64.80	10.2	6.35	A
4	8	Chico-Mallig	1900	305	300	260	180	2120	1262	858	156.8	100.0	90.0	1028	61.68	37.7	1.64	C
5	10	Matalag	655	90	85	72	28	900	354	546	40.5	50.5	45.5	134	8.04	2.2	3.65	A
6	12	Pinukpuk	850	162	157	138	78	1150	547	603	62.6	69.5	62.5	285	17.10	5.6	3.05	B
7	14	Babaca	253	240	235	200	125	340	187	153	21.3	92.5	83.5	130	7.80	3.8	2.05	B
8	15	Bitag	695	60	55	49	28	950	393	557	34.6	24.0	22.0	56	3.36	1.1	3.05	B
9	19	Aggugaddan	441	85	80	65	35	448	252	196	26.9	37.5	33.5	66	3.96	1.2	3.30	A
10	24	Siffu No.1(A)	656	125	120	105	68	540	302	238	27.9	44.5	40.5	82	4.92	1.7	2.89	B
11	24'	Siffu No.1(B)	626	130	125	108	70	335	241	94	26.6	46.5	41.5	81	4.86	1.8	2.70	B
12	25	Siffu NO.2	367	275	270	253	165	480	188	292	17.3	96.5	86.5	109	6.54	4.5	1.45	C
13	26	Mallig No.1	436	150	145	139	78	590	178	412	16.5	64.0	58.0	70	4.20	2.6	1.62	C
14	27	Mallig No.2	362	165	160	152	100	498	167	331	15.4	47.0	42.0	47	2.82	1.0	2.82	B
15	28	Ilagan No.1	1350	160	155	137	96	628	425	203	83.5	50.0	45.0	274	16.44	3.6	4.57	A
16	29	Ilagan No.2	876	265	260	233	158	1125	517	608	59.1	88.5	79.5	343	20.58	10.9	1.89	B
17	33	Disabungan	652	105	100	86	45	606	321	285	36.7	48.0	43.0	115	6.90	4.4	1.57	C
18	34	Catalangan	235	215	210	194	113	320	127	193	14.5	89.0	80.0	85	5.10	4.5	1.13	C
19	37	Alimit No.1(A)	559	315	310	291	193	740	286	454	26.4	107.5	96.5	186	11.16	7.1	1.57	C
20	41	Matuno No.1	550	530	525	502	300	157	75	82	36.4	213.5	192.5	511 (528)	30.66	8.1	3.79	A
21	47	Cagayan No.1	1214	165	160	146	118	956	628	330	73.9	35.0	31.0	167	10.02	1.2	8.35	A
22	48	Cagayan No.2	481	245	240	217	170	383	250	133	29.3	58.5	52.5	112	6.72	3.1	2.17	B
23	49	Casecnan (Conwap)	1150	432	427	398	222	2300	866	1434	76.4	190.0	171.0	953 (917)	85.62	28.9	2.96	B
		(Pantabangan)	-	232	228	216	127	-	-	-	76.4	95.0	85.0	474 (417)				
24	50	Addalam(A)	864	167	162	145	110	240	140	100	52.6	44.0	40.0	154	9.24	2.9	3.19	B
25	51	Diduyon	477	653	648	628	162	579	359	220	31.7	476.0	428.0	990 (957)	59.40	6.2	9.58	A
26	52	Dibuluan	159	385	380	336	150	182	110	72	9.7	208.0	187.0	132	7.92	10.3	0.77	C

NOTES : /1 ; Energy value --- 0.06 US $/kwh
/2 ; Class 'A'>=3.3 , 3.3 > Class 'B'>= 1.7 , 1.7 > Class 'C'
/3 ;( ) means energy value estimated in F/S

Table 1.9 Flood Control Efficiency for Second Screening

	NO.	NAME OF DAM	C.A. (sq.km)	DAM CREST ELEVATION (El..m)	FWL (m)	25-YR PROBABLE RAINFALL (mm)	25-YR FLOOD VOLUME (STORAGE) /1 (Mcm)	REDUCTION OF DIKE VOLUME (Mcm)	REDUCTION OF INUNDATION AREA (ha)	BENEFIT FROM REDUCTION OF DIKE VOLUME /2 (1000US$/y)	BENEFIT FROM REDUCTION OF INUNDATION AREA /3 (1000US$/y)	DAM VOLUME (1000cu.m)	FLOOD CONTROL EFFICIENCY (1) (US$/y/cu.m)	FLOOD CONTROL EFFICIENCY (2) (US$/y/cu.m)	CLASS /4 EF(1) /1	CLASS /5 EF(2) /2
1	1	Dummon	112	127	123	290	23	60	60	9	45	87	0.10	0.52	C	C
2	4	Chico No.4	1410	411	407	290	287	5686	5200	853	3900	1442	0.59	2.70	C	C
3	6	Chico No.2	720	771	767	290	147	4187	2630	628	1973	690	0.91	2.86	C	C
4	8	Chico-Mallig	1990	243	239	290	404	6946	7140	1042	5355	1954	0.53	2.74	C	C
5	10	Matalag	655	54	50	290	133	452	470	68	353	122	0.56	2.89	C	C
6	12	Pinukpuk	856	114	110	290	174	1998	1580	300	1185	269	1.12	4.41	B	B
7	14	Babaca	253	172	168	290	52	616	600	92	450	95	0.97	4.74	C	B
8	15	Bitag	695	45	41	317	155	2387	660	358	495	117	3.06	4.23	A	B
9	19	Aggugaddan	441	60	56	317	98	1574	710	236	533	93	2.54	5.73	A	A
10	24	Siffu No.1(A)	656	101	97	317	146	3440	1780	516	1335	158	3.27	8.45	A	A
11	24'	Siffu NO.1(B)	626	117	113	317	139	3457	1670	519	1253	259	2.00	4.84	B	B
12	25	Siffu No.2	367	224	220	317	82	2031	1110	305	833	253	1.21	3.29	B	B
13	26	Mallig No.1	436	119	115	317	97	2151	1340	323	1005	180	1.79	5.58	B	A
14	27	Mallig No.2	362	138	134	317	81	1762	1110	264	833	71	3.72	11.73	A	A
15	28	Tlagan No.1	1350	147	143	356	337	11350	3680	1703	2760	544	3.13	5.07	A	A
16	29	Tlagan No.2	876	206	202	356	219	7878	2130	1152	1598	570	2.02	2.80	B	C
17	33	Disabungan	652	82	78	356	163	4092	1200	614	900	409	1.50	2.20	B	C
18	34	Catalangan	235	166	162	356	59	1513	300	227	255	260	0.87	0.87	C	C
19	37	Alimit No.1(A)	559	262	258	407	160	3331	2540	500	1905	399	1.25	4.77	B	B
20	41	Matuno No.1	550	529	525	407	157	3316	2540	497	1905	1733	0.29	1.10	C	C
21	47	Cagayan No.1	2364	159	155	411	681	19050	10810	2858	8108	232	12.32	34.95	A	A
22	48	Cagayan No.2	1631	244	240	411	470(383)	9775	5360	1466	4020	717	2.04	5.61	B	A
23	49	Casecnan	1150	336	332	411	331	8636	4210	1295	3158	1098	1.18	2.88	B	C
24	50	Addalam(A)	864	166	162	411	249(240)	6301	2930	945	2198	652	1.45	3.37	B	B
25	51	Diduyon	477	624	620	411	138	4117	1670	618	1253	632	0.98	1.98	C	C
26	52	Dibuluan	159	321	317	411	48	507	540	76	405	555	0.14	0.73	C	C

NOTES : /1 ; Runoff coefficient ...0.70
/2 ; Unit value of dike embankment .....0.15 US $/cu.m./yr
/3 ; Annual flood damage..... 750 US $/ha./yr.
/4 ; Class 'A' >= 2.2, 2.2 > Class 'B' >= 1.1, 1.1 > Class 'C'
/5 ; Class 'A' >= 5, 5 > Class 'B' >= 3, 3 > Class 'C'

Table 1.10 Results of Second Screening

	NO.	NAME OF DAM	C.A. (sq.km)	IRRIGATION EFFICIENCY (US$ /y/cu.m)	CLASS	POWER GENERATION EFFICIENCY (US$ /y/cu.m)	CLASS	FLOOD CONTROL EFFICIENCY (1) (US$ /y/cu.m)	CLASS	FLOOD CONTROL EFFICIENCY (2) (US$ /y/cu.m)	CLASS	COMPENSATION NUMBER OF BUILDINGS IN RESERVOIR	ACCESSIBILITY LENGTH OF ACCESS ROAD (km)	GELOGICAL CONDITION	SELECTED DAMSITE /1	REMARKS
1	1	Dumaon	112	1.58	B	0.60	C	0.10	C	0.52	C	40	18	Conglomerate,Sandstone		Low efficiencies,thought possible for irrigation.
2	4	Chico No.4	1410	0.58	C	3.37	A	0.59	C	2.70	C	390	0	Sandstone,Mudstone	oo	High efficiency for power generation.Topo maps available.
3	6	Chico No.2	720	0.89	C	0.35	A	0.91	C	2.86	C	230	0	Basic volcanics	o	High efficiency for power generation.
4	8	Chico-Mallig	1990	0.92	C	1.64	C	0.53	C	2.74	C	880	0	Sandstone/Shale		Low efficiencies
5	10	Matalag	655	5.90	A	3.65	A	0.58	C	2.89	C	2150	0	Conglomerate,Sandstone		High efficiencies, but difficult due to compensation.
6	12	Pinukpuk	856	3.04	A	3.05	B	1.12	B	4.41	B	1050	0	Conglomerate,Sandstone	o	Effective for each purpose.
7	14	Babaca	253	1.70	B	2.05	B	0.97	C	4.74	B	470	11	Conglomerate,Sandstone		Postponed for future development.
8	15	Bitag	895	11.20	A	3.05	B	3.06	A	4.23	B	3900	0	Sandstone		High efficiencies, but difficult due to compensation.
9	19	Aggugaddan	441	6.08	A	3.30	A	2.54	A	5.73	A	780	13	Limestone weathered		High efficiencies, but foundation consists of weathered limestone,hence more geological survey needed.
10	24	Siffu No.1(A)	656	4.31	A	2.89	B	3.27	A	8.45	A	80	7	Pebble-conglomerate	o	High efficiencies for each purpose.
11	24'	Siffu No.1(B)	626	2.68	A	2.70	B	2.00	B	4.84	B	80	15	Sandstone,Shale		Siffu No.1(B) is discarded in favor of (A) due to lower efficiency.
12	25	Siffu No.2	367	1.39	B	1.45	C	1.21	B	3.29	B	40	40	Volcanic rocks		Postponed for future development.
13	26	Mallig No.1	436	2.37	B	1.62	C	1.79	B	5.58	A	160	8	Conglomerate,Sandstone		Postponed for future development.
14	27	Mallig No.2	362	6.68	A	2.82	B	3.72	A	11.73	A	100	12	Sandstone,Shale	o	High efficiencies for each purpose.
15	28	Ilagan No.1	1350	2.36	B	4.57	A	3.13	A	5.07	A	40	27	Meta-Andesite,Diorite	o	High efficiencies for each purpose.
16	29	Ilagan No.2	878	1.57	B	1.89	B	2.02	B	2.80	C	0	41	Meta-Andesite,Agglomerate		Postponed for future development.
17	33	Disabungan	652	1.89	B	1.57	C	1.50	B	2.20	C	270	5	Granodiorite,Sandstone	o	Flood control will be expected.
18	34	Catalangan	235	1.02	C	1.13	C	0.87	C	0.87	C	20	10	Andesite,Phyoclastics		Low efficiencies.
19	37	Alimit No.1(A)	559	1.40	B	1.57	C	1.25	B	4.77	B	0	25	Andesite,Agglomerate	o	Alternative for irrigation and water supply in case Magat storage is partly allocated for flood control.
20	41	Matuno No.1	550	0.19	C	3.79	A	0.29	C	1.10	C	0	8	Conglomerate	oo	High efficiency for power generation.Topo maps available.
21	47	Cagayan No.1	2364 (1214)	12.90	A	8.35	A	12.32	A	34.95	A	1440	22	Limestone (Callao-)	o	High efficiencies. Compensation problem can probably be settled.
22	48	Cagayan NO.2	1831 (481)	2.01	B	2.17	B	2.04	B	5.61	A	0	50	Limestone (Sicaloo-)	o	High efficiencies. Alternative in case compensation problem in Cagayan No. 1 cannot be settled.
23	49	Casecnan	1150	1.18	C	2.96	B	1.18	B	2.88	C	120	80	Agglomerate	oo	Definite design on-going by NIA. Topo maps available.
24	50	Addalam(A)	864 (387)	1.26	B	3.19	B	1.45	B	3.37	B	0	25	Agglomerate	o	Effective for each purpose.
25	51	Diduyos	477	1.35	B	0.58	A	0.98	C	1.98	C	0	55	Agglomerate,Andesite	oo	High efficiency for power generation.Topo maps available.
26	52	Dibuluan	159	0.29	C	0.77	C	0.14	C	0.73	C	0	28	Metasediments		Low efficiencies.

NOTE : /1 : oo .... Feasibility Study completed.

Table 1.11 Results of Geological Survey

Dam Name	Geology	Geological Age	Strike/Dip	Hardness/Weathering	Fault, Fracture Zone
Pinukpuk	conglomerate, sandstone	Upper Miocene	N30°E/30°SE	soft-partly hard	-
Chico No.4 /1	sandstone,shale, siltstone	Upper Miocene	N60°W/70°NE	hard-medium/moderately weathered (upland)	fault is present at the abutment
Chico No.2 /1	basic volcanics (basalt-spilite, diabase)	Cretaceous-Paleogene	-	generally very hard	-
Siffu No.1	pebble-conglomerate	Pliocene	strike: N-S dip: 30°E	soft/moderately to highly weathered	active structure inferred may be no problem
Mallig No.2	sandstone with conglomerate, mudstone	Upper Miocene	N10°/60°E	soft-medium/moderately weathered	-
Ilagan No.1	meta-ancesite, diorite	Cretaceous-Paleogene	-	very hard-medium/slightly altered	-
Disabungan	sandstone, andesite granodiorite	Cretaceous-Paleogene/Pliocene	almost horizontal (sandstone)	very soft, highly (upland)/hard (river bank)	-
Alimit No.1	agglomerate, andesite	Cretaceous-Paleogene	N50-60°W/50°NE	generally hard/slightly-moderately weathered	-
Matuno No.1 /1	conglomerate, sandstone	Middle Miocene	strike: E-W, dip: 30-40°N	hard/moderately weathered	-
Cagayan No.1	limestone (Callao-)	Upper Miocene	strike: N-S dip: 7-8°W	hard/slightly-moderately with solutive texture	-
Cagayan No.2	limestone (Sicalao-)	Middle Miocene	strike: NE-SW dip: 10°NW	hard-medium/moderately weathered	-
Casecnan /1	agglomerate	Upper Oligocene	strike: NE-SW dip: 20-30°N	hard, massive	sheared zone, consolidated
Addalam	agglomerate	Oligocene	N60°W/10°SW	med.-very hard/slightly-highly weathered (right)	-
Diduyon /1	agglomerate, andesite	Oligocene	N35-50°NE/25-35°E	hard/generally fresh	fault right bank
Dibuluan	metasediments	Cretaceous-Paleogene	strike: NE-SW dip: NW	medium hard/moderately weathered	-

Note; /1: Source, Feasibility or Pre-Feasibility Report of Each Projects

Table 1.12 Proposed Construction Material

(from surface inspection)

Number	Dam Name	Location	Material	Description	Class
1	Pinukpuk	2 km upstream river bed	sand, gravel	including cobble-boulder, hard	A
2	Siffu No. 1(A)	0.8 km downstream both banks	conglomerate sand-stone (preocene) End Teriary	very loose, moderately weathered	B
3	Mallig No. 2	*2.5 km SW right bank	sandstone, mud-stone (End Tertiary)	moderately-highly weathered soft rock	C
		**11 km NW (Chico River Channel)	sand, gravel	including cobble-boulder, hard	A
4	Ilagan No. 1	2 km downstream and 5 km upstream river bed	sand, gravel	including cobble-boulder, hard	A
5	Disabungan	1 km upstream right bank	andesite etc. (metavolcanics) (Not to be specified)	moderately weathered soft rock	B
6	Alimit No. 1(A)	1-2 km upstream right bank	agglomerate (cretaceous)	slightly-moderately weathered	A
7	Cagayan No. 1	3-5 km upstream river bed	sand, gravel	including cobble-boulder, hard	A
8	Cagayan No. 2	0.5-3 km upstream river bed	sand, gravel	including cobble-boulder, hard	A
9	Addalam	4 km SW both banks (upstream)	agglomerate (cretaceous)	slightly-moderately weathered	A

Notes: * and ** means alternative plan each other

Class - A: fresh-moderately weathered hard rock
- B: moderately weathered soft rock
- C: moderately-highly weathered soft rock

Table 1.13 Land Use and Number of Buildings in Reservoir Area

Name of Dam	Elevation (El.m)	Land Use (ha)				No. of Buildings (Nos.)
		Paddy	Agri-culture	Residen-tial	Others /1	
Pinukpuk	70	0	0	0	38	0
	80	8	26	0	336	113
	90	48	164	0	494	225
	100	76	272	0	692	470
	110	76	302	0	1,050	712
	120	76	314	0	1,420	965
	130	76	326	0	1,842	1,215
Siffu No.1	70	0	0	0	50	0
	80	0	30	0	180	25
	90	10	120	0	420	119
	100	40	240	0	700	219
	110	170	400	0	1,070	440
	120	340	590	0	1,610	492
	130	430	690	0	2,270	660
Mallig No.2	110	0	0	0	10	0
	120	0	10	0	70	0
	130	10	60	0	290	84
	140	30	150	0	630	198
	150	100	220	0	1,040	332
	160	140	270	0	1,560	409
	170	190	290	0	2,310	540
Disabungan	60	0	0	0	30	0
	70	0	160	0	210	79
	80	50	320	0	510	311
	90	70	410	0	860	531
	100	90	540	0	1,350	727
	110	100	640	0	2,030	881
Ilagan No.1	110	0	0	0	70	0
	120	0	50	0	250	2
	130	0	130	0	480	90
	140	0	210	0	890	267
	150	0	260	0	1,270	376
	160	0	270	0	1,820	415
	170	0	280	0	2,850	436

(to be continued)

(Continuation)

Name of Dam	Elevation (El.m)	Land Use (ha)				No. of Buildings (Nos.)
		Paddy	Agri-culture	Residen-tial	Others /1	
Addalam /2	120	0	0	0	199	0
	140	0	140	0	325	0
	160	0	320	0	766	0
	180	0	550	0	1,303	0
	200	0	740	0	1,774	0
	220	0	990	0	2,386	0
Cagayan No.1	120	0	0	0	20	0
	130	0	10	0	110	0
	135	0	50	0	300	0
	140	0	340	0	650	4
	145	20	840	10	1,090	230
	150	100	1,180	40	1,840	1,586
	160	240	1,430	60	3,310	3,458
	170	470	1,600	80	4,890	5,282
Cagayan No.2	180	0	0	0	50	0
	190	0	20	0	140	13
	200	0	100	0	290	38
	210	0	130	0	420	92
	220	0	160	0	560	173
	230	0	170	0	820	238
	240	0	180	0	1,220	288
	250	0	190	0	1,500	315
Alimit No.1 /2	200	0	0	0	37	0
	220	0	0	0	166	0
	240	0	0	0	334	0
	260	0	0	0	652	0
	280	10	0	0	1,019	0
	300	50	0	0	1,394	0
	320	116	0	0	2,090	0
	340	186	0	0	2,777	0
	360	271	0	0	3,177	0

Notws; /1: Include forest and grass land
/2: Data source,MAF Region II's investigation.
Other site are estimated on the basis of the topographic map in a scale of 1 to 25,000.

Table 2.1 Results of Screening for Small Dam Project

No.	Name of Dam	River	C.A. (km^2)	Annual Rainfall (mm)	Available Water [1] (MCM)	Riverbed Elevation (El.m)	Possible Max. Elevation (El.m)	Sediment Level (El.m)	HWL (El.m)	Dam Crest (El.m)	Sediment Storage ($10^6 m^3$)	Effect. Storage ($10^6 m^3$)	Gross Storage ($10^6 m^3$)	Dam Height (m)	Dam Volume ($10^6 m^3$)	Storage Efficiency	Selected Damsites	Remarks (Dam height is decided by following limit.)
1	Guising		5.3	2,100	3.74	45	72+	55.5	67	72	0.20	1.10	1.30	30	0.246	4.5		Maximum dam height (30 m).
2	Bulagao		17.3	2,100	12.21	37	60	46.3	55	60	0.65	2.05	2.70	26	0.160	12.8		Topographical condition.
3	San Luis		6.2	2,000	4.17	46	60	50.5	55	60	0.23	0.97	1.20	17	0.117	8.3		Topographical condition.
4	Asassi	Asassi	8.0	2,900	5.85	19	46+	22.8	41	46	0.22	4.68	4.90	30	0.504	9.3		Maximum dam height (30 m).
5	Nahialan	Afusing	6.7	2,000	4.50	37	50	41.5	45	50	0.25	0.95	1.20	16	0.137	6.9		Topographical condition.
6	Magogod		11.4	3,000	11.49	28	55+	35.0	50	55	0.43	2.87	3.30	30	0.332	8.6		Maximum dam height (30 m).
7	Manalo		26.9	2,900	26.21	25	52+	45.5	47	52	1.01	0.19	1.20	30	0.164	1.2		Maximum dam height (30 m).
8	Marohhod		21.0	2,800	19.76	25	52+	32.0	47	52	0.79	5.81	6.60	30	0.619	9.4		Maximum dam height (30 m).
9	Sta. Barbara		22.1	2,800	20.79	26	53+	38.6	48	53	0.83	2.17	3.00	30	0.281	7.7		Maximum dam height (30 m).
10	Bayo		7.5	2,600	6.55	27	50	33.0	45	50	0.28	2.72	3.00	26	0.295	9.2		Topographical condition.
11	San Juan		3.8	2,000	2.55	76	100	81.0	90	95	0.14	2.55	2.69	22	0.250	10.3		Hydrological condition.
12	Liwan Norte		6.0	2,000	4.03	59	70	61.5	65	70	0.23	0.57	0.80	14	0.025	22.6	*	Topographical condition.
13	Kinama		8.1	2,000	5.94	79	106+	87.5	101	106	0.30	1.80	2.10	30	0.187	9.6		Maximum dam height (30 m).
14	Liwan West		5.1	2,000	3.43	99	126+	106.1	121	126	0.19	1.91	2.10	30	0.276	6.9		Maximum dam height (30 m).
15	Santor		11.3	2,000	7.56	80	100	85.3	95	100	0.42	4.88	5.30	23	0.163	29.9	*	Topographical condition.
16	Maglatac 1	Paculagu	76.3	2,000	51.27	56	83+	70	78	83	2.86	6.84	9.70	30	0.263	26.0	*	Maximum dam height (30 m).
17	Maglatac 2	Paculagu	51.2	2,000	34.41	75	102+	87.5	97	102	1.92	8.08	10.00	30	0.386	20.9		Maximum dam height (30 m).
18	Minagbag		8.9	2,000	5.98	120	140	129.4	135	140	0.33	0.77	1.10	23	0.270	2.9		Topographical condition.
19	Laguinday		15.9	2,000	10.68	90	117+	98.0	112	117	0.60	6.40	7.00	30	0.596	10.7		Maximum dam height (30 m).
20	Bubug		4.9	2,000	3.29	68	95+	75.3	90	95	0.18	3.29	3.47	30	0.430	7.7		Max. dam height & hydro. condition.
21	San Vicente		11.6	2,300	8.96	40	67+	47.0	62	67	0.44	8.16	8.60	30	0.774	10.5		Maximum dam height (30 m).
22	Sto. Rosario		5.8	2,000	3.90	65	90	69.5	81	86	0.22	3.90	4.12	24	0.394	9.9		Hydrological condition.
23	Maui		4.2	2,000	2.82	78	100	80.3	95	100	0.16	2.82	2.98	25	0.250	11.3		Topo. & hydrological condition.
24	Carmencita	Calinauan	5.0	2,000	3.36	85	110	92.0	105	110	0.19	3.36	3.55	28	0.500	6.7		Topo. & hydrological condition.
25	Miguel		3.1	2,000	2.08	50	70	54.0	65	70	0.12	2.08	2.20	23	0.334	6.6		Topo. & hydrological condition.
26	Mangga		14.3	2,000	9.61	90	100	93.6	95	100	0.54	0.46	1.00	13	0.090	5.1		Topographical condition.
27	Malalao		8.8	2,000	5.91	117	144+	123.5	139	144	0.33	3.47	3.80	30	0.228	15.2		Maximum dam height (30 m).
28	Turod		33.0	2,000	22.18	73	100+	82.0	95	100	1.24	6.96	8.20	30	0.423	16.5		Maximum dam height (30 m).
29	Rang-ayan 1		15.1	2,000	10.15	77	104+	92.0	99	104	0.57	0.73	1.30	30	0.117	6.2		Maximum dam height (30 m).
30	Rang-ayan 2		9.7	2,000	6.52	135	162+	146.5	157	162	0.36	2.14	2.50	30	0.151	14.2		Maximum dam height (30 m).
31	Sinamar		5.1	2,000	3.43	90	117+	95.0	112	117	0.19	2.61	2.80	30	0.445	5.9		Maximum dam height (30 m).
32	San Rafael	Cabanayan	6.0	2,000	4.03	88	115+	97.2	110	115	0.23	1.17	1.40	30	0.377	3.1		Maximum dam height (30 m).
33	Matusalem	Barambam	20.2	2,000	13.57	88	115+	96.8	110	115	0.76	5.44	6.20	30	0.274	19.9		Maximum dam height (30 m).
34	Eden		13.5	2,000	9.07	95	122+	106.3	117	122	0.51	3.79	4.30	30	0.176	21.5		Maximum dam height (30 m).
35	Mapapi	Mapapi	12.8	2,000	8.60	95	122+	103.0	117	122	0.48	5.72	6.20	30	0.304	18.8		Maximum dam height (30 m).
36	Mangcuram	Manga	10.3	2,000	6.92	36	50	41.0	45	50	0.39	1.61	2.00	15	0.116	13.9		Topographical condition.
37	Pasa		17.9	2,900	17.44	90	117+	104.5	112	117	0.67	1.13	1.80	30	0.222	5.1		Maximum dam height (30 m).
38	Fuyo		6.0	2,700	5.44	66	90	71.0	84	89	0.23	5.44	5.67	26	0.507	10.7		Hydrological condition.
39	Yaban		10.7	2,300	8.27	47	70	52.0	64	69	0.40	8.27	8.67	25	0.424	19.5		Hydrological condition.
40	San Francisco		11.4	2,600	9.96	65	80	68.0	75	80	0.43	6.07	6.50	18	0.126	48.2	*	Topographical condition.
41	Songsong		14.8	2,700	10.44	30	50	39.1	45	50	0.56	2.54	3.10	23	0.113	22.5		Topographical condition.
42	Guihang		20.8	2,100	14.68	38	60	45.0	55	60	0.78	10.02	10.80	25	0.510	19.6		Topographical condition.
43	Bagong		22.9	2,000	15.39	45	60	51.1	55	60	0.86	2.84	3.70	18	0.103	27.6	*	Topographical condition.
44	Sta. Maria		30.6	2,300	23.65	55	80	60.0	74	79	1.15	23.65	24.80	27	0.267	88.6	*	Hydrological condition.
45	Calaocan	Madalen	26.8	2,200	19.81	62	90	68.0	79	84	1.01	19.81	20.82	25	0.273	72.6	*	Hydrological condition.
46	Bannawag		34.3	2,100	24.20	57	70	63.4	65	70	1.29	0.81	2.10	16	0.058	14.0		Topographical condition.
47	Linglingay		15.6	2,000	10.48	55	70	57.5	65	70	0.59	6.11	6.70	18	0.116	52.7	*	Topographical condition.
48	Colorado	Sinalugan	63.9	2,100	45.09	60	87+	67.0	82	87	2.40	45.09	47.49	30	0.505	89.3	*	Max. dam height & hydro. condition.
49	Lourdes	Sto. Nino	12.7	2,000	8.53	49	60	52.7	55	60	0.48	0.62	1.10	14	0.040	15.5		Topographical condition.
50	Salvacion	Macaluat	54.1	2,000	36.36	67	80	77.6	75	80	2.03	0						No effective storage
51	San Felipe		11.9	2,000	8.00	79	90	82.8	85	90	0.45	0.95	1.40	14	0.082	11.6		Topographical condition.
52	Bacradal		14.8	2,000	9.95	65	80	71.0	75	80	0.56	2.04	2.60	18	0.112	18.2		Topographical condition.
53	San Sebastian		9.0	2,000	6.05	85	100	89.0	95	100	0.34	2.46	2.80	18	0.139	18.9		Topographical condition.
54	Bello	Diarao	42.5	2,200	31.42	118	145+	127.0	140	145	1.59	12.71	14.30	30	0.303	42.0	*	Maximum dam height (30 m).
55	Fermin		4.4	2,000	2.96	87	100	90.8	95	100	0.17	1.33	1.50	16	0.094	14.1		Topographical condition.
56	San Marcos		13.2	2,000	8.87	88	115+	97.3	110	115	0.50	4.30	4.80	30	0.199	21.6		Maximum dam height (30 m).

Notes: [1] ; Potential water to be stored.

Table 2.2 Results of Screening for Pond Scheme

Item		Pond 1 (Carmencita)	Pond 2	Pond 3	Pond 4
Catchment Area, at Intake	(km^2)	16.0	4.2	2.9	2.4
at Pond	(km^2)	0.8	0.4	0.3	0.7
Annual Rainfall	(mm)	2,000	2,000	2,000	2,000
Potential Water to be stored	(10^6m^3)	11.29	3.09	2.15	2.08
Ground Elevation	(El.m)	45	55	75	82
Possible Maximum Elevation	(El.m)	60	70	90	100
Sediment Level	(El.m)	48	58	80	85
HWL.	(El.m)	57	67	87	97
Dam Crest	(El.m)	60	70	90	100
Sediment Storage Volume	(10^6m^3)	0.06	0.03	0.02	0.04
Effective Storage Volume	(10^6m^3)	1.34	0.51	0.35	0.84
Gross Storage Volume	(10^6m^3)	1.40	0.54	0.37	0.88
Dam Height	(m)	18	18	18	21
Dam Volume	(10^6m^3)	0.117	0.085	0.072	0.125
Length of Intake Channel	(m)	900	500	800	1,200
Storage Efficiency (1)		11.5	6.0	4.9	6.7
Storage Efficiency (2)		1,490	1,020	440	700
Selected Pond		*			

Table 2.3 Priority Ranking for Porposed Small Dam

Name of Sites	With Irrigation Development				Without Irrigation Development			
	Net Present Value/1 (₱x10^6)	Benefit Cost Ratio	EIRR (%)	Priority Ranking	Net Present Value/1 (₱x10^6)	Benefit Cost Ratio	EIRR (%)	Priority Ranking
Liwan Norte	4.3	1.11	11.8	2	7.6	1.22	13.8	3
Santor	13.6	1.17	12.6	1	18.7	1.35	16.5	1
Maglatac 1	-24.4	0.81	7.1	7	4.7	1.07	11.1	5
San Francisco	0.4	1.01	10.1	5	-2.5	0.89	8.1	6
Bagong	-0.7	0.99	9.8	6	7.7	1.22	14.0	2
Linglingay	3.6	1.07	11.1	3	4.7	1.12	12.5	4
Bello	5.8	1.06	10.8	4	-9.9	0.70	5.1	7
Carmencita Pond	0.7	1.02	10.3		9.9	1.44	18.6	

Note: /1; Discount Rate ... 10% per annum

Table 4.1 Unit Price for Dam Construction

(Unit: Pesos)

Item	Unit	F.C.	L.C.	Total
New road	km	825,000	675,000	1,500,000
Road improvement	km	165,000	135,000	300,000
Bridge	m	22,500	27,500	50,000
Excavation, common	m^3	35	30	65
rock	m^3	120	90	210
tunnel	m^3	740	300	1,040
shaft	m^3	820	320	1,140
Embankment, core & earth	m^3	65	45	110
filter	m^3	95	75	170
rock	m^3	110	80	190
riprap	m^3	160	120	280
Concrete, dam	m^3	820	600	1,420
spillway & tailrace	m^3	910	890	1,800
powerhouse	m^3	950	950	1,900
tunnel	m^3	1,080	1,010	2,090
plug & anchor block	m^3	870	840	1,710
other structure	m^3	1,010	990	2,000
Grout, curtain	m	1,310	590	1,900
blanket or consoli.	m	910	510	1,420
Reinforcement bar	ton	10,450	4,750	15,200
Steel support	ton	12,350	8,550	20,900
Metal works, valve	ton	188,100	20,900	209,000
intake gate	ton	116,280	12,920	129,200
other gate	ton	109,440	12,160	121,600
trash rack	ton	76,950	8,550	85,500
penstock	ton	68,400	7,600	76,000

Table 5.1 Allocated Dam Cost and Total Cost

(Unit: ₱ x 10^6)

Item	Dummon	Paranan	Zinundungan	Mallig No.2	Siffu No.1	Alimit No.1	Matuno No.1
I. Allocated Dam Cost							
Irrigation	354.56	355.46	226.13	1,188.68	-	-	578.28
Hydropower	35.49	47.10	83.64	-	245.06	589.12	2,023.20
Flood Control	-	-	-	388.48	304.15	978.22	-
Water Supply	-	-	-	-	-	80.47	53.68
Irrigation /1	-	-	-	-	286.05	137.70	239.12
Water Supply /1	-	-	-	-	109.56	51.86	92.72
Sub-Total of I	390.05	402.56	309.77	1,577.16	944.82	1,837.37	2,987.00
II. Specific Cost							
Irrigation	34.37	26.41	66.59	2,138.09	-	-	783.07
Hydropower	24.96	22.01	41.70	-	112.41	199.73	2,085.00
Sub-Total of II	59.33	48.42	108.29	2,138.09	112.41	199.73	2,868.07
III. Total	449.38	450.98	418.06	3,715.25	1,057.23	2,037.10	5,855.07

Note: /1 ; Supplement of Magat dam

Table 5.2 Principal Features of Siffu No. 1 Dam

Purpose	Flood Control, Hydropower and Supplemental water Supply of Magat Dam
Catchment area (km^2)	656
River name	Siffu
Reservoir	
Flood water level (EL. m)	115.5
Surcharge water level (EL. m)	113.0
High water level (EL. m)	106.0
Low water level (EL. m)	97.0
Gross storage (10^6 m^3)	314
Storage for water utility (10^6 m^3)	93
Storage for flood control (10^6 m^3)	115
Reservoir area at SWL (km^2)	19.0
Dam	
Type	Earthfill
Crest elevation (EL. m)	118
Crest length (m)	240
Crest width (m)	12
Height (m)	58
Upstream slope	1:3.9
Downstream slope	1:2.7
Embankment volume (m^3)	1,659,500
Spillway	
Type	Gated open chuteway
Design flood (m^3/s)	3,000
Gate width (m)	9.4
Gate height (m)	11.7
Gate units (nos)	3
Crest elevation (EL. m)	101.3
Crest width (m)	28.2
Energy dissipator	Stilling basin
Diversion	
Type	Tunnel
Design flood (m^3/s)	1,300
Tunnel diameter (m)	5.6
Tunnel length (m)	500
Number of tunnel (lanes)	2
Waterway	
Maximum discharge (m^3/s)	19.9
Intake sill elevation (EL. m)	93.5
Length of Waterway (m)	350
Power and Energy	
Maximum plant discharge (m^3/s)	19.9
Maximum gross head (m)	40.0
Rated head (m)	32.0
Installed capacity (kW)	5,400
Annual energy (GWh)	41.1

Table 5.3 Project Cost of Siffu No. 1 Dam

Work Item	Unit	Work Quantity	Foreign Portion		Local Portion		Total Amount (Mil.P)
			Unit Price (Pesos)	Amount (Mil.P)	Unit Price (Pesos)	Amount (Mil.P)	
I. PREPARATORY WORKS							
Access road (New)	km	1	825,000	0.83	675,000	0.68	1.50
Improvement of existing road	km	6	165,000	0.99	135,000	0.81	1.80
Bridge	m	20	22,500	0.45	27,500	0.55	1.00
Work shops, offices and quarters	L.S.			28.32		19.97	48.29
Total of I				**30.59**		**22.00**	**52.59**
II. CIVIL WORKS							
2.1 **River Diversion Works**							
Excavation (common)	m3	12,000	35	0.42	30	0.36	0.78
Excavation (rock)	m3	48,000	120	5.76	90	4.32	10.08
Excavation (tunnel)	m3	39,100	740	26.93	300	11.73	40.66
Concrete (inlet and outlet)	m3	660	1,010	0.67	990	0.65	1.32
Concrete (tunnel lining)	m3	14,500	1,080	15.66	1,010	14.65	30.31
Concrete (plug)	m3	1,440	870	1.25	840	1.21	2.46
Steel support	ton	286	12,350	3.53	8,550	2.45	5.98
Reinforcement steel bar	ton	751	10,450	7.85	4,750	3.57	11.42
Consolidation grout	m	7,000	910	6.37	510	3.57	9.94
Cofferdam	m3	4,000	110	0.44	80	0.32	0.76
Others	L.S.			7.09		4.28	11.37
Sub-Total of 2.1				77.97		47.10	125.07
2.2 **Dam**							
Excavation (common)	m3	133,000	35	4.66	30	3.99	8.65
Excavation (rock)	m3	54,000	120	6.48	90	4.86	11.34
Embankment (filter)	m3	27,500	95	2.61	75	2.06	4.68
Embankment (earth)	m3	1,555,000	65	101.08	45	69.98	171.05
Embankment (riprap)	m3	77,000	160	12.32	120	9.24	21.56
Curtain grout	m	13,400	1,310	17.55	590	7.91	25.46
Blanket or consolidation grout	m	3,900	910	3.55	510	1.99	5.54
Others	L.S.			14.82		10.00	24.83
Sub-Total of 2.2				163.07		110.02	273.09
2.3 **Spillway**							
Excavation (Common)	m3	83,700	35	2.93	30	2.51	5.44
Excavation (rock)	m3	334,700	120	40.16	90	30.12	70.29
Concrete	m3	44,000	910	40.04	890	39.16	79.20
Reinforcement steel bar	ton	880	10,450	9.20	4,750	4.18	13.38
Others	L.S.			9.23		7.60	16.83
Sub-Total of 2.3				101.56		83.57	185.13
2.4 **Waterway**							
Excavation (common)	m3	200	35	0.01	30	0.01	0.01
Excavation (rock)	m3	900	120	0.11	90	0.08	0.19
Excavation (tunnel)	m3	1,000	740	0.74	300	0.30	1.04
Excavation (shaft)	m3	260	820	0.21	320	0.08	0.30
Concrete (intake)	m3	70	1,010	0.07	990	0.07	0.14
Concrete (tunnel lining)	m3	460	1,080	0.50	1,010	0.46	0.96
Steel support	ton	9	12,350	0.11	8,550	0.08	0.19
Reinforcement steel bar	ton	9	10,450	0.09	4,750	0.04	0.14
Others	L.S.			0.18		0.11	0.30
Sub-Total of 2.4				2.02		1.24	3.26
2.5 **Powerhouse**							
Excavation (common)	m3	700	35	0.02	30	0.02	0.05
Excavation (rock)	m3	2,900	120	0.35	90	0.26	0.61
Concrete	m3	1,010	950	0.96	950	0.96	1.92
Reinforcement steel bar	ton	53	10,450	0.55	4,750	0.25	0.81
Architectual works	m3	2,800	1,990	5.57	1,620	4.54	10.11
Utility works	L.S.			1.11		0.91	2.02
Others	L.S.			0.88		0.69	1.55
Sub-Total of 2.5				9.43		7.63	17.06
Total of II				**354.08**		**249.57**	**503.62**
III. METAL WORKS							
Diversion closure gate	ton	70	109,440	7.66	12,160	0.85	8.51
Steel conduit	ton	71	68,400	4.86	7,600	0.54	5.40
Guard valve	ton	6	188,100	1.13	20,900	0.13	1.25
Outlet valve	ton	10	188,100	1.88	20,900	0.21	2.09
Spillway gate	ton	288	109,440	31.52	12,160	3.50	35.02
Intake gate	ton	9	116,280	1.05	12,920	0.12	1.16
Intake trashracks	ton	9	76,950	0.69	8,550	0.08	0.77
Penstock	ton	28	68,400	1.92	7,600	0.21	2.13
Draft tube gate	ton	6	109,440	0.66	12,160	0.07	0.73
Total of III				**51.38**		**5.71**	**57.06**
IV. ELECTRICAL WORKS							
Generating Equipment	L.S.			47.85		5.32	53.17
Transmission line	km	7	171,000	1.20	266,000	1.86	3.06
Sub-station	L.S.			4.18		0.95	5.13
Total of IV				**53.23**		**8.13**	**61.36**
Total of I to IV				**489.23**		**285.40**	**774.64**
V. COMPENSATION				0.00		28.50	28.50
VI. ENGINEERING SERVICE				61.97		15.49	77.46
VII. GOVERNMENT ADMINISTRATION				0.00		38.73	38.73
VIII. PHYSICAL CONTINGENCY				82.68		55.22	137.90
GRAND TOTAL (FINANCIAL)				**633.88**		**423.36**	**1,057.23**
GRAND TOTAL (ECONOMIC)				**633.88**		**337.06**	**970.94**

Table 5.4 Principal Features of Mallig No. 2 Dam

Purpose	Irrigation and Flood control
Catchment area (km^2)	362 at damsite and 1,951 at Chico river intake weir site
River name	Mallig
Reservoir	
Flood water level (EL. m)	185.5
Surcharge water level (EL. m)	183
High water level (EL. m)	180
Low water level (EL. m)	160
Gross storage (10^6 m^3)	1,037
Storage for water utility (10^6 m^3)	545
Storage for flood control (10^6 m^3)	112
Reservoir area at SWL (km^2)	41
Dam	
Type	Rockfill
Crest elevation (EL. m)	188
Crest length (m)	300
Crest width (m)	12
Height (m)	84
Upstream slope	1:2.9
Downstream slope	1:2.0
Embankment volume (m^3)	2,365,000
Spillway	
Type	Gated open chuteway
Design flood (m^3/s)	1,680
Gate width (m)	7.2
Gate height (m)	9.0
Gate units (nos)	3
Crest elevation (EL. m)	174
Crest width (m)	21.6
Energy dissipator	Stilling basin
Diversion	
Type	Tunnel
Design flood (m^3/s)	800
Tunnel diameter (m)	4.4
Tunnel length (m)	650
Number of tunnel (lanes)	2
Waterway	
Maximum discharge (m^3/s)	61
Intake sill elevation (EL. m)	150
Length of Waterway (m)	270
Transbasin basin (from Chico river to Mallig No. 2 dam)	
Type	Open channel and tunnel
Design discharge (m^3/s)	30
Tunnel diameter (m)	4.0
Tunnel length (m)	4,000
Channel length (m)	1,600

Table 5.5 Project Cost of Mallig No. 2 Dam

Work Item	Unit	Work Quantity	Foreign Portion Unit Price (Pesos)	Foreign Portion Amount (Mil.P)	Local Portion Unit Price (Pesos)	Local Portion Amount (Mil.P)	Total Amount (Mil.P)
I. PREPARATORY WORKS							
Access road (New)	km	11	825,000	9.08	675,000	7.43	16.51
Improvement of existing road	km	4	165,000	0.66	135,000	0.54	1.20
Bridge	m	20	22,500	0.45	27,500	0.55	1.00
Work shops, offices and quarters	L.S.			46.90		32.26	79.16
Total of I				**57.09**		**40.78**	**97.87**
II. CIVIL WORKS							
2.1 **River Diversion Works**							
Excavation (common)	m3	2,700	35	0.09	30	0.08	0.17
Excavation (rock)	m3	10,600	120	1.27	90	0.95	2.22
Excavation (tunnel)	m3	33,500	740	24.79	300	10.05	34.84
Concrete (inlet and outlet)	m3	320	1,010	0.32	990	0.32	0.64
Concrete (tunnel lining)	m3	13,700	1,080	14.80	1,010	13.84	28.64
Concrete (plug)	m3	1,300	870	1.13	840	1.09	2.22
Steel support	ton	260	12,350	3.21	8,550	2.22	5.43
Reinforcement steel bar	ton	700	10,450	7.32	4,750	3.33	10.65
Consolidation grout	m	7,200	910	6.55	510	3.67	10.22
Cofferdam	m3	9,200	110	1.01	80	0.74	1.75
Others	L.S.			6.05		3.63	9.68
Sub-Total of 2.1				66.54		39.92	106.46
2.2 **Dam**							
Excavation (common)	m3	79,500	35	2.78	30	2.39	5.17
Excavation (rock)	m3	56,600	120	6.78	90	5.09	11.87
Embankment (core)	m3	310,000	65	20.15	45	13.95	34.10
Embankment (filter)	m3	165,000	95	15.68	75	12.38	28.06
Embankment (rock)	m3	1,890,000	110	207.90	80	151.20	359.10
Curtain grout	m	17,500	1,310	22.93	590	10.33	33.26
Blanket or consolidation grout	m	4,450	910	4.05	510	2.27	6.32
Others	L.S.			28.03		19.76	47.79
Sub-Total of 2.2				308.30		217.37	525.67
2.3 **Spillway**							
Excavation (Common)	m3	52,700	35	1.84	30	1.58	3.42
Excavation (rock)	m3	210,700	120	25.28	90	18.96	44.24
Concrete	m3	38,600	910	35.13	890	34.35	69.48
Reinforcement steel bar	ton	772	10,450	8.07	4,750	3.67	11.74
Others	L.S.			7.03		5.86	12.89
Sub-Total of 2.3				77.35		64.42	141.77
2.4 **Waterway**							
Excavation (common)	m3	11,600	35	0.41	30	0.35	0.76
Excavation (rock)	m3	32,400	120	3.89	90	2.92	6.81
Excavation (tunnel)	m3	89,000	740	65.86	300	26.70	92.56
Concrete (intake)	m3	4,120	1,010	4.16	990	4.08	8.24
Concrete (tunnel lining)	m3	31,000	1,080	33.48	1,010	31.31	64.79
Steel support	ton	748	12,350	9.24	8,550	6.40	15.64
Reinforcement steel bar	ton	325	10,450	3.40	4,750	1.54	4.94
Consolidation grout	m	1,600	910	1.46	510	0.82	2.28
Others	L.S.			12.19		7.41	19.60
Sub-Total of 2.4				134.09		81.53	215.62
Total of II				**586.28**		**403.24**	**989.52**
III. METAL WORKS							
Diversion closure gate	ton	73	109,440	7.99	12,160	0.89	8.88
Steel conduit	ton	12	68,400	0.82	7,600	0.09	0.91
Guard valve	ton	44	188,100	8.28	20,900	0.92	9.20
Outlet valve	ton	68	188,100	12.79	20,900	1.42	14.21
Spillway gate	ton	142	109,440	15.54	12,160	1.73	17.27
Intake gate	ton	65	116,280	7.56	12,920	0.84	8.40
Intake trashracks	ton	28	76,950	2.15	8,550	0.24	2.39
Total of III				**55.13**		**6.13**	**61.26**
Total of I to III				**698.50**		**450.15**	**1,148.65**
V. COMPENSATION				0.00		50.50	50.50
VI. ENGINEERING SERVICE				91.89		22.97	114.86
VII. GOVERNMENT ADMINISTRATION				0.00		57.43	57.43
VIII. PHYSICAL CONTINGENCY				118.56		87.16	205.72
GRAND TOTAL (FINANCIAL)				**908.95**		**668.21**	**1,577.16**
GRAND TOTAL (ECONOMIC)				**908.95**		**532.46**	**1,441.41**

Table 5.6 Principal Features of Alimit No. 1 Dam

Purpose	Compensation for Flood control by Magat dam, Hydropower and Supplemental water supply of Magat dam
Catchment area (km^2)	559
River name	Alimit
Reservoir	
Flood water level (EL. m)	279
High water level (EL. m)	271
Low water level (EL. m)	246
Gross storage (10^6 m^3)	254
Storage for water utility (10^6 m^3)	156
Reservoir area at HWL (km^2)	8.4
Dam	
Type	Concrete gravity
Crest elevation (EL. m)	281
Crest length (m)	430
Crest width (m)	8
Height (m)	89
Upstream slope	1:0.1
Downstream slope	1:0.8
Embankment volume (m^3)	647,000
Spillway	
Type	Non-gated open chuteway
Design flood (m^3/s)	2,000
Crest elevation (EL. m)	271
Crest width (m)	44
Energy dissipator	Stilling basin
Diversion	
Type	Tunnel
Design flood (m^3/s)	450
Tunnel diameter (m)	5.4
Tunnel length (m)	630
Number of tunnel (lanes)	1
Waterway	
Maximum discharge (m^3/s)	26.0
Intake sill elevation (EL. m)	240
Length of Waterway (m)	130
Power and Energy	
Maximum plant discharge (m^3/s)	26.0
Maximum gross head (m)	75.0
Rated head (m)	56.3
Installed capacity (kW)	12,200
Annual energy (GWh)	80.6

Table 5.7 Project Cost of Alimit No. 1 Dam

Work Item	Unit	Work Quantity	Foreign Portion		Local Portion		Total Amount (Mil.P)
			Unit Price (Pesos)	Amount (Mil.P)	Unit Price (Pesos)	Amount (Mil.P)	
I. PREPARATORY WORKS							
Access road (New)	km	30	825,000	24.75	675,000	20.25	45.00
Bridge	m	50	22,500	1.13	27,500	1.38	2.51
Work shops, offices and quarters	L.S.			58.95		42.31	101.26
Total of I				**84.83**		**63.94**	**148.77**
II. CIVIL WORKS							
2.1 River Diversion Works							
Excavation (common)	m3	1,800	35	0.06	30	0.05	0.11
Excavation (rock)	m3	7,200	120	0.86	90	0.65	1.51
Excavation (tunnel)	m3	23,100	740	17.09	300	6.93	24.02
Concrete (inlet and outlet)	m3	300	1,010	0.30	990	0.30	0.60
Concrete (tunnel lining)	m3	8,670	1,080	9.36	1,010	8.76	18.12
Concrete (plug)	m3	1,200	870	1.04	840	1.01	2.05
Steel support	ton	171	12,350	2.11	8,550	1.46	3.57
Reinforcement steel bar	ton	446	10,450	4.66	4,750	2.12	6.78
Consolidation grout	m	4,280	910	3.89	510	2.18	6.07
Cofferdam	m3	68,500	110	7.54	80	5.48	13.02
Others	L.S.			4.69		2.89	7.58
Sub-Total of 2.1				51.60		31.83	83.43
2.2 Dam							
Excavation (common)	m3	20,500	35	0.72	30	0.62	1.34
Excavation (rock)	m3	60,000	120	7.20	90	5.40	12.60
Concrete	m3	647,000	820	530.54	600	388.20	918.74
Curtain grout	m	26,300	1,310	34.45	590	15.52	49.97
Blanket or consolidation grout	m	5,300	910	4.82	510	2.70	7.52
Others	L.S.			57.77		41.24	99.01
Sub-Total of 2.2				635.50		453.68	1,089.18
2.3 Spillway							
Excavation (Common)	m3	5,400	35	0.19	30	0.16	0.35
Excavation (rock)	m3	21,800	120	2.62	90	1.96	4.58
Concrete	m3	25,700	910	23.39	890	22.87	46.26
Reinforcement steel bar	ton	257	10,450	2.69	4,750	1.22	3.91
Others	L.S.			2.89		2.62	5.51
Sub-Total of 2.3				31.78		28.83	60.61
2.4 Waterway							
Concrete (intake)	m3	1,200	1,010	1.21	990	1.19	2.40
Reinforcement steel bar	ton	60	10,450	0.63	4,750	0.29	0.92
Others	L.S.			0.18		0.15	0.33
Sub-Total of 2.4				2.02		1.63	3.65
2.5 Powerhouse							
Excavation (common)	m3	1,900	35	0.07	30	0.06	0.13
Excavation (rock)	m3	7,800	120	0.94	90	0.70	1.64
Concrete	m3	2,700	950	2.57	950	2.57	5.14
Reinforcement steel bar	ton	140	10,450	1.46	4,750	0.67	2.13
Archtectual works	m3	3,950	1,990	7.86	1,620	6.40	14.26
Utility works	L.S.			1.57		1.28	2.85
Others	L.S.			1.45		1.17	2.62
Sub-Total of 2.5				15.92		12.85	28.77
Total of II				**736.82**		**528.82**	**1,265.64**
III. METAL WORKS							
Diversion closure gate	ton	59	109,440	6.46	12,160	0.72	7.18
Intake gate	ton	18	116,280	2.09	12,920	0.23	2.32
Intake trashracks	ton	12	76,950	0.92	8,550	0.10	1.02
Penstock	ton	130	68,400	8.89	7,600	0.99	9.88
Draft tube gate	ton	7	109,440	0.77	12,160	0.09	0.86
Total of III				**19.13**		**2.13**	**21.26**
IV. ELECTRICAL WORKS							
Generating Equipment	L.S.			72.05		9.01	81.06
Transmission line	km	36	171,000	6.16	266,000	9.58	15.74
Sub-station	L.S.			4.18		0.95	5.13
Total of IV				**82.39**		**19.54**	**101.93**
Total of I to IV				**923.17**		**614.43**	**1,537.60**
V. COMPENSATION				0.00		3.15	3.15
VI. ENGINEERING SERVICE				123.01		30.75	153.76
VII. GOVERNMENT ADMINISTRATION				0.00		76.88	76.88
VIII. PHYSICAL CONTINGENCY				156.93		108.78	265.71
GRAND TOTAL (FINANCIAL)				**1,203.11**		**833.99**	**2,037.10**
GRAND TOTAL (ECONOMIC)				**1,203.11**		**680.90**	**1,884.01**

Table 5.8 Principal Features of Santo Niño Dam

Purpose	Irrigation
Catchment area (km^2)	13.9
Reservoir	
Flood water level (EL. m)	148
High water level (EL. m)	145
Low water level (EL. m)	142
Gross storage (10^6 m^3)	4.6
Storage for water utility (10^6 m^3)	2.0
Reservoir area at HWL (km^2)	0.77
Dam	
Type	Earthfill
Crest elevation (EL. m)	150
Crest length (m)	450
Crest width (m)	8
Height (m)	18
Upstream slope	1:4.0
Downstream slope	1:3.0
Embankment volume (m^3)	145,100
Spillway	
Type	Non-gated open chuteway
Design flood (m^3/s)	210
Crest elevation (EL. m)	145
Crest width (m)	21
Energy dissipator	Stilling basin
Diversion	
Type	Open channel
Design flood (m^3/s)	120
Channel length (m)	130
Waterway	
Maximum discharge (m^3/s)	0.8
Intake sill elevation (EL. m)	140
Length of Waterway (m)	10

Table 5.9 Project Cost of Santo Niño Dam

Work Item	Unit	Work Quantity	Foreign Portion		Local Portion		Total Amount (Mil.P)
			Unit Price (Pesos)	Amount (Mil.P)	Unit Price (Pesos)	Amount (Mil.P)	
I. PREPARATORY WORKS							
Access road (New)	km	1	350,000	0.35	300,000	0.30	0.65
Work shops, offices and quarters	L.S.			0.74		0.57	1.31
Total of I				**1.09**		**0.87**	**1.96**
II. CIVIL WORKS							
2.2 **Dam**							
Excavation (common)	m3	14,500	15	0.22	15	0.22	0.44
Embankment (filter)	m3	3,600	65	0.23	55	0.20	0.43
Embankment (earth)	m3	123,400	30	3.70	20	2.47	6.17
Embankment (riprap)	m3	18,100	90	1.63	90	1.63	3.26
Others	L.S.			0.58		0.45	1.03
Sub-Total of 2.2				6.36		4.96	11.32
2.3 **Spillway**							
Excavation (Common)	m3	2,400	15	0.04	15	0.04	0.07
Excavation (rock)	m3	9,500	60	0.57	40	0.38	0.95
Concrete	m3	1,740	800	1.39	700	1.22	2.61
Reinforcement steel bar	ton	35	10,450	0.37	4,750	0.17	0.53
Others	L.S.			0.24		0.18	0.42
Sub-Total of 2.3				2.60		1.98	4.58
2.4 **Waterway**							
Excavation(common)	m3	500	15	0.01	15	0.01	0.02
Concrete	m3	180	800	0.14	700	0.13	0.27
Reinforcement steel bar	ton	9	10,450	0.09	4,750	0.04	0.14
Others	L.S.			0.02		0.02	0.04
Sub-Total of 2.4				0.27		0.19	0.46
Total of II				**9.23**		**7.14**	**16.37**
III. METAL WORKS							
Guard valve	ton	0.03	188,100	0.01	20,900	0.00	0.01
Outlet valve	ton	0.05	188,100	0.01	20,900	0.00	0.01
Intake gate	ton	0.2	116,280	0.02	12,920	0.00	0.03
Intake trushrack	ton	0.05	76,950	0.00	8,550	0.00	0.00
Total of III				**0.04**		**0.00**	**0.05**
Total of I to III				**10.36**		**8.01**	**18.36**
V. COMPENSATION				0.00		0.29	0.29
VI. ENGINEERING SERVICE				1.47		0.37	1.84
VII. GOVERNMENT ADMINISTRATION				0.00		0.92	0.92
VIII. PHYSICAL CONTINGENCY				1.77		1.44	3.21
GRAND TOTAL (FINANCIAL)				**13.61**		**11.03**	**24.63**
GRAND TOTAL (ECONOMIC)				**13.61**		**8.77**	**22.38**

Table 5.10 Principal Features of Sta. Maria Dam

Purpose	Irrigation
Catchment area (km^2)	30.6
Reservoir	
Flood water level (EL. m)	76.5
High water level (EL. m)	73.5
Low water level (EL. m)	65
Gross storage (10^6 m^3)	24.1
Storage for water utility (10^6 m^3)	18.1
Reservoir area at HWL (km^2)	3.2
Dam	
Type	Earthfill
Crest elevation (EL. m)	78.5
Crest length (m)	160
Crest width (m)	8
Height (m)	26.5
Upstream slope	1:4.0
Downstream slope	1:3.0
Embankment volume (m^3)	163,000
Spillway	
Type	Non-gated open chuteway
Design flood (m^3/s)	330
Crest elevation (EL. m)	73.5
Crest width (m)	32
Energy dissipator	Stilling basin
Diversion	
Type	Tunnel
Design flood (m^3/s)	150
Tunnel diameter (m)	3.5
Tunnel length (m)	240
Number of tunnel (lanes)	1
Waterway	
Maximum discharge (m^3/s)	1.5
Intake sill elevation (EL. m)	63
Length of Waterway (m)	240

Table 5.11 Project Cost of Sta. Maria Dam

Work Item	Unit	Work Quantity	Foreign Portion		Local Portion		Total Amount (Mil.P)
			Unit Price (Pesos)	Amount (Mil.P)	Unit Price (Pesos)	Amount (Mil.P)	
I. PREPARATORY WORKS							
Access road (New)	km	3	350,000	1.05	300,000	0.90	1.95
Improvement of existing road	km	3	70,000	0.21	60,000	0.18	0.39
Bridge	m	10	12,000	0.12	14,000	0.14	0.26
Work shops, offices and quarters	L.S.			2.64		1.78	4.42
Total of I				**4.02**		**3.00**	**7.02**
II. CIVIL WORKS							
2.1 **River Diversion Works**							
Excavation (common)	m3	600	15	0.01	15	0.01	0.02
Excavation (rock)	m3	2,200	60	0.13	40	0.09	0.22
Excavation (tunnel)	m3	4,180	670	2.80	300	1.25	4.05
Concrete (inlet and outlet)	m3	80	800	0.06	700	0.06	0.12
Concrete (tunnel lining)	m3	1,870	1,220	2.28	920	1.72	4.00
Concrete (plug)	m3	120	800	0.10	700	0.08	0.18
Steel support	ton	33	12,350	0.41	8,550	0.28	0.69
Reinforcement steel bar	ton	97	10,450	1.01	4,750	0.46	1.47
Consolidation grout	m	1,060	910	0.96	510	0.54	1.50
Cofferdam	m3	7,000	30	0.21	20	0.14	0.35
Others	L.S.			0.80		0.46	1.26
Sub-Total of 2.1				8.77		5.09	13.86
2.2 **Dam**							
Excavation (common)	m3	10,700	15	0.16	15	0.16	0.32
Excavation (rock)	m3	8,700	60	0.52	40	0.35	0.87
Embankment (filter)	m3	4,100	65	0.27	55	0.23	0.50
Embankment (earth)	m3	138,500	30	4.16	20	2.77	6.93
Embankment (riprap)	m3	20,400	90	1.84	90	1.84	3.68
Curtain grout	m	3,000	1,310	3.93	590	1.77	5.70
Blanket or consolidation grout	m	900	910	0.82	510	0.46	1.28
Others	L.S.			1.17		0.76	1.93
Sub-Total of 2.2				12.87		8.34	21.21
2.3 **Spillway**							
Excavation (Common)	m3	7,000	15	0.11	15	0.11	0.22
Excavation (rock)	m3	28,000	60	1.68	40	1.12	2.80
Concrete	m3	8,500	800	6.80	700	5.95	12.75
Reinforcement steel bar	ton	170	10,450	1.78	4,750	0.81	2.59
Others	L.S.			1.04		0.80	1.84
Sub-Total of 2.3				11.41		8.79	20.20
Total of II				**33.05**		**22.22**	**55.27**
III. METAL WORKS							
Diversion closure gate	ton	11	109,440	1.20	12,160	0.13	1.33
Steel conduit	ton	22	68,400	1.50	7,600	0.17	1.67
Guard valve	ton	2.4	188,100	0.45	20,900	0.05	0.50
Outlet valve	ton	3.7	188,100	0.70	20,900	0.08	0.78
Intake gate	ton	2.3	116,280	0.27	12,920	0.03	0.30
Intake trashracks	ton	0.3	76,950	0.02	8,550	0.00	0.02
Total of III				**4.14**		**0.46**	**4.60**
Total of I to III				**41.21**		**25.68**	**66.89**
V. COMPENSATION				0.00		2.32	2.32
VI. ENGINEERING SERVICE				5.35		1.34	6.69
VII. GOVERNMENT ADMINISTRATION				0.00		3.34	3.34
VIII. PHYSICAL CONTINGENCY				6.98		4.90	11.88
GRAND TOTAL (FINANCIAL)				**53.54**		**37.58**	**91.12**
GRAND TOTAL (ECONOMIC)				**53.54**		**29.53**	**83.07**

Table 5.12 Principal Features of Colorado Dam

Purpose	Irrigation
Catchment area (km^2)	63.9
River name	Sinalugan
Reservoir	
Flood water level (EL. m)	87.5
High water level (EL. m)	84.5
Low water level (EL. m)	72.5
Gross storage (10^6 m^3)	71.3
Storage for water utility (10^6 m^3)	58.4
Reservoir area at HWL (km^2)	9.8
Dam	
Type	Earthfill
Crest elevation (EL. m)	89.5
Crest length (m)	360
Crest width (m)	8
Height (m)	32.5
Upstream slope	1:4.0
Downstream slope	1:3.0
Embankment volume (m^3)	571,900
Spillway	
Type	Non-gated open chuteway
Design flood (m^3/s)	630
Crest elevation (EL. m)	84.5
Crest width (m)	60
Energy dissipator	Stilling basin
Diversion	
Type	Tunnel
Design flood (m^3/s)	280
Tunnel diameter (m)	4.3
Tunnel length (m)	220
Number of tunnel (lanes)	1
Channel length (m)	
Waterway	
Maximum discharge (m^3/s)	3.3
Intake sill elevation (EL. m)	70.5
Length of Waterway (m)	220

Table 5.13 Project Cost of Colorado Dam

Work Item	Unit	Work Quantity	Foreign Portion Unit Price (Pesos)	Foreign Portion Amount (Mil.P)	Local Portion Unit Price (Pesos)	Local Portion Amount (Mil.P)	Total Amount (Mil.P)
I. PREPARATORY WORKS							
Access road (New)	km	0.5	350,000	0.18	300,000	0.15	0.33
Improvement of existing road	km	6	70,000	0.42	60,000	0.36	0.78
Work shops, offices and quarters	L.S.			5.74		3.95	9.69
Total of I				**6.34**		**4.46**	**10.80**
II. CIVIL WORKS							
2.1 **River Diversion Works**							
Excavation (common)	m3	1,400	15	0.02	15	0.02	0.04
Excavation (rock)	m3	5,700	60	0.34	40	0.23	0.57
Excavation (tunnel)	m3	5,450	670	3.65	300	1.64	5.29
Concrete (inlet and outlet)	m3	150	800	0.12	700	0.11	0.23
Concrete (tunnel lining)	m3	2,260	1,220	2.76	920	2.08	4.84
Concrete (plug)	m3	210	800	0.17	700	0.15	0.32
Steel support	ton	42	12,350	0.52	8,550	0.36	0.88
Reinforcement steel bar	ton	119	10,450	1.24	4,750	0.57	1.81
Consolidation grout	m	1,200	910	1.09	510	0.61	1.70
Cofferdam	m3	5,000	30	0.15	20	0.10	0.25
Others	L.S.			1.01		0.59	1.60
Sub-Total of 2.1				11.07		6.46	17.53
2.2 **Dam**							
Excavation (common)	m3	33,500	15	0.50	15	0.50	1.00
Excavation (rock)	m3	27,400	60	1.64	40	1.10	2.74
Embankment (filter)	m3	14,300	65	0.93	55	0.79	1.72
Embankment (earth)	m3	486,100	30	14.58	20	9.72	24.30
Embankment (riprap)	m3	71,500	90	6.44	90	6.44	12.88
Curtain grout	m	7,400	1,310	9.69	590	4.37	14.06
Blanket or consolidation grout	m	2,200	910	2.00	510	1.12	3.12
Others	L.S.			3.58		2.40	5.98
Sub-Total of 2.2				39.36		26.44	65.80
2.3 **Spillway**							
Excavation (Common)	m3	14,000	15	0.21	15	0.21	0.42
Excavation (rock)	m3	56,100	60	3.37	40	2.24	5.61
Concrete	m3	15,700	800	12.56	700	10.99	23.55
Reinforcement steel bar	ton	314	10,450	3.28	4,750	1.49	4.77
Others	L.S.			1.94		1.49	3.43
Sub-Total of 2.3				21.36		16.42	37.78
Total of II				**71.79**		**49.32**	**121.11**
III. METAL WORKS							
Diversion closure gate	ton	16	109,440	1.75	12,160	0.19	1.94
Steel conduit	ton	27	68,400	1.85	7,600	0.21	2.06
Guard valve	ton	5.2	188,100	0.98	20,900	0.11	1.09
Outlet valve	ton	8	188,100	1.50	20,900	0.17	1.67
Intake gate	ton	2.5	116,280	0.29	12,920	0.03	0.32
Intake trashracks	ton	0.8	76,950	0.06	8,550	0.01	0.07
Total of III				**6.43**		**0.72**	**7.15**
Total of I to III				**84.56**		**54.50**	**139.06**
V. COMPENSATION				0.00		6.20	6.20
VI. ENGINEERING SERVICE				11.12		2.78	13.90
VII. GOVERNMENT ADMINISTRATION				0.00		6.95	6.95
VIII. PHYSICAL CONTINGENCY				14.35		10.56	24.91
GRAND TOTAL (FINANCIAL)				**110.03**		**80.99**	**191.02**
GRAND TOTAL (ECONOMIC)				**110.03**		**62.54**	**172.57**

Table 5.14 Principal Features of Calaocan Dam

Purpose	Irrigation
Catchment area (km^2)	26.8
River name	Madalan
Reservoir	
Flood water level (EL. m)	87.5
High water level (EL. m)	84.5
Low water level (EL. m)	72
Gross storage (10^6 m^3)	46.9
Storage for water utility (10^6 m^3)	41.0
Reservoir area at HWL (km^2)	5.5
Dam	
Type	Earthfill
Crest elevation (EL. m)	89.5
Crest length (m)	260
Crest width (m)	8
Height (m)	30.5
Upstream slope	1:4.0
Downstream slope	1:3.0
Embankment volume (m^3)	348,200
Spillway	
Type	Non-gated open chuteway
Design flood (m^3/s)	290
Crest elevation (EL. m)	84.5
Crest width (m)	28
Energy dissipator	Stilling basin
Diversion	
Type	Tunnel
Design flood (m^3/s)	130
Tunnel diameter (m)	3.1
Tunnel length (m)	180
Number of tunnel (lanes)	1
Waterway	
Maximum discharge (m^3/s)	1.8
Intake sill elevation (EL. m)	70
Length of Waterway (m)	180

Table 5.15 Project Cost of Calaocan Dam

Work Item	Unit	Work Quantity	Foreign Portion Unit Price (Pesos)	Foreign Portion Amount (Mil.P)	Local Portion Unit Price (Pesos)	Local Portion Amount (Mil.P)	Total Amount (Mil.P)
I. PREPARATORY WORKS							
Access road (New)	km	1	350,000	0.35	300,000	0.30	0.65
Bridge	m	10	12,000	0.12	14,000	0.14	0.26
Work shops, offices and quarters	L.S.			3.38		2.31	5.69
Total of I				**3.85**		**2.75**	**6.60**
II. CIVIL WORKS							
2.1 River Diversion Works							
Excavation (common)	m3	2,600	15	0.04	15	0.04	0.08
Excavation (rock)	m3	10,600	60	0.64	40	0.42	1.06
Excavation (tunnel)	m3	2,540	670	1.70	300	0.76	2.46
Concrete (inlet and outlet)	m3	60	800	0.05	700	0.04	0.09
Concrete (tunnel lining)	m3	1,180	1,220	1.44	920	1.09	2.53
Concrete (plug)	m3	110	800	0.09	700	0.08	0.17
Steel support	ton	19	12,350	0.23	8,550	0.16	0.39
Reinforcement steel bar	ton	61	10,450	0.64	4,750	0.29	0.93
Consolidation grout	m	930	910	0.85	510	0.47	1.32
Cofferdam	m3	3,000	30	0.09	20	0.06	0.15
Others	L.S.			0.58		0.34	0.92
Sub-Total of 2.1				6.35		3.75	10.10
2.2 Dam							
Excavation (common)	m3	25,300	15	0.38	15	0.38	0.76
Excavation (rock)	m3	16,800	60	1.01	40	0.67	1.68
Embankment (filter)	m3	8,700	65	0.57	55	0.48	1.05
Embankment (earth)	m3	296,000	30	8.88	20	5.92	14.80
Embankment (riprap)	m3	43,500	90	3.92	90	3.92	7.84
Curtain grout	m	5,000	1,310	6.55	590	2.95	9.50
Blanket or consolidation grout	m	1,500	910	1.37	510	0.77	2.14
Others	L.S.			2.27		1.51	3.78
Sub-Total of 2.2				24.95		16.60	41.55
2.3 Spillway							
Excavation (Common)	m3	7,200	15	0.11	15	0.11	0.22
Excavation (rock)	m3	28,800	60	1.73	40	1.15	2.88
Concrete	m3	8,100	800	6.48	700	5.67	12.15
Reinforcement steel bar	ton	162	10,450	1.69	4,750	0.77	2.46
Others	L.S.			1.00		0.77	1.77
Sub-Total of 2.3				11.01		8.47	19.48
Total of II				**42.31**		**28.82**	**71.13**
III. METAL WORKS							
Diversion closure gate	ton	10	109,440	1.09	12,160	0.12	1.21
Steel conduit	ton	19.2	68,400	1.31	7,600	0.15	1.46
Guard valve	ton	2.7	188,100	0.51	20,900	0.06	0.57
Outlet valve	ton	4.1	188,100	0.77	20,900	0.09	0.86
Intake gate	ton	2.2	116,280	0.26	12,920	0.03	0.29
Intake trashracks	ton	0.3	76,950	0.02	8,550	0.00	0.02
Total of III				**3.96**		**0.45**	**4.41**
Total of I to III				**50.12**		**32.02**	**82.14**
V. COMPENSATION				0.00		4.39	4.39
VI. ENGINEERING SERVICE				6.57		1.64	8.21
VII. GOVERNMENT ADMINISTRATION				0.00		4.11	4.11
VIII. PHYSICAL CONTINGENCY				8.50		6.32	14.82
GRAND TOTAL (FINANCIAL)				65.19		48.48	113.67
GRAND TOTAL (ECONOMIC)				65.19		37.77	102.96

Table 5.16 Principal Features of Paranan Dam

Purpose	Irrigation and Hydropower
Catchment area (km^2)	64
River name	Paranan
Reservoir	
Flood water level (EL. m)	173
High water level (EL. m)	170
Low water level (EL. m)	155
Gross storage (10^6 m^3)	28.5
Storage for water utility (10^6 m^3)	18.1
Reservoir area at HWL (km^2)	0.8
Dam	
Type	Rockfill
Crest elevation (EL. m)	175
Crest length (m)	180
Crest width (m)	12
Height (m)	50
Upstream slope	1:2.9
Downstream slope	1:2.0
Embankment volume (m^3)	640,000
Spillway	
Type	Non-gated open chuteway
Design flood (m^3/s)	760
Crest elevation (EL. m)	170
Crest width (m)	73
Energy dissipator	Stilling basin
Diversion	
Type	Tunnel
Design flood (m^3/s)	440
Tunnel diameter (m)	3.7
Tunnel length (m)	380
Number of tunnel (lanes)	2
Waterway	
Maximum discharge (m^3/s)	2.8
Intake sill elevation (EL. m)	153
Length of Waterway (m)	350
Power and Energy	
Maximum plant discharge (m^3/s)	2.8
Maximum gross head (m)	39.0
Rated head (m)	28.4
Installed capacity (kW)	600
Annual energy (GWh)	4.96

Table 5.17 Project Cost of Paranan Dam

Work Item	Unit	Work Quantity	Foreign Portion		Local Portion		Total Amount (Mil.P)
			Unit Price (Pesos)	Amount (Mil.P)	Unit Price (Pesos)	Amount (Mil.P)	
I. PREPARATORY WORKS							
Access road (New)	km	2	825,000	1.65	675,000	1.35	3.00
Improvement of existing road	km	6	165,000	0.99	135,000	0.81	1.80
Bridge	m	40	22,500	0.90	27,500	1.10	2.00
Work shops, offices and quarters	L.S.			12.81		9.09	21.90
Total of I				**16.35**		**12.35**	**28.70**
II. CIVIL WORKS							
2.1 **River Diversion Works**							
Excavation (common)	m3	2,600	35	0.09	30	0.08	0.17
Excavation (rock)	m3	10,400	120	1.25	90	0.94	2.19
Excavation (tunnel)	m3	14,500	740	10.73	300	4.35	15.08
Concrete (inlet and outlet)	m3	190	1,010	0.19	990	0.19	0.38
Concrete (tunnel lining)	m3	6,300	1,080	6.80	1,010	6.36	13.16
Concrete (plug)	m3	530	870	0.46	840	0.45	0.91
Steel support	ton	114	12,350	1.41	8,550	0.97	2.38
Reinforcement steel bar	ton	322	10,450	3.36	4,750	1.53	4.89
Consolidation grout	m	3,500	910	3.19	510	1.79	4.98
Cofferdam	m3	4,700	110	0.52	80	0.38	0.90
Others	L.S.			2.80		1.70	4.50
Sub-Total of 2.1				30.80		18.74	49.54
2.2 **Dam**							
Excavation (common)	m3	39,700	35	1.39	30	1.19	2.58
Excavation (rock)	m3	32,400	120	3.89	90	2.92	6.81
Embankment (core)	m3	105,800	65	6.88	45	4.76	11.64
Embankment (filter)	m3	52,900	95	5.03	75	3.97	9.00
Embankment (rock)	m3	481,300	110	52.94	80	38.50	91.44
Curtain grout	m	8,600	1,310	11.27	590	5.07	16.34
Blanket or consolidation grout	m	2,600	910	2.37	510	1.33	3.70
Others	L.S.			8.38		5.77	14.15
Sub-Total of 2.2				92.15		63.51	155.66
2.3 **Spillway**							
Excavation (Common)	m3	13,900	35	0.49	30	0.42	0.91
Excavation (rock)	m3	55,700	120	6.68	90	5.01	11.69
Concrete	m3	21,400	910	19.47	890	19.05	38.52
Reinforcement steel bar	ton	428	10,450	4.47	4,750	2.03	6.50
Others	L.S.			3.11		2.65	5.76
Sub-Total of 2.3				34.22		29.16	63.38
2.4 **Waterway**							
Excavation (common)	m3	30	35	0.00	30	0.00	0.00
Excavation (rock)	m3	130	120	0.02	90	0.01	0.03
Excavation (tunnel)	m3	530	740	0.39	300	0.16	0.55
Excavation (shaft)	m3	60	820	0.05	320	0.02	0.07
Concrete (intake)	m3	14	1,010	0.01	990	0.01	0.02
Concrete (tunnel lining)	m3	250	1,080	0.27	1,010	0.25	0.52
Steel support	ton	4.3	12,350	0.05	8,550	0.04	0.09
Reinforcement steel bar	ton	2.2	10,450	0.02	4,750	0.01	0.03
Others	L.S.			0.08		0.05	0.13
Sub-Total of 2.4				0.89		0.55	1.44
2.5 **Powerhouse**							
Excavation (common)	m3	130	35	0.00	30	0.00	0.00
Excavation (rock)	m3	530	120	0.06	90	0.05	0.11
Concrete	m3	180	950	0.17	950	0.17	0.34
Reinforcement steel bar	ton	9.4	10,450	0.10	4,750	0.04	0.14
Architectual works	m3	630	1,990	1.25	1,620	1.02	2.27
Utility works	L.S.			0.25		0.20	0.45
Others	L.S.			0.16		0.15	0.33
Sub-Total of 2.5				2.01		1.63	3.64
Total of II				**160.07**		**113.59**	**273.66**
III. METAL WORKS							
Diversion closure gate	ton	35	109,440	3.83	12,160	0.43	4.26
Steel conduit	ton	17.8	68,400	1.22	7,600	0.14	1.36
Guard valve	ton	1.7	188,100	0.32	20,900	0.04	0.36
Outlet valve	ton	2.6	188,100	0.49	20,900	0.05	0.54
Intake gate	ton	2	116,280	0.23	12,920	0.03	0.26
Intake trashracks	ton	0.6	76,950	0.05	8,550	0.01	0.06
Penstock	ton	10.7	68,400	0.73	7,600	0.08	0.81
Draft tube gate	ton	2.1	109,440	0.23	12,160	0.03	0.26
Total of III				**7.10**		**0.81**	**7.91**
IV. ELECTRICAL WORKS	L.S.			**9.27**		**1.03**	**10.30**
Total of I to IV				**192.79**		**127.78**	**320.57**
V. COMPENSATION				0.00		0.54	0.54
VI. ENGINEERING SERVICE				25.65		6.41	32.06
VII. GOVERNMENT ADMINISTRATION				0.00		16.03	16.03
VIII. PHYSICAL CONTINGENCY				32.77		22.61	55.38
GRAND TOTAL (FINANCIAL)				**251.21**		**173.37**	**424.58**
GRAND TOTAL (ECONOMIC)				**251.21**		**141.66**	**392.87**

Table 5.18 Principal Features of Dummon Dam

Purpose	Irrigation and Hydropower
Catchment area (km^2)	112
River name	Dummon
Reservoir	
Flood water level (EL. m)	133
High water level (EL. m)	130
Low water level (EL. m)	122
Gross storage (10^6 m^3)	43.4
Storage for water utility (10^6 m^3)	24.1
Reservoir area at HWL (km^2)	4.3
Dam	
Type	Rockfill
Crest elevation (EL. m)	135
Crest length (m)	240
Crest width (m)	12
Height (m)	36
Upstream slope	1:2.9
Downstream slope	1:2.0
Embankment volume (m^3)	493,300
Spillway	
Type	Non-gated open chuteway
Design flood (m^3/s)	1,220
Crest elevation (EL. m)	130
Crest width (m)	117
Energy dissipator	Stilling basin
Diversion	
Type	Tunnel
Design flood (m^3/s)	710
Tunnel diameter (m)	4.6
Tunnel length (m)	240
Number of tunnel (lanes)	2
Waterway	
Maximum discharge (m^3/s)	4.0
Intake sill elevation (EL. m)	120
Length of Waterway (m)	240
Power and Energy	
Maximum plant discharge (m^3/s)	4.0
Maximum gross head (m)	25.0
Rated head (m)	18.9
Installed capacity (kW)	600
Annual energy (GWh)	4.21

Table 5.19 Project Cost of Dummon Dam

Work Item	Unit	Work Quantity	Foreign Portion		Local Portion		Total Amount (Mil.P)
			Unit Price (Pesos)	Amount (Mil.P)	Unit Price (Pesos)	Amount (Mil.P)	
I. PREPARATORY WORKS							
Access road (New)	km	10	825,000	8.25	675,000	6.75	15.00
Bridge	m	50	22,500	1.13	27,500	1.38	2.51
Work shops, offices and quarters	L.S.			11.83		8.46	20.29
Total of I				**21.21**		**16.59**	**37.80**
II. CIVIL WORKS							
2.1 **River Diversion Works**							
Excavation (common)	m3	2,800	35	0.10	30	0.08	0.18
Excavation (rock)	m3	11,100	120	1.33	90	1.00	2.33
Excavation (tunnel)	m3	13,400	740	9.92	300	4.02	13.94
Concrete (inlet and outlet)	m3	370	1,010	0.37	990	0.37	0.74
Concrete (tunnel lining)	m3	5,420	1,080	5.85	1,010	5.47	11.32
Concrete (plug)	m3	570	870	0.50	840	0.48	0.98
Steel support	ton	103	12,350	1.27	8,550	0.88	2.15
Reinforcement steel bar	ton	286	10,450	2.99	4,750	1.36	4.35
Consolidation grout	m	2,770	910	2.52	510	1.41	3.93
Cofferdam	m3	13,500	110	1.49	80	1.08	2.57
Others	L.S.			2.63		1.62	4.25
Sub-Total of 2.1				28.97		17.77	46.74
2.2 **Dam**							
Excavation (common)	m3	40,700	35	1.42	30	1.22	2.64
Excavation (rock)	m3	33,300	120	4.00	90	3.00	7.00
Embankment (core)	m3	90,900	65	5.91	45	4.09	10.00
Embankment (filter)	m3	45,400	95	4.31	75	3.41	7.72
Embankment (rock)	m3	357,000	110	39.27	80	28.56	67.83
Curtain grout	m	9,100	1,310	11.92	590	5.37	17.29
Blanket or consolidation grout	m	2,700	910	2.46	510	1.38	3.84
Others	L.S.			6.93		4.70	11.63
Sub-Total of 2.2				76.22		51.73	127.95
2.3 **Spillway**							
Excavation (Common)	m3	14,400	35	0.50	30	0.43	0.93
Excavation (rock)	m3	57,600	120	6.91	90	5.18	12.09
Concrete	m3	25,400	910	23.11	890	22.61	45.72
Reinforcement steel bar	ton	508	10,450	5.31	4,750	2.41	7.72
Others	L.S.			3.58		3.06	6.64
Sub-Total of 2.3				39.41		33.69	73.10
2.4 **Waterway**							
Excavation (tunnel)	m3	560	740	0.41	300	0.17	0.58
Concrete (intake)	m3	130	1,010	0.13	990	0.13	0.26
Concrete (tunnel lining)	m3	230	1,080	0.25	1,010	0.23	0.48
Steel support	ton	4.6	12,350	0.06	8,550	0.04	0.10
Reinforcement steel bar	ton	6.5	10,450	0.07	4,750	0.03	0.10
Others	L.S.			0.09		0.06	0.15
Sub-Total of 2.4				1.01		0.66	1.67
2.5 **Powerhouse**							
Excavation (common)	m3	140	35	0.00	30	0.00	0.00
Excavation (rock)	m3	580	120	0.07	90	0.05	0.12
Concrete	m3	200	950	0.19	950	0.19	0.38
Reinforcement steel bar	ton	10.4	10,450	0.11	4,750	0.05	0.16
Architectual works	m3	720	1,990	1.43	1,620	1.17	2.60
Utility works	L.S.			0.29		0.23	0.52
Others	L.S.			0.21		0.17	0.38
Sub-Total of 2.5				2.30		1.86	4.16
Total of II				**147.91**		**105.71**	**253.62**
III. METAL WORKS							
Diversion closure gate	ton	38	109,440	4.16	12,160	0.46	4.62
Steel conduit	ton	13.5	68,400	0.92	7,600	0.10	1.02
Guard valve	ton	1.8	188,100	0.34	20,900	0.04	0.38
Outlet valve	ton	2.8	188,100	0.53	20,900	0.06	0.59
Intake gate	ton	3	116,280	0.35	12,920	0.04	0.39
Intake trashracks	ton	0.9	76,950	0.07	8,550	0.01	0.08
Penstock	ton	11.5	68,400	0.79	7,600	0.09	0.88
Draft tube gate	ton	2.3	109,440	0.25	12,160	0.03	0.28
Total of III				**7.41**		**0.83**	**8.24**
IV. ELECTRICAL WORKS	L.S.			**10.80**		**1.20**	**12.00**
Total of I to IV				**187.33**		**124.33**	**311.66**
V. COMPENSATION				**0.00**		**2.66**	**2.66**
VI. ENGINEERING SERVICE				**24.93**		**6.23**	**31.16**
VII. GOVERNMENT ADMINISTRATION				**0.00**		**15.58**	**15.58**
VIII. PHYSICAL CONTINGENCY				**31.84**		**22.32**	**54.16**
GRAND TOTAL (FINANCIAL)				**244.10**		**171.12**	**415.22**
GRAND TOTAL (ECONOMIC)				**244.10**		**139.24**	**383.34**

Table 5.20 Principal Features of Zinundungan Dam

Purpose	Irrigation and Hydropower
Catchment area (km^2)	147
River name	Zinundungan
Reservoir	
Flood water level (EL. m)	78
High water level (EL. m)	72
Low water level (EL. m)	60
Gross storage (10^6 m^3)	78.4
Storage for water utility (10^6 m^3)	53.1
Reservoir area at HWL SWL (km^2)	6.0
Dam	
Type	Concrete gravity
Crest elevation (EL. m)	79
Crest length (m)	150
Crest width (m)	8
Height (m)	48
Upstream slope	1:0.1
Downstream slope	1:0.8
Embankment volume (m^3)	60,500
Spillway	
Type	Non-gated open chuteway
Design flood (m^3/s)	1,340
Crest elevation (EL. m)	72
Crest width (m)	50
Energy dissipator	Stilling basin
Diversion	
Type	Tunnel
Design flood (m^3/s)	440
Tunnel diameter (m)	5.0
Tunnel length (m)	290
Number of tunnel (lanes)	1
Waterway	
Maximum discharge (m^3/s)	7.2
Intake sill elevation (EL. m)	57
Length of Waterway (m)	220
Power and Energy	
Maximum plant discharge (m^3/s)	7.2
Maximum gross head (m)	33
Rated head (m)	24.3
Installed capacity (kW)	1,400
Annual energy (GWh)	10.21

Table 5.21 Project Cost of Zinundungan Dam

Work Item	Unit	Work Quantity	Foreign Portion		Local Portion		Total Amount (Mil.P)
			Unit Price (Pesos)	Amount (Mil.P)	Unit Price (Pesos)	Amount (Mil.P)	
I. PREPARATORY WORKS							
Access road (New)	km	4	825,000	3.30	675,000	2.70	6.00
Improvement of existing road	km	10	165,000	1.65	135,000	1.35	3.00
Bridge	m	50	22,500	1.13	27,500	1.38	2.51
Work shops, offices and quarters	L.S.			9.49		6.51	16.00
Total of I				**15.57**		**11.94**	**27.51**
II. CIVIL WORKS							
2.1 River Diversion Works							
Excavation (common)	m3	500	35	0.02	30	0.02	0.04
Excavation (rock)	m3	1,800	120	0.22	90	0.16	0.38
Excavation (tunnel)	m3	9,300	740	6.88	300	2.79	9.67
Concrete (inlet and outlet)	m3	240	1,010	0.24	990	0.24	0.48
Concrete (tunnel lining)	m3	3,600	1,080	3.89	1,010	3.64	7.53
Concrete (plug)	m3	440	870	0.38	840	0.37	0.75
Steel support	ton	70	12,350	0.86	8,550	0.60	1.46
Reinforcement steel bar	ton	190	10,450	1.99	4,750	0.90	2.89
Consolidation grout	m	1,800	910	1.64	510	0.92	2.56
Cofferdam	m3	29,800	110	3.28	80	2.38	5.66
Others	L.S.			1.94		1.20	3.14
Sub-Total of 2.1				21.34		13.22	34.56
2.2 Dam							
Excavation (common)	m3	6,700	35	0.23	30	0.20	0.43
Excavation (rock)	m3	26,900	120	3.23	90	2.42	5.65
Concrete	m3	60,500	820	49.61	600	36.30	85.91
Curtain grout	m	11,500	1,310	15.07	590	6.79	21.86
Blanket or consolidation grout	m	3,450	910	3.14	510	1.76	4.90
Others	L.S.			7.13		4.75	11.88
Sub-Total of 2.2				78.41		52.22	130.63
2.3 Spillway							
Excavation (Common)	m3	2,800	35	0.10	30	0.08	0.18
Excavation (rock)	m3	11,200	120	1.34	90	1.01	2.35
Concrete	m3	9,940	910	9.05	890	8.85	17.90
Reinforcement steel bar	ton	199	10,450	2.08	4,750	0.95	3.03
Others	L.S.			1.26		1.09	2.35
Sub-Total of 2.3				13.83		11.98	25.81
2.4 Waterway							
Excavation (common)	m3	60	35	0.00	30	0.00	0.00
Excavation (rock)	m3	260	120	0.03	90	0.02	0.05
Excavation (tunnel)	m3	570	740	0.42	300	0.17	0.59
Excavation (shaft)	m3	90	820	0.07	320	0.03	0.10
Concrete (intake)	m3	32	1,010	0.03	990	0.03	0.06
Concrete (tunnel lining)	m3	275	1,080	0.30	1,010	0.28	0.58
Steel support	ton	5	12,350	0.06	8,550	0.04	0.10
Reinforcement steel bar	ton	4	10,450	0.04	4,750	0.02	0.06
Others	L.S.			0.10		0.06	0.16
Sub-Total of 2.4				1.05		0.65	1.70
2.5 Powerhouse							
Excavation (common)	m3	310	35	0.01	30	0.01	0.02
Excavation (rock)	m3	1,230	120	0.15	90	0.11	0.26
Concrete	m3	430	950	0.41	950	0.41	0.82
Reinforcement steel bar	ton	22.4	10,450	0.23	4,750	0.11	0.34
Archtectual works	m3	1,200	1,990	2.39	1,620	1.94	4.33
Utility works	L.S.			0.48		0.39	0.87
Others	L.S.			0.37		0.30	0.67
Sub-Total of 2.5				4.04		3.27	7.31
Total of II				**118.67**		**81.34**	**200.01**
III. METAL WORKS							
Diversion closure gate	ton	26	109,440	2.85	12,160	0.32	3.17
Steel conduit	ton	17.6	68,400	1.20	7,600	0.13	1.33
Guard valve	ton	2.7	188,100	0.51	20,900	0.06	0.57
Outlet valve	ton	4.1	188,100	0.77	20,900	0.09	0.86
Intake gate	ton	5.2	116,280	0.60	12,920	0.07	0.67
Intake trashracks	ton	1.7	76,950	0.13	8,550	0.01	0.14
Penstock	ton	12.6	68,400	0.86	7,600	0.10	0.96
Draft tube gate	ton	2.4	109,440	0.26	12,160	0.03	0.29
Total of III				**7.18**		**0.81**	**7.99**
IV. ELECTRICAL WORKS	L.S.			**18.90**		**2.10**	**21.00**
Total of I to IV				**160.32**		**96.19**	**256.51**
V. COMPENSATION				**0.00**		**10.70**	**10.70**
VI. ENGINEERING SERVICE				**20.52**		**5.13**	**25.65**
VII. GOVERNMENT ADMINISTRATION				**0.00**		**12.83**	**12.83**
VIII. PHYSICAL CONTINGENCY				**27.13**		**18.73**	**45.86**
GRAND TOTAL (FINANCIAL)				**207.97**		**143.58**	**351.55**
GRAND TOTAL (ECONOMIC)				**207.97**		**114.62**	**322.59**

Table 5.22 Principal Features of San Vicente Dam

Purpose	Irrigation
Catchment area (km^2)	10.2
Reservoir	
Flood water level (EL. m)	72
High water level (EL. m)	69
Low water level (EL. m)	57.5
Gross storage (10^6 m^3)	8.8
Storage for water utility (10^6 m^3)	6.9
Reservoir area at HWL (km^2)	1.1
Dam	
Type	Earthfill
Crest elevation (EL. m)	74
Crest length (m)	355
Crest width (m)	8
Height (m)	30
Upstream slope	1:4.0
Downstream slope	1:3.0
Embankment volume (m^3)	384,000
Spillway	
Type	Non-gated open chuteway
Design flood (m^3/s)	120
Crest elevation (EL. m)	69
Crest width (m)	12
Energy dissipator	Stilling basin
Diversion	
Type	Open channel
Design flood (m^3/s)	50
Channel length (m)	320
Waterway	
Maximum discharge (m^3/s)	1.6
Intake sill elevation (EL. m)	56
Length of Waterway (m)	180

Table 5.23 Project Cost of San Vicente Dam

Work Item	Unit	Work Quantity	Foreign Portion Unit Price (Pesos)	Foreign Portion Amount (Mil.P)	Local Portion Unit Price (Pesos)	Local Portion Amount (Mil.P)	Total Amount (Mil.P)
I. PREPARATORY WORKS							
Access road (New)	km	1	350,000	0.35	300,000	0.30	0.65
Improvement of existing road	km	5	70,000	0.35	60,000	0.30	0.65
Work shops, offices and quarters	L.S.			2.83		1.94	4.77
Total of I				**3.53**		**2.54**	**6.07**
II. CIVIL WORKS							
2.1 **River Diversion Works & Waterway**							
Excavation (common)	m3	5,900	15	0.09	15	0.09	0.18
Excavation (rock)	m3	19,600	60	1.18	40	0.78	1.96
Concrete	m3	400	800	0.32	700	0.28	0.60
Reinforcement steel bar	ton	20	10,450	0.21	4,750	0.10	0.31
Cofferdam	m3	5,000	30	0.15	20	0.10	0.25
Others	L.S.			0.20		0.14	0.34
Sub-Total of 2.1				2.15		1.49	3.64
2.2 **Dam**							
Excavation (common)	m3	34,600	15	0.52	15	0.52	1.04
Excavation (rock)	m3	23,000	60	1.38	40	0.92	2.30
Embankment (filter)	m3	9,600	65	0.62	55	0.53	1.15
Embankment (earth)	m3	326,400	30	9.79	20	6.53	16.32
Embankment (riprap)	m3	48,000	90	4.32	90	4.32	8.64
Curtain grout	m	5,300	1,310	6.94	590	3.13	10.07
Blanket or consolidation grout	m	1,600	910	1.46	510	0.82	2.28
Others	L.S.			2.50		1.68	4.18
Sub-Total of 2.2				27.53		18.45	45.98
2.3 **Spillway**							
Excavation (Common)	m3	5,000	15	0.08	15	0.08	0.16
Excavation (rock)	m3	19,900	60	1.19	40	0.80	1.99
Concrete	m3	3,850	800	3.08	700	2.70	5.78
Reinforcement steel bar	ton	77	10,450	0.80	4,750	0.37	1.17
Others	L.S.			0.52		0.40	0.92
Sub-Total of 2.3				5.67		4.35	10.02
Total of II				**35.35**		**24.29**	**59.64**
III. METAL WORKS							
Steel conduit	ton	5	68,400	0.34	7,600	0.04	0.38
Guard valve	ton	2.4	188,100	0.45	20,900	0.05	0.50
Outlet valve	ton	3.7	188,100	0.70	20,900	0.08	0.78
Intake gate	ton	2.3	116,280	0.27	12,920	0.03	0.30
Intake trashracks	ton	0.3	76,950	0.02	8,550	0.00	0.02
Total of III				**1.78**		**0.20**	**1.98**
Total of I to III				**40.66**		**27.03**	**67.69**
V. COMPENSATION				0.00		0.45	0.45
VI. ENGINEERING SERVICE				5.42		1.35	6.77
VII. GOVERNMENT ADMINISTRATION				0.00		3.38	3.38
VIII. PHYSICAL CONTINGENCY				6.91		4.83	11.74
GRAND TOTAL (FINANCIAL)				**52.99**		**37.04**	**90.03**
GRAND TOTAL (ECONOMIC)				**52.99**		**29.95**	**82.94**

Table 5.24 Principal Features of Santor Dam

Purpose	Cattle farm and Irrigation
Catchment area (km^2)	11.3
Reservoir	
Flood water level (EL. m)	98
High water level (EL. m)	95
Low water level (EL. m)	85
Gross storage (10^6 m^3)	5.3
Storage for water utility (10^6 m^3)	4.7
Reservoir area at HWL (km^2)	0.8
Dam	
Type	Earthfill
Crest elevation (EL. m)	100
Crest length (m)	240
Crest width (m)	8
Height (m)	23
Upstream slope	1:4.0
Downstream slope	1:3.0
Embankment volume (m^3)	139,000
Spillway	
Type	Non-gated open chuteway
Design flood (m^3/s)	150
Crest elevation (EL. m)	95
Crest width (m)	15
Energy dissipator	Stilling basin
Diversion	
Type	Tunnel
Design flood (m^3/s)	70
Tunnel diameter (m)	2.4
Tunnel length (m)	100
Number of tunnel (lanes)	1
Waterway	
Maximum discharge (m^3/s)	0.56
Intake sill elevation (EL. m)	84
Length of Waterway (m)	100

Table 5.25 Project Cost of Santor Dam

Work Item	Unit	Work Quantity	Foreign Portion Unit Price (Pesos)	Foreign Portion Amount (Mil.P)	Local Portion Unit Price (Pesos)	Local Portion Amount (Mil.P)	Total Amount (Mil.P)
I. PREPARATORY WORKS							
Access road (New)	km	2	350,000	0.70	300,000	0.60	1.30
Bridge	m	10	12,000	0.12	14,000	0.14	0.26
Work shops, offices and quarters	L.S.			0.85		0.62	1.47
Total of I				**1.67**		**1.36**	**3.03**
II. CIVIL WORKS							
2.1 **River Diversion Works**							
Excavation (common)	m3	900	15	0.01	15	0.01	0.02
Excavation (rock)	m3	3,600	60	0.22	40	0.14	0.36
Excavation (tunnel)	m3	790	670	0.53	300	0.24	0.77
Concrete (inlet and outlet)	m3	50	800	0.04	700	0.04	0.08
Concrete (tunnel lining)	m3	340	1,220	0.41	920	0.31	0.72
Concrete (plug)	m3	50	800	0.04	700	0.04	0.08
Steel support	ton	6	12,350	0.07	8,550	0.05	0.12
Reinforcement steel bar	ton	19	10,450	0.20	4,750	0.09	0.29
Consolidation grout	m	300	910	0.27	510	0.15	0.42
Others	L.S.			0.18		0.11	0.29
Sub-Total of 2.1				1.97		1.18	3.15
2.2 **Dam**							
Excavation (common)	m3	20,900	15	0.31	15	0.31	0.62
Embankment (filter)	m3	3,500	65	0.23	55	0.19	0.42
Embankment (earth)	m3	122,500	30	3.68	20	2.45	6.13
Embankment (riprap)	m3	13,000	90	1.17	90	1.17	2.34
Others	L.S.			0.54		0.41	0.95
Sub-Total of 2.2				5.93		4.53	10.46
2.3 **Spillway**							
Excavation (Common)	m3	2,600	15	0.04	15	0.04	0.08
Excavation (rock)	m3	10,500	60	0.63	40	0.42	1.05
Concrete	m3	1,800	800	1.44	700	1.26	2.70
Reinforcement steel bar	ton	36	10,450	0.38	4,750	0.17	0.55
Others	L.S.			0.25		0.19	0.44
Sub-Total of 2.3				2.74		2.08	4.82
Total of II				**10.64**		**7.79**	**18.43**
III. METAL WORKS							
Diversion closure gate	ton	2	109,440	0.22	12,160	0.02	0.24
Steel conduit	ton	4.4	68,400	0.30	7,600	0.03	0.33
Guard valve	ton	1.7	188,100	0.32	20,900	0.04	0.36
Outlet valve	ton	2.6	188,100	0.49	20,900	0.05	0.54
Intake gate	ton	0.5	116,280	0.06	12,920	0.01	0.07
Intake trashracks	ton	0.1	76,950	0.01	8,550	0.00	0.01
Total of III				**1.40**		**0.15**	**1.55**
Total of I to III				**13.71**		**9.30**	**23.01**
V. COMPENSATION				0.00		0.38	0.38
VI. ENGINEERING SERVICE				1.84		0.46	2.30
VII. GOVERNMENT ADMINISTRATION				0.00		1.15	1.15
VIII. PHYSICAL CONTINGENCY				2.33		1.69	4.02
GRAND TOTAL (FINANCIAL)				**17.88**		**12.98**	**30.86**
GRAND TOTAL (ECONOMIC)				**17.88**		**10.29**	**28.17**

Table 5.26 Principal Features of Carmencita Pond

Purpose	Cattle farm and Irrigation
Catchment area (km^2)	0.8 at damsite and 16 at Intake site
Reservoir	
Flood water level (EL. m)	58
High water level (EL. m)	57
Low water level (EL. m)	48
Gross storage (10^6 m^3)	1.4
Storage for water utility (10^6 m^3)	1.2
Reservoir area at HWL (km^2)	0.23
Dam	
Type	Earthfill
Crest elevation (EL. m)	60
Crest length (m)	270
Crest width (m)	8
Height (m)	18
Upstream slope	1:4.0
Downstream slope	1:3.0
Embankment volume (m^3)	119,600
Spillway	
Type	Non-gated open chuteway
Design flood (m^3/s)	15
Crest elevation (EL. m)	57
Crest width (m)	7.5
Energy dissipator	Stilling basin
Diversion	
Type	Open channel
Design flood (m^3/s)	10
Channel length (m)	130
Waterway	
Maximum discharge (m^3/s)	0.15
Intake sill elevation (EL. m)	47
Length of Waterway (m)	120
Transbasin channel	
Design discharge (m^3/s)	0.1
Channel length (m)	900

Table 5.27 Project Cost of Carmencita Pond

Work Item	Unit	Work Quantity	Foreign Portion Unit Price (Pesos)	Foreign Portion Amount (Mil.P)	Local Portion Unit Price (Pesos)	Local Portion Amount (Mil.P)	Total Amount (Mil.P)
I. PREPARATORY WORKS							
Access road (New)	km	0.5	350,000	0.18	300,000	0.15	0.33
Work shops, offices and quarters	L.S.			0.52		0.41	0.93
Total of I				**0.70**		**0.56**	**1.26**
II. CIVIL WORKS							
2.2 **Dam**							
Excavation (common)	m3	26,100	15	0.39	15	0.39	0.78
Embankment (filter)	m3	3,000	65	0.20	55	0.17	0.37
Embankment (earth)	m3	101,600	30	3.05	20	2.03	5.08
Embankment (riprap)	m3	15,000	90	1.35	90	1.35	2.70
Others	L.S.			0.50		0.39	0.89
Sub-Total of 2.2				5.49		4.33	9.82
2.3 **Spillway**							
Excavation (Common)	m3	900	15	0.01	15	0.01	0.02
Excavation (rock)	m3	3,600	60	0.22	40	0.14	0.36
Concrete	m3	400	800	0.32	700	0.28	0.60
Reinforcement steel bar	ton	8	10,450	0.08	4,750	0.04	0.12
Others	L.S.			0.06		0.05	0.11
Sub-Total of 2.3				0.69		0.52	1.21
2.4 **Waterway**							
Excavation(common)	m3	3,000	15	0.05	15	0.05	0.10
Concrete	m3	180	800	0.14	700	0.13	0.27
Reinforcement steel bar	ton	9	10,450	0.09	4,750	0.04	0.13
Others	L.S.			0.03		0.02	0.05
Sub-Total of 2.4				0.31		0.24	0.55
Total of II				**6.49**		**5.09**	**11.58**
III. METAL WORKS							
Guard valve	ton	0.03	188,100	0.01	20,900	0.00	0.01
Outlet valve	ton	0.05	188,100	0.01	20,900	0.00	0.01
Intake gate	ton	0.2	116,280	0.02	12,920	0.00	0.02
Intake trushrack	ton	0.05	76,950	0.00	8,550	0.00	0.00
Total of III				**0.04**		**0.00**	**0.04**
Total of I to III				7.23		5.65	12.88
V. COMPENSATION				0.00		0.08	0.08
VI. ENGINEERING SERVICE				1.03		0.26	1.29
VII. GOVERNMENT ADMINISTRATION				0.00		0.64	0.64
VIII. PHYSICAL CONTINGENCY				1.24		0.99	2.23
GRAND TOTAL (FINANCIAL)				9.50		7.62	17.12
GRAND TOTAL (ECONOMIC)				9.50		6.18	15.68

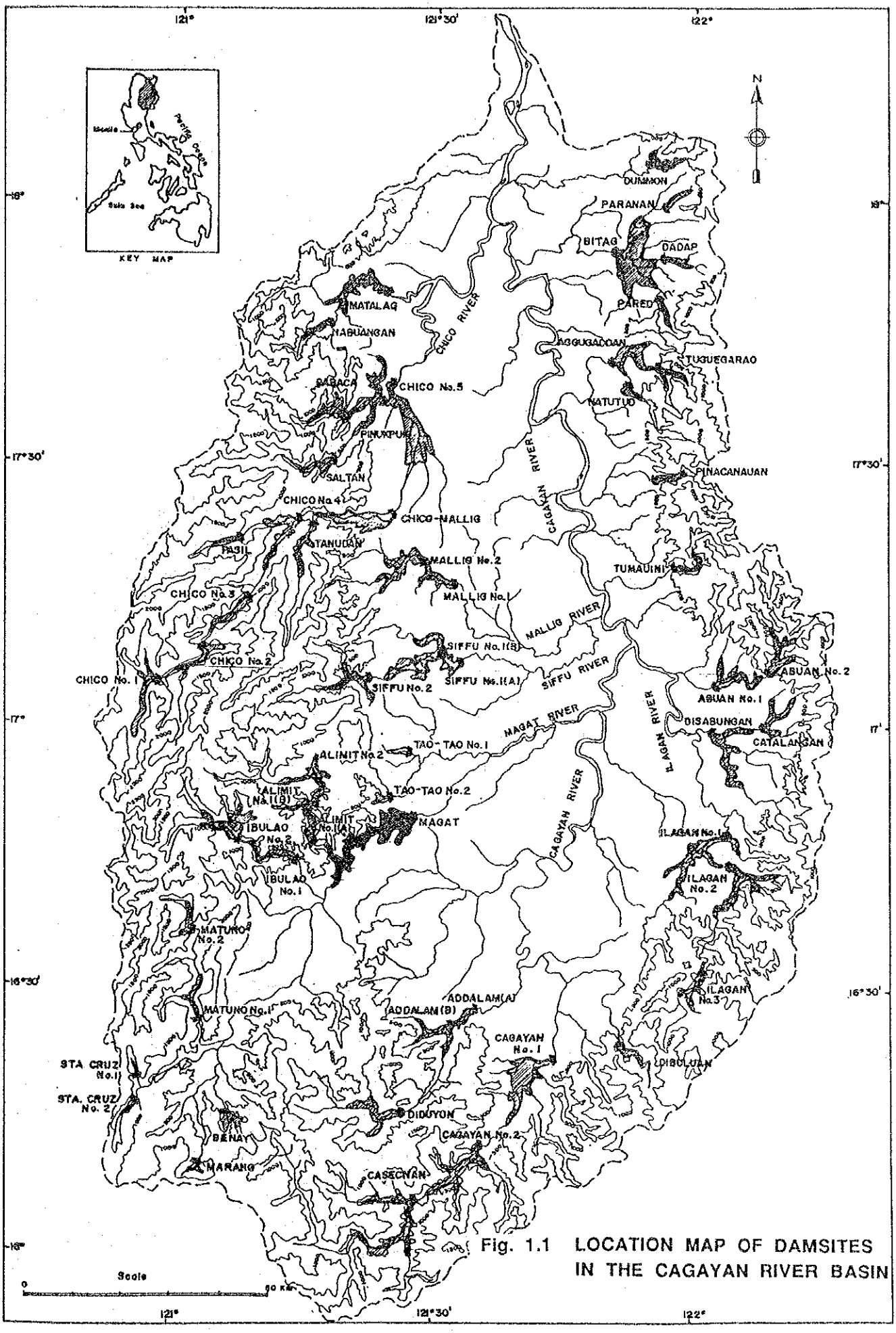


Fig. 1.1 LOCATION MAP OF DAMSITES IN THE CAGAYAN RIVER BASIN

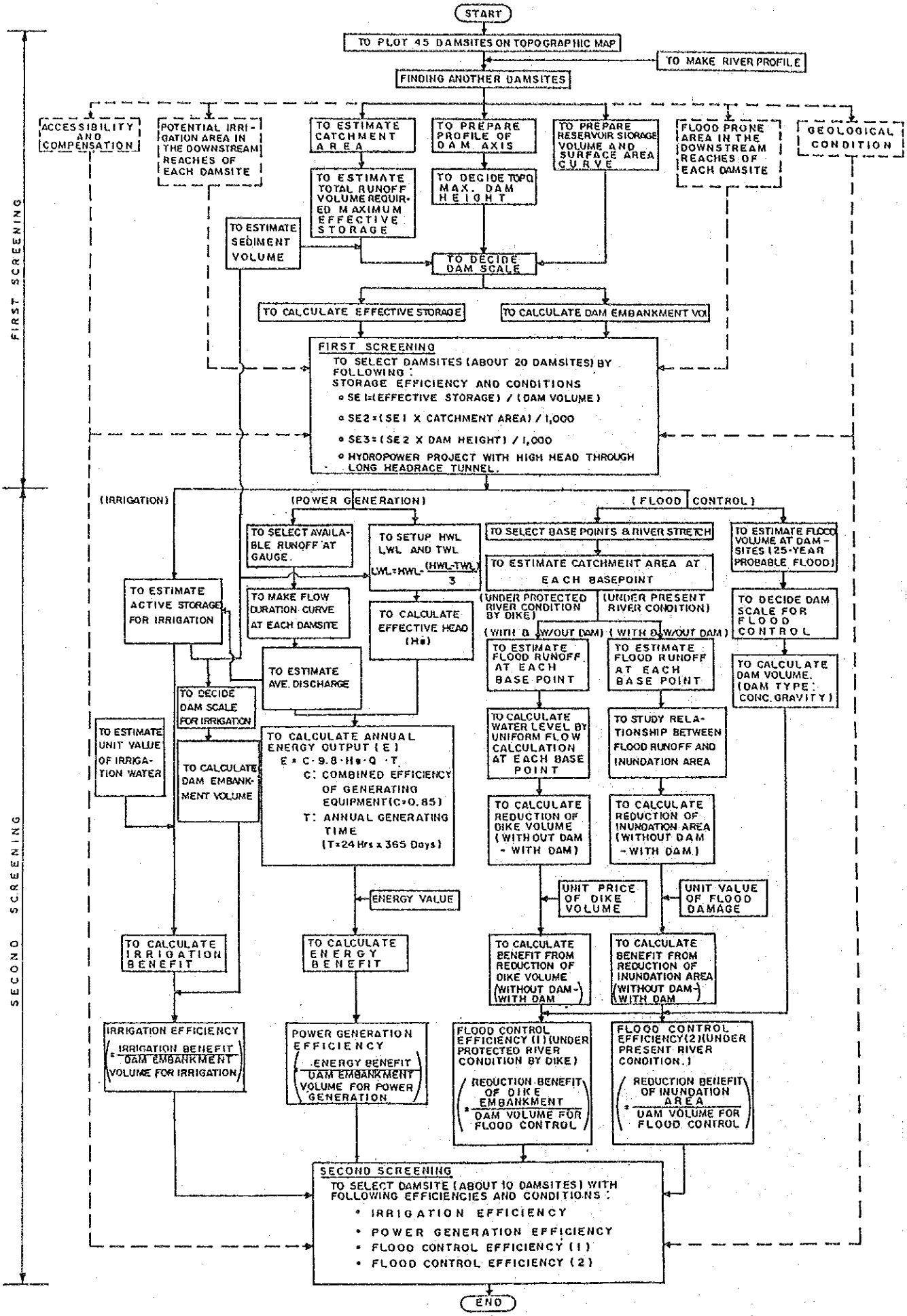
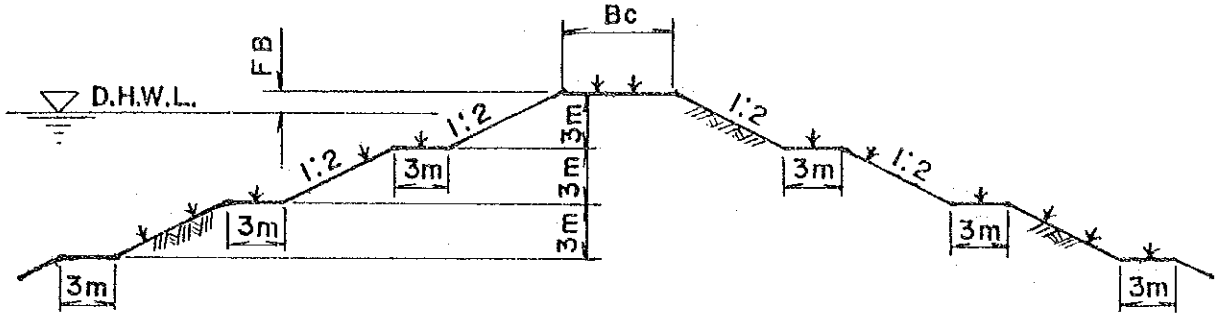


Fig. 1.2 FLOW CHART FOR SELECTION OF PROSPECTIVE DAMSITES



Design Discharge Q (m^3/s)	Free-board FB (m) not less than	Crown width Bc (m) not less than
< 200	0.6	3
200 to 500	0.8	3
500 to 2,000	1.0	4
2,000 to 5,000	1.2	5
5,000 to 10,000	1.5	6
10,000 <	2.0	7

Fig. 1.3 STANDARD CROSS SECTION OF DIKE

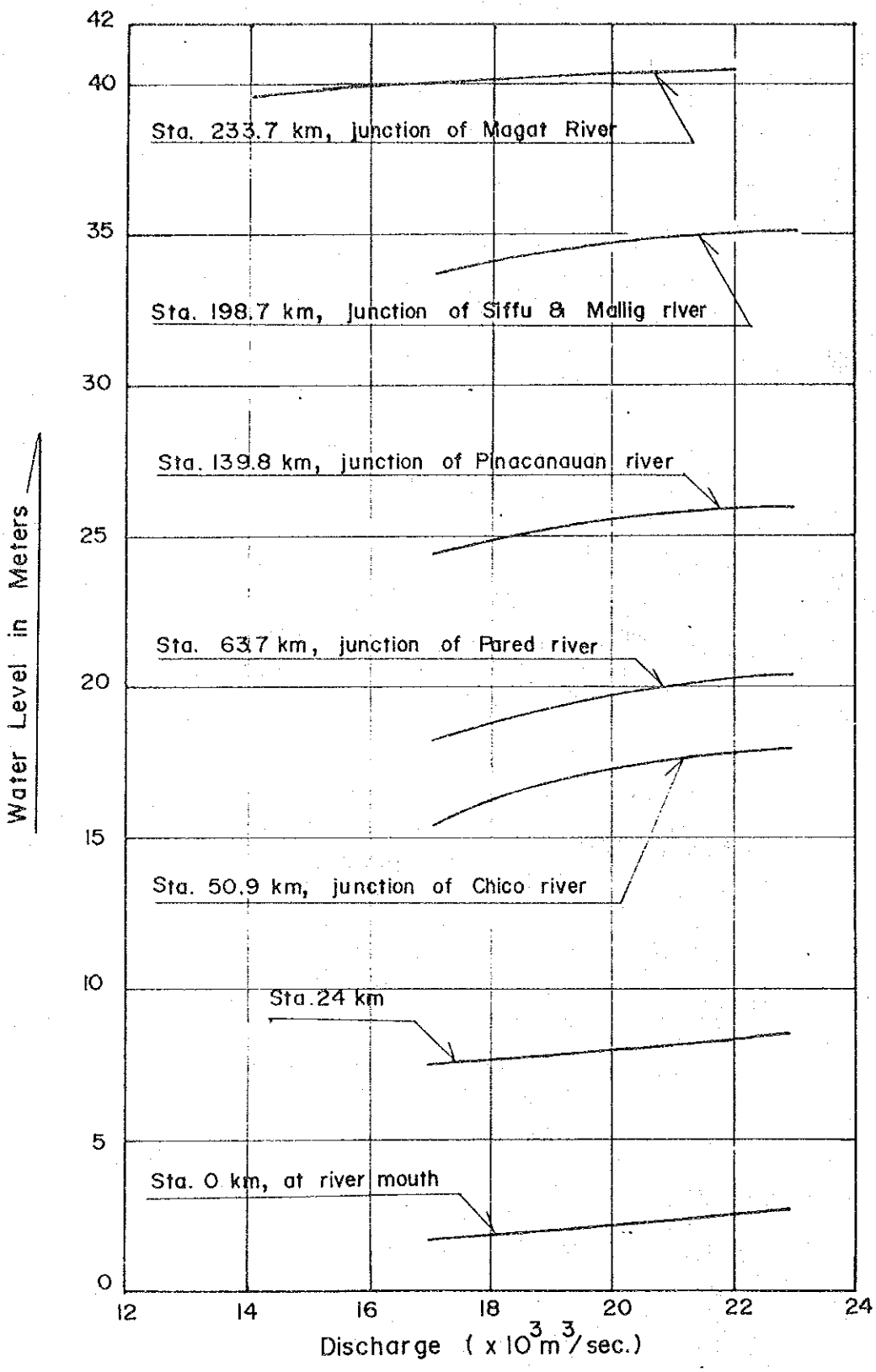
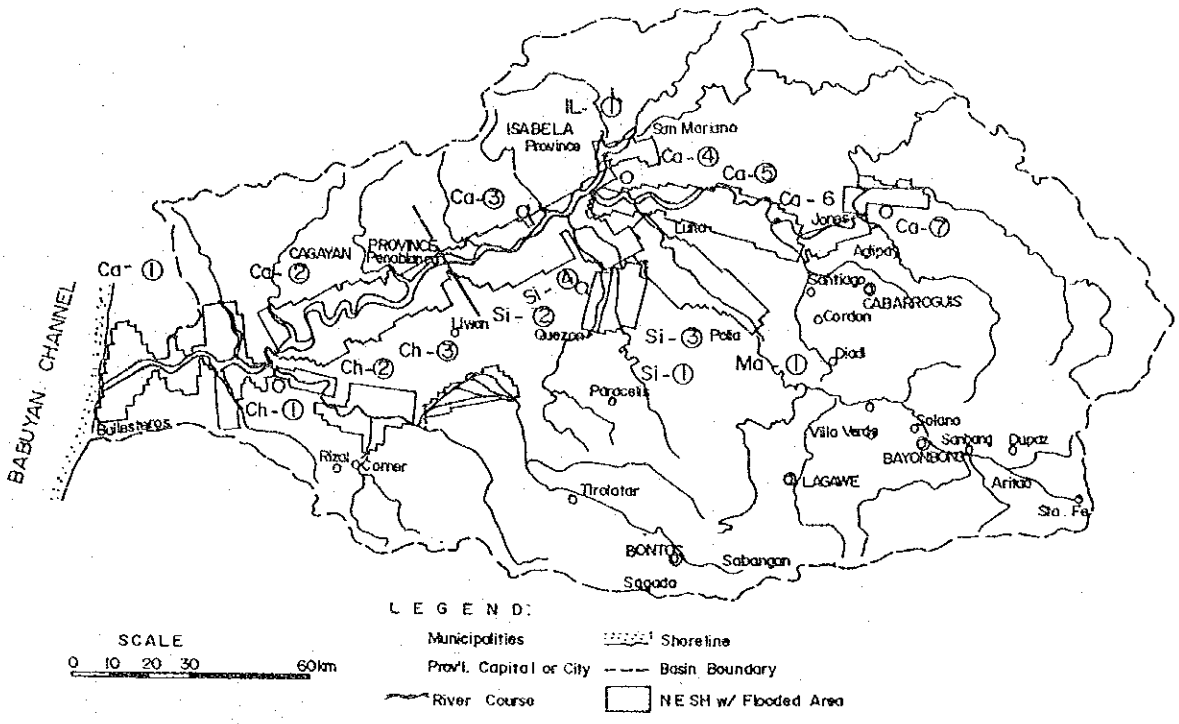


Fig. 1.4 DISCHARGE RATING CURVES AT SELECTED CROSS SECTIONS



Unit: ha

Block No. \ Return Period	1.05	2.00	5.00	10.00	25.00	50.00	100.00
Cagayan Block No. 1	1,104.1	3290.0	5,640.0	8,550.0	11,957.3	14,430.0	16,425.0
Cagayan Block No. 2	22,711.9	30,550.7	33,890.5	35,268.9	37,095.4	38,518.8	39,762.3
Cagayan Block No. 3	12,842.0	16,649.2	19,731.5	21,345.0	22,687.3	23,638.7	24,749.2
Cagayan Block No. 4	1,069.3	1,264.4	1,640.4	2,736.4	3,222.3	3,422.7	3,643.6
Cagayan Block No. 5	2,791.4	5,398.0	7,384.3	8,990.9	10,731.5	11,971.5	13,304.7
Cagayan Block No. 6	3,265.0	3,512.9	3,743.3	4,065.9	4,207.4	4,383.6	4,581.8
Cagayan Block No. 7	2,895.0	3,209.7	3,484.1	3,827.7	3,935.8	4,042.3	4,156.8
Chico Block No. 1	0.0	0.0	72.7	100.0	100.0	100.0	227.2
Chico Block No. 2	3,300.8	3,642.7	2,133.2	3,333.4	4,575.0	4,575.0	4,581.8
Chico Block No. 3	10,370.0	10,370.0	10,515.4	10,570.0	10,570.0	10,570.0	10,570.0
Siffu Block No. 1	1,591.5	1,697.7	1,720.0	1,720.0	1,775.5	1,810.0	1,861.9
Siffu Block No. 2	645.0	1,541.3	1,730.0	1,730.0	1,840.9	1,910.0	2,129.2
Siffu Block No. 3	0.0	404.5	540.0	605.5	962.6	1,170.0	1,328.6
Siffu Block No. 4	965.6	4,250.2	4,950.0	4,950.0	4,950.0	5,043.9	5,235.7
Ilagan Block No. 1	490.0	589.3	877.9	990.6	1,188.3	1,354.4	1,531.8
Magat Block No. 1	5,858.6	9,057.7	12,866.5	15,083.5	17,256.9	18,996.1	20,825.0

Fig. 1.5 INUNDATION AREA ESTIMATED UNDER PRESENT RIVER CONDITION WITH MAGAT DAM

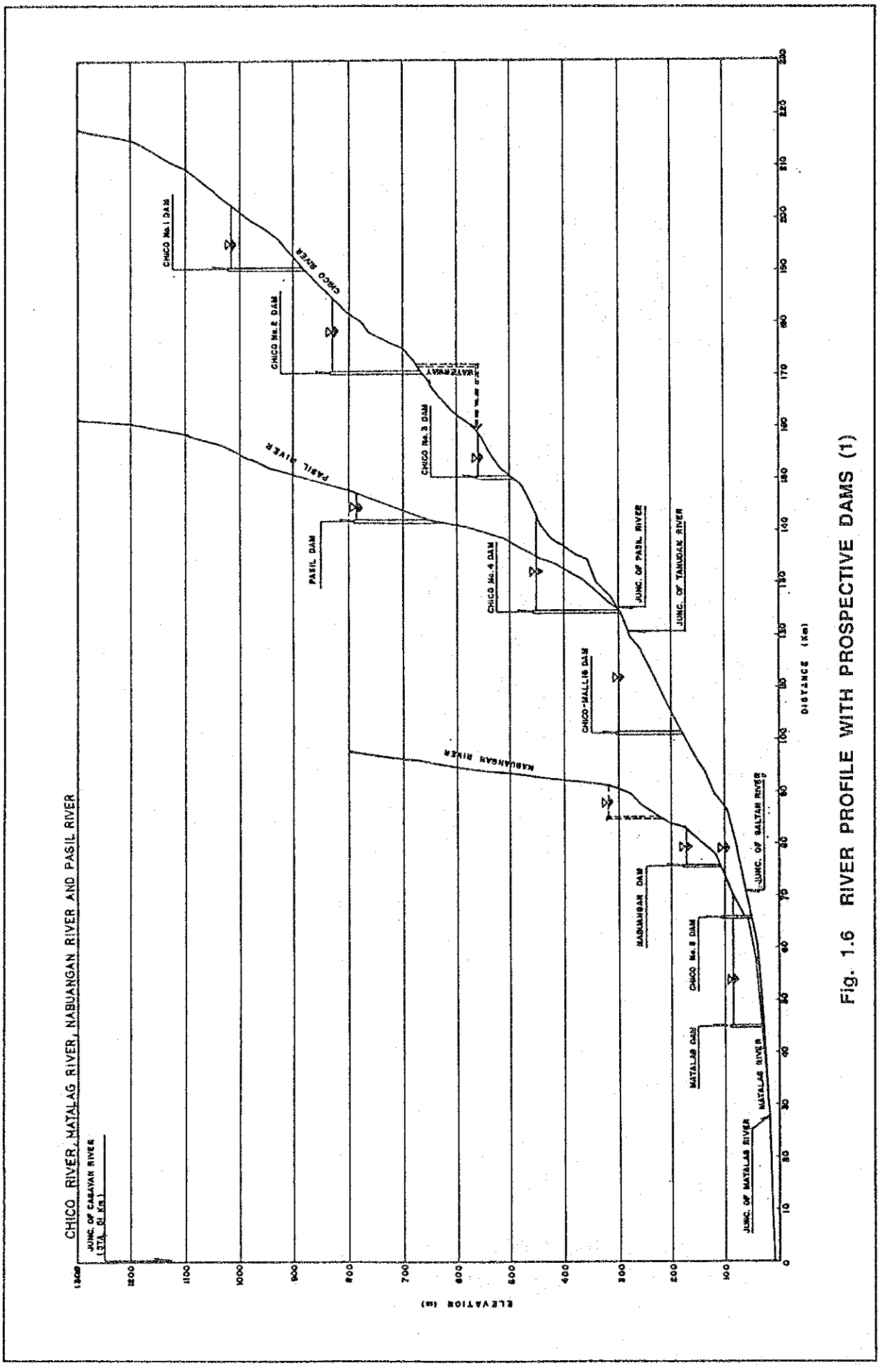


Fig. 1.6 RIVER PROFILE WITH PROSPECTIVE DAMS (1)

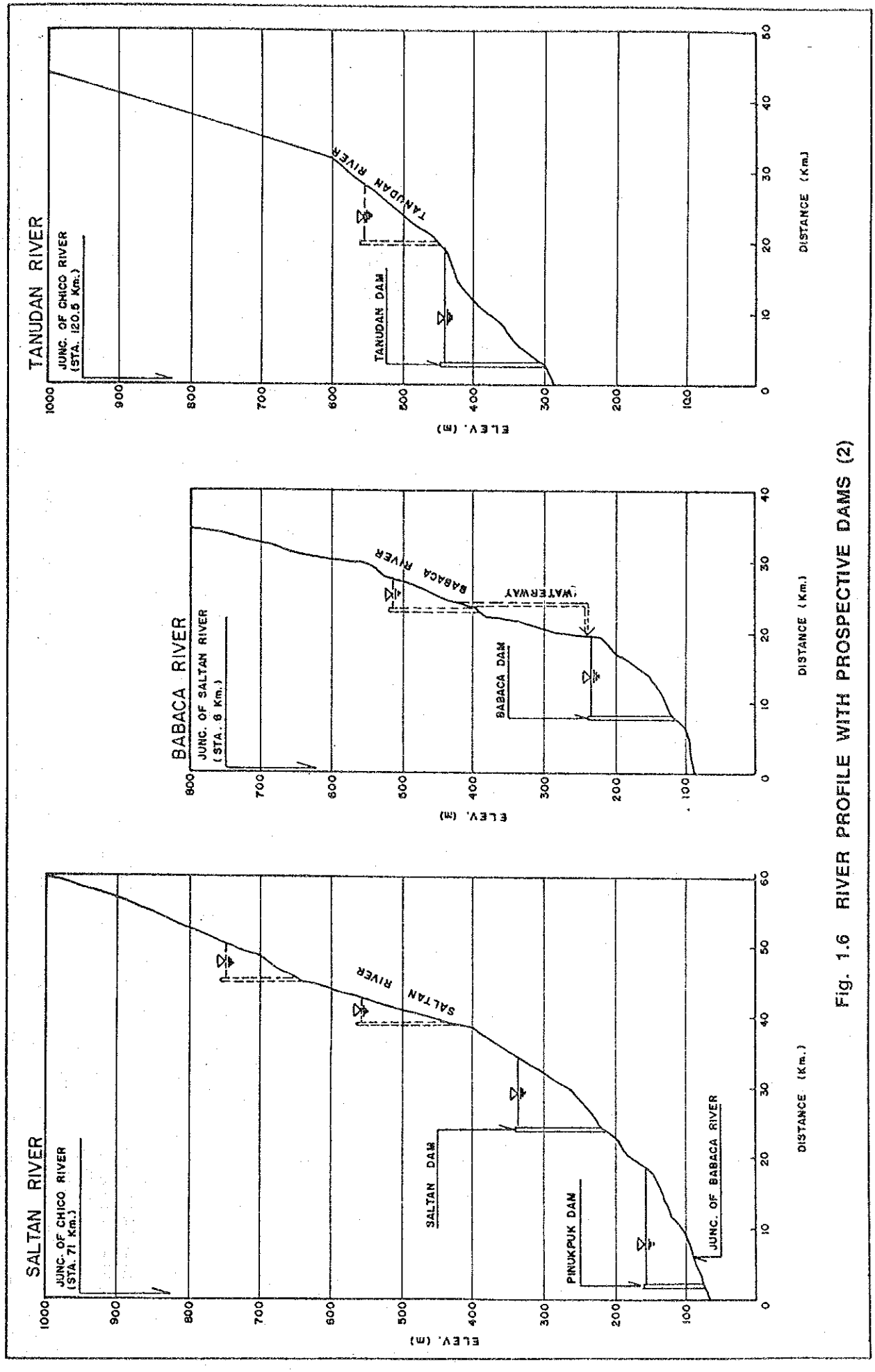
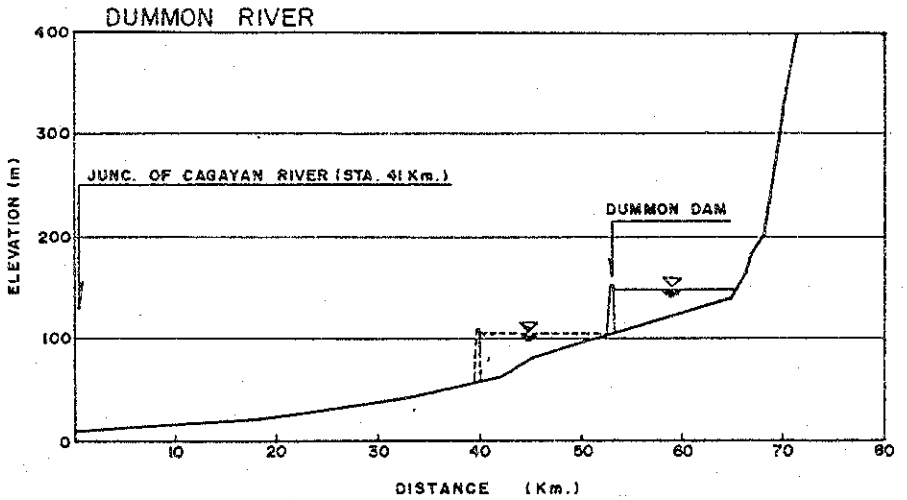
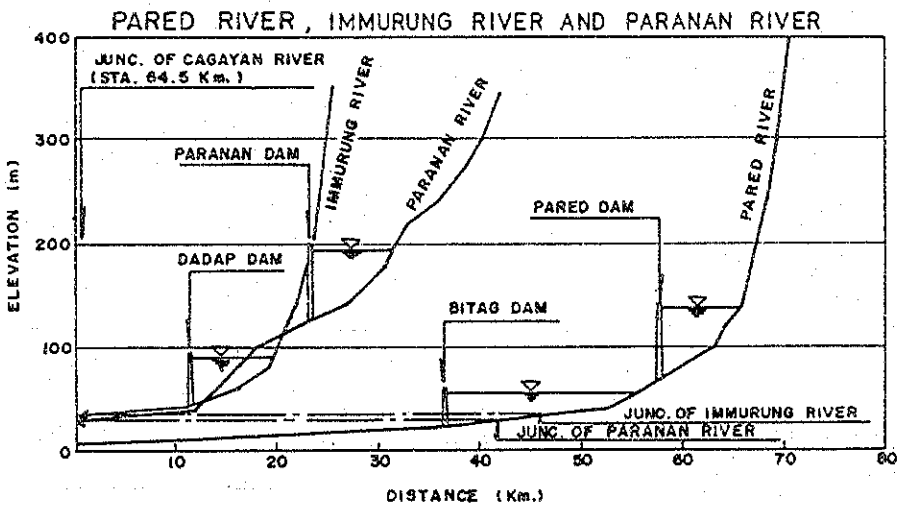


Fig. 1.6 RIVER PROFILE WITH PROSPECTIVE DAMS (2)





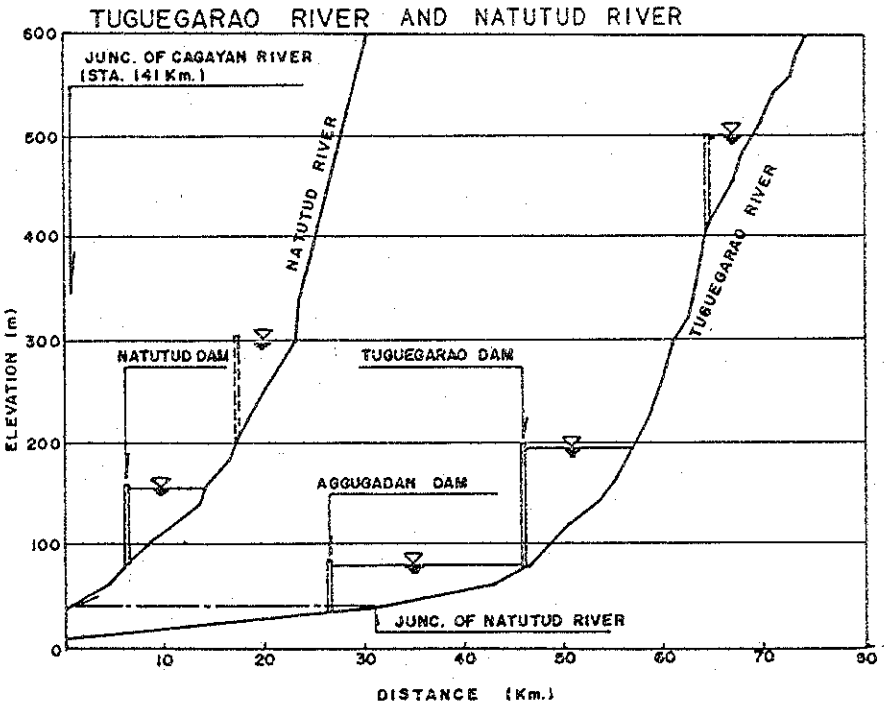
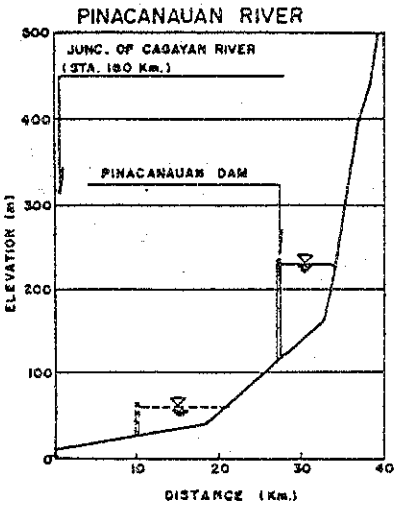
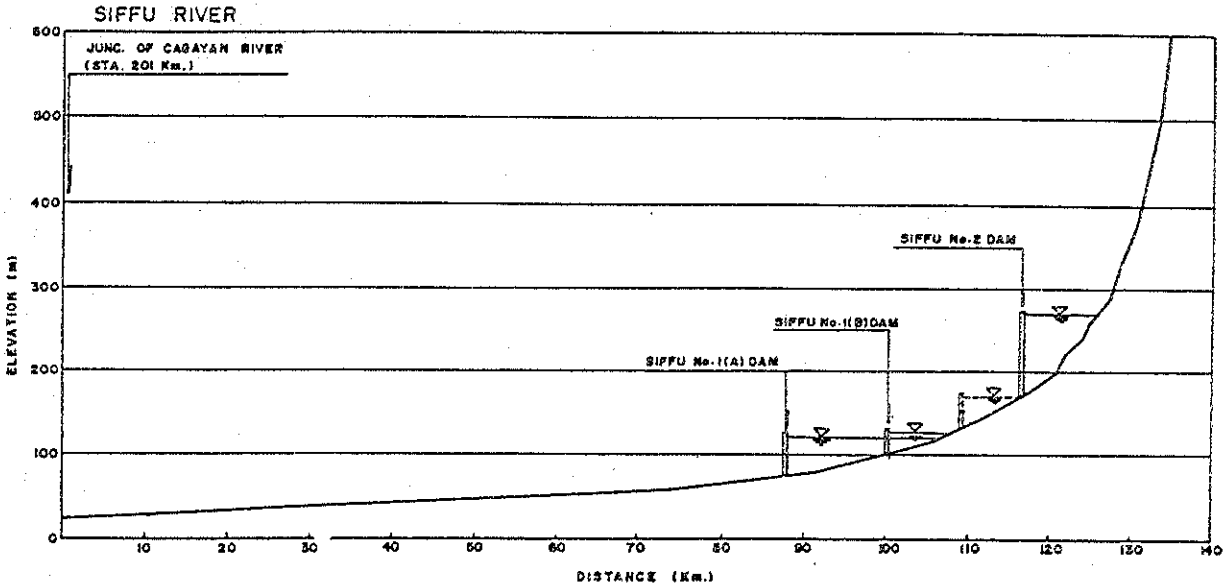
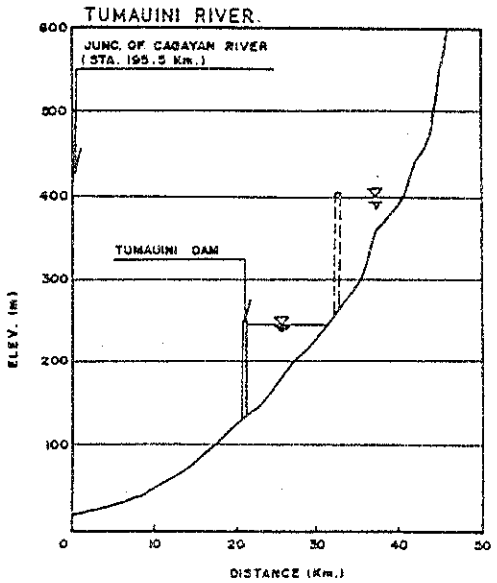


Fig. 1.6 RIVER PROFILE WITH PROSPECTIVE DAMS (3)







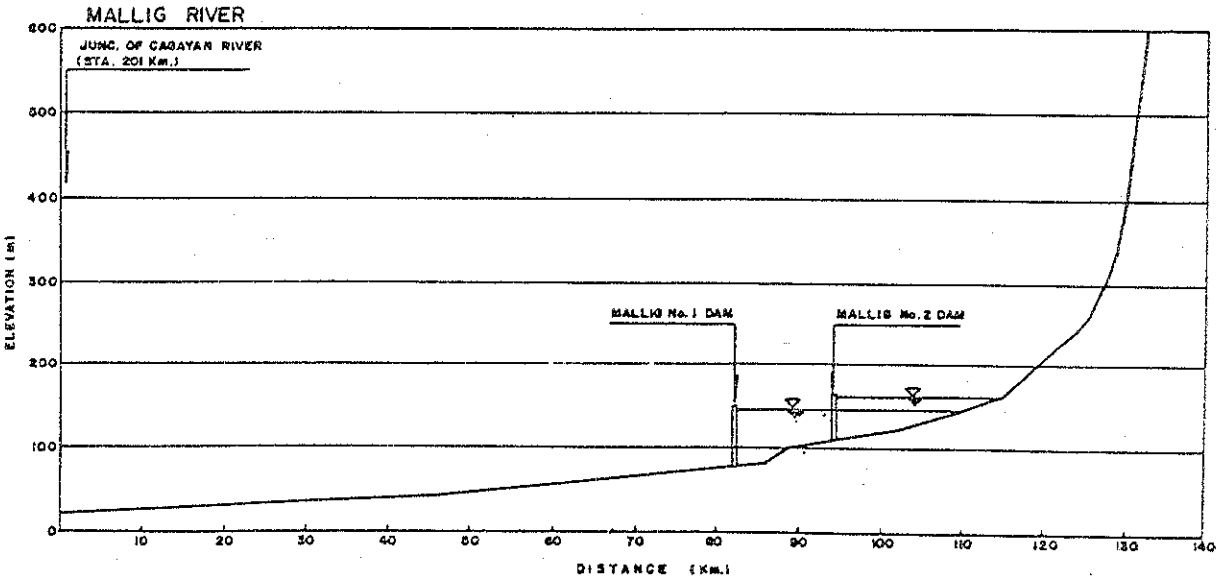


Fig. 1.6 RIVER PROFILE WITH PROSPECTIVE DAMS (4)

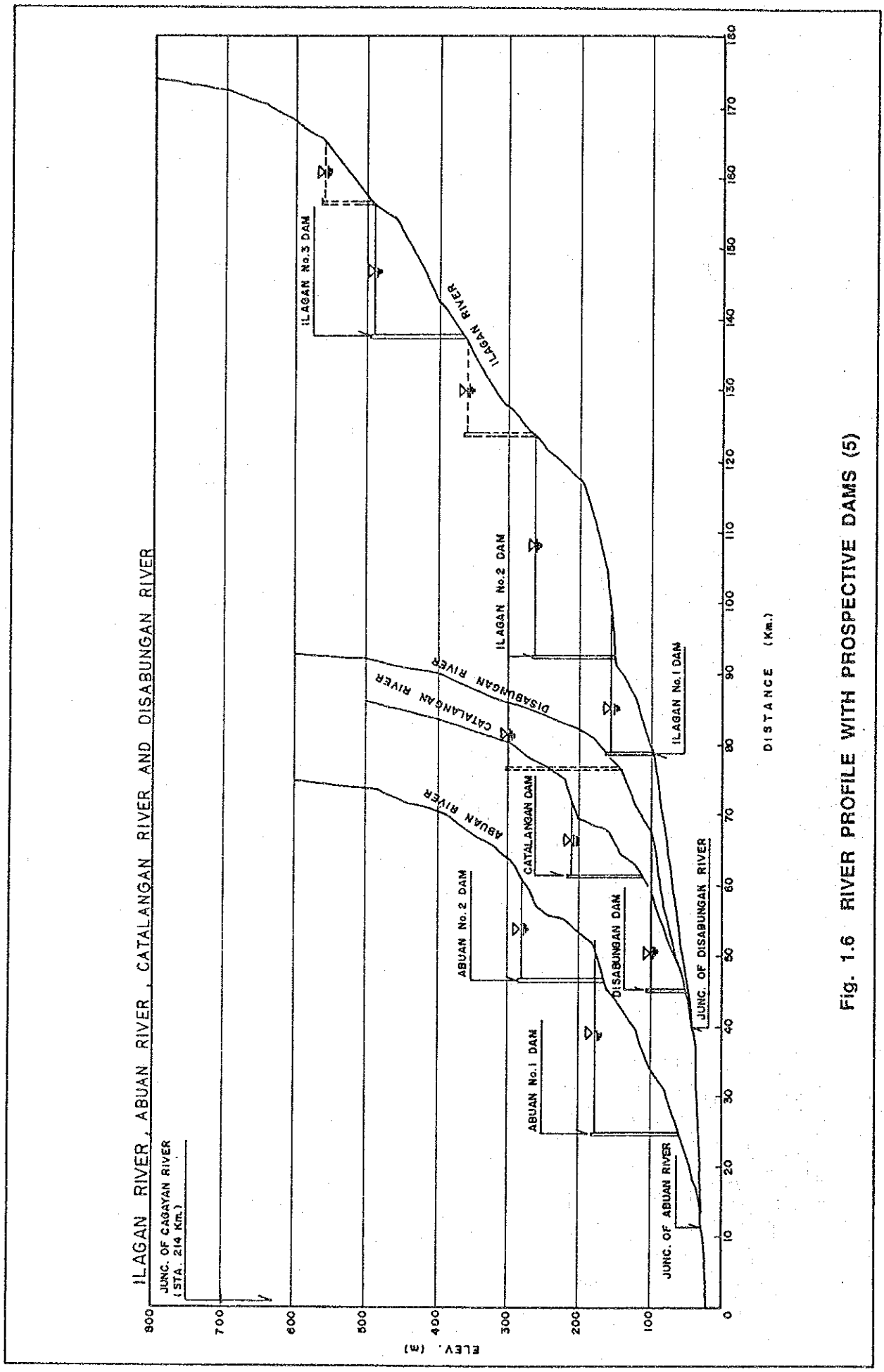


Fig. 1.6 RIVER PROFILE WITH PROSPECTIVE DAMS (5)

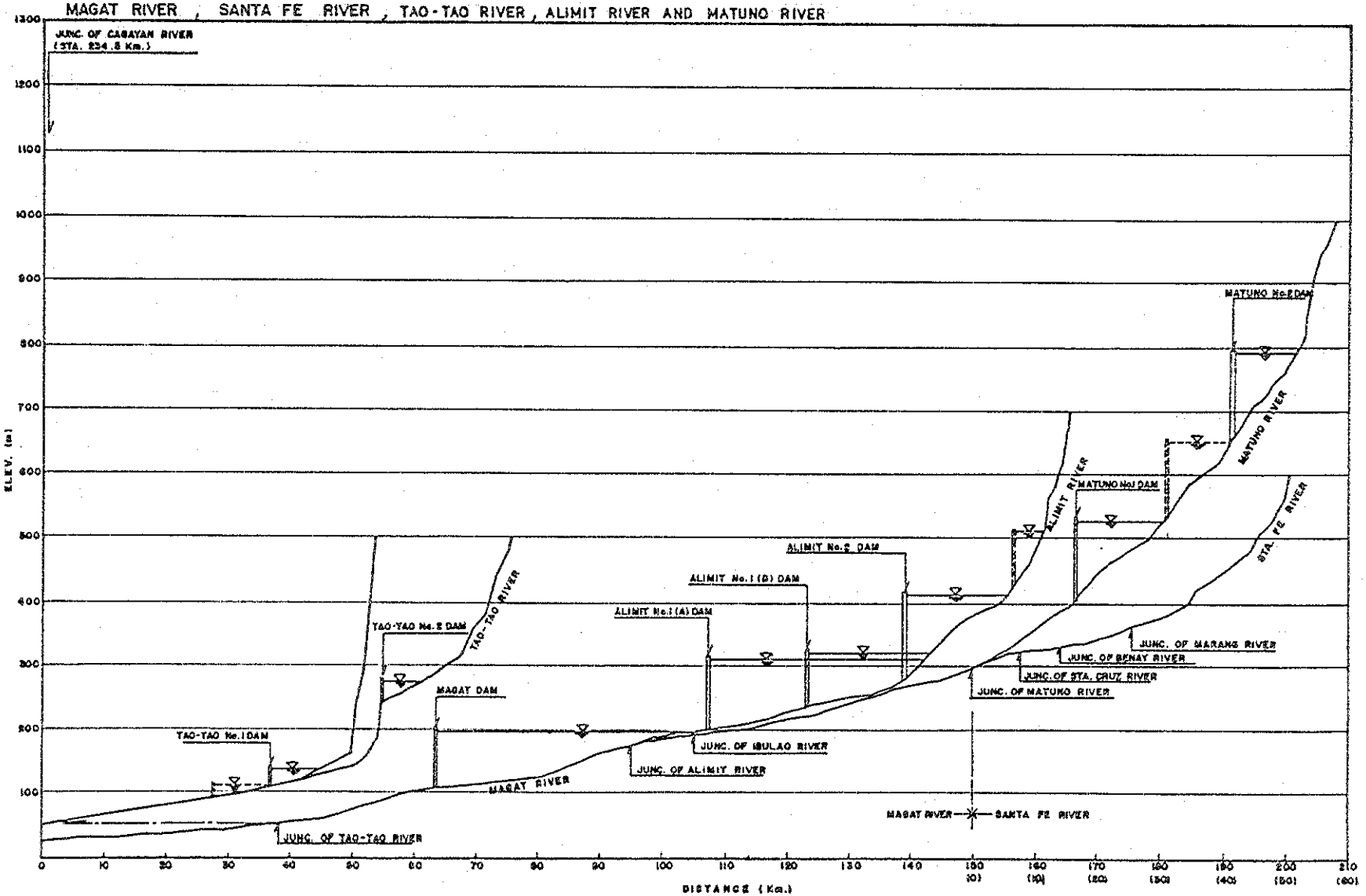


Fig. 1.6 RIVER PROFILE WITH PROSPECTIVE DAMS (6)

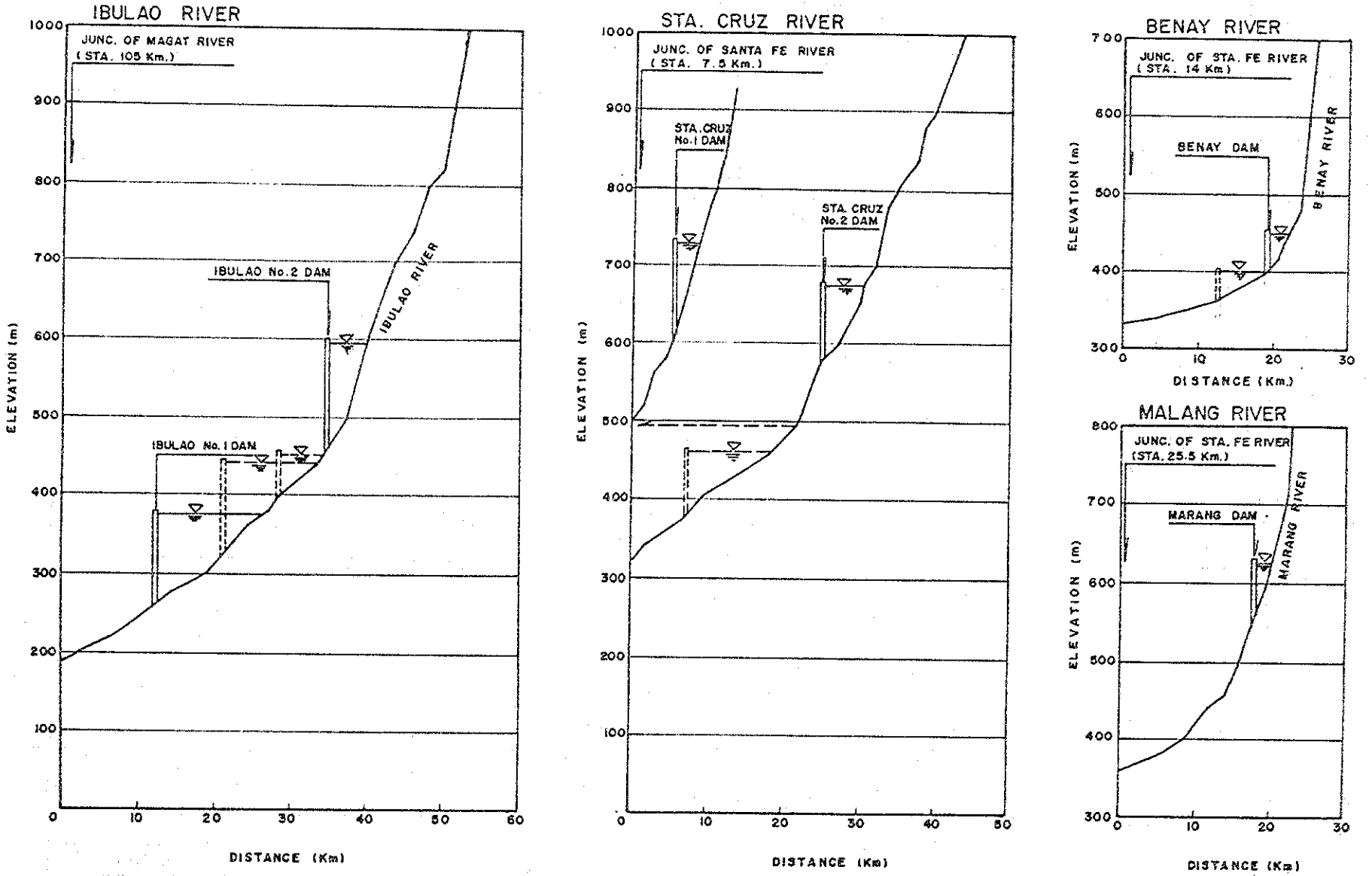


Fig. 1.6 RIVER PROFILE WITH PROSPECTIVE DAMS (7)

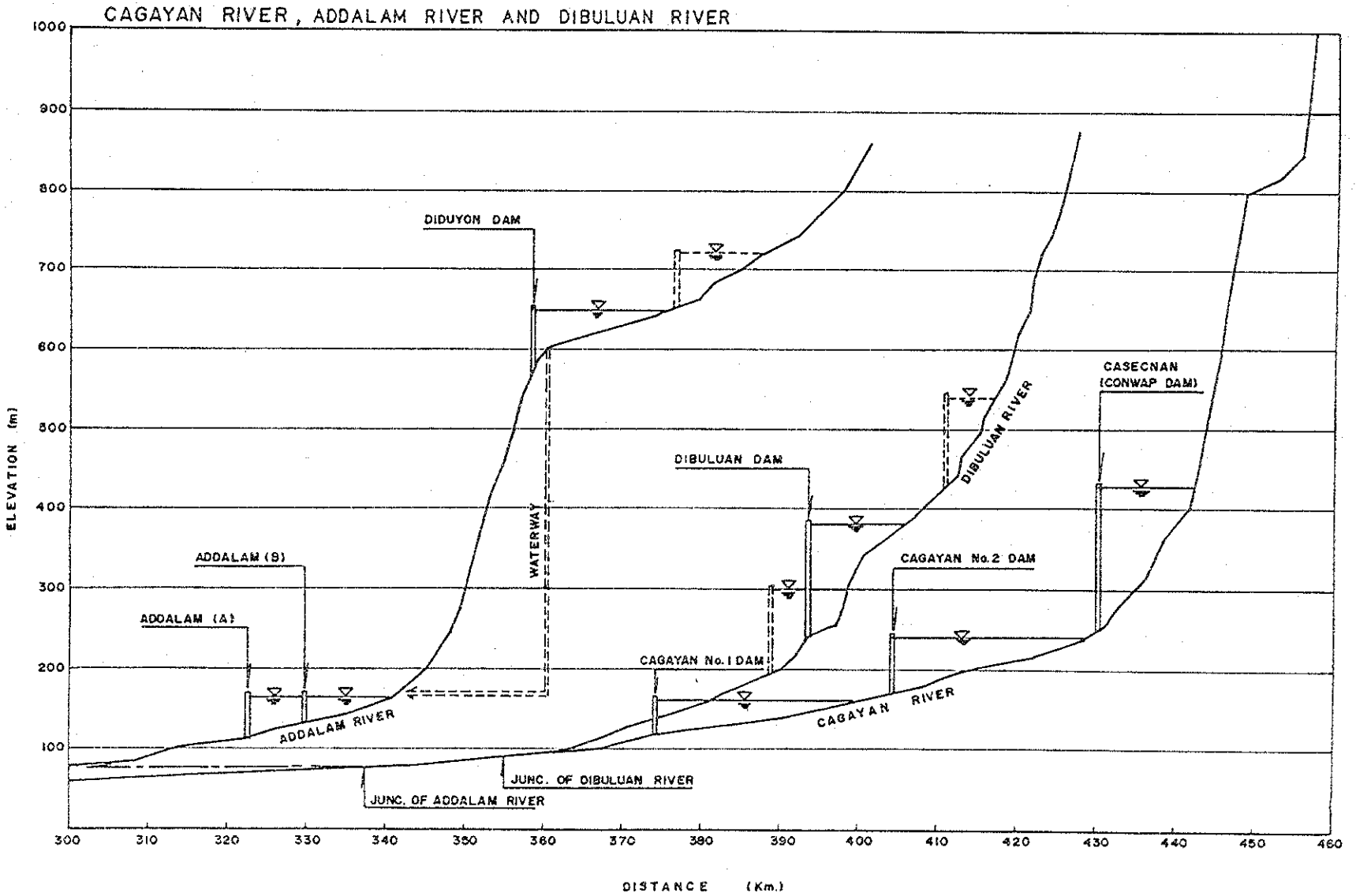


Fig. 1.6 RIVER PROFILE WITH PROSPECTIVE DAMS (8)

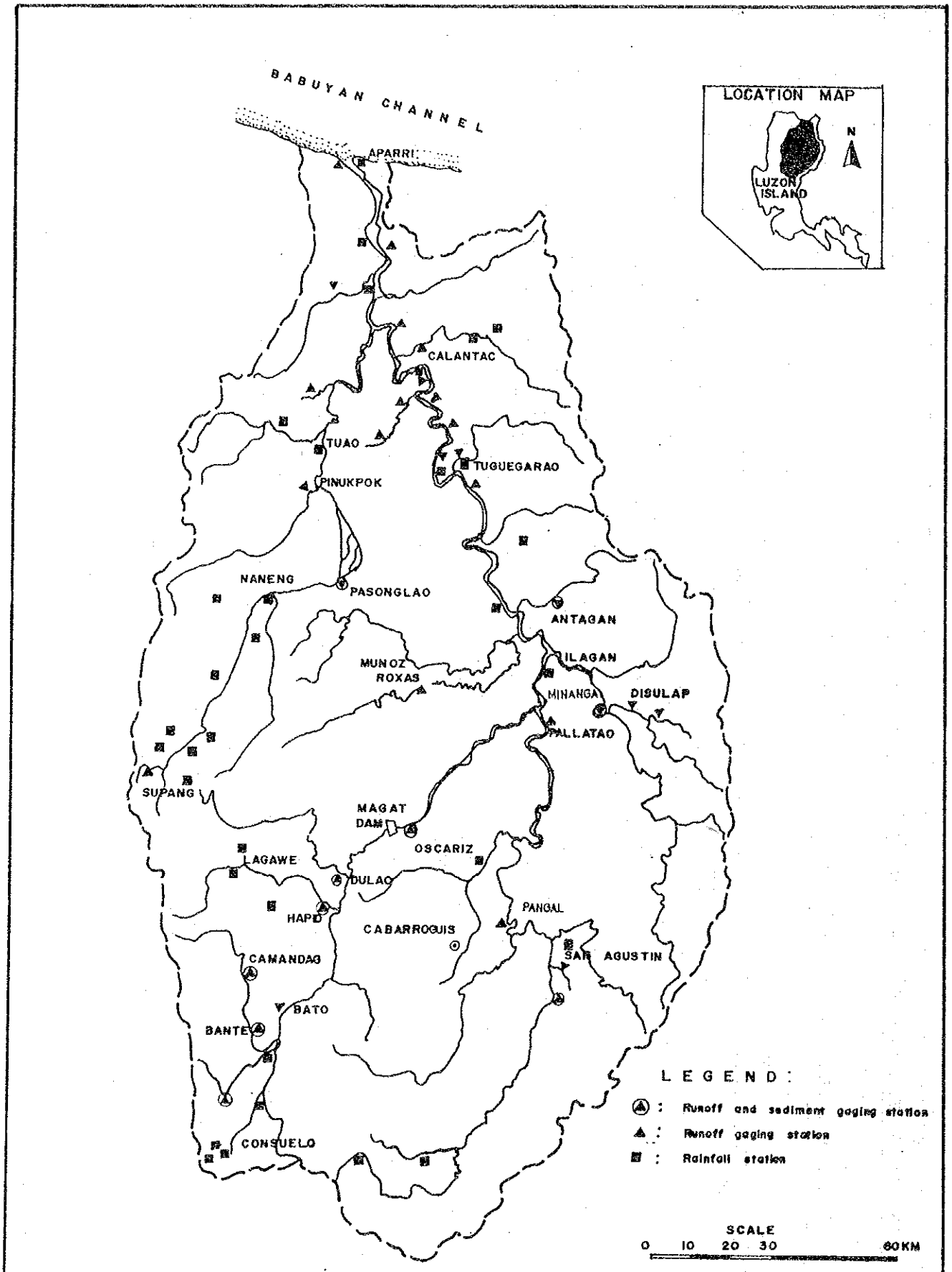


Fig. 1.7 LOCATION MAP OF RAINFALL AND RUNOFF GAUGING STATION

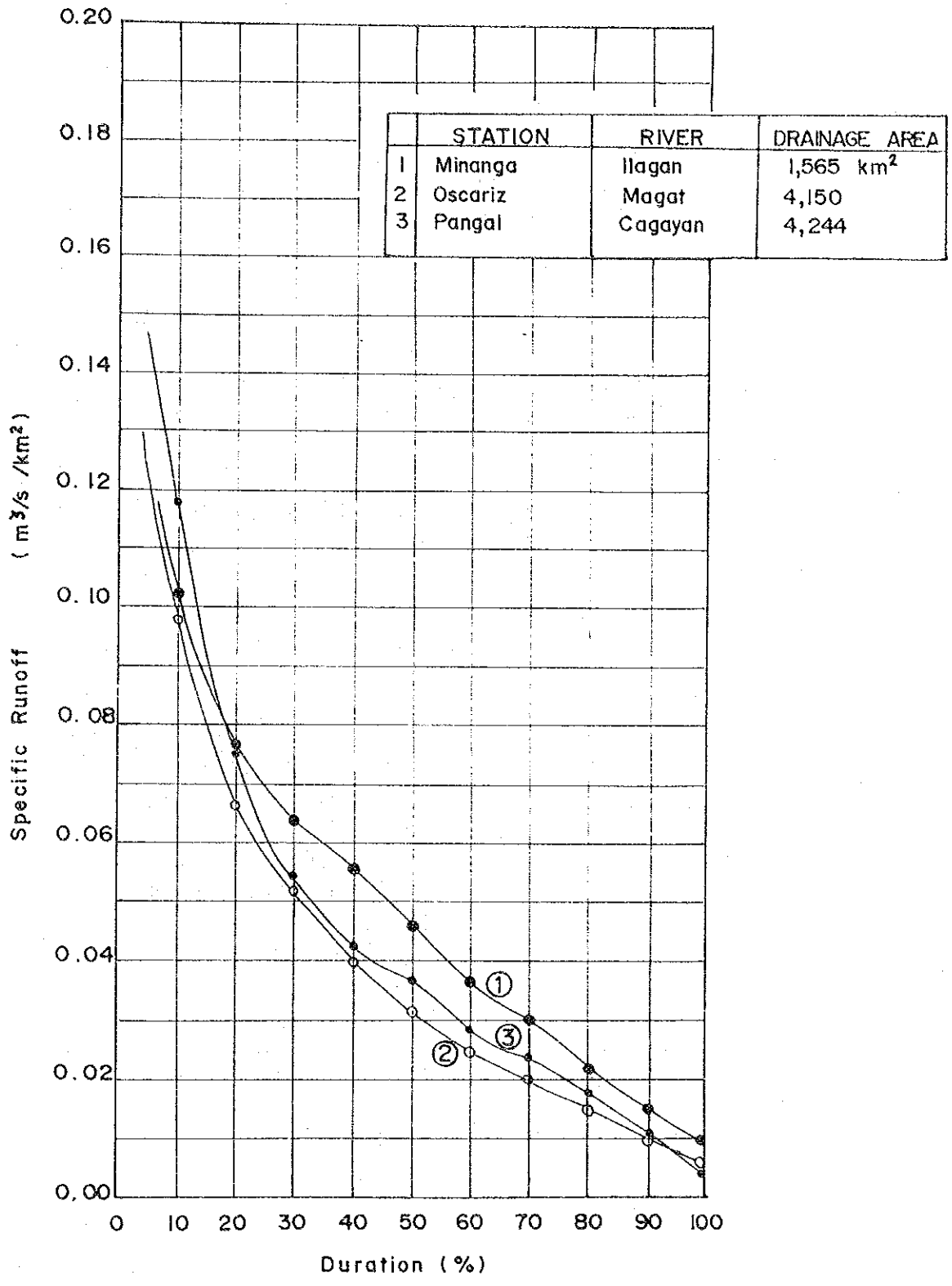
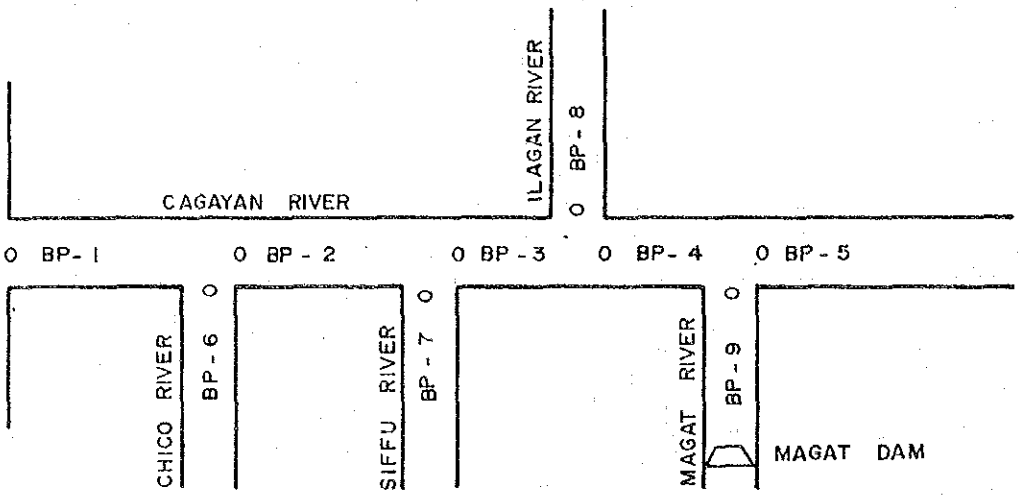


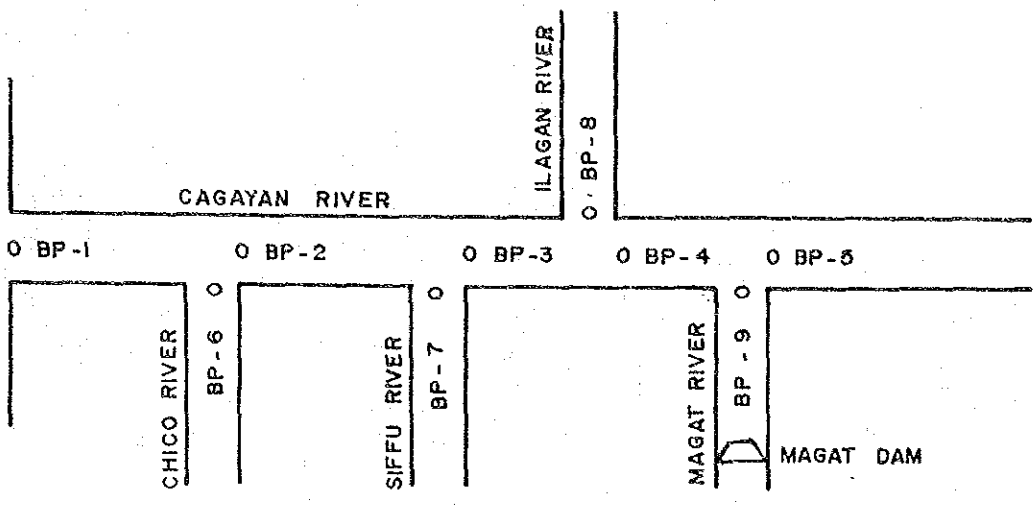
Fig. 1.8 RUNOFF DURATION CURVES AT SELECTED GAUGES



PEAK RUNOFF (m^3/s)

BASE POINT \ RETURN PERIOD (YR)	1.05	2	5	10	25	50	100
BP - 1	3,950	6,250	8,100	9,250	10,250	11,600	12,850
BP - 2	3,750	6,150	8,000	9,350	10,800	11,950	13,050
BP - 3	4,380	7,000	9,250	10,850	12,950	14,600	16,350
BP - 4	4,000	6,750	9,300	11,050	12,950	13,150	15,700
BP - 5	2,500	3,750	5,250	6,300	8,000	9,200	10,500
BP - 6	1,950	2,850	3,500	3,950	4,350	4,700	5,150
BP - 7	1,000	1,450	2,000	2,400	2,900	3,250	3,600
BP - 8	1,600	2,800	3,750	4,400	5,250	5,650	6,450
BP - 9	2,100	3,400	4,600	5,450	6,700	7,650	8,650

Fig. 1.9 DISTRIBUTION OF FLOOD RUNOFF UNDER PRESENT RIVER CONDITION WITH MAGAT DAM



PEAK RUNOFF (m^3/s)

BASE POINT \ RETURN PERIOD (YR)	10	25	50	100
BP- 1	17,000	19,500	21,400	23,100
BP - 2	17,000	19,500	21,400	23,100
BP - 3	17,000	19,500	21,400	23,100
BP - 4	15,700	17,100	19,700	22,400
BP - 5	7,900	10,200	11,200	13,450
BP - 6	4,050	5,000	5,700	6,480
BP - 7	2,550	3,200	3,750	4,300
BP - 8	5,200	6,350	7,250	8,000
BP - 9	8,050	9,900	11,300	12,600

Fig. 1.10 DISTRIBUTION OF FLOOD RUNOFF UNDER FLOOD CONTROL SCHEME WITH CONFINING DIKES AND MAGAT DAM

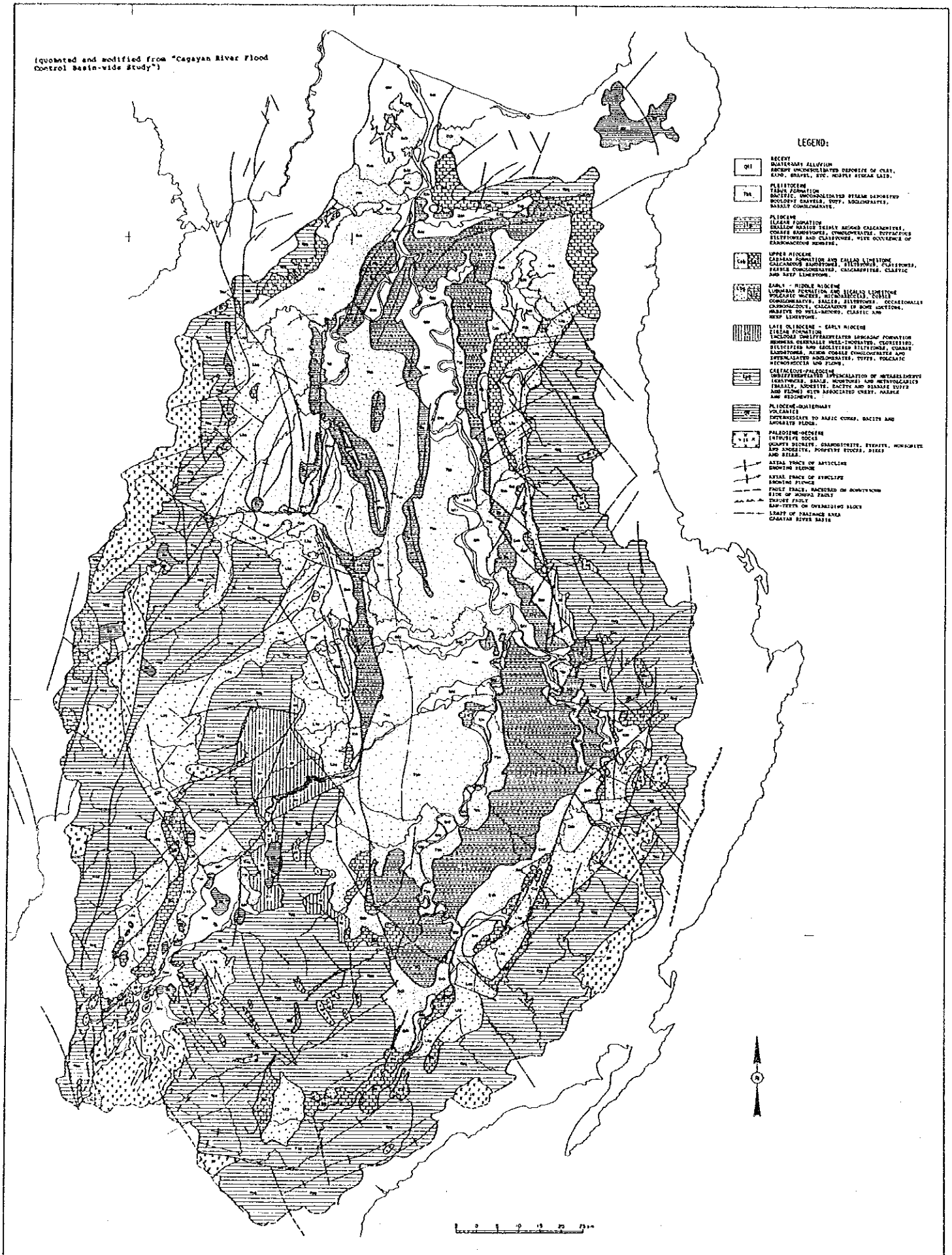


Fig. 1.11 GEOLOGICAL MAP OF CAGAYAN RIVER BASIN

No.	Name of Dam
1	GUISING
2	BULAGAO
3	SAN LUIS
4	ASASSI
5	NABIALAN
6	MAGOGOD
7	MANALO
8	MAROBBOB
9	STA. BARBARA
10	BAYO
11	SAN JUAN
12	LIWAN NORTE
13	KINAMA
14	LIWAN WEST
15	SANTOR
16	MAGLATAC 1
17	MAGLATAC 2
18	MINAGBAG
19	LAGUINDAY
20	BUBUG
21	SAN VICENTE
22	STO. ROSARIO
23	MAUI
24	CARMENCITA
25	MIGUEL
26	MANGGA
27	MALALAO
28	TUROD
29	RANG-AYAN 1
30	RANG-AYAN 2
31	SINAMAR
32	SAN RAFAEL
33	MATUSALEM
34	EDEN
35	MAPAPI
36	MANGCURAM
37	PASA
38	FUYO
39	YEBAN
40	SAN FRANCISCO
41	SONG SONG
42	GUIBANG
43	BAGONG
44	STA. MARIA
45	CALAOCAN
46	BANNAWAG
47	LINGLINGAY
48	COLORADO
49	LOURDES
50	SALVACION
51	SAN FELIPE
52	BACRADAL
53	SAN SEBASTIAN
54	BELLO
55	FERMIN
56	SAN MARCOS

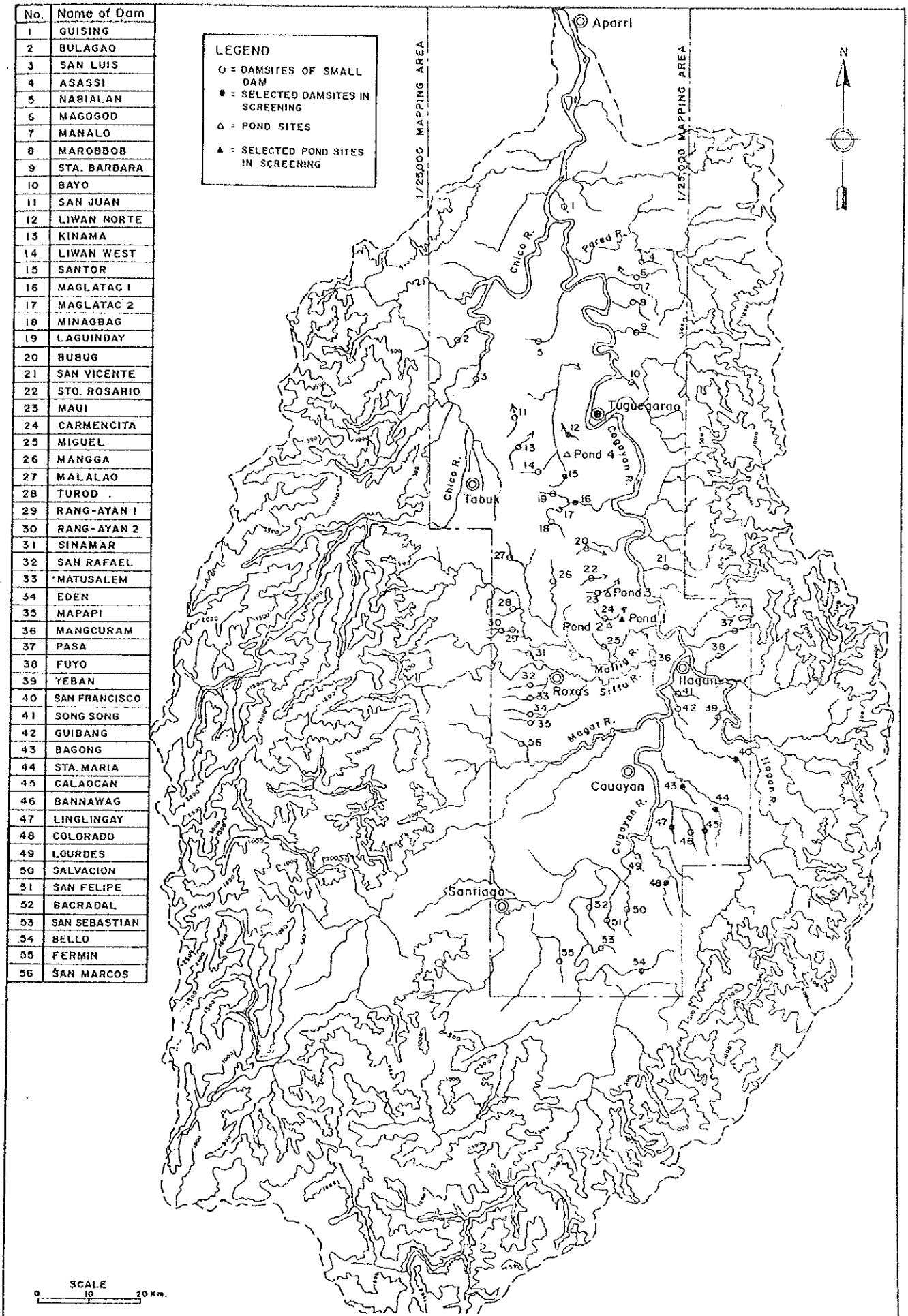


Fig. 2.1 LOCATION MAP OF SMALL DAM AND POND

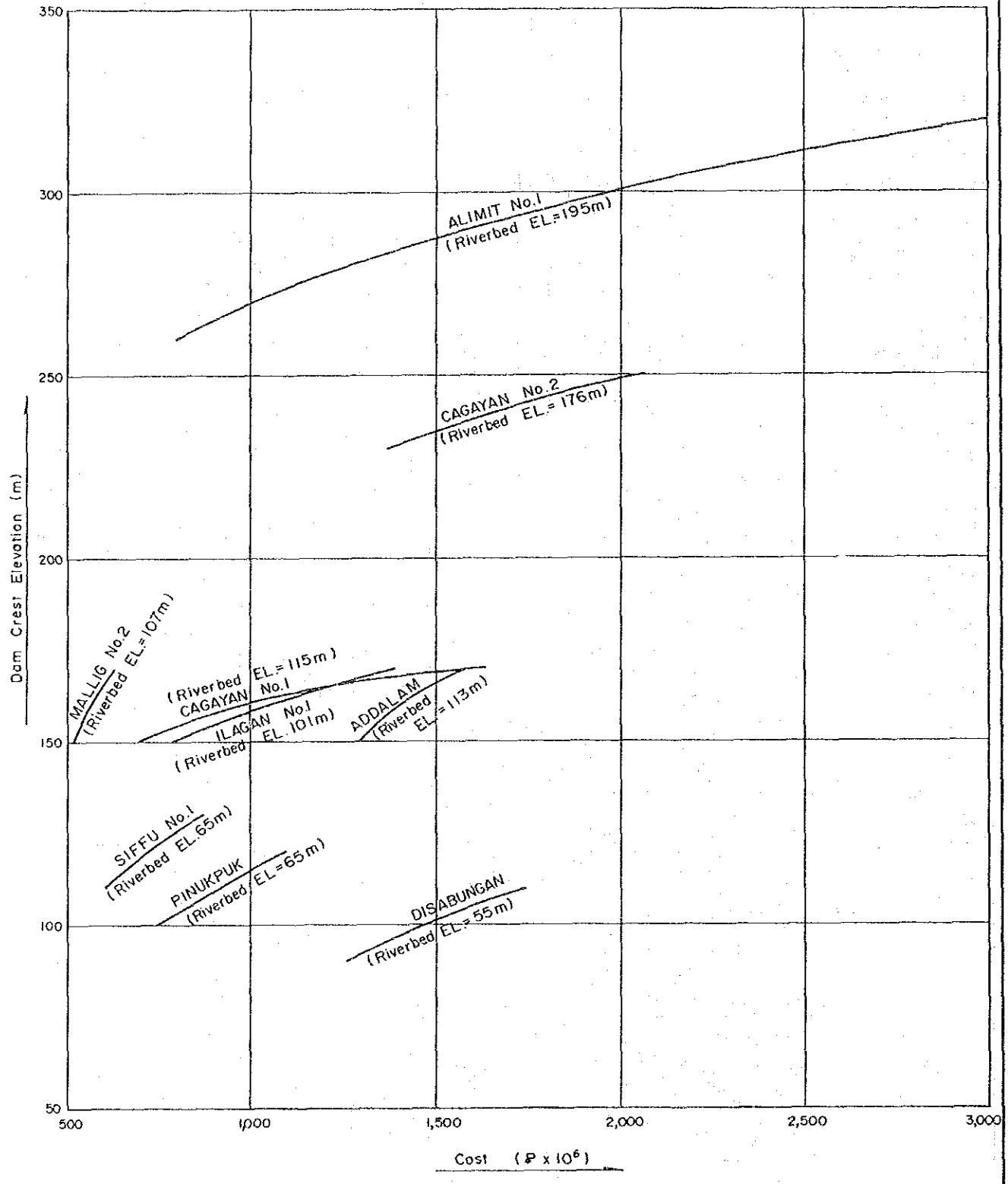


Fig. 4.1 TOTAL CONSTRUCITON COST OF CIVIL WORKS FOR DIVERSION, DAM AND SPILLWAY

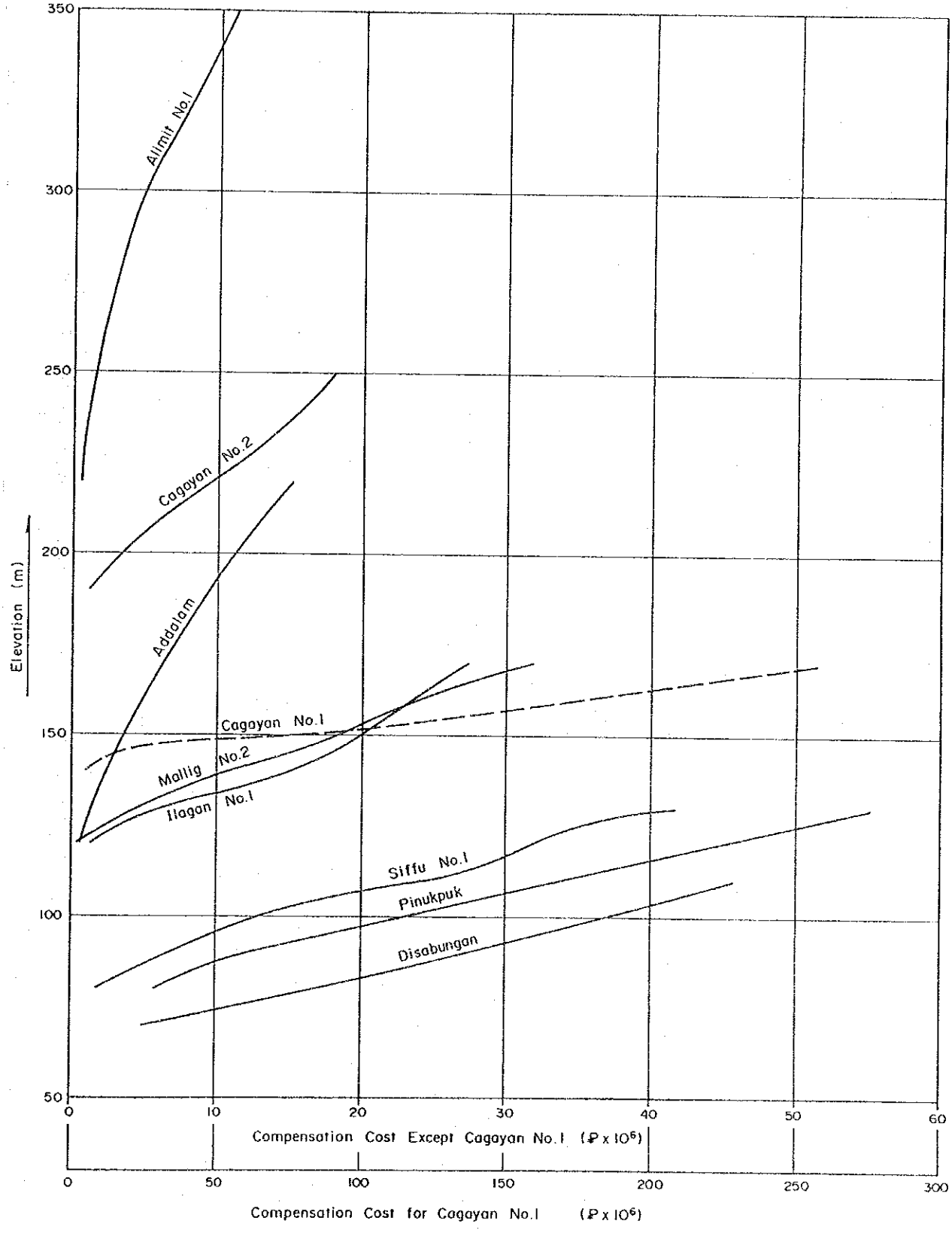


Fig. 4.2 COMPEMSATION COST FOR DAM DEVELOPMENT

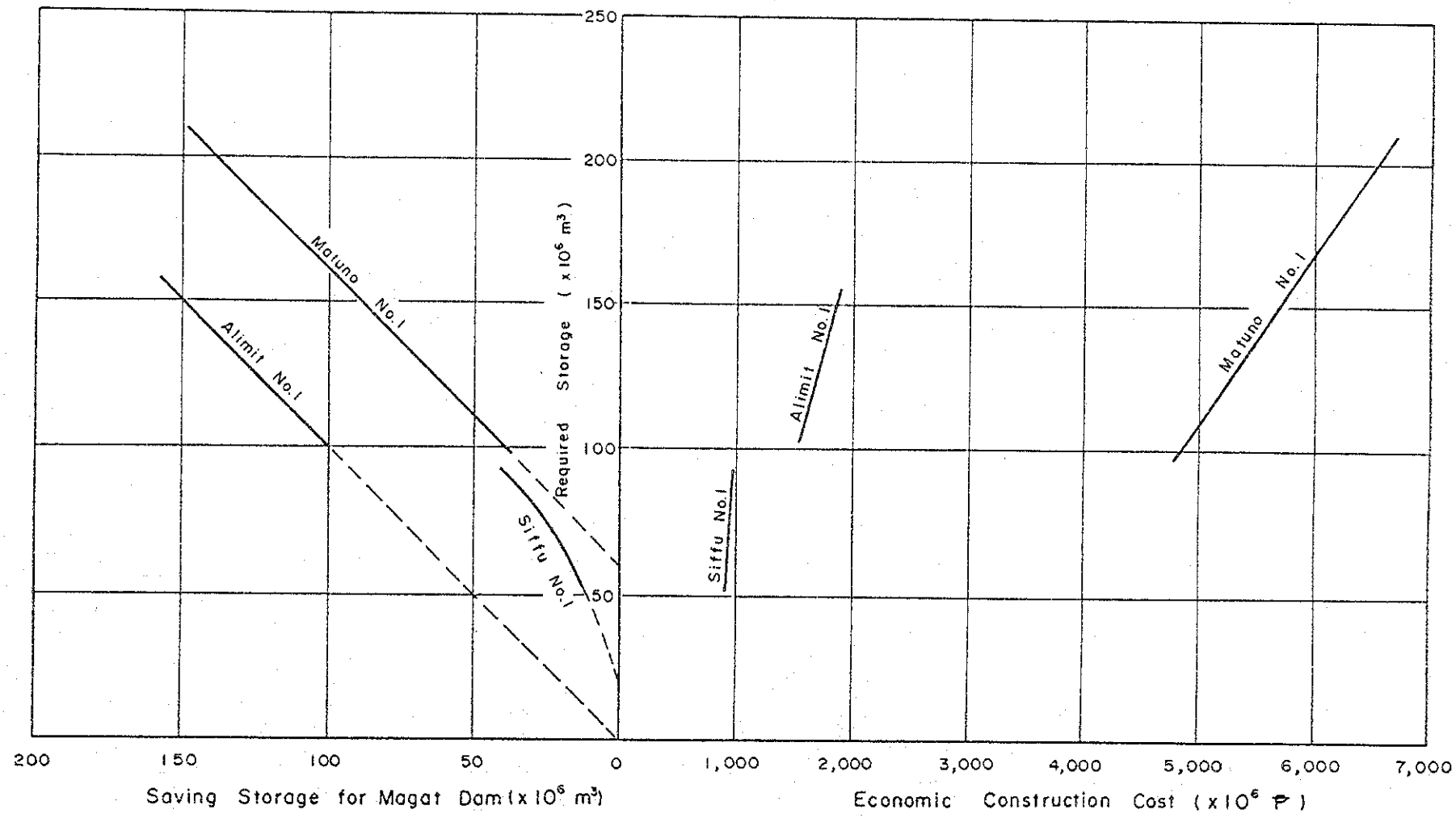


Fig. 5.1 COST ESTIMATE FOR SAVING STORAGE OF MAGAT RESERVOIR

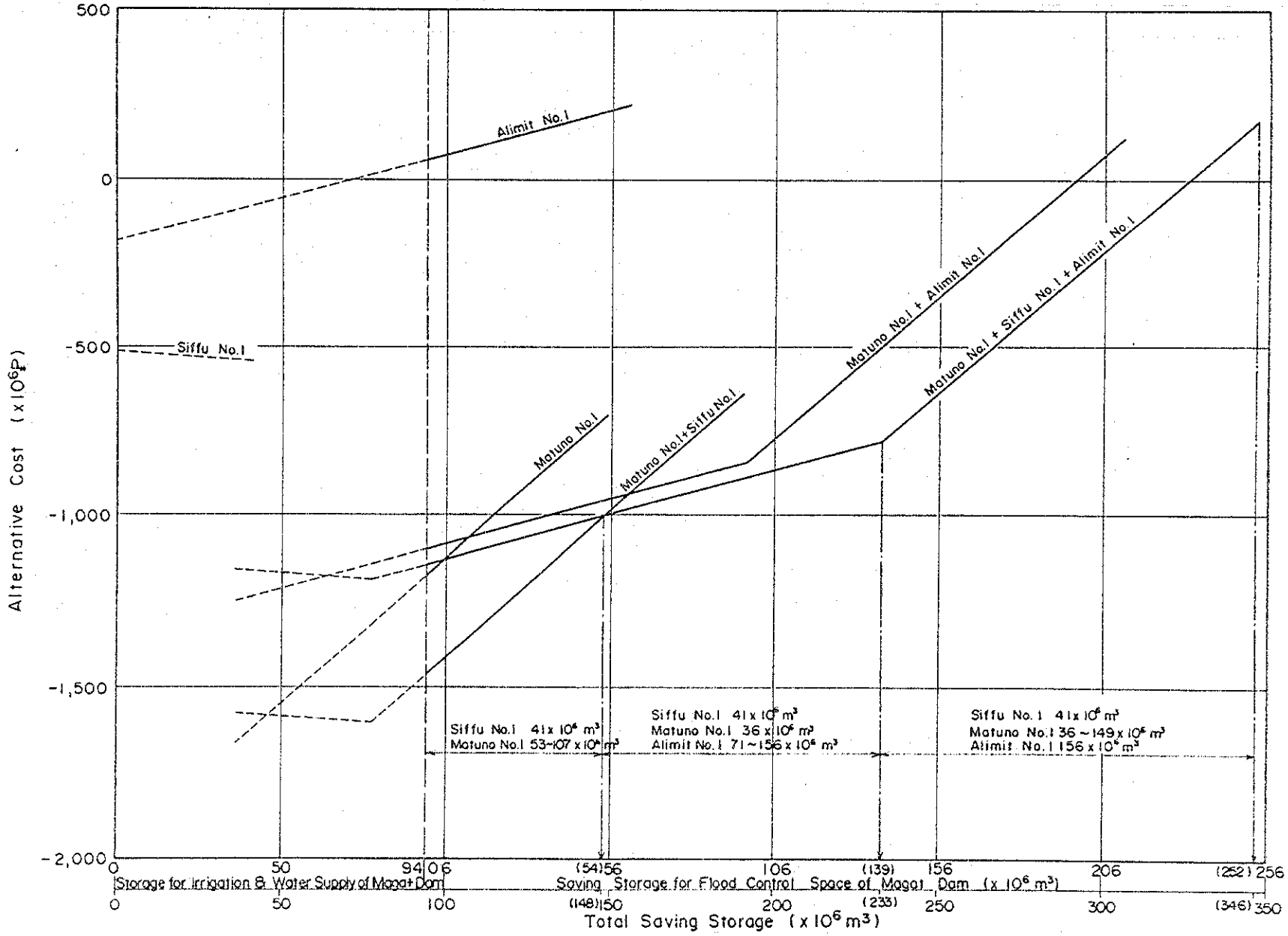
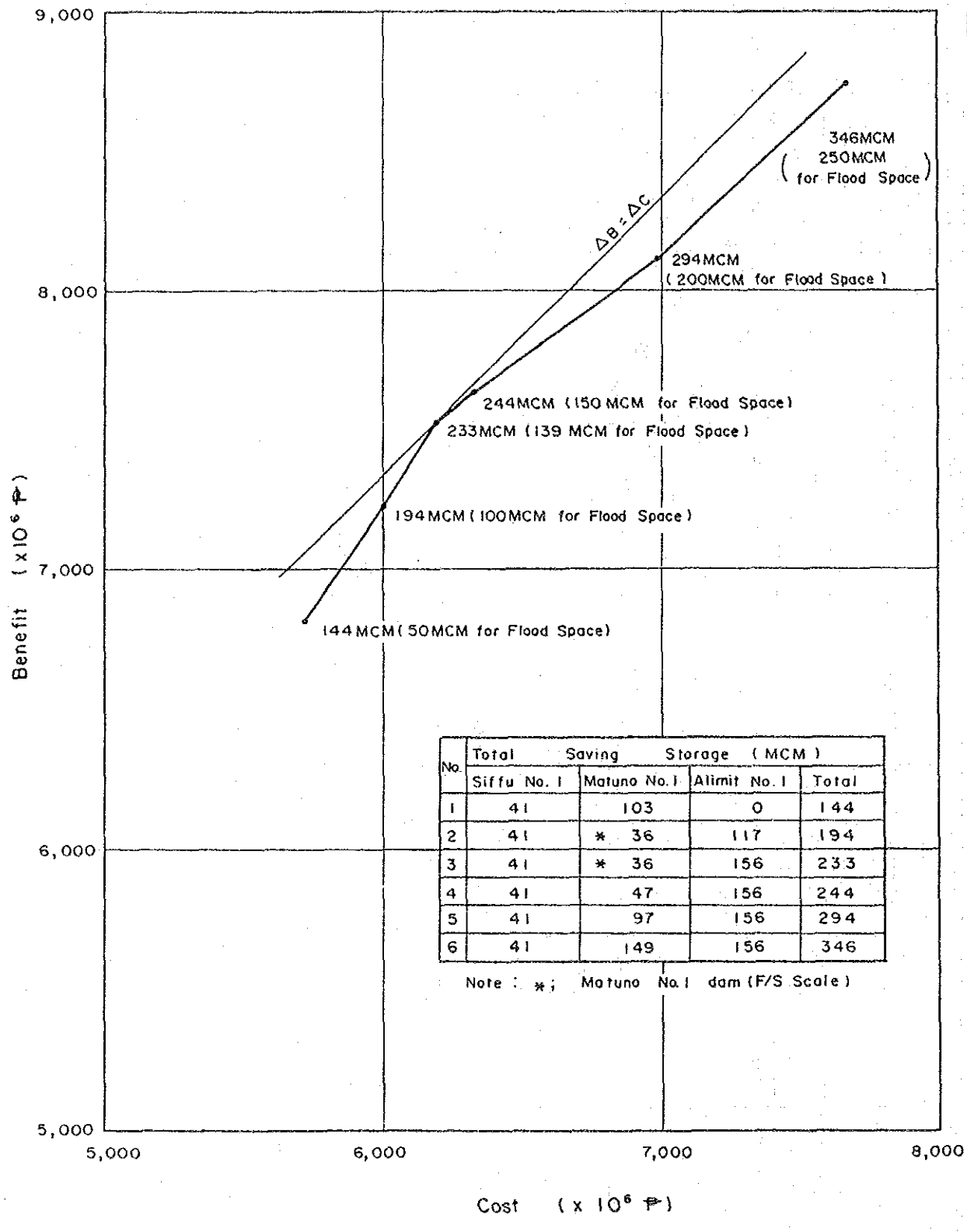


Fig. 5.2 LEAST COSTLY ALTERNATIVES



No.	Total Saving Storage (MCM)			
	Siffu No. 1	Matuno No. 1	Alimit No. 1	Total
1	41	103	0	144
2	41	* 36	117	194
3	41	* 36	156	233
4	41	47	156	244
5	41	97	156	294
6	41	149	156	346

Note : *; Matuno No. 1 dam (F/S Scale)

Fig. 5.3 BENEFITS AND COSTS FOR ALTERNATIVE SPACES OF MAGAT RESERVOIR

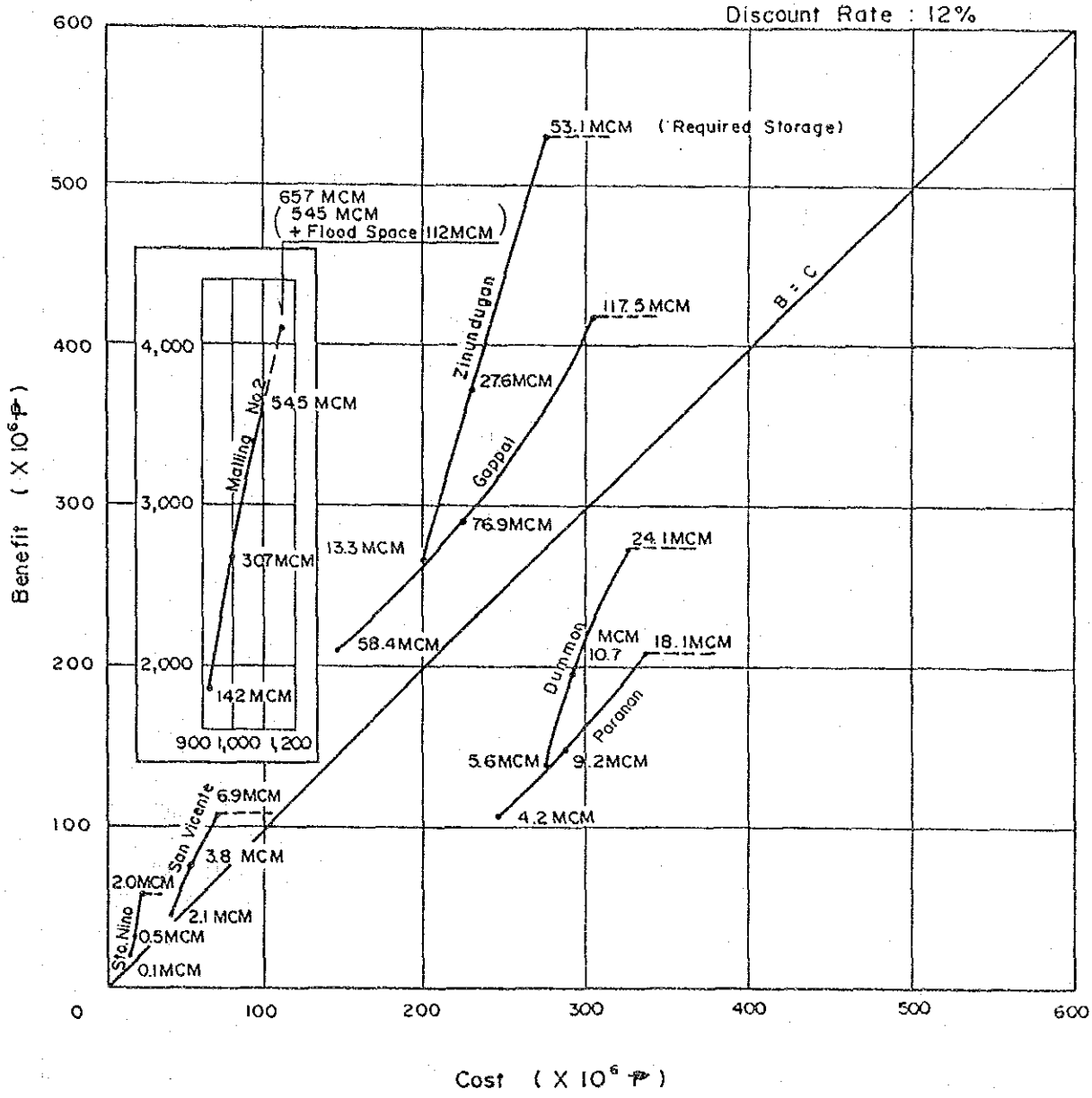


Fig. 5.4 BENEFITS AND COSTS FOR ALTERNATIVE SCALES OF DAM

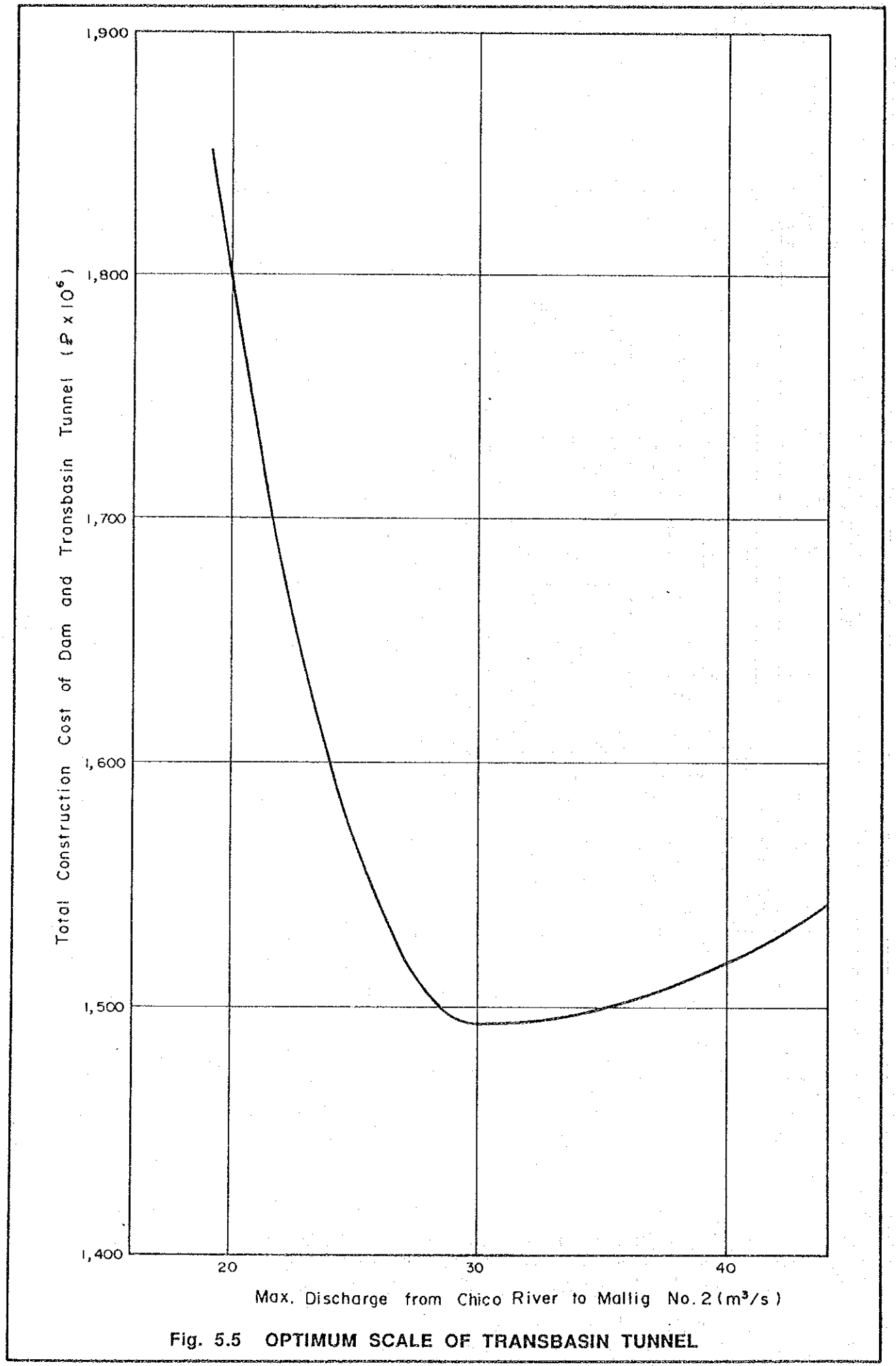


Fig. 5.5 OPTIMUM SCALE OF TRANSBASIN TUNNEL

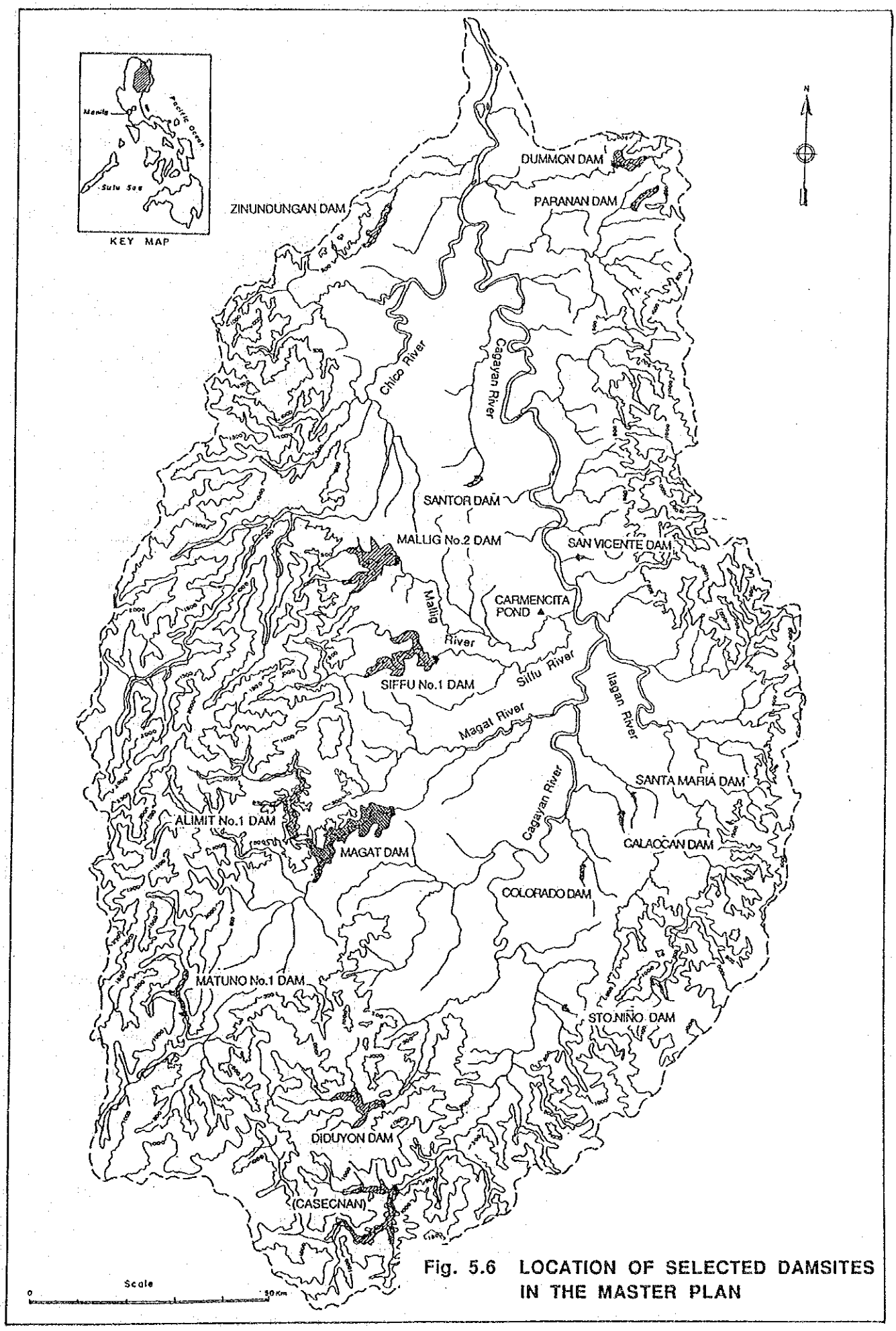


Fig. 5.6 LOCATION OF SELECTED DAMSITES IN THE MASTER PLAN

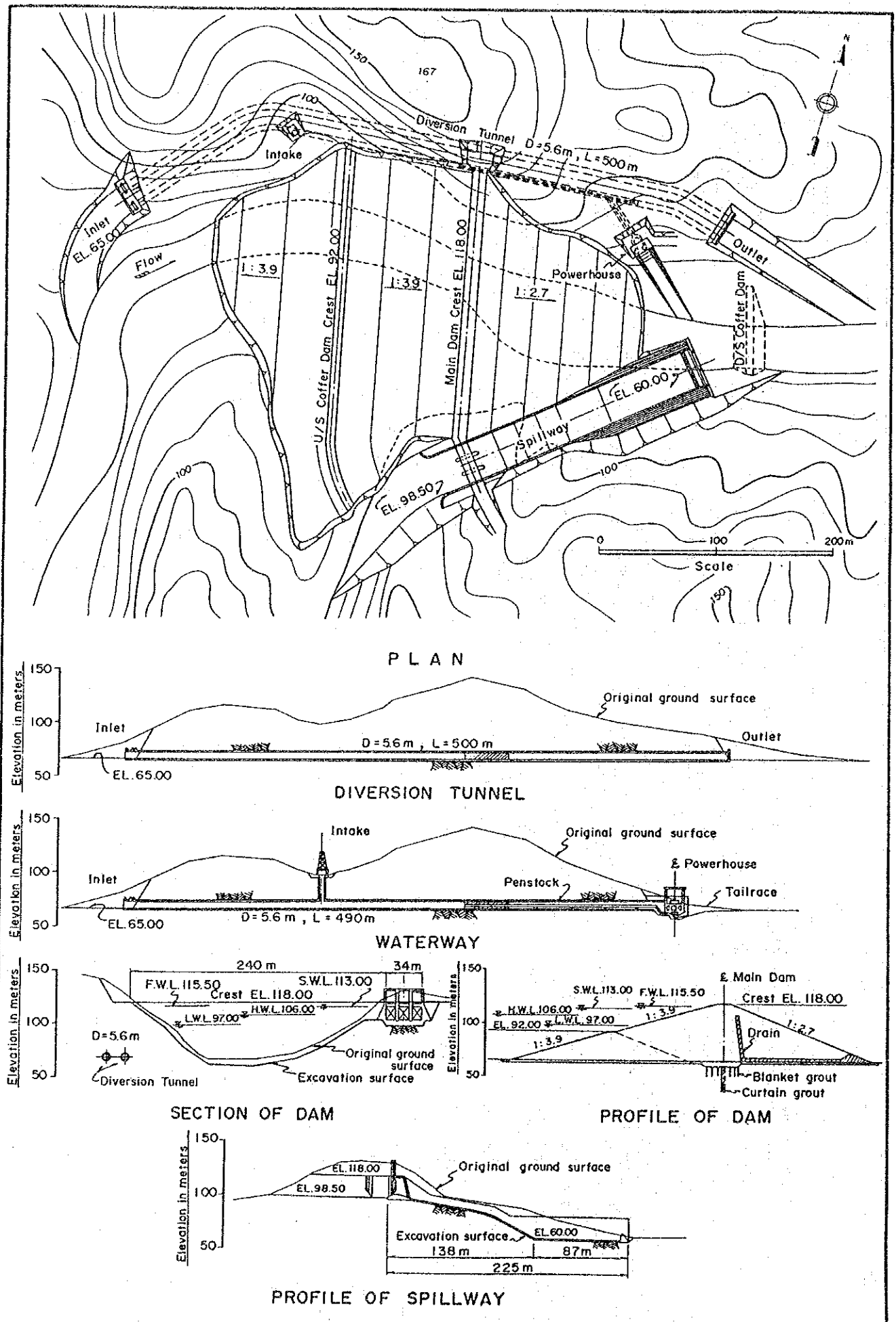
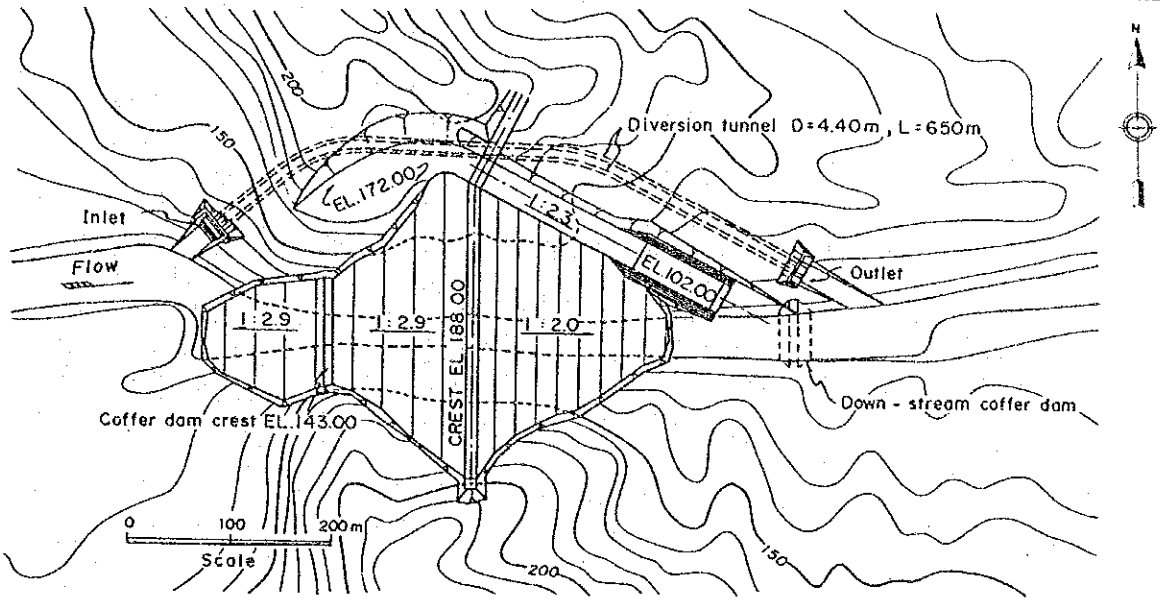
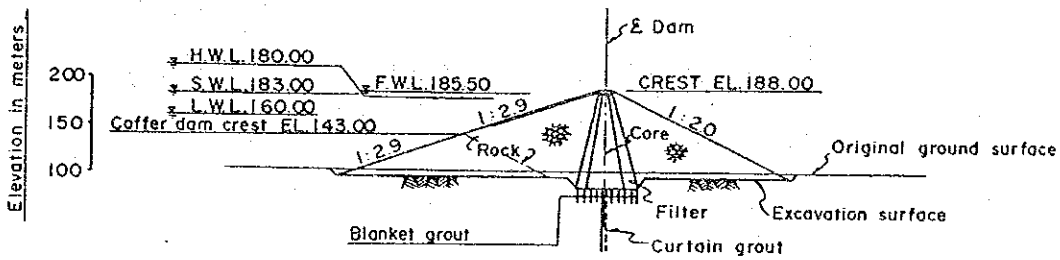


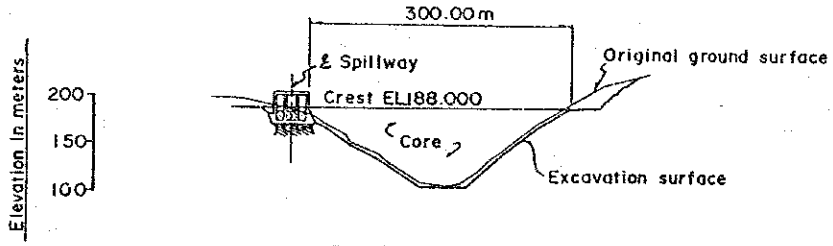
Fig. 5.7 LAYOUT PLAN OF SIFFU NO. 1 DAM



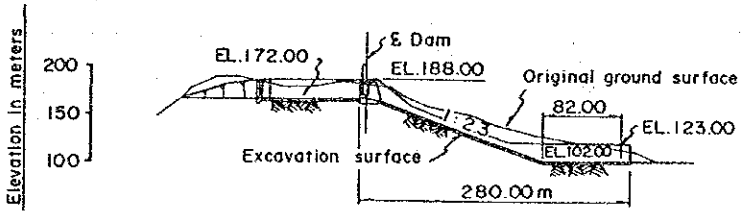
PLAN



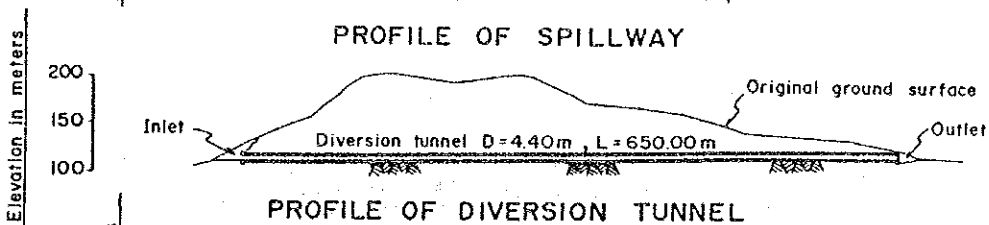
PROFILE OF DAM



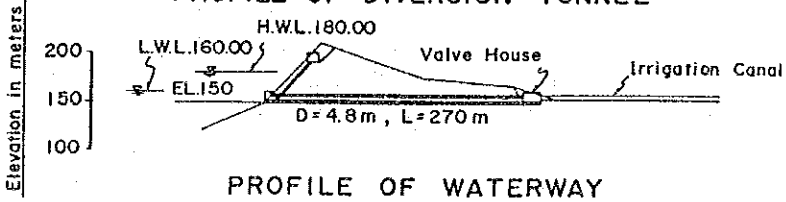
ELEVATION



PROFILE OF SPILLWAY

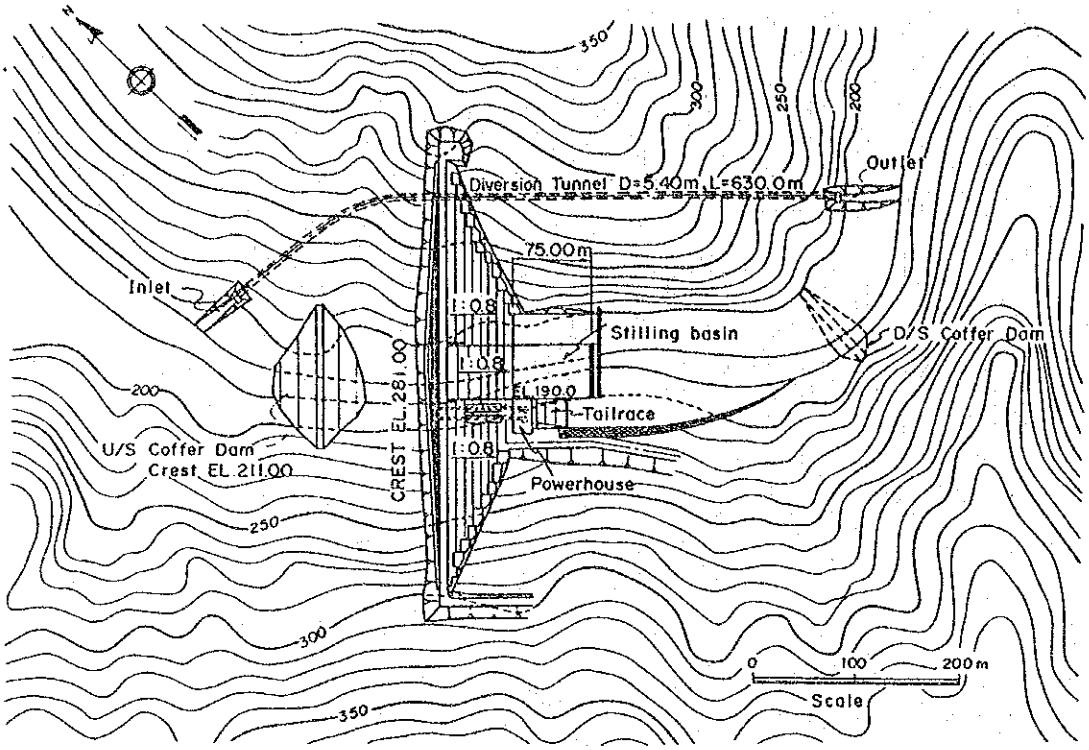


PROFILE OF DIVERSION TUNNEL



PROFILE OF WATERWAY

Fig. 5.8 LAYOUT PLAN OF MALLIG NO. 2 DAM



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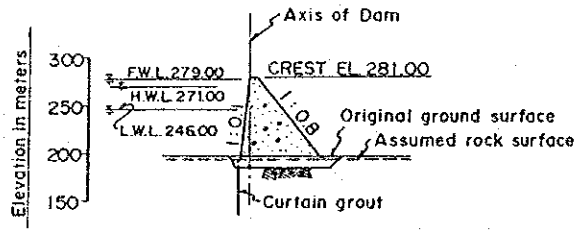
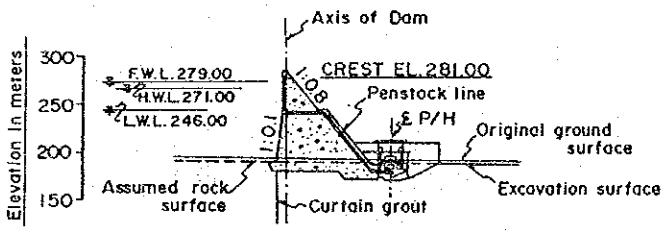
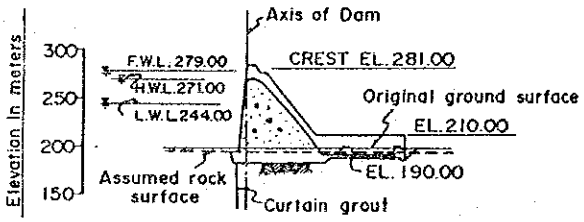


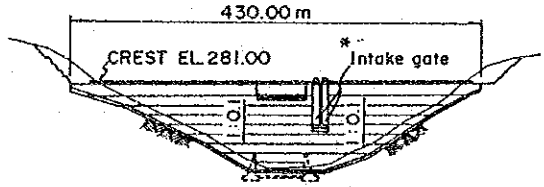
TYPICAL SECTION



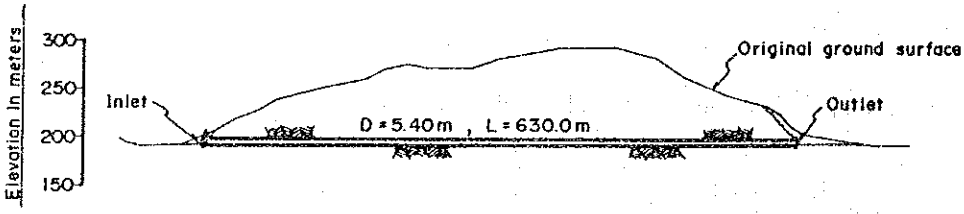
PROFILE OF POWER LINE



OVERFLOW SECTION

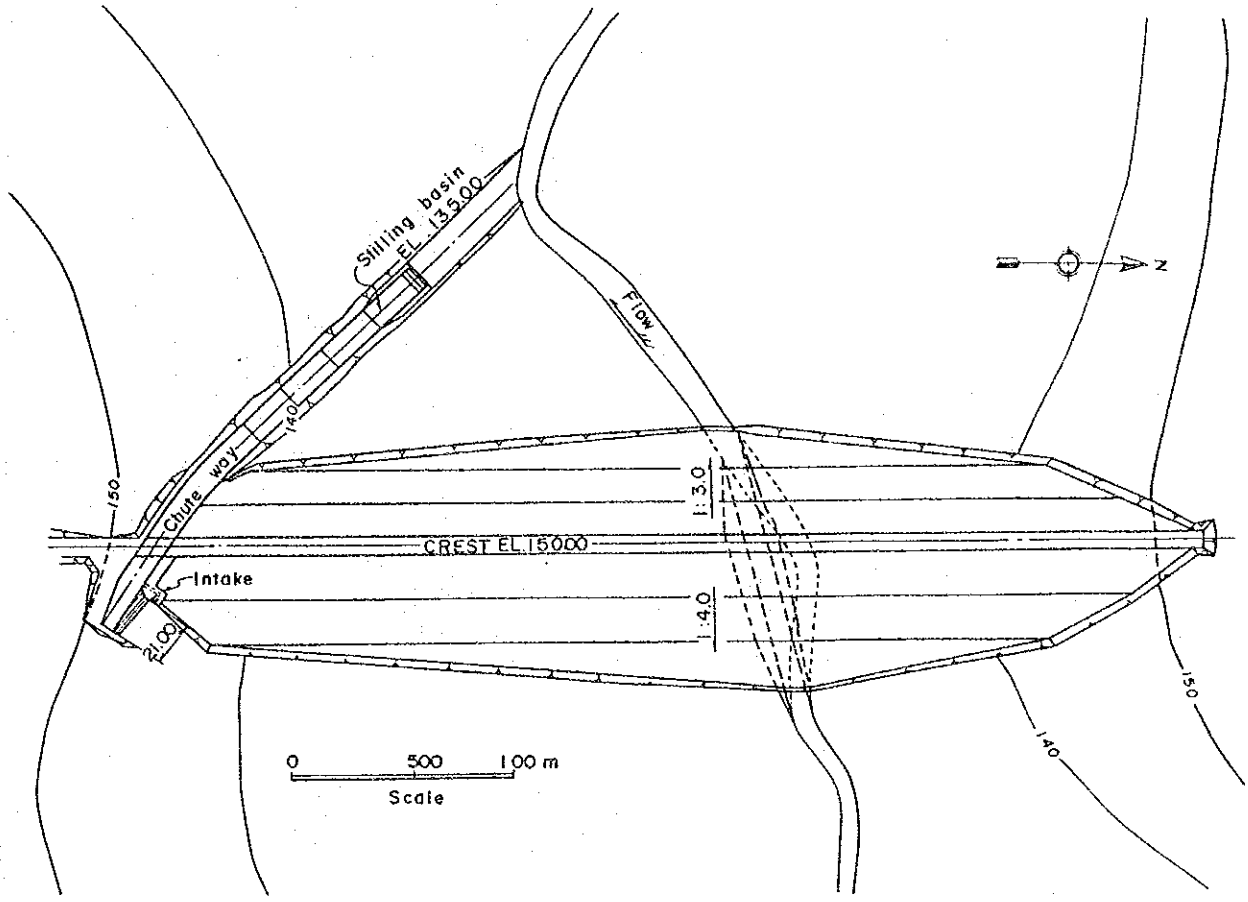


ELEVATION

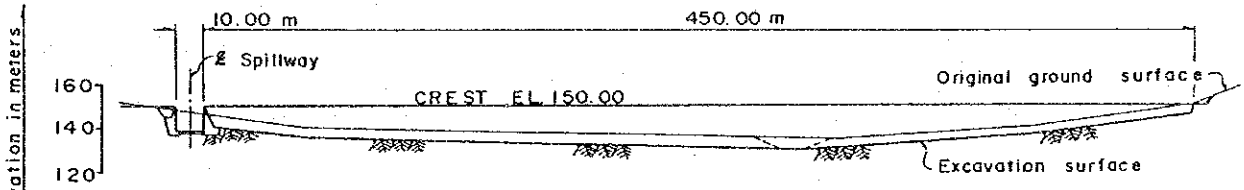


PROFILE OF DIVERSION TUNNEL

Fig. 5.9 LAYOUT PLAN OF ALIMIT NO. 1 DAM



PLAN



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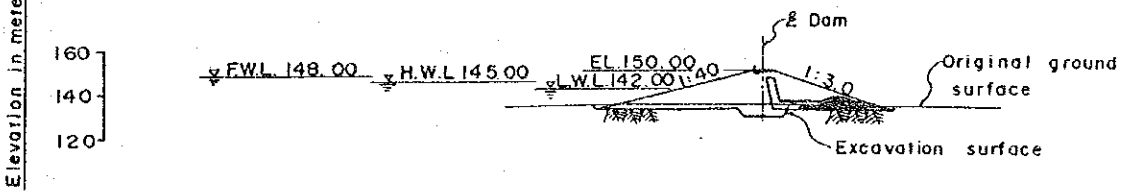
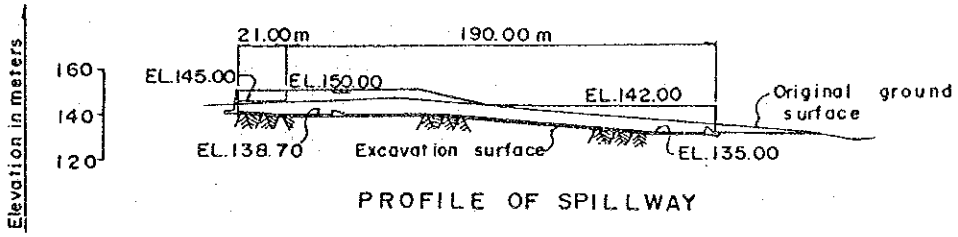
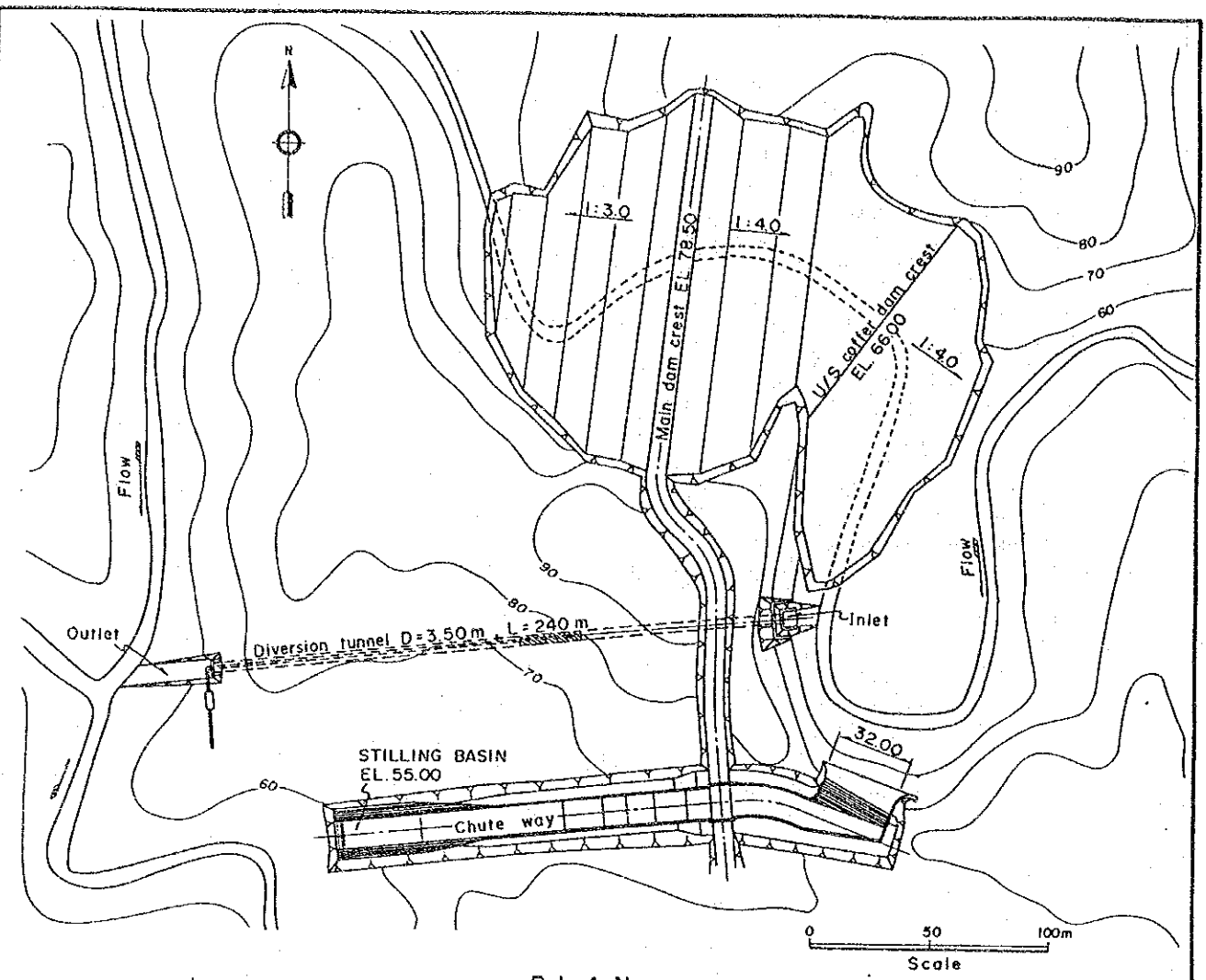


PROFILE OF DAM

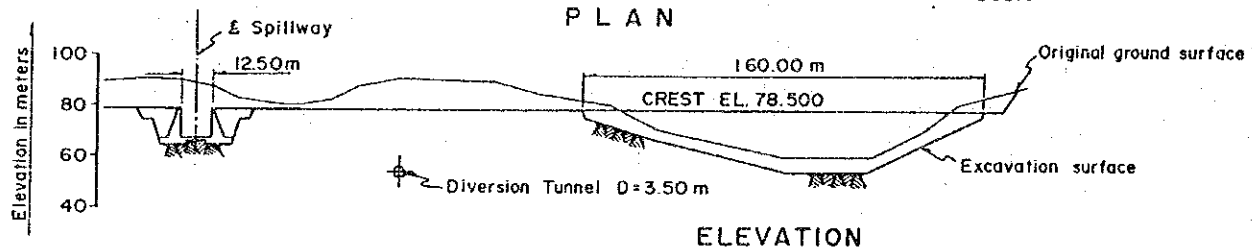


PROFILE OF SPILLWAY

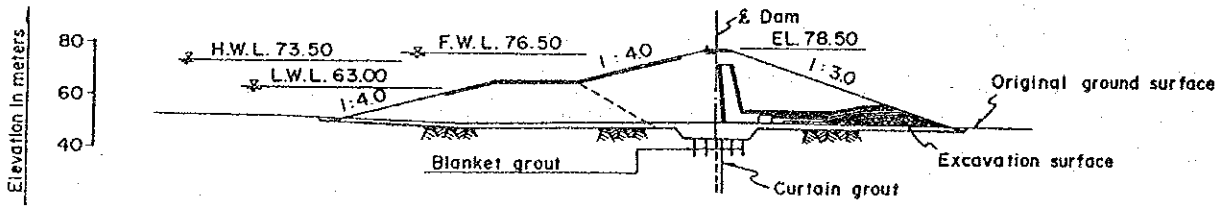
Fig. 5.10 LAYOUT PLAN OF STO. NIÑO DAM



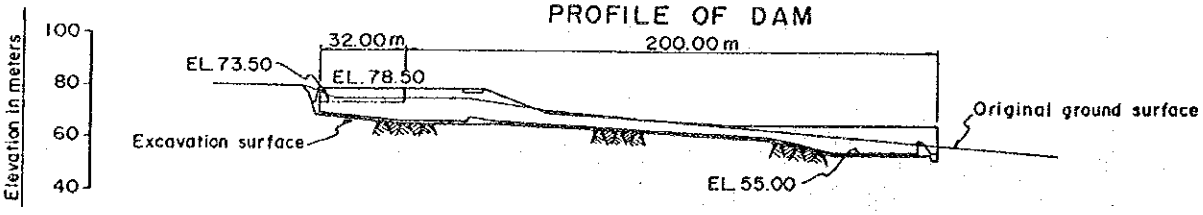
PLAN



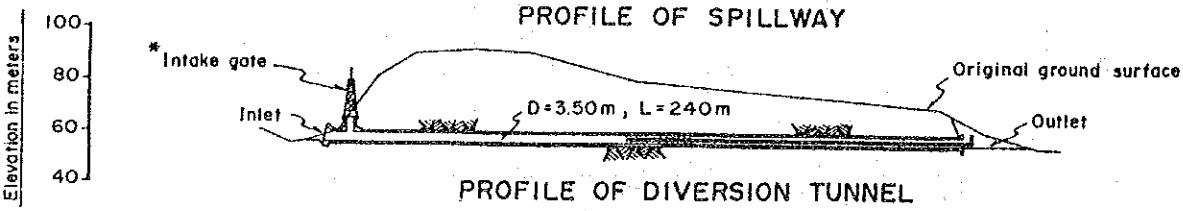
ELEVATION



PROFILE OF DAM

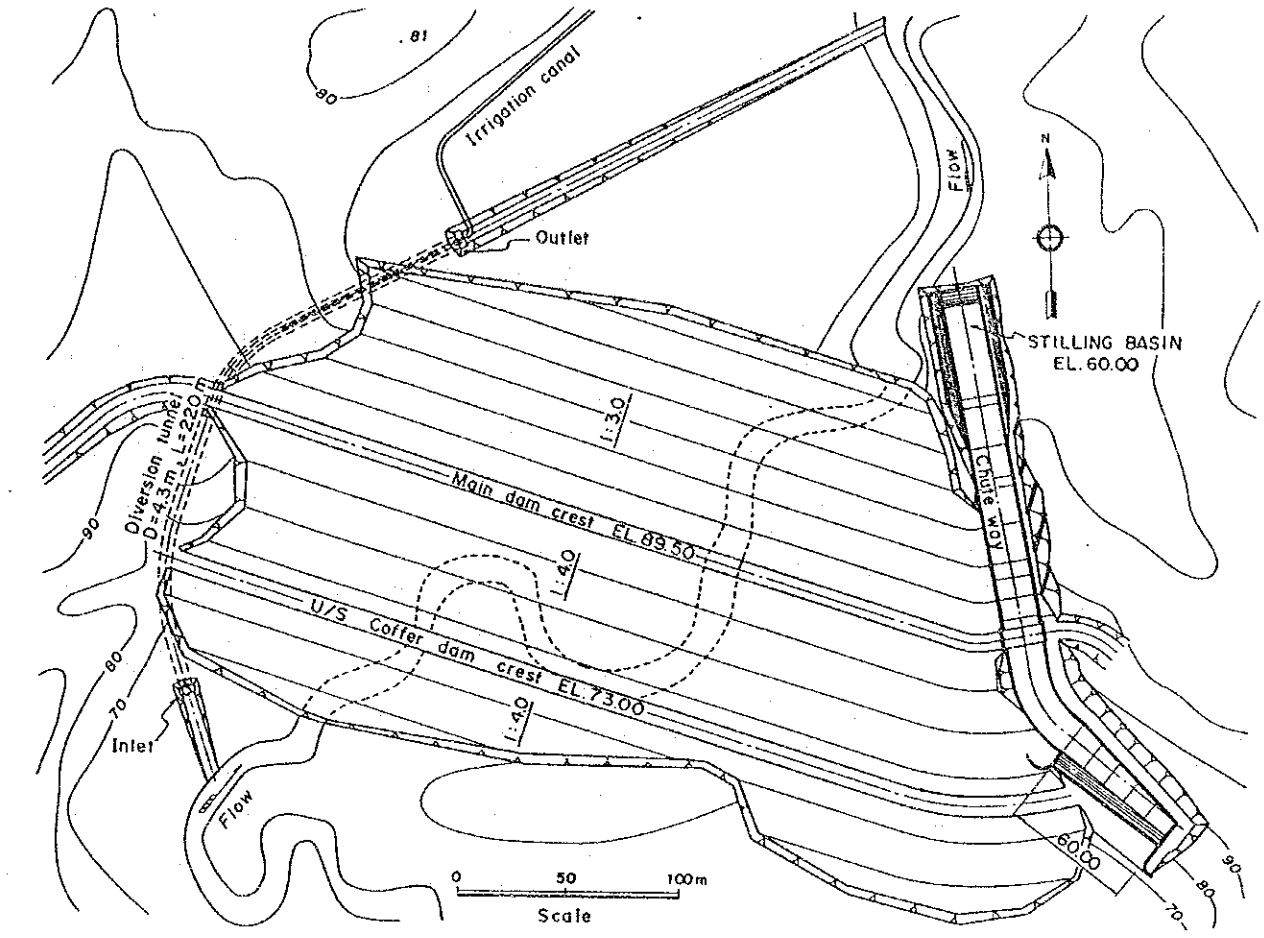


PROFILE OF SPILLWAY



PROFILE OF DIVERSION TUNNEL

Fig. 5.11 LAYOUT PLAN OF STA. MARIA DAM



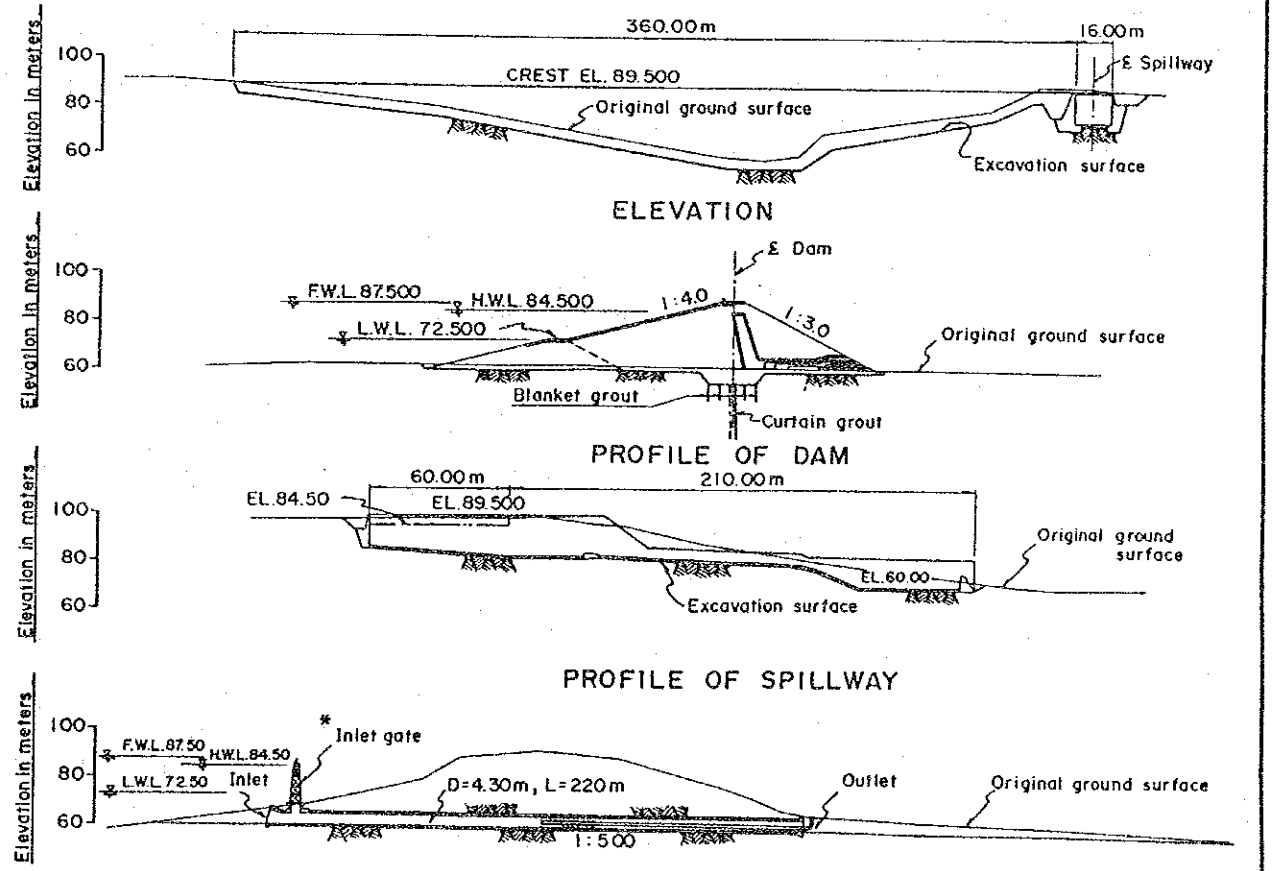
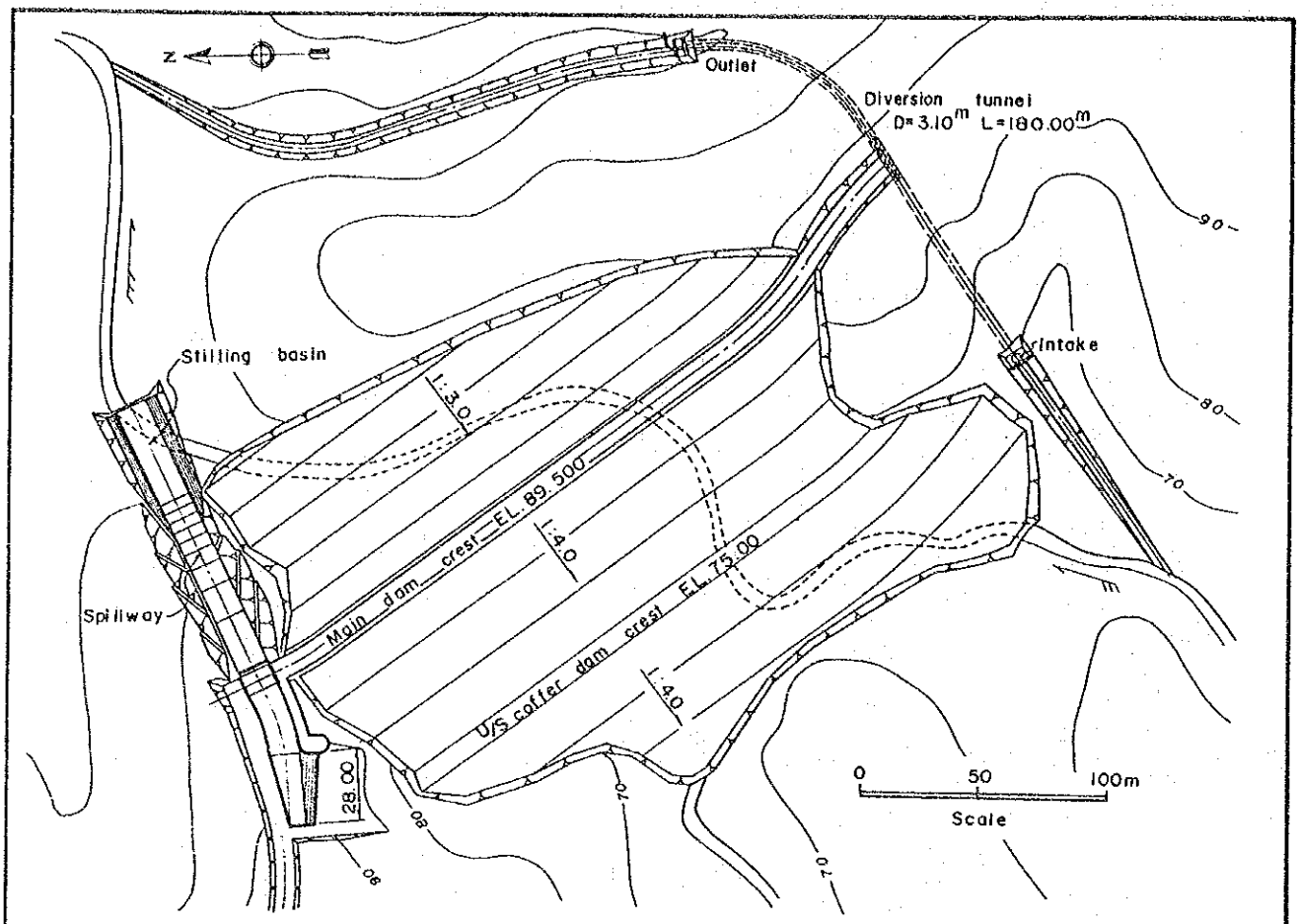
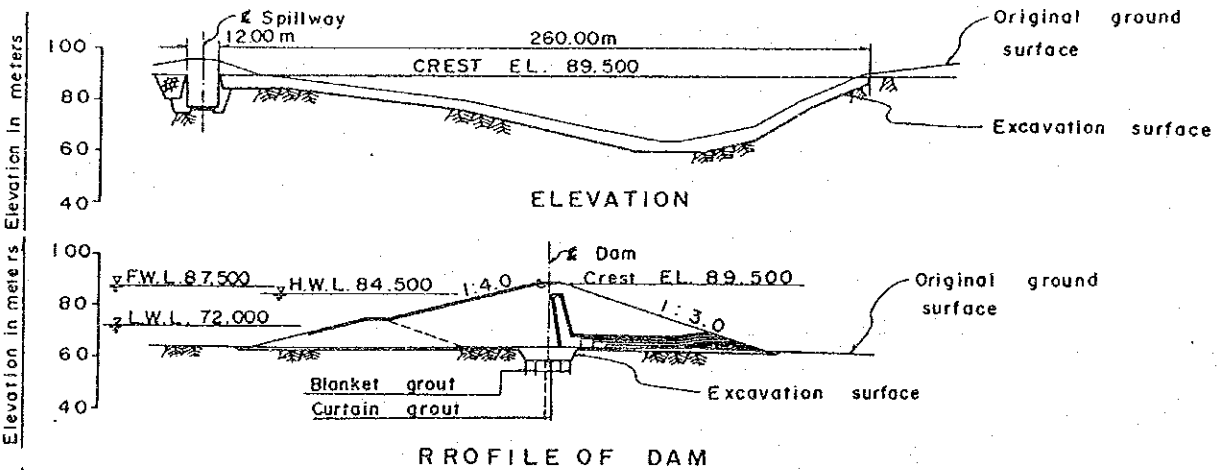
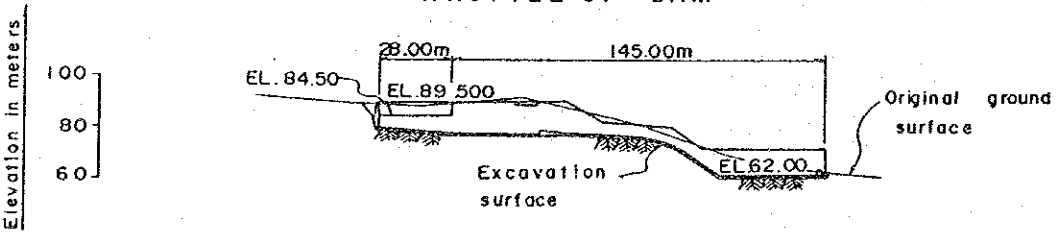


Fig. 5.12 LAYOUT PLAN OF COLORADO DAM







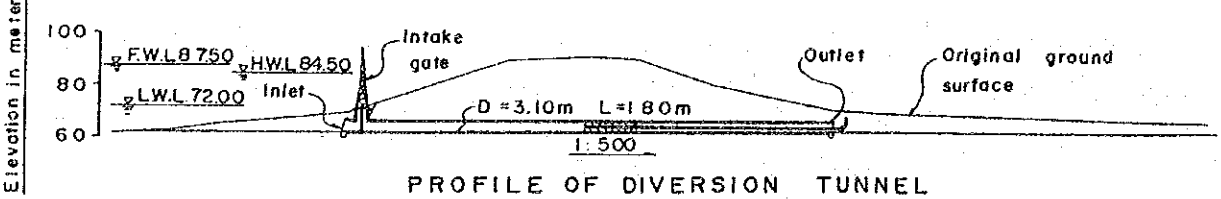
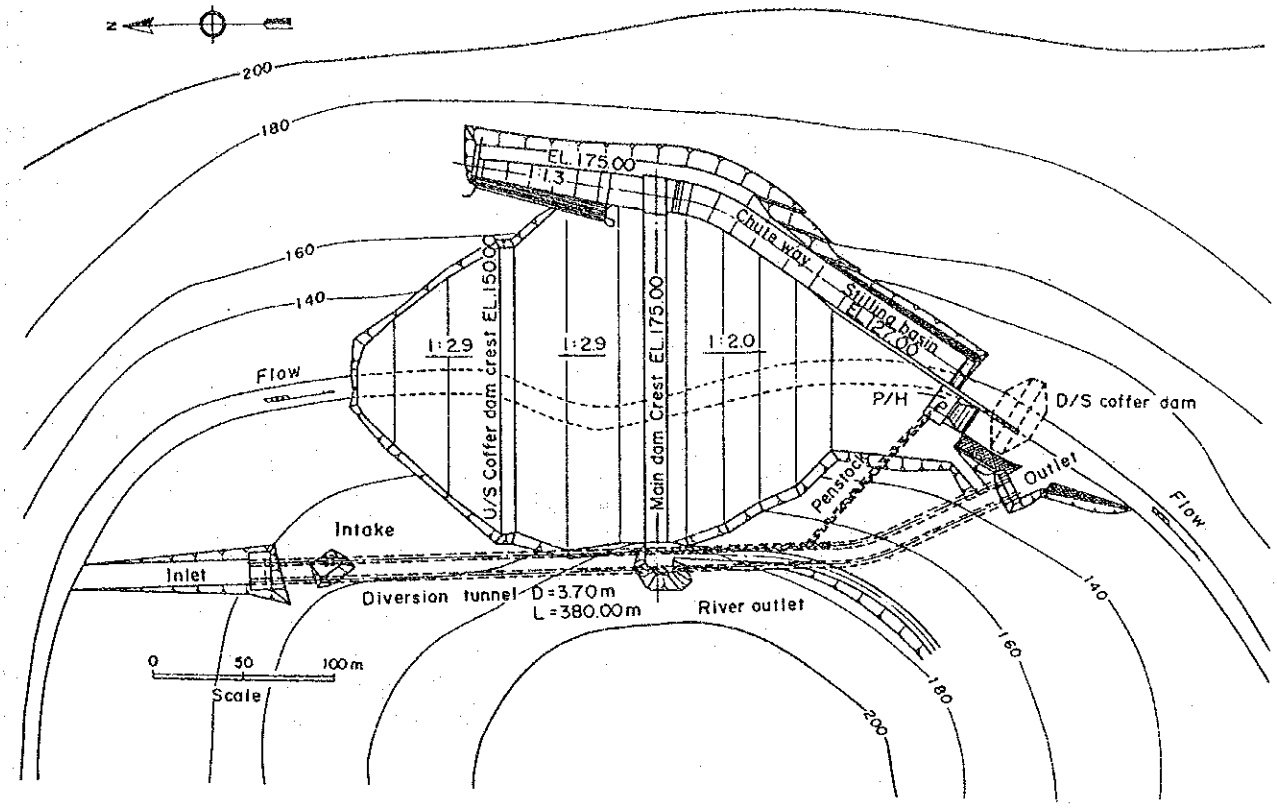


Fig. 5.13 LAYOUT PLAN OF CALAOCAN DAM



PLAN

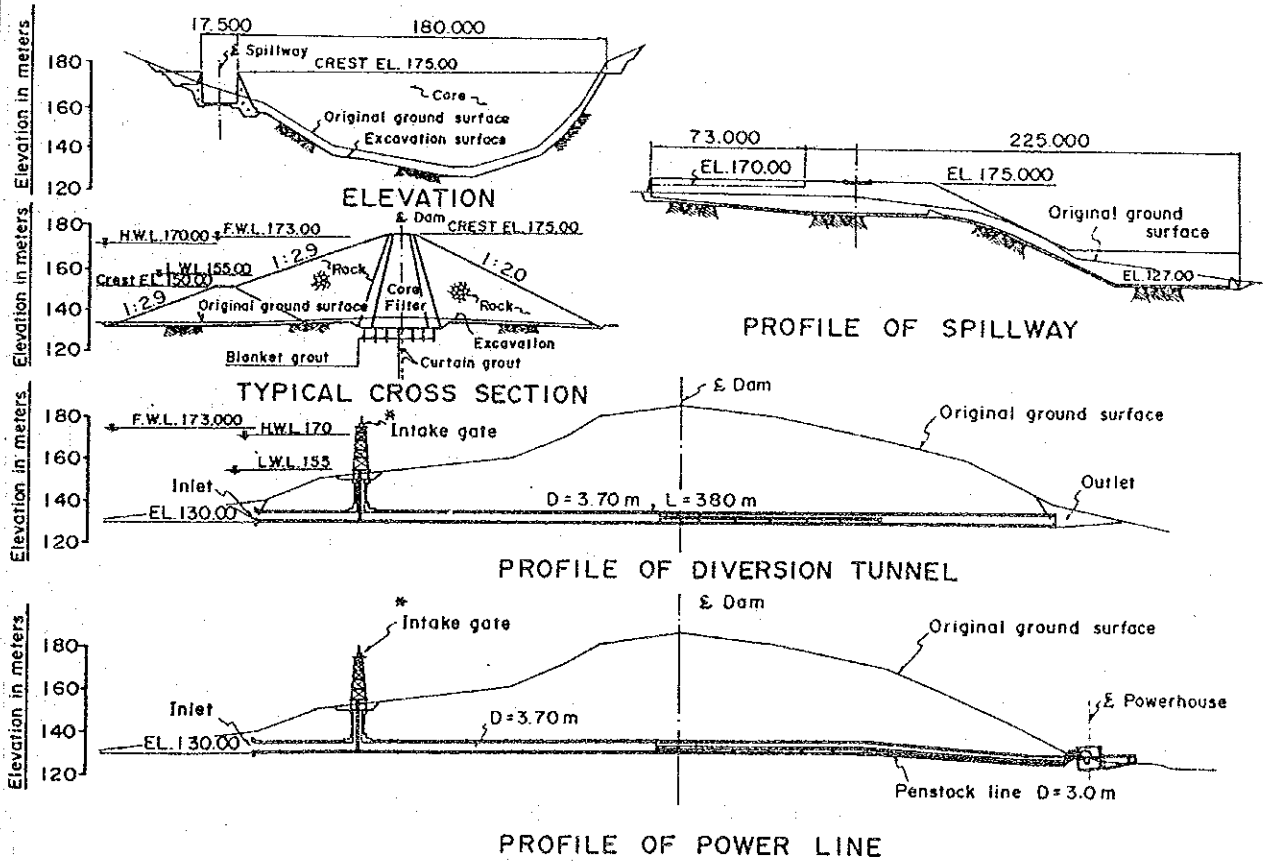
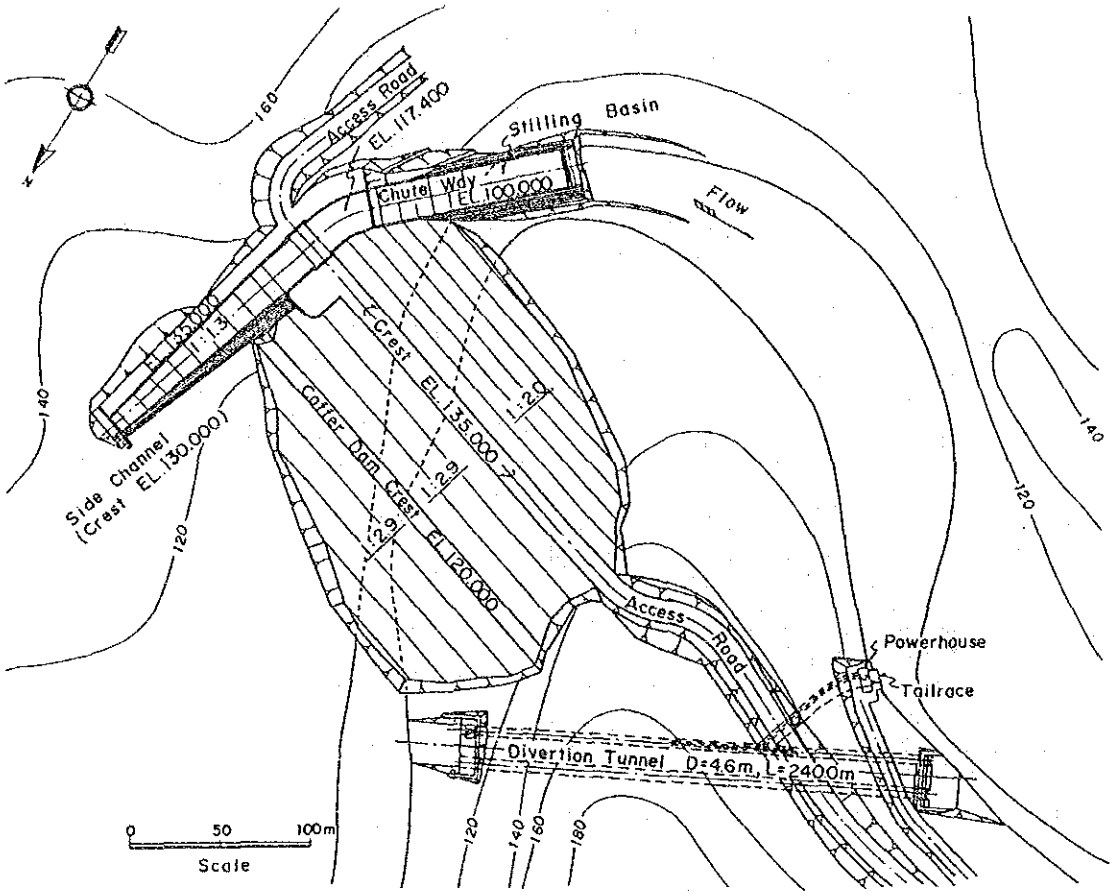


Fig. 5.14 LAYOUT PLAN OF PARANAN DAM



PLAN

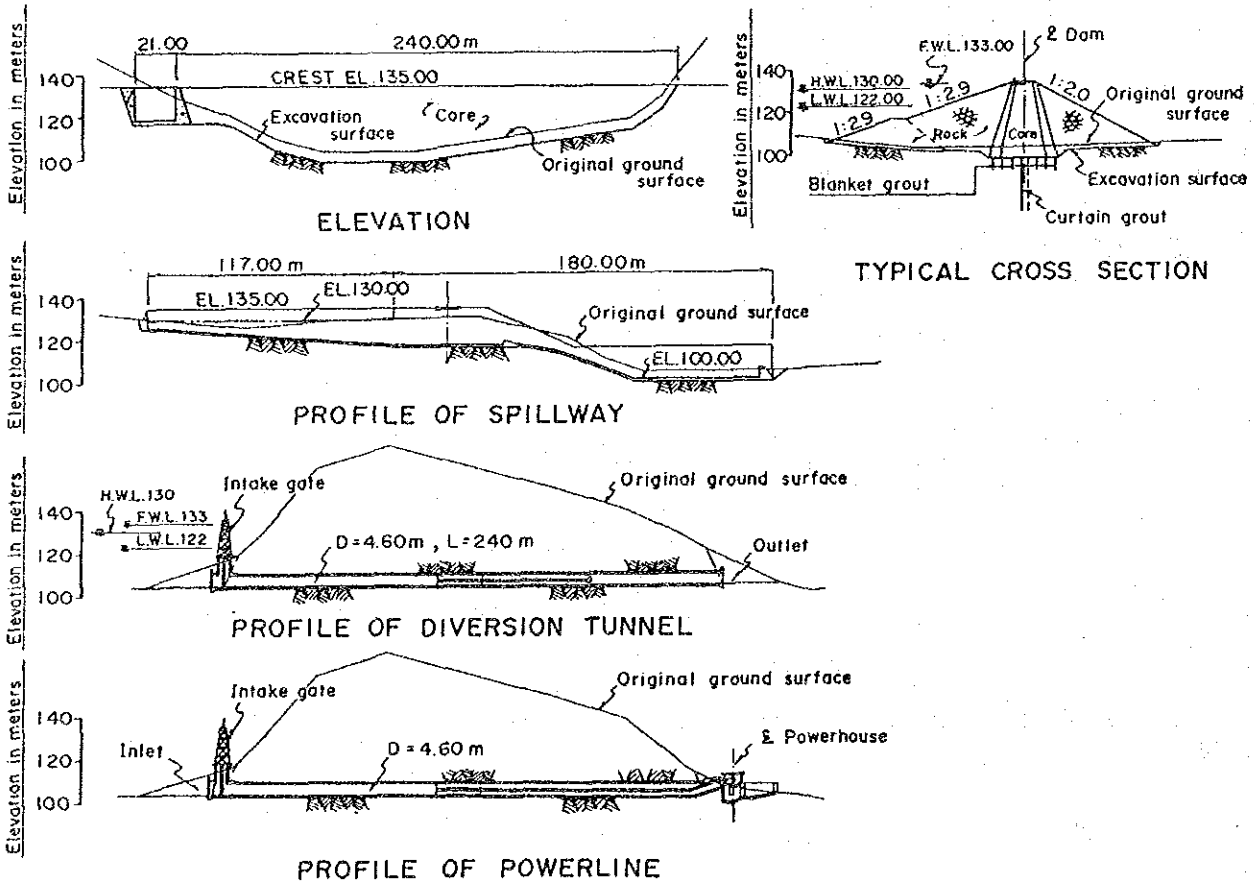
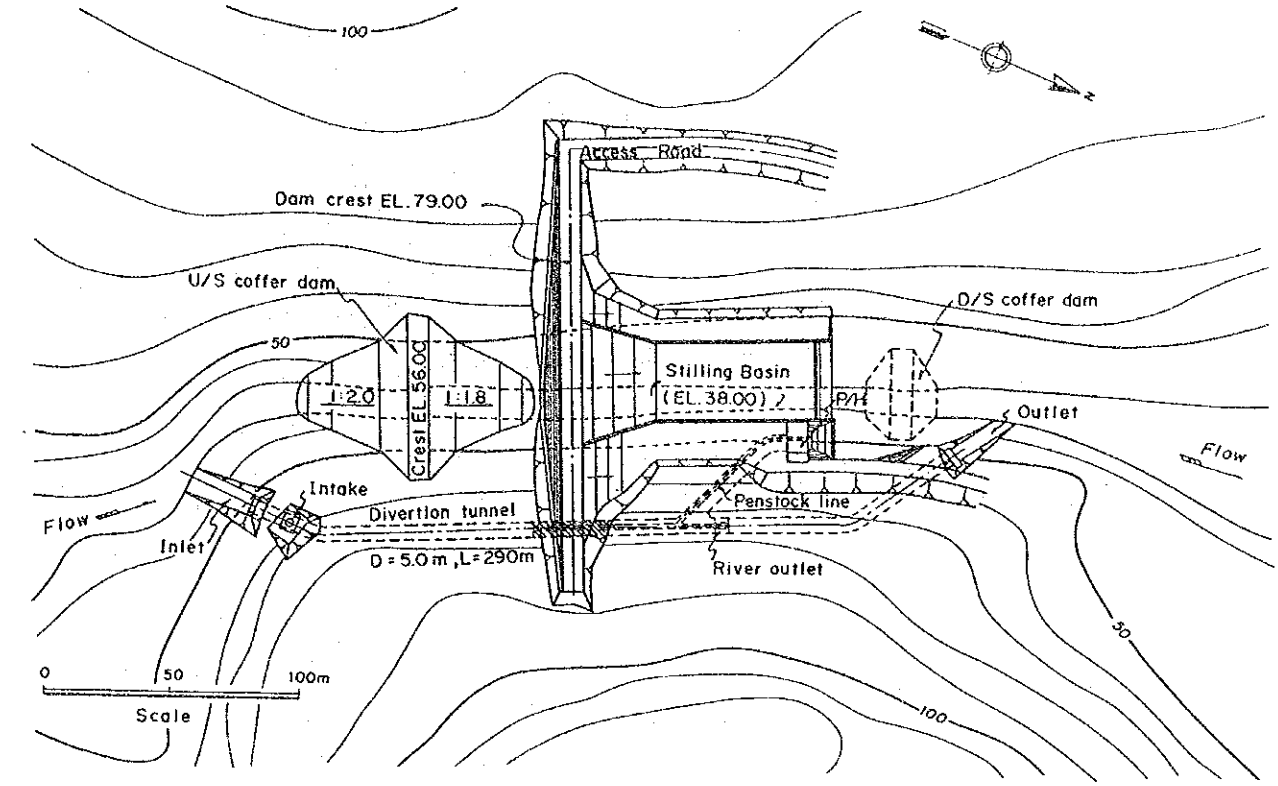


Fig. 5.15 LAYOUT PLAN OF DUMMON DAM



PLAN

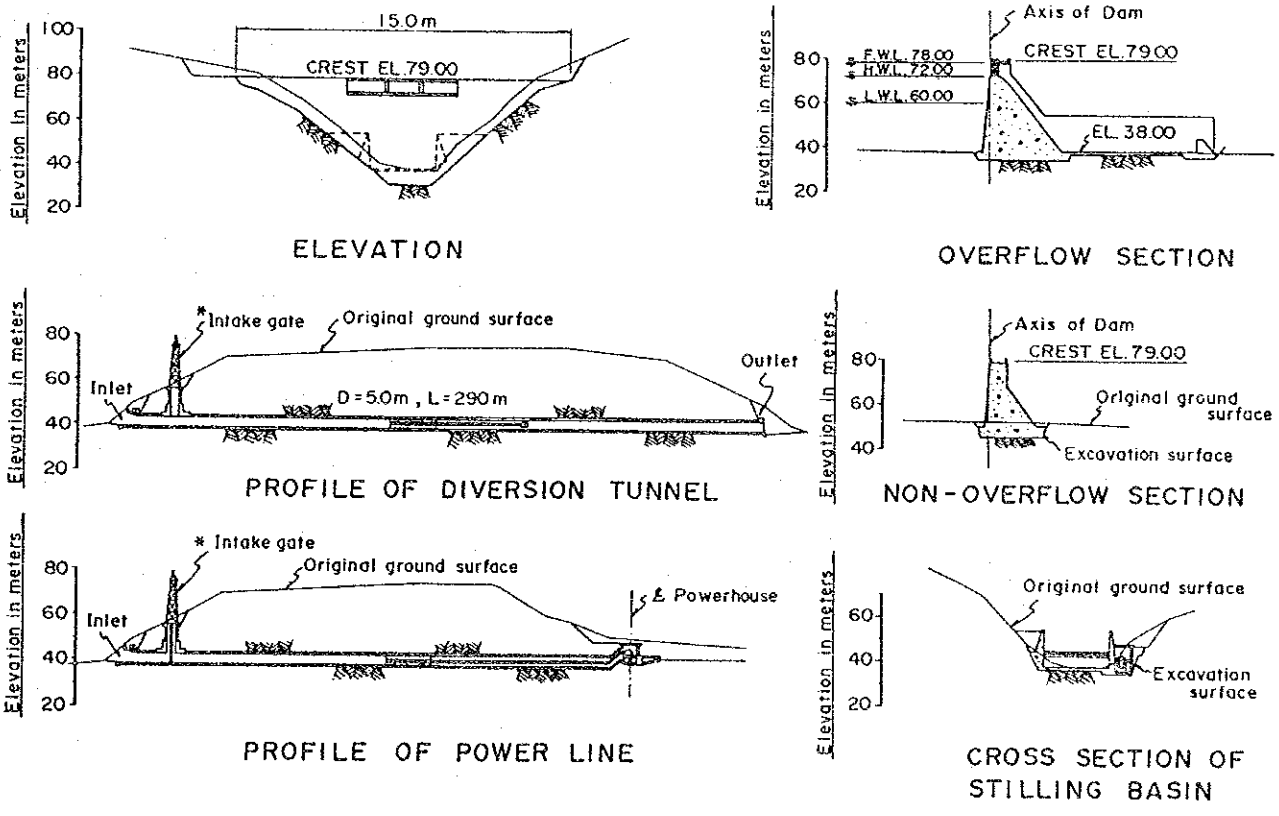
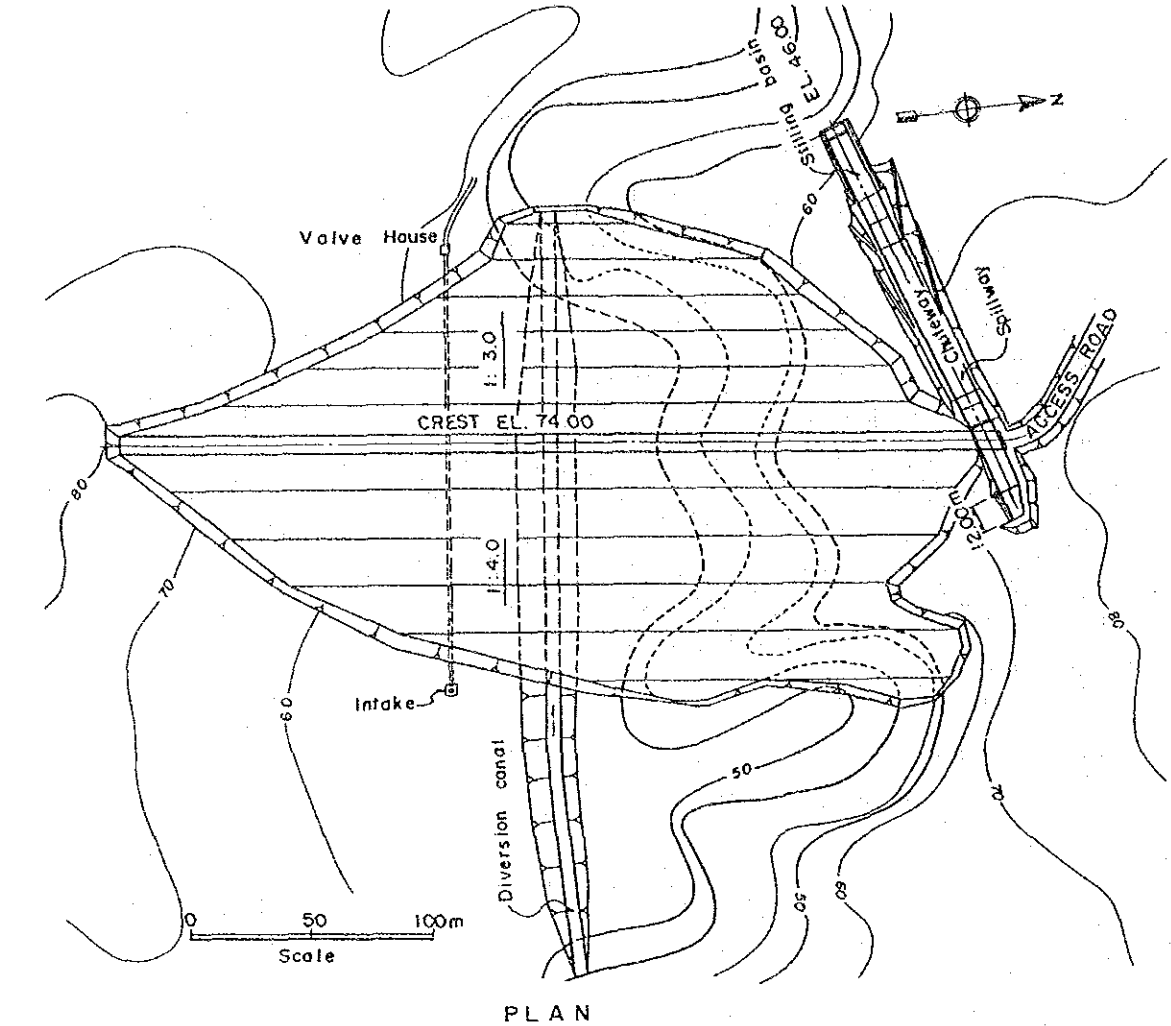
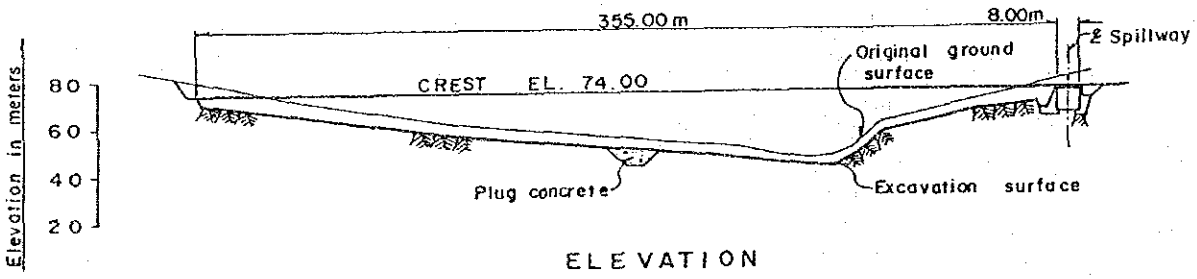


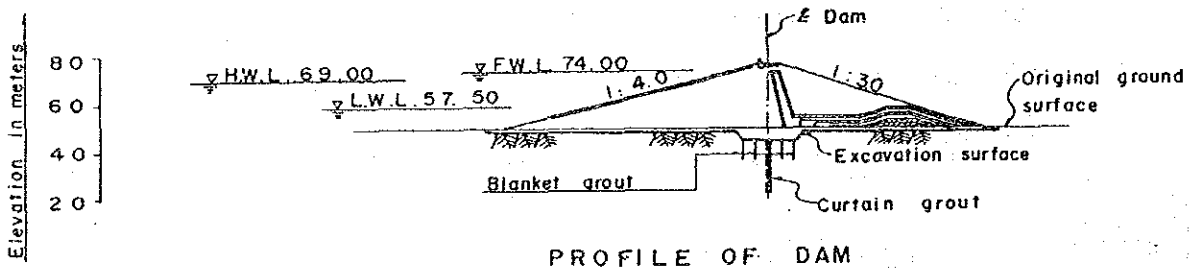
Fig. 5.16 LAYOUT PLAN OF ZINUNDUNGAN DAM



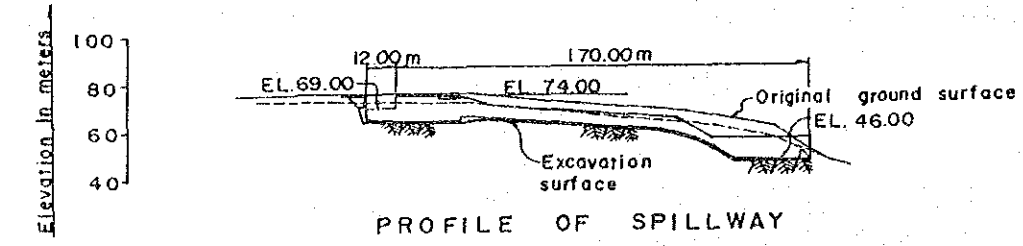
PLAN



ELEVATION

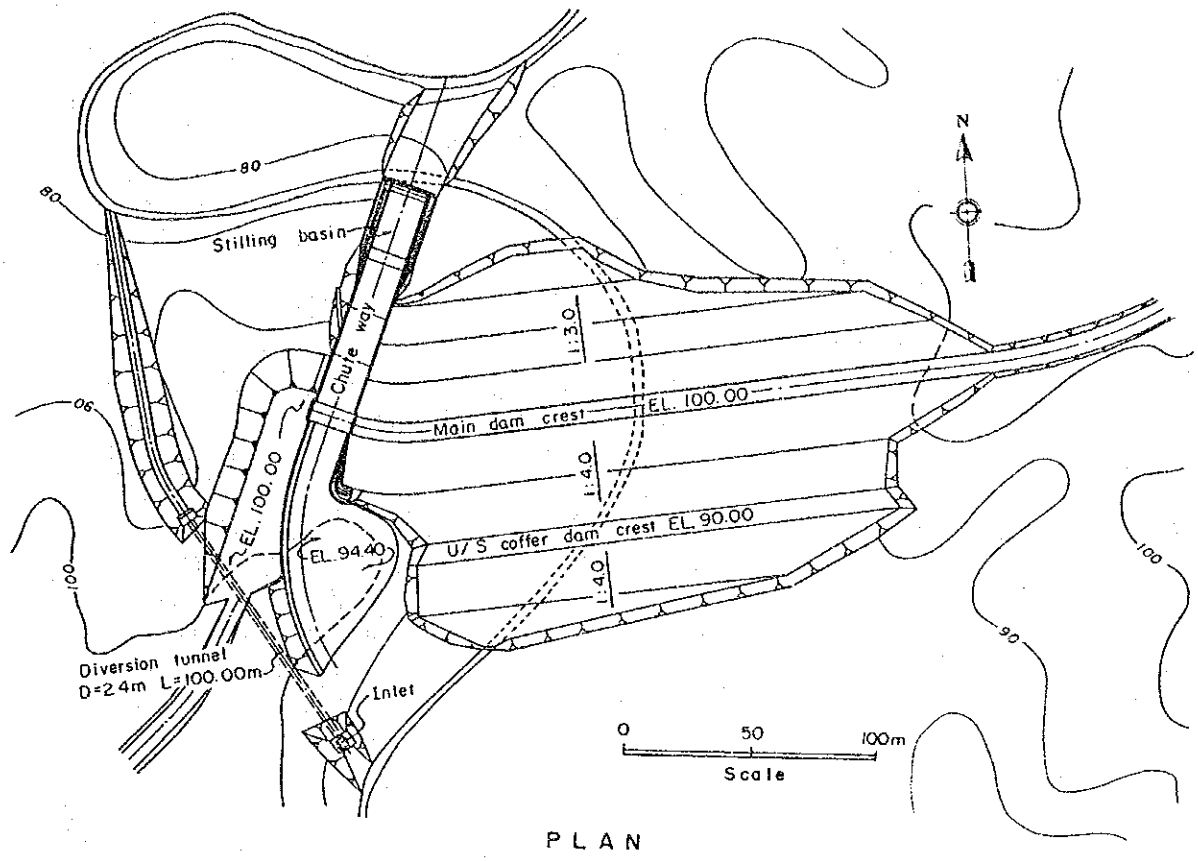


PROFILE OF DAM

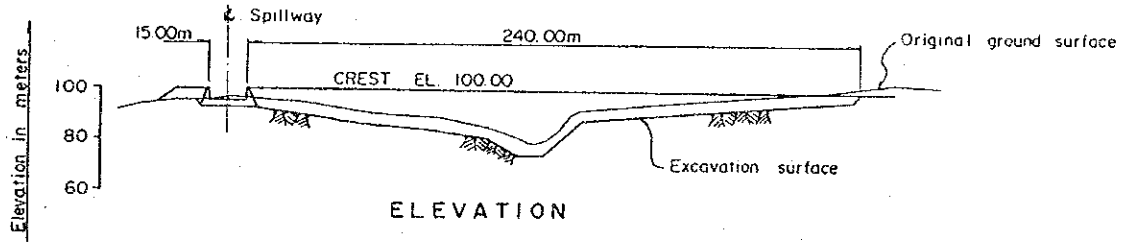


PROFILE OF SPILLWAY

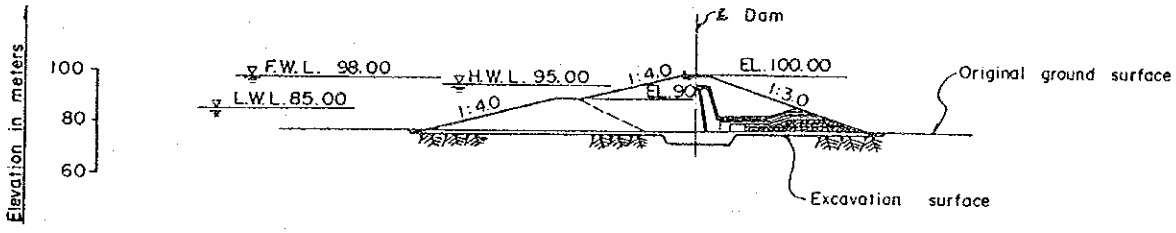
Fig. 5.17 LAYOUT PLAN OF SAN VICENTE DAM



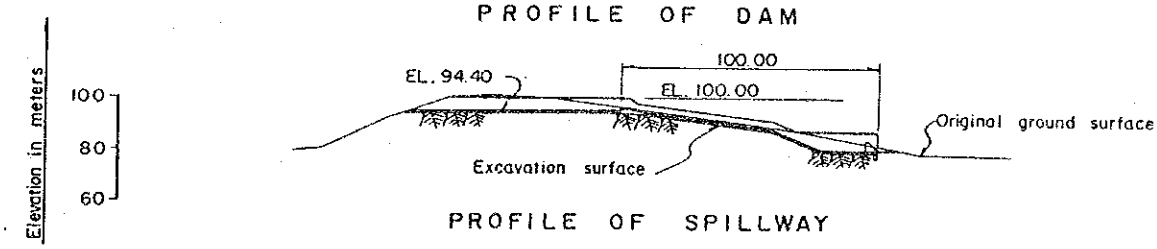
PLAN



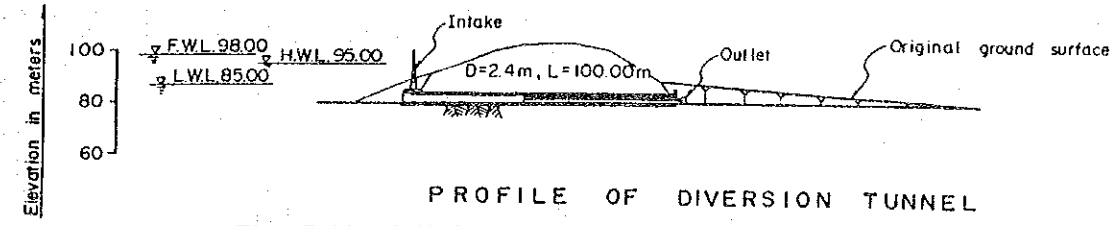
ELEVATION



PROFILE OF DAM

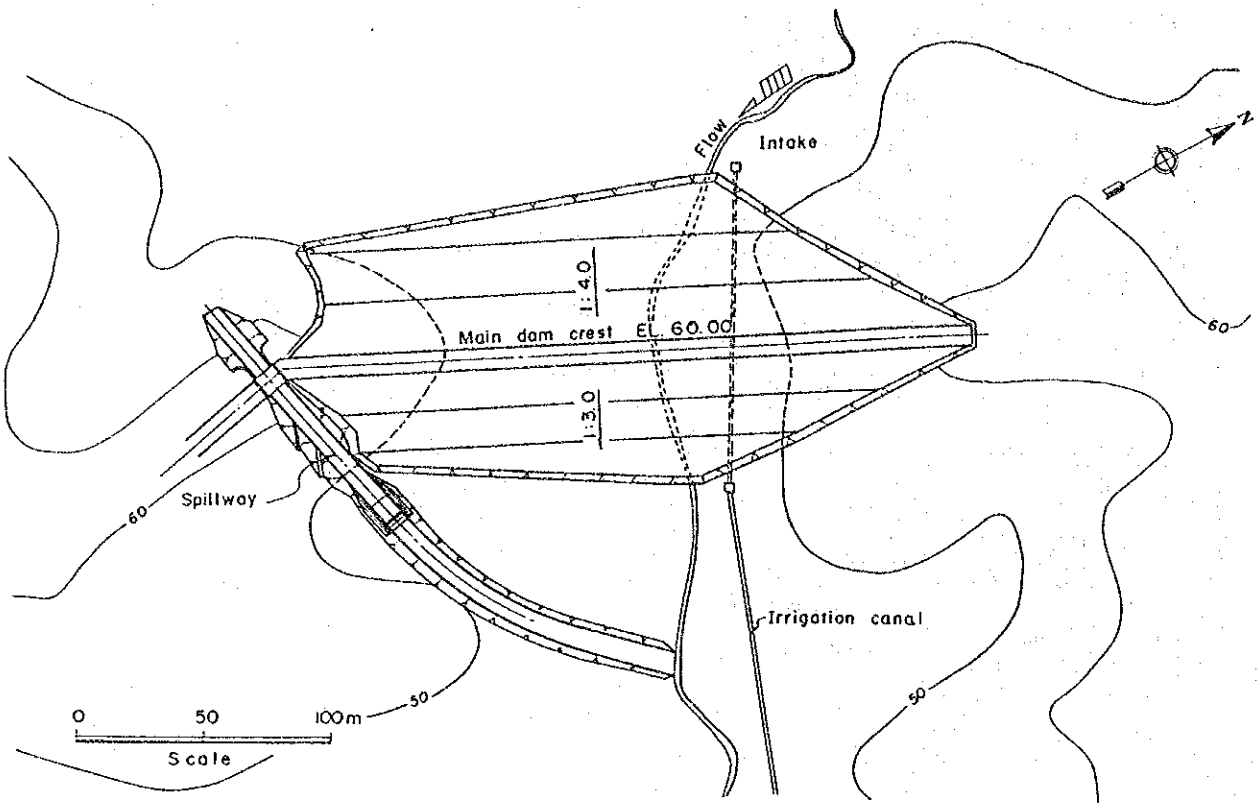


PROFILE OF SPILLWAY

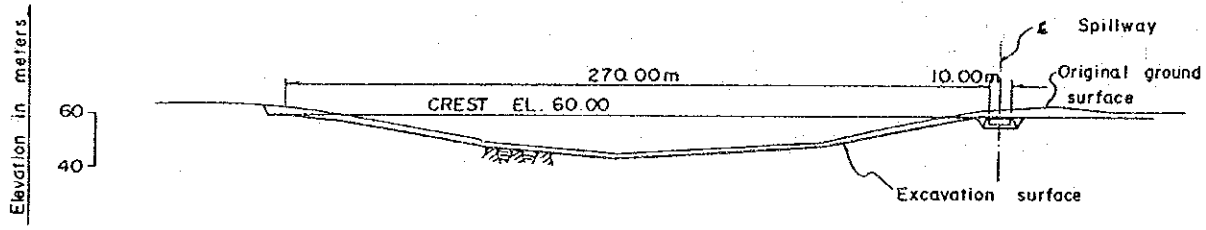


PROFILE OF DIVERSION TUNNEL

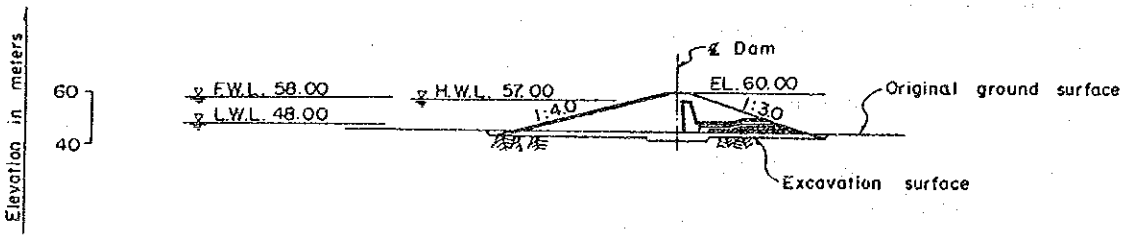
Fig. 5.18 LAYOUT PLAN OF SANTOR DAM



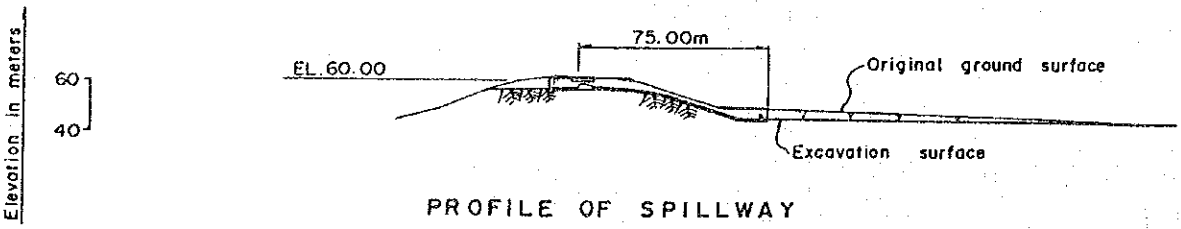
PLAN



ELEVATION

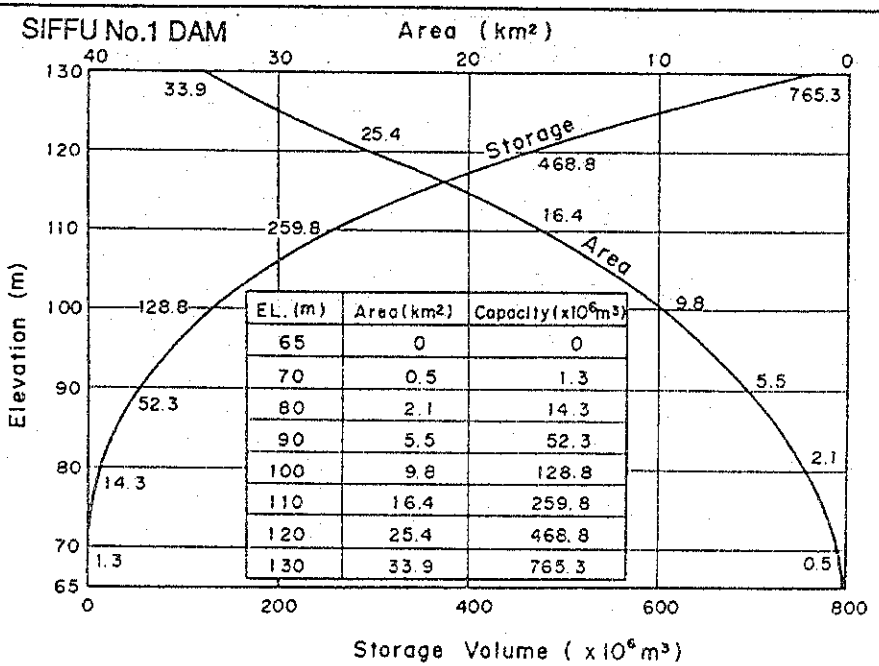


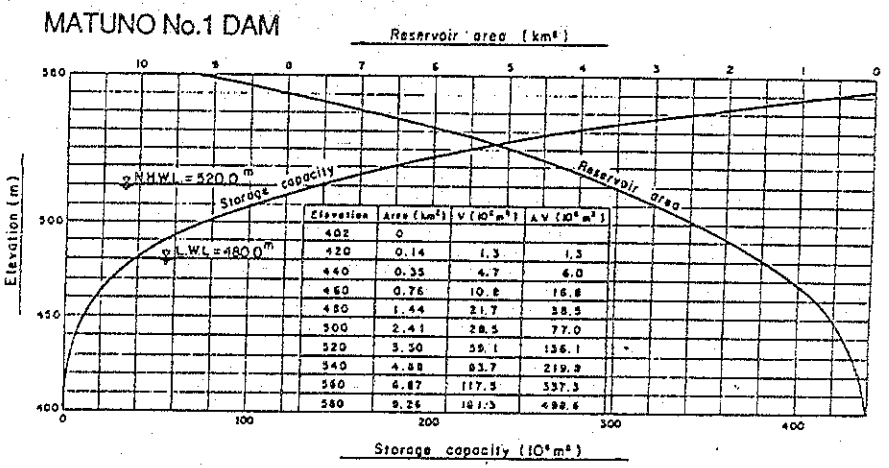
PROFILE OF DAN

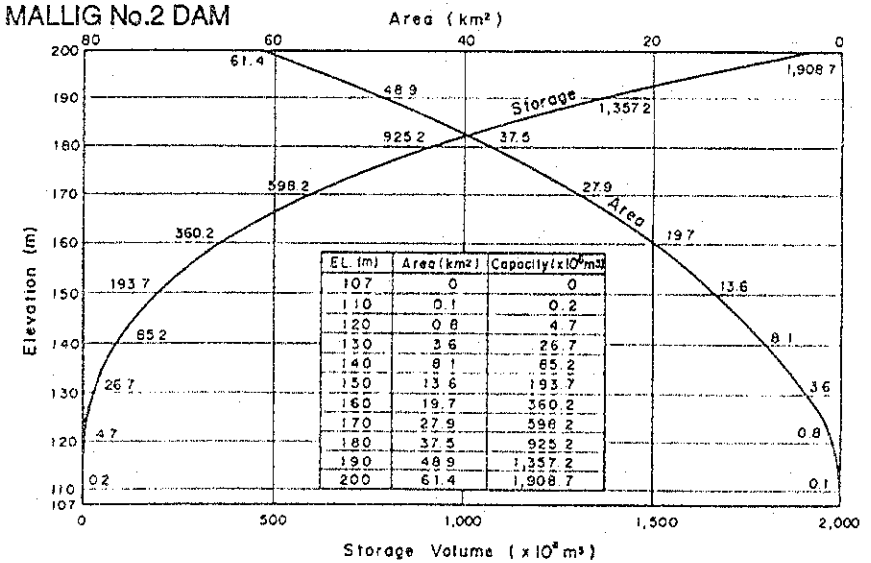


PROFILE OF SPILLWAY

Fig. 5.19 LAYOUT PLAN OF CARMENCITA POND







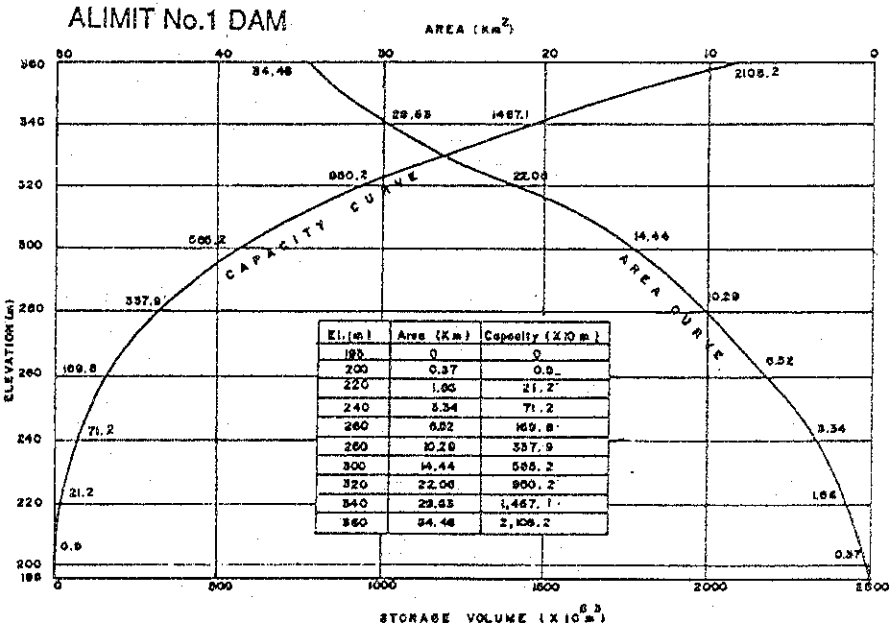
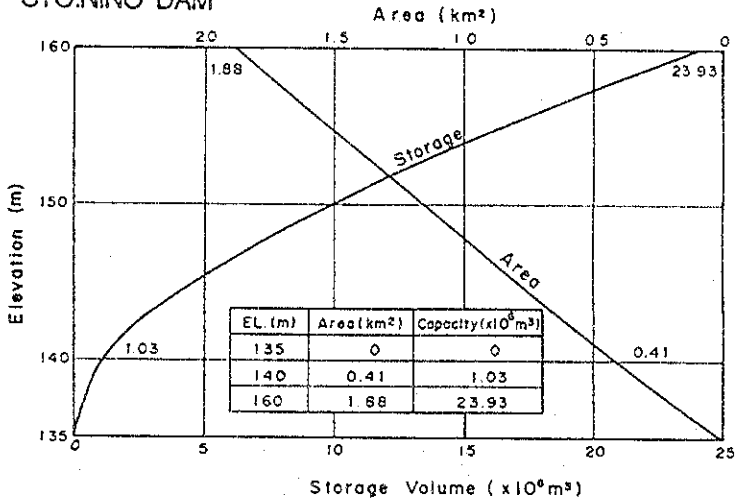


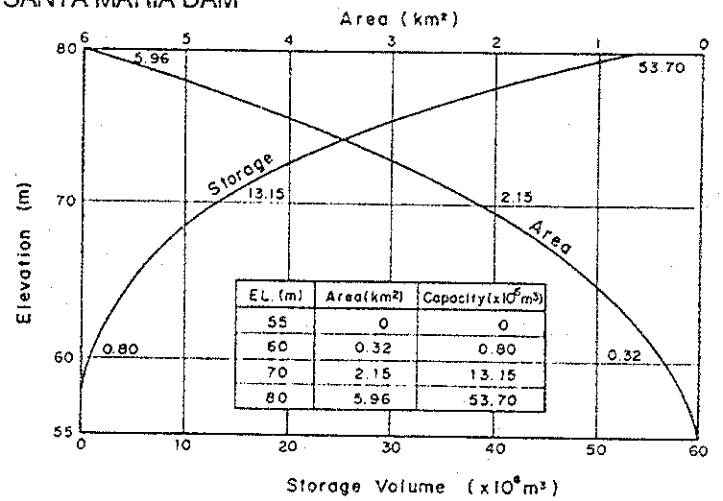
Fig. 5.20 PESERVOIR STORAGE AND SURFACE AREA CURVE (1)

STO.NIÑO DAM



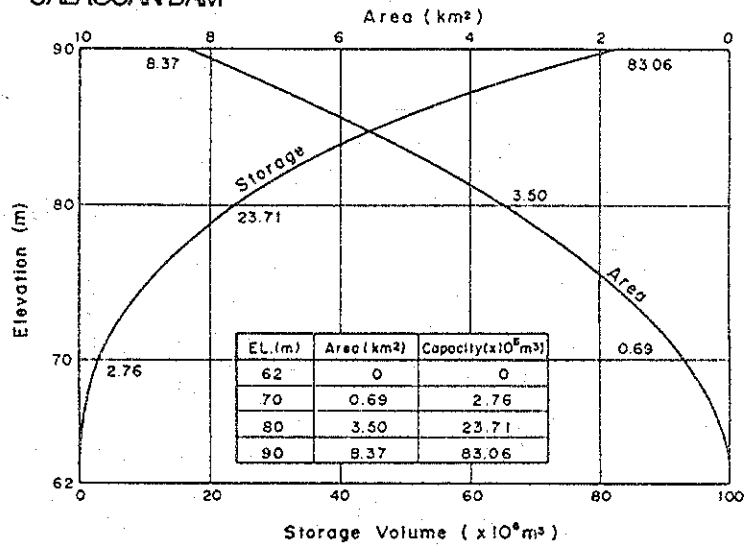
EL. (m)	Area (km²)	Capacity (x10⁶m³)
135	0	0
140	0.41	1.03
160	1.88	23.93

SANTA MARIA DAM



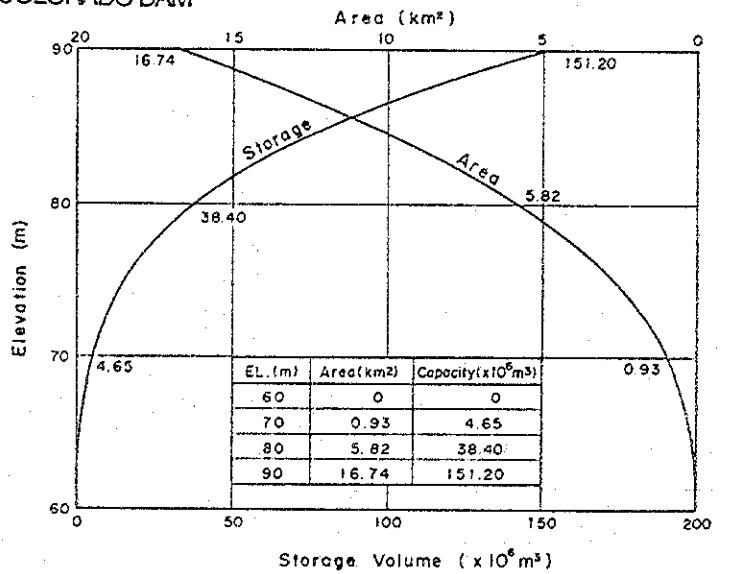
EL. (m)	Area (km²)	Capacity (x10⁶m³)
55	0	0
60	0.32	0.80
70	2.15	13.15
80	5.96	53.70

CALAOCAN DAM



EL. (m)	Area (km²)	Capacity (x10⁵m³)
62	0	0
70	0.69	2.76
80	3.50	23.71
90	8.37	83.06

COLORADO DAM



EL. (m)	Area (km²)	Capacity (x10⁵m³)
60	0	0
70	0.93	4.65
80	5.82	38.40
90	16.74	151.20

Fig. 5.20 PESERVOIR STORAGE AND SURFACE AREA CURVE (2)

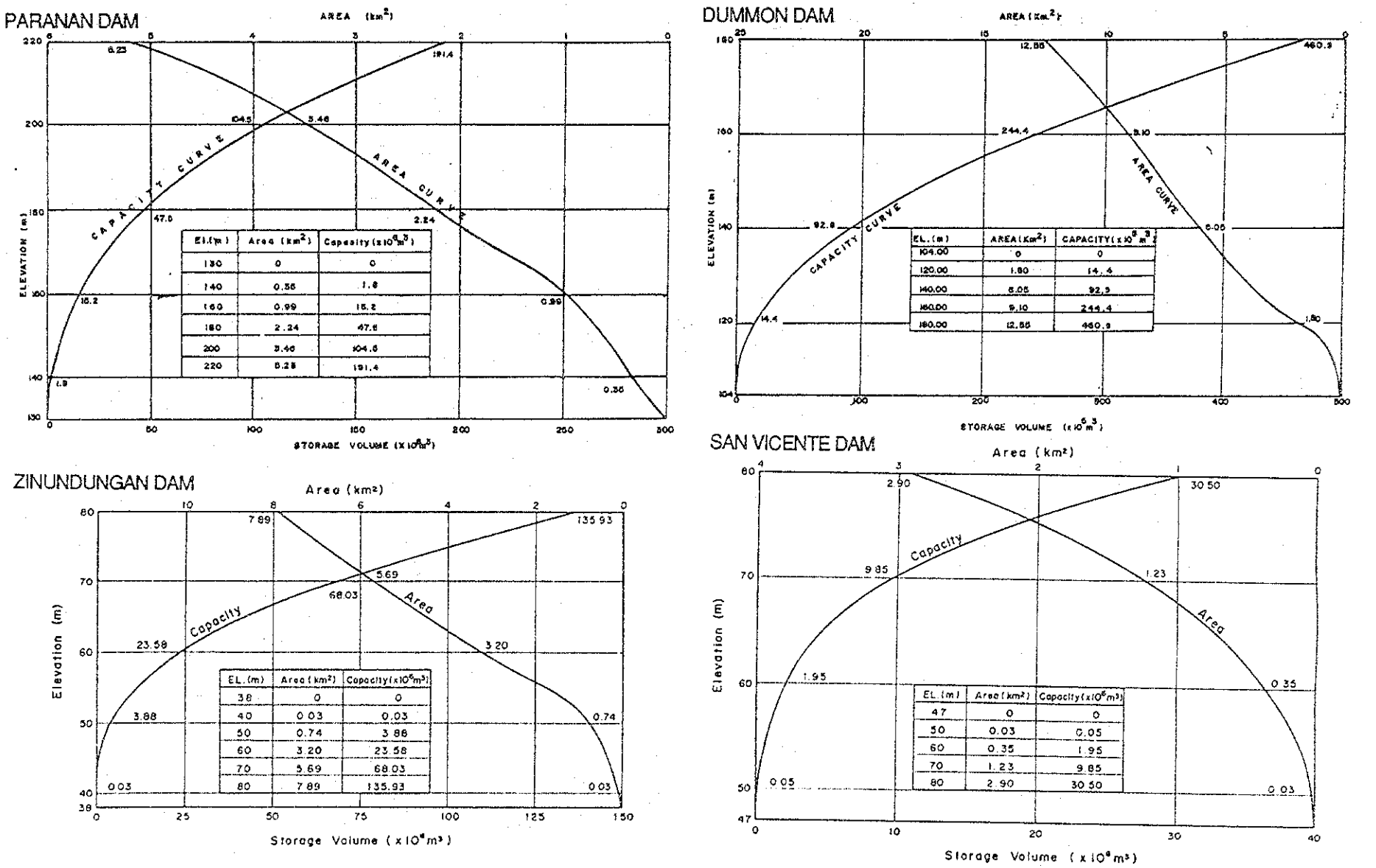
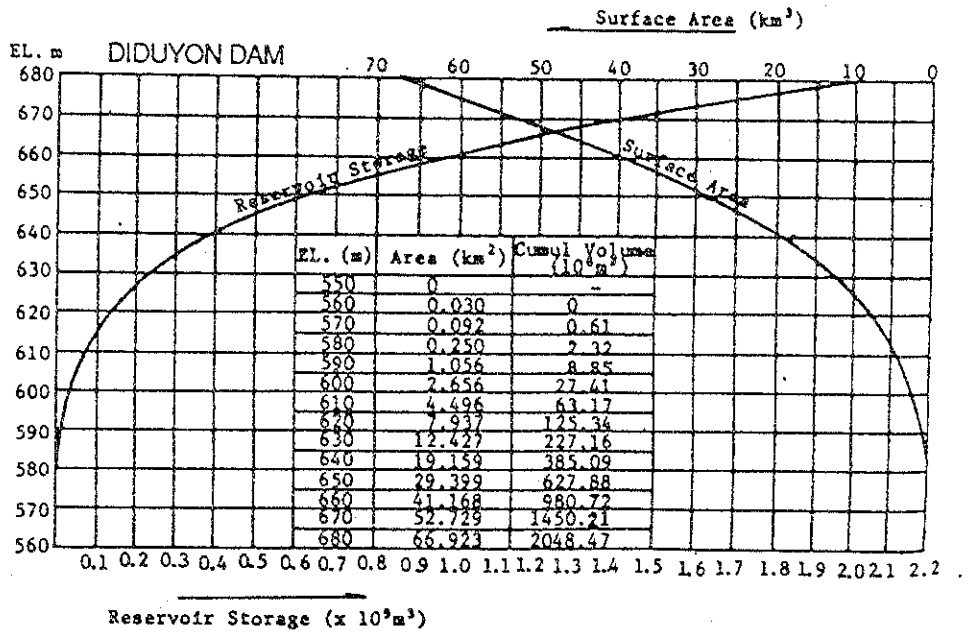
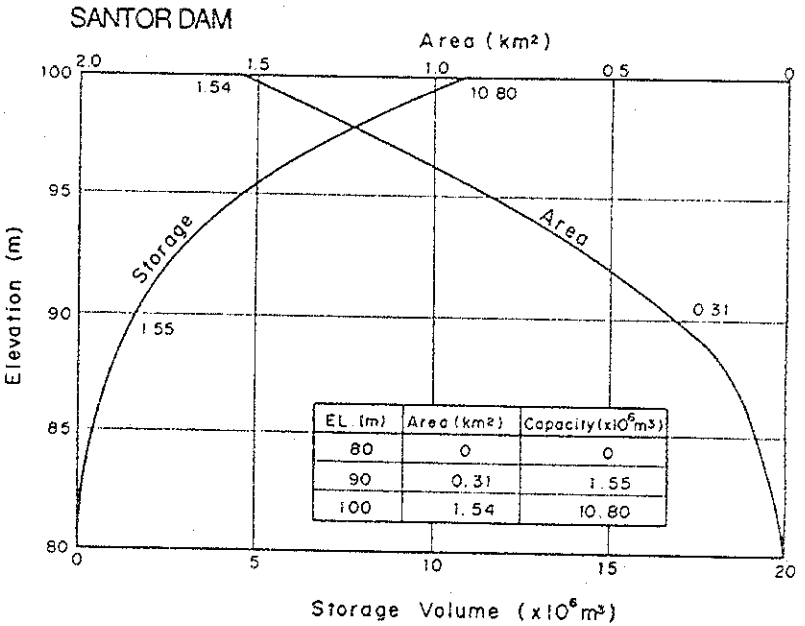


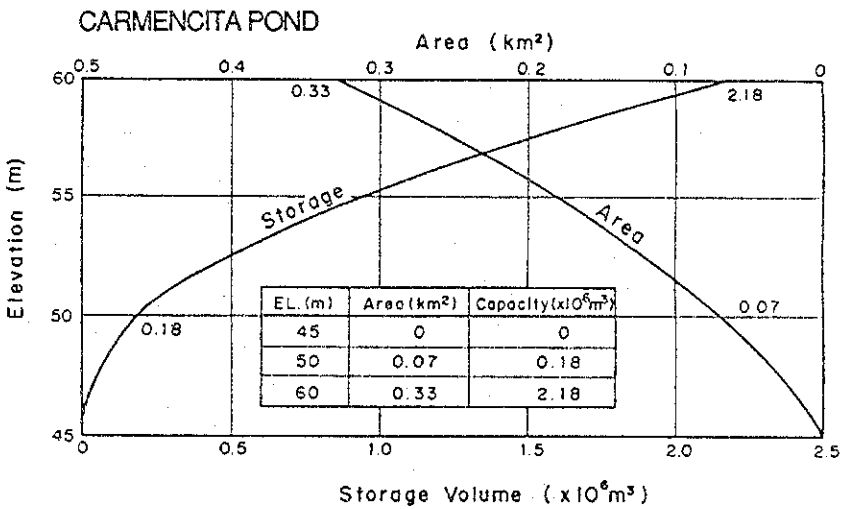
Fig. 5.20 PESERVOIR STORAGE AND SURFACE AREA CURVE (3)



EL. (m)	Area (km²)	Cumul Volume (10⁶m³)
550	0	-
560	0.030	0
570	0.092	0.61
580	0.250	2.32
590	1.056	8.85
600	2.656	27.41
610	4.496	63.17
620	7.937	125.34
630	12.427	227.16
640	19.159	385.09
650	29.399	627.88
660	41.168	980.72
670	52.729	1450.21
680	66.923	2048.47



EL. (m)	Area (km²)	Capacity (x10⁶m³)
80	0	0
90	0.31	1.55
100	1.54	10.80



EL. (m)	Area (km²)	Capacity (x10⁶m³)
45	0	0
50	0.07	0.18
60	0.33	2.18

Fig. 5.20 PESERVOIR STORAGE AND SURFACE AREA CURVE (4)