The study shows that both plans provide a B/C less than 1.0, as shown in **Table 7.3-19**. At this stage, however, Case-2, which provides a larger B/C value is selected for the inventory from the viewpoint of evaluating the hydropower potential in the basin.

(7) Project on The Houay Lamphan Gnai River

The Houay Lamphan Gnai River's upstream basin lies in the northeastern part of the Bolaven Plateau and flows down through steep rapids at the northern end of the plateau to the mainstream of the Se Kong River. Based on the basin's topographic characteristics, the Houay Lamphan Gnai Project is planned as a dam and waterway type development which utilizes a head of approximately 700m between its reservoir on the mid to upstream basin and the mainstream of the Se Kong River, as proposed in the previous study.

(7.1) Houay Lamphan Gnai Project (Fig. 7.3-20)

Although a number of alternative dam sites are available, the dam site in this study is selected at a riverbed elevation of 785m, where an adequate reservoir capacity can be assured with the smallest dam. The tailrace site is selected where the riverbed elevation is 160m on the downstream section of the Houay Lamphan Gnai River and where the total length of the waterway is the shortest.

Regarding the waterway and the powerhouse connecting the reservoir and the tailrace, a layout consisting of a vertical shaft type embedded penstock, an underground powerhouse, and a tailrace tunnel is selected because, similar to the Houay Katak Tok Project, it is technically difficult to install a penstock of an approximately 700m head on the extremely steep slopes of the eastern side of Bolaven Plateau.

Based on the above, the project scale is studied by three cases with HWLs of 830m, 840m and 850m, as shown in **Table 7.3-20**. Through this study, the development plan with an HWL of 850m which provides the highest largest B-C value, is selected.

7.3.5 Formulation of Development Plan Inventory

The results of the study described in 7.3.3 are summarized in **Table 7.3-2**. The detailed features of each project are listed in **Table 7.3-21**. Although this table includes development plans with B/Cs of less than 1.0, the development plan inventory is formulated by employing all projects studied in 7.3.3 to evaluate the hydropower potential in the basin.

At this stage, the following remarks are provided for the evaluation of the development inventory and hydropower potential in the basin, or for further planning including for purposes other than hydropower development;

- Concerning the reservoir type development projects, a plant capacity factor of 60% or so is assumed for this study. However, a new economical value might be added to these plans as peak supply power plants, when the peak power demands increase in the future.

- In addition, for the reservoir type development projects, since reservoir type development plans have small degrees of freedom in their planning, it is important to consider their relation to integrated multi-purpose development plans in which the benefit of irrigation and other contributions are taken into account.

- Concerning the regulating pond type development plans, their energy potentials are small, and do not contribute so much to the evaluation of the hydroelectric potential of the entire basin, nor do they exert influence of any recognizable degree on the development scheme of the basin and, therefore, have large degrees of freedom in their project scales and relation with other activities. Also, their optimal project scales are affected by changes in the various social conditions that prevail around them.

- As the project scales proposed in the Development Plan Inventory were decided by the study by employing purposes such as evaluation of hydropower potential and selection of the projects for the Pre-feasibility Study, the study does not provide the optimum scale. Also, the study was done using river flow data produced by assumptions in the difficult conditions that prevailed at the time.

- In this context, the Development Plan Inventory proposed in this report should be treated as the hydropower potential in the basin, studied with the data available at present and should, therefore, be revised by the result of further studies on priority projects and/or basic data obtained by further investigation in the future.

In this report, the results of this chapter are reviewed with the results of pre-feasibility studies on the selected priority projects. The contents of this review are described in Chapter 13.

Table 7.3-1 Project Cost Parameters

Unit: US$

Item	Description	Unit	Unit Rate 1993
Excavation	Earth (Open)	m^3	4
	Rock (Open)	m^3	9
	Tunnel	m^3	50
	Shaft	m^3	100
	Underground	m^3	50
Embankment	Average	m^3	6
Concrete	Dam	m^3	100
	Structure	m^3	150
	Lining	m^3	200
	Base	m^3	150
	Backfill	m^3	150
Reinforcement Bar		t	1,000
Hydro-mechanical Equipment	Gates	t	5,000
	Penstock	t	4,000
	Trashrack	t	5,000
Construction Road	Plain (unpaved)	km	50,000
	Mountainous (unpaved)	km	70,000
	Improvement	km	30,000
Concrete Bridge	W = 7 m, L = 25 m	m	5,000
	W = 7 m, L = 40 m	m	8,000
	W = 7 m, L = 80 m	m	11,000
	W = 7 m,. L = 130 m	m	9,000
Transmission Line	Estimated separately	km	--

Table 7.3-2 Summary of Development Plan Inventory of Se Kong Basin

No.	Project	River	Catchment Area (km^2)	HWL (m)	TWL (m)	Rated Net Head (m)	Maximum Discharge (m^3/s)	Installed Capacity (MW)	Firm Capacity (MW)	Annual Energy (GWH)	Plant Factor (%)	Construc-tion Cost (M$)	B-C (M$)	B/C (-)	Unit Energy Cost (US¢/KWH)	Const. Cost/KW (US$/KW)
1	**Se Kong No. 3**	Se Kong	9710	160	95	59	588	298	265	1603	61	691.1	5.5	1.07	4.74	2315
2	**Se Kong No. 4**	Se Kong	5400	300	160	140	288	346	331	1925	63	754.9	17.6	1.21	4.31	2182
3	**Se Kong No. 5**	Se Kong	2600	500	300	186	158	253	225	1353	61	574.6	5.7	1.09	4.67	2275
4	**Xe Kaman No. 1**	Xe Kaman	3800	280	118	159	186	255	250	1354	61	520.7	29.6	1.52	4.23	2045
5	**Xe Kaman No. 2**	Xe Kaman	1770	380	280	86	72	53	38	302	64	308.3	-21.3	0.37	11.20	5768
6	1) **Xe Kaman No. 3**	Xe Kaman	665	790	380	385	24	79	79	441	63	118.5	12.1	1.93	2.95	1491
7	**Xe Kaman No. 4**	Xe Kaman	381	1080	380	644	21	115	113	597	59	450.4	-16.0	0.68	8.30	3908
8	**Xe Namnoy**	Xe Namnoy	3)1273	-	-	520	-	255	2)228	1499	67	429.6	24.5	1.52	3.15	1685
8-1	**Midstream**	Xe Namnoy/Xe Pian	3) 749	760	280	446	50	192	186	1161	69	313.6	23.2	1.67	2.97	1637
8-2	1) **Downstream**	Xe Namnoy	3)1273	280	200	74	100	63	63	338	61	116.0	8.9	1.70	3.78	1828
9	**Houay Katak Tok**	Xe Namnoy (Houay Katak Tok)	199	880	100	730	16.7	105	104	550	60	137.6	15.7	2.03	2.75	1312
10	**Nam Kong No. 1**	Nam Kong	1250	340	160	163	75	105	91	518	56	233.0	1.9	1.07	4.95	2223
11	**Nam Kong No. 2**	Nam Kong	850	460	340	108	32	30	27	184	71	124.9	-5.1	0.63	7.48	4209
12	**Nam Kong No. 3**	Nam Kong	600	540	460	74	32	21	19	112	62	100.5	-5.2	0.53	9.87	4859
13	**Xe Xou**	Xe Xou	1480	180	120	55	73	35	33	184	60	142.1	-5.8	0.63	8.48	4081
14	**Dak E Meule**	Nam Emun	446	-	-	575	-	138	136	660	55	393.2	-3.8	0.91	6.60	2844
14-1	**Upstream**	Nam Emun	230	960	760	170	16	23	22	115	56	122.6	-6.9	0.49	11.80	5256
14-2	**Midstream**	Nam Emun	446	770	380	405	33	115	114	545	54	270.6	3.1	1.10	5.50	2354
15	**Houay Lamphan Gnai**	Houay Lamphan Gnai	195	840	160	629	16	87	84	500	66	182.1	5.6	1.28	4.00	2103
	Total / Average		3)16460	-	-	-	-	2175	2)2023	11782	62	5161.5	-	-	4.82	2373

1) Planned as daily regulation type with 6 hours peak power duration. (All the others are planned applying 12 hours peak power duration.)
2) Figures obtained by adjusting firm capacities of daily regulation projects to the figures for 12 hours peak power duration.
3) Includes 223 km^2 of the Xe Pian diversion scheme.

Table 7.3-3 Justification Study on Se Kong No. 3 Project

Item	Unit	Case-1	Case-2	Case-3
High Water Level	m	140	150	160
Net Storage Capacity	MCM	1,315	2,630	2,630
Firm Discharge	m^3/s	213	294	294
Maximum Discharge	m^3/s	426	588	588
Installed Capacity	MW	142	244	298
Firm Capacity (12 hours)	MW	121	189	265
Annual Energy	GWH	871	1,126	1,603
Plant Factor	%	70	53	61
Project Cost	M$	463.6	621.6	691.1
B-C	M$	-11.9	-10.6	5.5
B/C	--	0.77	0.85	1.07
Unit Energy Cost	¢/kWh	5.85	6.07	4.74
Unit Construction Cost	$/kW	3,256	2,543	2,315
Selected Case	--			*

Table 7.3-4 Justification Study on Se Kong No. 4 Project

Item	Unit	Case-1	Case-2	Case-3
High Water Level	m	280	300	320
Net Storage Capacity	MCM	1,287	1,287	1,287
Firm Discharge	m^3/s	144	144	144
Maximum Discharge	m^3/s	288	288	288
Installed Capacity	MW	294	346	397
Firm Capacity (12 hours)	MW	273	331	385
Annual Energy	GWH	1,609	1,925	2,220
Plant Factor	%	62	63	64
Project Cost	M$	618.7	754.9	920.1
B-C	M$	15.2	17.6	15.6
B/C	--	1.22	1.21	1.15
Unit Energy Cost	¢/kWh	4.23	4.31	4.56
Unit Construction Cost	$/kW	2,106	2,182	2,317
Selected Case	--		*	

Table 7.3-5 Justification Study on Se Kong No. 5 Project

Item	Unit	Case-1	Case-2	Case-3
High Water Level	m	460	480	500
Net Storage Capacity	MCM	1,403	1,403	1,403
Firm Discharge	m^3/s	79	79	79
Maximum Discharge	m^3/s	158	158	158
Installed Capacity	MW	187	221	253
Firm Capacity (12 hours)	MW	136	184	225
Annual Energy	GWH	1,042	1,209	1,353
Plant Factor	%	64	62	61
Project Cost	M$	409.3	479.3	574.6
B-C	M$	0.0	5.3	5.7
B/C	--	1.00	1.10	1.09
Unit Energy Cost	₡/kWh	4.32	4.36	4.67
Unit Construction Cost	$/kW	2,192	2,166	2,275
Selected Case	--			*

Table 7.3-6 Justification Study on Xe Kaman No. 1 Project

Item	Unit	Case-1	Case-2	Case-3
High Water Level	m	260	270	280
Net Storage Capacity	MCM	833	833	833
Firm Discharge	m^3/s	93	93	93
Maximum Discharge	m^3/s	186	186	186
Installed Capacity	MW	222	239	255
Firm Capacity (12 hours)	MW	218	234	250
Annual Energy	GWH	1,169	1,262	1,354
Plant Factor	%	60	60	61
Project Cost	M$	439.1	477.9	520.7
B-C	M$	26.8	28.5	29.6
B/C	--	1.56	1.54	1.52
Unit Energy Cost	₡/kWh	4.13	4.17	4.23
Unit Construction Cost	$/kW	1,976	2,003	2,045
Selected Case	--			*

Table 7.3-7 Justification Study on Xe Kaman No. 2 Project

Item	Unit	Case-1	Case-2	Case-3	Case-4
High Water Level	m	380	400	420	440
Net Storage Capacity	MCM	289	481	577	577
Firm Discharge	m^3/s	36	45	46	46
Maximum Discharge	m^3/s	72	90	92	92
Installed Capacity	MW	53	78	97	116
Firm Capacity (12 hours)	MW	38	51	72	96
Annual Energy	GWH	302	400	506	609
Plant Factor	%	64	58	60	60
Project Cost	M$	308.3	407.3	548.6	680.8
B-C	M$	-21.3	-27.8	-37.3	-44.9
B/C	--	0.37	0.38	0.38	0.40
Unit Energy Cost	¢/kWh	11.2	11.2	11.9	12.3
Unit Construction Cost	$/kW	5,768	5,199	5,655	5,874
Selected Case	--	*			

Table 7.3-8 Justification Study on Xe Kaman No. 3 Project

Item	Unit	Case-1	Case-2	Case-3
High Water Level	m	790	790	790
Net Storage Capacity	MCM	Daily Regulation	Daily Regulation	Daily Regulageion
Firm Discharge	m^3/s	6.0	6.0	6.0
Maximum Discharge	m^3/s	12.0	18.0	24.0
Installed Capacity	MW	38	59	79
Firm Capacity	MW	(12 hrs) 38	(8 hrs) 59	(6 hrs) 79
Annual Energy	GWH	285	375	441
Plant Factor	%	84	73	63
Project Cost	M$	91.9	105.7	118.5
B-C	M$	7.1	10.2	12.1
B/C	--	1.70	1.88	1.93
Unit Energy Cost	¢/kWh	3.55	3.10	2.95
Unit Construction Cost	$/kW	2,389	1,792	1,491
Selected Case	--			*

Table 7.3-9 Justification Study on Xe Kaman No. 4 Project

Item	Unit	with A,B,C,D & E	with A,B & C
		Case-1	Case-2
High Water Level	m	1,080	1,080
Net Storage Capacity	MCM	1,063	1,063
Firm Discharge	m^3/s	10.4	7.5
Maximum Discharge	m^3/s	20.8	15.0
Installed Capacity	MW	115	82
Firm Capacity (12 hours)	MW	113	80
Annual Energy	GWH	597	427
Plant Factor	%	59	60
Project Cost	M$	450.4	338.8
B-C	M$	-16.0	-13.5
B/C	--	0.68	0.64
Unit Energy Cost	C/kWh	8.30	8.72
Unit Construction Cost	$/kW	3,908	4,155
Selected Case	--	*	

Table 7.3-10 Justification Study on Xe Namnoy Midstream Project

Item	Unit	without Xe Pian Diversion			
		Case-1	Case-2	Case-3	Case-4
High Water Level	m	750	760	770	780
Net Storage Capacity	MCM	85	255	255	255
Firm Discharge	m^3/s	13.0	20.4	20.4	20.4
Maximum Discharge	m^3/s	26.0	40.8	40.8	40.8
Installed Capacity	MW	95	156	161	165
Firm Capacity (12 hours)	MW	94	152	159	163
Annual Energy	GWH	636	887	909	932
Plant Factor	%	76	65	64	65
Project Cost	M$	175.3	256.2	290.7	343.8
B-C	M$	10.5	18.0	16.0	11.4
B/C	--	1.55	1.64	1.50	1.30
Unit Energy Cost	¢/kWh	3.03	3.18	3.52	4.06
Unit Construction Cost	$/kW	1,844	1,639	1,806	2,088
Selected Case	--		*		

Table 7.3-11 Justification Study on Xe Namnoy Downstream Project

Item	Unit	without Xe Pian Diversion/ with H. Katak Tok		
		Case-1	Case-2	Case-3
High Water Level	m	280	280	280
Net Storage Capacity	MCM	1	1	1
Firm Discharge	m^3/s	16.5	16.5	16.5
Maximum Discharge	m^3/s	49.5	66.0	75.0
Installed Capacity	MW	31	42	48
Firm Capacity	MW	(8 hrs) 31	(6 hrs) 41	(6 hrs) 41
Annual Energy	GWH	221	254	268
Plant Factor	%	80	69	64
Project Cost	M$	71.4	85.8	93.5
B-C	M$	5.6	6.4	6.3
B/C	--	1.71	1.68	1.61
Unit Energy Cost	¢/kWh	3.56	3.72	3.83
Unit Construction Cost	$/kW	2,278	2,051	1,967
Selected Case	--			*

Table 7.3-12 Justification Study on Xe Pian Project

Item	Unit	without diversion to Xe Namnoy		
		Case-1	Case-2	Case-3
High Water Level	m	760	760	760
Net Storage Capacity	MCM	Daily Regulation	Daily Regulation	Daily Regulation
Firm Discharge	m^3/s	3.0	3.0	3.0
Maximum Discharge	m^3/s	9.0	12.0	15.0
Installed Capacity	MW	23.0	30.0	38.0
Firm Capacity	MW	(8 hrs) 23.0	(6 hrs) 30.0	(6 hrs) 30.0
Annual Energy	GWH	154	189	203
Plant Factor	%	77	71	61
Project Cost	M$	53.9	59.4	64.7
B-C	M$	3.5	5.2	5.9
B/C	--	1.59	1.80	1.82
Unit Energy Cost	¢/kWh	3.9	3.5	3.5
Unit Construction Cost	$/kW	2,362	1,950	1,700
Selected Case	--			*

Table 7.3-13 Justification Study on Xe Namnoy Project (Mid + Down)

Item	Unit	Case-1: without Xe Pian Diversion			
		Midstream	Downstream	Xe Pian	Total
High Water Level	m	760	280	760	--
Net Storage Capacity	MCM	255	Daily Regulation	Daily Regulation	--
Firm Discharge	m^3/s	20.4	16.5	3.0	--
Maximum Discharge	m^3/s	40.8	75.0	15.0	--
Installed Capacity	MW	156	48	38	242
Firm Capacity	MW	(12 hours) 152	(6 hours) 41 (21)	(6 hours)30 (15)	(12 hours) 188
Annual Energy	GWH	887	268	203	1,358
Plant Factor	%	65	64	61	64
Project Cost	M$	256.2	93.5	64.7	414.4
B-C	M$	18.0	6.3 (-1.9)	5.9 (-0.9)	15.2
B/C	--	1.64	1.61 (0.82)	1.82 (0.88)	1.33
Unit Energy Cost	¢/kWh	3.18	3.83	3.50	3.36
Unit Construction Cost	$/kW	1,639	1,967	1,700	1,712
Selected Case	--	-	-	-	-

Note) Figures in parentheses are of evaluation with the condition of 12 hours peak power duration.

Item	Unit	Case-2: with Xe Pian Diversion			
		Midstream	Downstream	Xe Pian	Total
High Water Level	m	760	280	--	--
Net Storage Capacity	MCM	255	Daily Regulation	--	--
Firm Discharge	m^3/s	25.0	33.4	--	--
Maximum Discharge	m^3/s	50	100	--	--
Installed Capacity	MW	192	63	--	255
Firm Capacity	MW	(12 hours) 186	(6 hours) 63 (42)	--	(12 hours) 228
Annual Energy	GWH	1,161	338	--	1,499
Plant Factor	%	69	61	--	67
Project Cost	M$	313.6	116.0	--	429.6
B-C	M$	23.2	8.9 (1.3)	--	24.5
B/C	--	1.67	1.70 (1.11)	--	1.52
Unit Energy Cost	¢/kWh	2.97	3.78	--	3.15
Unit Construction Cost	$/kW	1,637	1,828	--	1,685
Selected Case	--	*	*	-	*

Note) Figures in parentheses are of evaluation with the condition of 12 hours peak power duration.

Table 7.3-14 Justification Study on Hounay Katak Tok Project

Item	Unit	Case-1	Case-2	Case-3
High Water Level	m	870	880	890
Net Storage Capacity	MCM	85	142	142
Firm Discharge	m^3/s	7.6	8.4	8.4
Maximum Discharge	m^3/s	15.2	16.7	16.7
Installed Capacity	MW	93	105	107
Firm Capacity (12 hours)	MW	92	104	106
Annual Energy	GWH	506	550	560
Plant Factor	%	62	60	60
Project Cost	M$	121.5	137.6	157.9
B-C	M$	14.3	15.7	14.0
B/C	--	2.07	2.03	1.81
Unit Energy Cost	¢/kWh	2.64	2.75	3.10
Unit Construction Cost	$/kW	1,304	1,312	1,482
Selected Case	--		*	

Table 7.3-15 Justification Study on Nam Kong No. 1 Project

Item	Unit	Case-1	Case-2	Case-3
High Water Level	m	320	330	340
Net Storage Capacity	MCM	145	290	435
Firm Discharge	m^3/s	22	29	37
Maximum Discharge	m^3/s	44	58	75
Installed Capacity	MW	55	77	105
Firm Capacity (12 hours)	MW	51	68	91
Annual Energy	GWH	360	450	518
Plant Factor	%	75	67	56
Project Cost	M$	155.0	192.2	233.0
B-C	M$	-0.6	0.4	1.9
B/C	--	0.97	1.02	1.07
Unit Energy Cost	¢/kWh	4.73	4.70	4.95
Unit Construction Cost	$/kW	2,821	2,509	2,223
Selected Case	--			*

Table 7.3-16 Justification Study on Nam Kong No. 2 Project

Item	Unit	Case-1	Case-2	Case-3
High Water Level	m	460	470	480
Net Storage Capacity	MCM	98	196	293
Firm Discharge	m^3/s	16.0	21.9	24.9
Maximum Discharge	m^3/s	32	44	50
Installed Capacity	MW	30	45	56
Firm Capacity (12 hours)	MW	27	41	51
Annual Energy	GWH	184	242	285
Plant Factor	%	71	62	58
Project Cost	M$	124.9	167.0	212.1
B-C	M$	-5.1	-5.9	-7.9
B/C	--	0.63	0.68	0.66
Unit Energy Cost	¢/kWh	7.48	7.59	8.20
Unit Construction Cost	$/kW	4,209	3,741	3,792
Selected Case	--	*		

Table 7.3-17 Justification Study on Nam Kong No. 3 Project

Item	Unit	Case-1	Case-2
High Water Level	m	530	540
Net Storage Capacity	MCM	66	199
Firm Discharge	m^3/s	11.0	16.2
Maximum Discharge	m^3/s	22	32
Installed Capacity	MW	12	21
Firm Capacity (12 hours)	MW	11	19
Annual Energy	GWH	75	112
Plant Factor	%	72	62
Project Cost	M$	75.7	100.5
B-C	M$	-4.8	-5.2
B/C	--	0.43	0.53
Unit Energy Cost	¢/kWh	11.14	9.87
Unit Construction Cost	$/kW	6,342	4,859
Selected Case	--		*

Table 7.3-18 Justification Study on Xe Xou Project

Item	Unit	Case-1	Case-2	Case-3	Case-4
High Water Level	m	160	180	200	220
Net Storage Capacity	MCM	464	464	464	464
Firm Discharge	m^3/s	36.6	36.6	36.6	36.6
Maximum Discharge	m^3/s	73	73	73	73
Installed Capacity	MW	21	35	48	61
Firm Capacity (12 hours)	MW	16	33	47	60
Annual Energy	GWH	113	184	269	343
Plant Factor	%	61	60	64	64
Project Cost	M$	107.3	142.1	237.7	346.4
B-C	M$	-6.6	-5.8	-12.0	-20.0
B/C	--	0.44	0.63	0.54	0.47
Unit Energy Cost	¢/kWh	10.47	8.48	9.72	11.12
Unit Construction Cost	$/kW	5,130	4,081	4,969	5,713
Selected Case	--		*		

Table 7.3-19 Justification Study on Dak E Meule Project

Item	Unit	Case-1: with A,B,C,D and E Reservoirs		
		Upstream Project	Downstream Project	Total
High Water Level	m	960	770	--
Net Storage Capacity	MCM	Resv.A 144	--	--
Firm Discharge	m^3/s	8.0	16.5	--
Maximum Discharge	m^3/s	16.0	33.0	--
Installed Capacity	MW	23	115	138
Firm Capacity (12 hours)	MW	22	114	136
Annual Energy	GWH	115	545	660
Plant Factor	%	56	54	55
Project Cost	M$	122.6	270.6	393.2
B-C	M$	-6.9	3.1	-3.8
B/C	--	0.49	1.10	0.91
Unit Energy Cost	¢/kWh	11.8	5.5	6.6
Unit Construction Cost	$/kW	5,256	2,354	2,844
Selected Case	--	*	*	*

Item	Unit	Case-2: with A,C and D Reservoirs		
		Upstream Project	Downstream Project	Total
High Water Level	m	960	770	--
Net Storage Capacity	MCM	Resv.A 144	--	--
Firm Discharge	m^3/s	9.8	18.0	--
Maximum Discharge	m^3/s	19.6	36.0	--
Installed Capacity	MW	29	126	155
Firm Capacity (12 hours)	MW	28	124	152
Annual Energy	GWH	143	598	741
Plant Factor	%	56	54	55
Project Cost	M$	176.9	295.8	472.7
B-C	M$	-11.3	3.4	-7.9
B/C	--	0.42	1.10	0.85
Unit Energy Cost	¢/kWh	13.6	5.4	7.0
Unit Construction Cost	$/kW	6,083	2,353	3,054
Selected Case	--	-	-	-

Table 7.3-20 Justification Study on Houay Lamphan Gnai Project

Item	Unit	Case-1	Case-2	Case-3
High Water Level	m	830	840	850
Net Storage Capacity	MCM	38	76	114
Firm Discharge	m^3/s	6.0	8.0	9.4
Maximum Discharge	m^3/s	12.0	16.0	18.8
Installed Capacity	MW	63	87	103
Firm Capacity (12 hours)	MW	62	84	99
Annual Energy	GWH	406	500	547
Plant Factor	%	73	66	61
Project Cost	M$	138.4	182.1	233.8
B-C	M$	4.3	5.6	4.0
B/C	--	1.28	1.28	1.15
Unit Energy Cost	¢/kWh	3.7	4.0	4.7
Unit Construction Cost	$/kW	2,183	2,103	2,268
Selected Case	--		*	

Table 7.3-21 Profile of Projects in Development Plan Inventory (1/5)

Project	Unit	Se Kong		
		No.3	No.4	No.5
Hydrology				
Catchment Area	km^2	9,710	5,400	2,600
Annual Inflow Volume	10^6m^3	13,140	6,444	2,810
Average Inflow	m^3/s	417	204	89
Project Structure				
Dam Height x Crest Length	m	80x2,090	155x880	170x520
Tunnel Length	m	--	--	850
Open Channel Length	m	550	--	--
Penstock Length	m	500	870	340
Reservoir				
High Water Level	m	160	300	500
Low Water Level	m	149	291	469
Gross Storage Capacity	10^6m^3	7,103	7,776	3,551
Effective Storage Capacity	10^6m^3	2,630	1,287	1,403
Regulation Ratio	%	20	20	50
Regulated Firm Flow	m^3/s	294	144	79
Power Generation Plan				
Tail Water Level	m	95	160	300
Maximum Gross Head	m	65	145	200
Net Head	m	59	140	186
Maximum Discharge	m^3/s	588	288	158
Installed Capacity	MW	298	346	253
Firm Capacity	MW	265	331	225
Annual Energy	GWh	1,603	1,925	1,353
Plant Factor	%	61	63	61
Project Economy				
Construction Cost[1)]	$10^6$$	691.1	754.9	574.6
Net Benefit (B-C)	$10^6$$	5.5	17.6	5.7
Benefit Cost Ratio (B/C)	--	1.07	1.21	1.09
Energy Cost	¢/kWh	4.74	4.31	4.67
Construction Cost per kW	$/kW	2,315	2,182	2,275

1) Construction cost includes transmission line cost and excludes interest during construction.

Table 7.3-21 Profile of Projects in Development Plan Inventory (2/5)

Project	Unit	Xe Kaman			
		No.1	No.2	No.3	No.4
Hydrology					
Catchment Area	km^2	3,800	1,770	655	381
Annual Inflow Volume	10^6m^3	4,177	1,926	758	386
Average Inflow	m^3/s	132	61	24	12
Project Structure					
Dam Height x Crest Length	m	170x410	110x290	30x150	A:55x500 B:110x1040 C:60x340 D:65x340 E:50x280
Tunnel Length	m	--	--	5,000	23,200
Open Channel Length	m	--	--	--	--
Penstock Length	m	580	110	950	2,300
Reservoir					
High Water Level	m	280	380	790	1,080
Low Water Level	m	276	342	788	1,063
Gross Storage Capacity	10^6m^3	16,208	431	1.5	26
Effective Storage Capacity	10^6m^3	833	289	Daily Regulation	18
Regulation Ratio	%	20	15	--	5
Regulated Firm Flow	m^3/s	93	36	6.0	10.4
Power Generation Plan					
Tail Water Level	m	118	280	380	380
Maximum Gross Head	m	162	100	410	700
Net Head	m	159	86	385	644
Maximum Discharge	m^3/s	186	72	24	21
Installed Capacity	MW	255	53	79	115
Firm Capacity	MW	250	38	(6 hours) 79	113
Annual Energy	GWh	1,354	302	441	597
Plant Factor	%	61	64	63	59
Project Economy					
Construction Cost[1)]	$10^6$$	520.7	308.3	118.5	450.4
Net Benefit (B-C)	$10^6$$	29.6	-21.3	12.1	-16.0
Benefit Cost Ratio (B/C)	--	1.52	0.37	1.93	0.68
Energy Cost	¢/kWh	4.23	11.2	2.95	8.30
Construction Cost per kW	$/kW	2,045	5,768	1,491	3,908

1) Construction cost includes transmission line cost and excludes interest during construction.

Table 7.3-21 Profile of Projects in Development Plan Inventory (3/5)

Project	Unit	Xe Namnoy			H. Katak Tok
		Midstream	Downstream	Total	
Hydrology					
Catchment Area	km^2	(529+220) 749	(1,252+220-199) 1,273	--	199
Annual Inflow Volume	10^6m^3	1,151	2,209	--	299
Average Inflow	m^3/s	36	70	--	9
Project Structure					
Dam Height x Crest Length	m	50x920	30x230	--	65x260
Tunnel Length	m	9,350	3,500	--	6,000
Open Channel Length	m	1,400	--	--	--
Penstock Length	m	1,390	220	--	900
Reservoir					
High Water Level	m	760	280	--	880
Low Water Level	m	741	278	--	869
Gross Storage Capacity	10^6m^3	323	16	--	316
Effective Storage Capacity	10^6m^3	255	Daily Regulation	--	142
Regulation Ratio	%	22	--	--	47
Regulated Firm Flow	m^3/s	25.0	33.4	--	8.4
Power Generation Plan					
Tail Water Level	m	280	200	--	100
Maximum Gross Head	m	480	80	560	780
Net Head	m	446	74	520	730
Maximum Discharge	m^3/s	50	100	--	16.7
Installed Capacity	MW	192	63	255	105
Firm Capacity	MW	186	(6 hours) 63(42)	228	104
Annual Energy	GWh	1,161	338	1,499	550
Plant Factor	%	69	61	67	60
Project Economy					
Construction Cost[1)]	$10^6$$	313.6	116.0	429.6	137.6
Net Benefit (B-C)	$10^6$$	23.2	8.9(1.3)	24.5	15.7
Benefit Cost Ratio (B/C)	--	1.67	1.70(1.11)	1.52	2.03
Energy Cost	¢/kWh	2.97	3.78	3.15	2.75
Construction Cost per kW	$/kW	1,637	1,828	1,685	1,312

1) Construction cost includes transmission line cost and excludes interest during construction.
2) Figures in parentheses are of evaluation with the condition of 12 hours peak power duration.

Table 7.3-21 Profile of Projects in Development Plan Inventory (4/5)

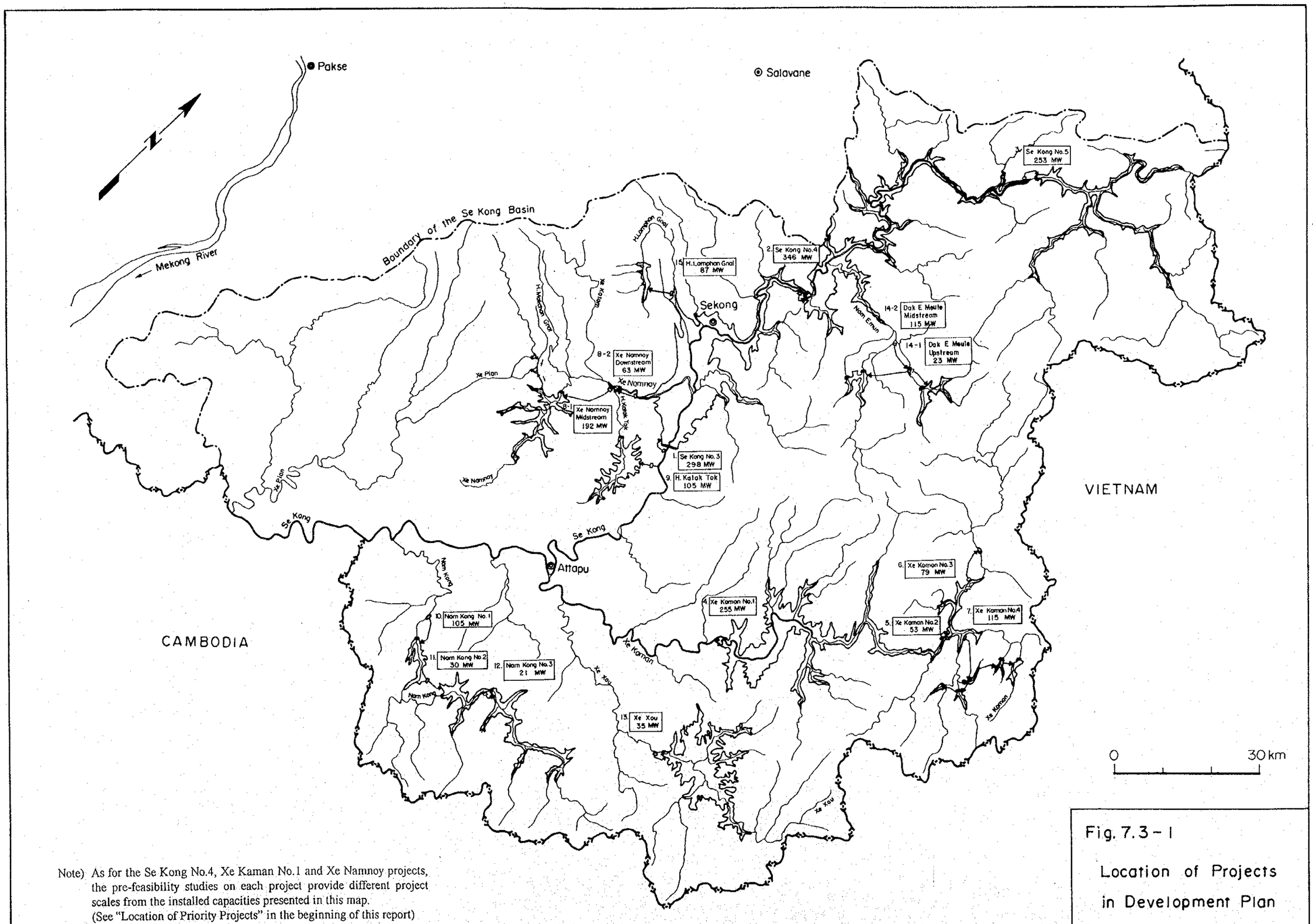
Project	Unit	Nam Kong			Xe Xou
		No.1	No.2	No.3	
Hydrology					
Catchment Area	km^2	1250	850	600	1,480
Annual Inflow Volume	10^6m^3	1,460	968	677	1,534
Average Inflow	m^3/s	46	31	21	49
Project Structure					
Dam Height x Crest Length	m	85x380	70x270	65x330	70x360
Tunnel Length	m	3,700	2,700	1,000	750
Open Channel Length	m	--	100	--	--
Penstock Length	m	440	610	150	260
Reservoir					
High Water Level	m	340	460	540	180
Low Water Level	m	308	448	532	175
Gross Storage Capacity	10^6m^3	612	171	377	2,328
Effective Storage Capacity	10^6m^3	435	98	199	464
Regulation Ratio	%	30	10	29	30
Regulated Firm Flow	m^3/s	37.3	16.0	16.2	36.6
Power Generation Plan					
Tail Water Level	m	160	340	460	120
Maximum Gross Head	m	180	120	80	60
Net Head	m	163	108	74	55
Maximum Discharge	m^3/s	75	32	32	73
Installed Capacity	MW	105	30	21	35
Firm Capacity	MW	91	27	19	33
Annual Energy	GWh	518	184	112	184
Plant Factor	%	56	71	62	60
Project Economy					
Construction Cost[1)]	$10^6$$	233.0	124.9	100.5	142.1
Net Benefit (B-C)	$10^6$$	1.9	-5.1	-5.2	-5.8
Benefit Cost Ratio (B/C)	--	1.07	0.63	0.53	0.63
Energy Cost	¢/kWh	4.95	7.48	9.87	8.48
Construction Cost per kW	$/kW	2,223	4,209	4,859	4,081

1) Construction cost includes transmission line cost and excludes interest during construction.

Table 7.3-21 Profile of Projects in Development Plan Inventory (5/5)

Project	Unit	Dak E Meule			H. Lamphan Gnai
		Upstream	Midstream	Total	
Hydrology					
Catchment Area	km^2	230	446	--	195
Annual Inflow Volume	10^6m^3	286	565	--	364
Average Inflow	m^3/s	9	18	--	12
Project Structure					
Dam Height x Crest Length	m	A:80x290	C:110x450 D: 45x220 F: 40x170		
Tunnel Length	m	4,700	14,600	19,300	4,800
Open Channel Length	m	--	--	--	--
Penstock Length	m	650	1,500	2,150	2,100
Reservoir					
High Water Level	m	960	770	--	840
Low Water Level	m	950	765	--	811
Gross Storage Capacity	10^6m^3	470	5	--	99
Effective Storage Capacity	10^6m^3	144	1	--	76
Regulation Ratio	%	50	--	--	21
Regulated Firm Flow	m^3/s	8.0	16.5	--	8.0
Power Generation Plan					
Tail Water Level	m	760	380	--	160
Maximum Gross Head	m	200	420	620	680
Net Head	m	170	405	575	629
Maximum Discharge	m^3/s	16	33	--	16
Installed Capacity	MW	23	115	138	87
Firm Capacity	MW	22	114	136	84
Annual Energy	GWh	115	545	660	500
Plant Factor	%	56	54	55	66
Project Economy					
Construction Cost[1)]	$10^6$$	122.6	270.6	393.2	182.1
Net Benefit (B-C)	$10^6$$	-6.9	3.1	-3.8	5.6
Benefit Cost Ratio (B/C)	--	0.49	1.10	0.91	1.28
Energy Cost	¢/kWh	11.8	5.5	6.6	4.0
Construction Cost per kW	$/kW	5,256	2,354	2,844	2,103

1) Construction cost includes transmission line cost and excludes interest during construction.



Note) As for the Se Kong No.4, Xe Kaman No.1 and Xe Namnoy projects, the pre-feasibility studies on each project provide different project scales from the installed capacities presented in this map.
(See "Location of Priority Projects" in the beginning of this report)

Fig. 7.3 - 1

Location of Projects in Development Plan Inventory

Fig.7.3-2 Development Profile of Se Kong Mainstream

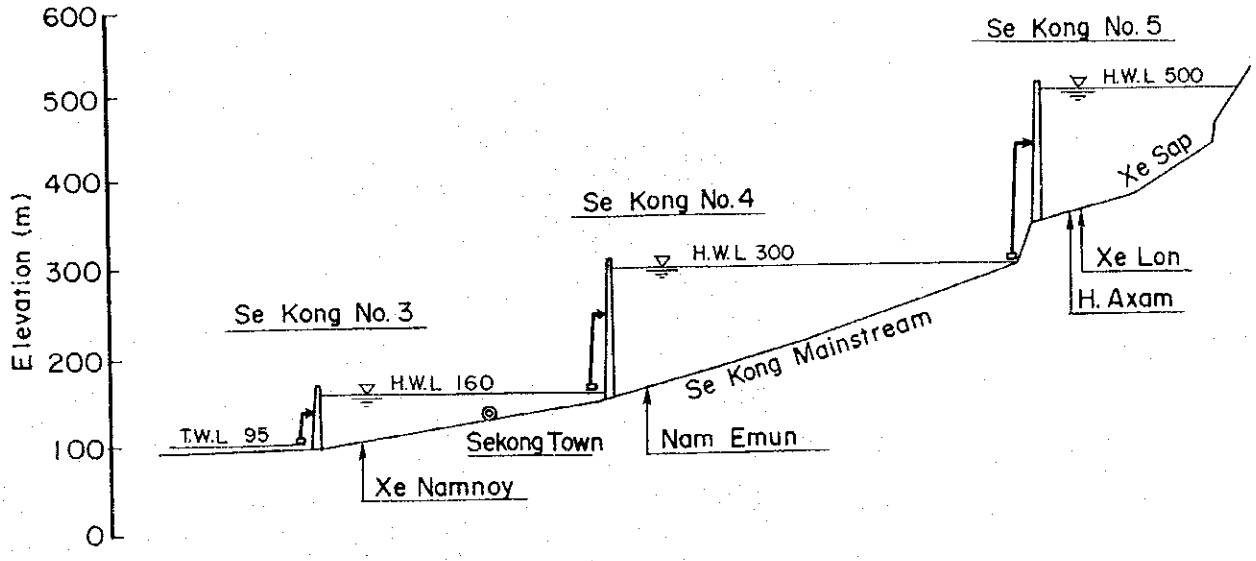


Fig.7.3-3 Development Profile of Xe Kaman

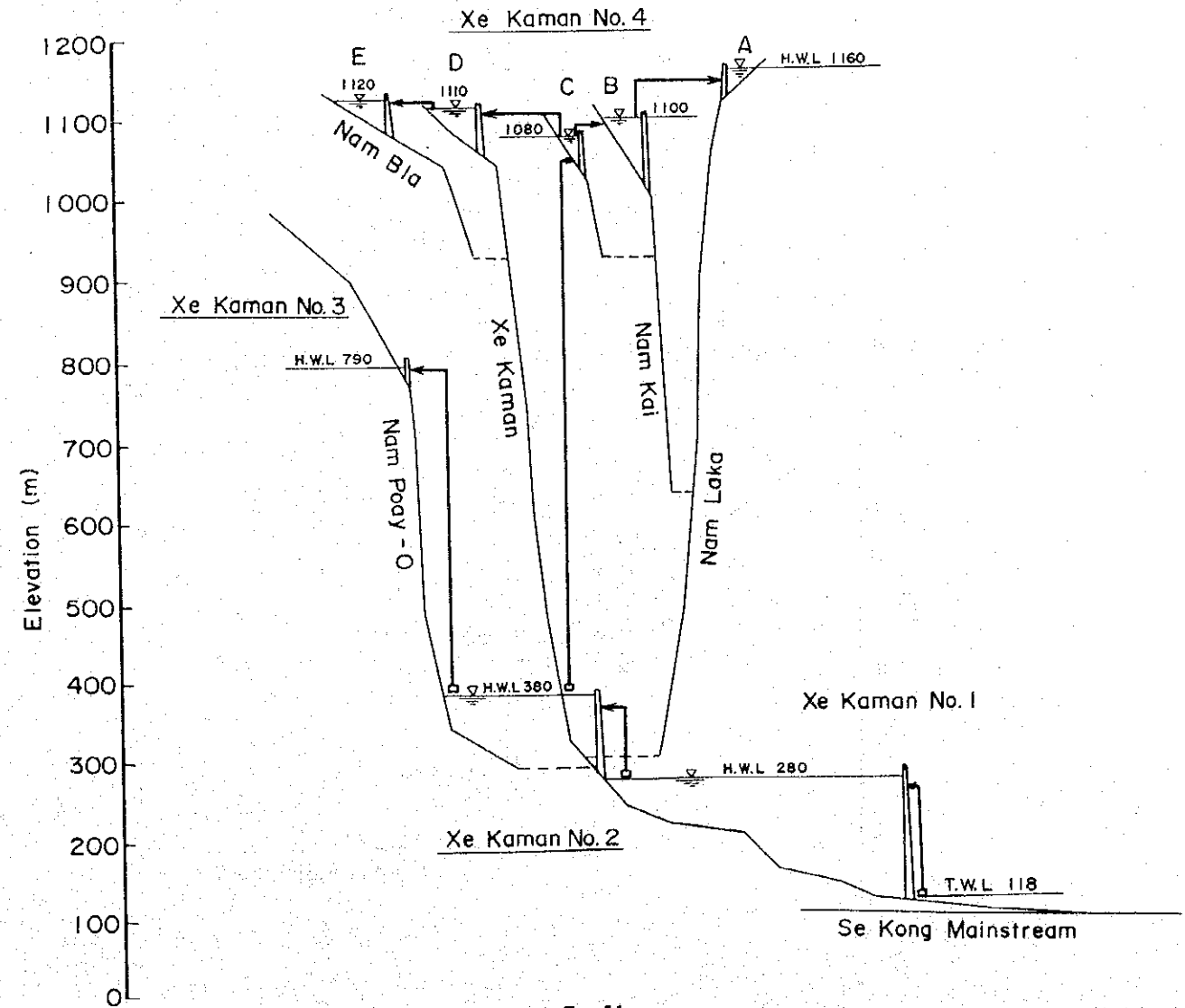


Fig.7.3-4 Alternative Development Plan of Xe Pian

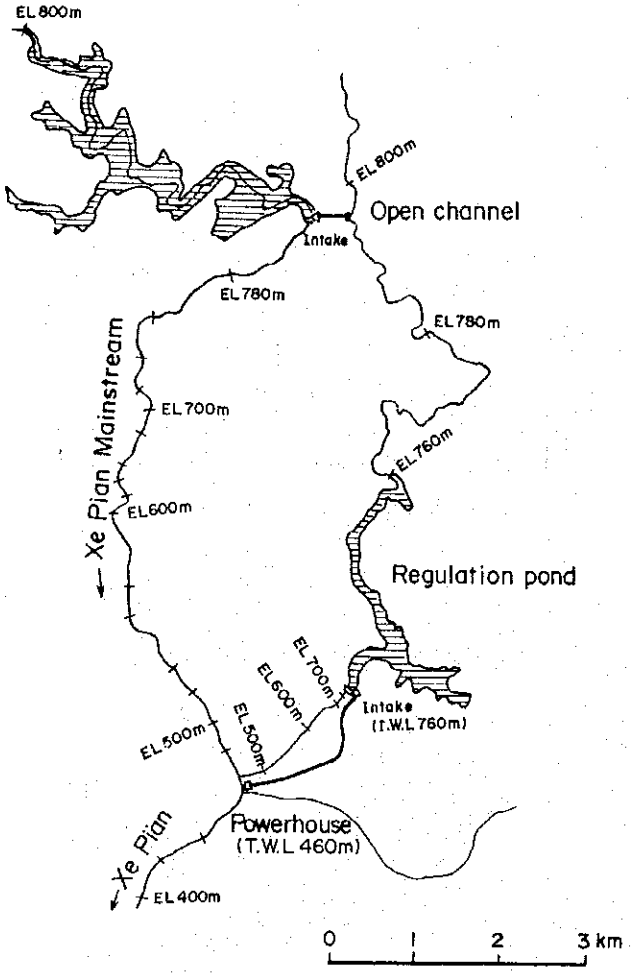
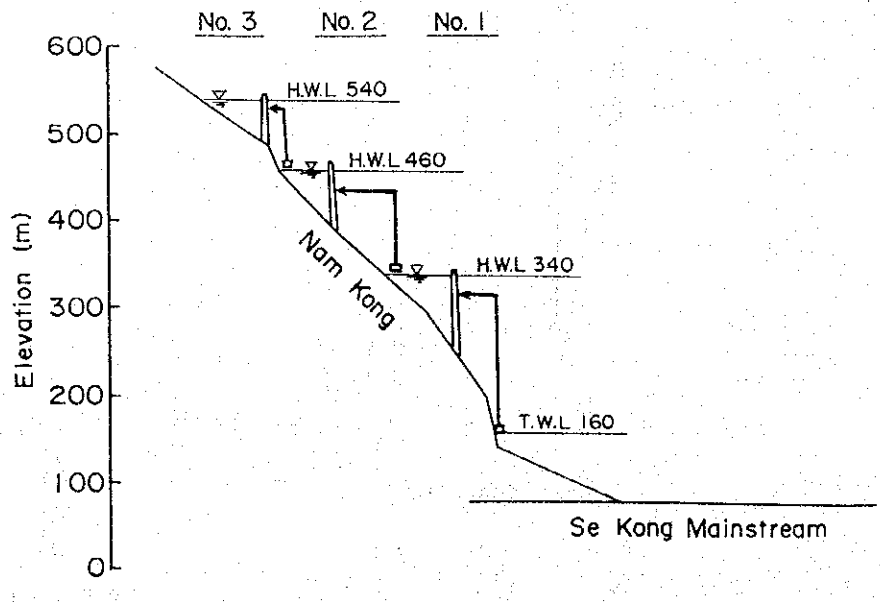
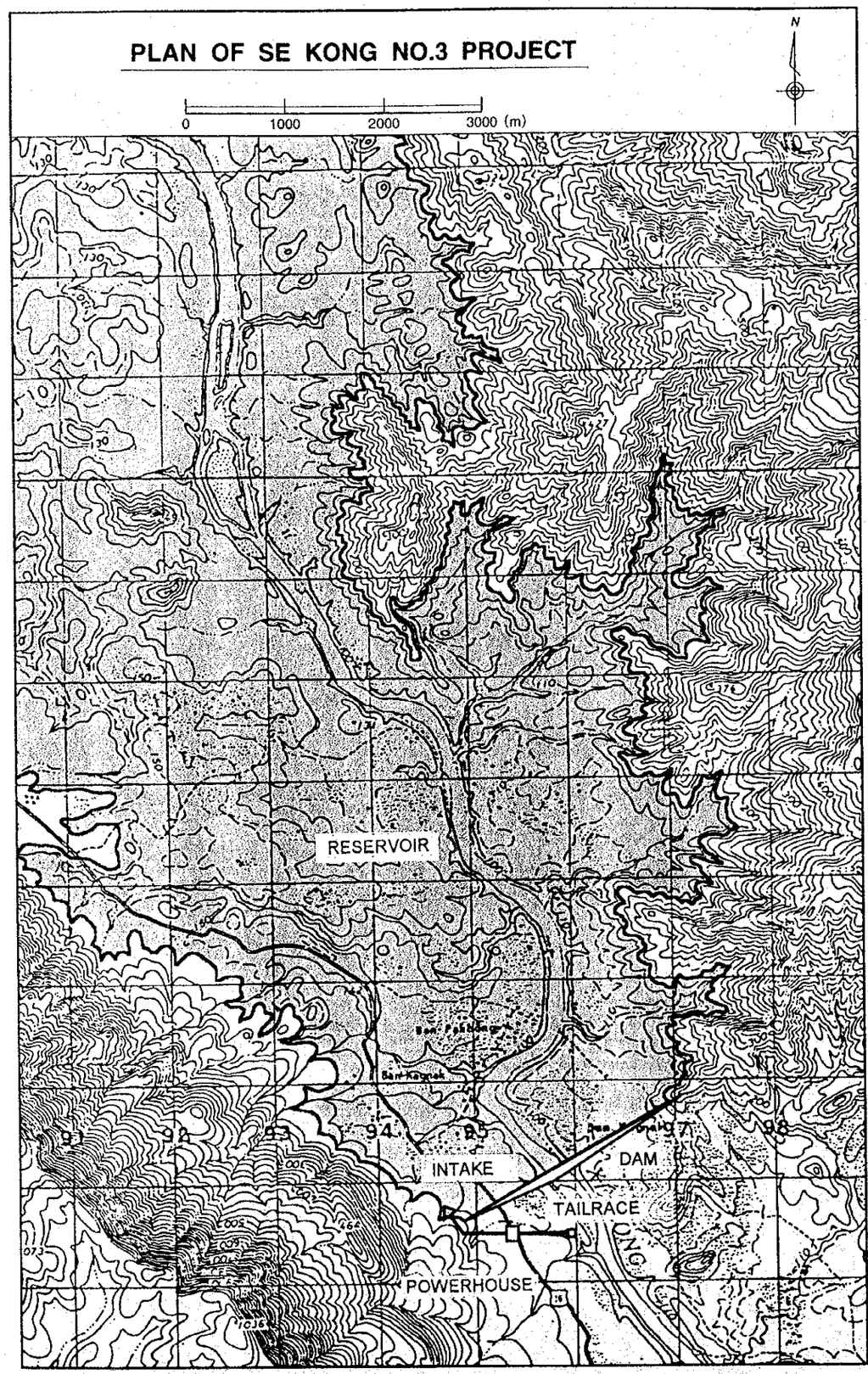


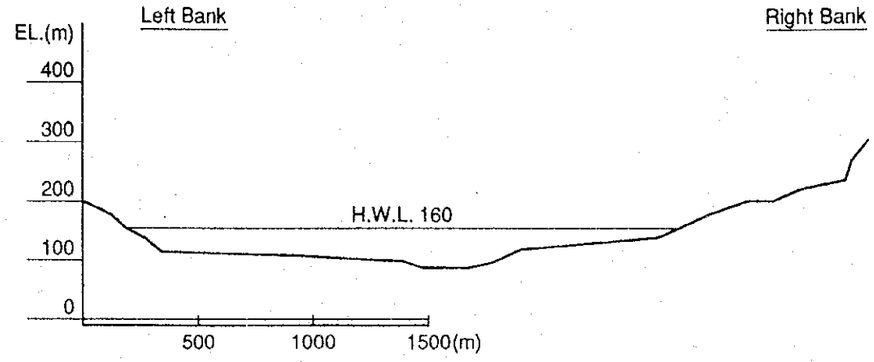
Fig.7.3-5 Development Profile of Nam Kong



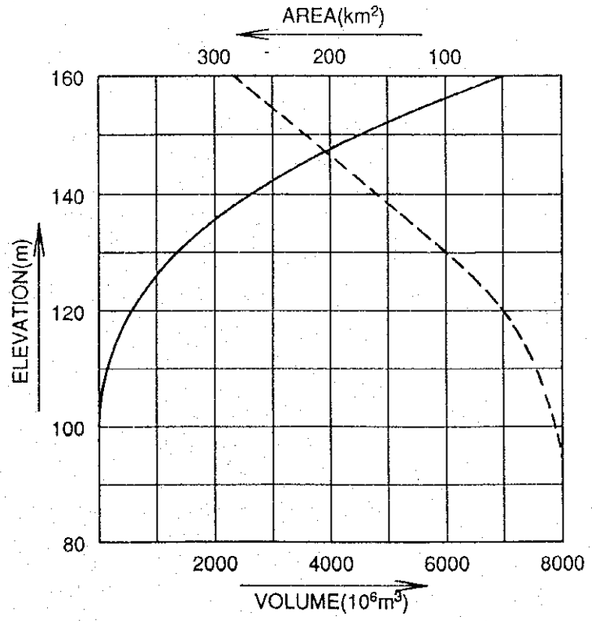
PLAN OF SE KONG NO.3 PROJECT



CROSS SECTION AT THE DAM SITE



AREA AND CAPACITY CURVE



ELEVATION (m)	AREA (Km^2)	VOLUME (10^6m^3)
160	279.24	7,103
140	162.42	2,687
120	49.48	568
100	5.84	15
95	0.00	0

MASTER PLAN STUDY ON HYDROELECTRIC POWER DEVELOPMENT IN THE SE KONG BASIN

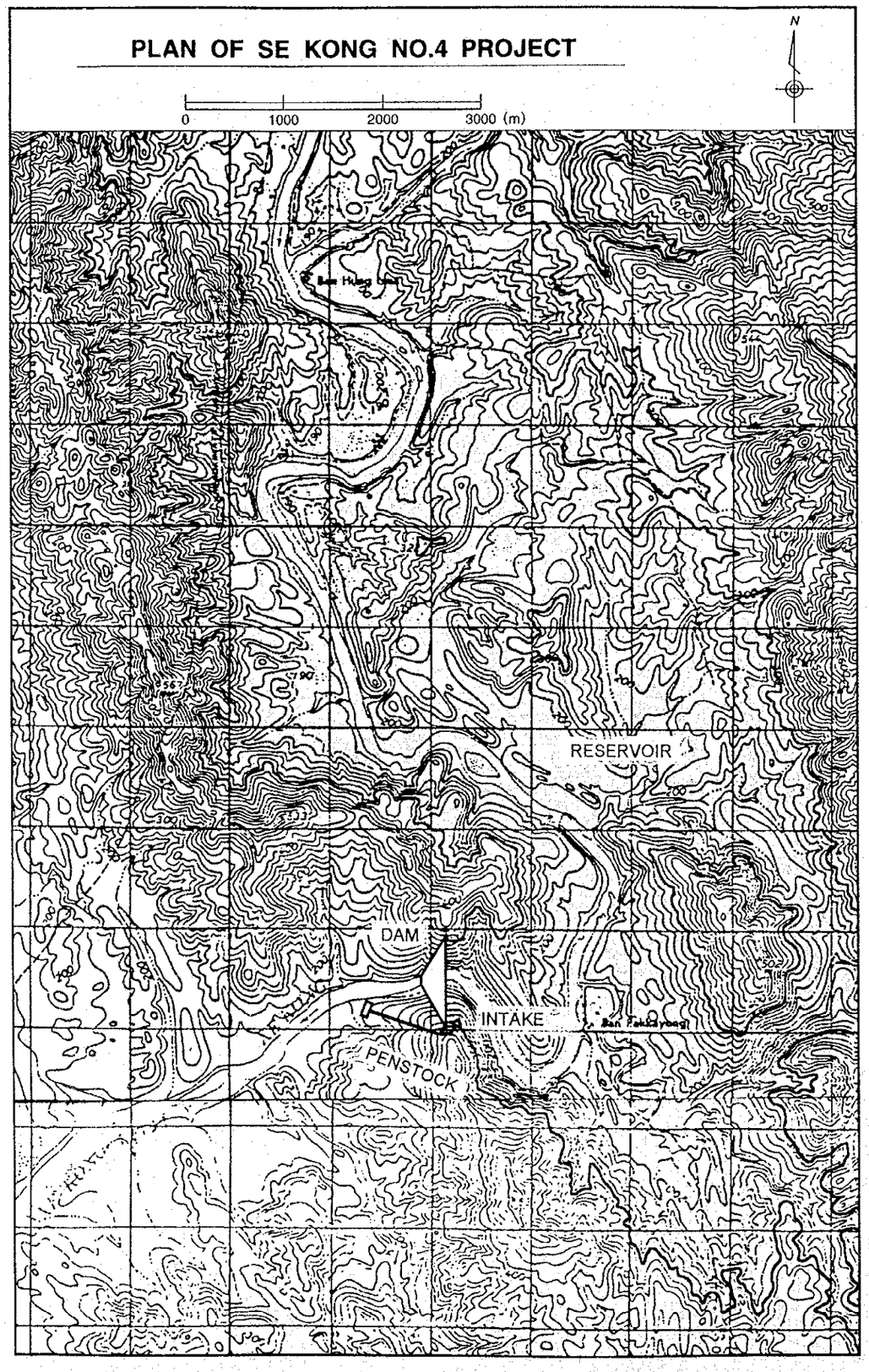
SE KONG NO. 3 PROJECT

CROSS SECTION OF THE DAM SITE &

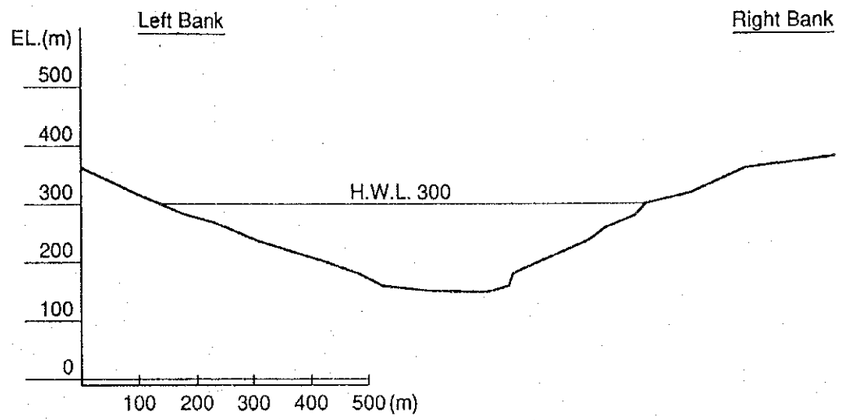
AREA-CAPACITY CURVE

Fig. 7.3-6

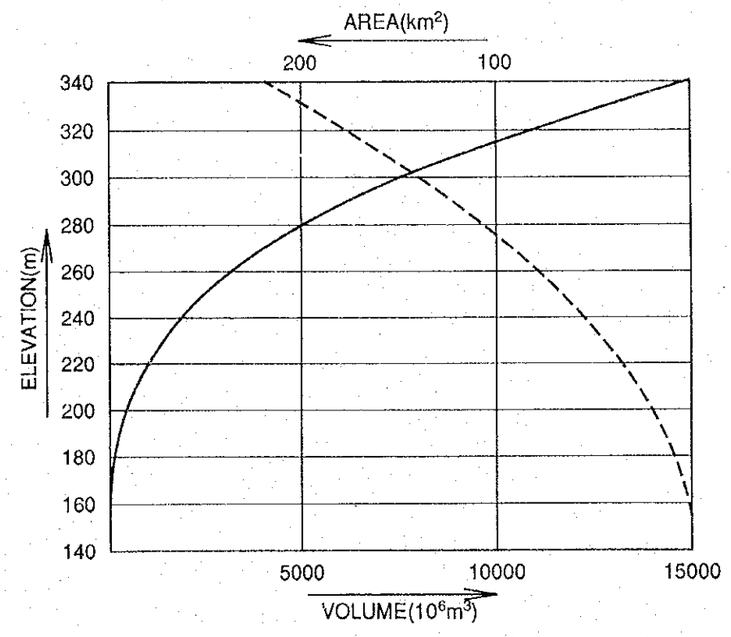
PLAN OF SE KONG NO.4 PROJECT



CROSS SECTION AT THE DAM SITE



AREA AND CAPACITY CURVE



ELEVATION (m)	AREA (Km^2)	VOLUME (10^6m^3)
340	215.69	14,997
320	180.53	11,035
300	145.38	7,776
280	114.24	5,180
260	82.05	3,217
240	55.36	1,843
220	36.96	920
200	19.66	353
180	7.08	86
160	1.23	3
155	0	0

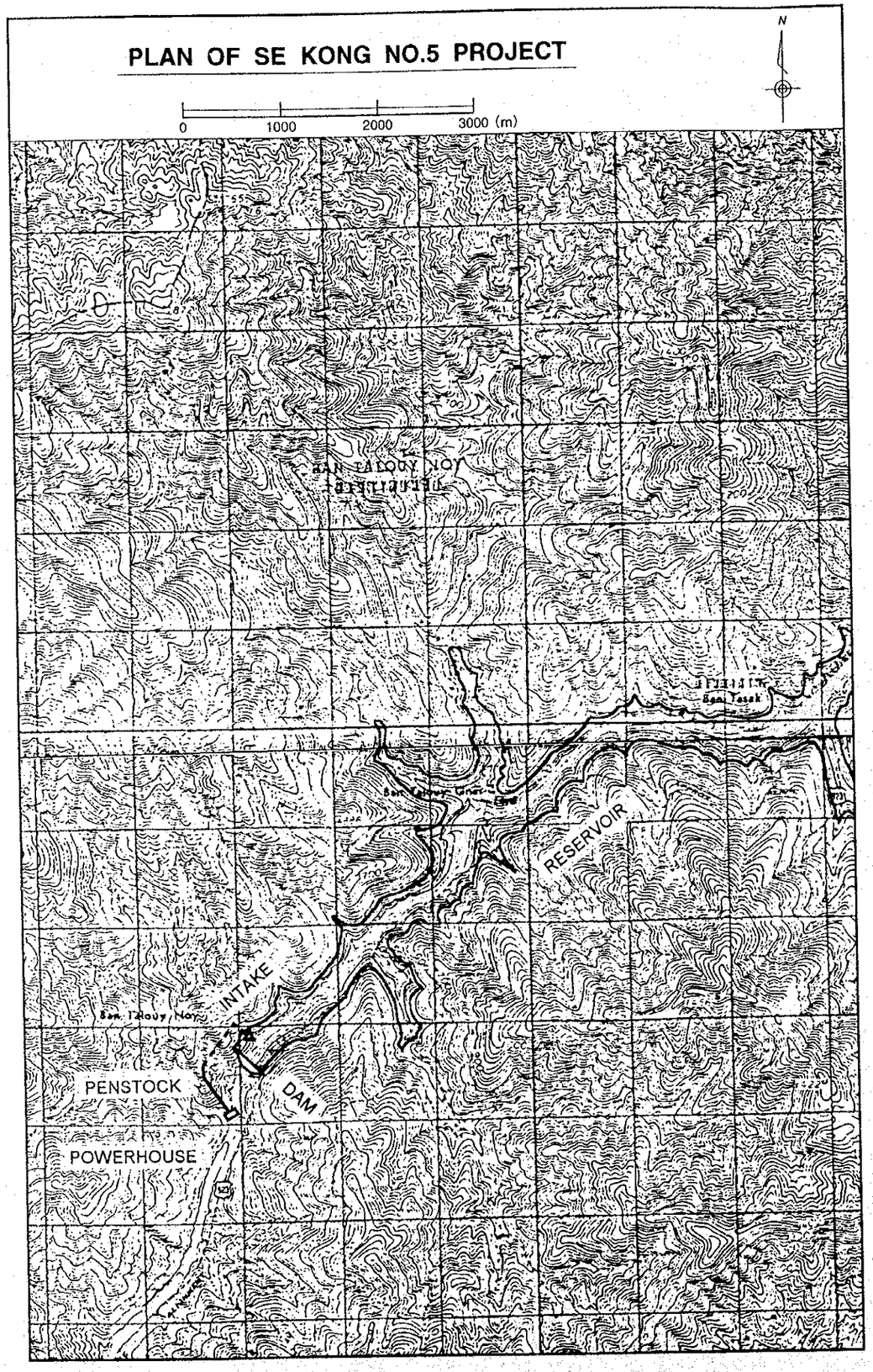
MASTER PLAN STUDY ON HYDROELECTRIC POWER DEVELOPMENT IN THE SE KONG BASIN

SE KONG NO. 4 PROJECT

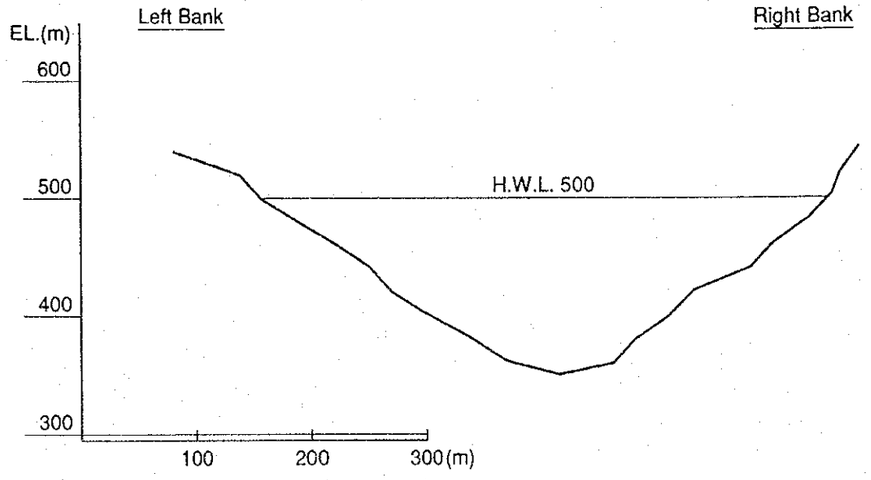
PLAN OF THE PROJECT,
CROSS SECTION OF THE DAM SITE &
AREA - CAPACITY CURVE

Fig. 7.3-7

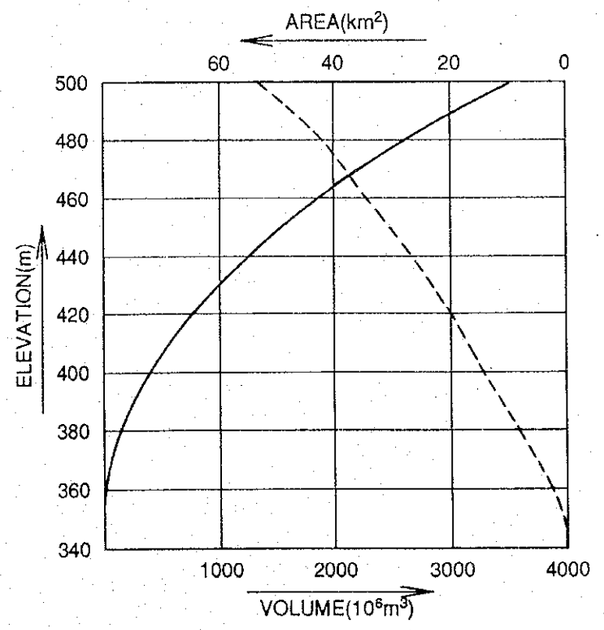
PLAN OF SE KONG NO.5 PROJECT



CROSS SECTION AT THE DAM SITE



AREA AND CAPACITY CURVE



ELEVATION (m)	AREA (Km^2)	VOLUME (10^6m^3)
500	53.35	3,551
480	41.99	2,597
460	34.47	1,883
440	26.71	1,221
420	20.25	752
400	16.02	389
380	8.60	143
360	2.84	28
340	0.00	0

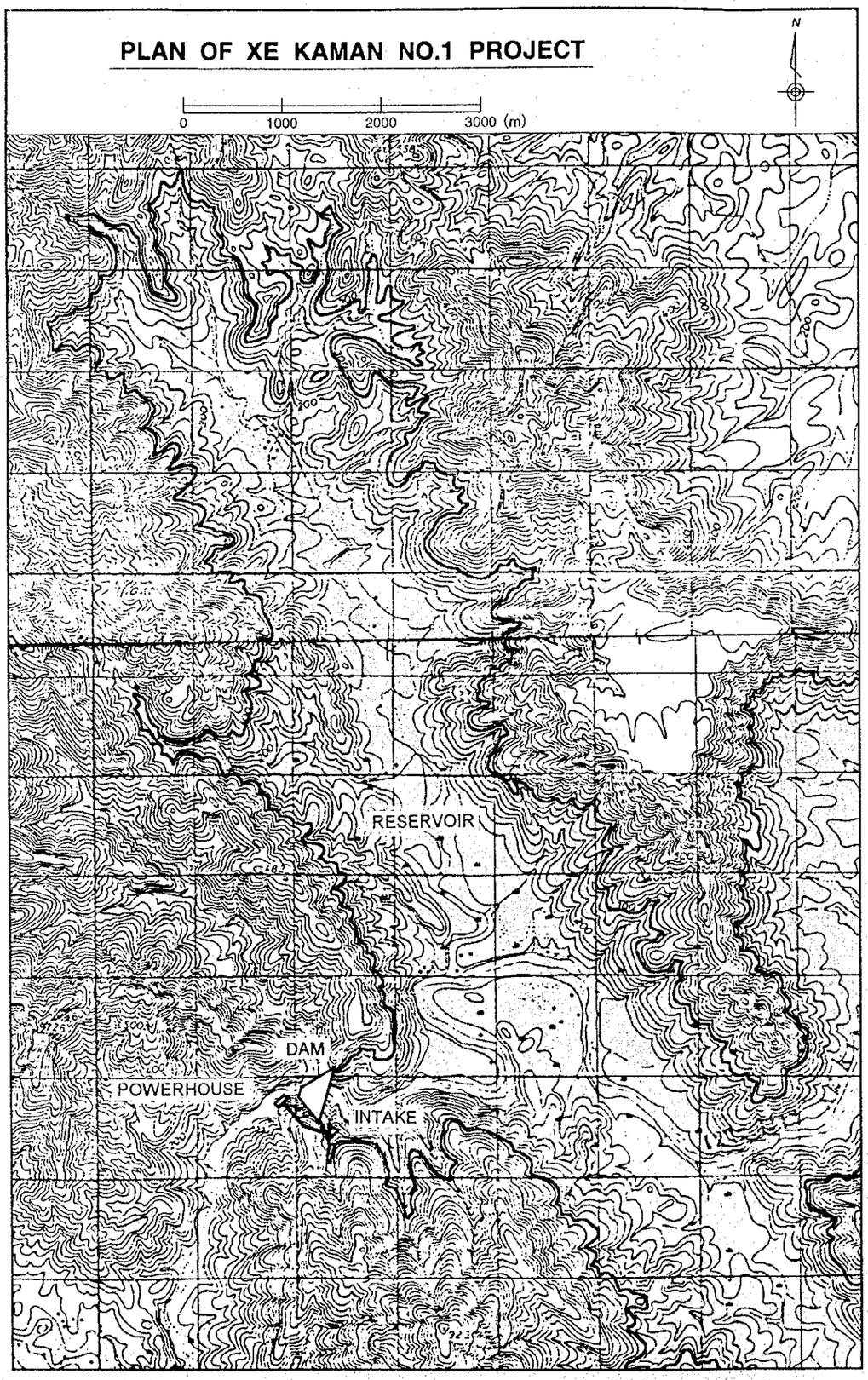
MASTER PLAN STUDY ON HYDROELECTRIC POWER DEVELOPMENT IN THE SE KONG BASIN

SE KONG NO. 5 PROJECT

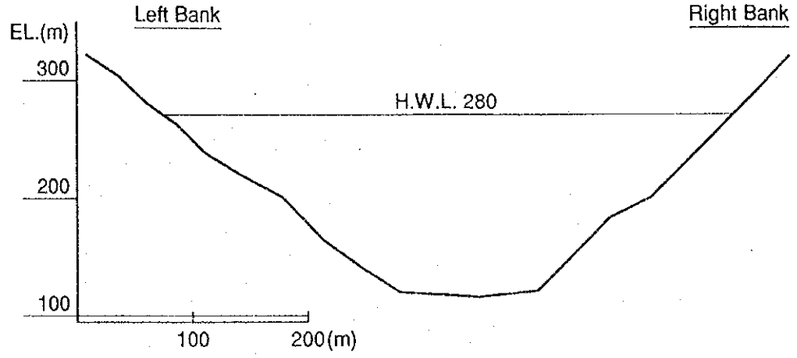
CROSS SECTION OF THE DAM SITE &
AREA-CAPACITY CURVE

Fig. 7.3 - 8

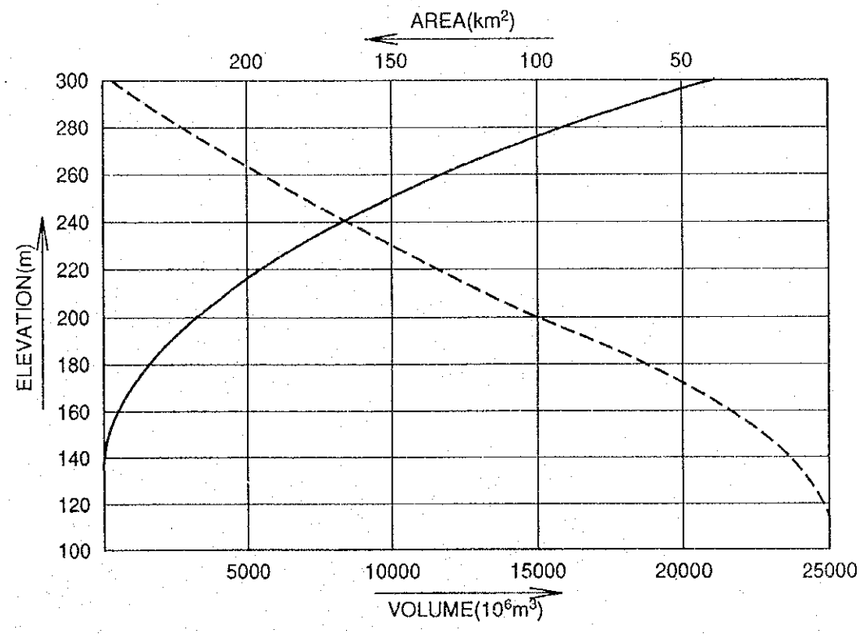
PLAN OF XE KAMAN NO.1 PROJECT



CROSS SECTION AT THE DAM SITE



AREA AND CAPACITY CURVE



ELEVATION (m)	AREA (Km²)	VOLUME (10^6m^3)
300	248.25	20,905
280	221.50	16,208
260	193.15	12,061
240	163.92	8,490
220	132.80	5,523
200	99.04	3,205
180	63.97	1,575
160	33.91	596
140	11.61	141
120	2.24	2
118	0.00	0

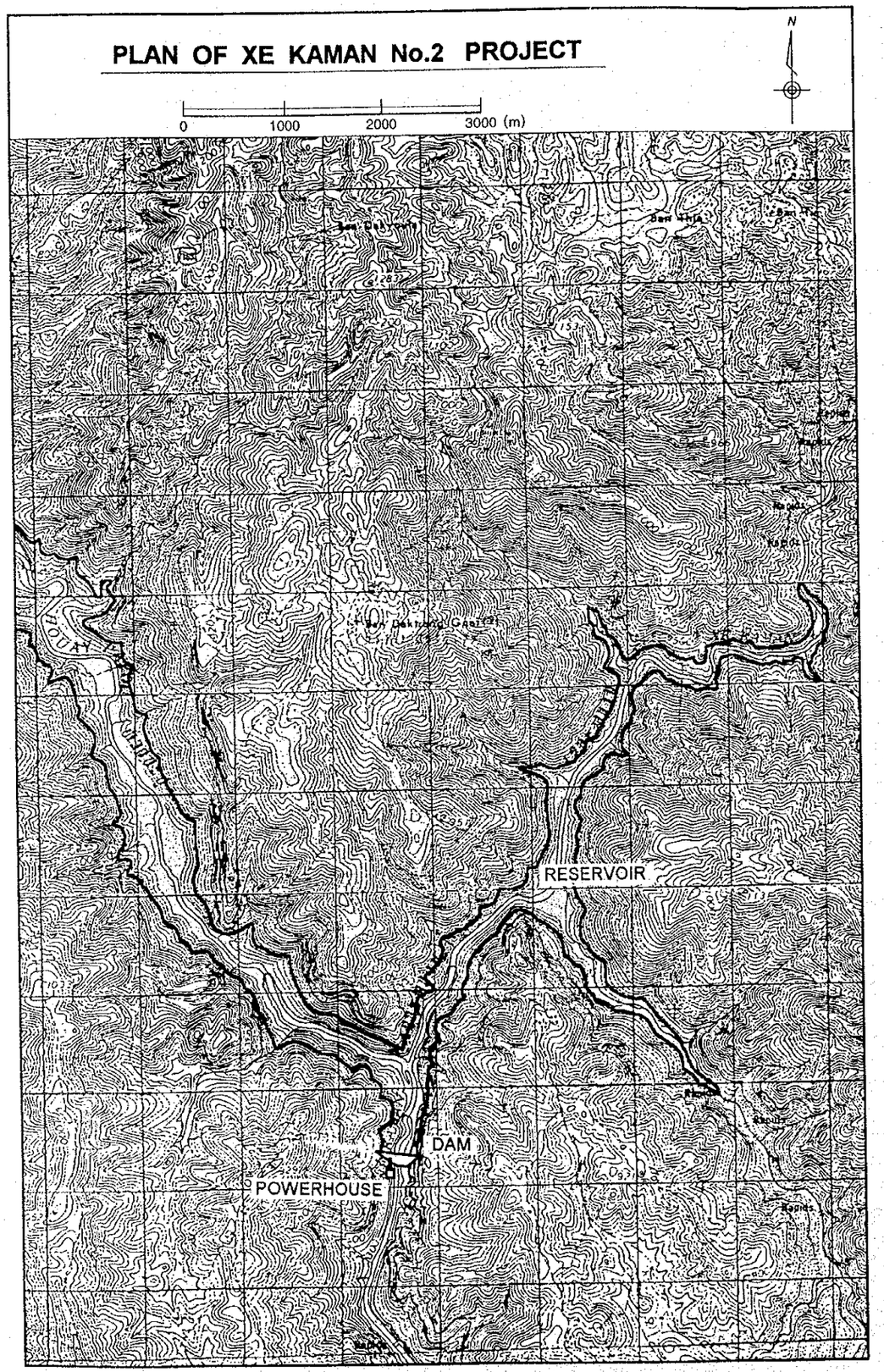
MASTER PLAN STUDY ON HYDROELECTRIC POWER DEVELOPMENT IN THE SE KONG BASIN

XE KAMAN NO. 1 PROJECT

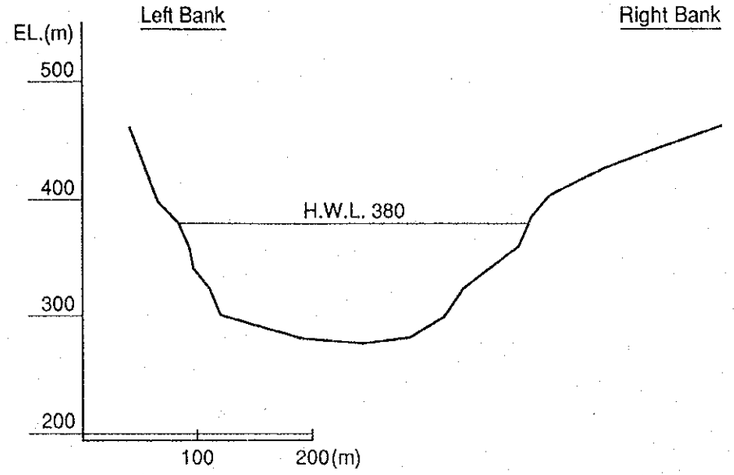
PLAN OF THE PROJECT,
CROSS SECTION OF THE DAM SITE &
AREA - CAPACITY CURVE

Fig. 7.3-9

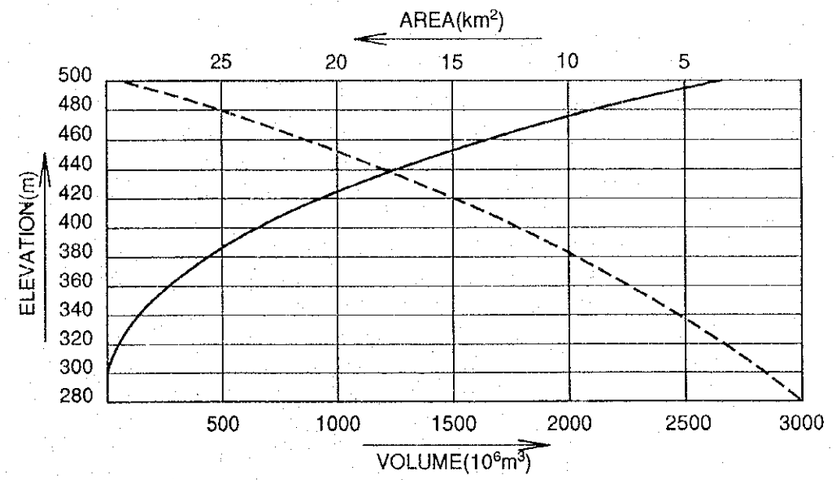
PLAN OF XE KAMAN No.2 PROJECT



CROSS SECTION AT THE DAM SITE



AREA AND CAPACITY CURVE



ELEVATION (m)	AREA (Km^2)	VOLUME (10^6m^3)
500	29.00	2,661
480	24.79	2,123
460	21.48	1,660
440	18.21	1,264
420	15.22	929
400	12.40	653
380	9.77	431
360	7.54	258
340	5.36	129
320	3.31	43
300	0.47	5
280	0.00	0

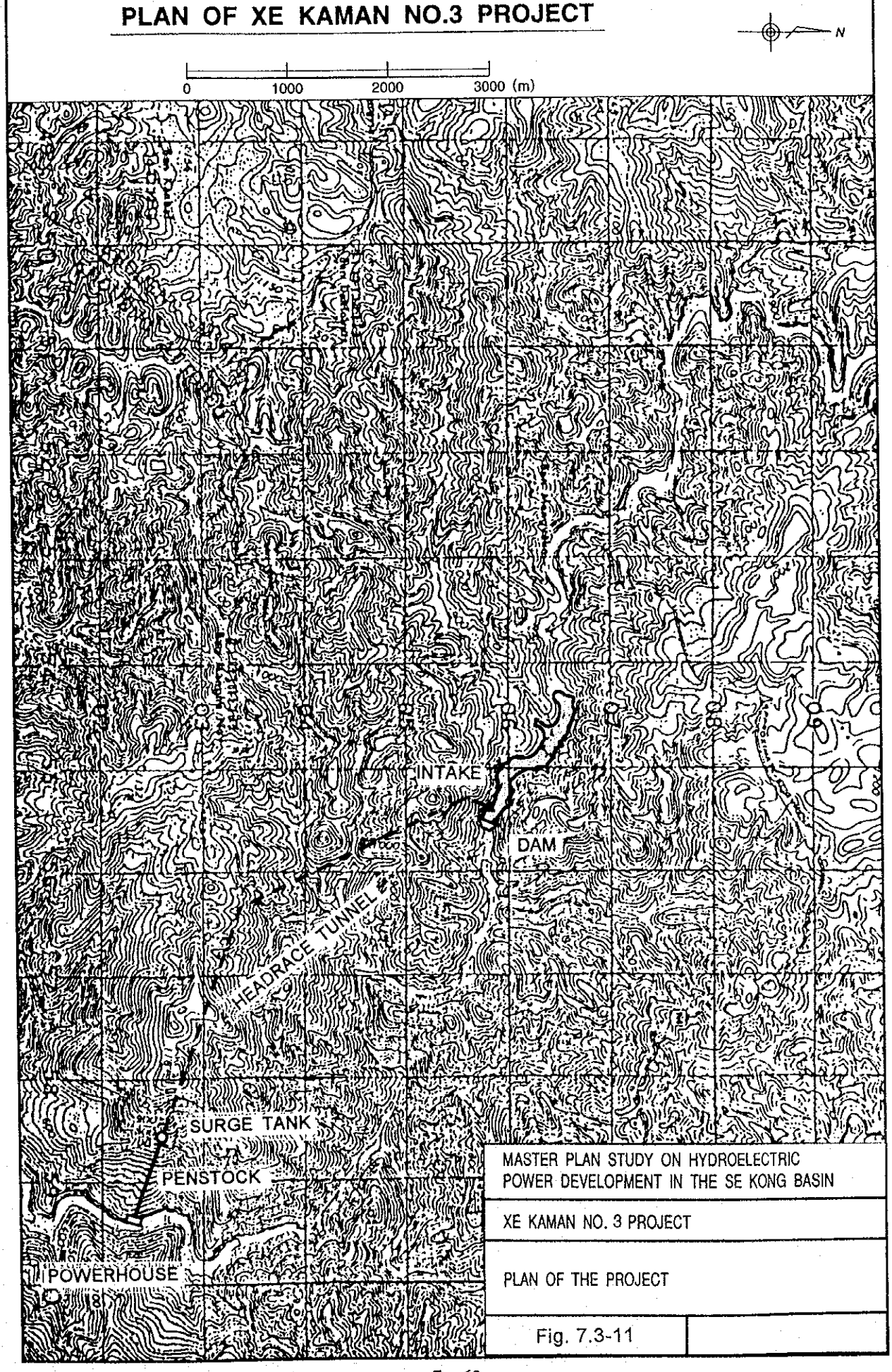
MASTER PLAN STUDY ON HYDROELECTRIC POWER DEVELOPMENT IN THE SE KONG BASIN

XE KAMAN NO. 2 PROJECT

PLAN OF THE PROJECT,
CROSS SECTION OF THE DAM SITE &
AREA - CAPACITY CURVE

Fig. 7.3-10

PLAN OF XE KAMAN NO.3 PROJECT

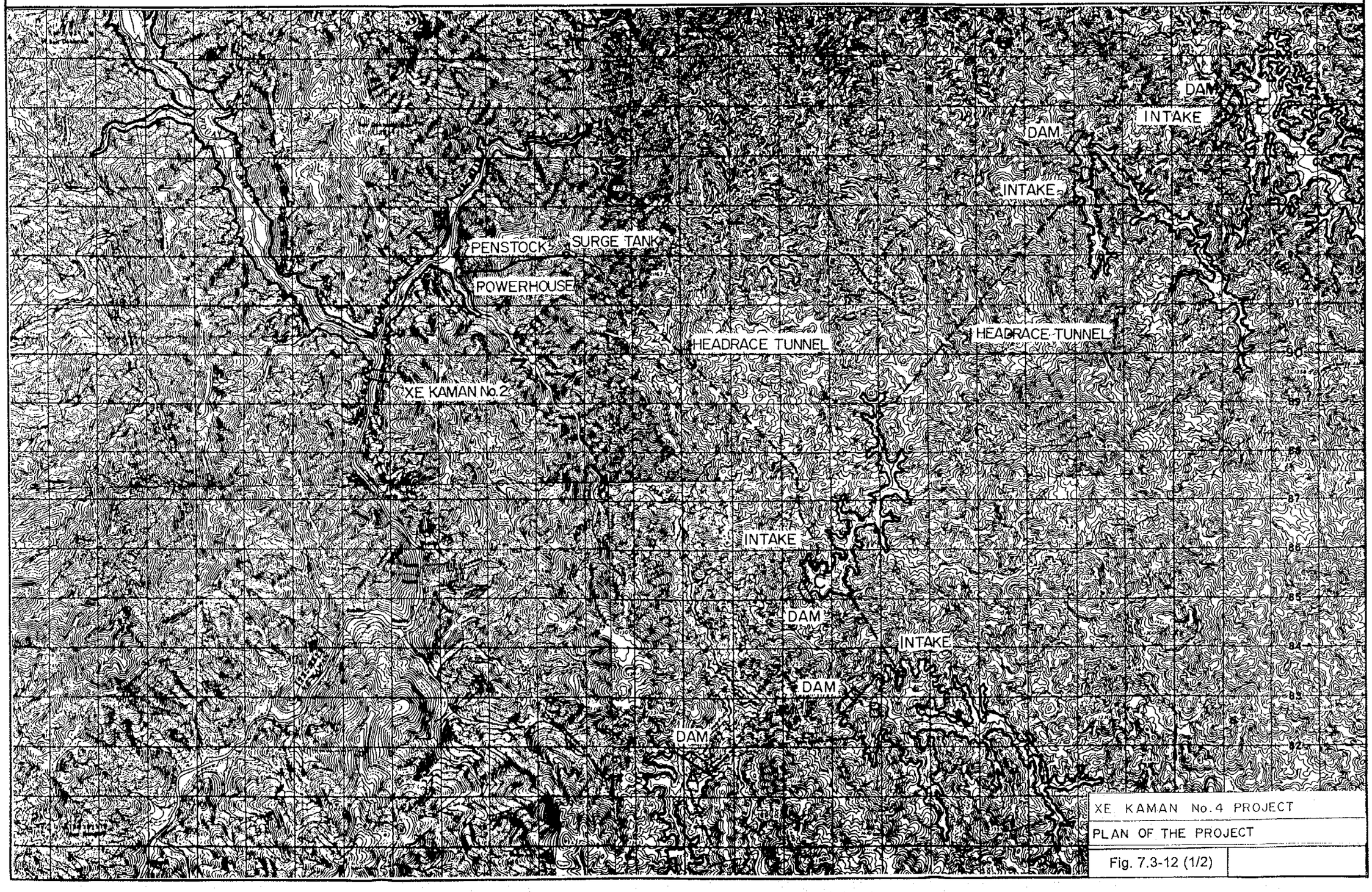


MASTER PLAN STUDY ON HYDROELECTRIC POWER DEVELOPMENT IN THE SE KONG BASIN
XE KAMAN NO. 3 PROJECT
PLAN OF THE PROJECT
Fig. 7.3-11

PLAN OF XE KAMAN No. 4 PROJECT

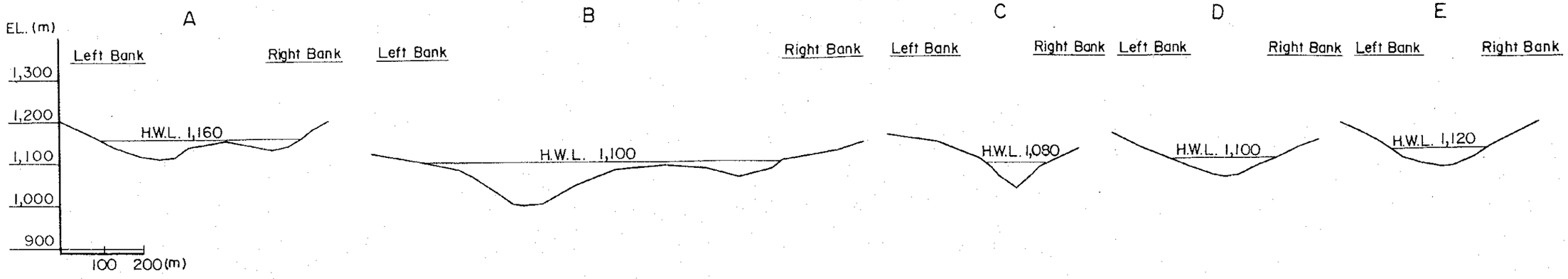
0 1000 2000 3000(m)

N

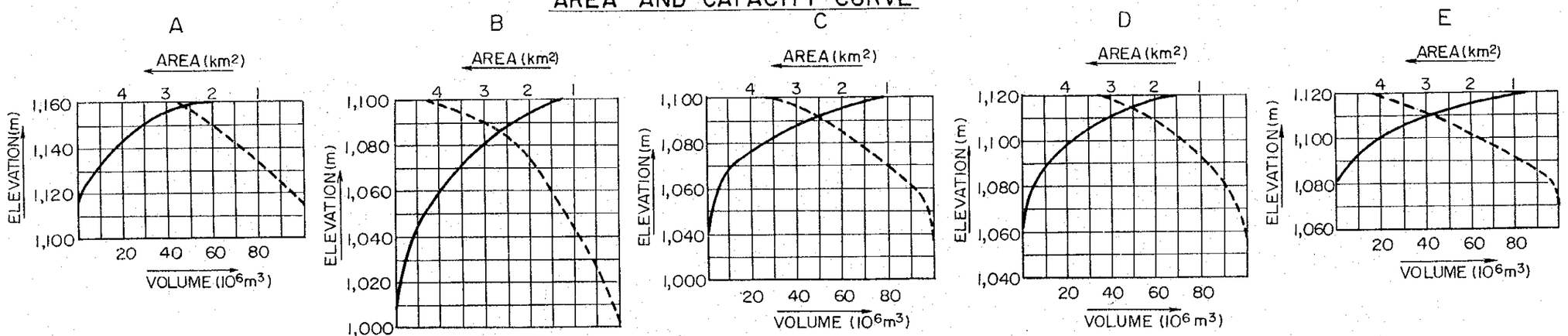


XE KAMAN No.4 PROJECT	
PLAN OF THE PROJECT	
Fig. 7.3-12 (1/2)	

CROSS SECTION AT THE DAM SITE



AREA AND CAPACITY CURVE



XE KAMAN No.4-A AREA-VOLUME CURVE

ELEVATION (m)	AREA (km²)	VOLUME (10⁶m³)
1,160	2.83	60
1,140	1.39	18
1,120	0.31	1
1,100	0.00	0

XE KAMAN No.4-B AREA-VOLUME CURVE

ELEVATION (m)	AREA (km²)	VOLUME (10⁶m³)
1,100	4.39	148
1,080	2.36	80
1,060	1.55	41
1,040	0.90	17
1,020	0.39	4
1,000	0.00	0

XE KAMAN No.4-C AREA-VOLUME CURVE

ELEVATION (m)	AREA (km²)	VOLUME (10⁶m³)
1,100	3.67	79
1,080	1.66	26
1,060	0.47	5
1,040	0.01	0
1,030	0.00	0

XE KAMAN No.4-D AREA-VOLUME CURVE

ELEVATION (m)	AREA (km²)	VOLUME (10⁶m³)
1,120	3.26	70
1,100	1.36	23
1,080	0.47	5
1,060	0.05	0
1,055	0.00	0

XE KAMAN No.4-E AREA-VOLUME CURVE

ELEVATION (m)	AREA (km²)	VOLUME (10⁶m³)
1,120	4.12	85
1,100	1.88	19
1,080	0.05	0
1,060	0.00	0

MASTER PLAN STUDY ON HYDROELECTRIC POWER DEVELOPMENT IN THE SE KONG BASIN

XE KAMAN No.4 PROJECT

CROSS SECTION OF THE DAM SITE &
AREA - CAPACITY CURVE

FIG. 7.3-12 (2/2)