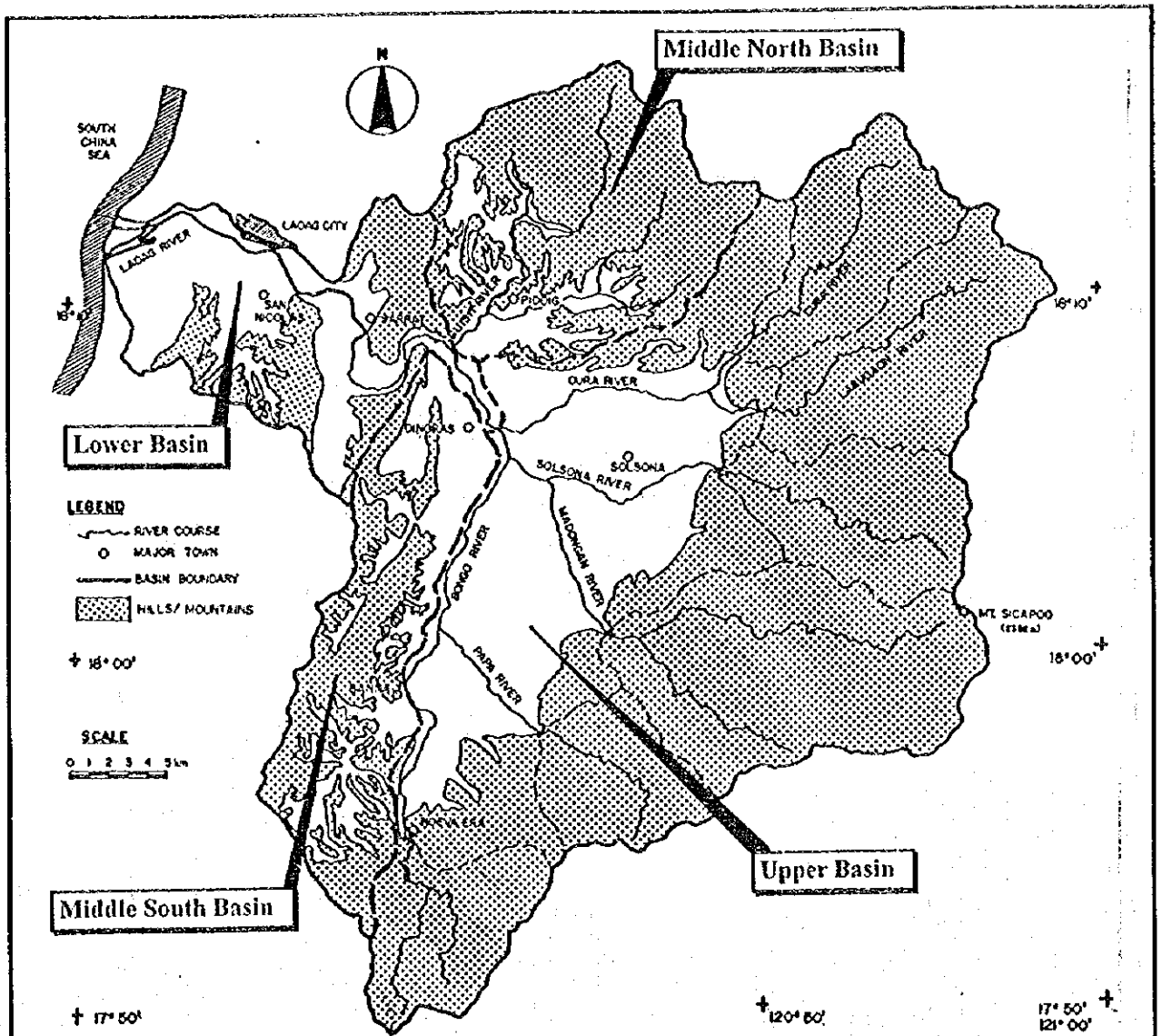


FIGURES



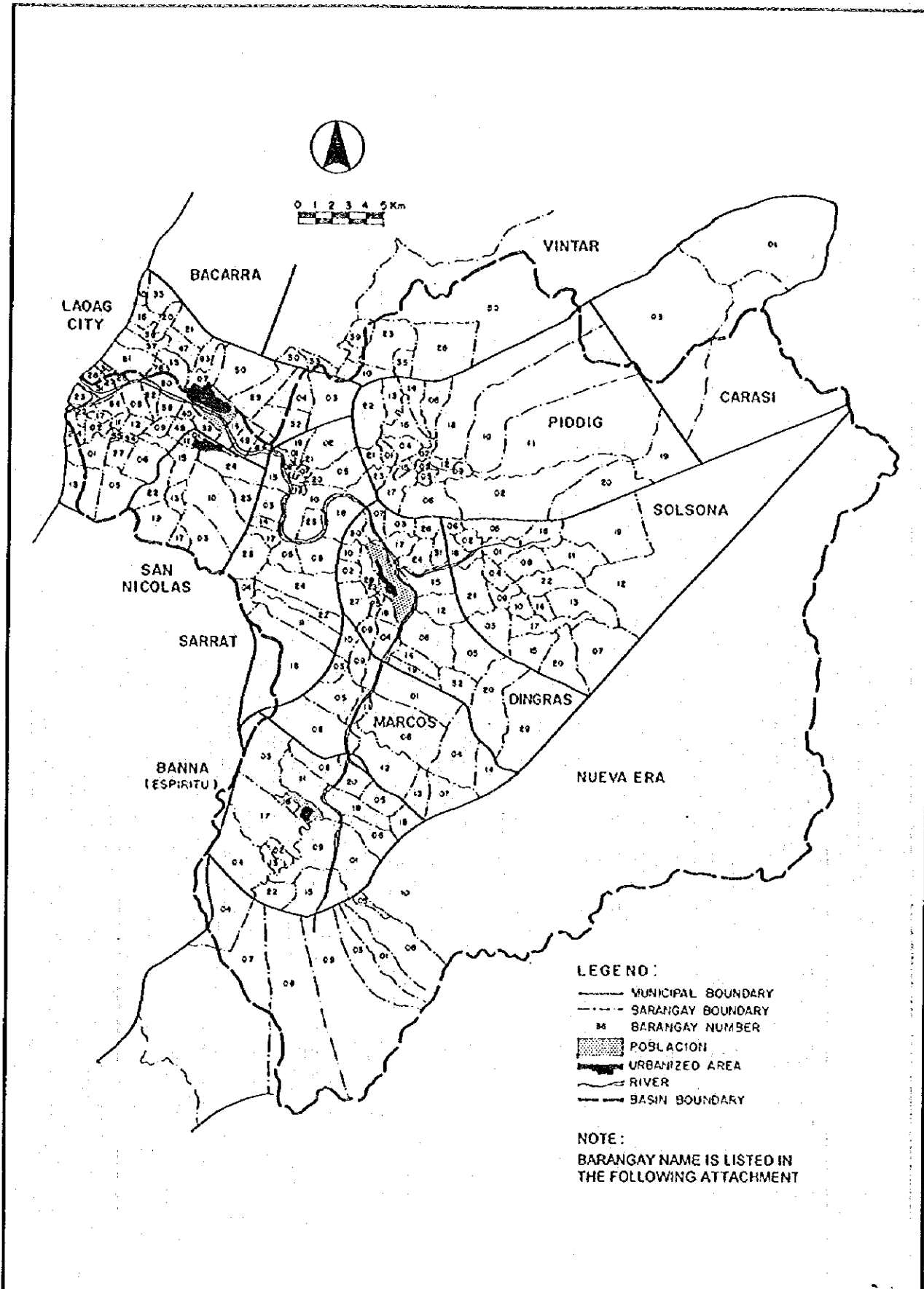
Sub-Basin	Topographic Components	Area	Remarks (Major Tributaries)
Upper Basin	Mountains/Hills	633.9 km ²	Cura R., Labugaon R., Solsona R., Madongan R., Papa R., Bongo R.
	Alluvial Fan	201.1 km ²	
	Total	835.0 km ²	
Middle South Basin	Hills	109.0 km ²	Magalis C., Suyo C.
	Alluvial Plain	51.0 km ²	
	Total	160.0 km ²	
Middle North Basin	Mountains/Hills	135.5 km ²	Guisit R.
	Alluvial Plain	42.8 km ²	
	Total	178.3 km ²	
Lower Basin	Hills	57.2 km ²	
	Alluvial Plain	101.6 km ²	
	Total	158.8 km ²	
Whole Basin	Mountains/Hills	935.6 km ²	(70.2 %)
	Alluvial Fan	201.1 km ²	(15.1 %)
	Alluvial Plain	195.4 km ²	(14.7 %)
	Total	1332.1 km ²	

THE STUDY ON SABO AND FLOOD CONTROL
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Fig. 1.1

Location and Main Features of Laoag River Basin



THE STUDY ON SABO AND FLOOD CONTROL
IN THE LAOAG RIVER BASIN

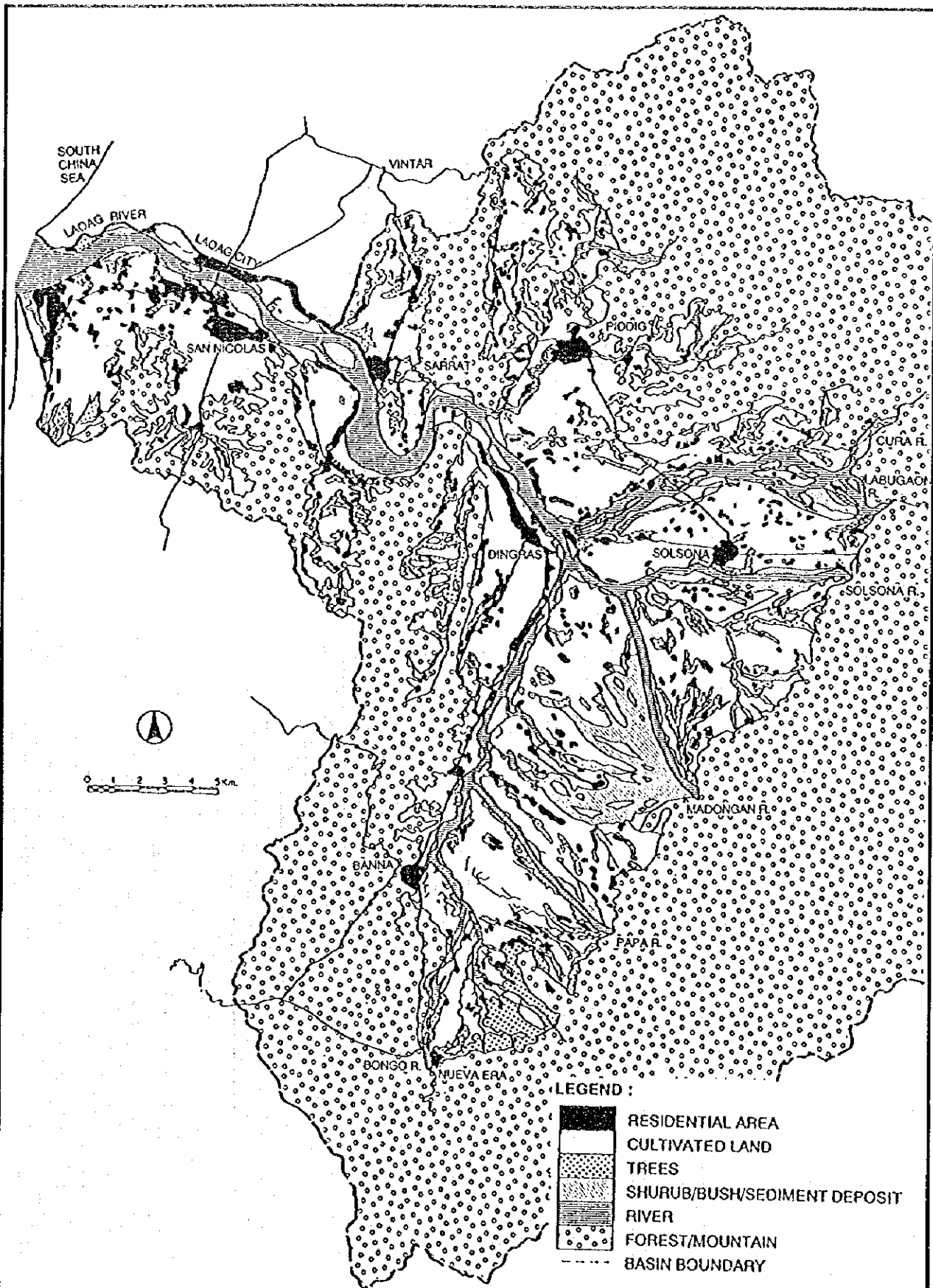
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Fig. 1.2

Administrative Boundary in Laoag River Basin

List of Barangay in the Laoag River Basin

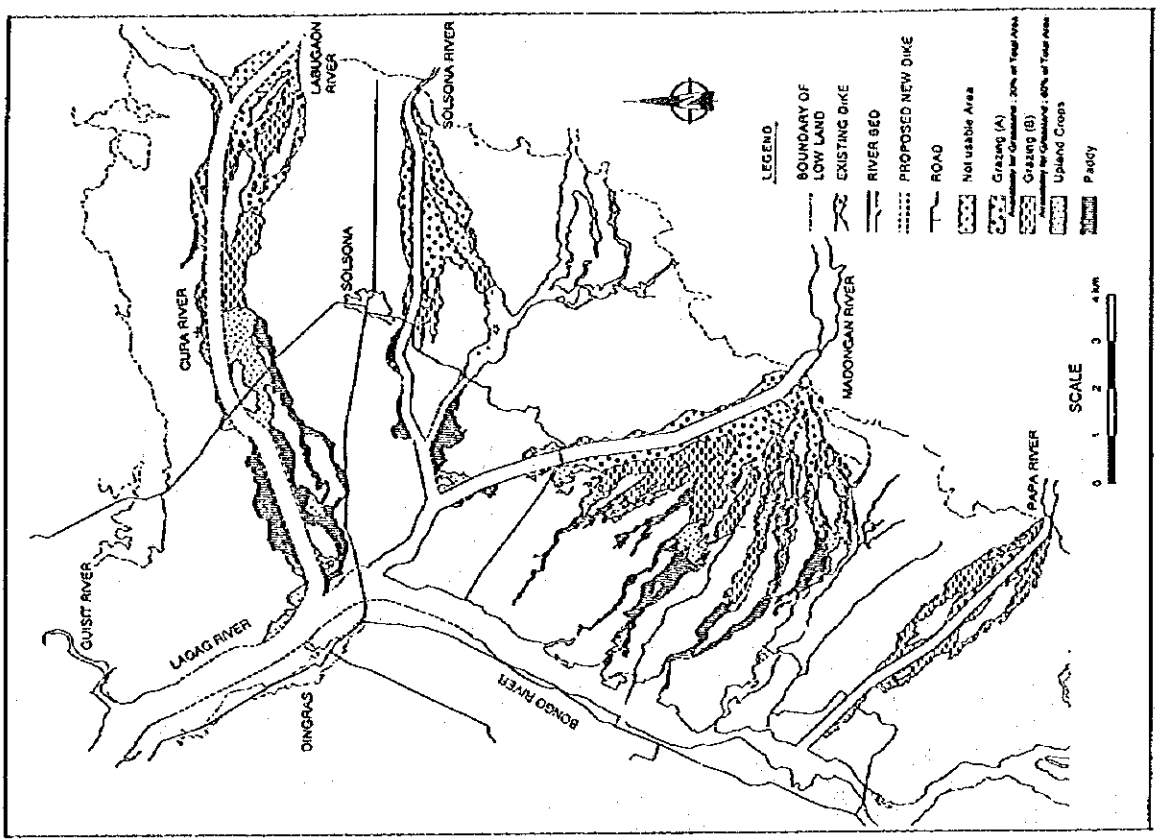
Code	Name	Code	Name	Code	Name	Code	Name
	CARASI (3)	11	Cabungaan 43-a North	83	55-c Vira	15	San Miguel (Bo.7)
01	Angset	12	Cabungaan 43-b South	84	44 Zamboanga	17	San Pablo (Bo.20)
02	Barbaqueso	13	37 Calayab		MARCOS	18	San Paulo (Bo.10)
03	Virbira	14	54-b Camangaan	01	Pacifico (Agunit)	19	18 San Pedro (Bingao)
	DINGRAS	15	58 Casili	02	Imelda (Caparisan)	20	San Rufino (Bo.8)
01	Albano	16	61 Cataban	03	Elizabeth (Culao)	21	San Silvestre (Bo.5)
02	Bacsil	17	43 Cavit (4)	05	Daguioag	22	17 Santa Asuncion (Samoc)
03	Bagut	19	49-a Darayday	06	Escoda	23	23 Santa Cecilia (Barabar)
04	Bangay	20	59-b Dibua North	07	Ferdinand	24	Santa Monica (Nagrebcan)
05	Baresbes	21	59-a Dibua South	08	Fortuna		SARRAT
06	Barong	22	34-b Gabu Norte East	09	Lydia	01	San Agustin
07	Bungcaag	23	34-a Gabu Norte West	10	Mabuti	02	San Andres
09	Cali	24	35 Gabu Sur	11	Valdez (Bidiag)	03	San Antonio
10	Capasan	26	32-c La Paz East	12	Tabucbuc (Ragas)	04	San Bernabe
11	Dancel	27	33-b La Paz Proper	13	Santiago	05	San Cristobal
12	Foz	28	32-b La Paz West	14	Cacafean	06	San Felipe
13	Guenero	29	54-a Lagui-sail		NUEVA ERA	07	San Francisco
14	Lanas	30	32-a La Paz East	01	Acnam	08	San Isidro
15	Lumbad	31	33-a La Paz Proper	02	Barangobong	09	San Joaquin
16	Madamba	32	52-b Lataag	03	Barikir	10	San Jose
17	Mandaloque	33	60-b Maditadig	04	Bugayong	11	San Juan
18	Medina	34	38-a Mangato East	05	Cabillauran	12	San Leandro
19	Ver	35	38-b Mangato West	06	Caray	14	San Lorenzo
20	San Marcelino (Padong)	36	62-a Navotas North	07	Garnaden	15	San Manuel
21	Puruganan	37	62-b Navotas South	08	Pagpagong	16	San Marcos
22	Peralta	38	46 Nalbo	09	Poblacion	17	San Nicolas
23	Root (Baldas)	39	51-a Nangalisan East	10	Santo Nino	18	San Pedro
24	Sagpatan	40	51-b Nangalisan West	11	Uguis	19	San Roque
25	Saludares	41	24 Nstra Sra De Consolacion		PIDDIG	20	San Vicente
26	San Esteban	42	7-a Nstra Sra De Natividad	01	Ab-abut	21	Santa Barbara
27	Espiritu	43	7-b Nstra Sra De Natividad	02	Abucay	22	Santa Magdalena
28	Sulguiano	44	27 Nstra Sra De Soledad	03	Anao	23	Santa Rosa
29	San Francisco	45	13 Nstra Sra de Visitacion	04	Arua-ay	24	Santo Santiago
30	Suyo (J)	46	3 Nstra Sra Del Rosario	05	Bimmanga	25	Santo Tomas
31	San Marcos	47	57 Pila	06	Boyboy		SOLSONA
32	Elizabeth	48	49-b Raraburan	07	Cabaroan	01	Aguitap
	ESPIRITU (BANNA)	49	53 Riceng	08	Calambeg	02	Bugbag
01	Babocag	50	53-b Salet-bulangan	09	Callusa	03	Bugbago
02	Bangsar	53	6 San Agustin	10	Dupitac	04	Barcelona
03	Barbarangay	54	22 San Andres	11	Estancia	05	Bubuos
04	Bomitoag	55	28 San Bernardo	12	Gayamat	06	Capurician
05	Bugasi	56	17 San Francisco	13	Lagandit	07	Caangraan
06	Caestebanan	57	4 San Guillermo	14	Libraoan	08	Darasdas
08	Caribquib	58	15 San Guillermo	15	Loing	09	Juan
09	Catagtaguen	59	12 San Isidro	16	Msab-abaca	10	Laureta
11	Crispina	60	16 San Jacinto	17	Mangitayag	11	Lipay
12	Hilaria	61	10 San Jose	18	Maruaya	12	Msananteng
13	Inelda	62	1 San Lorenzo	19	San Antonio (6)	13	Munaltac
14	Lorenzo	63	26 San Marcelino	20	Santa Maria	14	Mariquet
15	Macayepyep	64	52-a San Mateo	21	Sucusquen	15	Nagpatpatan
16	Marcos	65	23 San Matias	22	Tangaon	16	Nalasin
17	Nagpatayan	66	20 San Miguel	23	Topoton	17	Puttuo
18	Valdez	67	21 San Pedro		SAN NICOLAS	18	San Juan
19	Sinamar	68	5 San Pedro	01	1 San Francisco	19	San Julian
20	Tablabagan	69	18 San Quirino	02	San Ildefonso (Bo.3)	20	Santa Ana
21	Valenciano	70	8 San Vicente	03	21 San Agustin	21	Santiago
22	Binacang	71	9 Santa Angela	04	San Baltazar (Bo.2)	22	Talugtog
	LAOAG CITY	72	11 Santa Balbina	05	San Bartolome (Bo.4)		VINTAR
01	42 Apaya	73	25 Santa Cayetana	06	San Cayetano (Bo.12)	10	Bulbulala
02	36 Aramix (4)	74	2 Santa Joaquina	07	San Eugenio (Bo.13)	23	Ester
03	56-a Bacsil North	75	19 Santa Marcela	08	San Fernando (Bo.11)	28	Mabanbanag
04	56-b Bacsil South	76	30-b Santa Maria	09	San Gregorio (Bo.14)	30	Alejo Masasig
05	41 Balacad	77	39 Santa Rosa	10	22 San Guillermo	33	Margay
06	40 Bafatong	78	14 Santo Tomas	11	San Jose (Bo.15)	35	Namoroc
07	55-a Barit-vira-pandan	79	29 Santo Tomas	12	San Juan baulista (Bo.6)	39	Paparotoc
08	47 Bongcaag	80	30-a Suyo	13	San Lorenzo (Bo.19)	58	Visaya
09	50 Buitong	81	31 Talingaan	14	San Lucas (Bo.9)		
10	60-a Caaocan	82	43 Tangid	15	16 San Marcos (Payas)		



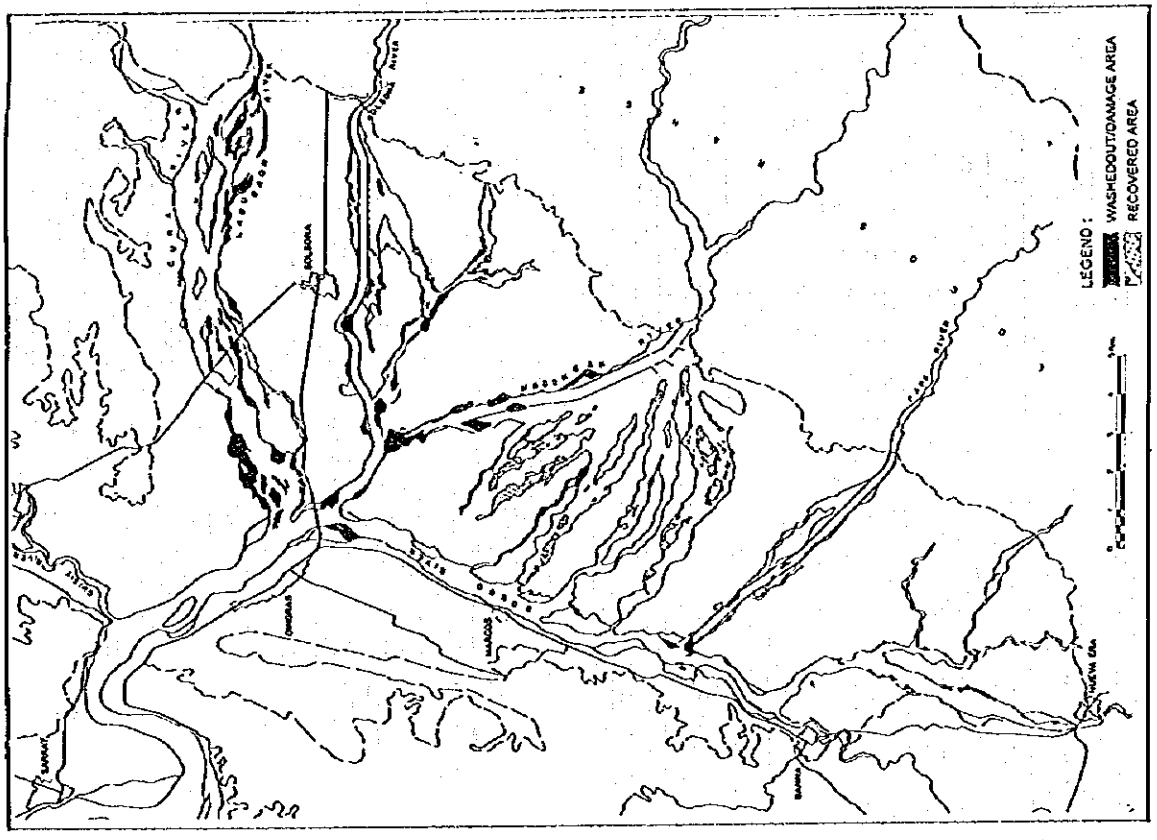
THE STUDY ON SABO AND FLOOD CONTROL
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Fig. I.3
Existing Land Use

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Potential Restorable Farm Land

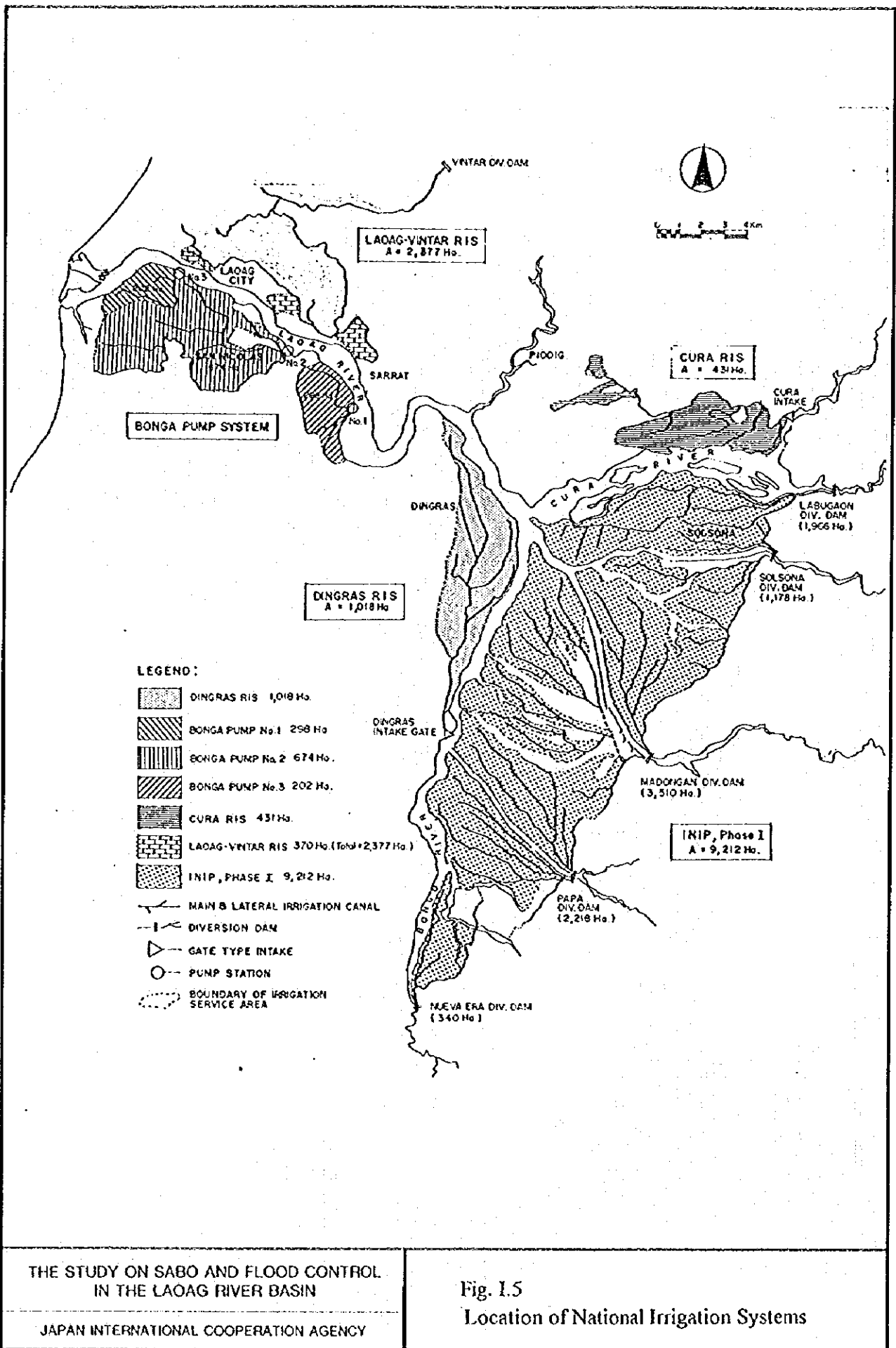


Past Land Loss by Floods (1975 - 1995)

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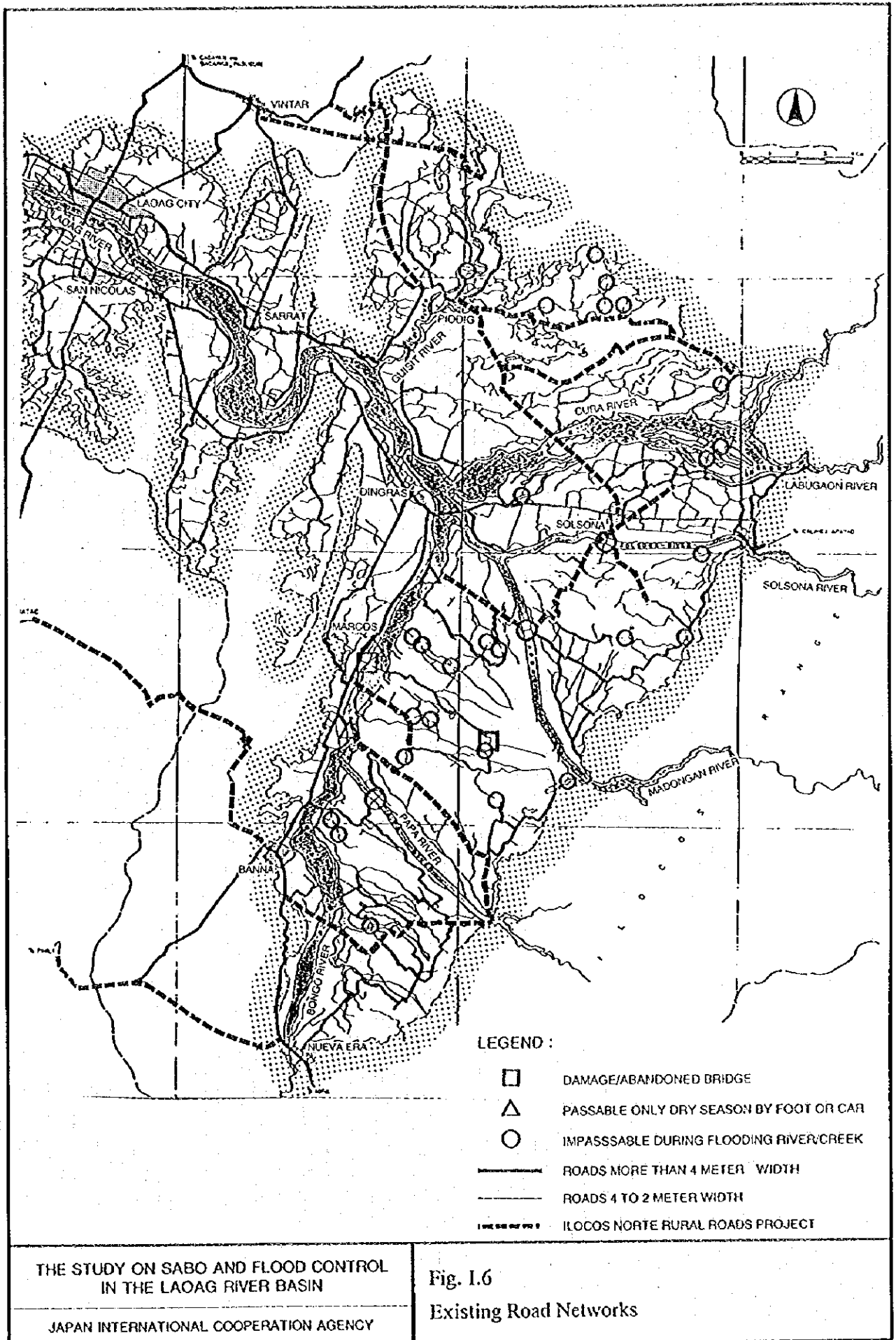
Fig. I.4
Past Land Loss and Future Restorable Land

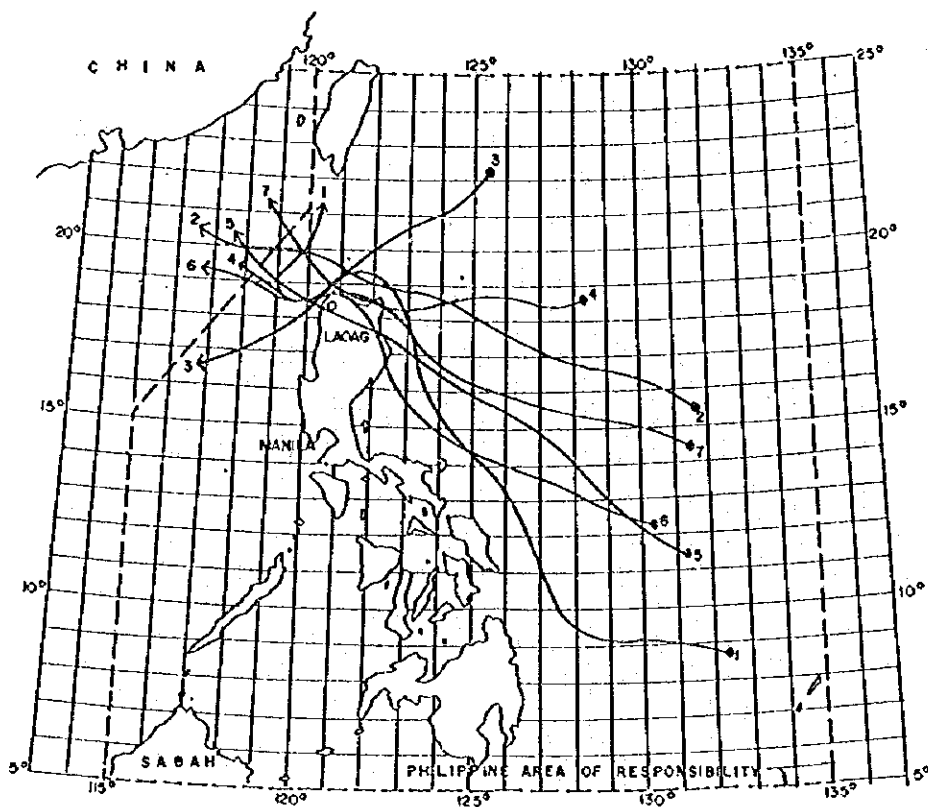


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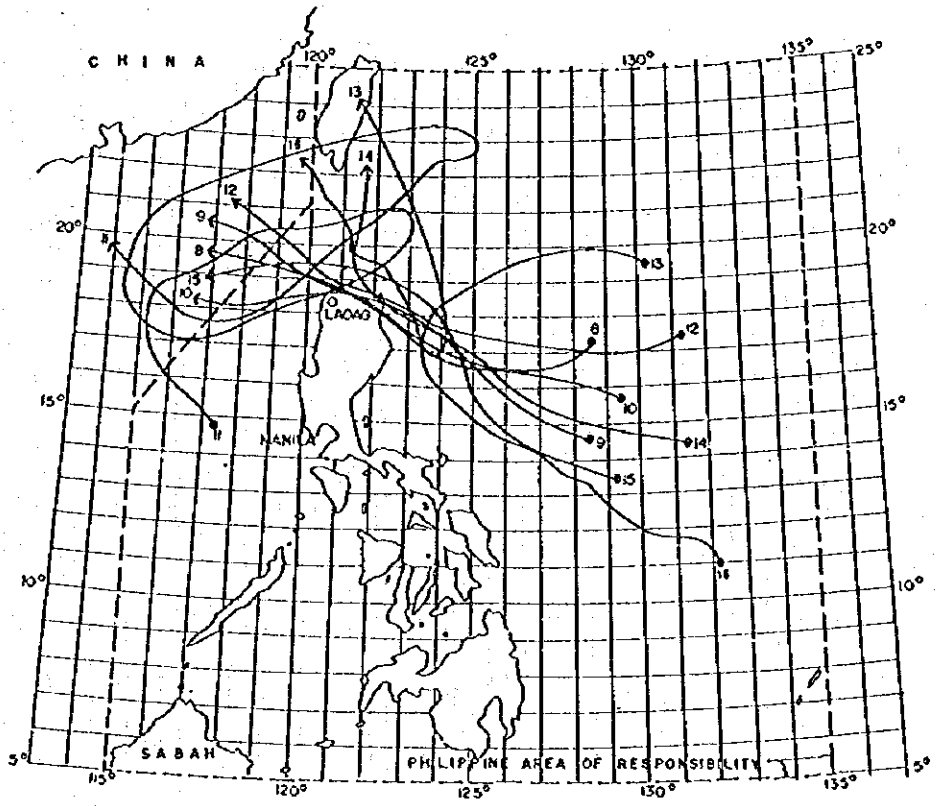
Fig. 1.5
Location of National Irrigation Systems





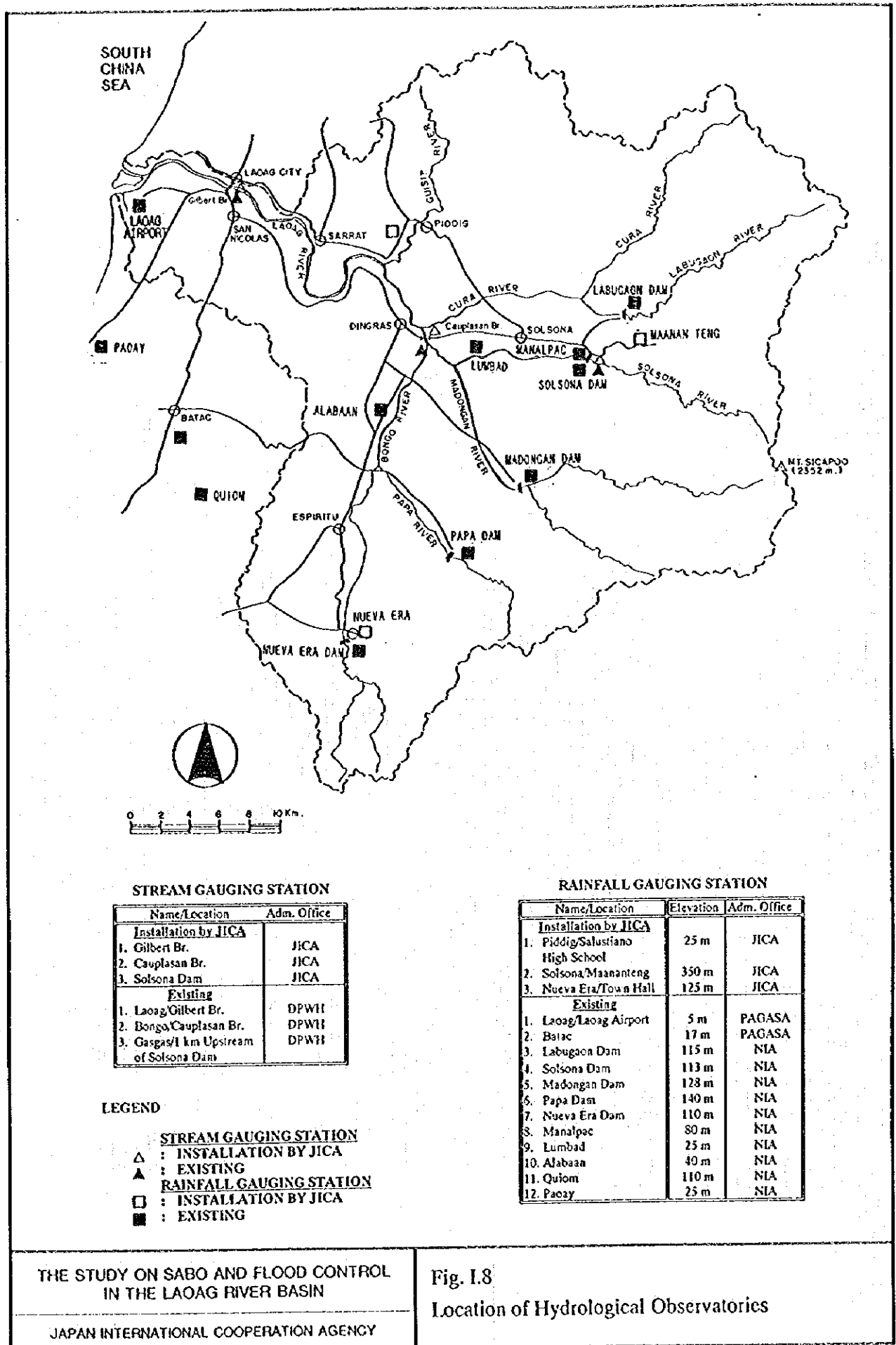
1. TY Kate
Jul. 18-23 '62
2. TY Wanda
Aug. 29- Sep. 03 '62
3. TS Bebeug
Jun. 04-09 '63
4. TY Yoning
Sep. 02-04 '64
5. TY Gening
Jun. 27-29 '67
6. TS Huling
Sep. 01-03 '73
7. TY Goring
Jun. 23-25 '77
8. TS Maring
Aug. 27-30 '84
9. TY Kuring
Jun. 21-25 '85
10. TY Gading
Jul. 07-10 '86
11. TY Miding
Aug. 30-Sep. 03 '86
12. TY Pepang
Oct. 23-25 '87
13. TY Openg
Sep. 08-11 '89
14. TS Maring
Sep. 19-22 '92
15. TD Weling
Sep. 09-11 '94
16. TY Gioring
Jul. 24-26 '96

TY : Typhoon
 TS : Tropical Storm
 TD : Tropical Depression



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Fig. I.7
 Tracks of Major Cyclones that Affected
 the Laoag River Basin

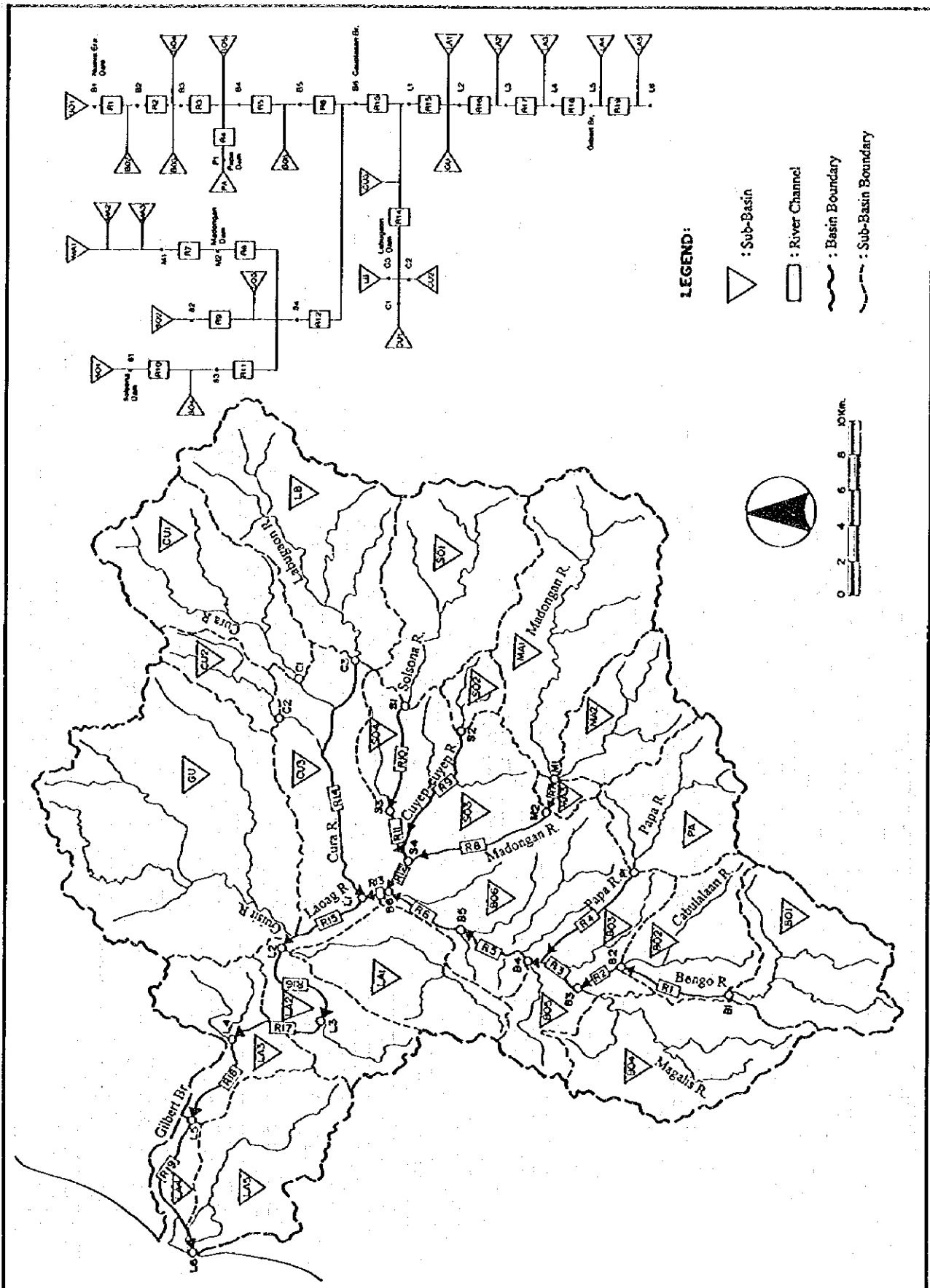


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Fig. I.8

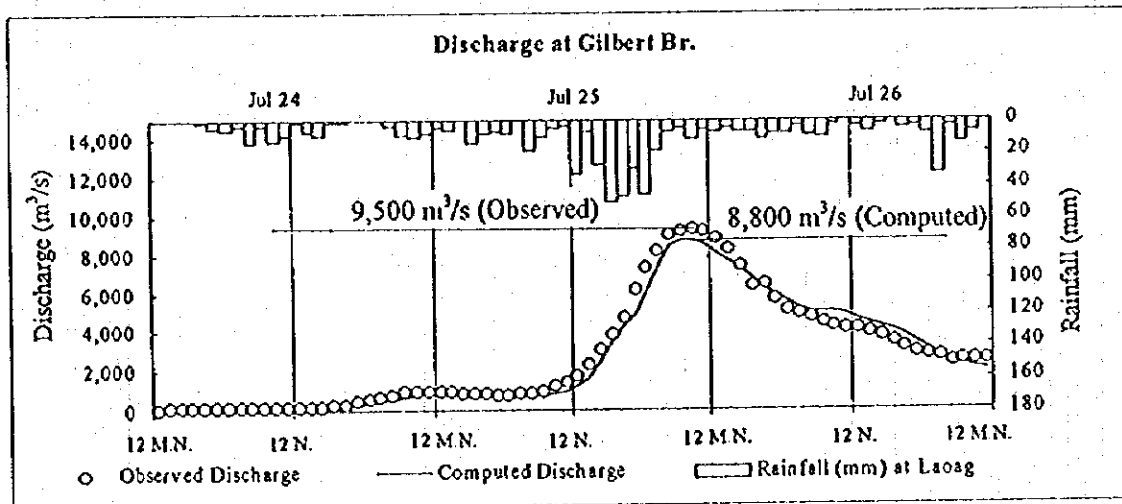
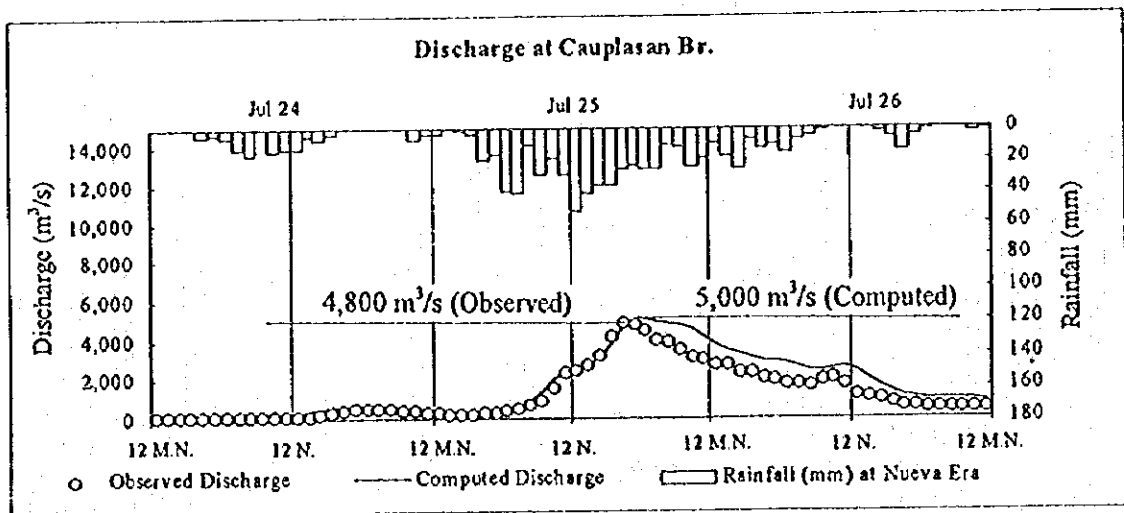
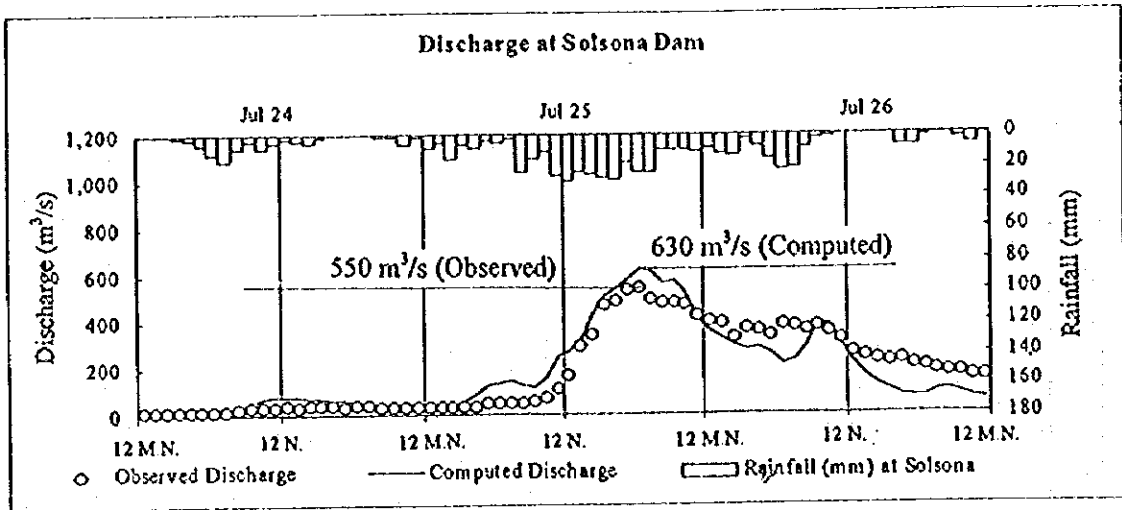
Location of Hydrological Observatories



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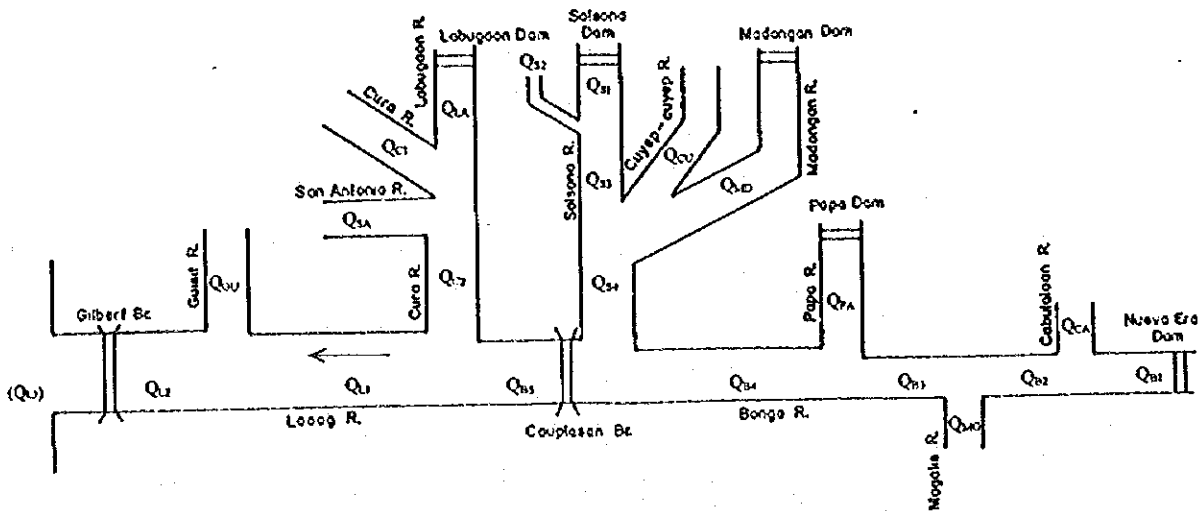
Fig. 1.9
 River System Model for the Flood Runoff Simulation



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Fig. I.10
Comparison of Observed and Computed
Hydrographs of Typhoon Gloring



	Probable Flood Discharge (m ³ /s)					
	2-year	5-year	10-year	25-year	50-year	100-year
QB1	340	510	620	750	830	920
QCA	190	300	360	440	490	540
QB2	520	790	960	1,160	1,300	1,440
QMB	280	450	540	660	740	820
QB3	860	1,340	1,640	2,000	2,240	2,480
QPA	310	470	570	690	770	850
QB4	1,380	2,150	2,630	3,220	3,620	4,020
QMB	880	1,320	1,610	1,970	2,220	2,470
QS1	460	690	840	1,030	1,150	1,280
QS2	40	70	90	120	130	150
QS3	490	760	920	1,120	1,250	1,390
QC2	170	290	360	460	530	590
QS4	1,500	2,330	2,860	3,490	3,920	4,360
QB5	2,810	4,390	5,400	6,500	7,000	8,200
QC1	380	580	700	850	960	1,060
QLA	560	850	1,020	1,260	1,410	1,570
QSA	130	190	230	280	310	350
QC2	1,050	1,580	1,930	2,360	2,650	2,940
QL1	3,760	5,800	7,100	8,700	9,800	10,900
QOU	470	840	1,080	1,390	1,590	1,800
QL2	4,500	7,200	8,900	10,900	12,300	13,700
QL3	4,580	7,300	9,100	11,200	12,700	14,200

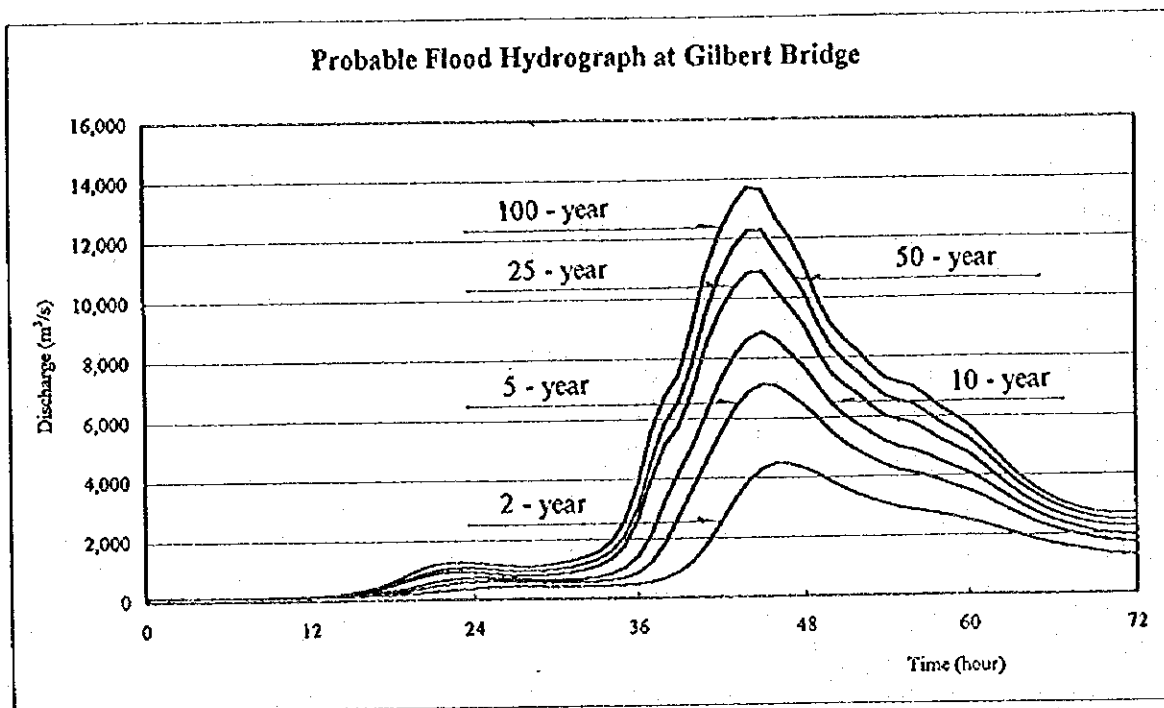
* : (QL3) is flood discharge at river mouth

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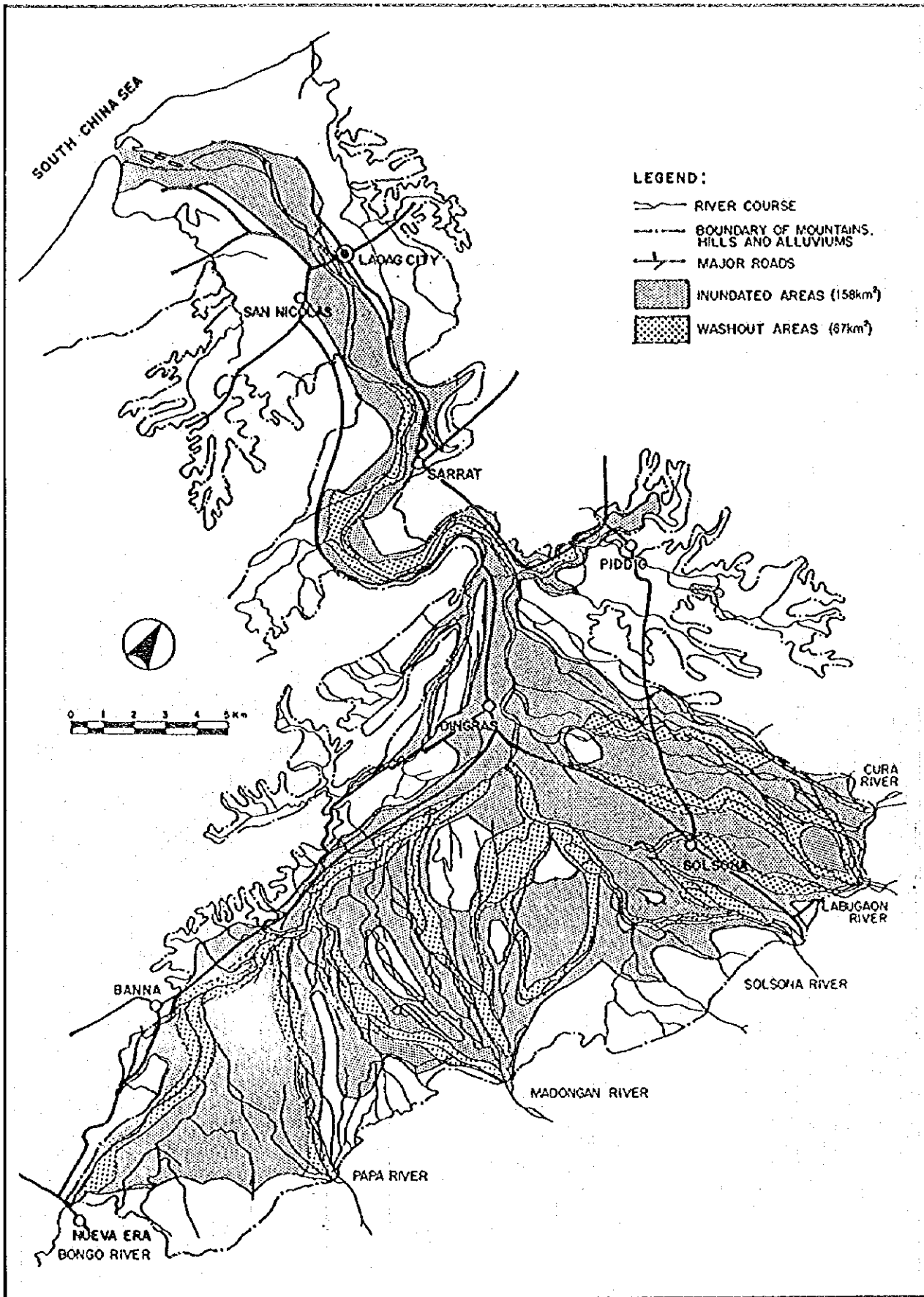
Fig. I.11

Probable Flood Discharge



Probable Maximum Flood Discharge at Gilbert Bridge

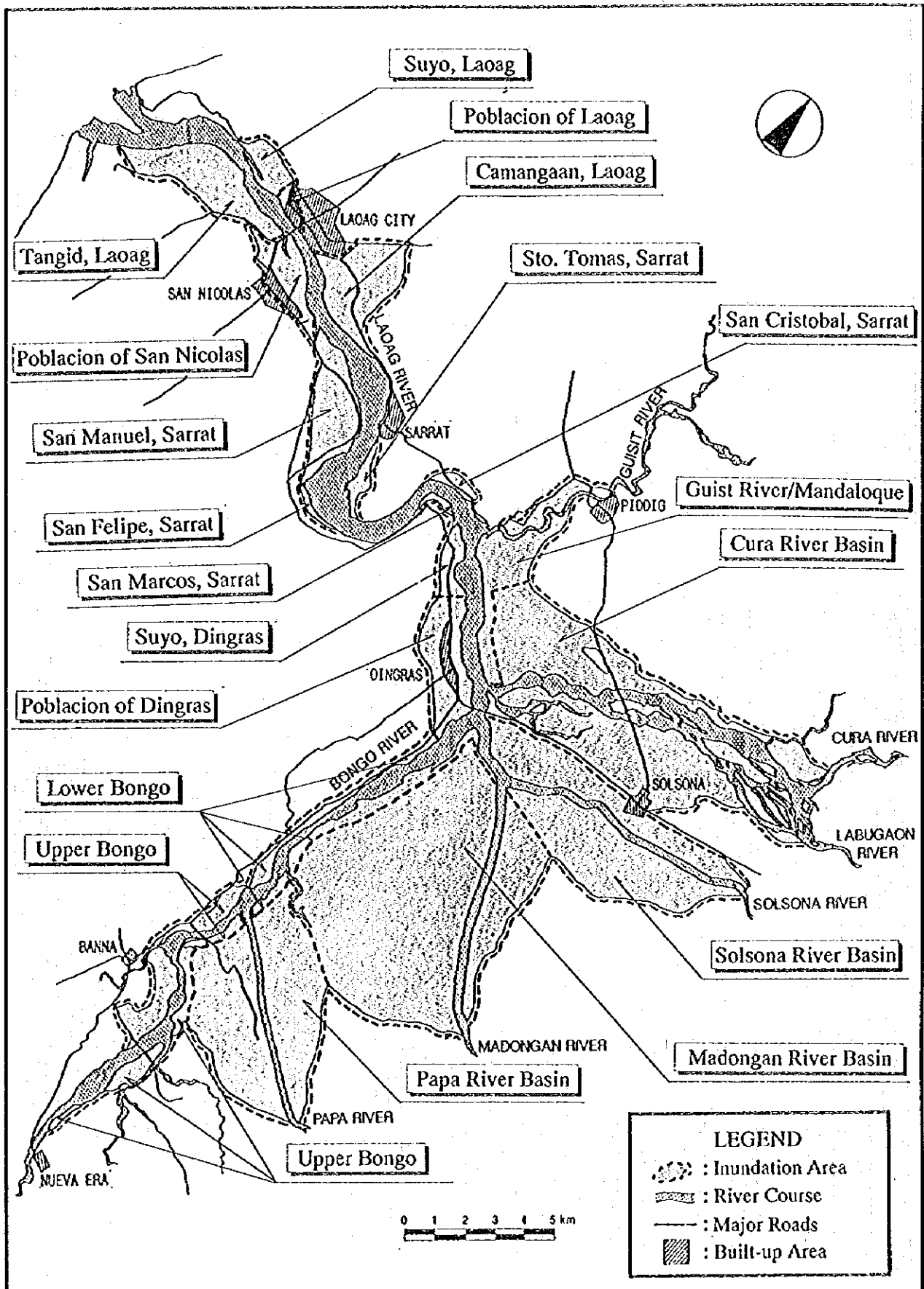
Return Period	Water Level	Flood Discharge
2 - year	6.85 m	4,500 m ³ /s
5 - year	8.29 m	7,200 m ³ /s
10 - year	9.06 m	8,900 m ³ /s
25 - year	9.90 m	10,900 m ³ /s
50 - year	10.44 m	12,300 m ³ /s
100 - year	10.94 m	13,700 m ³ /s



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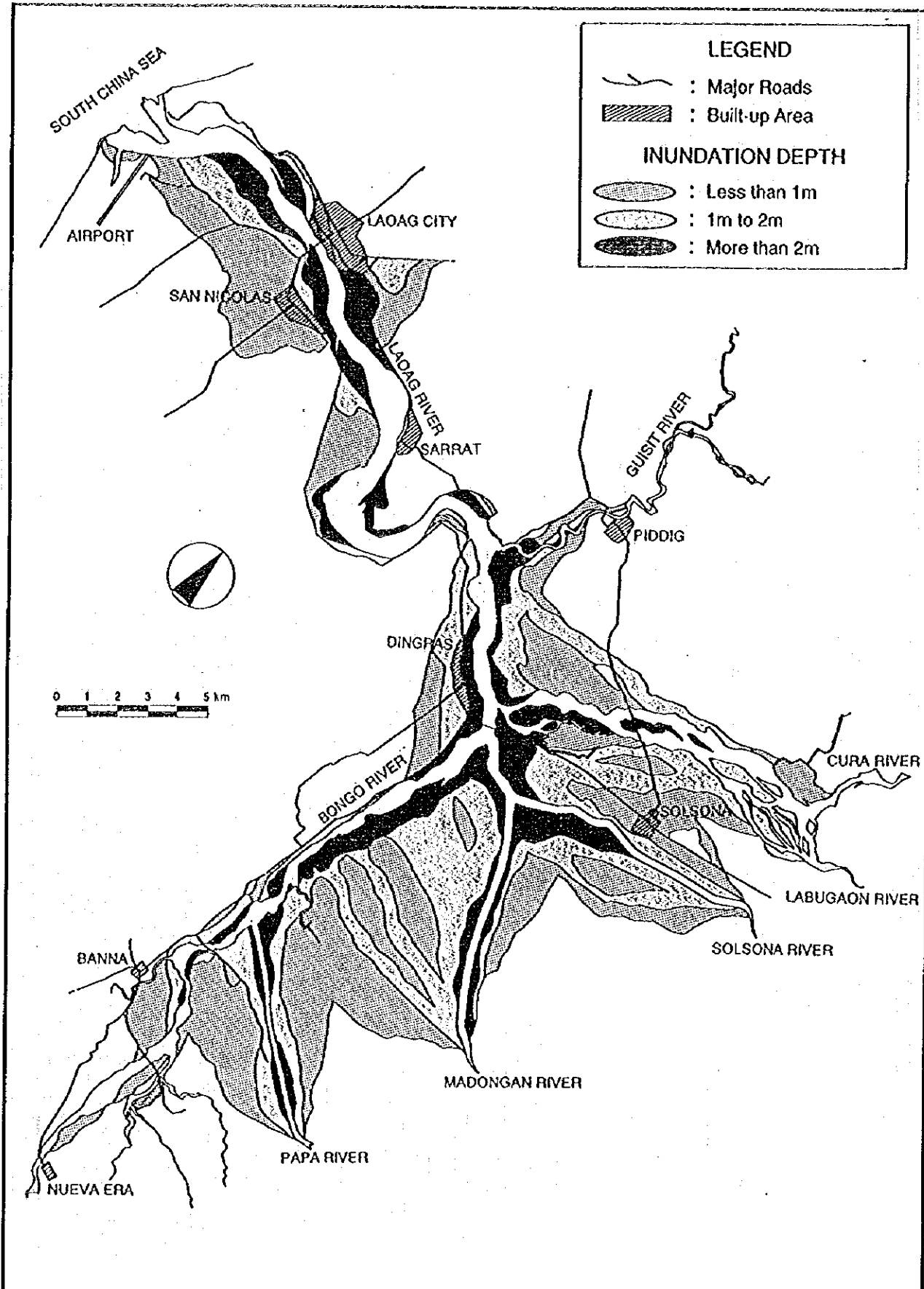
Fig. I.13
Potential Flood Area



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Fig. 1.14
Inundation Area of 25-year Flood

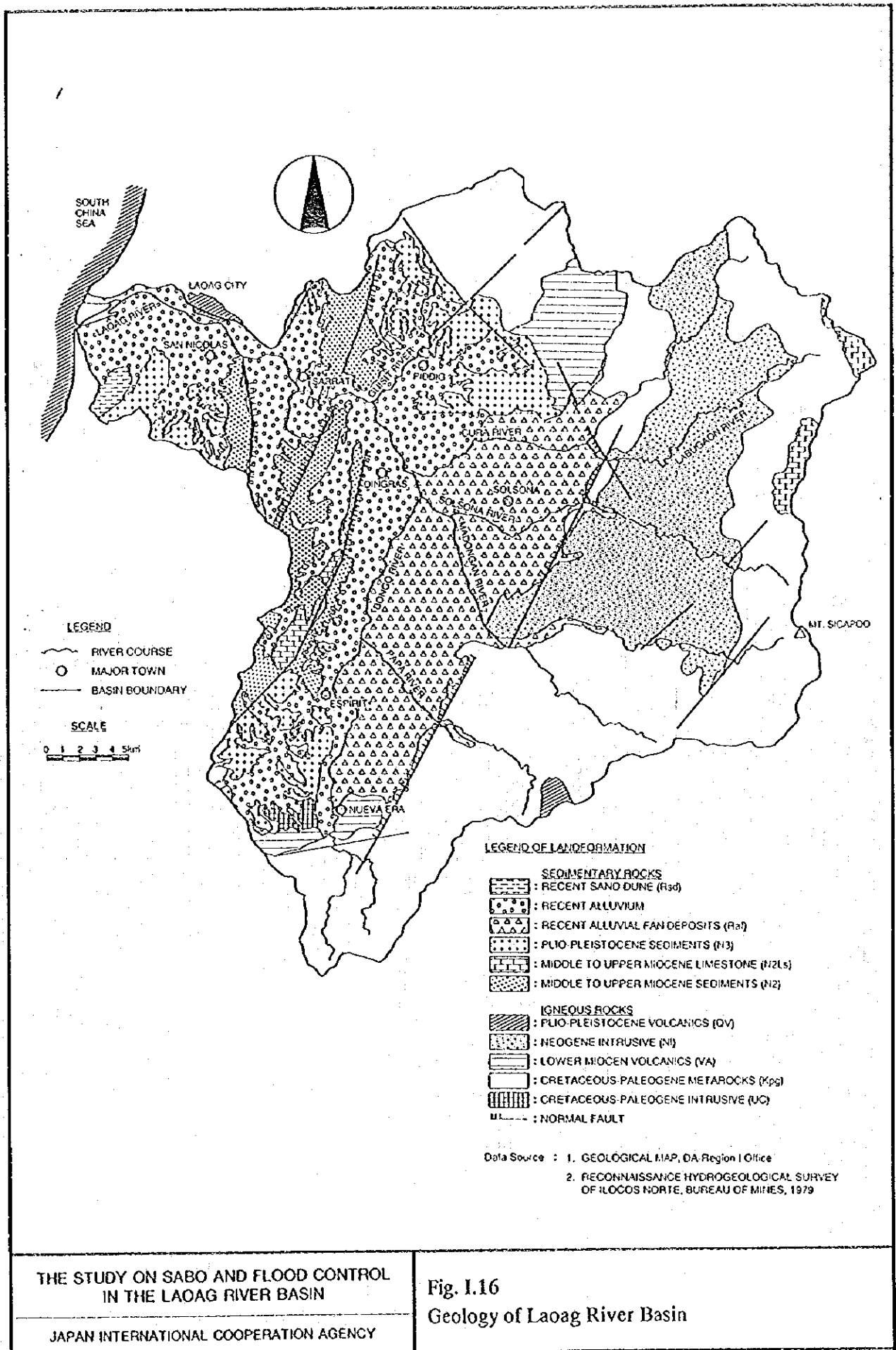


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Fig. I.15

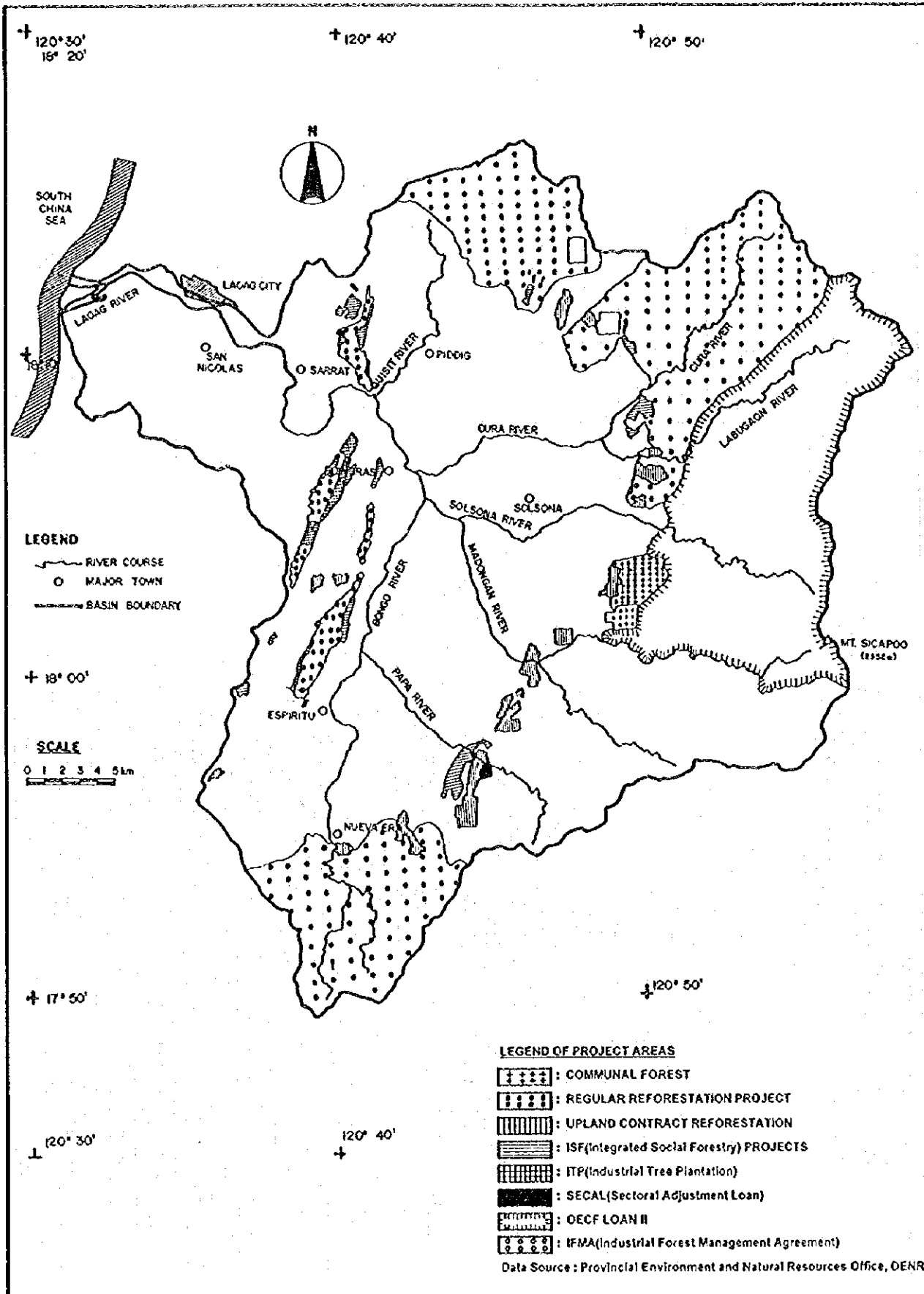
Inundation Area and Depth by 100-year Flood



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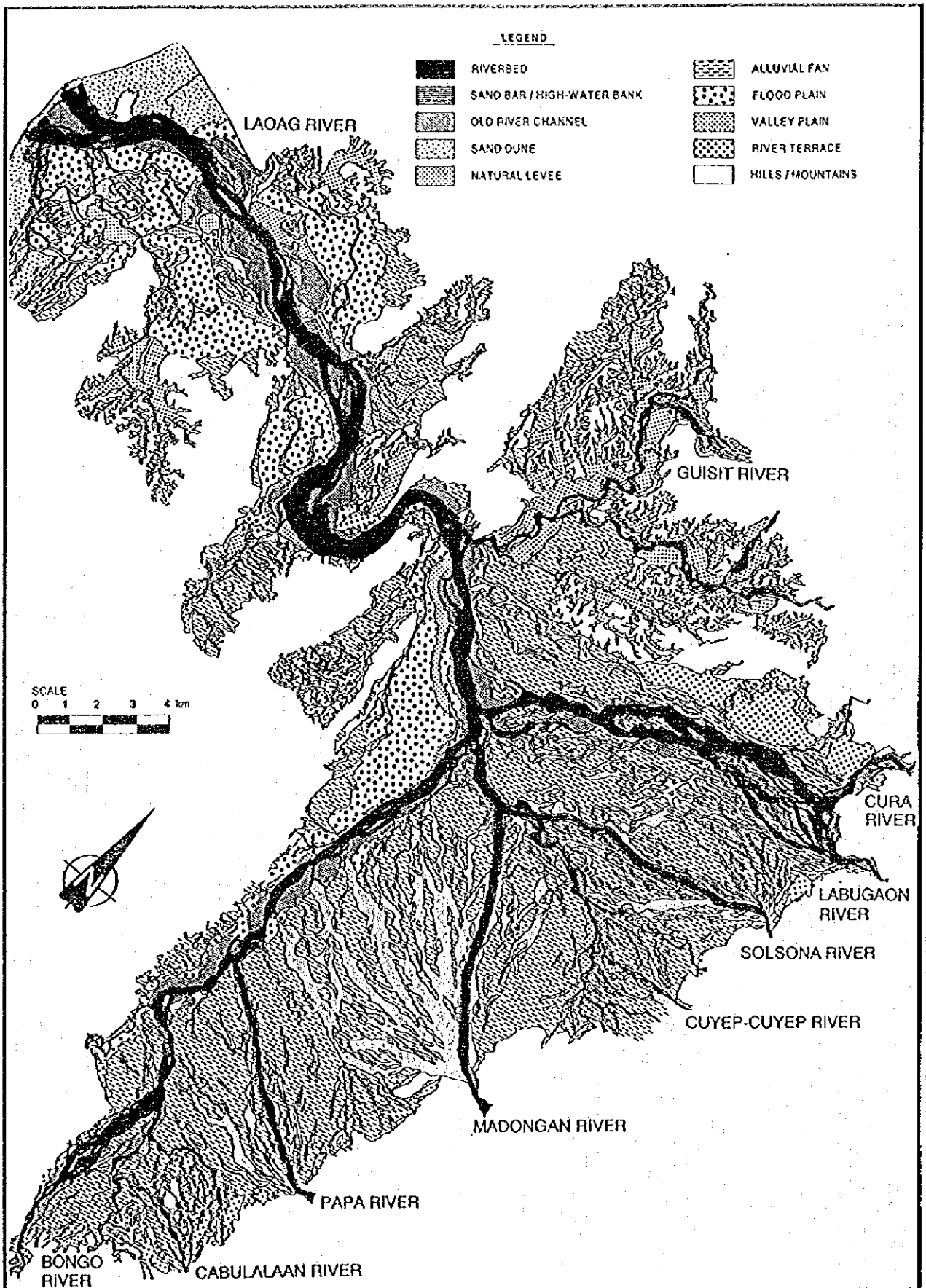
Fig. I.16
Geology of Laoag River Basin



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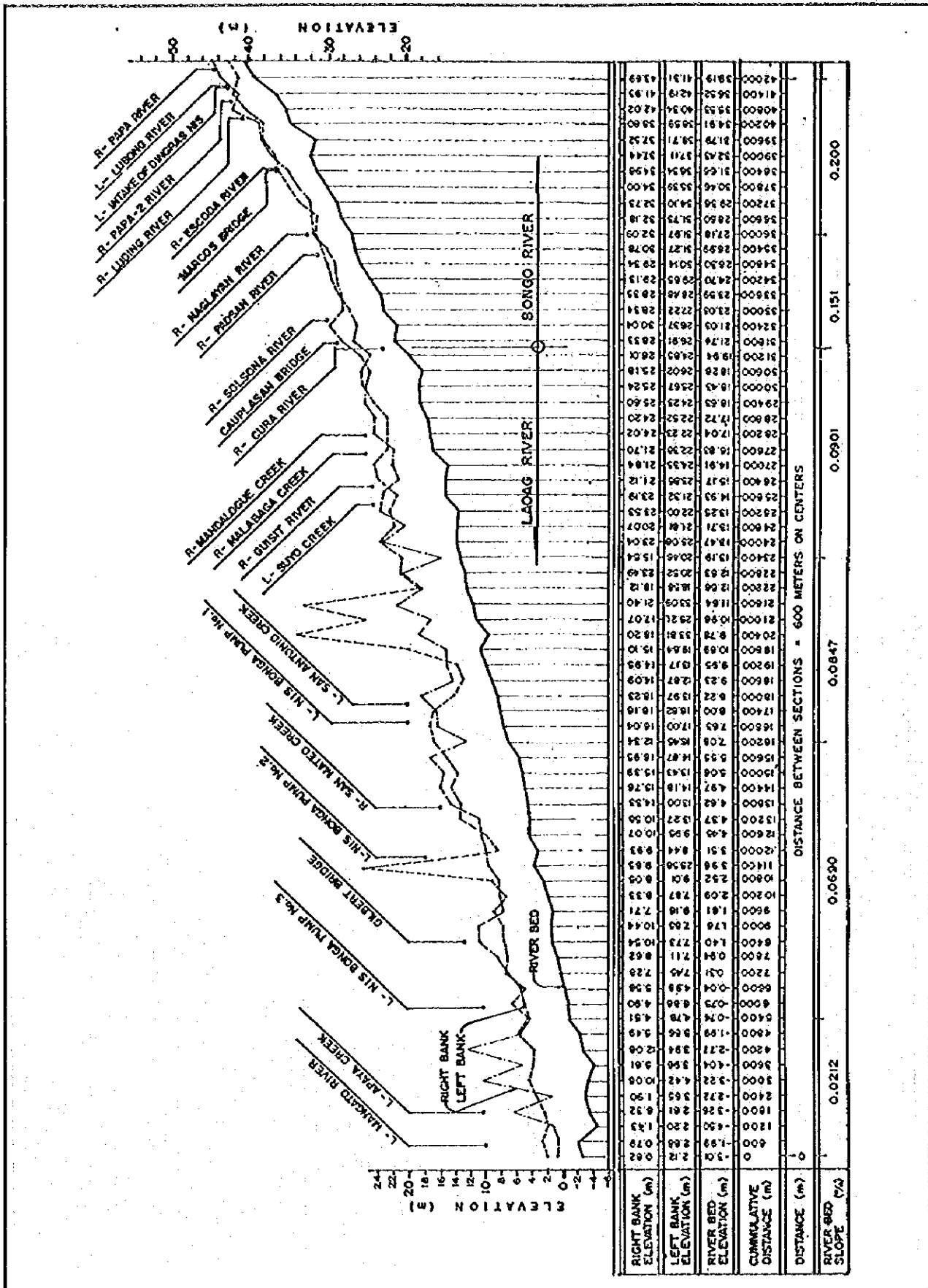
Fig. I.17
Reforestation Project Area



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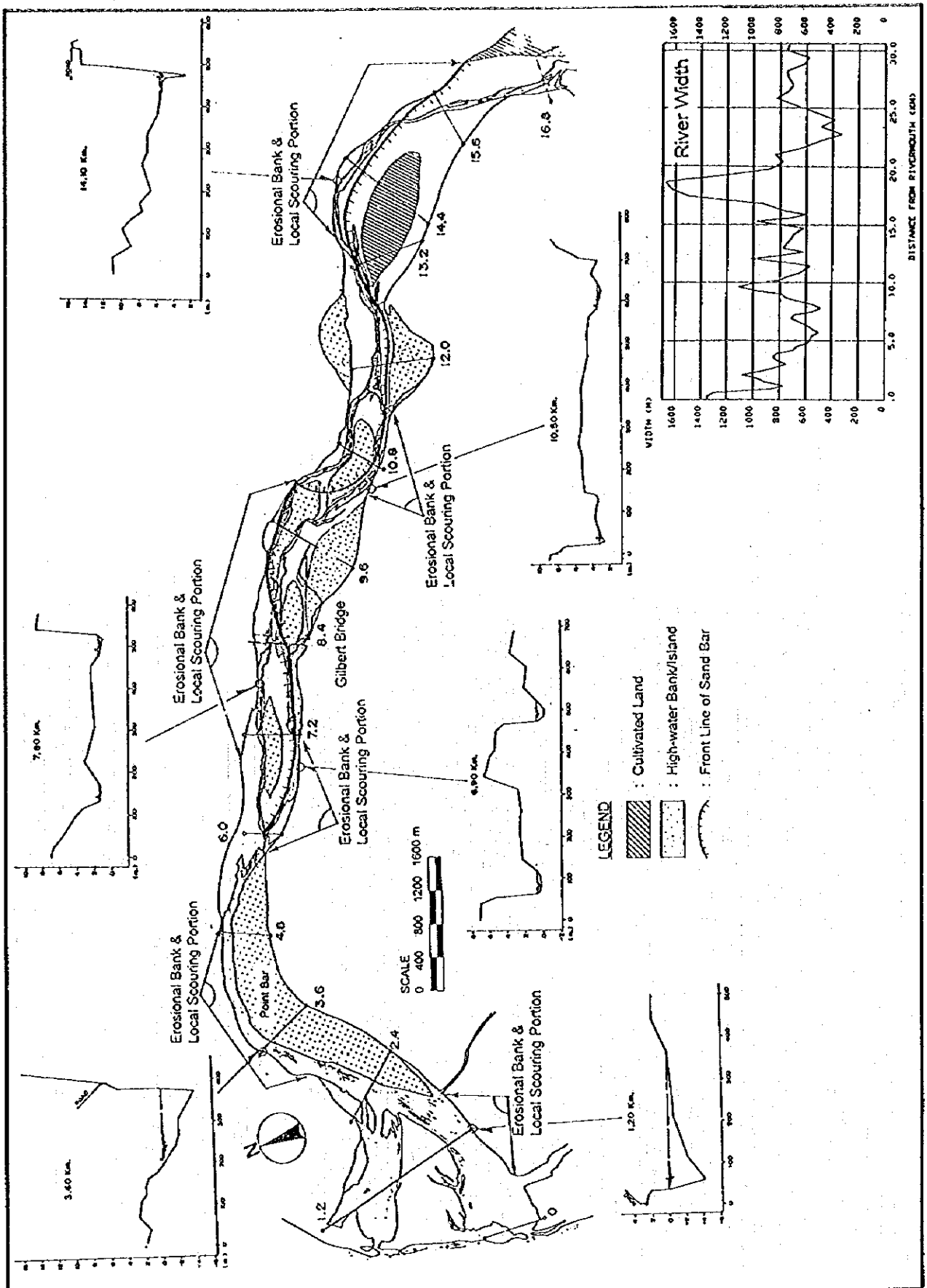
Fig. I.18
Geomorphological Features of Laoag Alluvium



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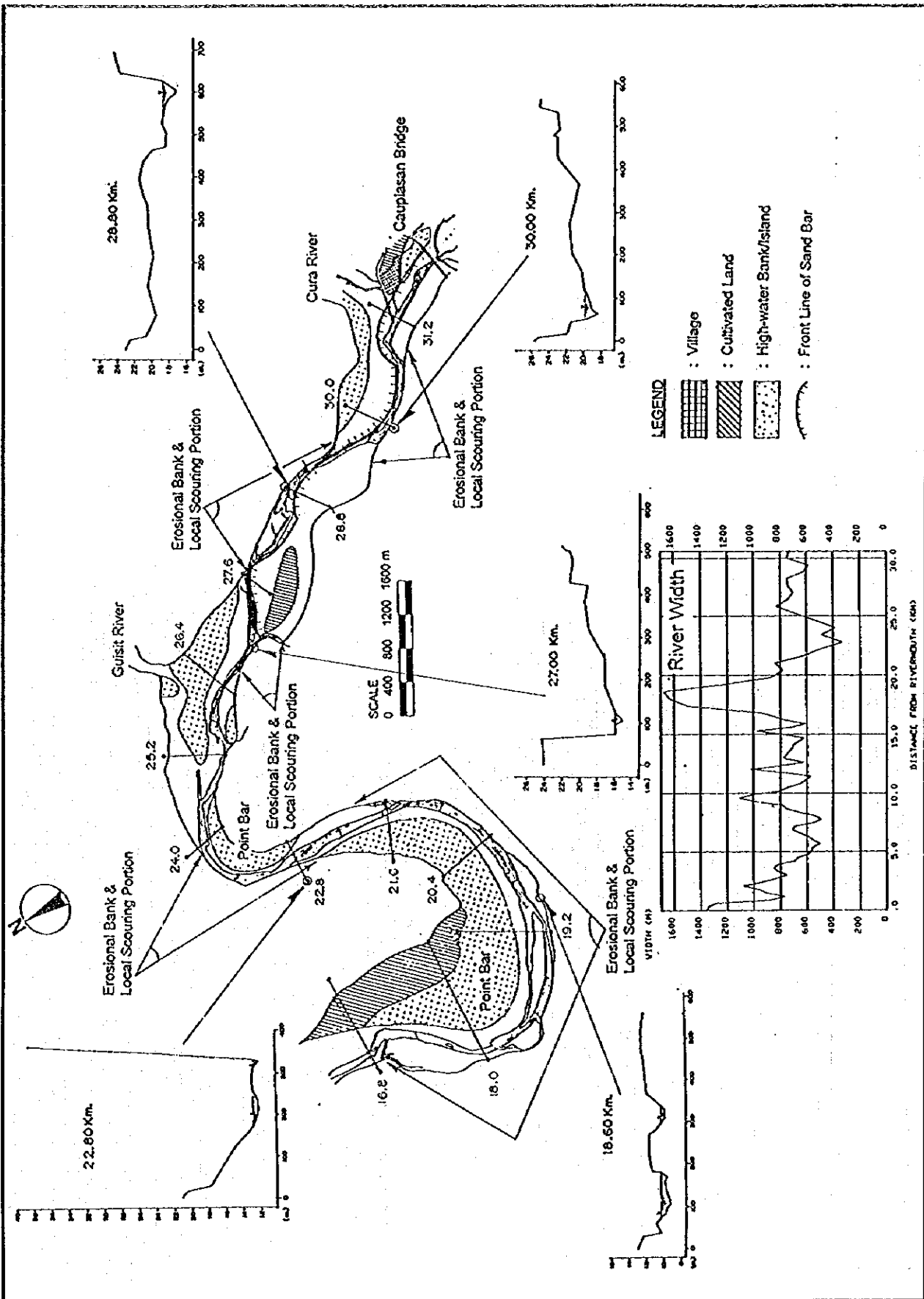
Fig. I.19 (1)
River Morphology
(Longitudinal Profile of Laoag and Lower Bongo Rivers)



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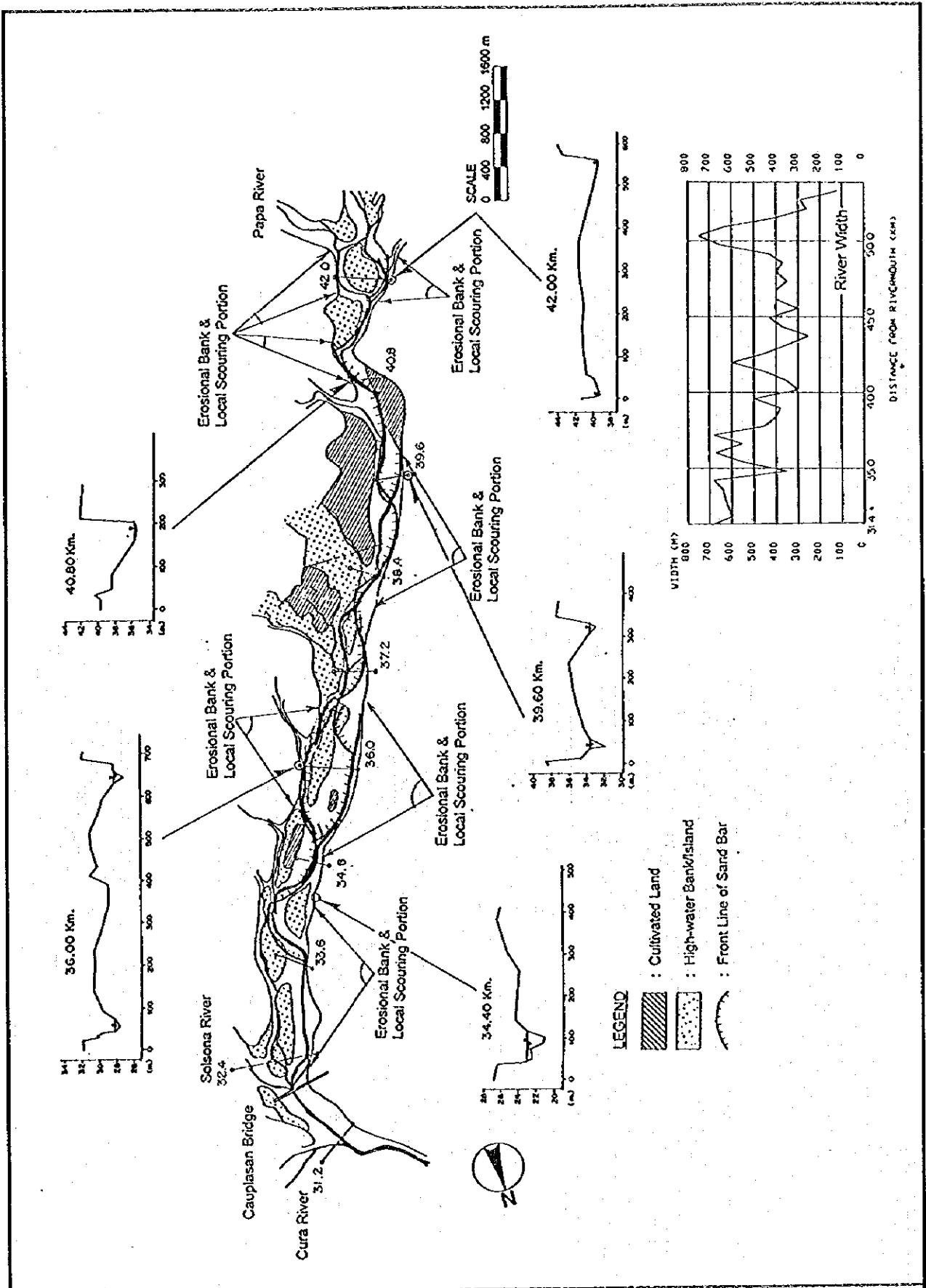
Fig. 1.19 (2)
River Morphology (Lower Laoag River)



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Fig. I.19 (3)
River Morphology (Upper Laoag River)

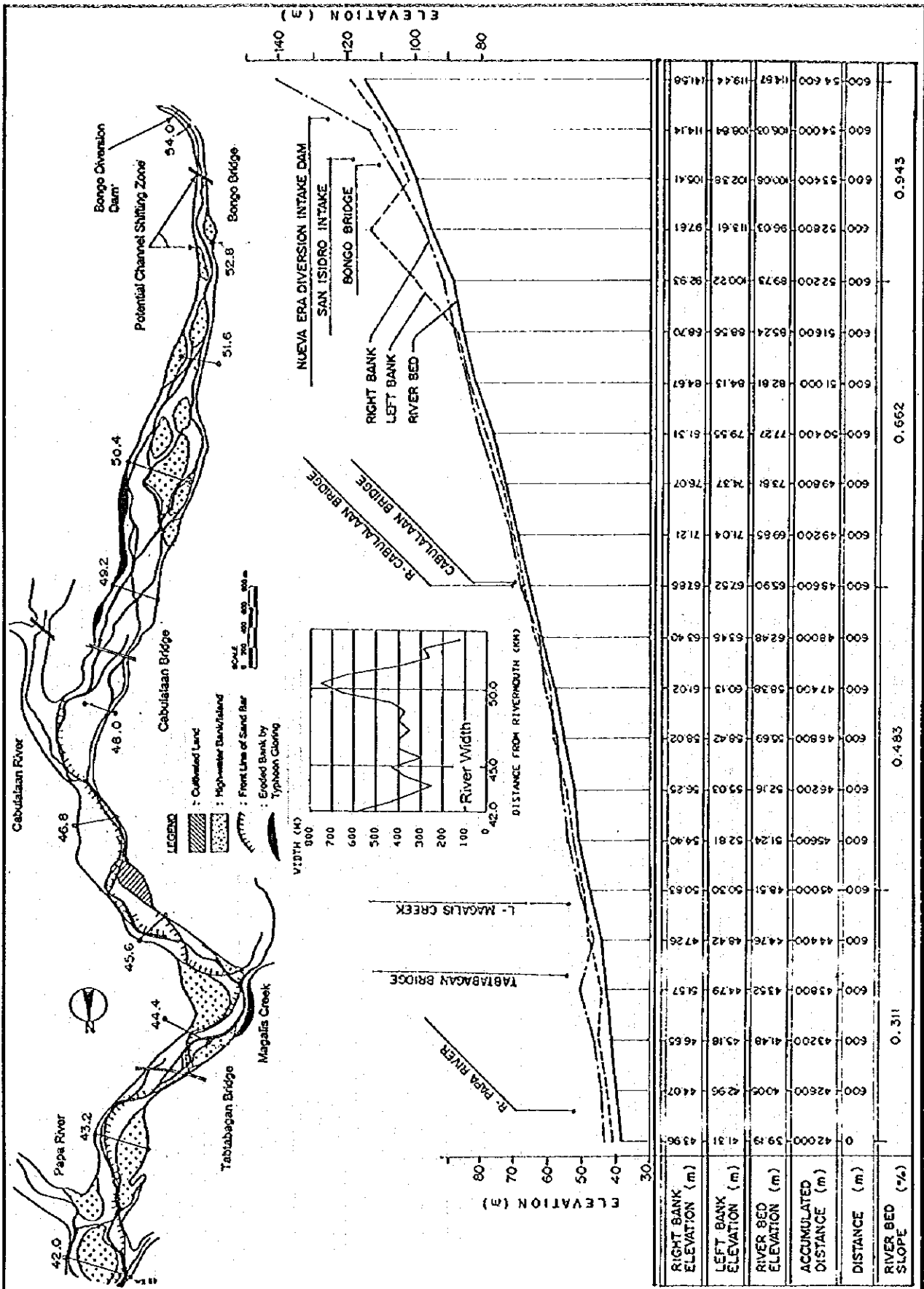


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Fig. I.19 (4)

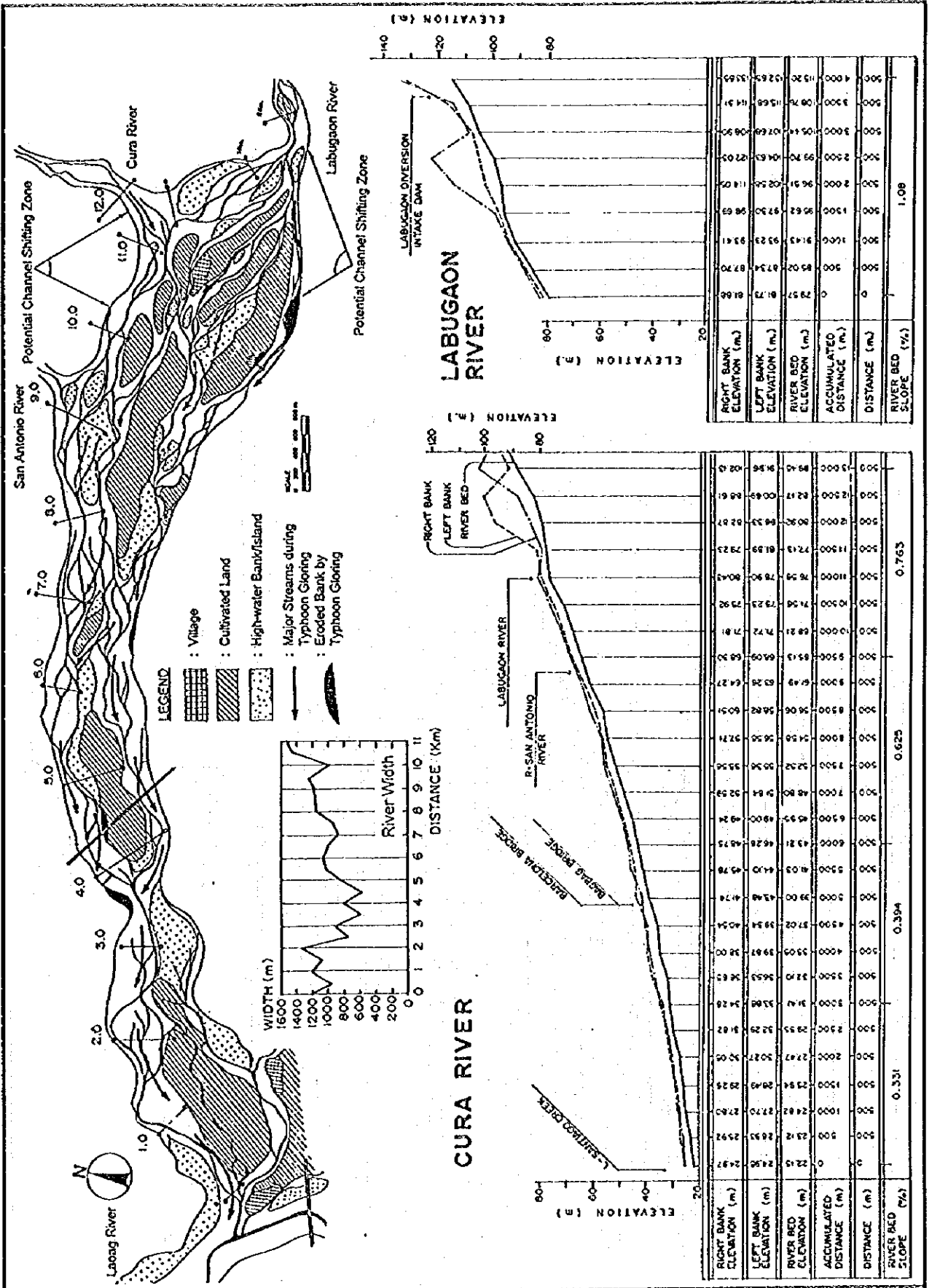
River Morphology (Lower Bongo River)

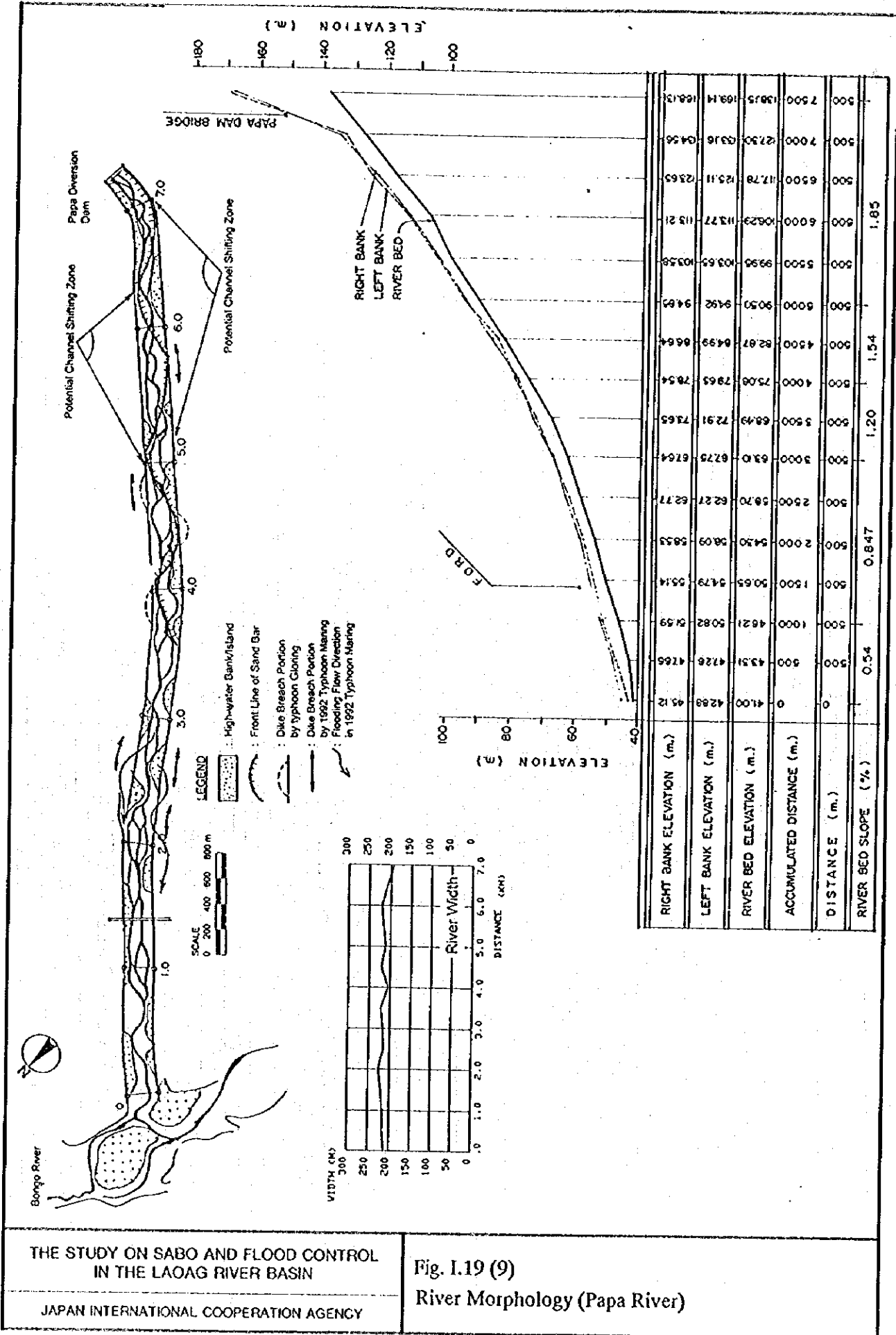


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Fig. I.19 (5)
River Morphology (Upper Bongo River)



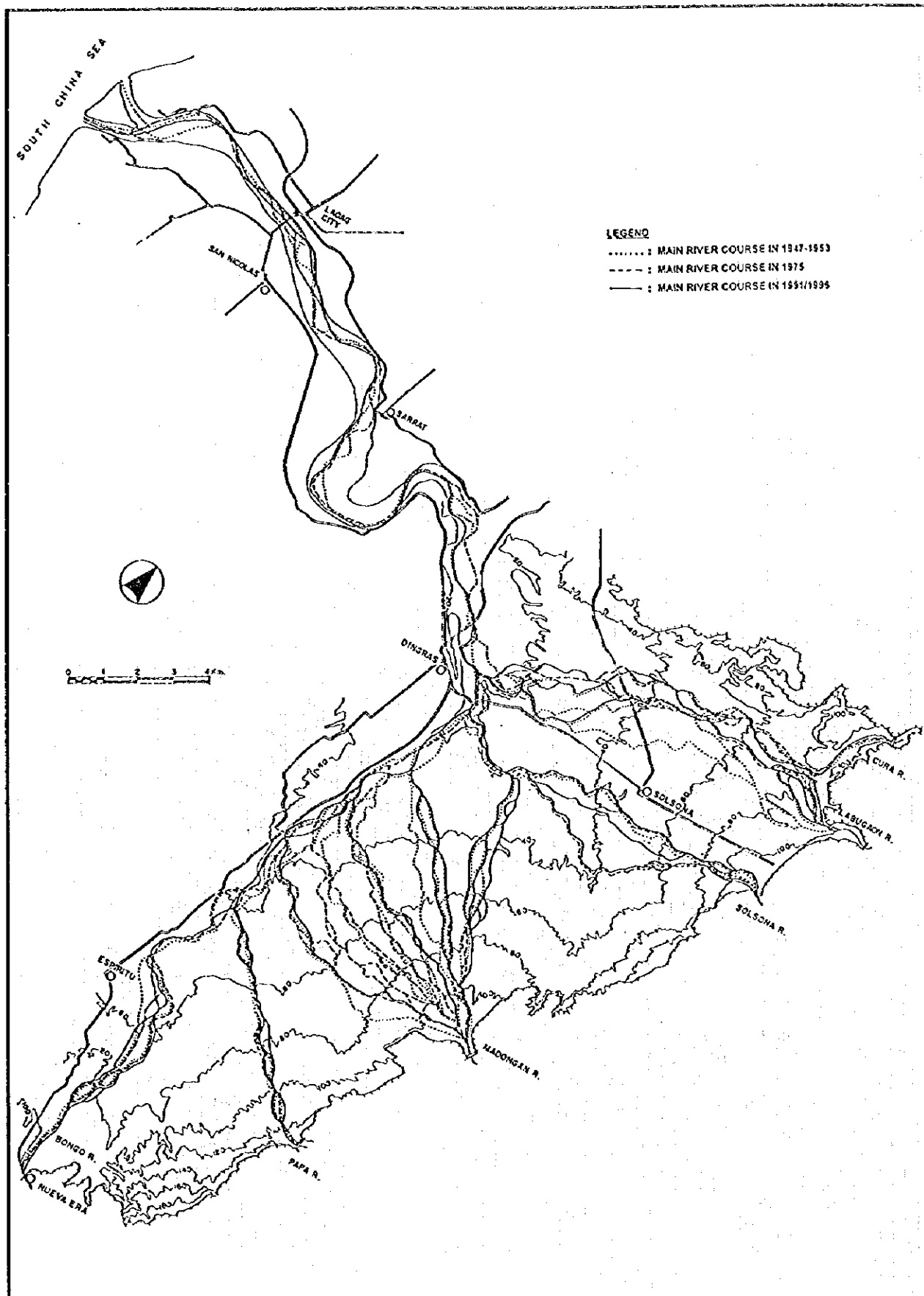


RIGHT BANK ELEVATION (m.)	0	41.00	42.88	45.12	47.66	49.59	51.14	52.14	53.14	54.20	58.53	58.70	62.27	62.77	67.64	67.75	72.91	73.65	78.54	79.65	82.67	84.99	86.64	94.65	94.92	90.50	94.92	103.65	103.58	113.77	115.21	125.11	123.65	127.30	134.56	138.15	168.13
LEFT BANK ELEVATION (m.)	0	43.51	47.28	47.66	46.21	50.82	51.59	50.65	54.79	55.14	58.09	58.53	62.27	62.77	67.75	67.64	72.91	73.65	78.54	79.65	82.67	84.99	86.64	94.65	94.92	90.50	94.92	103.65	103.58	113.77	115.21	125.11	123.65	127.30	134.56	138.15	168.13
RIVER BED ELEVATION (m.)	0	41.00	42.88	45.12	47.66	49.59	51.14	52.14	53.14	54.20	58.53	58.70	62.27	62.77	67.64	67.75	72.91	73.65	78.54	79.65	82.67	84.99	86.64	94.65	94.92	90.50	94.92	103.65	103.58	113.77	115.21	125.11	123.65	127.30	134.56	138.15	168.13
ACCUMULATED DISTANCE (m.)	0	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500	8000	8500	9000	9500	10000	10500	11000	11500	12000	12500	13000	13500	14000	14500	15000	15500	16000	16500	17000	17500	
DISTANCE (m.)	0	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500	8000	8500	9000	9500	10000	10500	11000	11500	12000	12500	13000	13500	14000	14500	15000	15500	16000	16500	17000	17500	
RIVER BED SLOPE (%)	0.54	0.847	1.20	1.54	1.85																																

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Fig. I.19 (9)
River Morphology (Papa River)

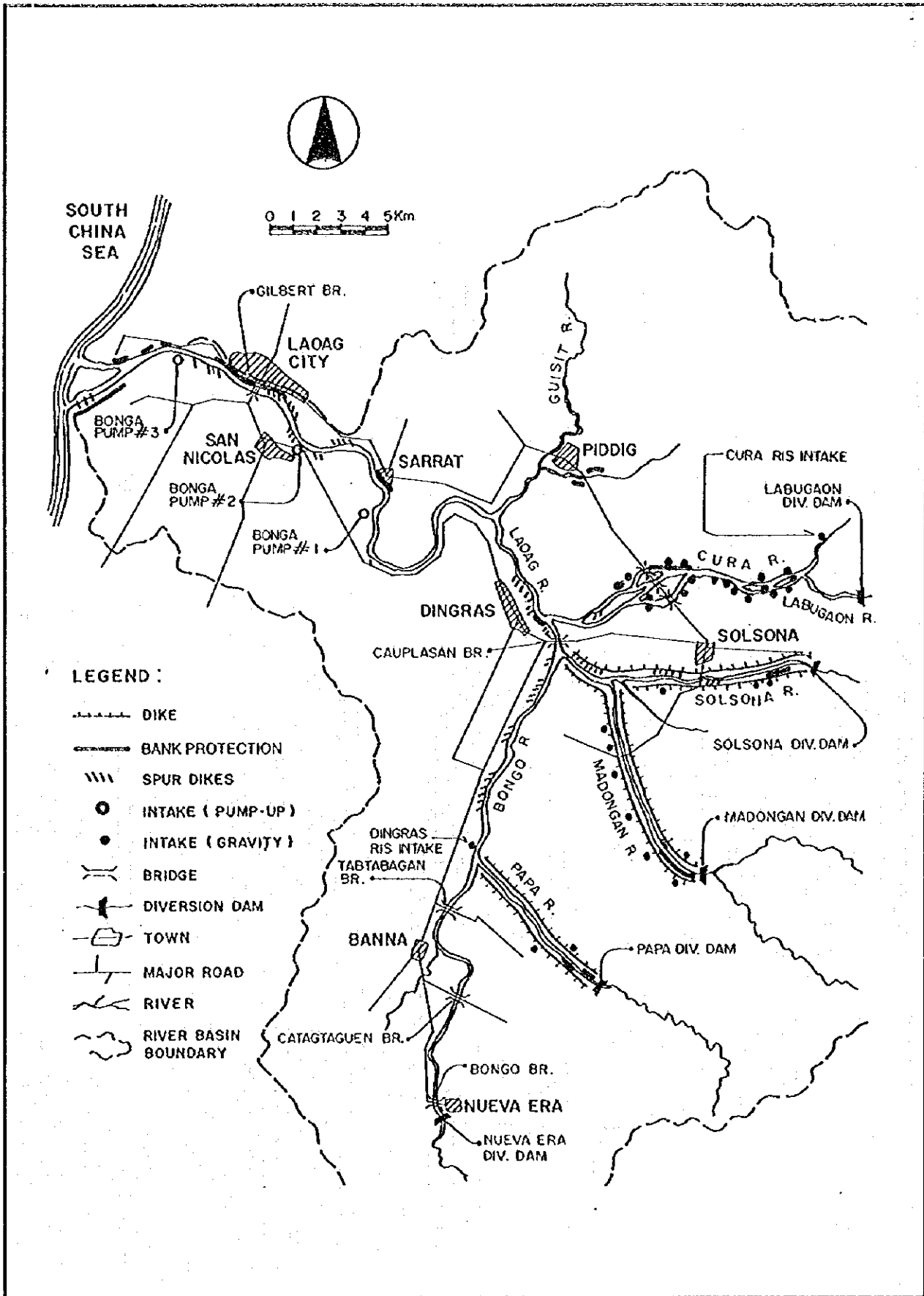


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Fig. I.20

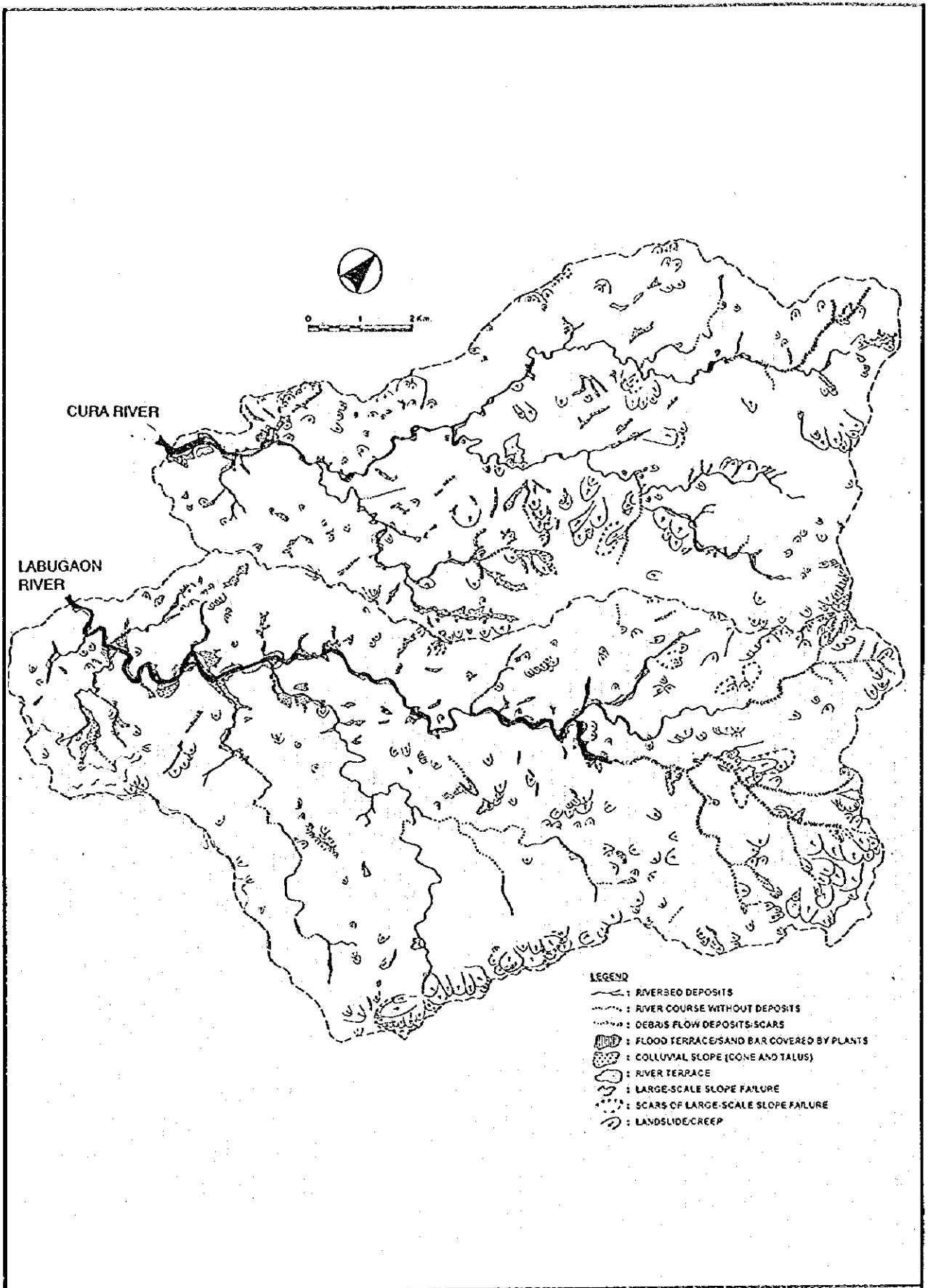
River Course Change in the Past



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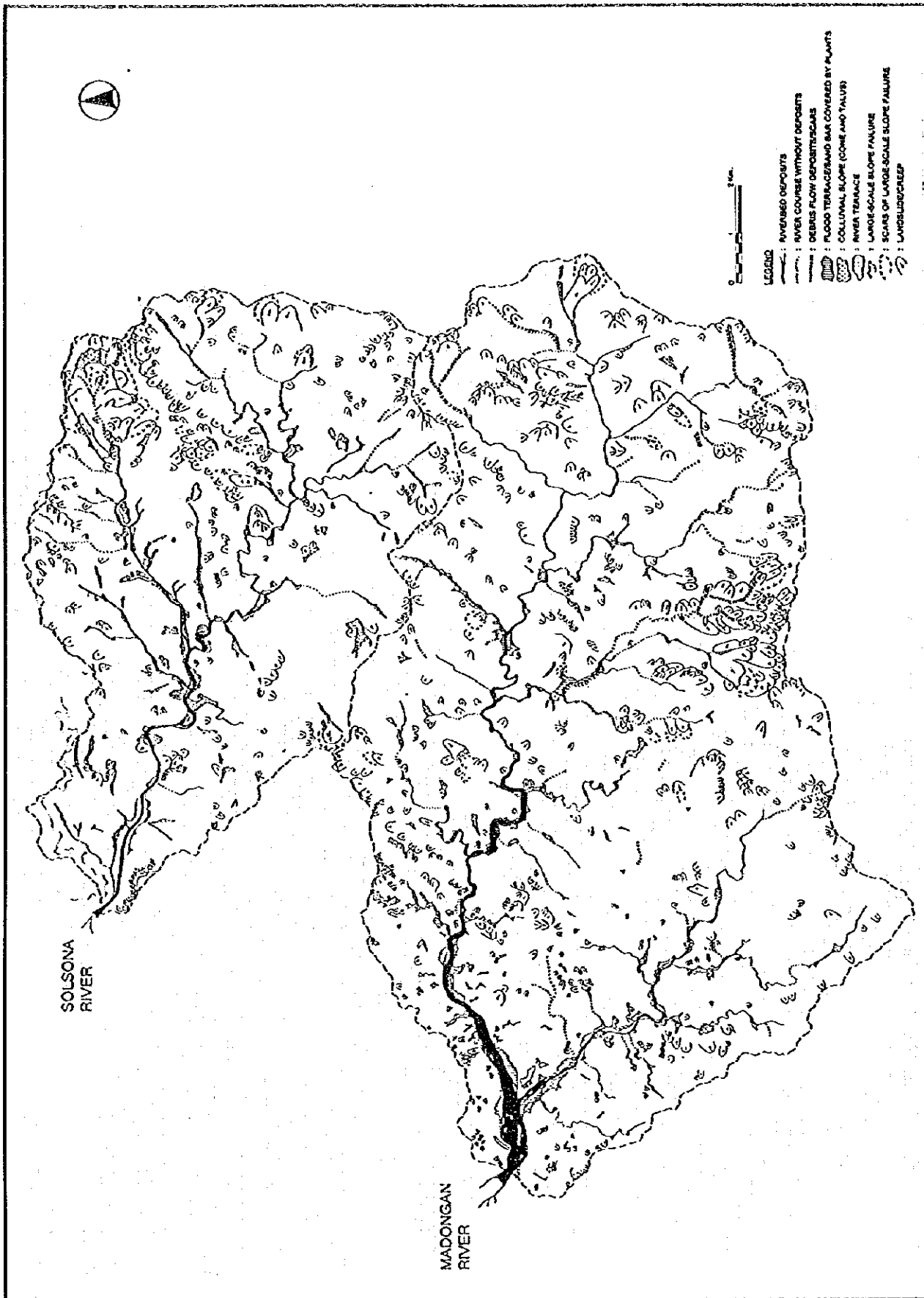
Fig. I.21
Existing River Structures



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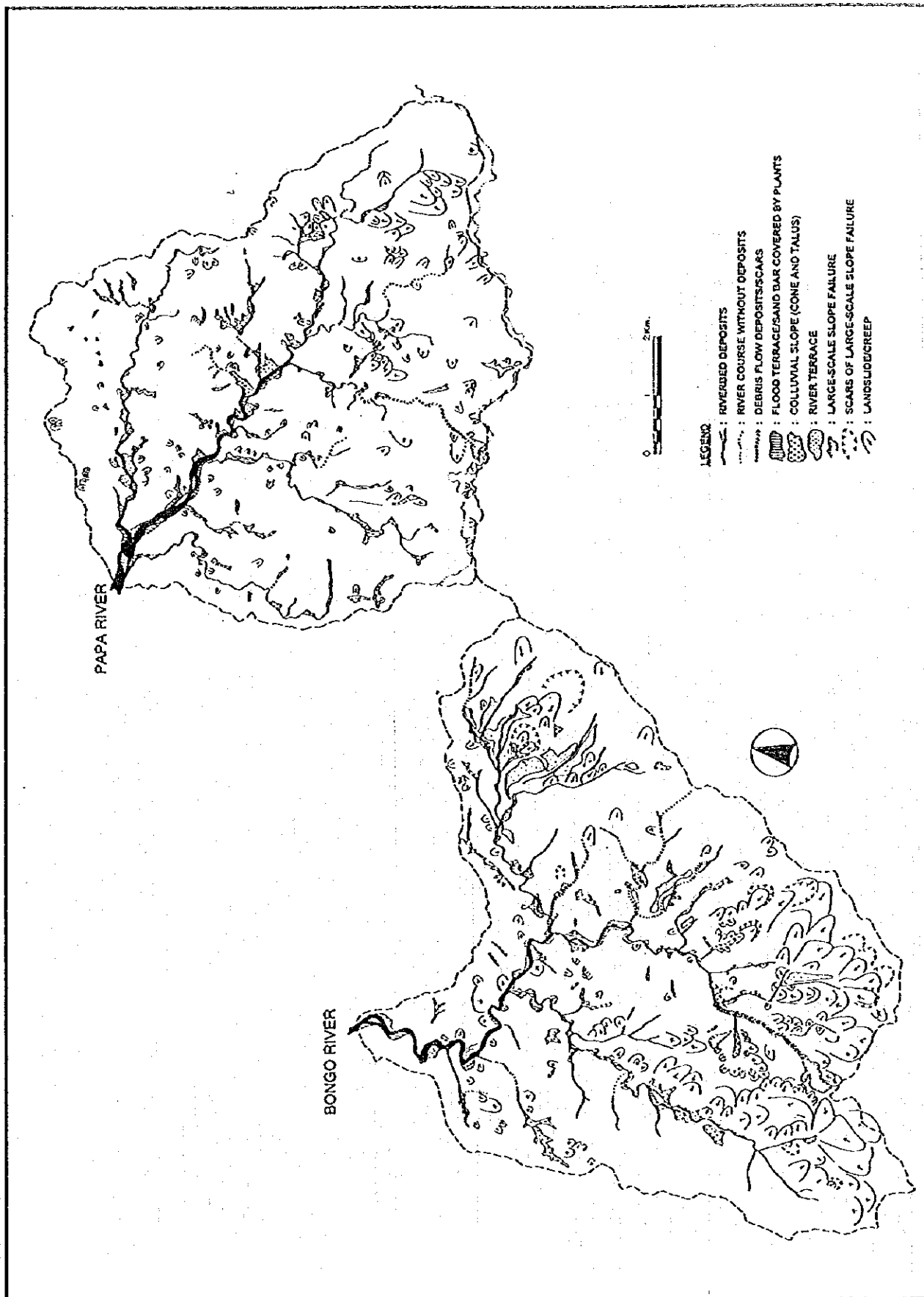
Fig. 1.22 (1)
Micro-topography Related to Sediment Yield
(Cura and Labugaon Watersheds)



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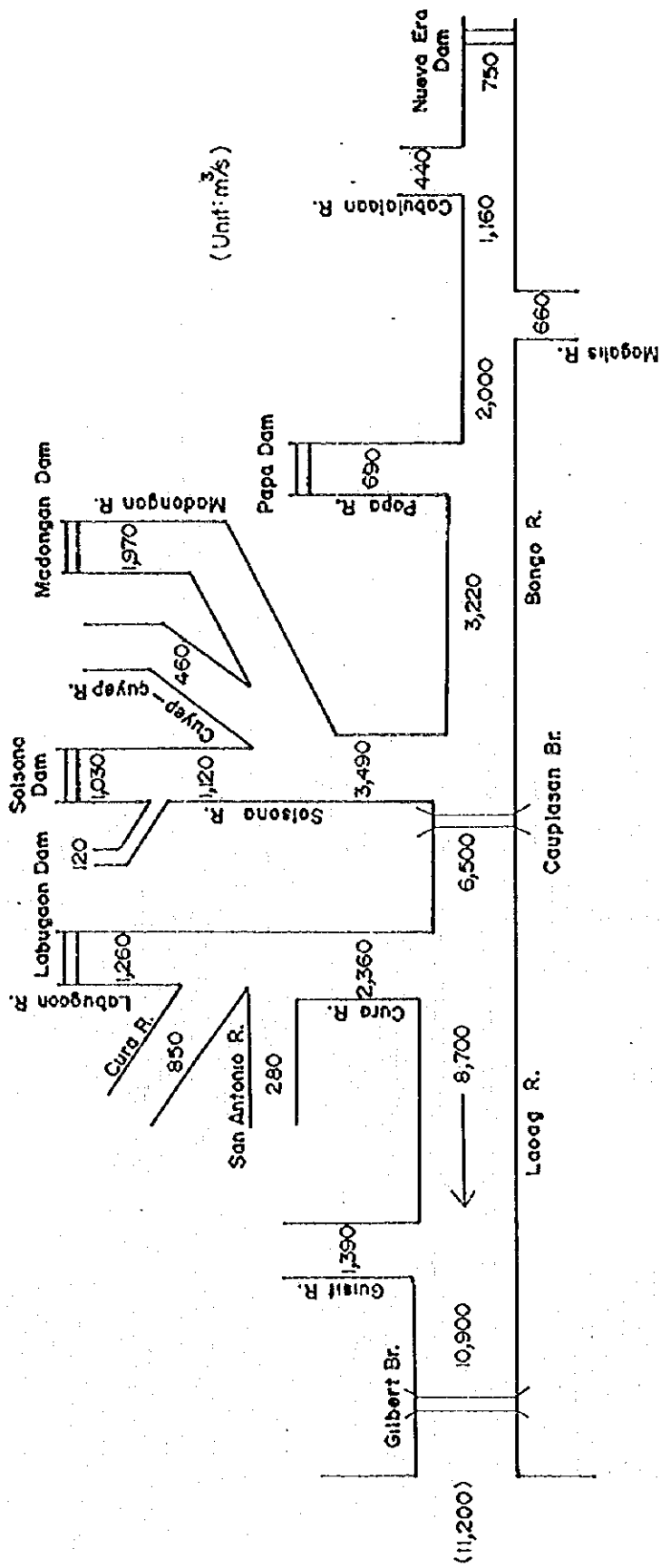
Fig. I.22 (2)
Micro-topography Related to Sediment Yield
(Solsona and Madongan Watershed)



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Fig. I.22 (3)
Micro-topography Related to Sediment Yield
(Papa and Bongo Watershed)

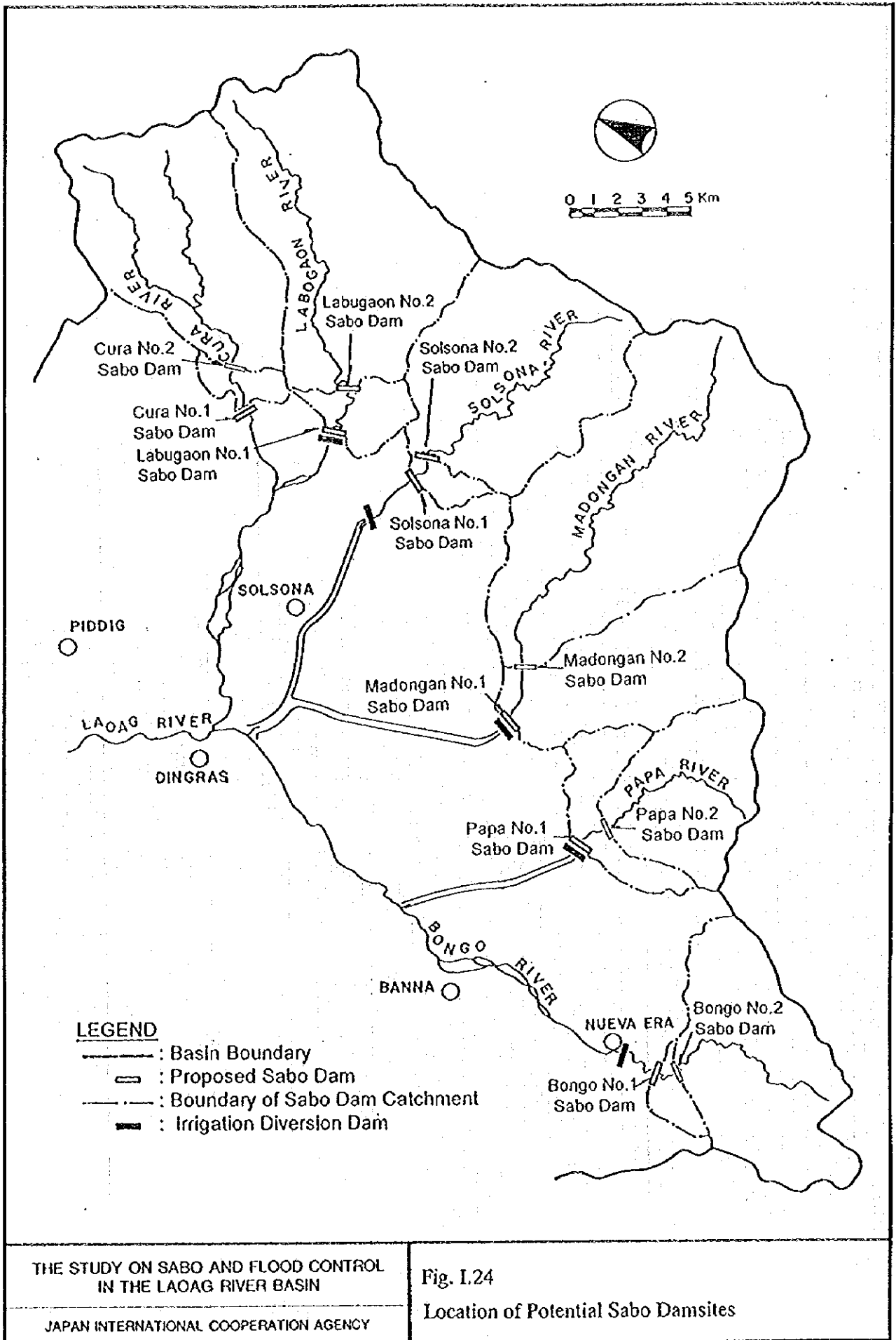


THE STUDY ON SABO AND FLOOD CONTROL
IN THE LAOAG RIVER BASIN

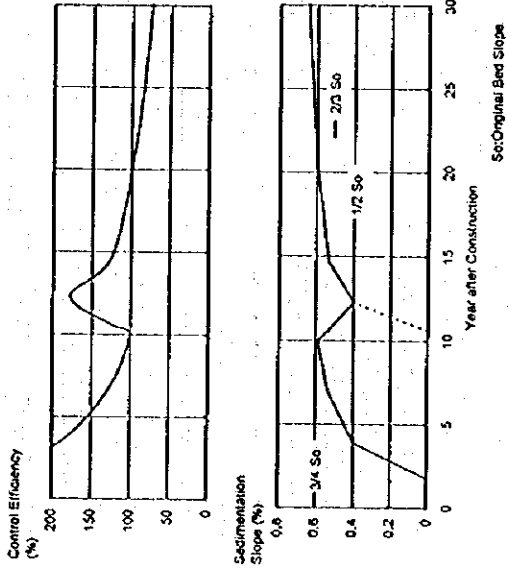
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Fig. I.23

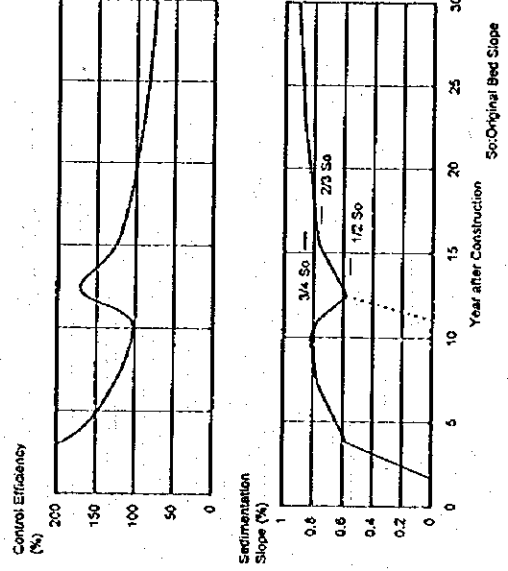
Design Flood Discharge Distribution



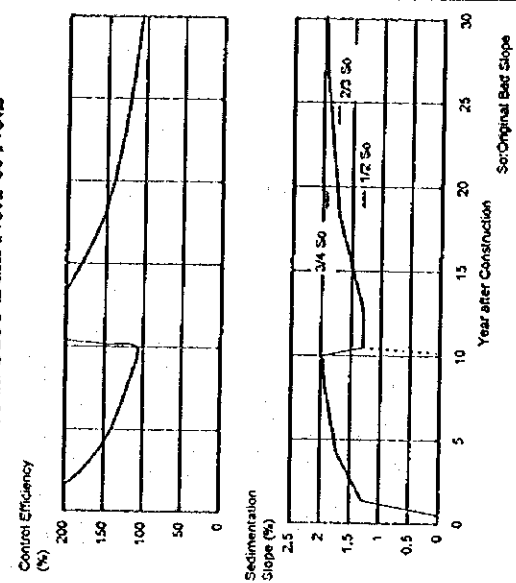
Cura Sabo Dam No.1 & No.2



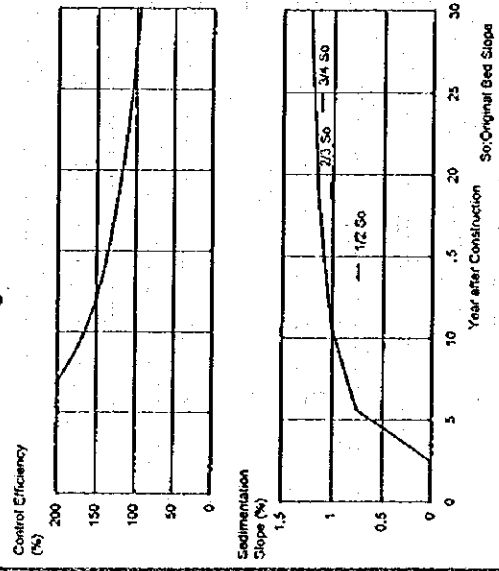
Labugaon Sabo Dam No.1 & No.2



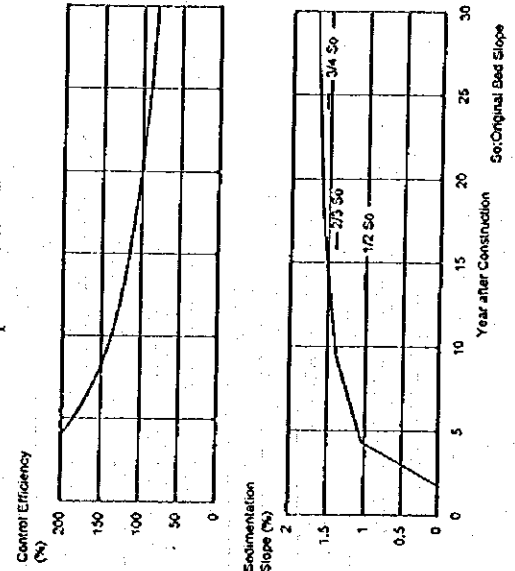
Solsona Sabo Dam No.1 & No.2



Madongan Sabo Dam

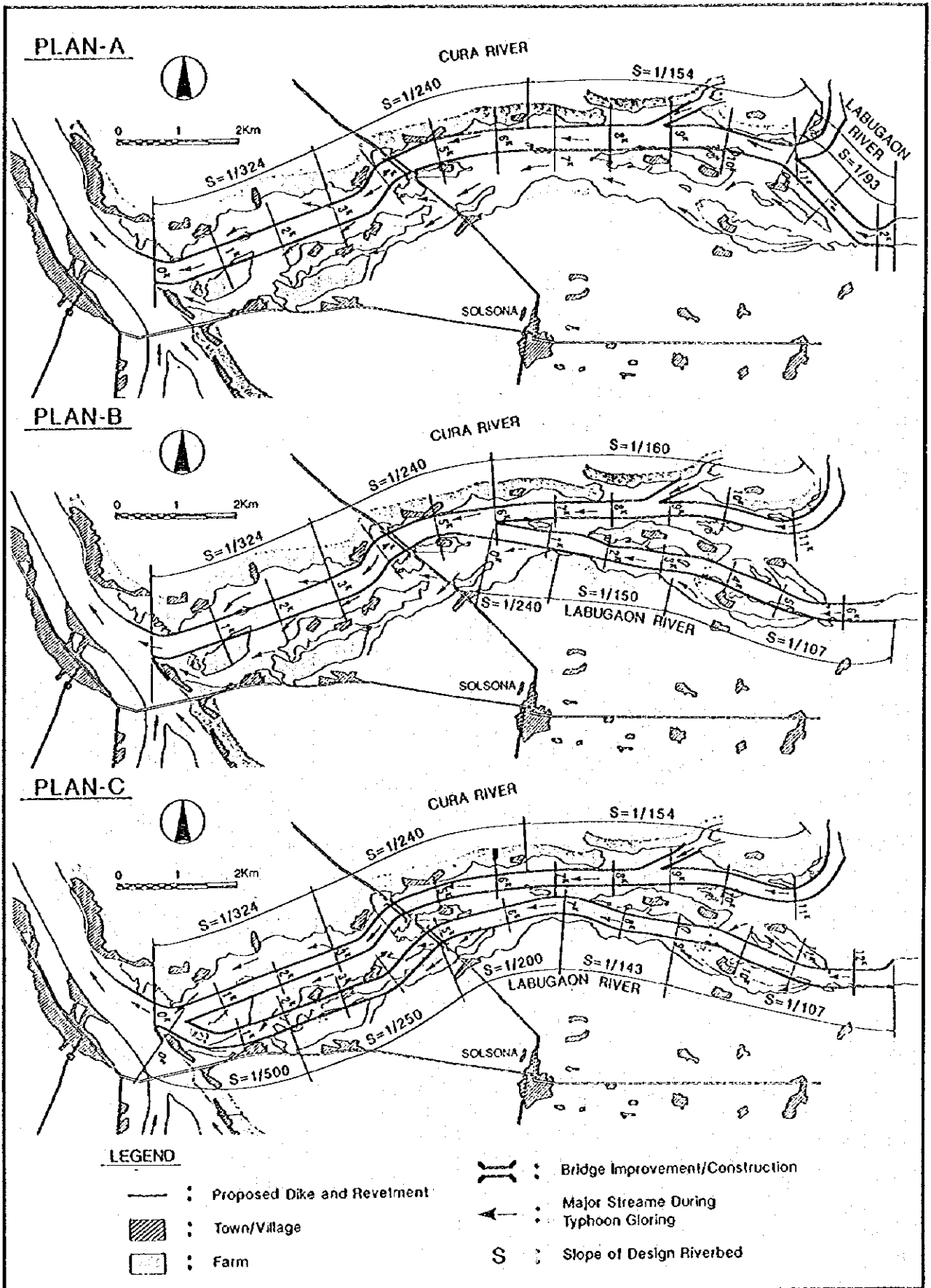


Papa Sabo Dam



Control Efficiency (%) = $(Q_{in} - Q_{out}) / (Q_{in} - Q_{apex})$
 Q_{in} : Sediment Inflow at Sabo Dam
 Q_{out} : Sediment Outflow at Sabo Dam
 Q_{apex} : Sediment Discharge Capacity at Fan Apex

Fig. 1.25
 Control Efficiency of Proposed Sabo Dam

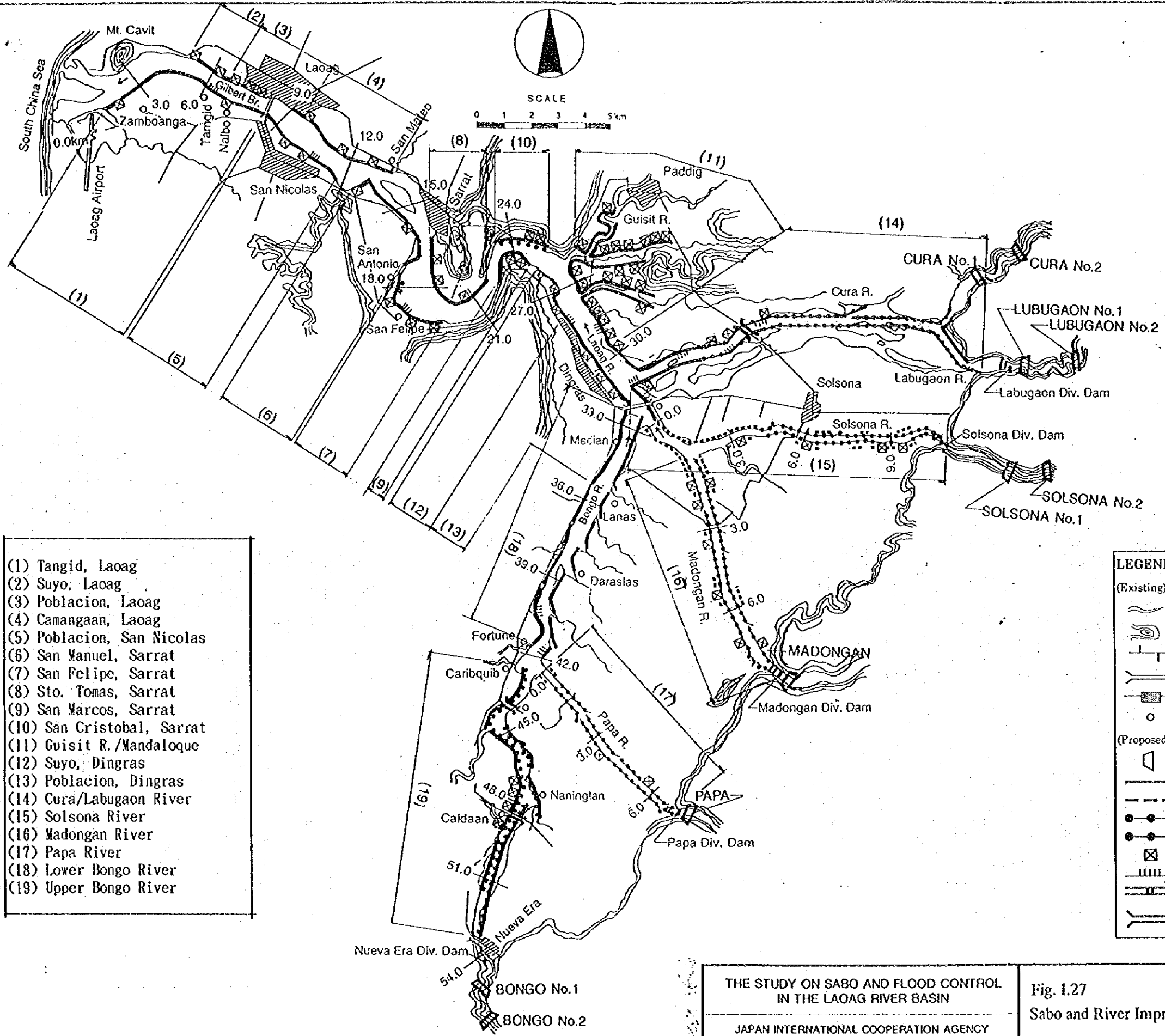


THE STUDY ON SABO AND FLOOD CONTROL
IN THE LAOAG RIVER BASIN

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Fig. I.26

Alignment Alternatives of Cura/Labugaon River



- (1) Tangid, Laoag
- (2) Suyo, Laoag
- (3) Poblacion, Laoag
- (4) Camangaan, Laoag
- (5) Poblacion, San Nicolas
- (6) San Manuel, Sarrat
- (7) San Felipe, Sarrat
- (8) Sto. Tomas, Sarrat
- (9) San Marcos, Sarrat
- (10) San Cristobal, Sarrat
- (11) Guisit R./Mandaloque
- (12) Suyo, Dingras
- (13) Poblacion, Dingras
- (14) Cura/Labugaon River
- (15) Solsona River
- (16) Madongan River
- (17) Papa River
- (18) Lower Bongo River
- (19) Upper Bongo River

LEGEND:

(Existing)

- : River
- : Mountain
- : Road
- : Bridge
- : Town
- : Village

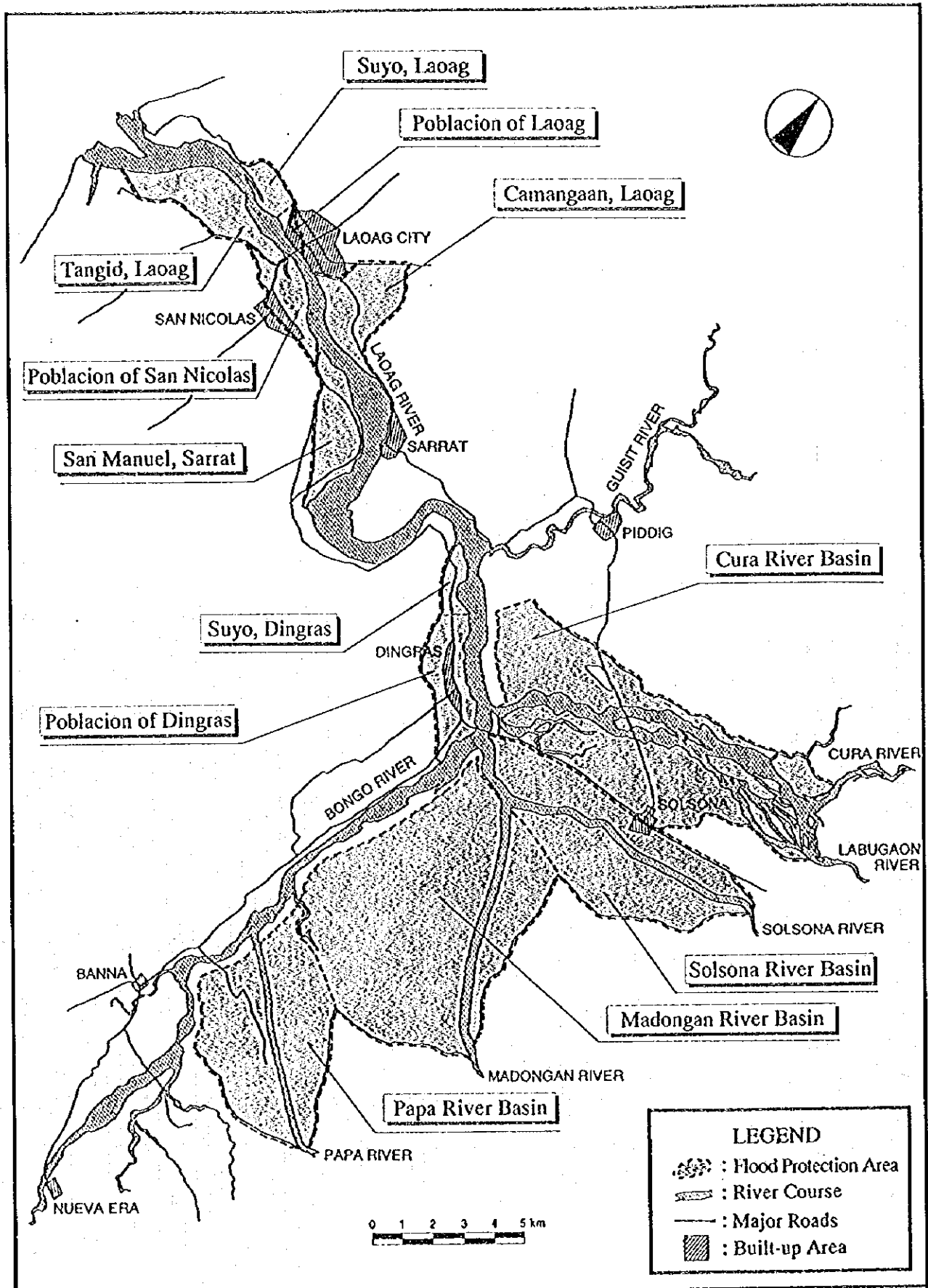
(Proposed)

- : Sabo Dam
- : Dike
- : Heightening of Existing Dike
- : Bank Protection for Existing Dike
- : Bank Protection for New Dike
- : Sluiceway
- : Spurdike
- : Groundsill
- : Bridge Extension
- : Reconstruction

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Fig. I.27
Sabo and River Improvement Works of Sub-projects

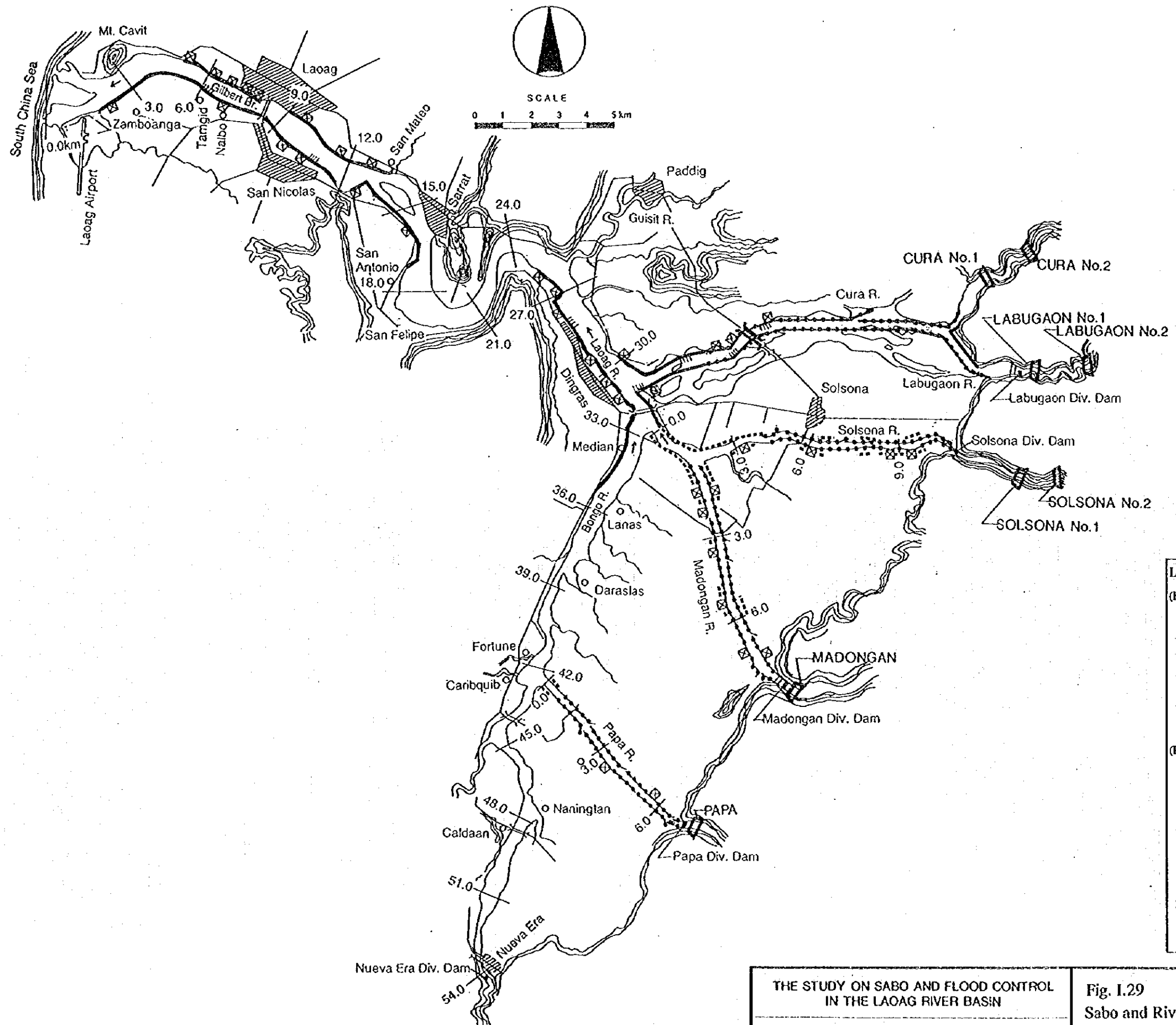


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Fig. 1.28

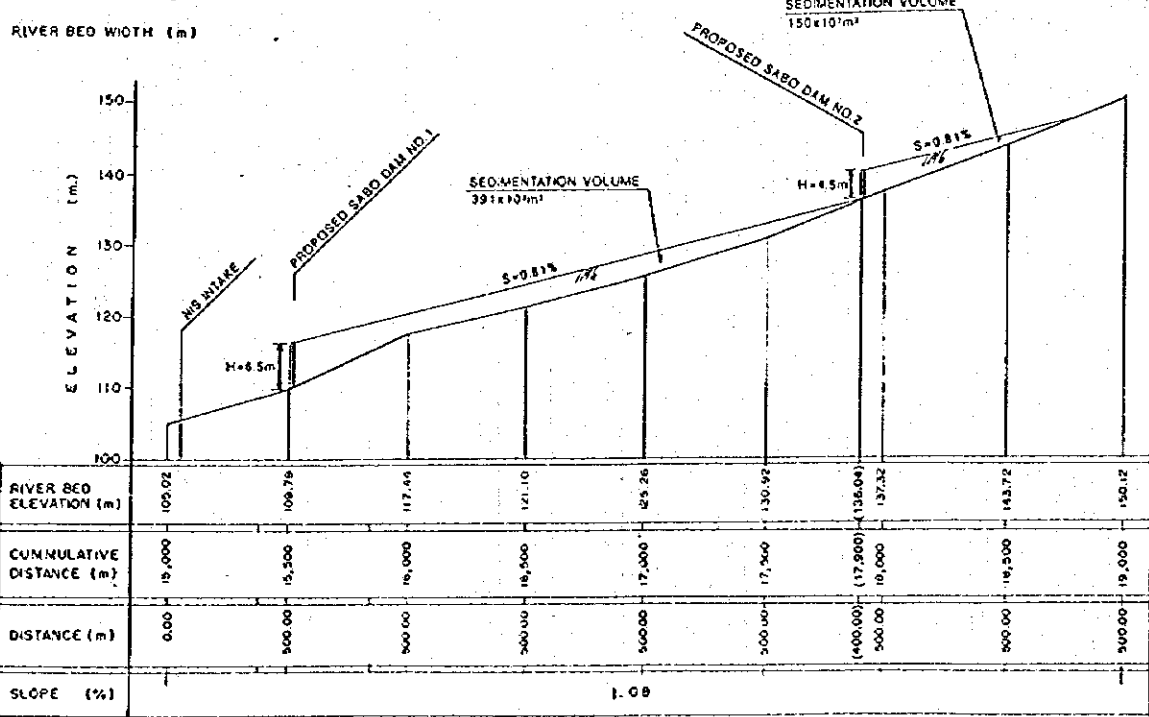
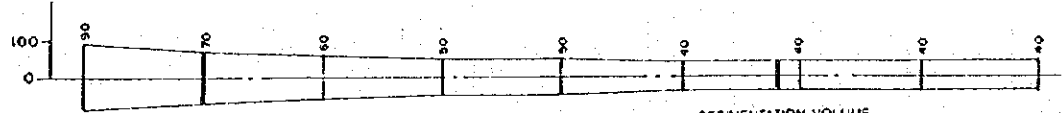
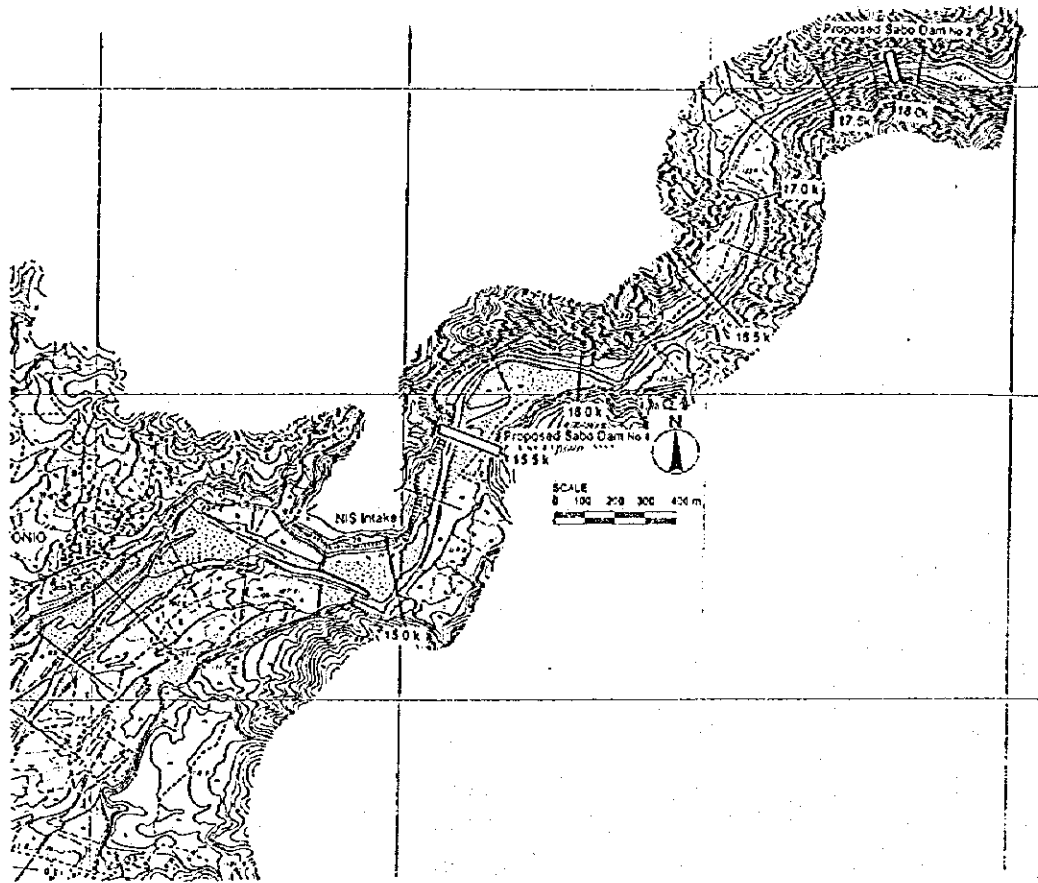
Target Flood Protection Districts



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IN THE LAOAG RIVER BASIN

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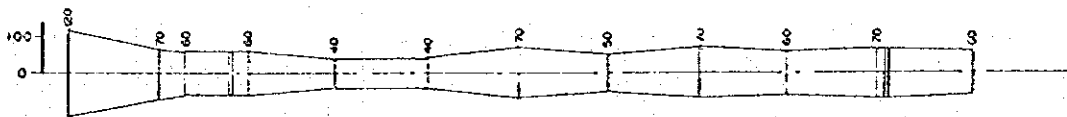
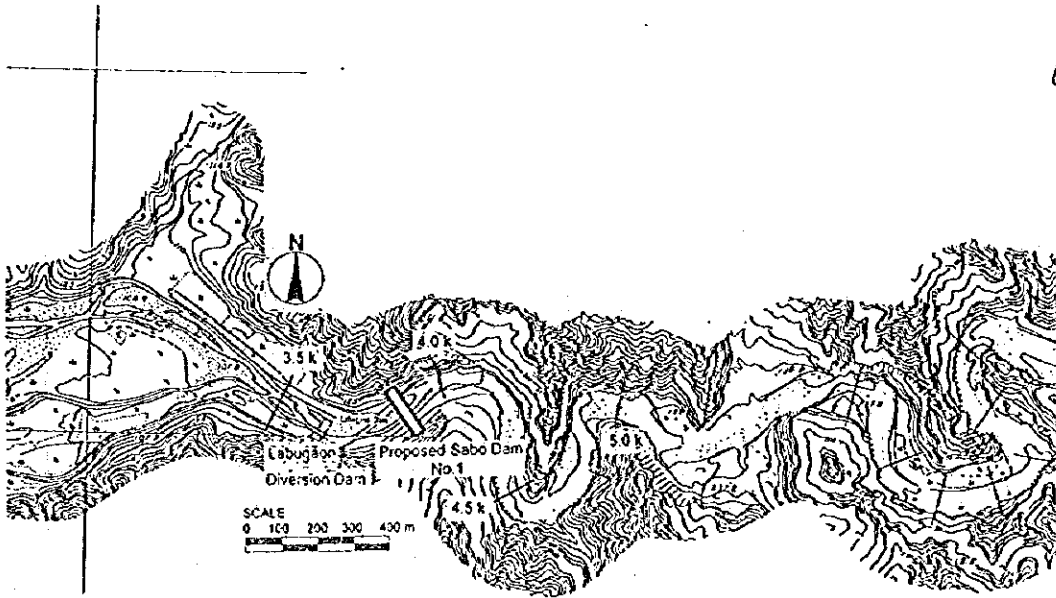
Fig. I.29
Sabo and River Improvement Works of Master Plan



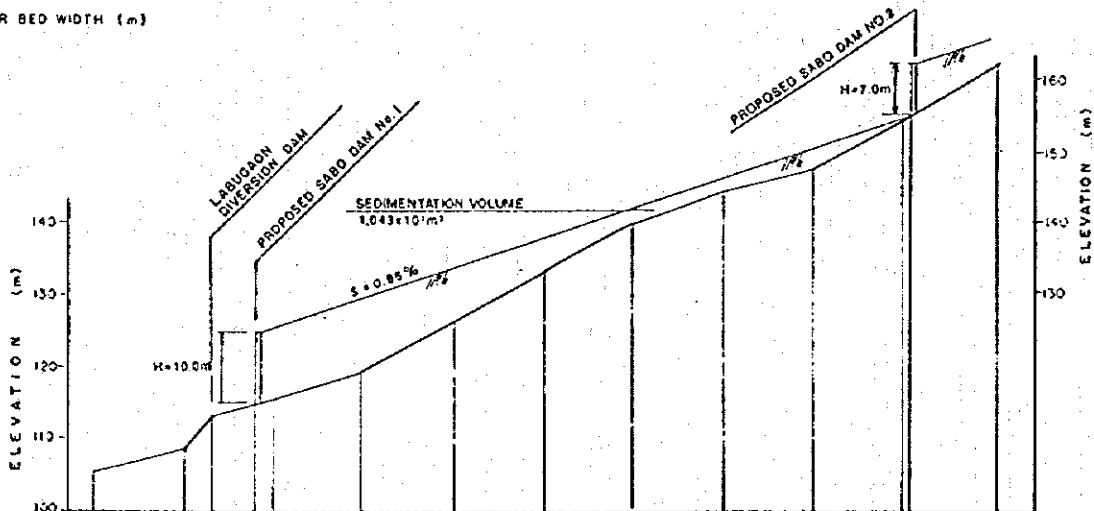
THE STUDY ON SABO AND FLOOD CONTROL
IN THE LAOAG RIVER BASIN

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Fig. I.30 (1)
Plan and Longitudinal Profile of Proposed Sabo
Dams(Cura River)



RIVER BED WIDTH (m)



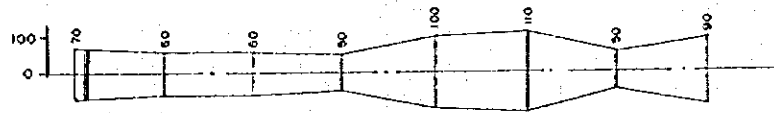
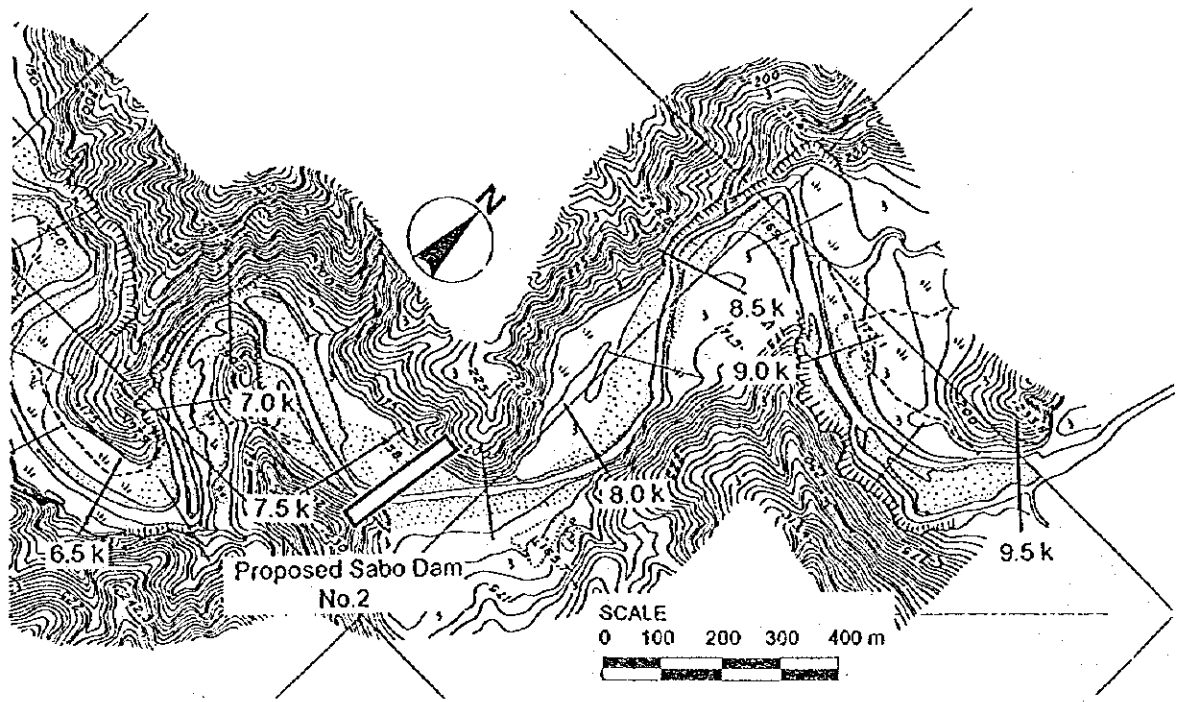
RIVER BED ELEVATION (m)	105.44	109.76	112.81	114.40	115.20	119.45	126.49	133.25	139.86	144.46	147.84	155.50 (155.20)	161.59
CUMMULATIVE DISTANCE (m)	3,000	3,000	3,550	3,990	4,000	4,500	5,000	5,560	6,000	6,900	7,000	7,500 (7,550)	8,000
DISTANCE (m)	0.00	500.00	550.00	400.00	100.00	500.00	500.00	504.44	500.00	900.00	500.00	500.00 (500.00)	500.00
SLOPE (%)			0.83							1.15			

THE STUDY ON SABO AND FLOOD CONTROL
IN THE LAOAG RIVER BASIN

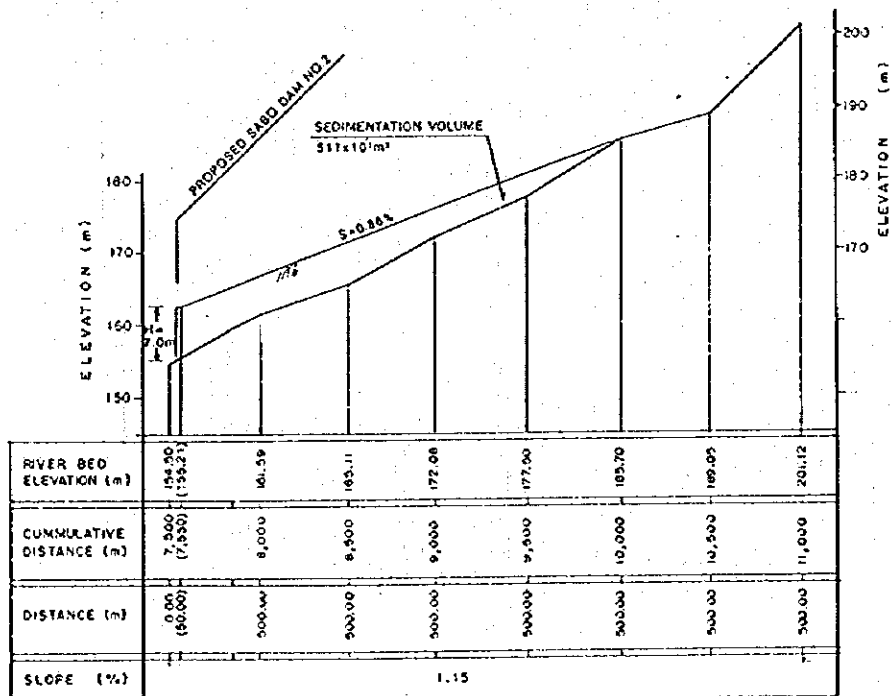
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Fig. I.30 (2)

Plan and Longitudinal Profile of Proposed Sabo
Dams(Labugaon River 1/2)



RIVER BED WIDTH (m)

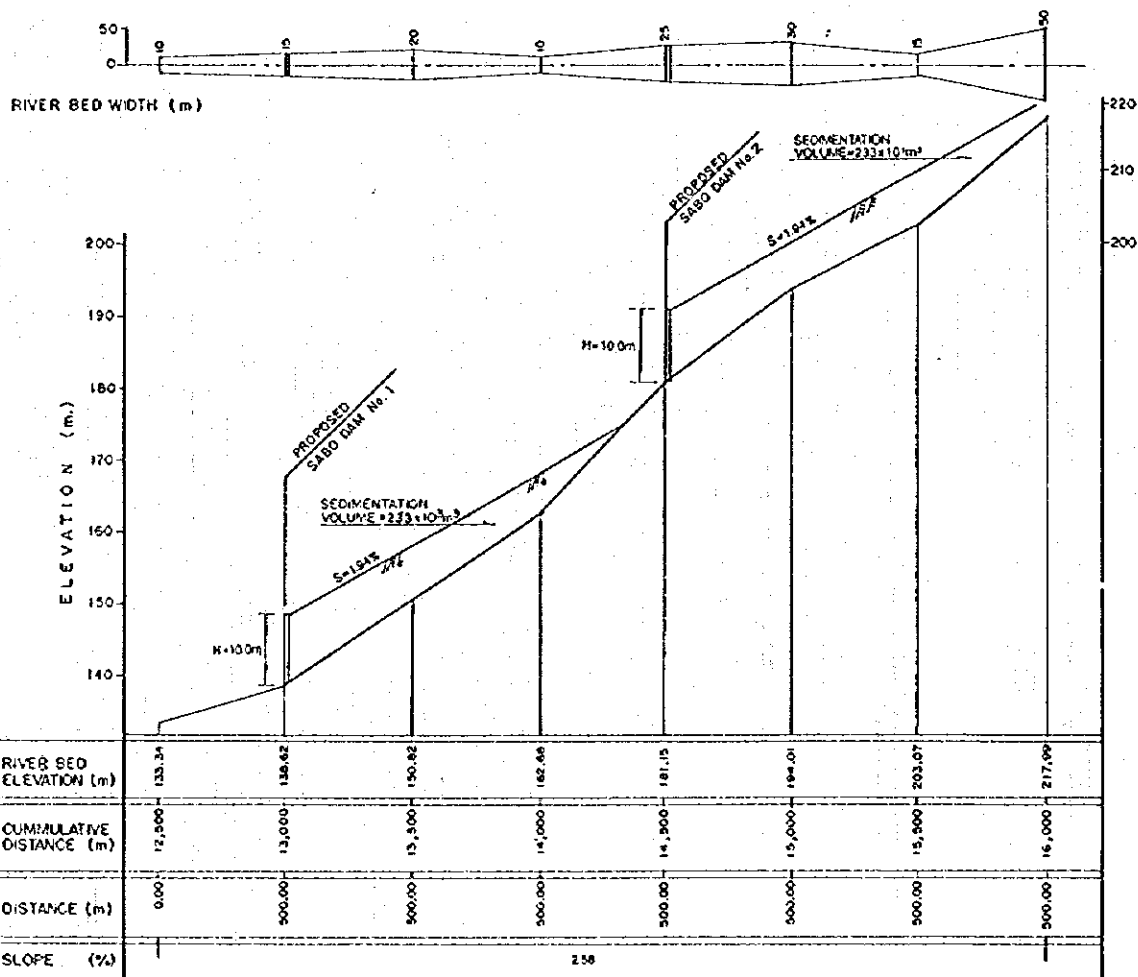
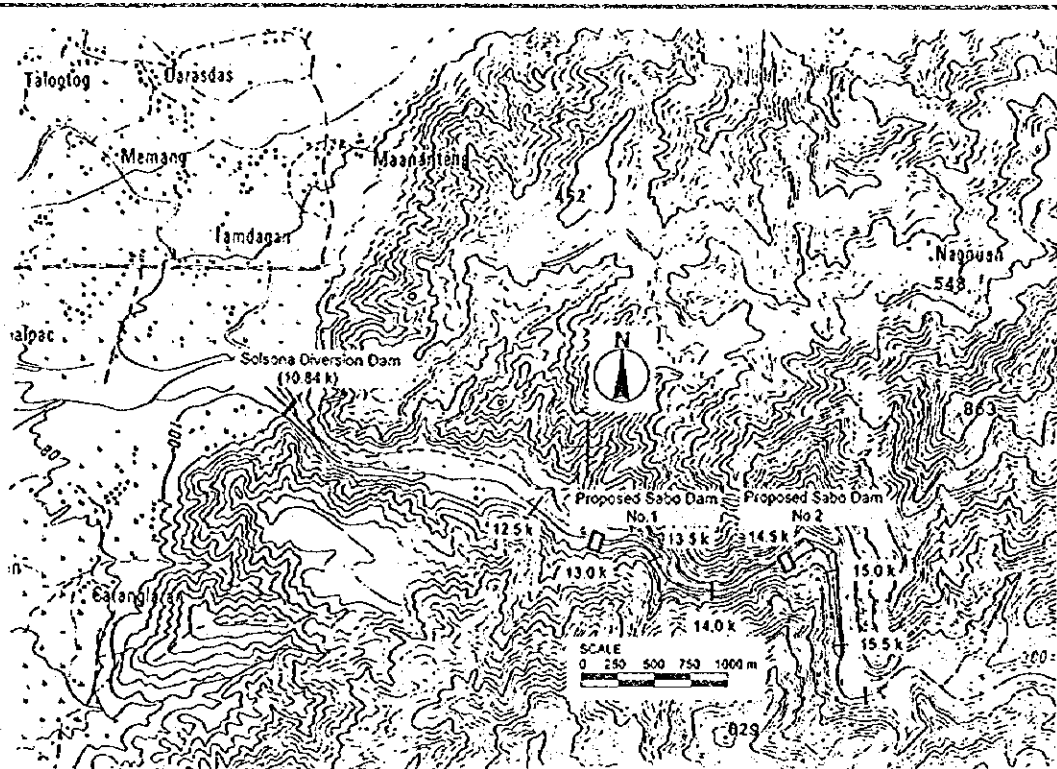


THE STUDY ON SABO AND FLOOD CONTROL
IN THE LAOAG RIVER BASIN

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Fig. I.30 (3)

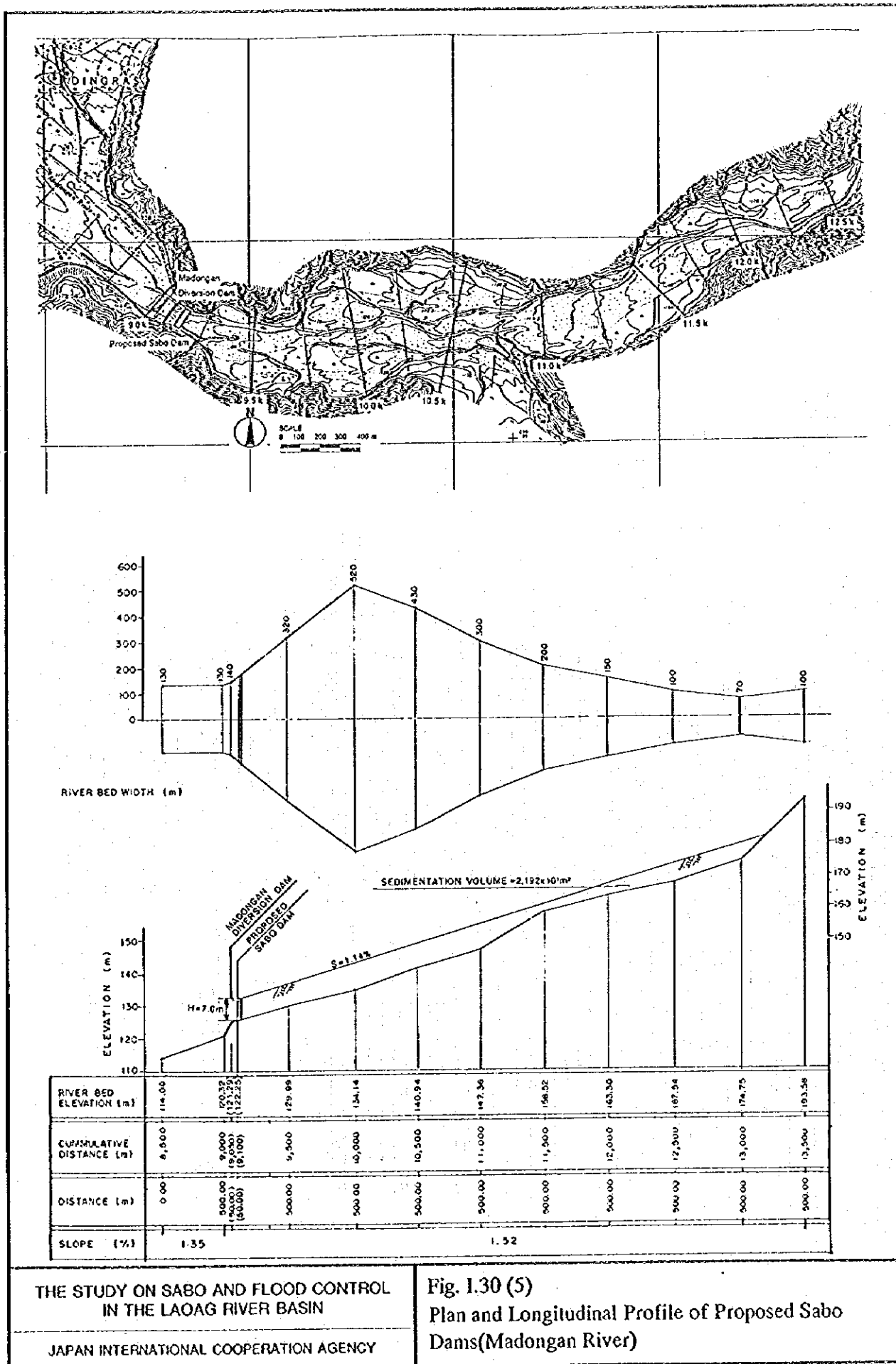
Plan and Longitudinal Profile of Proposed Sabo
Dams(Labugaon River 2/2)



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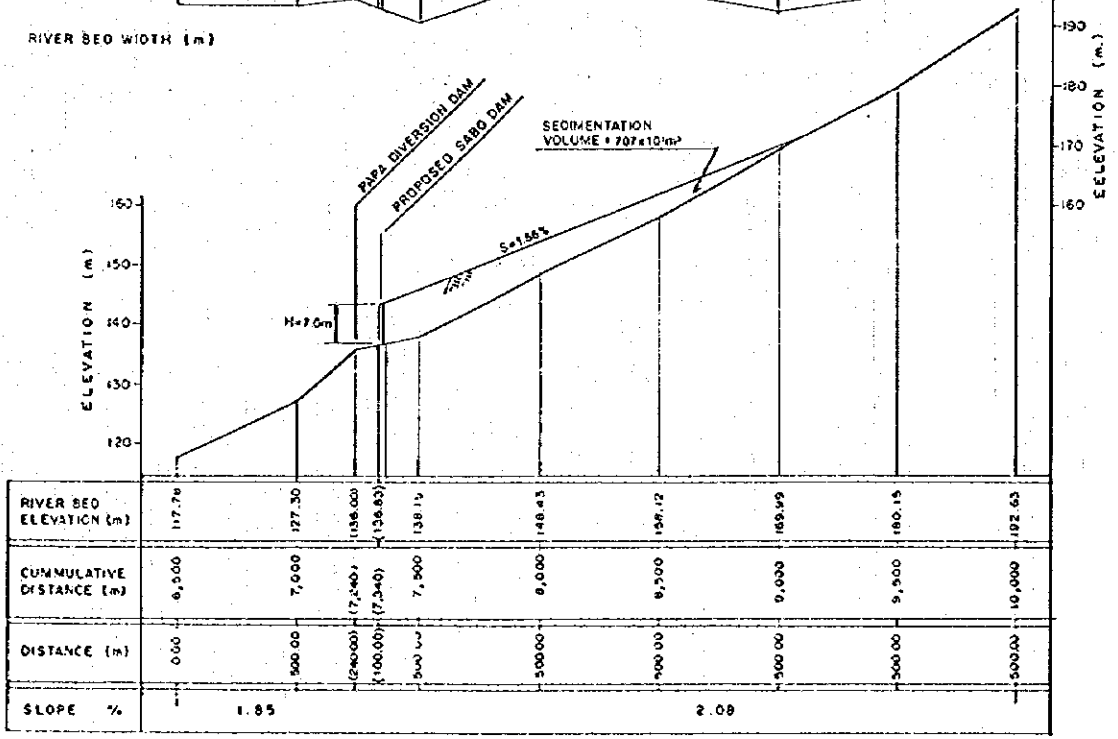
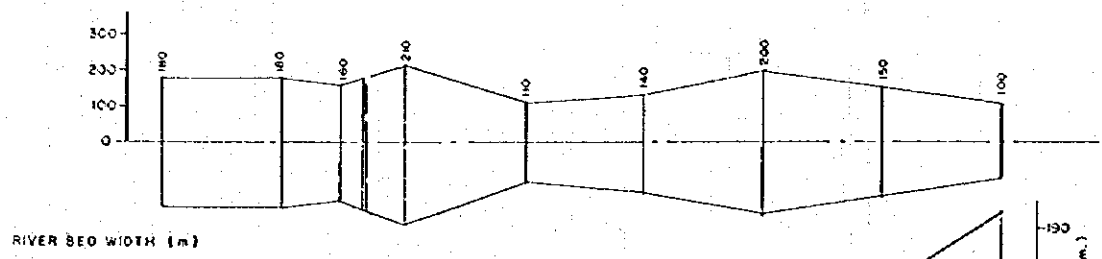
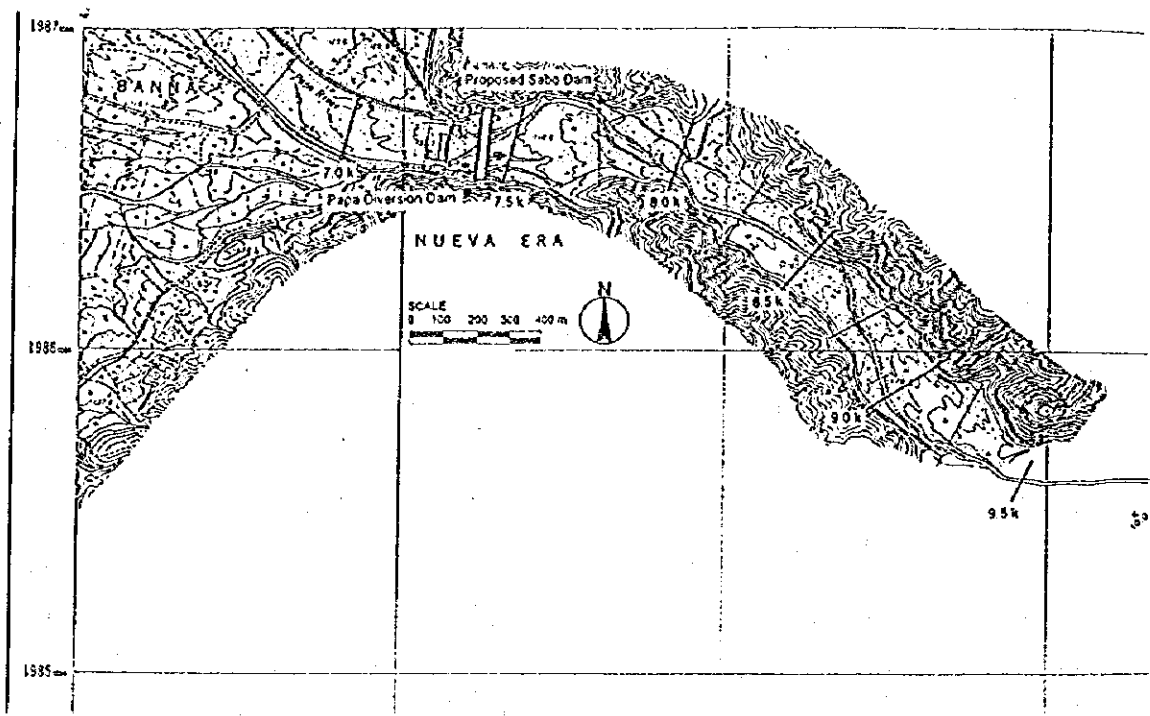
Fig. I.30 (4)
Plan and Longitudinal Profile of Proposed Sabo
Dams(Solsona River)



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IN THE LAOAG RIVER BASIN

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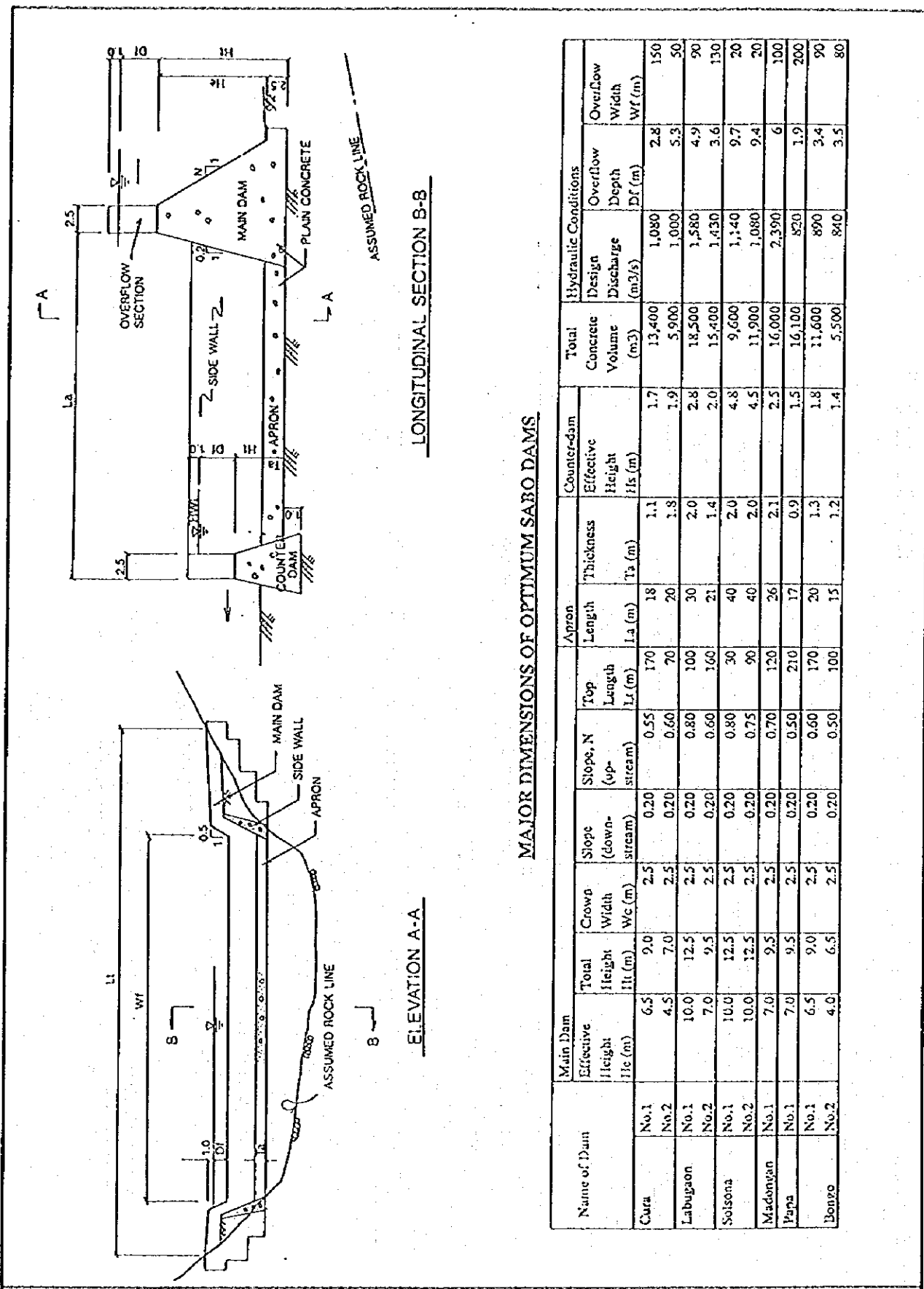
Fig. I.30 (5)
Plan and Longitudinal Profile of Proposed Sabo
Dams(Madongan River)



THE STUDY ON SABO AND FLOOD CONTROL
IN THE LAOAG RIVER BASIN

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Fig. I.30 (6)
Plan and Longitudinal Profile of Proposed Sabo
Dams(Papa River)



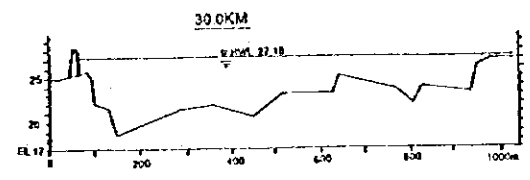
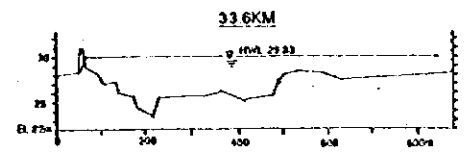
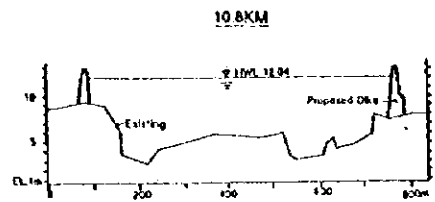
MAJOR DIMENSIONS OF OPTIMUM SABO DAMS

Name of Dam	Main Dam			Apron			Counter-dam		Hydraulic Conditions				
	Effective Height H_e (m)	Total Height H_t (m)	Crown Width W_c (m)	Slope (down-stream)	Slope, N (up-stream)	Top Length L_t (m)	Length L_a (m)	Thickness T_s (m)	Effective Height H_s (m)	Total Concrete Volume (m ³)	Design Discharge (m ³ /s)	Overflow Depth D_f (m)	Overflow Width W_f (m)
Cura	No.1	6.5	9.0	2.5	0.20	0.55	170	18	1.1	13,400	1,080	2.8	150
	No.2	4.5	7.0	2.5	0.20	0.60	70	20	1.8	5,900	1,000	5.3	50
Labugan	No.1	10.0	12.5	2.5	0.20	0.80	100	30	2.0	18,500	1,580	4.9	90
	No.2	7.0	9.5	2.5	0.20	0.60	160	21	1.4	15,400	1,430	3.6	130
Solisona	No.1	10.0	12.5	2.5	0.20	0.80	30	40	2.0	9,600	1,140	9.7	20
	No.2	10.0	12.5	2.5	0.20	0.75	90	40	2.0	11,900	1,080	9.4	20
Madonjan	No.1	7.0	9.5	2.5	0.20	0.70	120	26	2.1	16,000	2,390	6	100
	No.1	7.0	9.5	2.5	0.20	0.50	210	17	0.9	16,100	820	1.9	200
Papa	No.1	6.5	9.0	2.5	0.20	0.60	170	20	1.3	11,600	890	3.4	90
	No.2	4.0	6.5	2.5	0.20	0.50	100	15	1.2	5,500	840	3.5	80

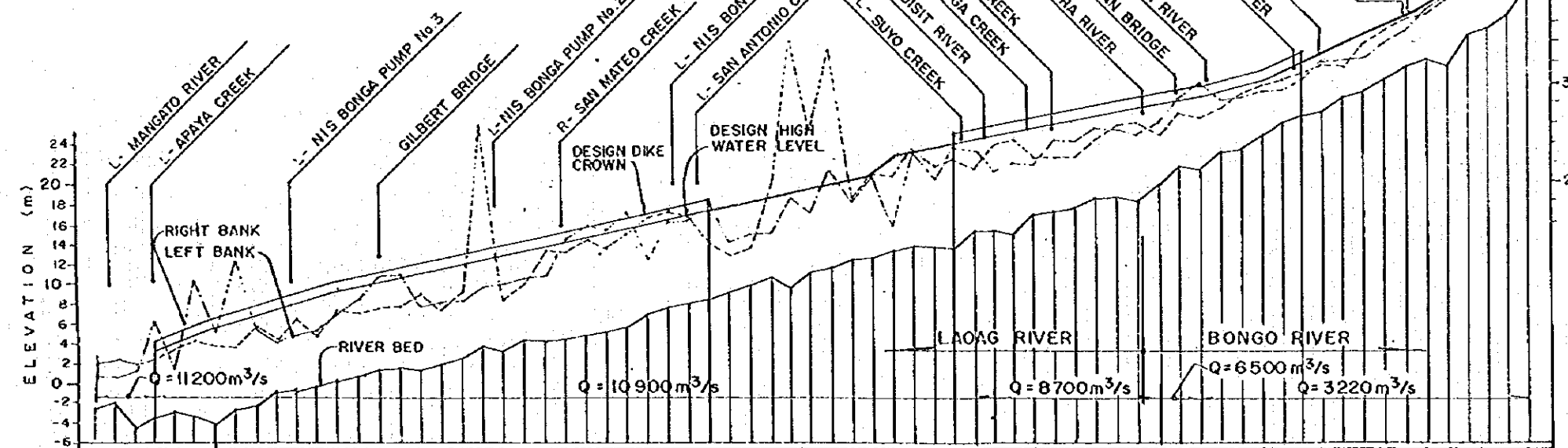
THE STUDY ON SABO AND FLOOD CONTROL IN THE LAOAG RIVER BASIN

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Fig. I.31 Structural Layout of Sabo Dams



CROSS SECTION



GRADIENT OF H.W.L.	1/750		1/1020		1/1316										1/345		1/1540		1/1100		1/657		1/495																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
DESIGN DIKE CROWN EL. (m)	4.44		6.84		H.W.L. + 1.0m										18.51		25.07		23.74		31.38		33.20		44.04																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
DESIGN HIGH WATER LEVEL (m)	3.44		5.84		13.51										17.51		16.07		22.74		21.38		23.20		34.04																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
RIGHT BANK ELEVATION (m)	0.62	0.79	1.43	6.32	4.24	5.04	5.61	6.43	7.02	7.60	8.19	8.79	9.30	9.76	10.22	10.67	11.13	11.58	12.04	12.49	12.95	13.41	13.86	14.32	14.77	15.23	15.69	16.14	16.60	17.05	17.51	17.97	18.42	18.88	19.33	19.79	20.25	20.70	21.16	21.61	22.07	22.52	22.98	23.43	23.89	24.34	24.80	25.25	25.71	26.16	26.62	27.07	27.53	27.98	28.44	28.89	29.35	29.80	30.26	30.71	31.17	31.62	32.08	32.53	32.99	33.44	33.90	34.35	34.81	35.26	35.72	36.17	36.63	37.08	37.54	37.99	38.45	38.90	39.36	39.81	40.27	40.72	41.18	41.63	42.09	42.54	43.00	43.45	43.91	44.36	44.82	45.27	45.73	46.18	46.64	47.09	47.55	48.00	48.46	48.91	49.37	49.82	50.28	50.73	51.19	51.64	52.10	52.55	53.01	53.46	53.92	54.37	54.83	55.28	55.74	56.19	56.65	57.10	57.56	58.01	58.47	58.92	59.38	59.83	60.29	60.74	61.20	61.65	62.11	62.56	63.02	63.47	63.93	64.38	64.84	65.29	65.75	66.20	66.66	67.11	67.57	68.02	68.48	68.93	69.39	69.84	70.30	70.75	71.21	71.66	72.12	72.57	73.03	73.48	73.94	74.39	74.85	75.30	75.76	76.21	76.67	77.12	77.58	78.03	78.49	78.94	79.40	79.85	80.31	80.76	81.22	81.67	82.13	82.58	83.04	83.49	83.95	84.40	84.86	85.31	85.77	86.22	86.68	87.13	87.59	88.04	88.50	88.95	89.41	89.86	90.32	90.77	91.23	91.68	92.14	92.59	93.05	93.50	93.96	94.41	94.87	95.32	95.78	96.23	96.69	97.14	97.60	98.05	98.51	98.96	99.42	99.87	100.33	100.78	101.24	101.69	102.15	102.60	103.06	103.51	103.97	104.42	104.88	105.33	105.79	106.24	106.70	107.15	107.61	108.06	108.52	108.97	109.43	109.88	110.34	110.79	111.25	111.70	112.16	112.61	113.07	113.52	113.98	114.43	114.89	115.34	115.80	116.25	116.71	117.16	117.62	118.07	118.53	118.98	119.44	119.89	120.35	120.80	121.26	121.71	122.17	122.62	123.08	123.53	123.99	124.44	124.90	125.35	125.81	126.26	126.72	127.17	127.63	128.08	128.54	128.99	129.45	129.90	130.36	130.81	131.27	131.72	132.18	132.63	133.09	133.54	134.00	134.45	134.91	135.36	135.82	136.27	136.73	137.18	137.64	138.09	138.55	139.00	139.46	139.91	140.37	140.82	141.28	141.73	142.19	142.64	143.10	143.55	144.01	144.46	144.92	145.37	145.83	146.28	146.74	147.19	147.65	148.10	148.56	149.01	149.47	149.92	150.38	150.83	151.29	151.74	152.20	152.65	153.11	153.56	154.02	154.47	154.93	155.38	155.84	156.29	156.75	157.20	157.66	158.11	158.57	159.02	159.48	159.93	160.39	160.84	161.30	161.75	162.21	162.66	163.12	163.57	164.03	164.48	164.94	165.39	165.85	166.30	166.76	167.21	167.67	168.12	168.58	169.03	169.49	169.94	170.40	170.85	171.31	171.76	172.22	172.67	173.13	173.58	174.04	174.49	174.95	175.40	175.86	176.31	176.77	177.22	177.68	178.13	178.59	179.04	179.50	179.95	180.41	180.86	181.32	181.77	182.23	182.68	183.14	183.59	184.05	184.50	184.96	185.41	185.87	186.32	186.78	187.23	187.69	188.14	188.60	189.05	189.51	189.96	190.42	190.87	191.33	191.78	192.24	192.69	193.15	193.60	194.06	194.51	194.97	195.42	195.88	196.33	196.79	197.24	197.70	198.15	198.61	199.06	199.52	199.97	200.43	200.88	201.34	201.79	202.25	202.70	203.16	203.61	204.07	204.52	204.98	205.43	205.89	206.34	206.80	207.25	207.71	208.16	208.62	209.07	209.53	209.98	210.44	210.89	211.35	211.80	212.26	212.71	213.17	213.62	214.08	214.53	214.99	215.44	215.90	216.35	216.81	217.26	217.72	218.17	218.63	219.08	219.54	219.99	220.45	220.90	221.36	221.81	222.27	222.72	223.18	223.63	224.09	224.54	225.00	225.45	225.91	226.36	226.82	227.27	227.73	228.18	228.64	229.09	229.54	230.00	230.45	230.91	231.36	231.82	232.27	232.73	233.18	233.64	234.09	234.55	235.00	235.46	235.91	236.37	236.82	237.28	237.73	238.19	238.64	239.10	239.55	240.01	240.46	240.92	241.37	241.83	242.28	242.74	243.19	243.64	244.10	244.55	245.01	245.46	245.92	246.37	246.83	247.28	247.74	248.19	248.65	249.10	249.56	250.01	250.47	250.92	251.38	251.83	252.29	252.74	253.20	253.65	254.11	254.56	255.02	255.47	255.93	256.38	256.84	257.29	257.75	258.20	258.66	259.11	259.57	260.02	260.48	260.93	261.39	261.84	262.30	262.75	263.21	263.66	264.12	264.57	265.03	265.48	265.94	266.39	266.85	267.30	267.76	268.21	268.67	269.12	269.58	270.03	270.49	270.94	271.40	271.85	272.31	272.76	273.22	273.67	274.13	274.58	275.04	275.49	275.95	276.40	276.86	277.31	277.77	278.22	278.68	279.13	279.59	280.04	280.50	280.95	281.41	281.86	282.32	282.77	283.23	283.68	284.14	284.59	285.05	285.50	285.96	286.41	286.87	287.32	287.78	288.23	288.69	289.14	289.60	290.05	290.51	290.96	291.42	291.87	292.33	292.78	293.24	293.69	294.15	294.60	295.06	295.51	295.97	296.42	296.88	297.33	297.79	298.24	298.70	299.15	299.61	300.06	300.52	300.97	301.43	301.88	302.34	302.79	303.25	303.70	304.16	304.61	305.07	305.52	305.98	306.43	306.89	307.34	307.80	308.25	308.71	309.16	309.62	310.07	310.53	310.98	311.44	311.89	312.35	312.80	313.26	313.71	314.17	314.62	315.08	315.53	315.99	316.44	316.90	317.35	317.81	318.26	318.72	319.17	319.63	320.08	320.54	320.99	321.45	321.90	322.36	322.81	323.27	323.72	324.18	324.63	325.09	325.54	326.00	326.45	326.91	327.36	327.82	328.27	328.73	329.18	329.64	330.09	330.55	331.00	331.46	331.91	332.37	332.82	333.28	333.73	334.19	334.64	335.10	335.55	336.01	336.46	336.92	337.37	337.83	338.28	338.74	339.19	339.64	340.10	340.55	341.01	341.46	341.92	342.37	342.83	343.28	343.74	344.19	344.65	345.10	345.56	346.01	346.47	346.92	347.38	347.83	348.29	348.74	349.20	349.65	350.11	350.56	351.02	351.47	351.93	352.38	352.84	353.29	353.75	354.20	354.66	355.11	355.57	356.02	356.48	356.93	357.39	357.84	358.30	358.75	359.21	359.66	360.12	360.57	361.03	361.48	361.94	362.39	362.85	363.30	363.76	364.21	364.67	365.12	365.58	366.03	366.49	366.94	367.40	367.85	368.31	368.76	369.22	369.67	370.13	370.58	371.04	371.49	371.95	372.40	372.86	373.31	373.77	374.22	374.68	375.13	375.59	376.04	376.50	376.95	377.41	377.86	378.32	378.77	379.23	379.68	380.14	380.59	381.05	381.50	381.96	382.41	382.87	383.32	383.78	384.23	384.69	385.14	385.60	386.05	386.51	386.96	387.42	387.87	388.33	388.78	389.24	389.69	390.15	390.60	391.06	391.51	391.97	392.42	392.88	393.33	393.79	394.24	394.70	395.15	395.61	396.06	396.52	396.97	397.43	397.88	398.34	398.79	399.25	399.70	400.16	400.61	401.07	401.52	401.98	402.43	402.89	403.34	403.80	404.25	404.71	405.16	405.62	406.07	406.53	406.98	407.44	407.89	408.35	408.80	409.26	409.71	410.17	410.62	411.08	411.53	411.99	412.44	412.90	413.35	413.81	414.26	414.72	415.17	415.63	416.08	416.54	416.99	417.45	417.90	418.36	418.81	419.27	419.72	420.18	420.63	421.09	421.54	422.00	422.45	422.91	423.36	423.82	424.27	424.73	425.18	425.64	426.09	426.55	427.00	427.46	427.91	428.37	428.82	429.28	429.73	430.19	430.64	431.10	431.55	432.01	432.46	432.92	433.37	433.83	434.28	434.74	435.19	435.65	436.10	436.56	437.01	437.47	437.92	438.38	438.83	439.29	439.74	440.20	440.65	441.11	441.56	442.02	442.47	442.93	443.38	443.84	444.29	444.75	445.20	445.66	446.11	446.57	447.02	447.48	447.93	448.39	448.84	449.30	449.75	450.21	450.66	451.12	451.57	452.03	452.48	452.94	453.39	453.85	454.30	454.76	455.21	455.67	456.12	456.58	457.03	457.49	457.94	458.40	458.85	459.31	459.76	460.22	460.67	461.13	461.58	462.04	462.49	462.95	463.40	463.86	464.31	464.77	465.22	465.68	466.13	466.59	467.04	467.50	467.95	468.41	468.86	469.32	469.77	470.23	470.68	471.14	471.59	472.05	472.50	472.96	473.41	473.87	474.32	474.78	475.23	475.69	476.14	476.60	477.05	477.51	477.96	478.42	478.87	479.33	479.78	480.24	480.69	481.15	481.60	482.06	482.51	482.97	483.42	483.88	484.33	484.79	485.24	485.70	486.15	486.61	487.06	487.52	487.97	488.43	488.88	489.34	489.79	490.25	490.70	491.16	491.61	492.07	492.52

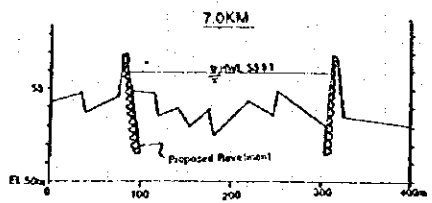
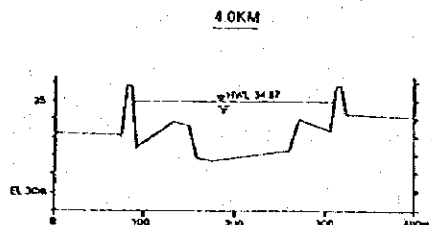
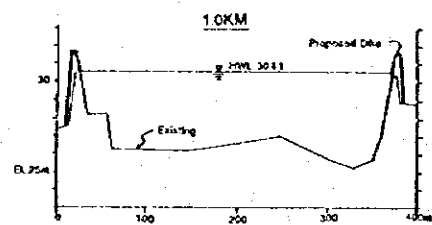
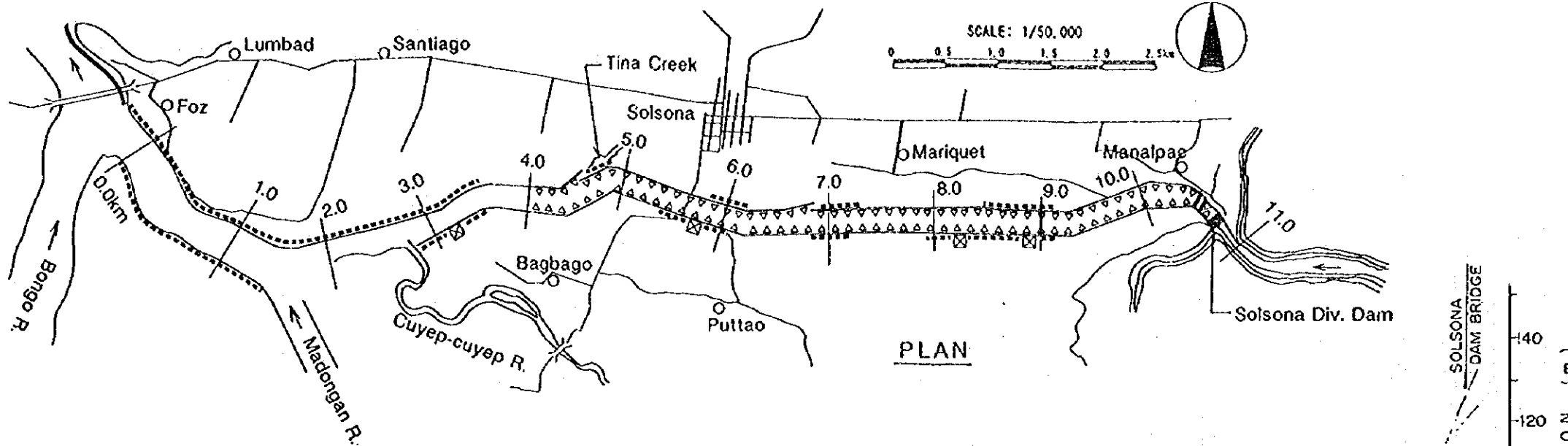
LEGEND:

(Existing)

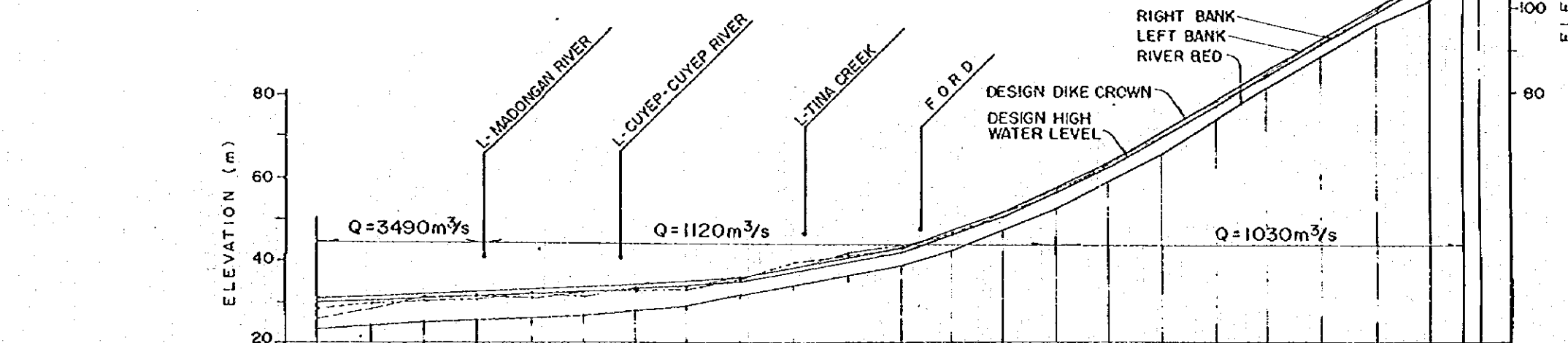
- : Dike
- ▬ : Diversion Dam
- : Bridge

(Proposed)

- : Dike
- : Heightening of Existing Dike
- △-△-△ : Slope and Toe Protection
- ⊠ : Sluiceway
- : Groundsill
- ||||| : Spurdike
- : Bridge Extension
- : Reconstruction



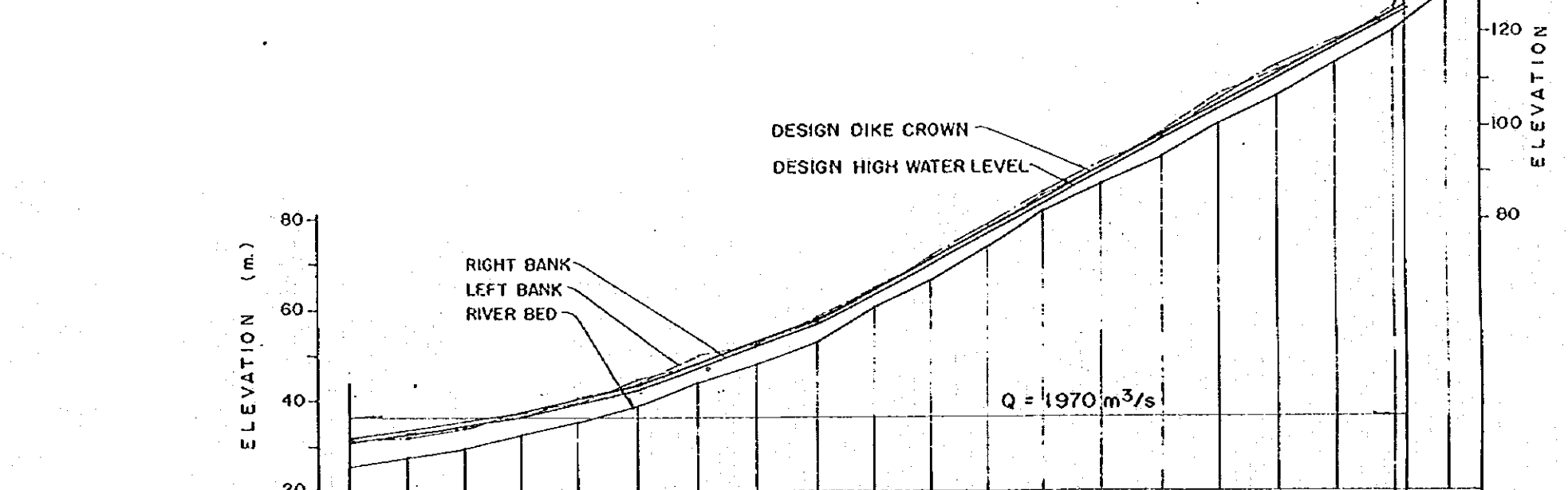
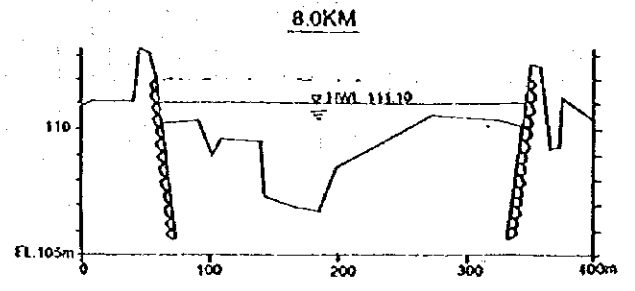
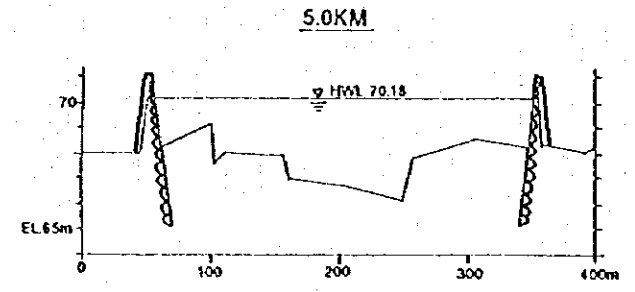
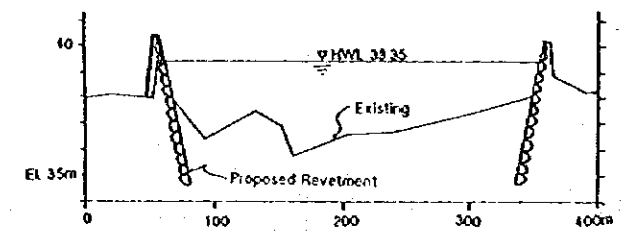
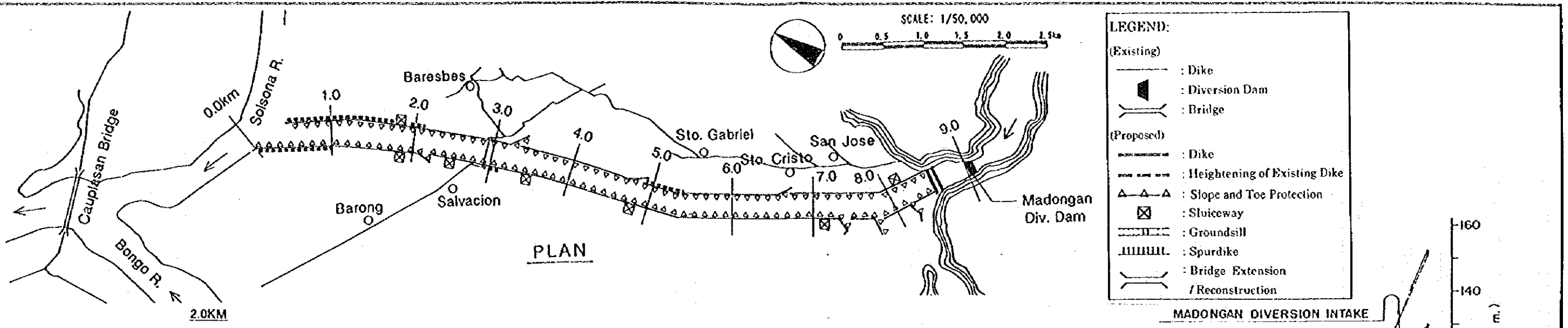
CROSS SECTION



GRADIENT OF H.W.L.	1 / 1100			1 / 410		1 / 195		1 / 130		1 / 90		1 / 67	
DESIGN DIKE CROWN EL. (m)	30.70	31.15	31.61	32.06	33.43	34.65	35.87	38.43	40.99	43.56	47.40	51.23	56.81
DESIGN HIGH WATER LEVEL (m)	29.70	30.15	30.61	31.06	32.43	33.65	34.87	37.43	39.99	42.56	46.40	50.23	55.81
RIGHT BANK ELEVATION (m)	28.60	29.95	30.25	30.58	31.37	31.34	31.97	32.97	33.76	34.81	41.28	43.43	46.32
LEFT BANK ELEVATION (m)	26.49	28.72	30.78	31.32	30.78	32.62	32.79	33.56	35.91	39.25	40.92	43.38	46.77
RIVER BED ELEVATION (m)	23.24	24.14	25.12	25.30	26.25	27.16	28.37	29.64	31.70	34.32	36.68	38.70	42.54
ACCUMULATED DISTANCE (m.)	0	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000
DISTANCE (m.)	0	500	500	500	500	500	500	500	500	500	500	500	500

LONGITUDINAL PROFILE

THE STUDY ON SABO AND FLOOD CONTROL IN THE LAOAG RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. I.32 (3) River Improvement Plan (Solsona River)
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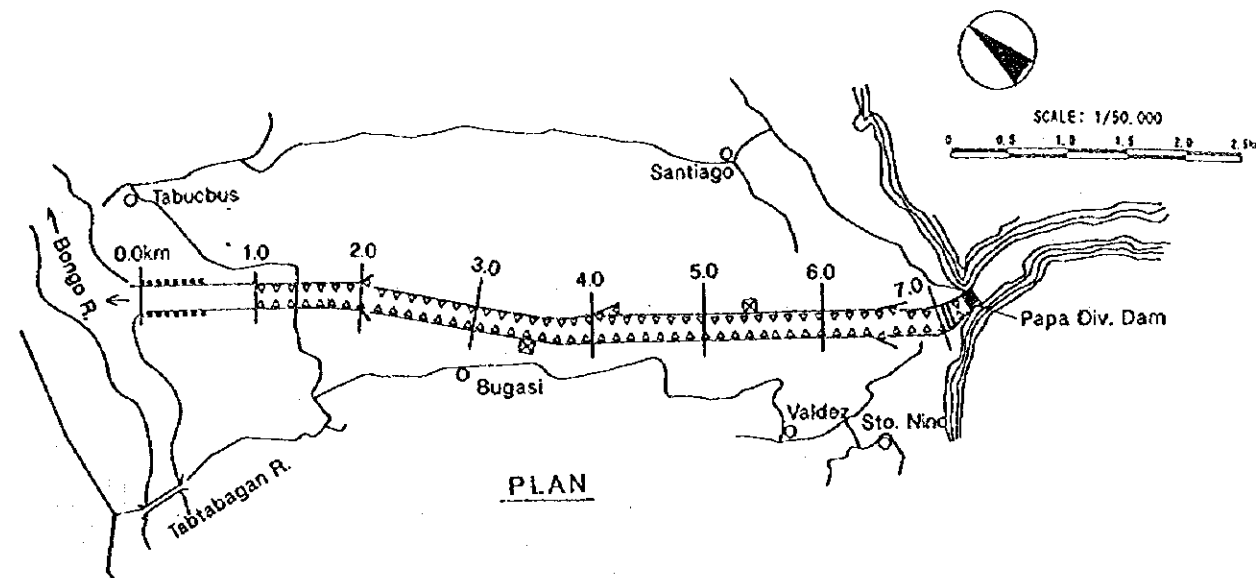


GRADIENT OF H.W.L.	1/285		1/165		1/105		1/74		1/72	
DESIGN DIKE CROWN EL. (m)	32.06	33.81	35.57	37.32	39.08	40.83	42.58	44.33	46.08	47.83
DESIGN HIGH WATER LEVEL (m)	31.06	32.81	34.57	36.32	38.08	39.83	41.58	43.33	45.08	46.83
RIGHT BANK ELEVATION (m)	30.83	32.59	34.35	36.11	37.87	39.63	41.39	43.15	44.91	46.67
LEFT BANK ELEVATION (m)	30.95	31.93	32.91	33.89	34.87	35.85	36.83	37.81	38.79	39.77
RIVER BED ELEVATION (m)	25.36	27.60	29.84	32.08	34.32	36.56	38.80	41.04	43.28	45.52
ACCUMULATED DISTANCE (m.)	0	500	1000	1500	2000	2500	3000	3500	4000	4500
DISTANCE (m.)	0	500	500	500	500	500	500	500	500	500

LONGITUDINAL PROFILE

THE STUDY ON SABO AND FLOOD CONTROL
IN THE LAOAG RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. I.32 (4)
River Improvement Plan (Madongan River)



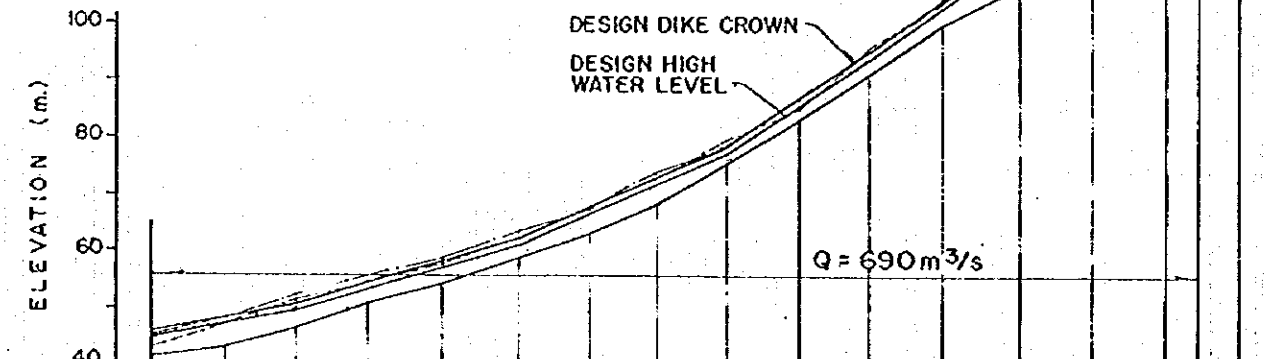
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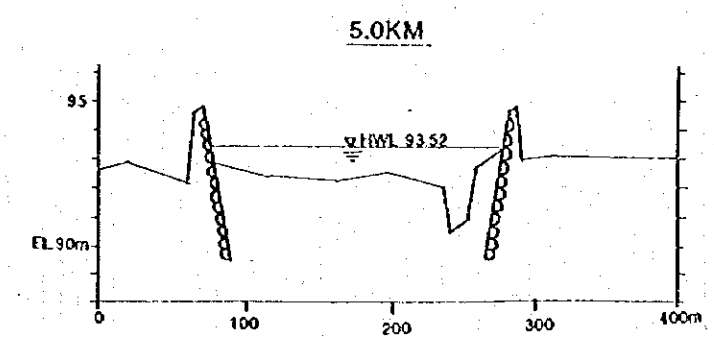
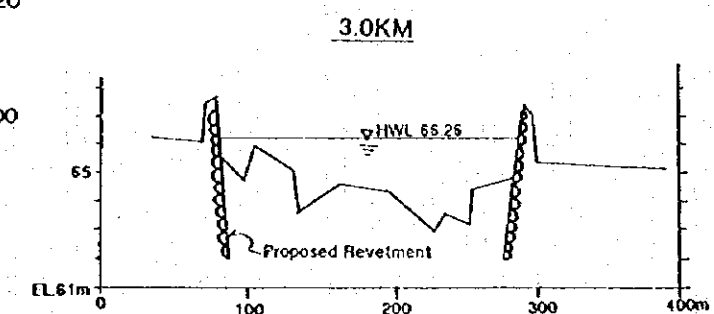
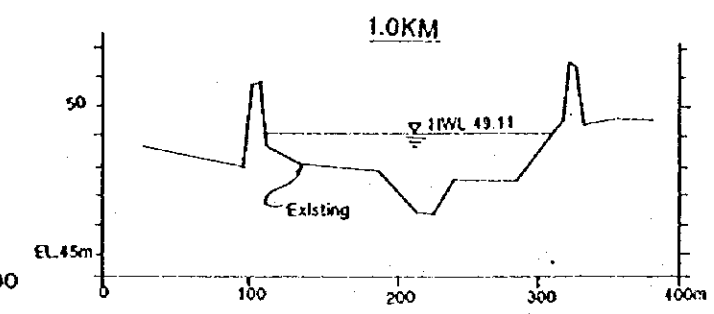
- : Dike
- : Diversion Dam
- : Bridge

(Proposed)

- : Dike
- : Heightening of Existing Dike
- : Slope and Toe Protection
- : Sluiceway
- : Groundsill
- : Spurdike
- : Bridge Extension
- : Reconstruction



GRADIENT OF H.W.L.	1/230	1/128	1/92	1/61	1/55
DESIGN DIKE CROWN EL. (m)	44.76-45.76	46.93-47.93	49.11-50.11	53.01-54.01	56.92-57.92
DESIGN HIGH WATER LEVEL (m)	44.76-45.76	46.93-47.93	49.11-50.11	53.01-54.01	56.92-57.92
RIGHT BANK ELEVATION (m)	45.12-46.12	47.06-48.06	49.11-50.11	53.14-54.14	57.53-58.53
LEFT BANK ELEVATION (m)	42.89-43.89	47.26-48.26	50.82-51.82	54.79-55.79	59.09-60.09
RIVER BED ELEVATION (m)	41.00-42.00	43.31-44.31	46.21-47.21	50.65-51.65	54.30-55.30
ACCUMULATED DISTANCE (m.)	0	500	1000	1500	2000
DISTANCE (m.)	0	500	500	500	500

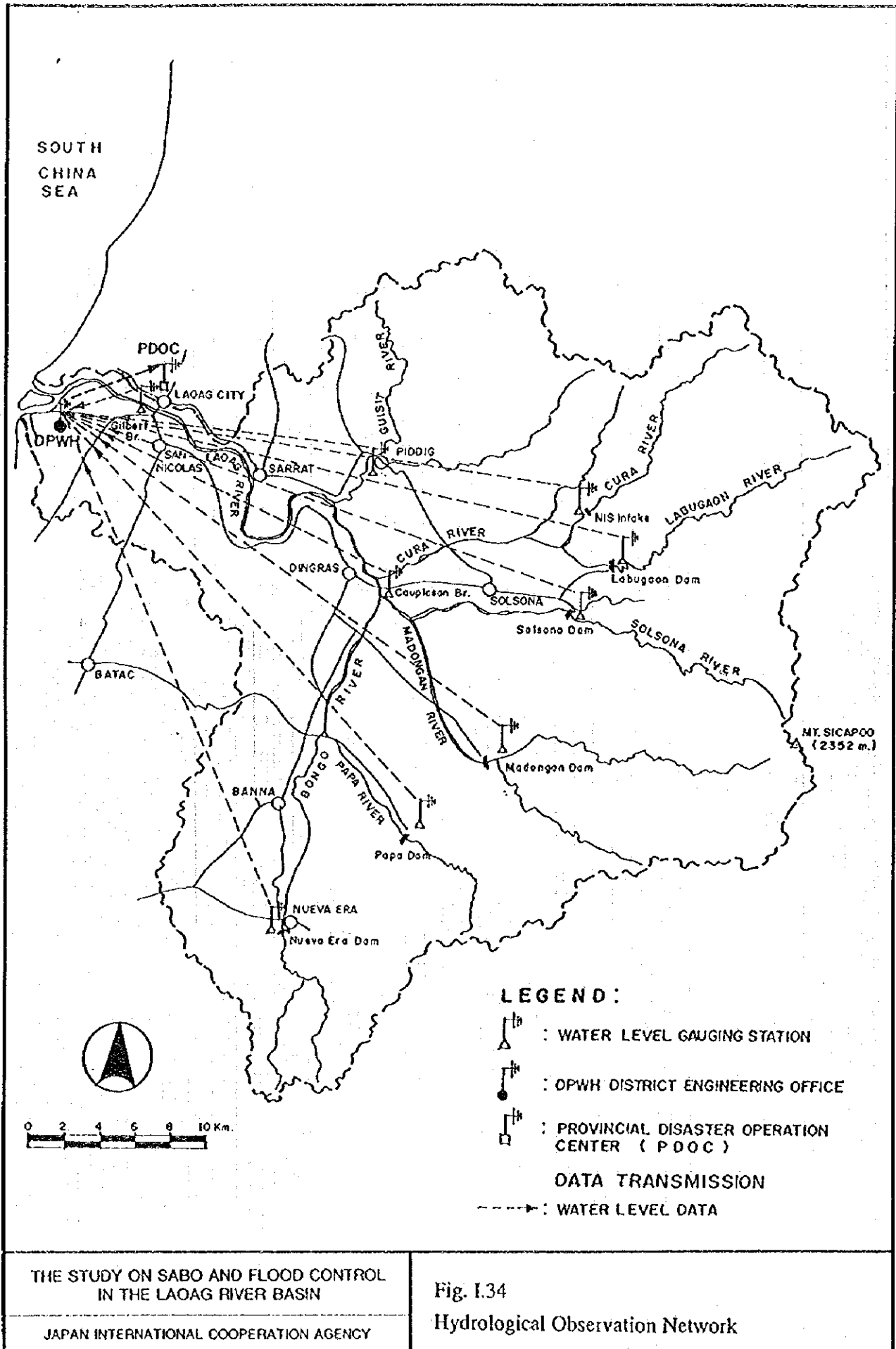


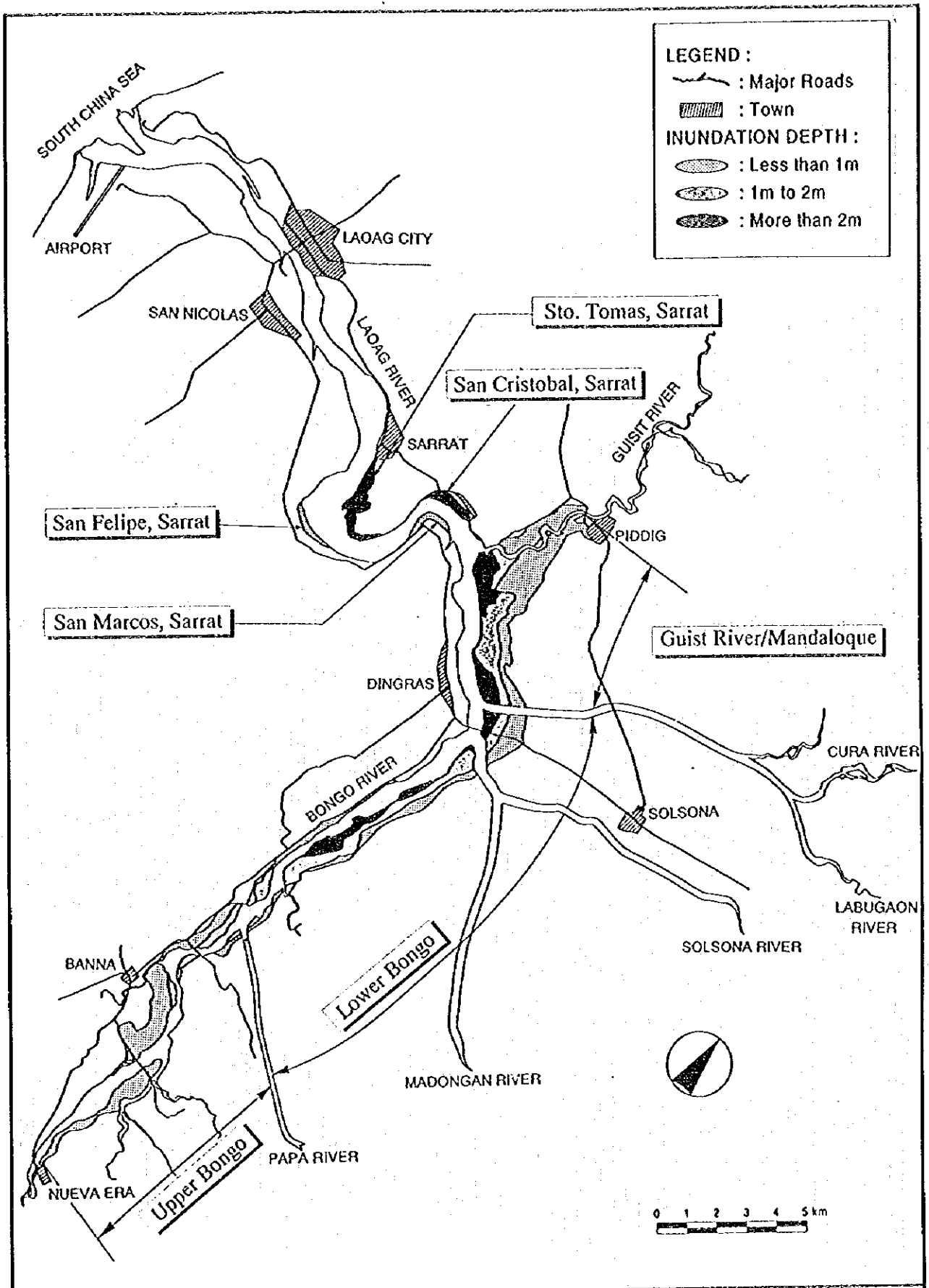
CROSS SECTION

LONGITUDINAL PROFILE

THE STUDY ON SABO AND FLOOD CONTROL
IN THE LAOAG RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. I.32 (5)
River Improvement Plan (Papa River)





THE STUDY ON SABO AND FLOOD CONTROL
 IN THE LAOAG RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. I.35
 Location of Unprotected Flood Area