

FIGURES

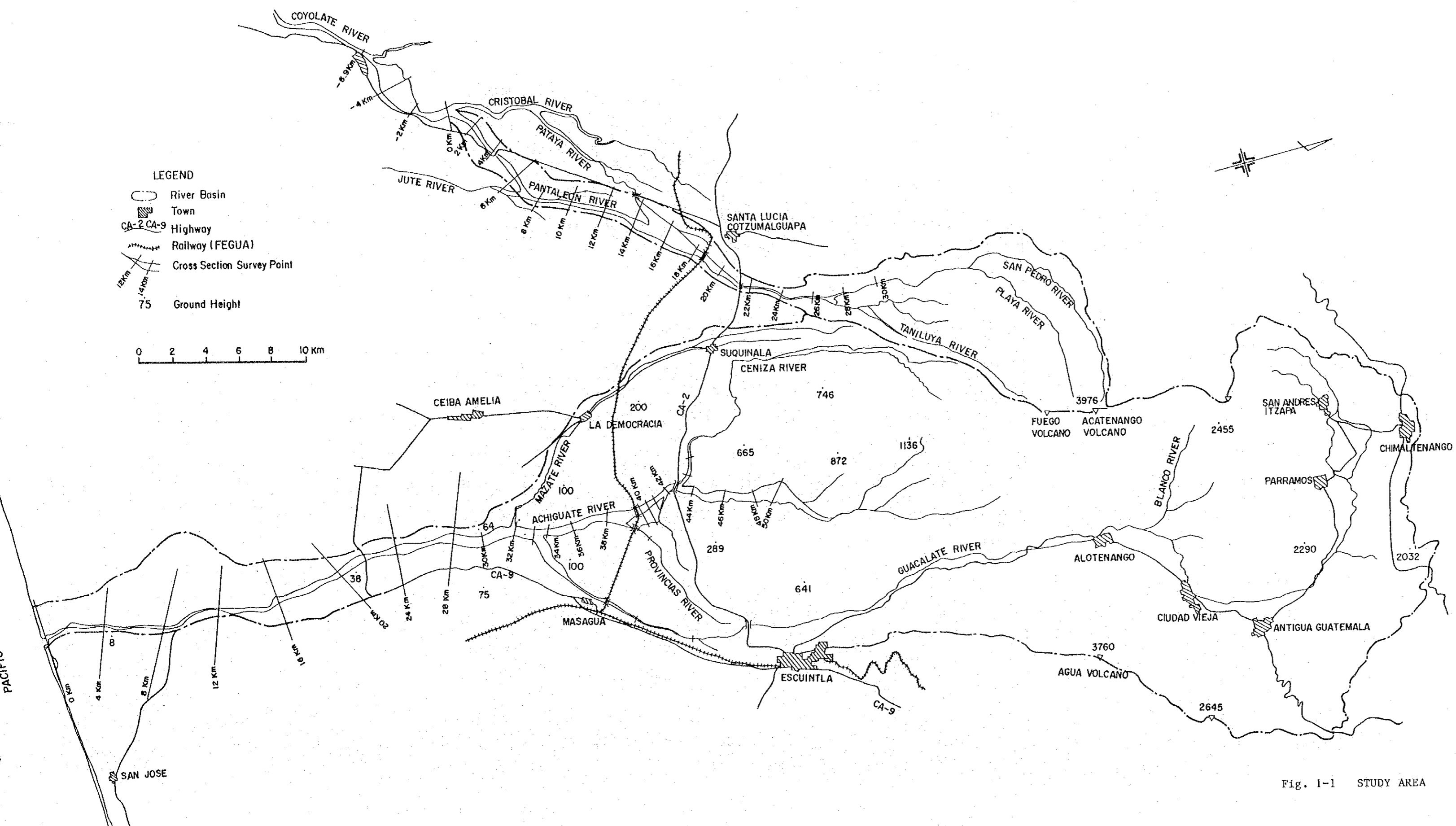


Fig. 1-1 STUDY AREA

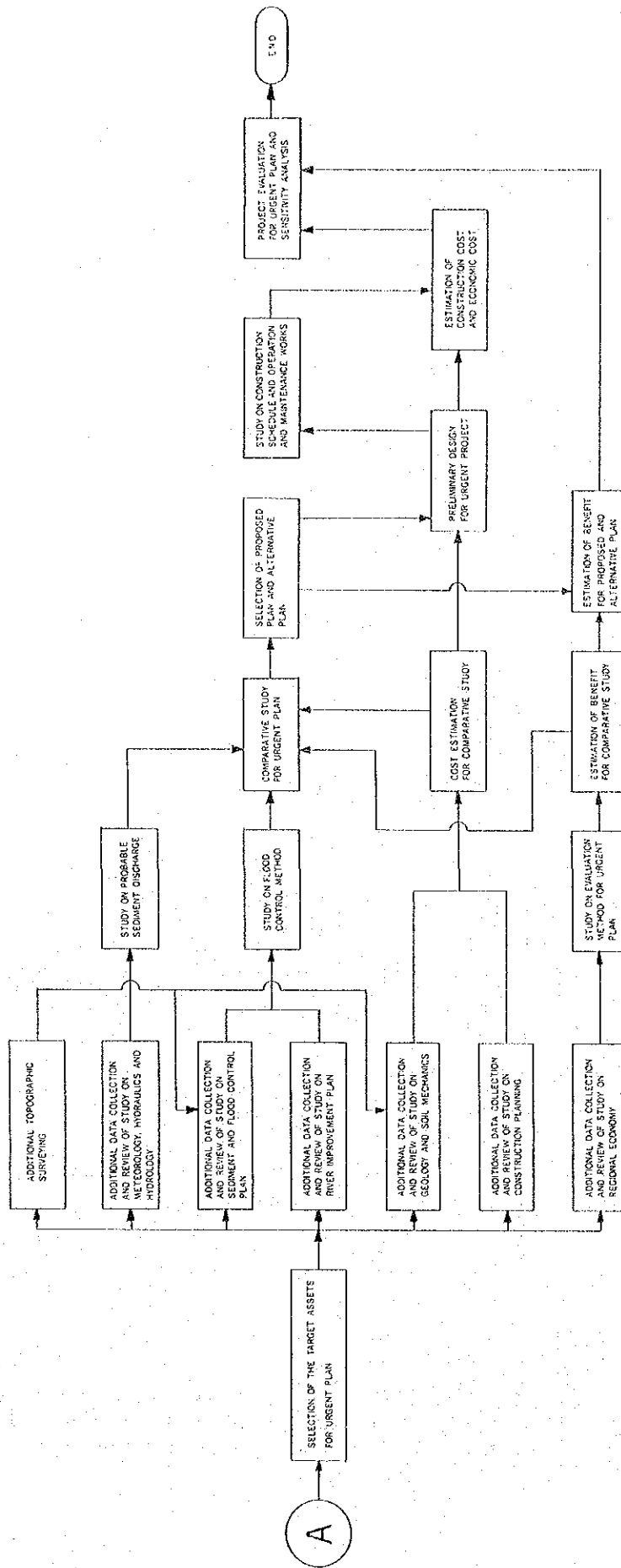


Fig. 1-2 (2/2) STUDY PROCEDURE (URGENT PLAN)

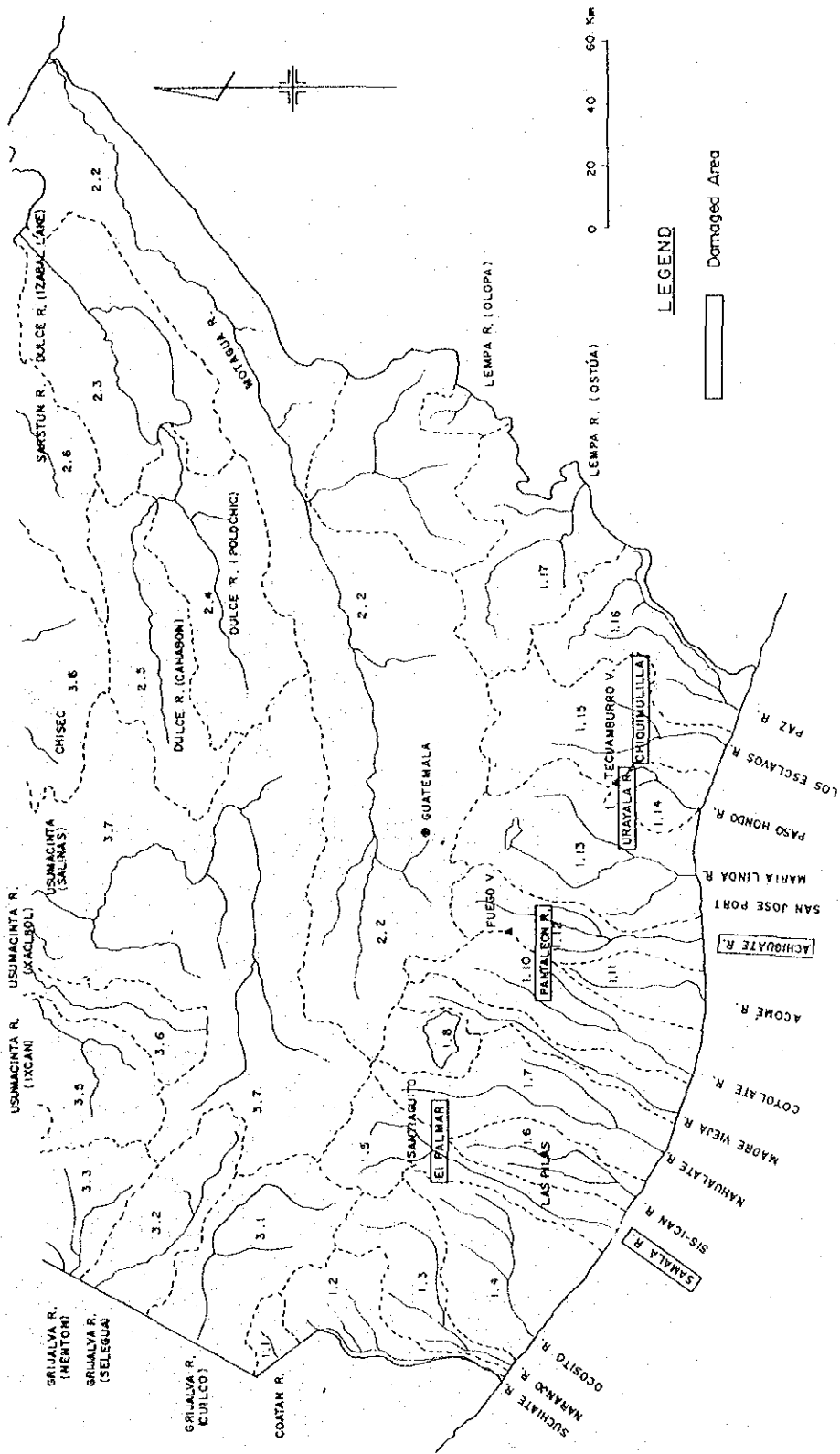
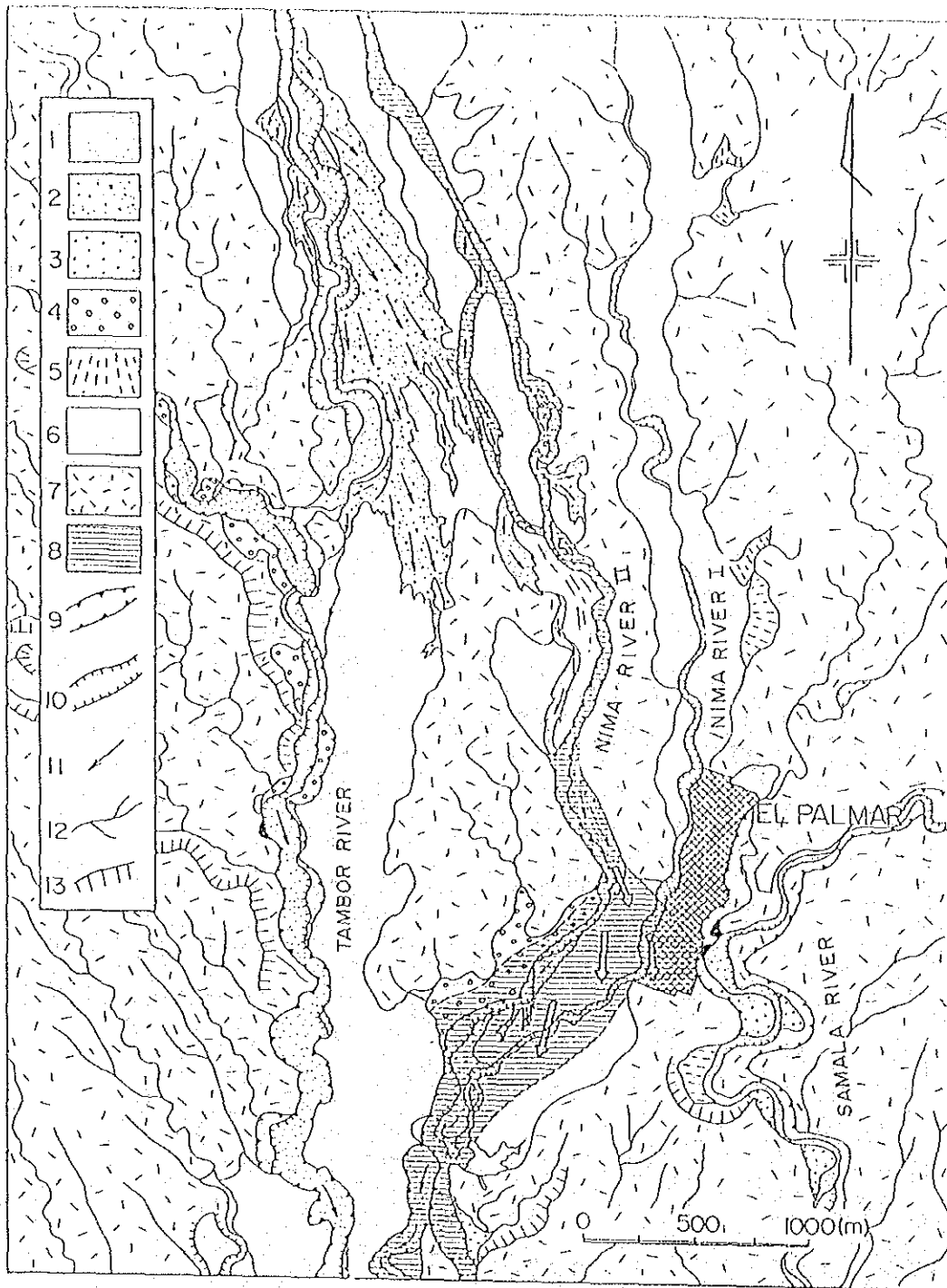


Fig. 2-1 LOCATION OF DAMAGED AREA IN GUATEMALA



- | | | |
|---------------------|--|------------------|
| 1: Recent riverbed | 2: Recent debris flow deposits | 3: Lower terrace |
| 4: Middle terrace | 5: Talus | 6: Volcanic fan |
| 7: Mountain slope | 8: Debris flow deposits in June-July, 1983 | 9: Gully (deep) |
| 10: Gully (shallow) | 11: Direction of debris flow | 12: Stream |
| 13: Cliff | | |

Fig. 2-2 DAMAGED AREA OF EL PALMAR AND GEOMORPHOLOGICAL CONDITION

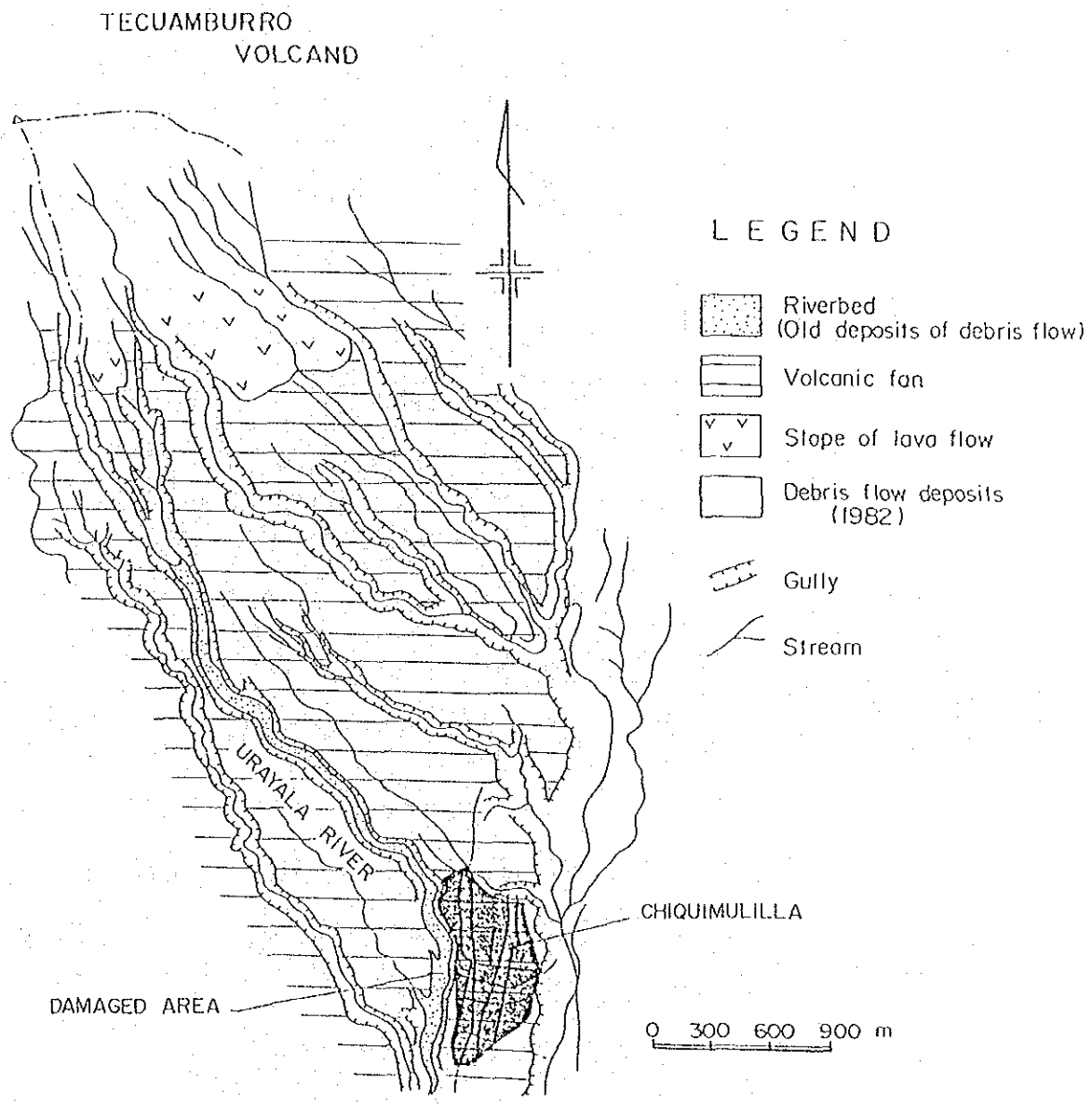


Fig. 2-3 DAMAGED AREA OF CHIQUIMULILLA AND GEOMORPHOLOGICAL CONDITION

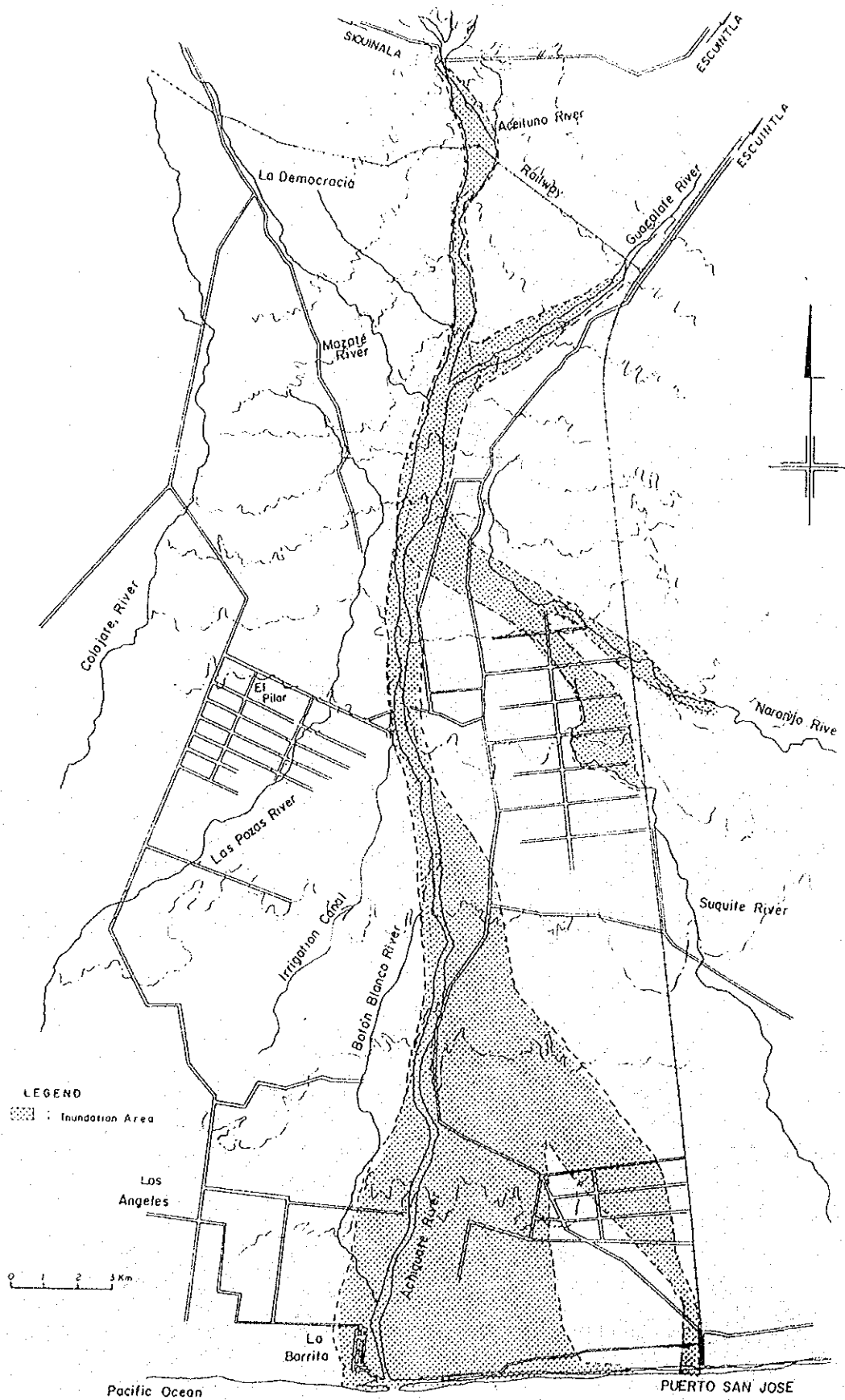


Fig. 3-1 (1/2) INUNDATION MAP OF THE FLOOD IN SEP. 1969 (ACHIGUATE RIVER)

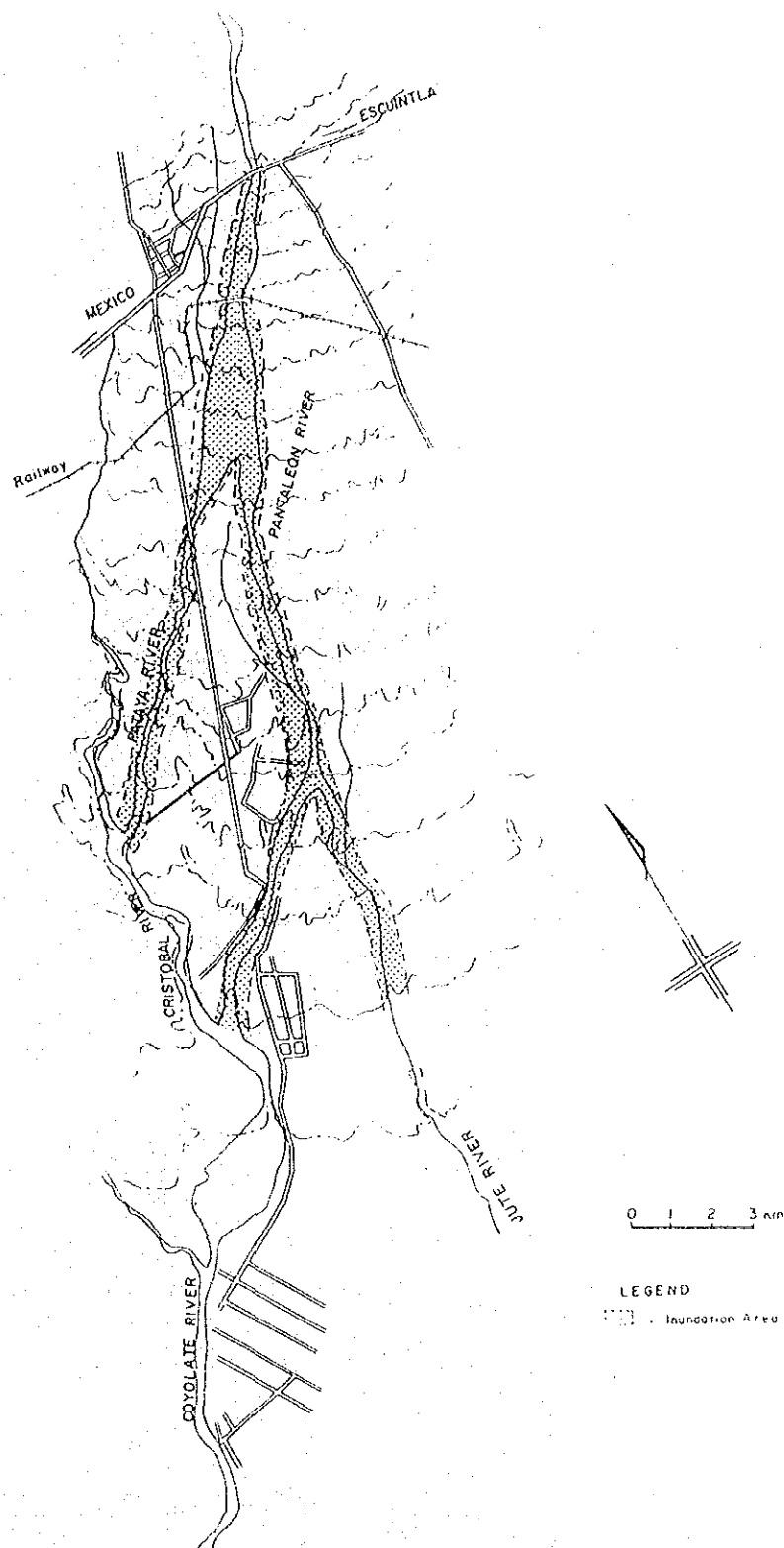


Fig. 3-1 (2/2) INUNDATION MAP OF THE FLOOD IN SEP. 1969
(PANTALEON RIVER)

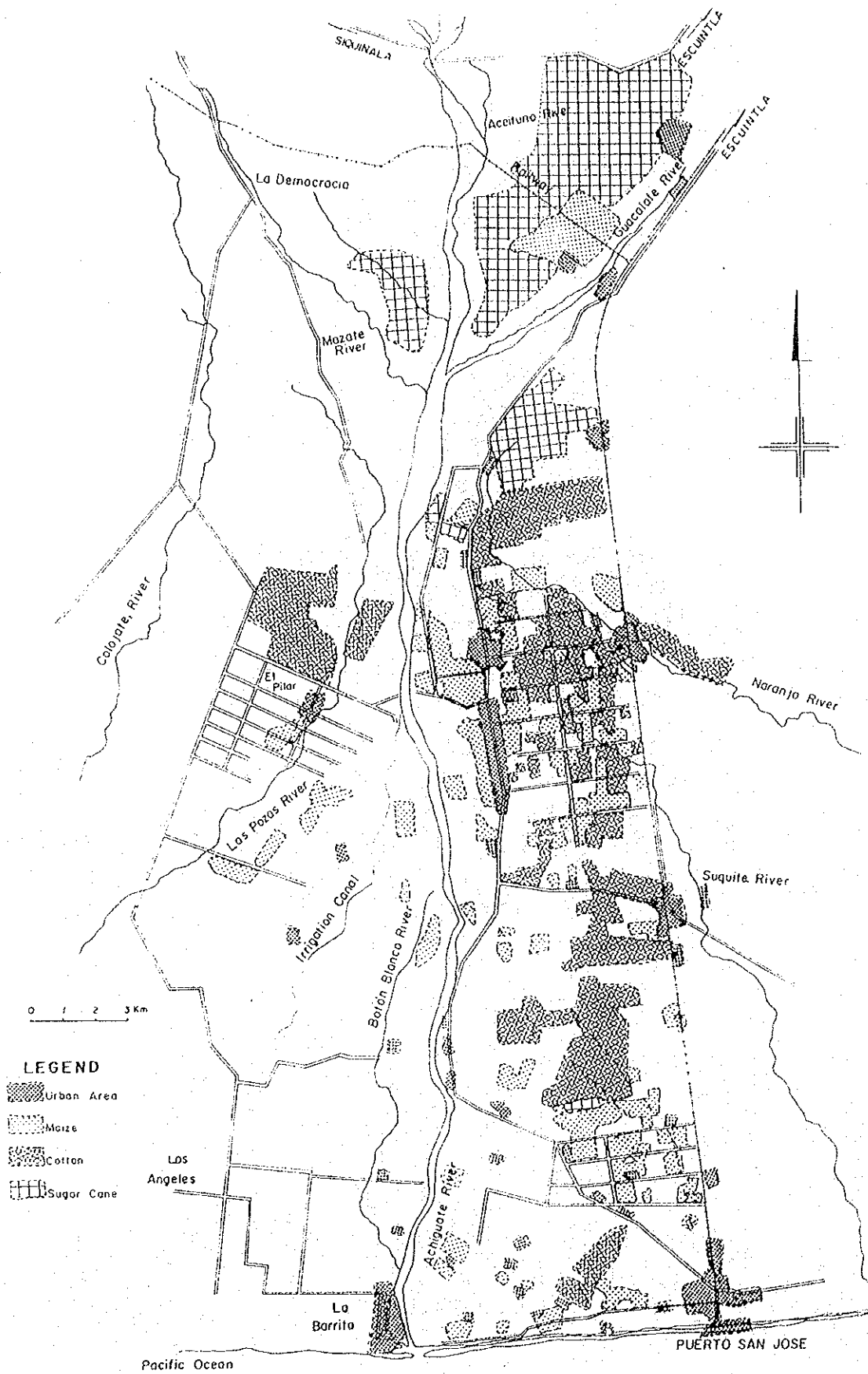


Fig. 3-2 (1/2) LAND USE MAP (ACHIGUATE RIVER BASIN)

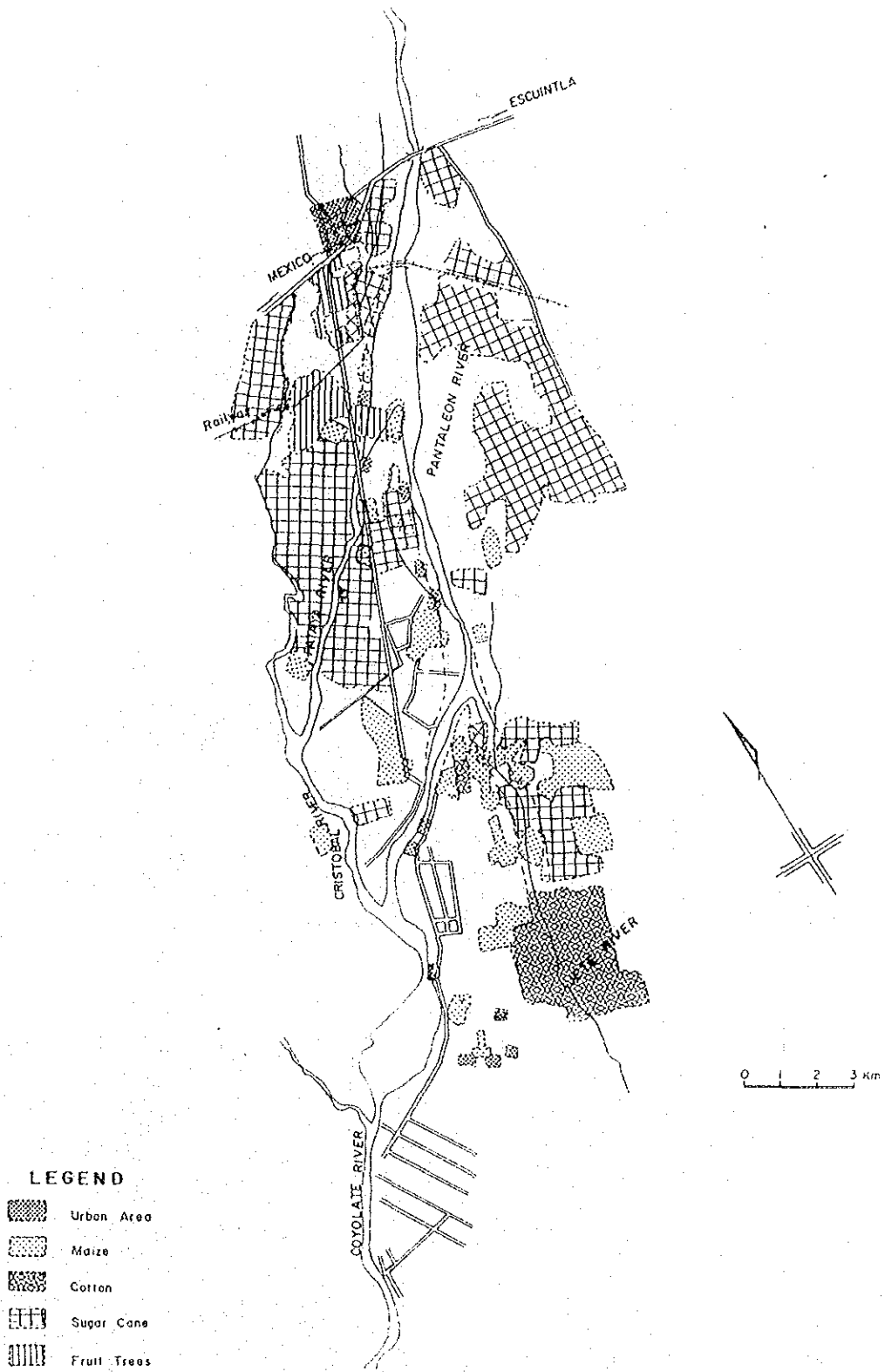


Fig. 3-2 (2/2) LAND USE MAP (PANTALEON RIVER BASIN)

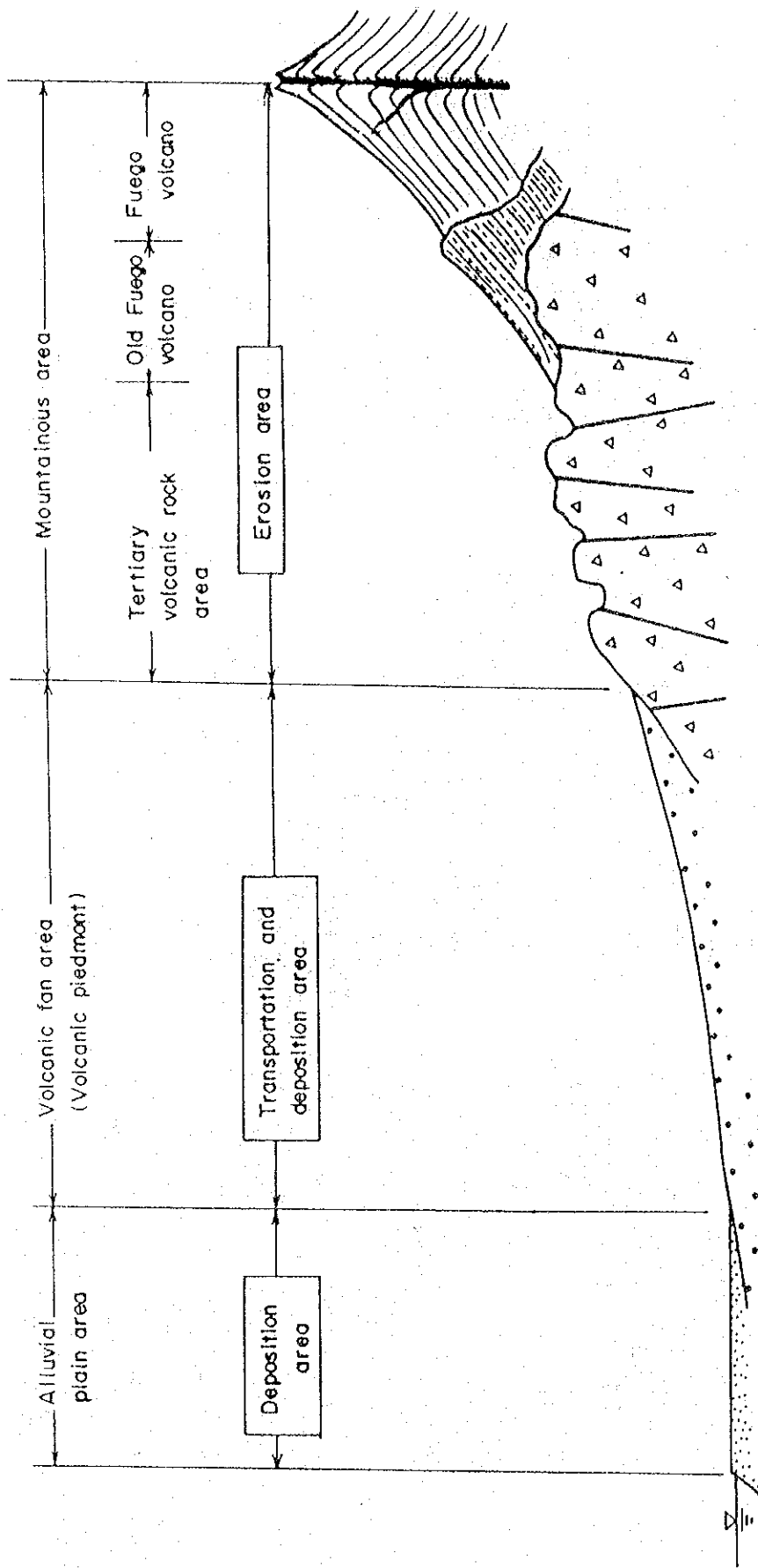


Fig. 3-3 GEOMORPHOLOGICAL DIVISION OF THE STUDY AREA

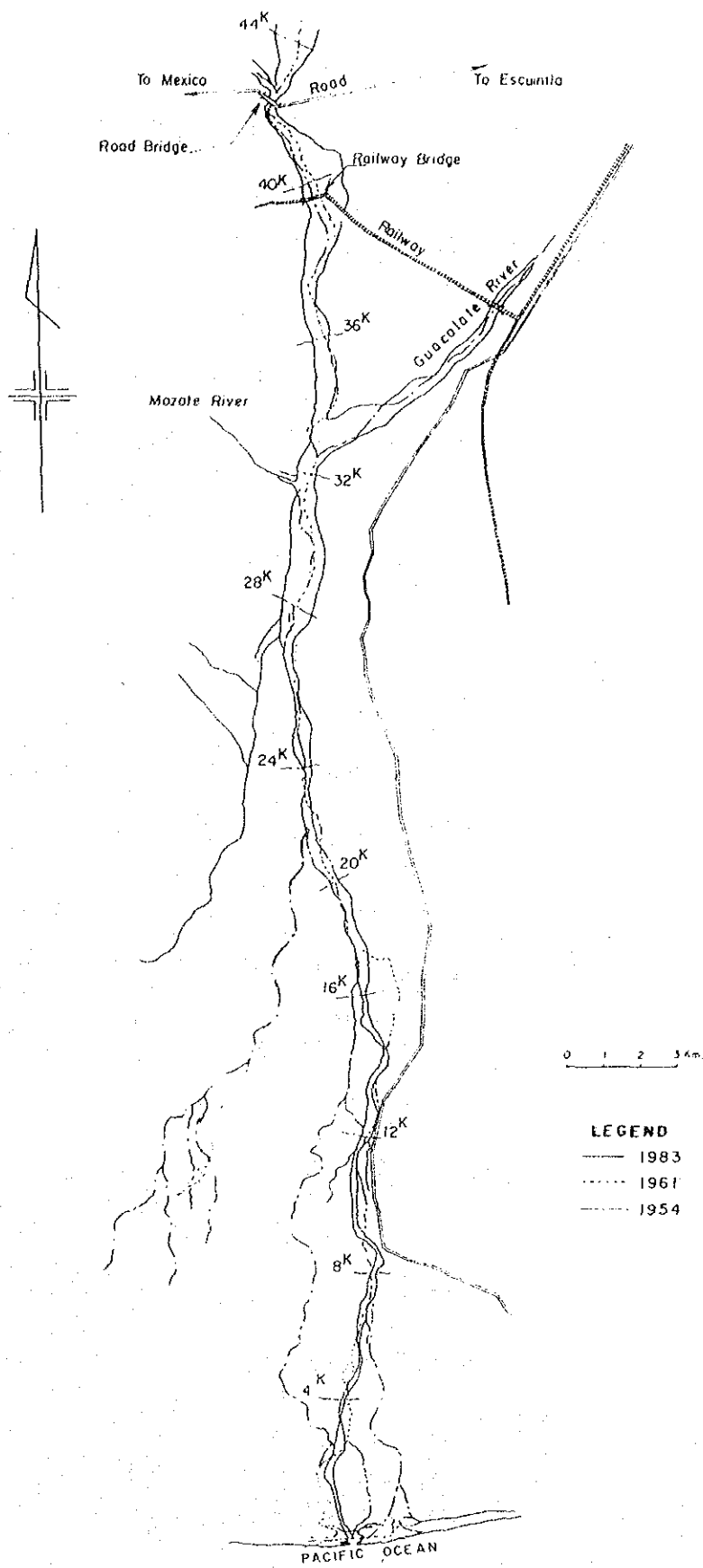


Fig. 3-4 (1/2) TRANSITION OF RIVER COURSE (ACHIGUATE RIVER)

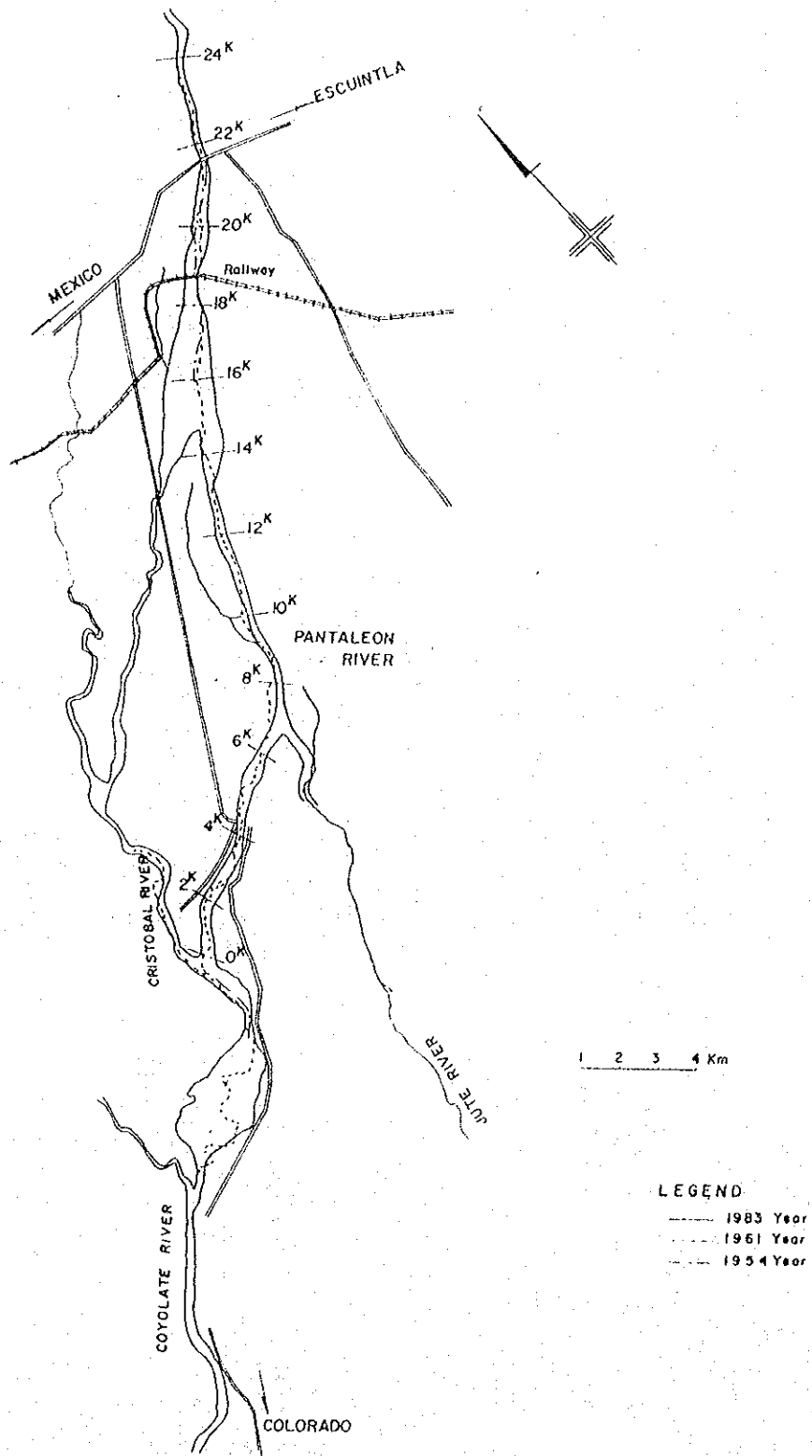


Fig. 3-4 (2/2) TRANSITION OF RIVER COURSE (PANTALEON RIVER)

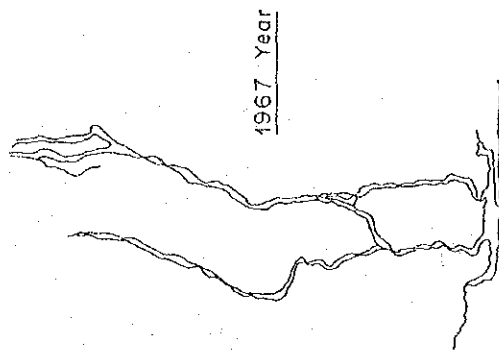
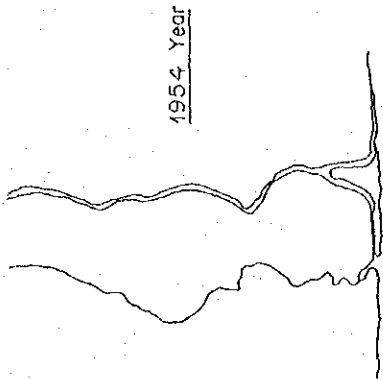
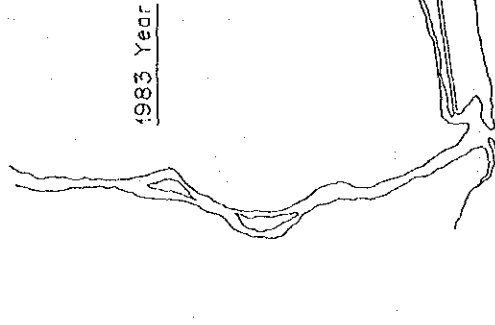
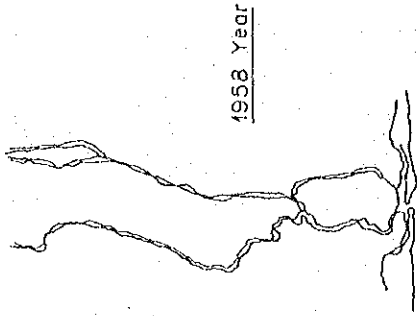


Fig. 3-5 TRANSITION OF RIVER MOUTH IN ACHIGUATE RIVER

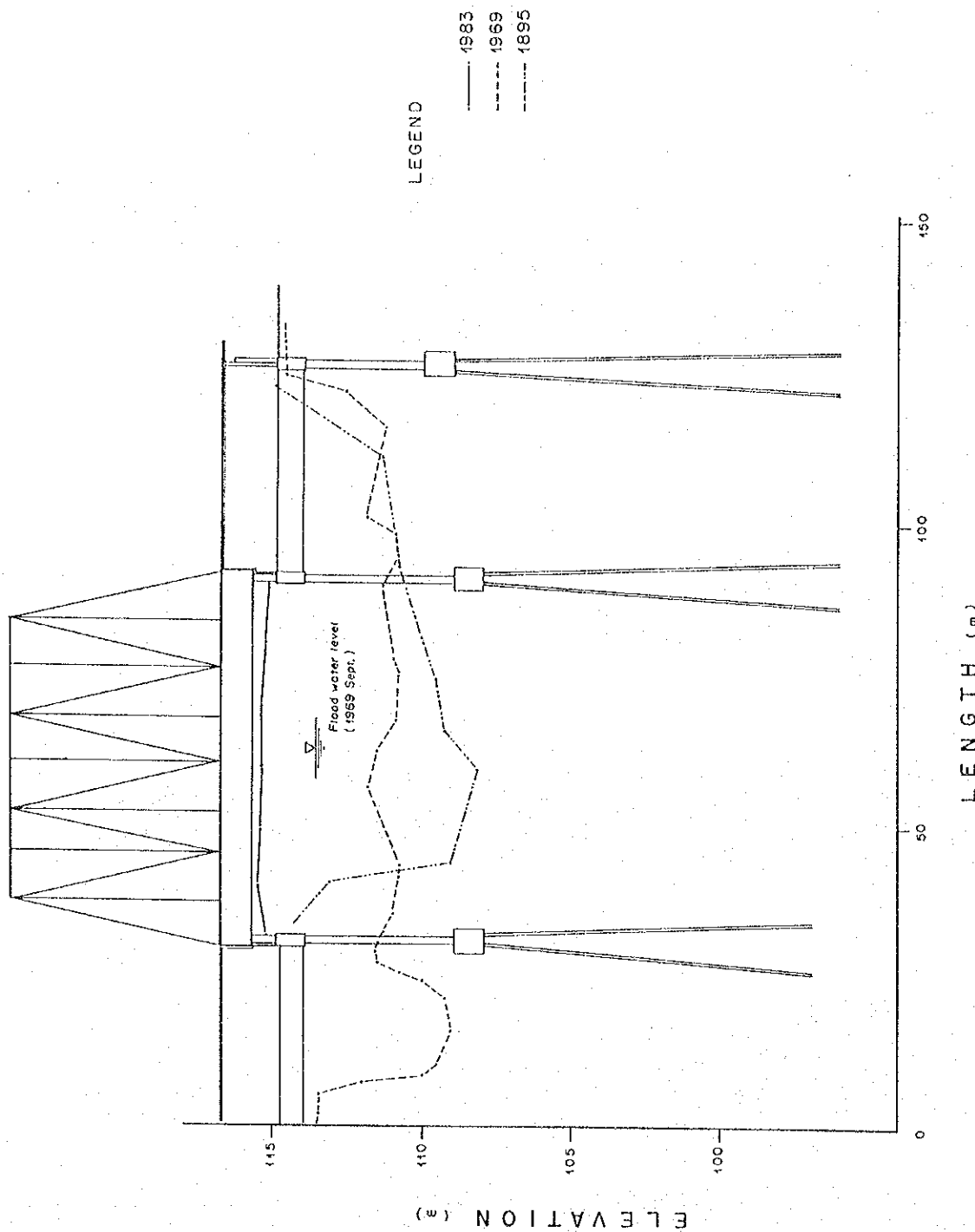


Fig. 3-6 TRANSITION OF CROSS-SECTION AT RAILWAY BRIDGE IN ACHIGUATE RIVER

LEGEND
 — 1983
 - - 1973
 ···· 1972
 - · - 1960

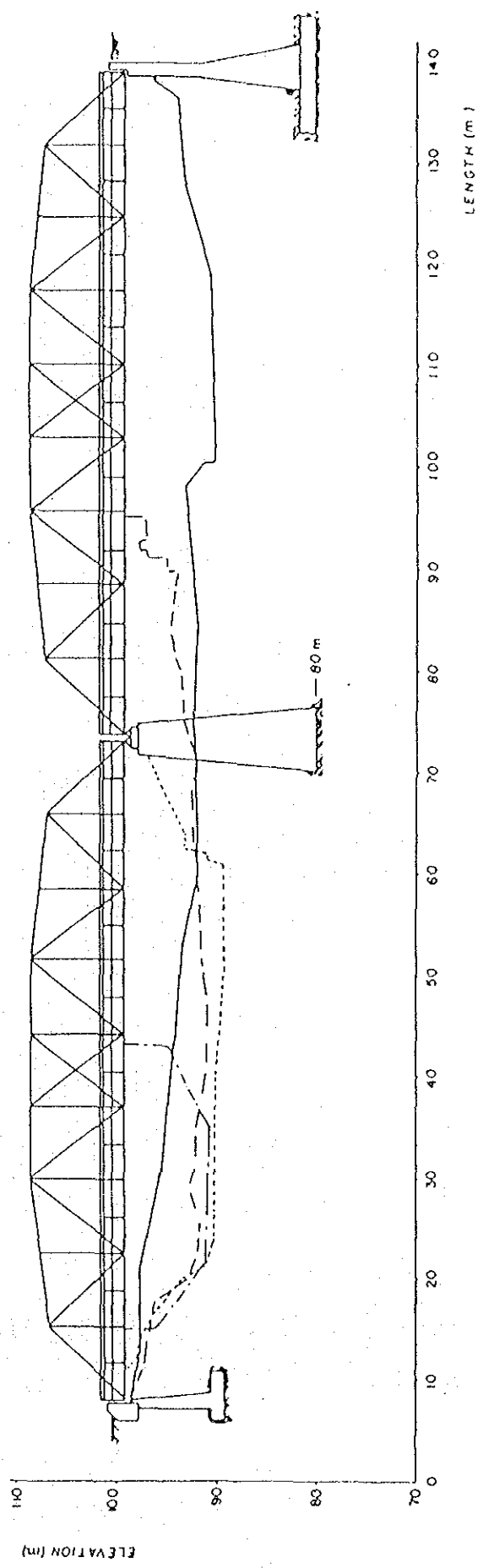


Fig. 3-7 TRANSITION OF CROSS-SECTION AT ROAD BRIDGE IN PANTALEON RIVER

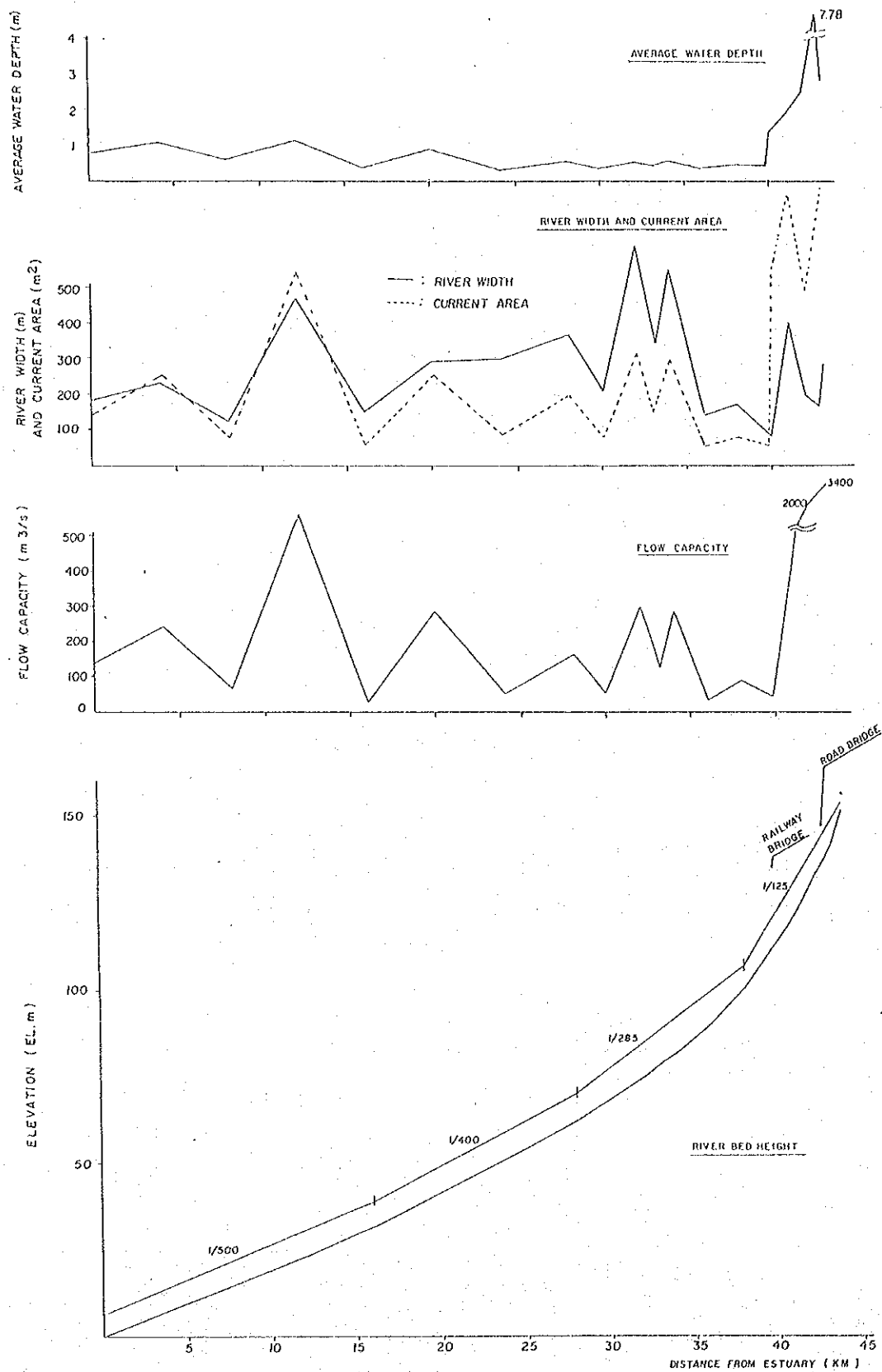


Fig. 3-8 (1/2) FEATURES OF RIVER (ACHIGUATE RIVER)

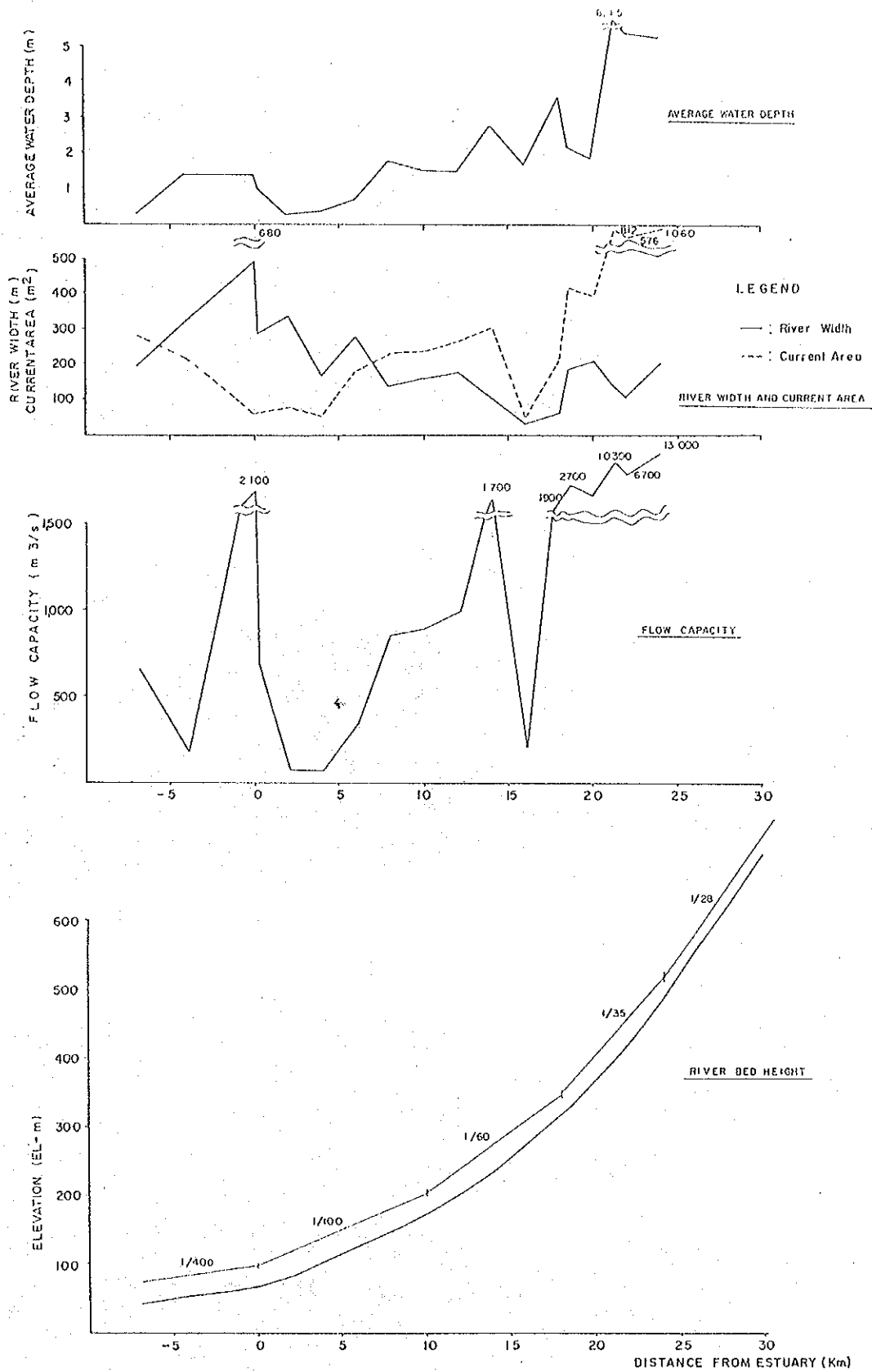


Fig. 3-8 (2/2) FEATURES OF RIVER (PANTALEON RIVER)

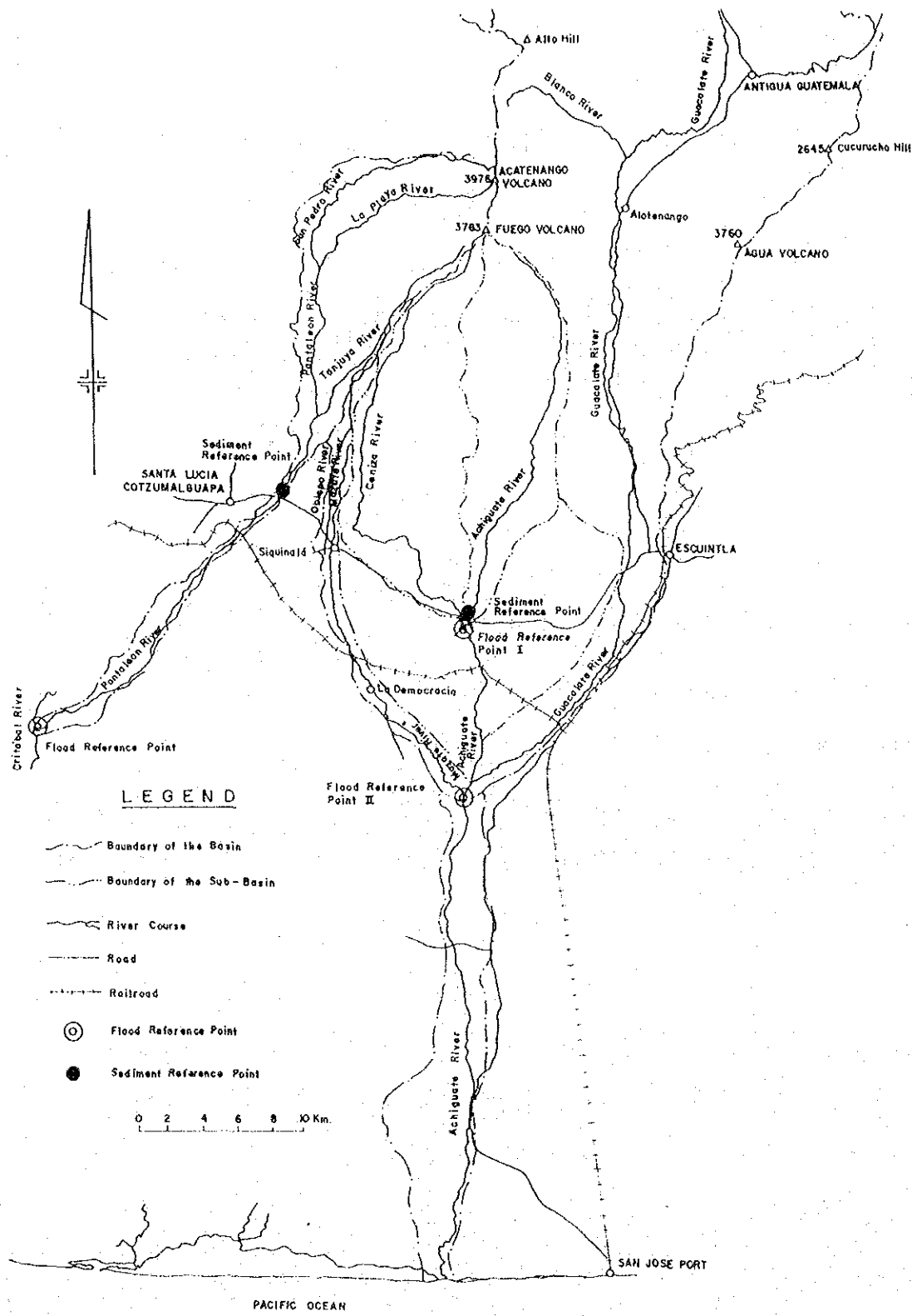


Fig. 4-1 LOCATION OF REFERENCE POINTS

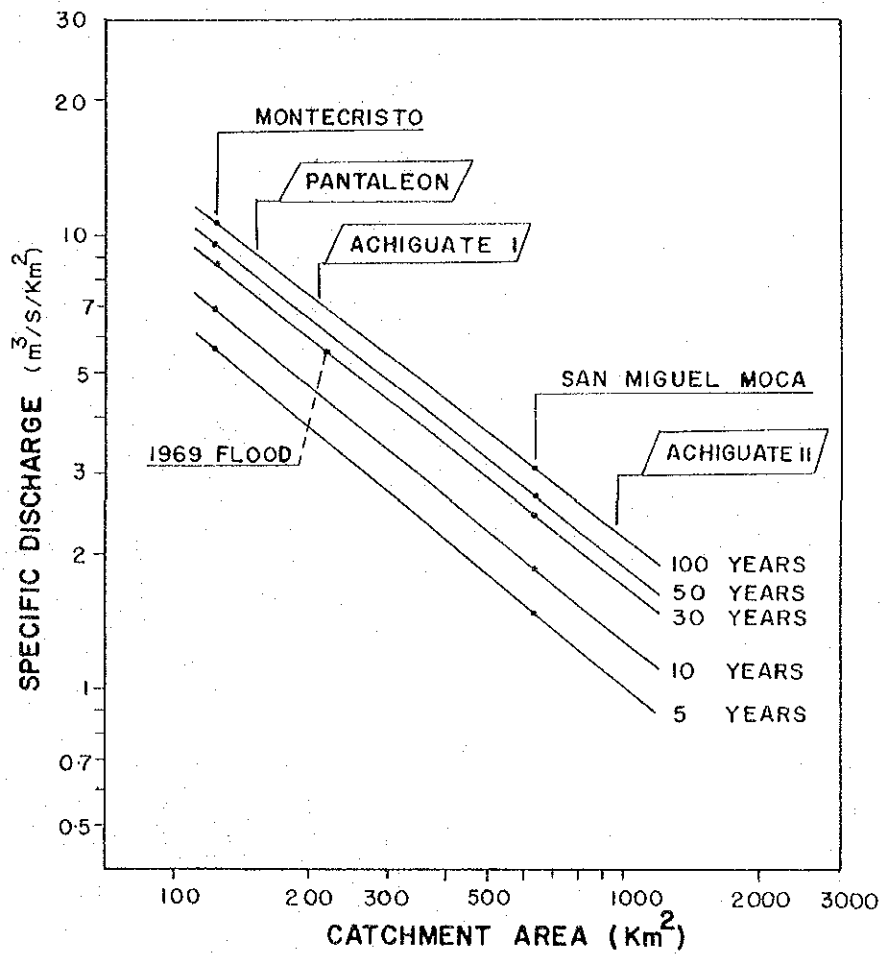


Fig. 4-2 SPECIFIC DISCHARGE

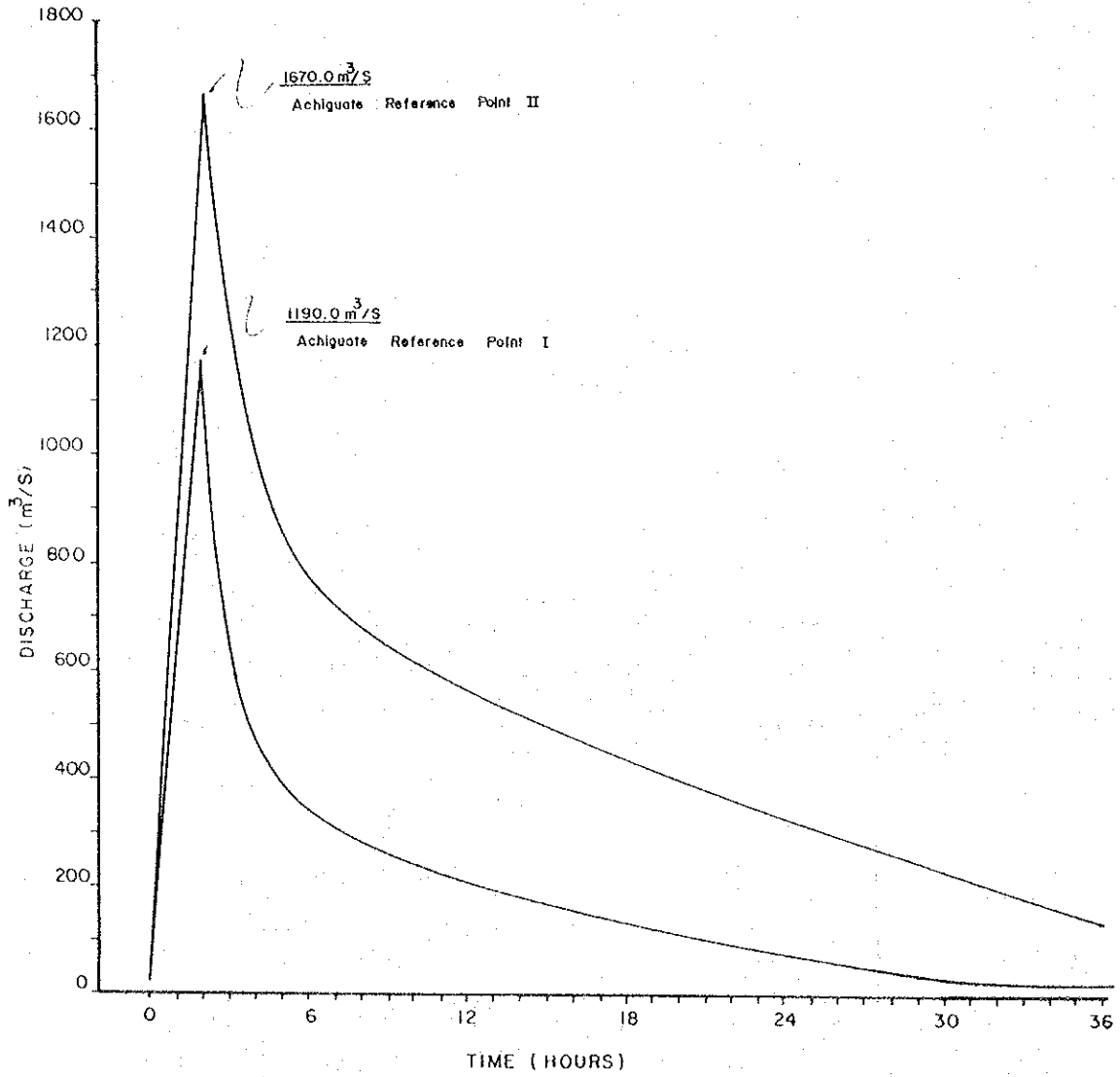


Fig. 4-3 (1/2) MODEL HYDROGRAPH (ACHIGUATE RIVER)

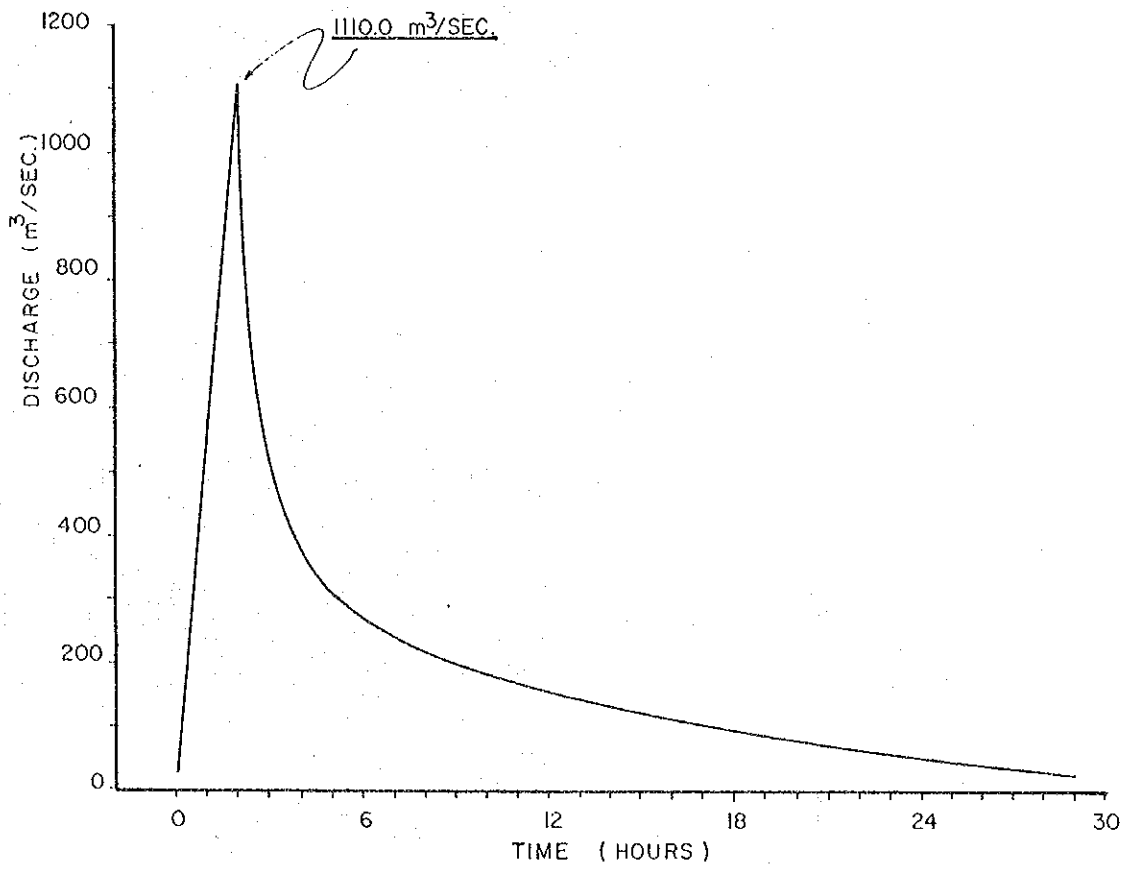
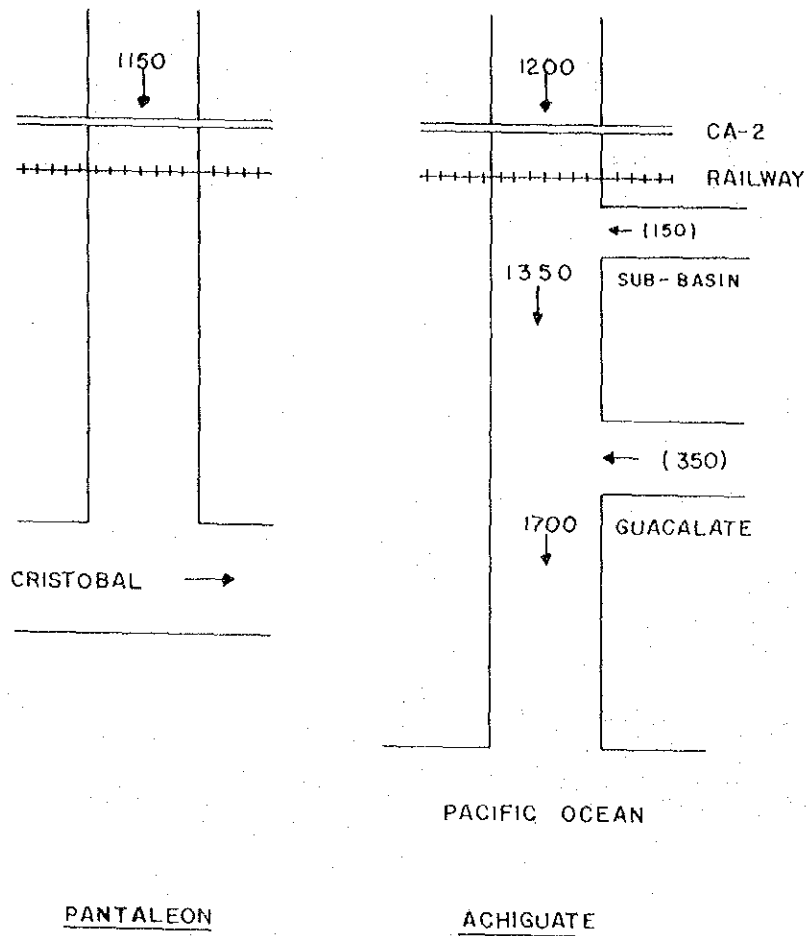


Fig. 4-3 (2/2) MODEL HYDROGRAPH (PANTALEON RIVER)

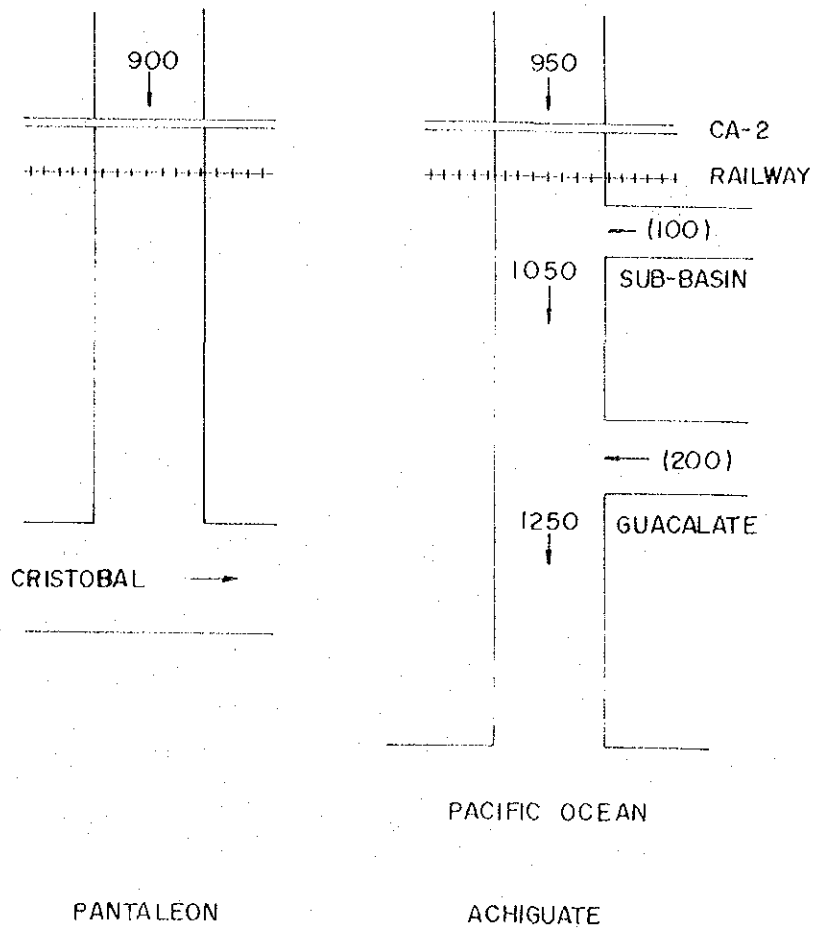


NOTE

Unit : m^3/sec

Figures in parentheses show the discharge added by the tributary at the peak flow time of the main river

Fig. 5-1 (1/2) DESIGN DISCHARGE DISTRIBUTION (30 YEARS)



NOTE

Unit : m^3/sec

Figures in parentheses show the discharge added by the tributary at the peak flow time of the main river

Fig. 5-1 (2/2) DESIGN DISCHARGE DISTRIBUTION (10 YEARS)

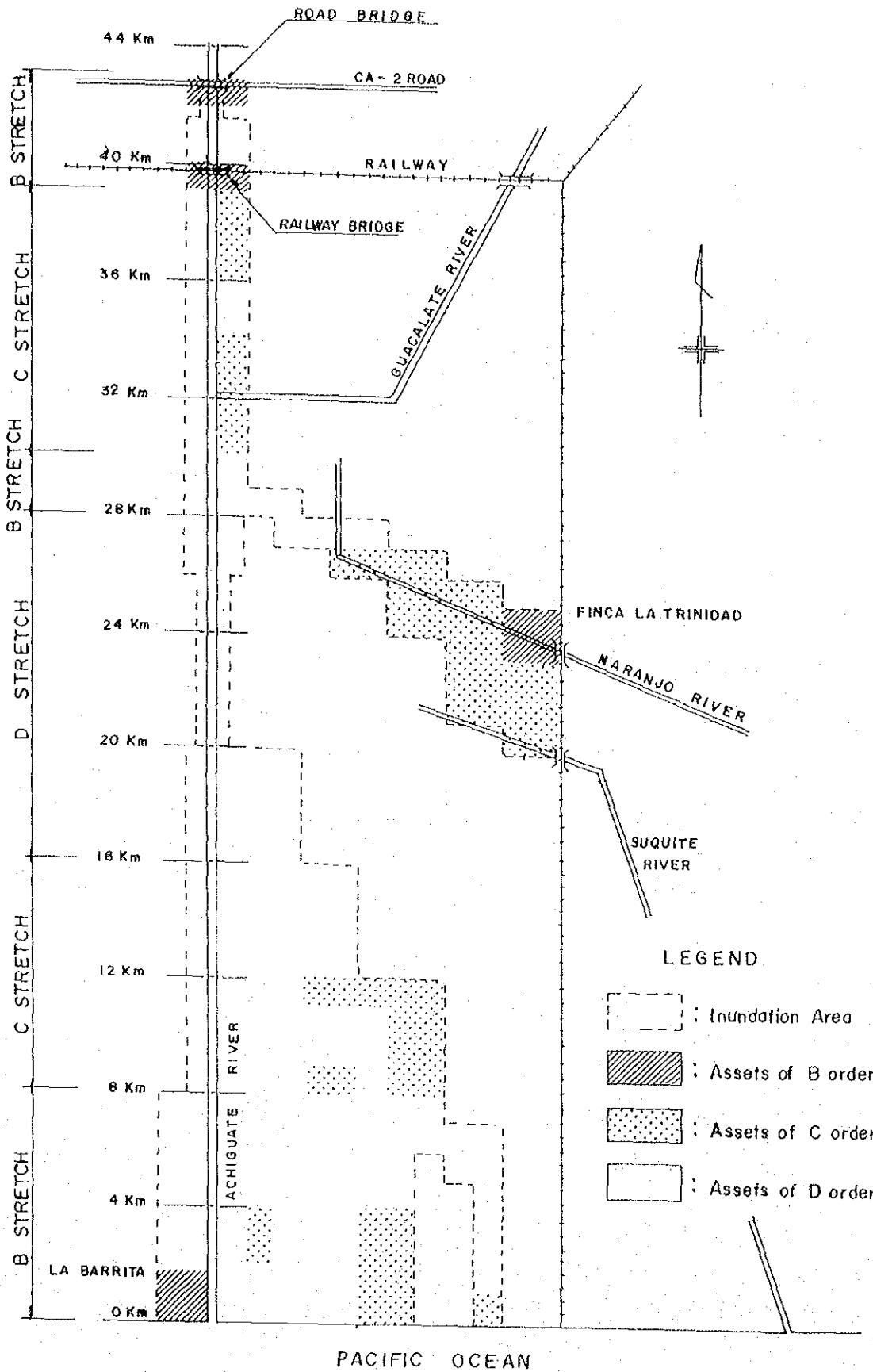


Fig. 5-2 (1/2) CLASSIFICATION OF ASSETS (ACHIGUATE RIVER BASIN)

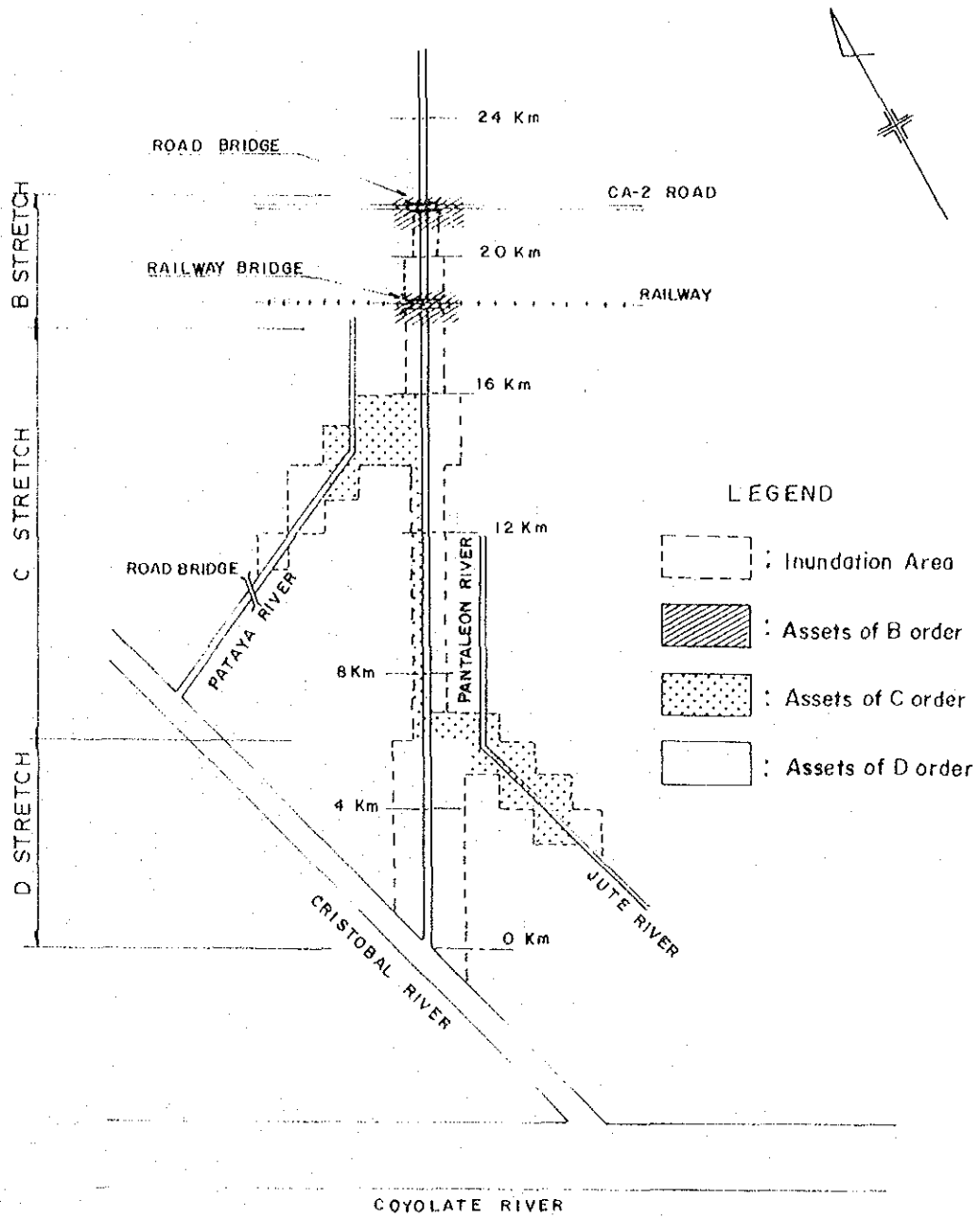
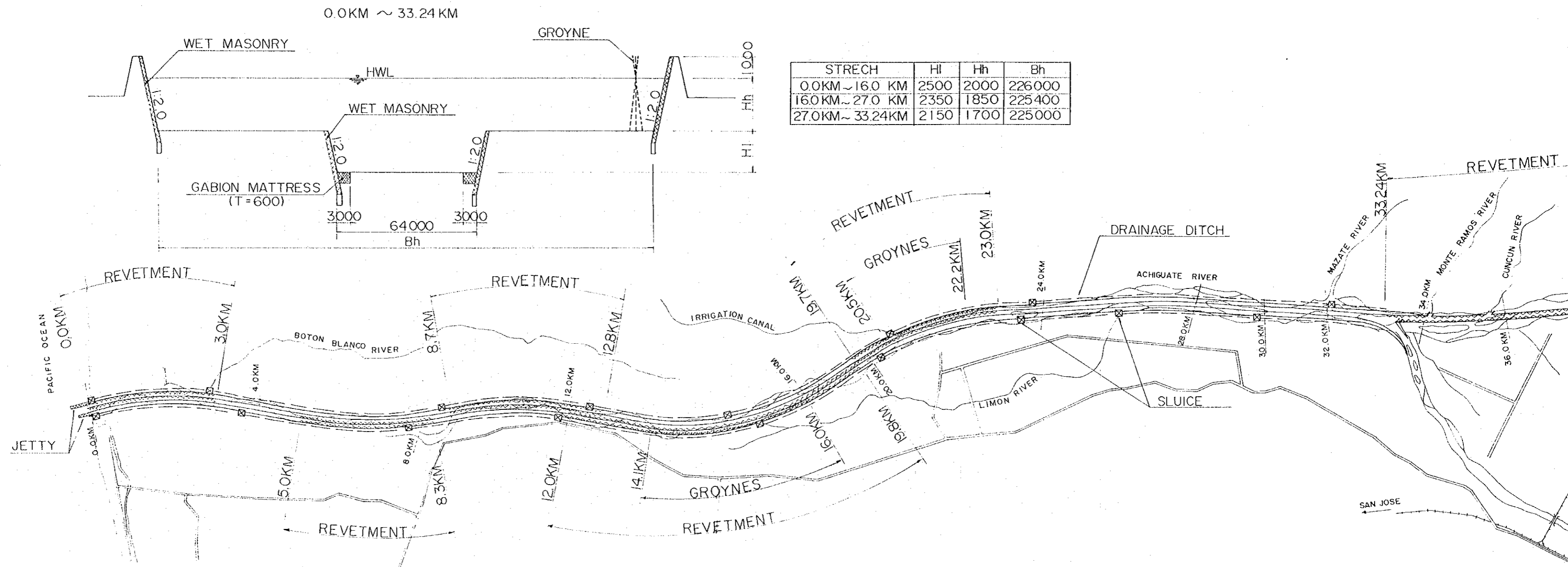
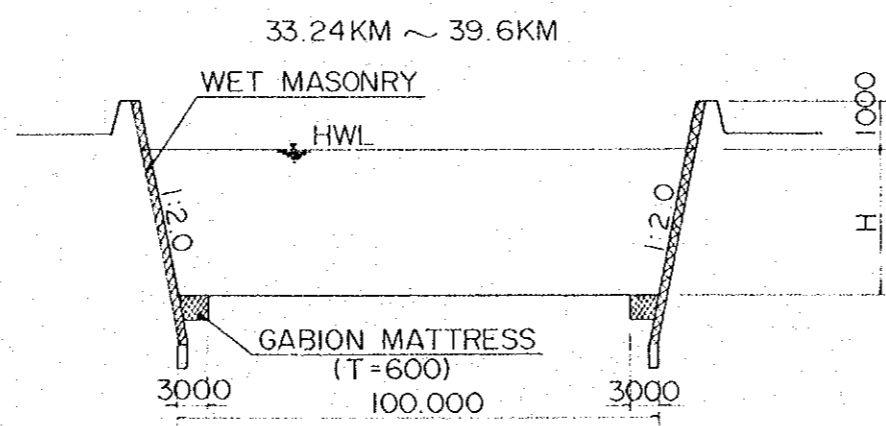
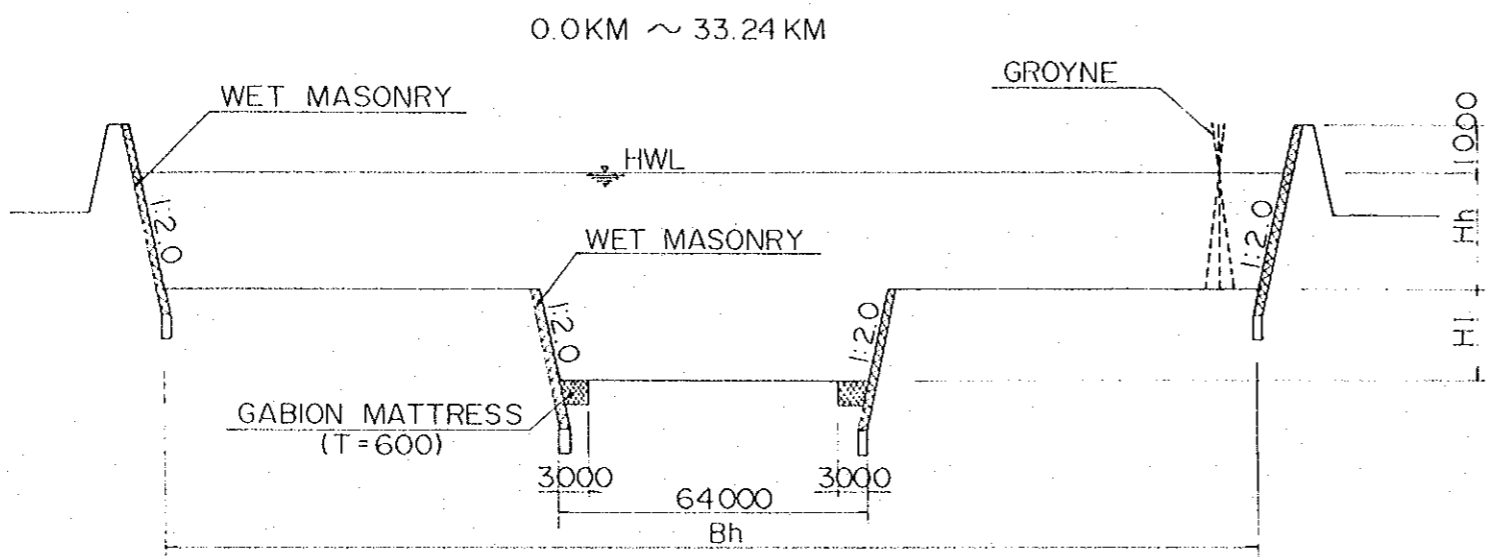


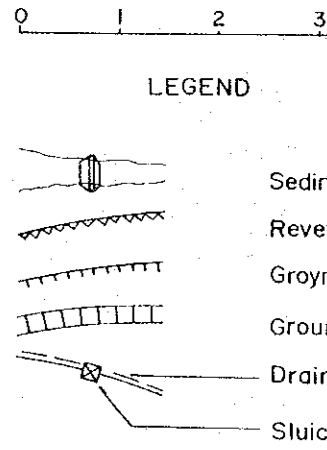
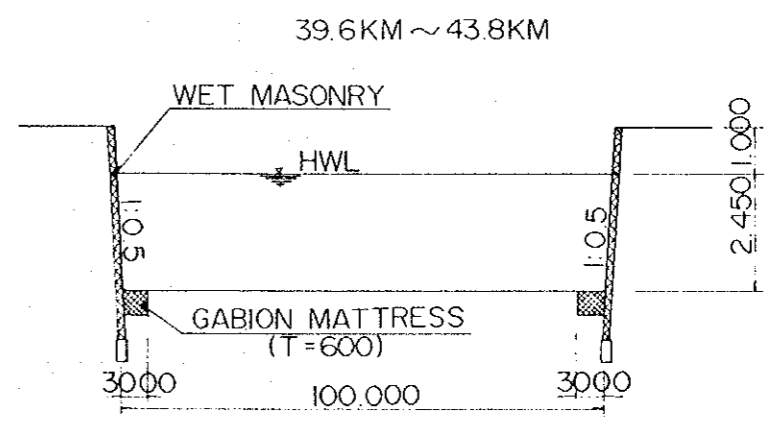
Fig. 5-2 (2/2) CLASSIFICATION OF ASSETS (PANTALEON RIVER BASIN)



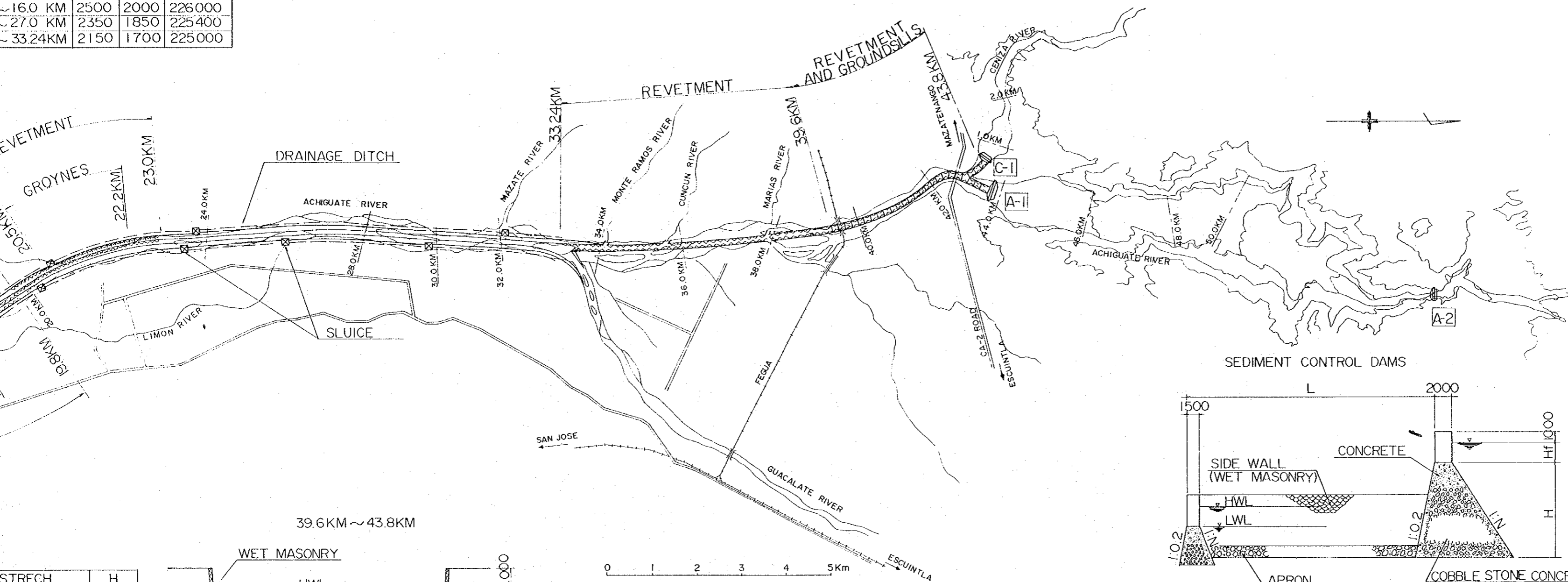
STRECH	Hi	Hh	Bh
0.0KM ~ 16.0 KM	2500	2000	226000
16.0KM ~ 27.0 KM	2350	1850	225400
27.0KM ~ 33.24KM	2150	1700	225000



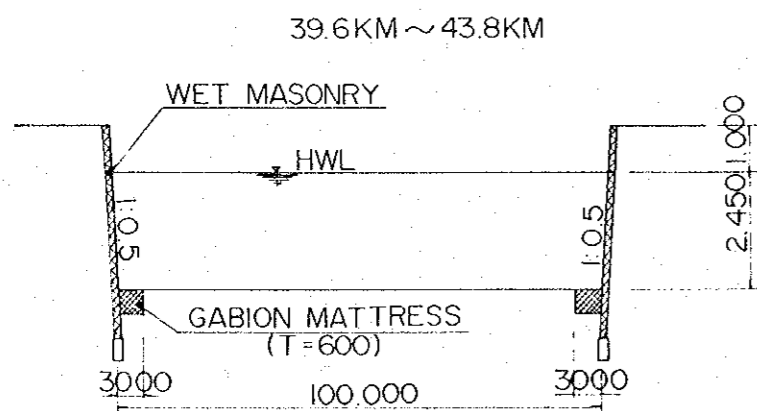
STRECH	H
33.24KM ~ 38.0KM	3250
38.0 KM ~ 39.6KM	2750



RECH	HI	Hh	Bh
~16.0 KM	2500	2000	226 000
~27.0 KM	2350	1850	225 400
~33.24KM	2150	1700	225 000

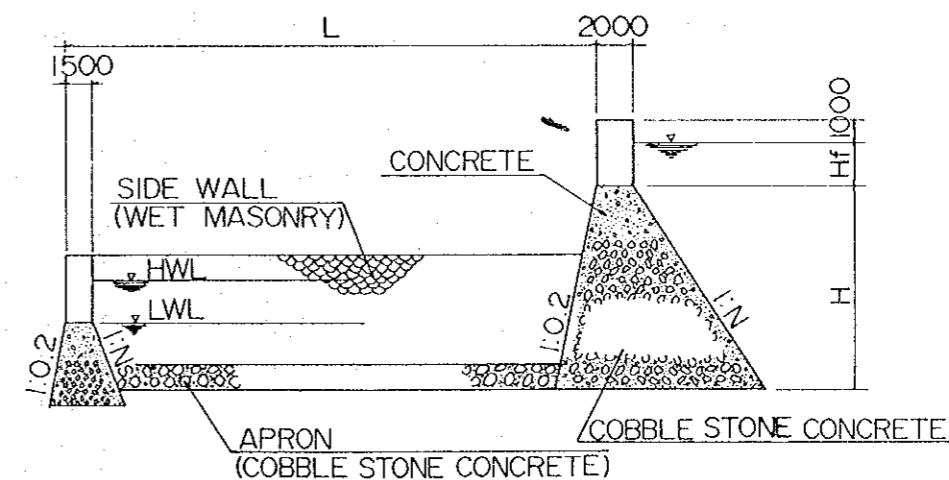


STRECH	H
4KM~38.0KM	3250
KM~39.6KM	2750



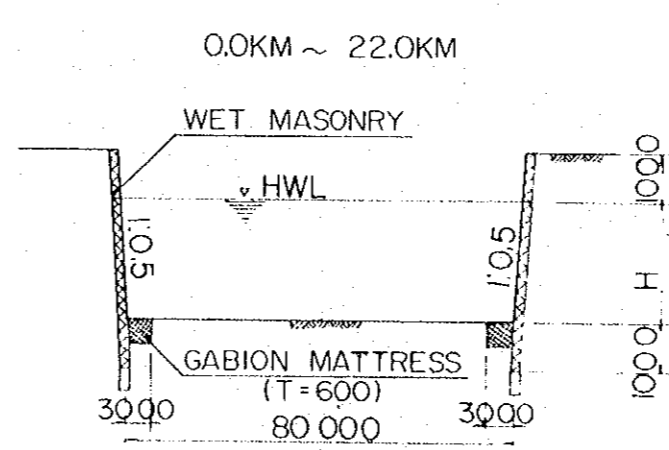
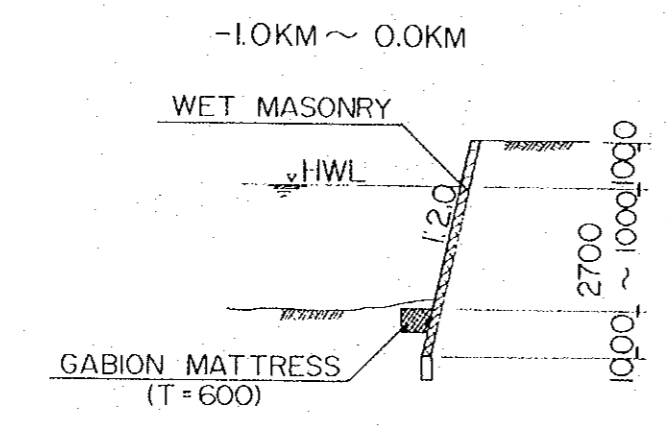
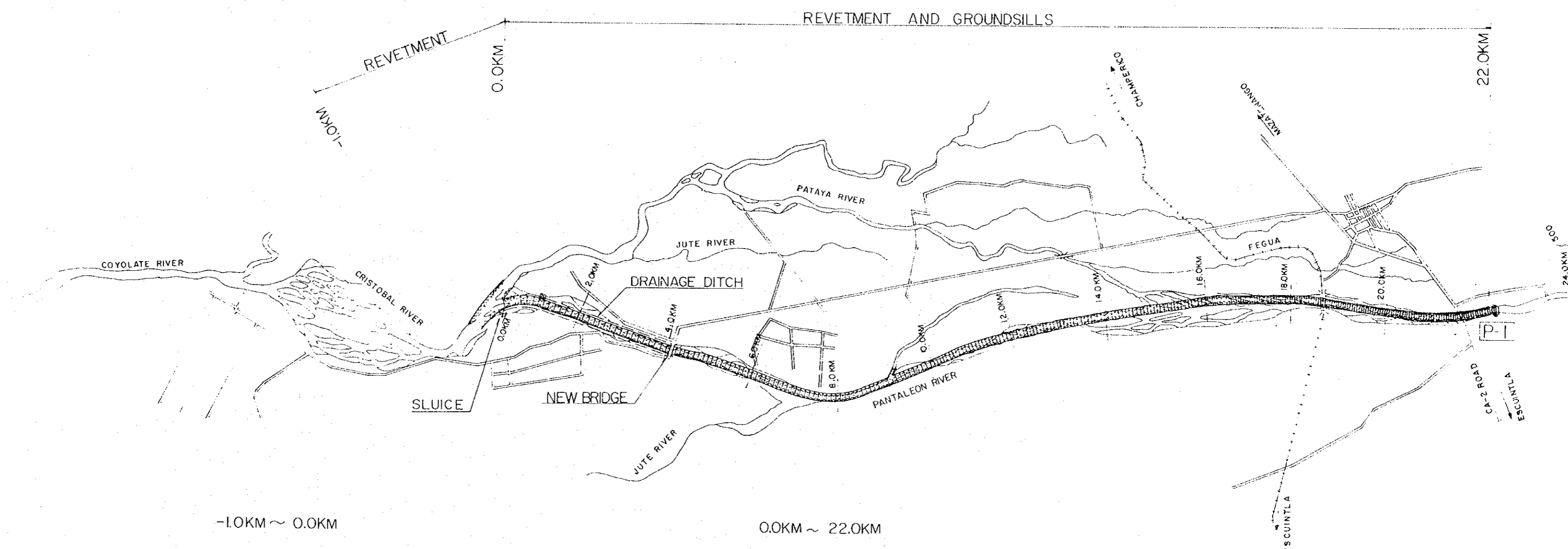
- LEGEND
- Sediment Control Dam
 - Revetment
 - Groyne
 - Groundsill (30 Places)
 - Drainage Ditch
 - Sluice (17 Places)

SEDIMENT CONTROL DAMS

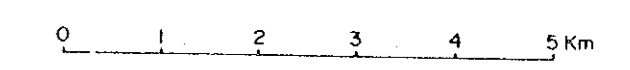


DAM	N	H _i (m)	H _f (m)	L (m)	N _s	CREST LENGTH (m)	DAM VOLUME (m ³)
A-1	0.6	8.5	2.4	29	0.3	460	26,500
A-2	1.2	20.0	2.1	35	0.3	135	25,200
C-1	0.6	8.5	2.1	29	0.2	455	23,200

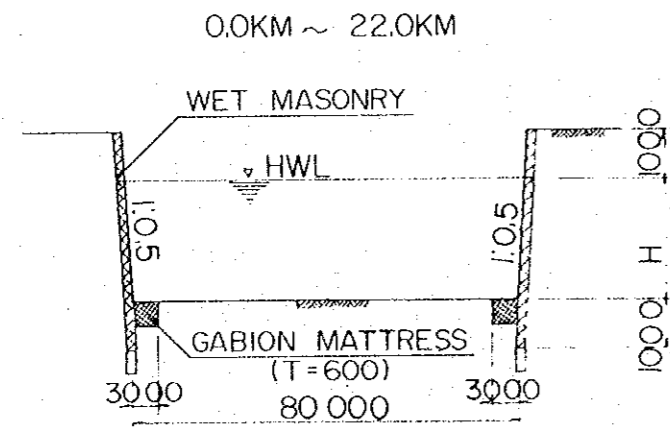
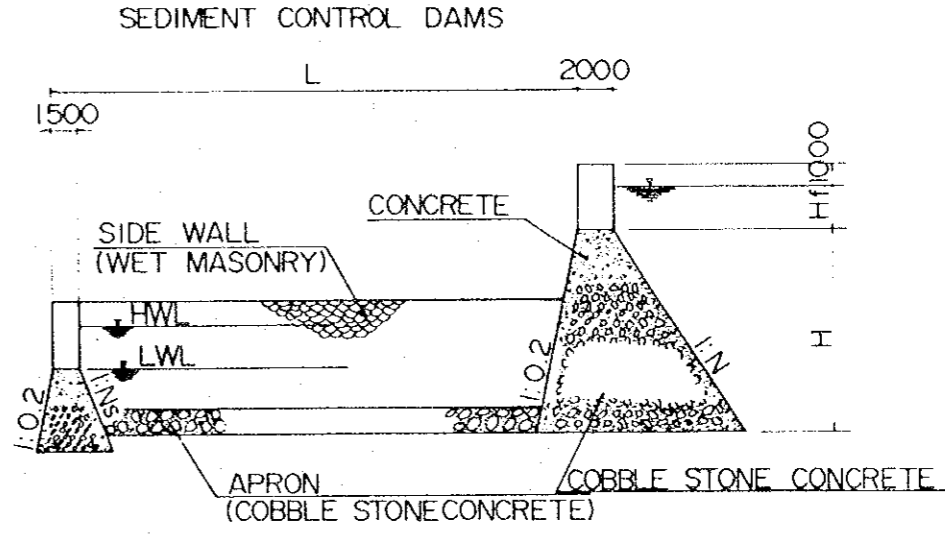
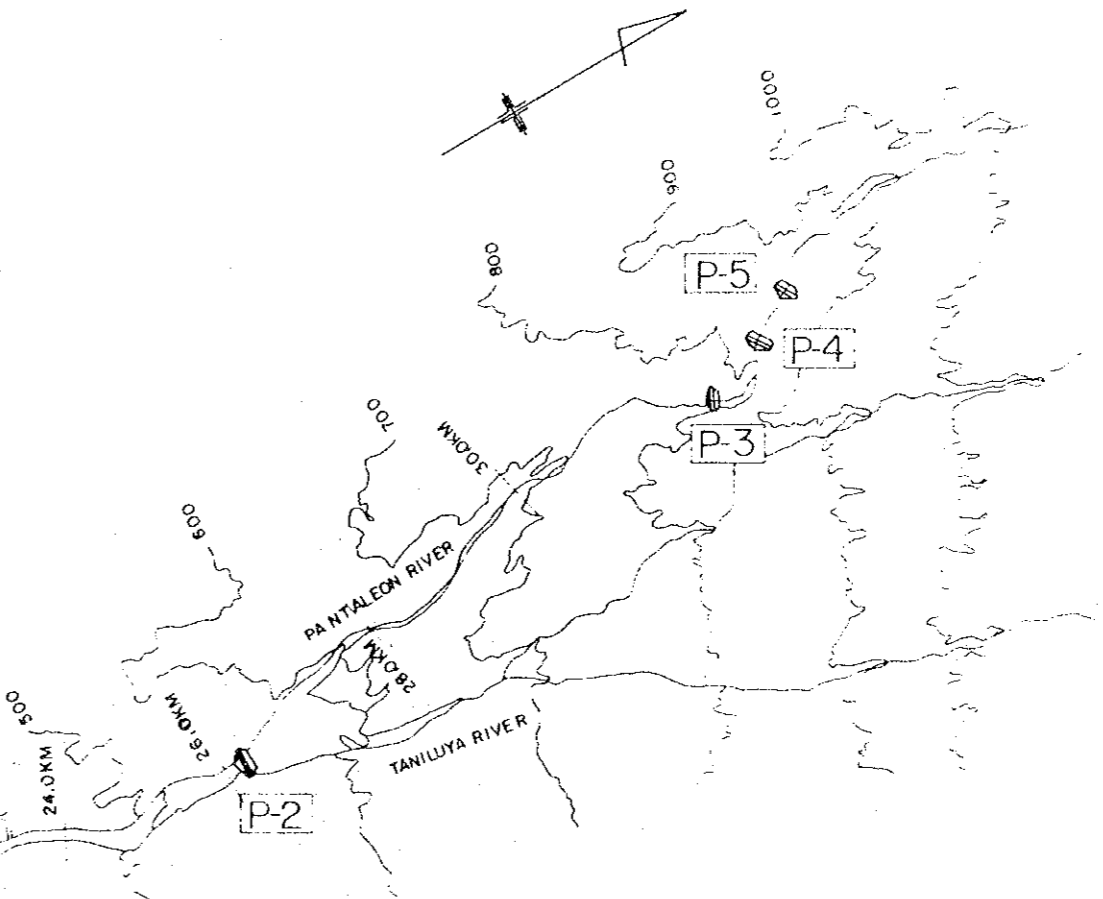
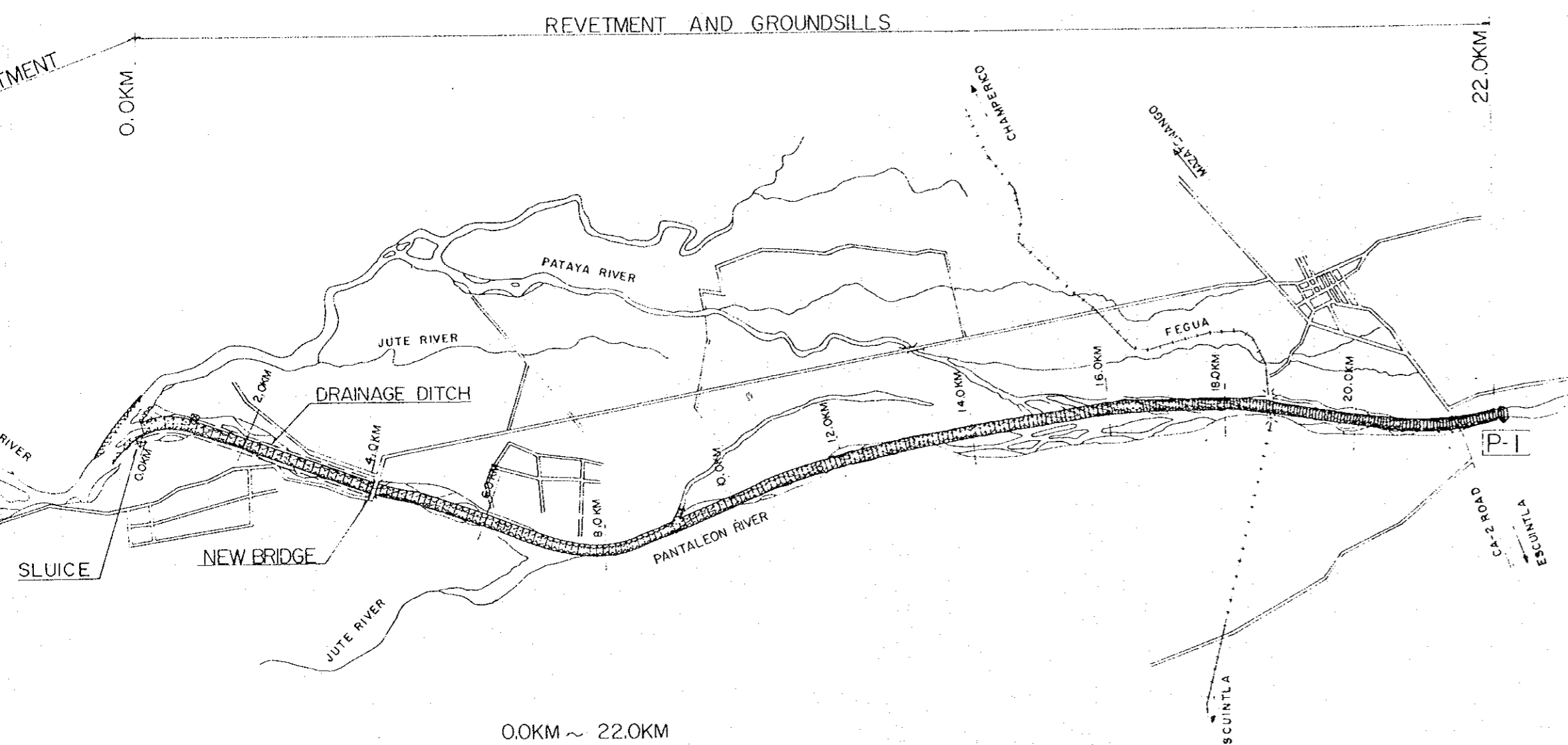
Fig. 5-3 (1/2) COMPREHENSIVE PALM (ACHIGUATE RIVER)



STRETCH	H
0.0KM-4.0KM	2 700
4.0KM-6.0KM	2 600
6.0KM-10.0KM	2 500
10.0KM-12.0KM	2 350
12.0KM-14.0KM	2 250
14.0KM-16.0KM	2 200
16.0KM-18.3KM	2 050
18.3KM-22.0KM	2 000



- LEGEND
- Sediment Control Dam
 - Revetment (Wet Masonry)
 - Groundsill (293 Places)
 - Drainage Ditch
 - Sluice (2 Places)



STRETCH	H
0.0KM~4.0KM	2 700
4.0KM~6.0KM	2 600
6.0KM~10.0KM	2 500
10.0KM~12.0KM	2 350
12.0KM~14.0KM	2 250
14.0KM~16.0KM	2 200
16.0KM~18.3KM	2 050
18.3KM~22.0KM	2 000

- LEGEND
- Sediment Control Dam
 - Revetment (Wet Masonry)
 - Groundsill (293 Places)
 - Drainage Ditch
 - Sluice (2 Places)

DAM	N	H (m)	H _f (m)	L (m)	N _s	CREST LENGTH (m)	DAM VOLUME (m ³)
P-1	0.5	6.5	2.6	20	0.4	210	4,400
P-2	0.65	11.0	2.6	29	0.4	392	20,600
P-3	0.90	13.0	2.8	30	0.4	155	19,600
P-4	0.65	10.5	2.8	29	0.4	190	15,400
P-5	1.30	20.0	2.8	35	0.4	230	47,400

Fig. 5-3 (2/2) COMPREHENSIVE PLAN (PANTALEON RIVER)

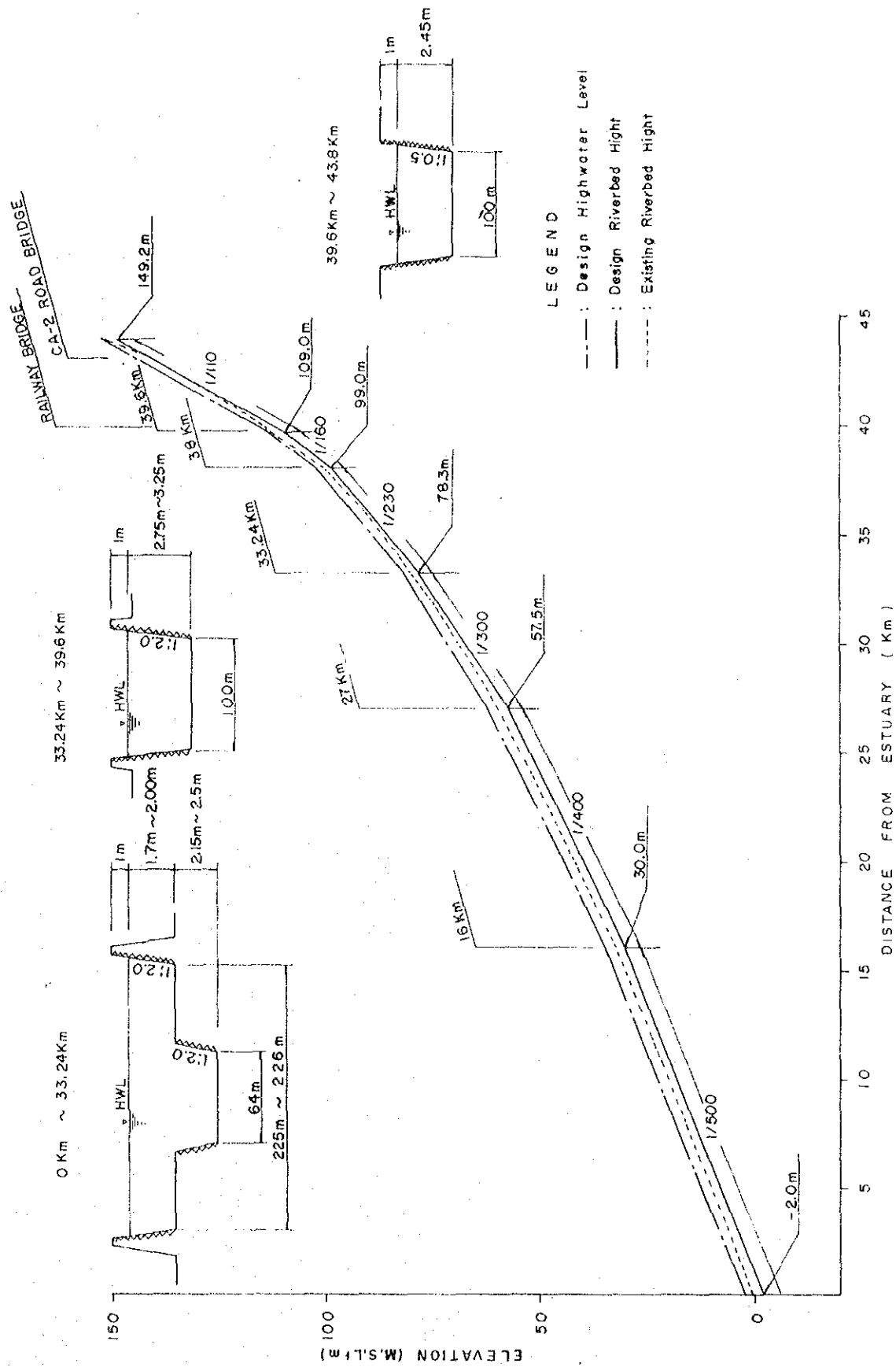


Fig. 5-4 (1/2) LONGITUDINAL PROFILE (ACHIGUATE RIVER)

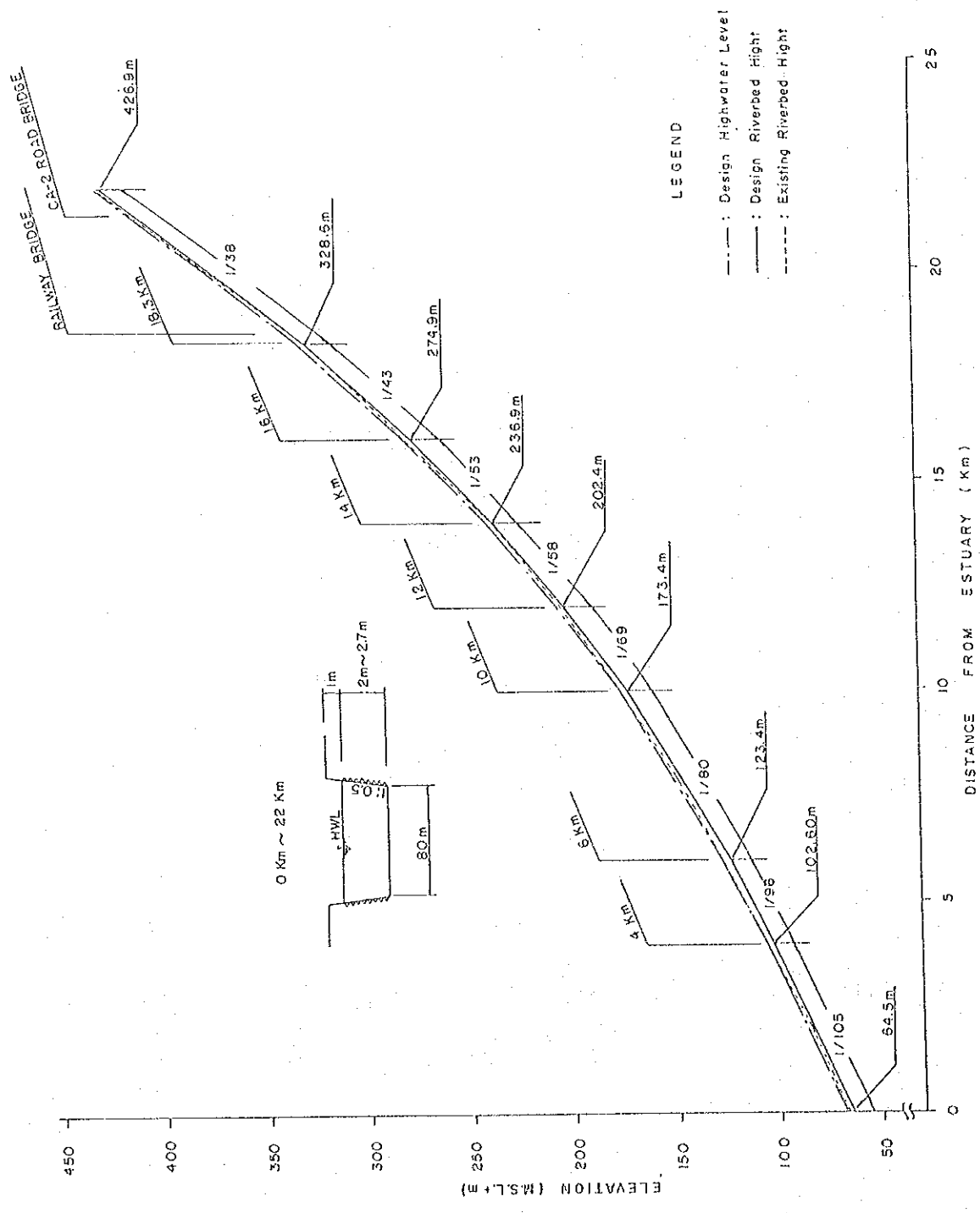


Fig. 5-4 (2/2) LONGITUDINAL PROFILE (PANTALEON RIVER)

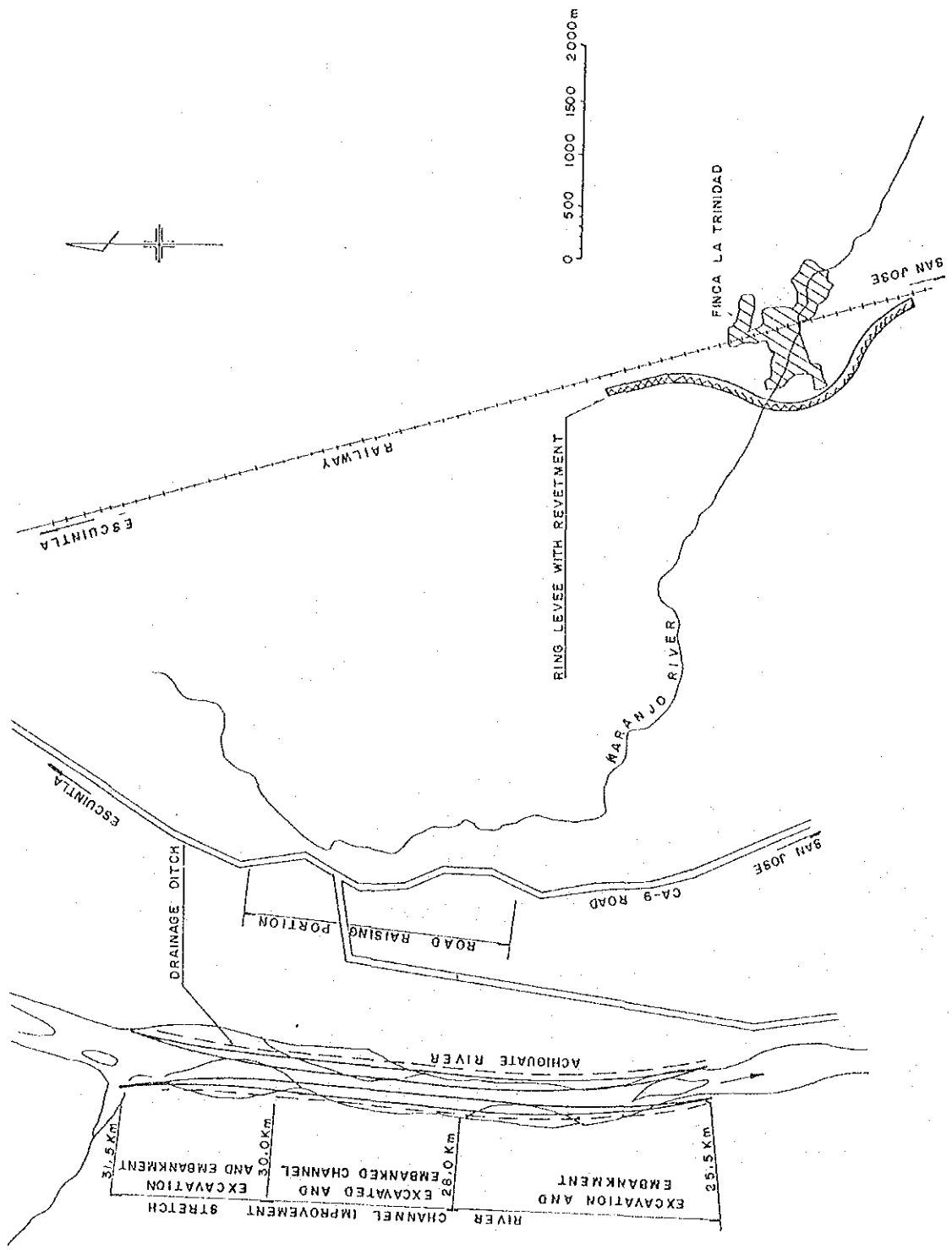


Fig. 5-5 (2/4) LOCATION OF ALTERNATIVE WORKS (ACHIGUATZE RIVER, PROTECTION OF FINCA LA TRINIDAD)

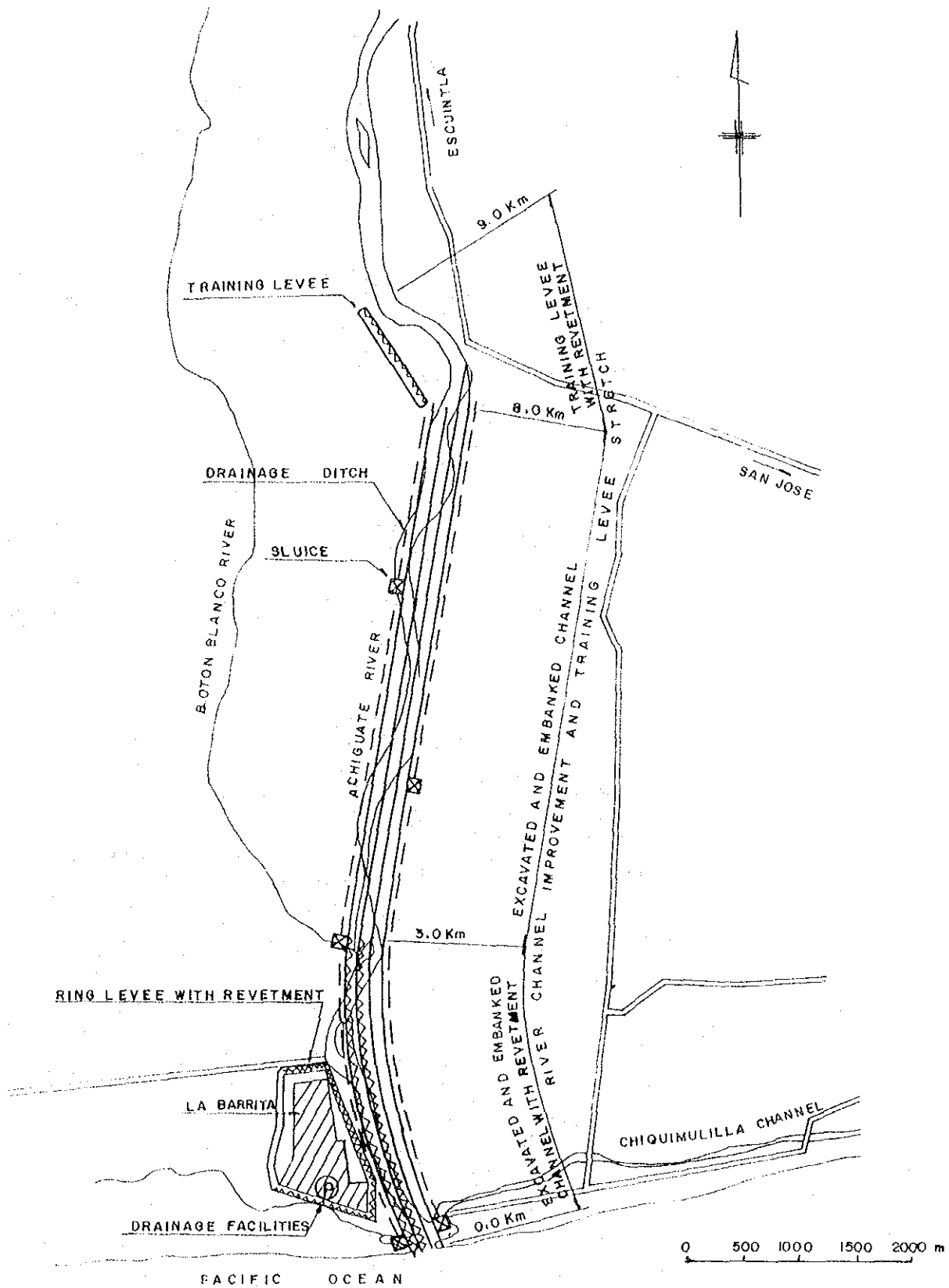


Fig. 5-5 (3/4) LOCATION OF ALTERNATIVE WORKS
 (ACHIGUATE RIVER, PROTECTION OF LA BARRITA)

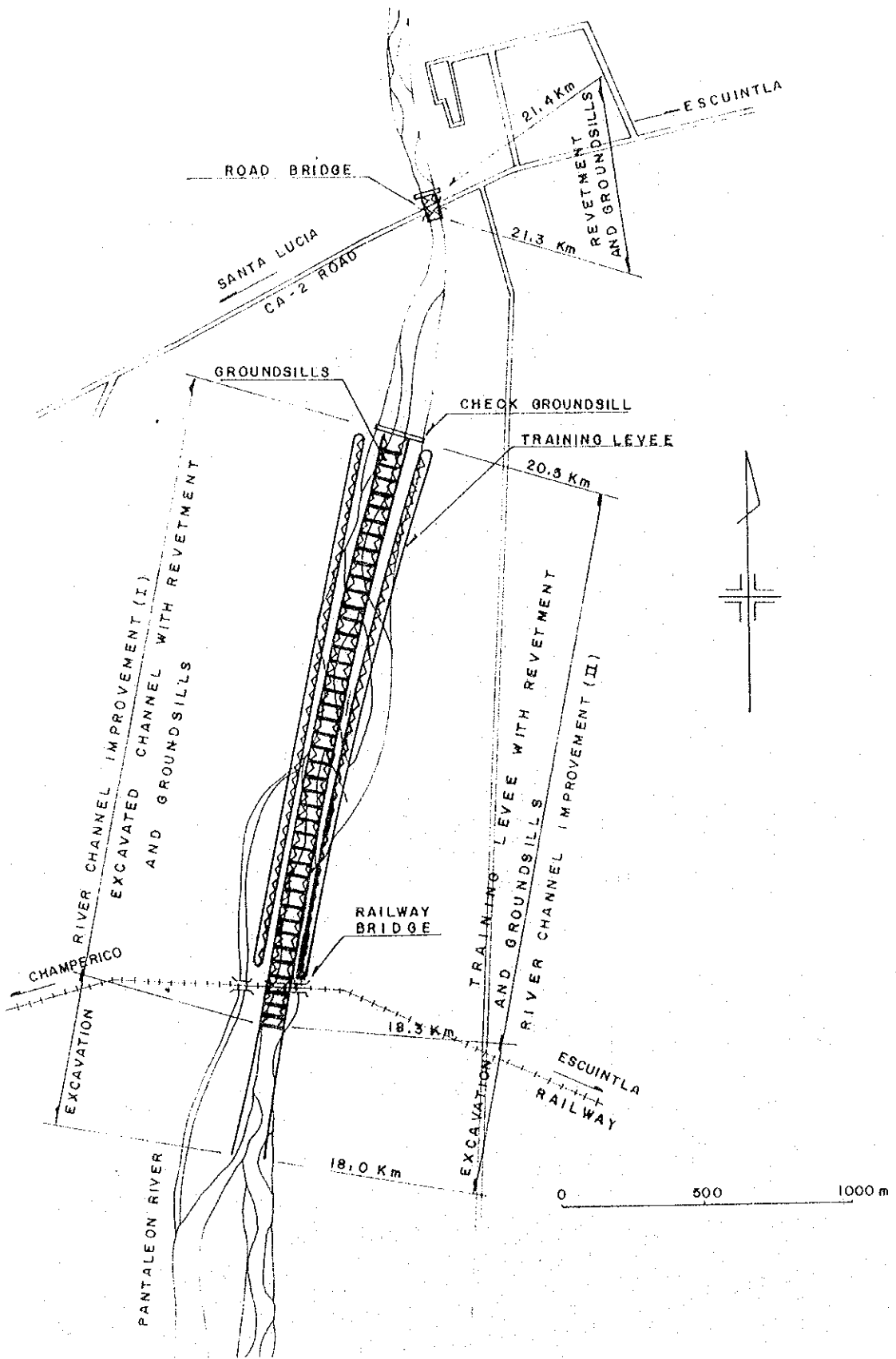
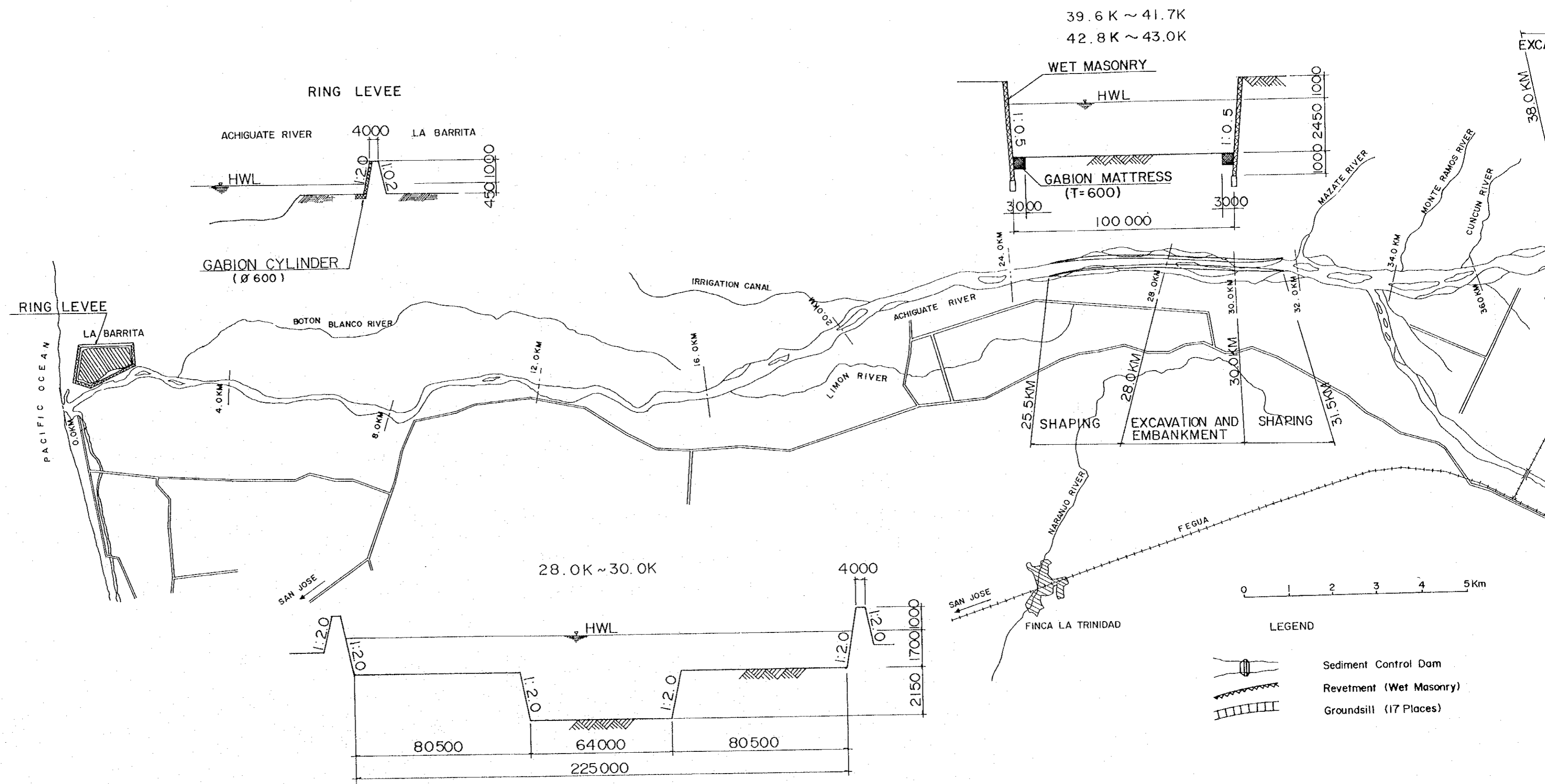
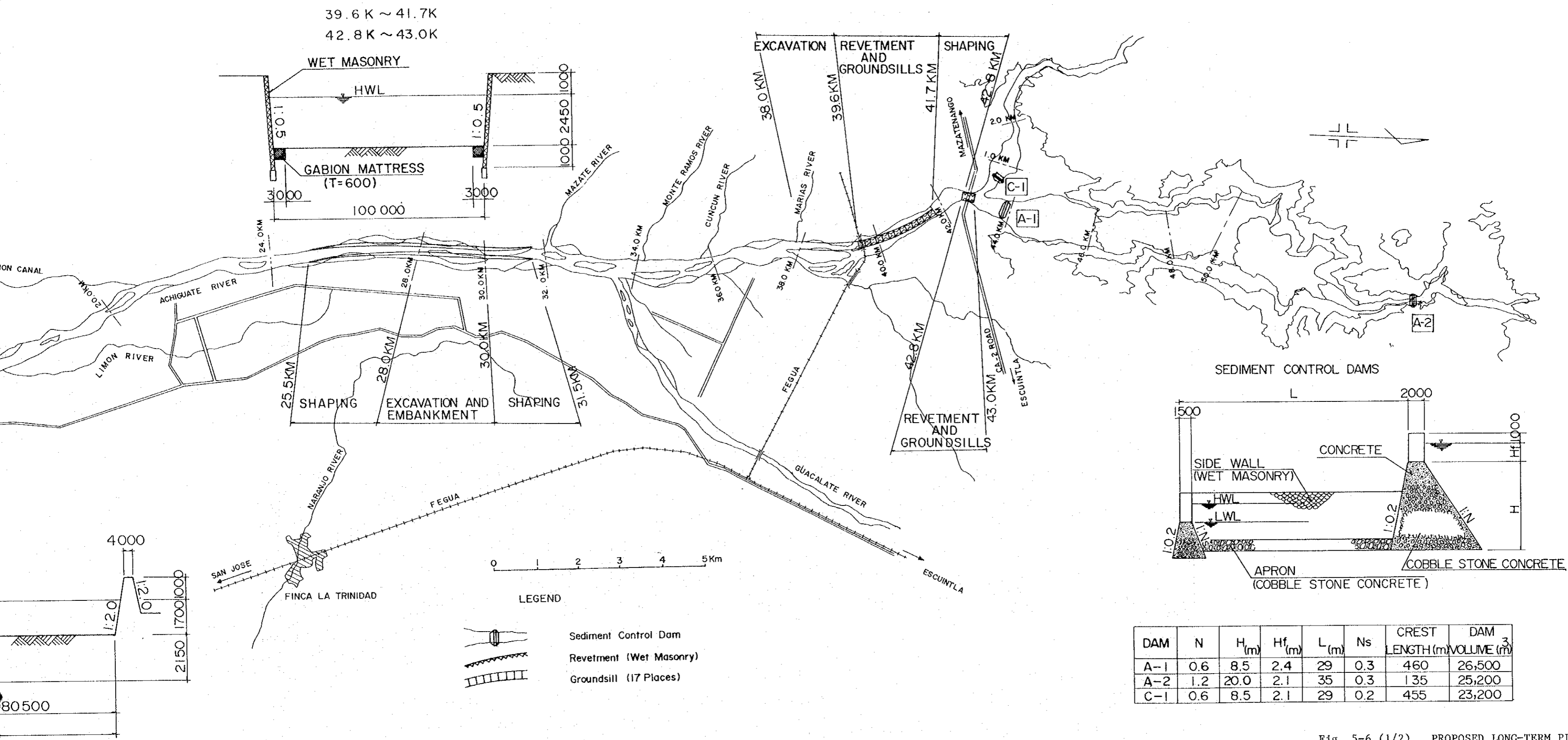
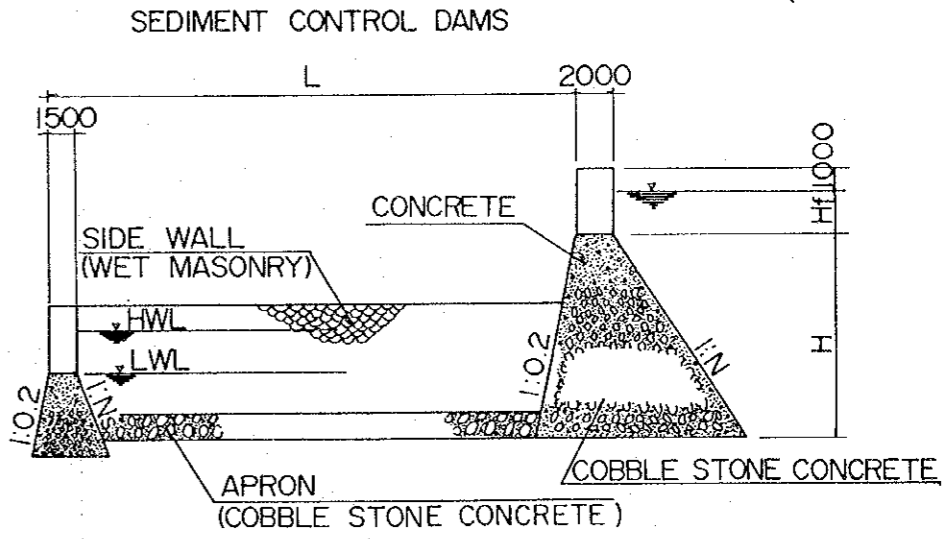
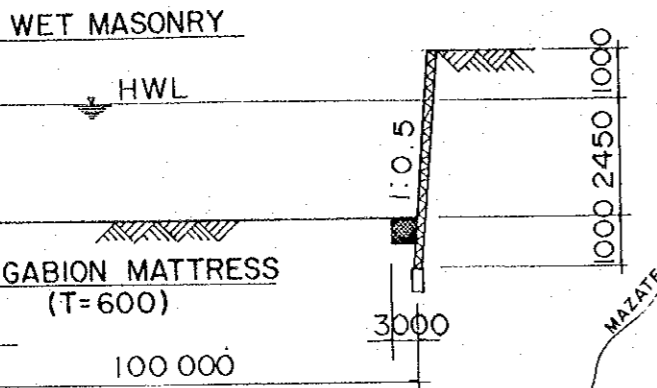


Fig. 5-5 (4/4) LOCATION OF ALTERNATIVE WORKS
(PANTALEON RIVER, PROTECTION OF THE BRIDGES)



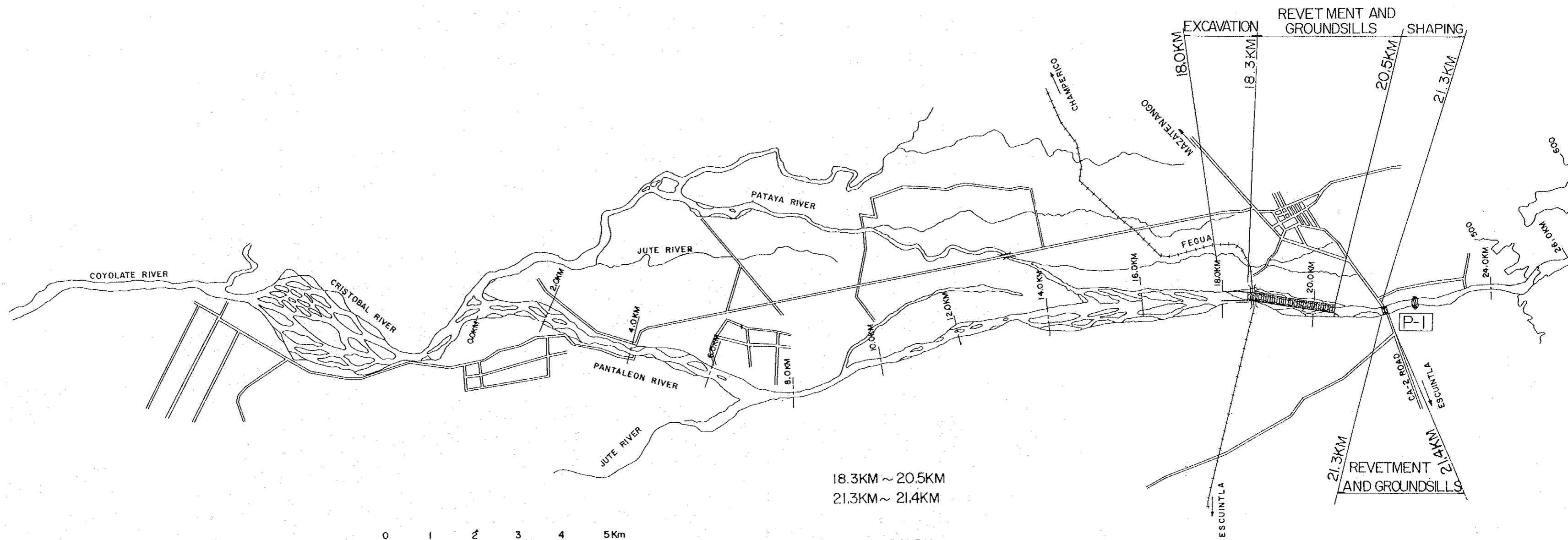


39.6 K ~ 41.7K
42.8 K ~ 43.0K



DAM	N	H ₁ (m)	H _f (m)	L (m)	N _s	CREST LENGTH (m)	DAM VOLUME (m ³)
A-1	0.6	8.5	2.4	29	0.3	460	26,500
A-2	1.2	20.0	2.1	35	0.3	135	25,200
C-1	0.6	8.5	2.1	29	0.2	455	23,200




Fig. 5-6 (1/2) PROPOSED LONG-TERM PLAN (ACHIGUATE RIVER)

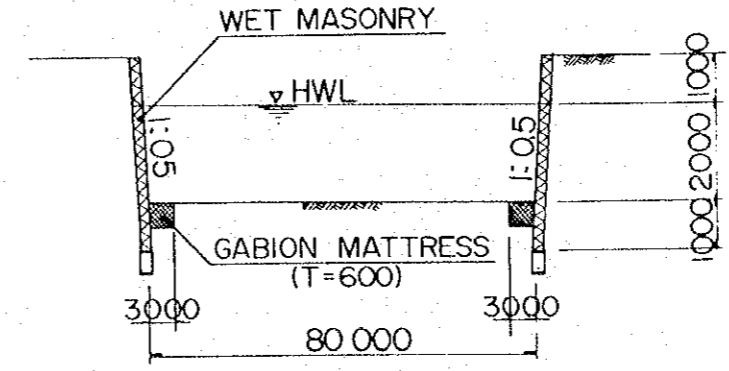


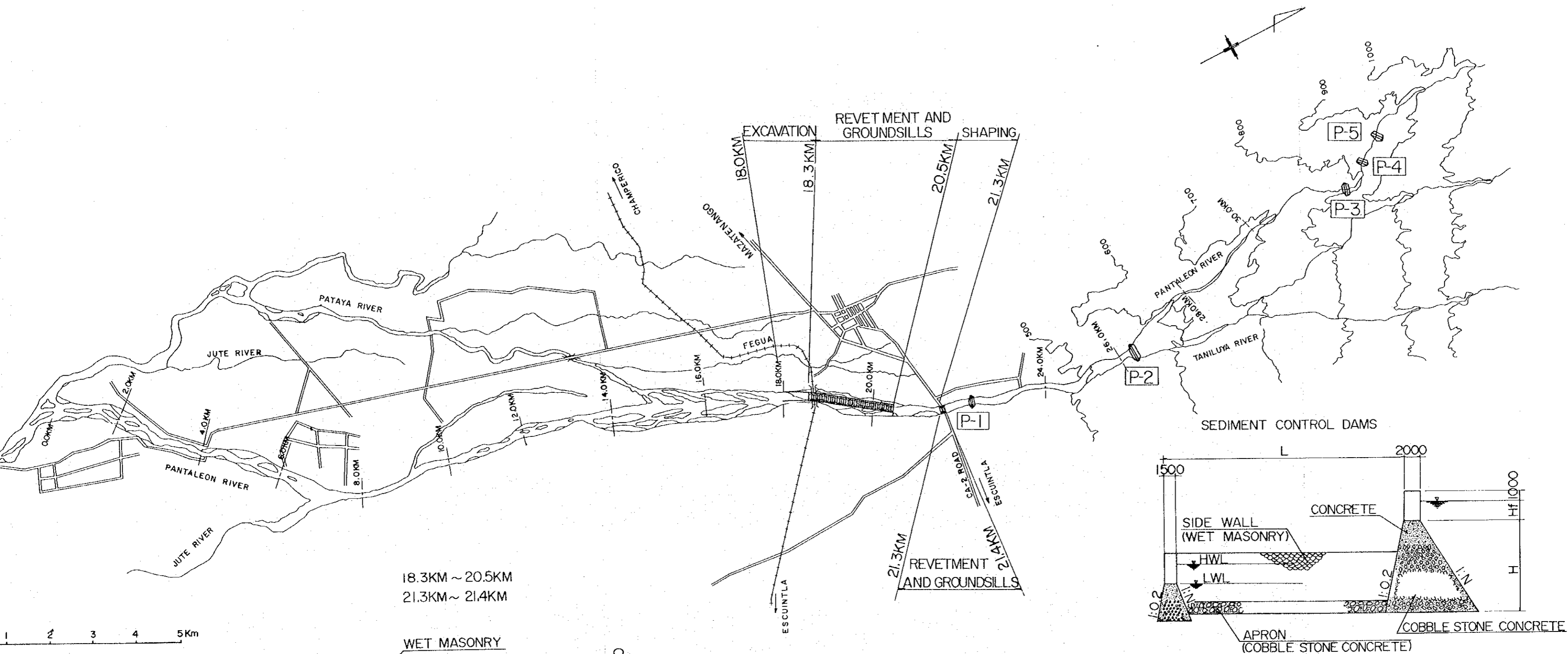
18.3KM ~ 20.5KM
21.3KM ~ 21.4KM



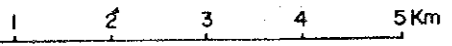
LEGEND

-  Sediment Control Dam
-  Revetment (Wet Masonry)
-  Groundsill (47 Places)

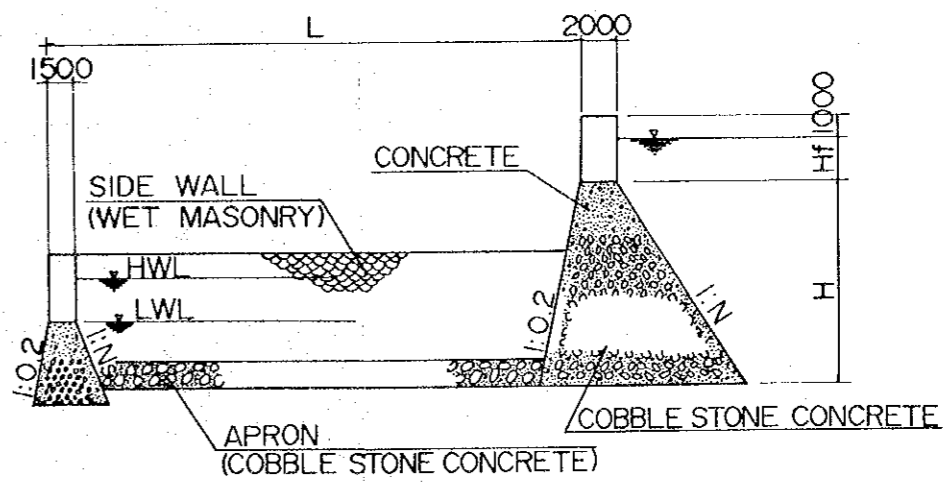
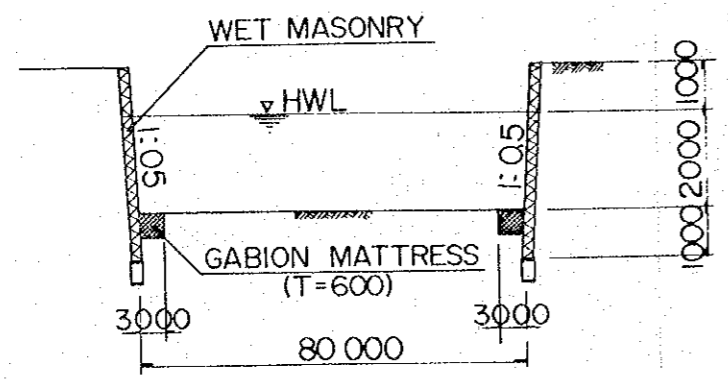




18.3KM ~ 20.5KM
21.3KM ~ 21.4KM



- GEND
- Sediment Control Dam
 - Revetment (Wet Masonry)
 - Groundsill (47 Places)

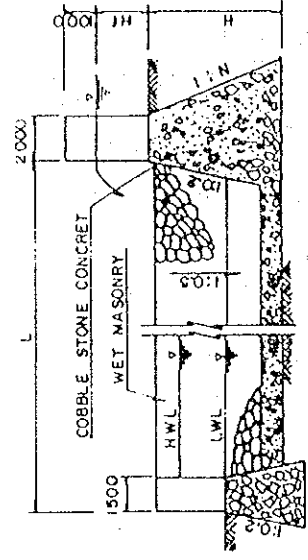


DAM	N	H _i (m)	H _f (m)	L (m)	N _s (m)	CREST LENGTH (m)	DAM VOLUME (m ³)
P-1	0.5	6.5	2.6	20	0.4	210	4,400
P-2	0.65	11.0	2.6	29	0.4	392	20,600
P-3	0.90	13.0	2.8	30	0.4	155	19,600
P-4	0.65	10.5	2.8	29	0.4	190	15,400
P-5	1.30	20.0	2.8	35	0.4	230	47,400

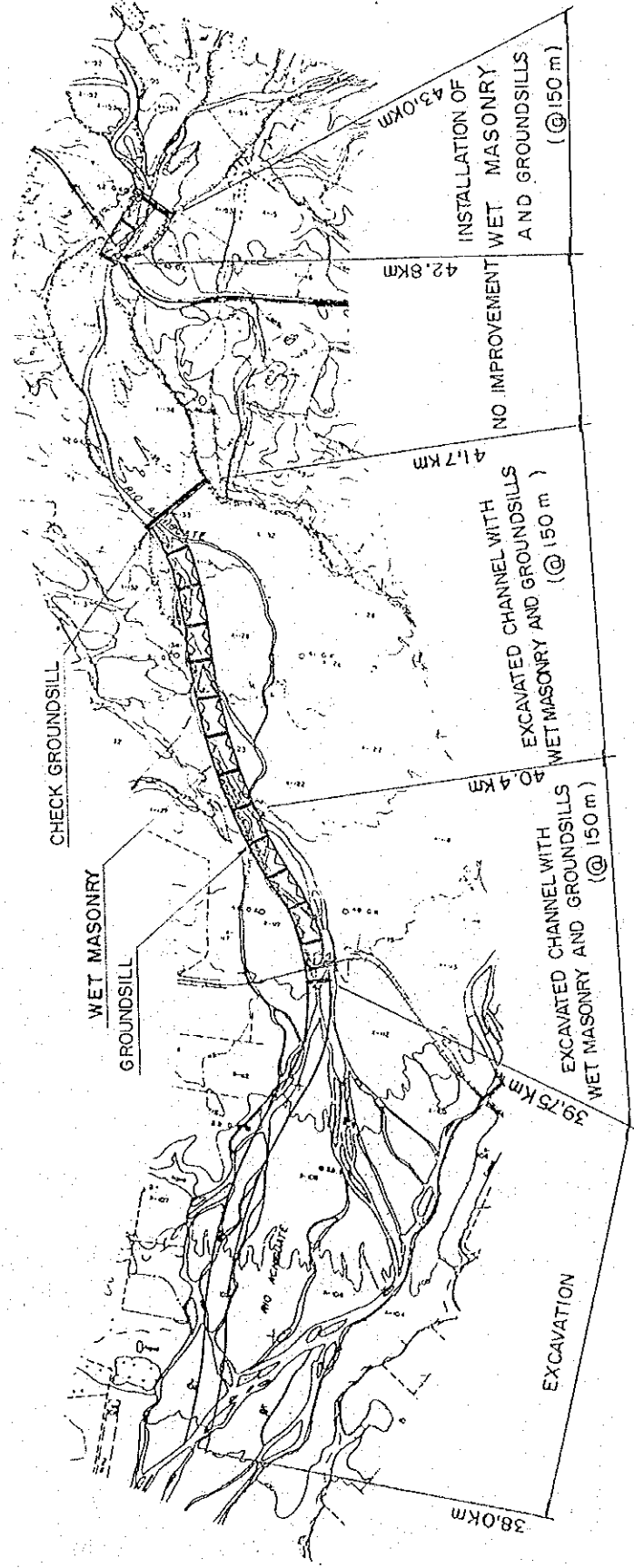
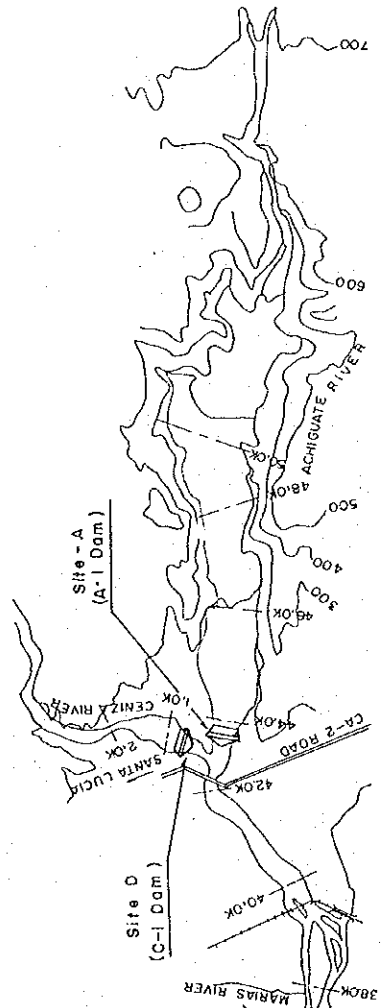
Fig. 5-6 (2/2) PROPOSED LONG-TERM PLAN (PANTALEON RIVER)

WORK STAGE	WORK VOLUME	1st Yr	2nd Yr	3rd Yr	4th Yr	5th Yr	6th Yr	7th Yr
SEDIMENT CONTROL DAM	ACHIGUATE	1 L/S						
	PREPARATION	1 L/S						
	EXCAVATION	103 000 m ³						
	MAIN DAM	78 000 m ³						
PANTALEON	SUB DAM	10 000 m ³						
	PREPARATION	1 L/S						
	EXCAVATION	202 000 m ³						
	MAIN DAM	126 000 m ³						
ACHIGUATE	SUB DAM	11 000 m ³						
	PREPARATION	1 L/S						
	EXCAVATION	140 000 m ³						
	EMBANKMENT	160 000 m ³						
	REVTMENT	4 600 m						
PANTALEON	GROUNDSILL	17 Units						
	DRAINAGE FACILITIES (RING LEVEE)	1 L/S						
	PREPARATION	1 L/S						
	EXCAVATION	240 000 m ³						
RIVER IMPROVEMENT	REVTMENT	4 600 m						
	GROUNDSILL	47 Units						

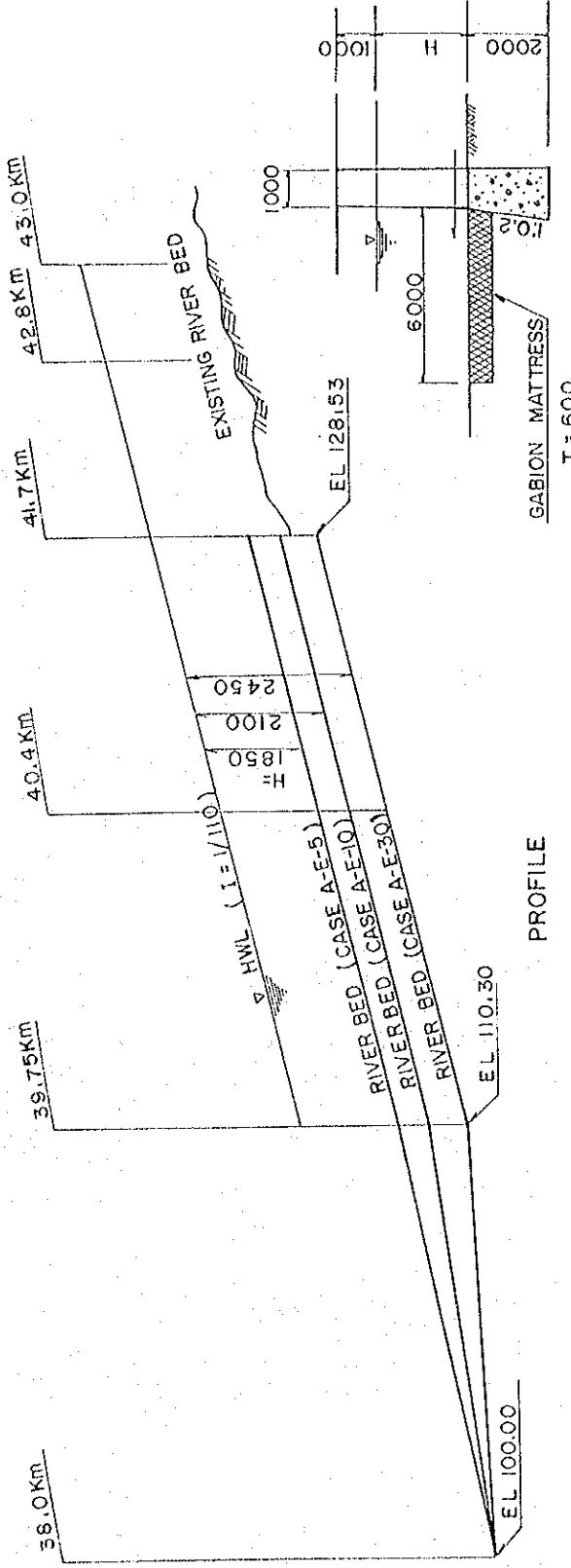
Fig. 5-7 CONSTRUCTION SCHEDULE



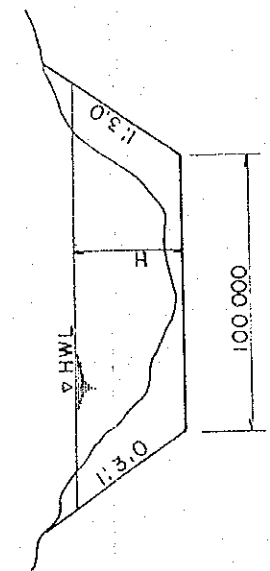
DAM	CASE	H (m)	I : N	Hf (m)	L (m)
A-1	A-E-5	6.5	0.5	2.4	24.0
	A-E-10	7.0	0.5	2.4	24.0
	A-E-30	7.5	0.55	2.4	24.0
C-1	A-E-5	5.5	0.4	2.1	21.0
	A-E-10	6.0	0.45	2.1	21.0
	A-E-30	7.5	0.5	2.1	21.0



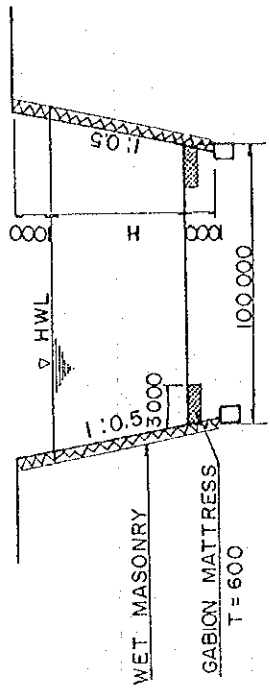
PLAN



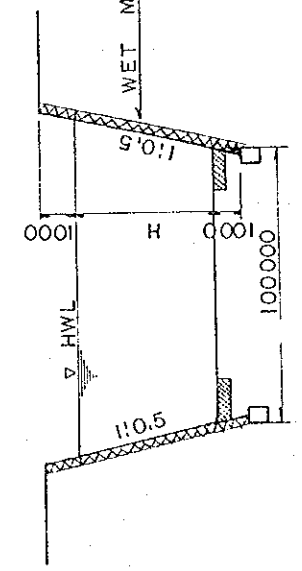
PROFILE



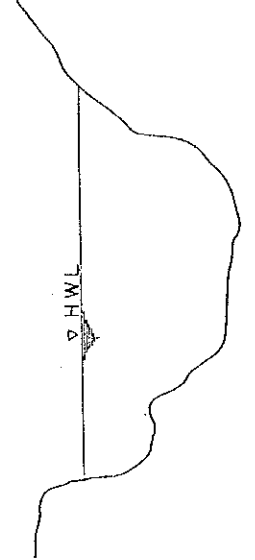
38.0 Km ~ 39.75 Km



39.75 Km ~ 40.4 Km



40.4 Km ~ 41.7 Km



41.7 Km ~ 43.0 Km

CROSS-SECTION

Fig. 6-1 (1/4) GENERAL FEATURES OF COMPARATIVE PLANS (A-E)

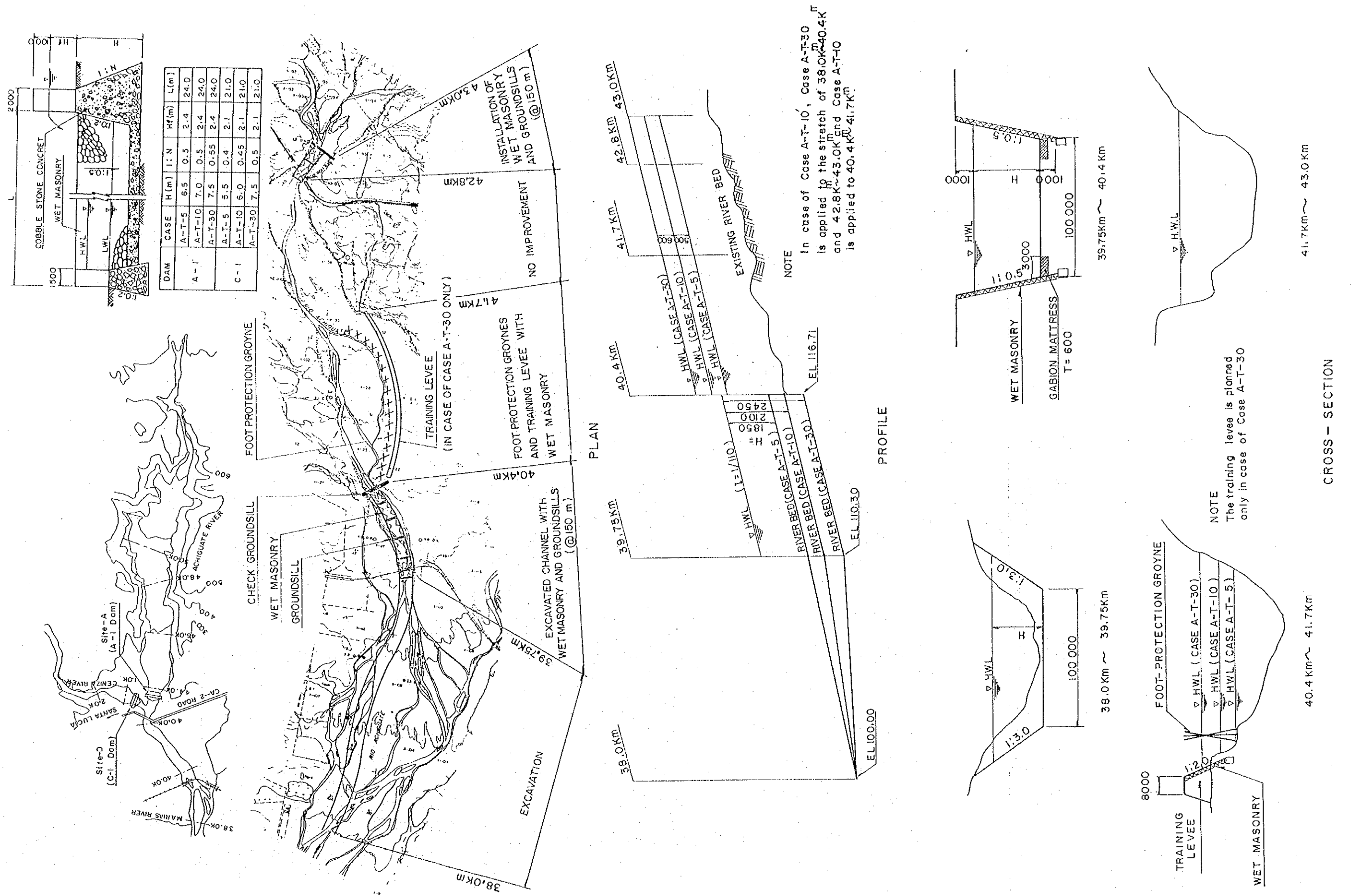
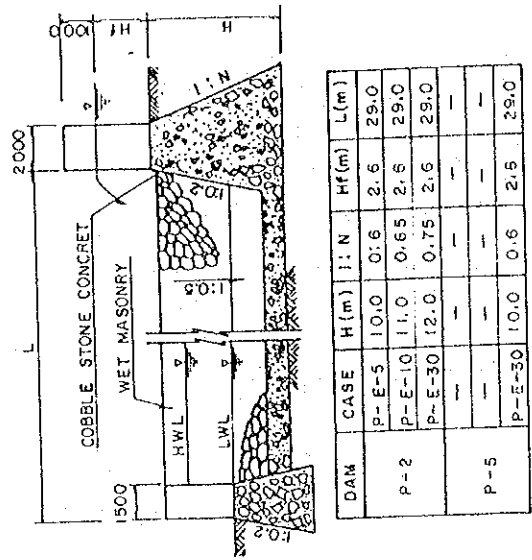
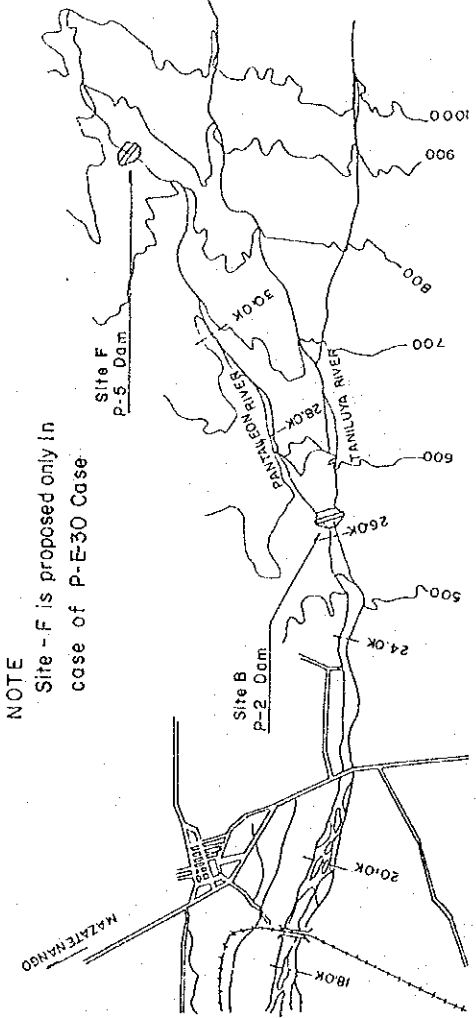


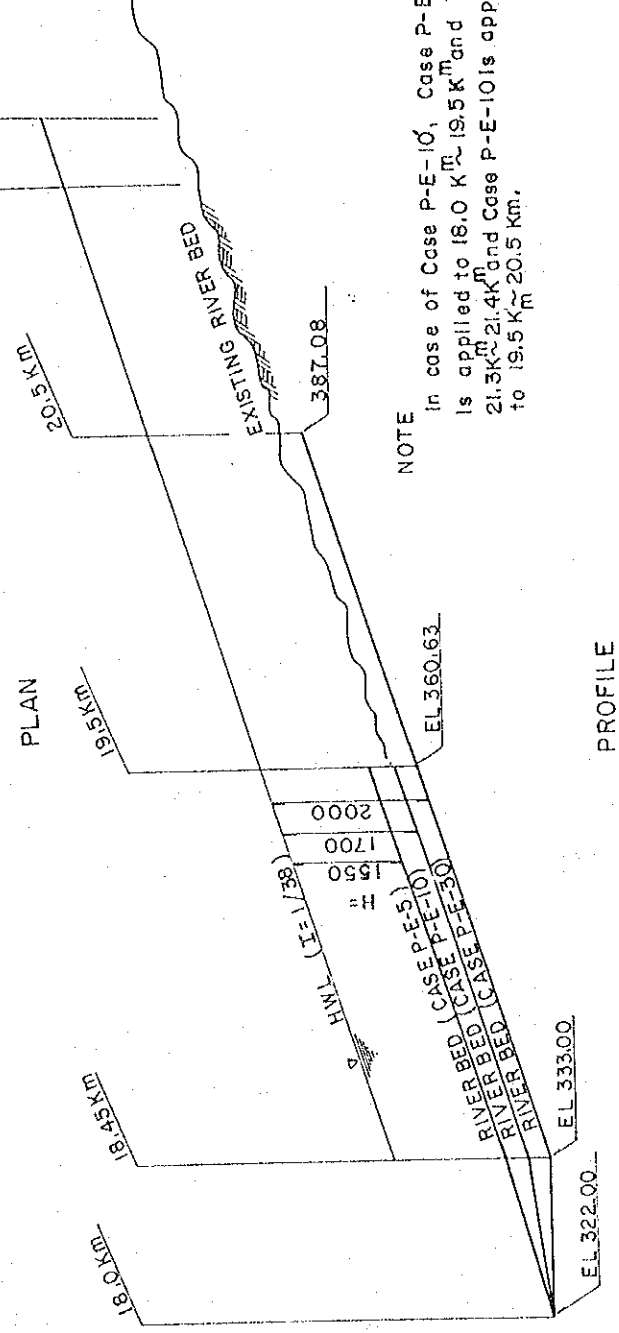
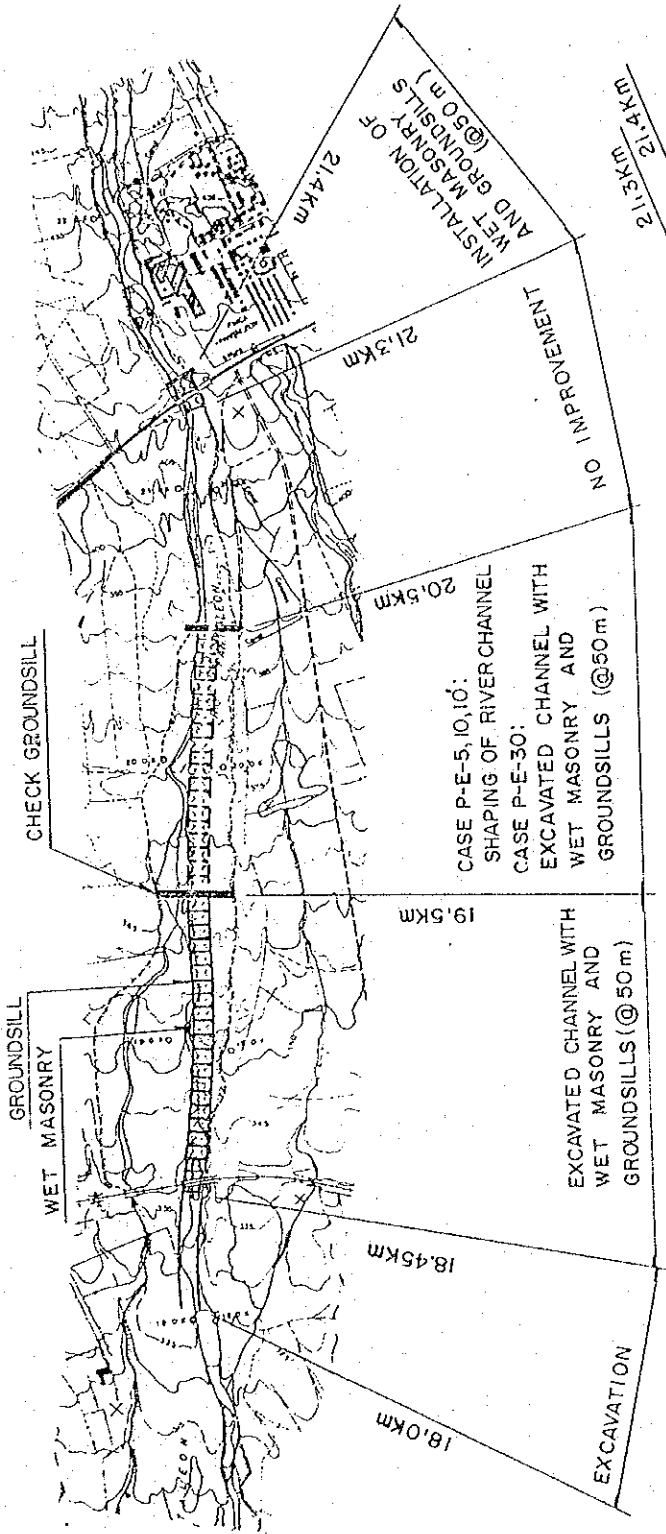
Fig. 6-1 (2/4) GENERAL FEATURES OF COMPARATIVE PLANS (A-T)



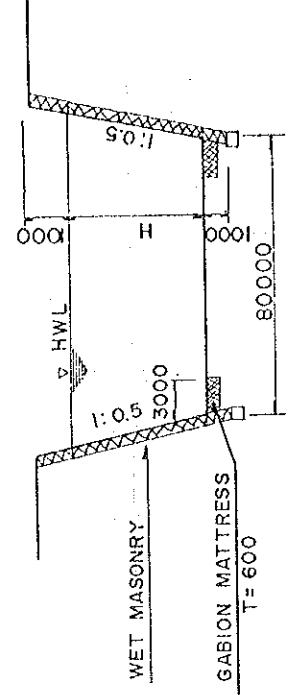
DAM	CASE	H (m)	I: N	Hf (m)	L (m)
P-2	P-E-5	10.0	0:6	2.5	29.0
	P-E-10	11.0	0:65	2.5	29.0
	P-E-30	12.0	0:75	2.6	29.0
P-5	—	—	—	—	—
	P-E-30	10.0	0:6	2.6	29.0



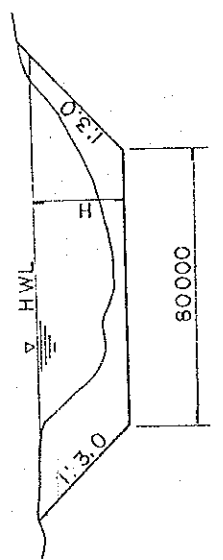
NOTE
Site - F is proposed only in case of P-E-30 Case



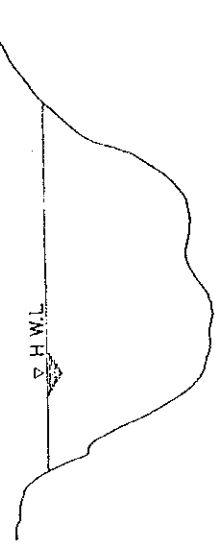
NOTE
In case of Case P-E-10, Case P-E-30 is applied to 18.0 Km, 19.5 Km and 21.3 Km, 21.4 Km and Case P-E-10 is applied to 19.5 Km ~ 20.5 Km.



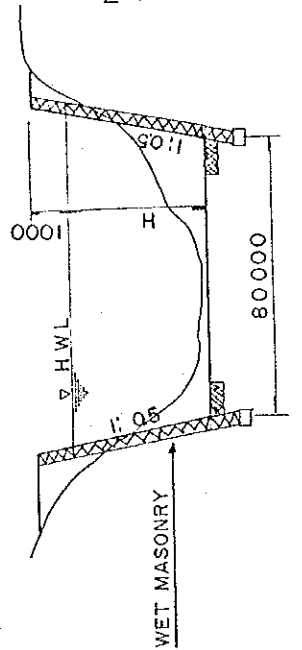
18.45km ~ 19.5km



18.0km ~ 18.45km



20.5km ~ 21.4km

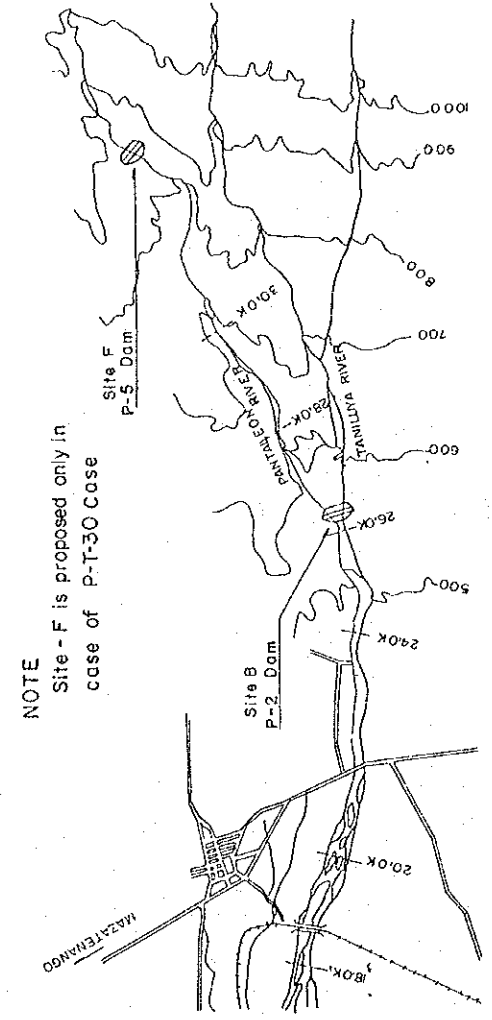
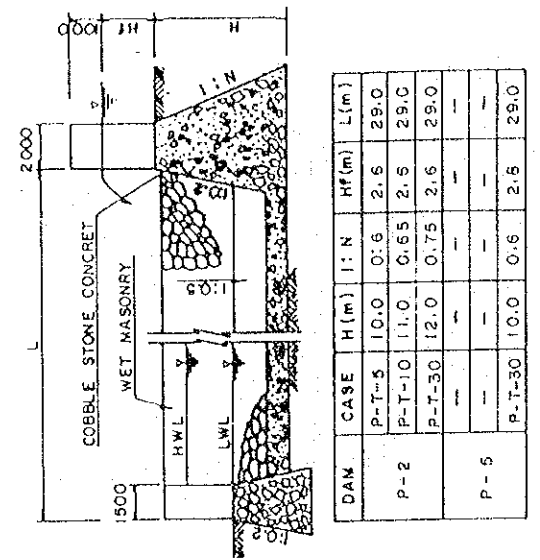


19.5km ~ 20.5km

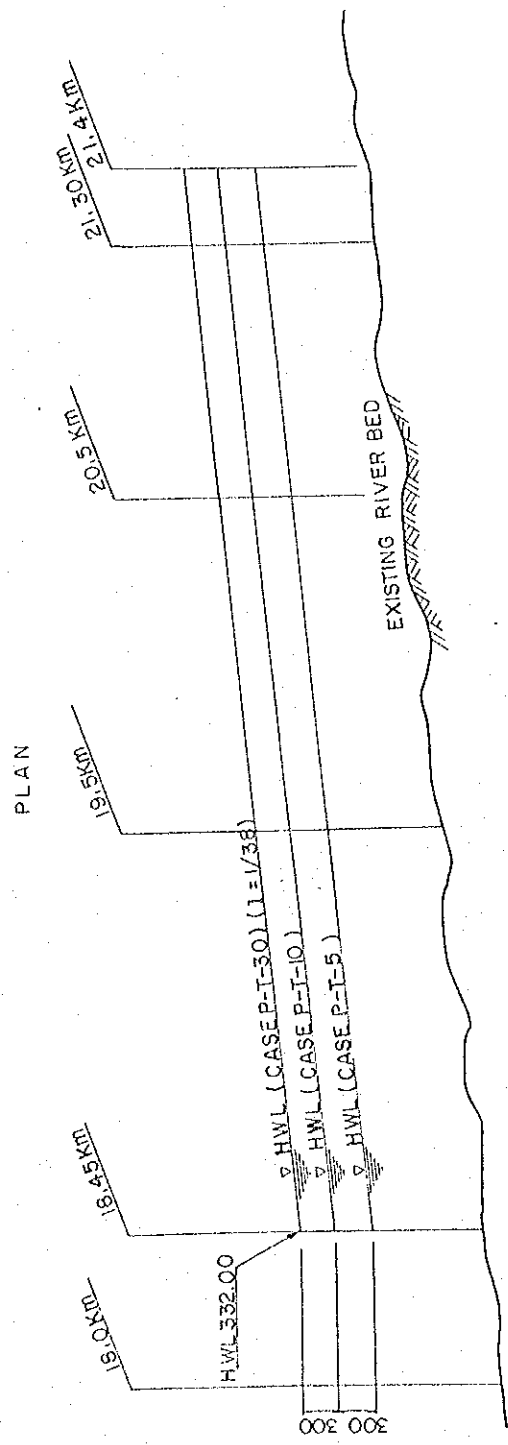
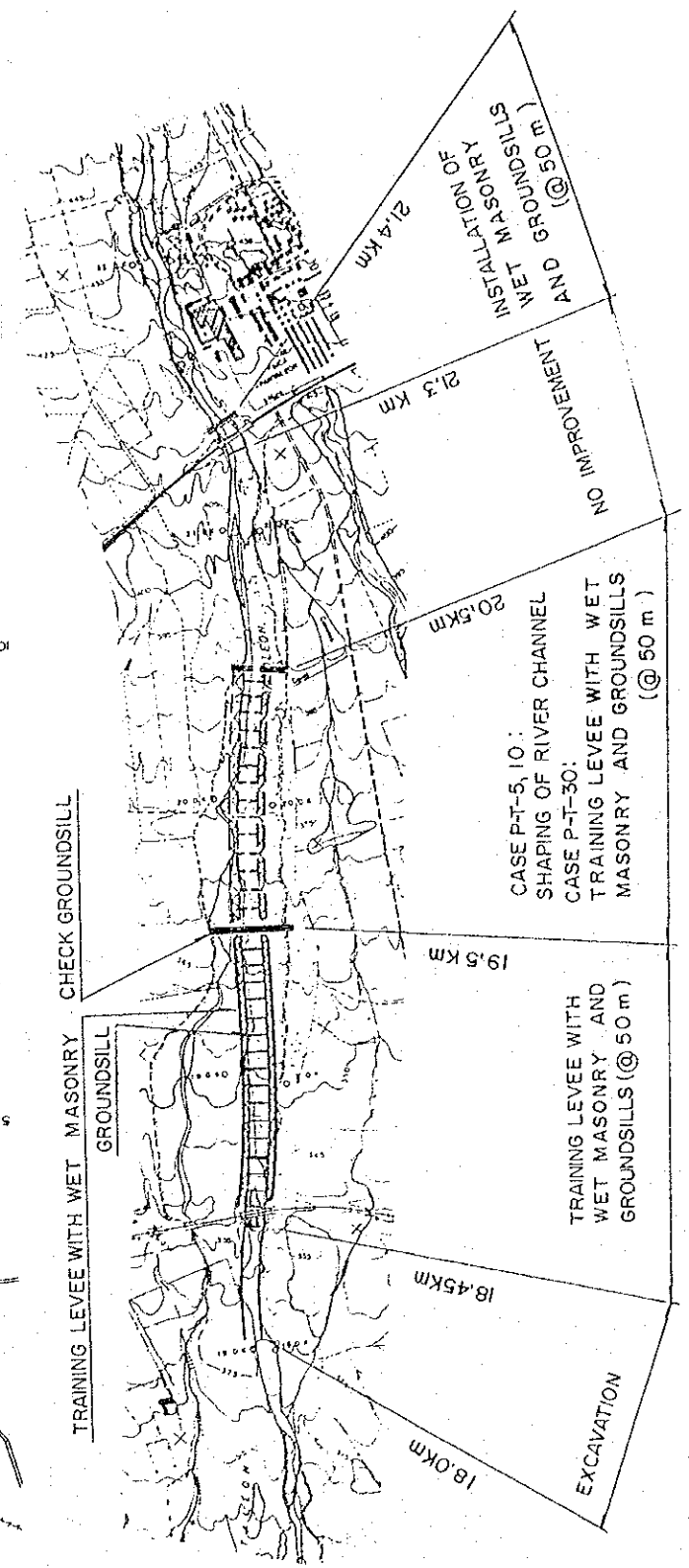
NOTE
The Wet Masonry works is planned only in case of Case P-E-30.

CROSS - SECTION

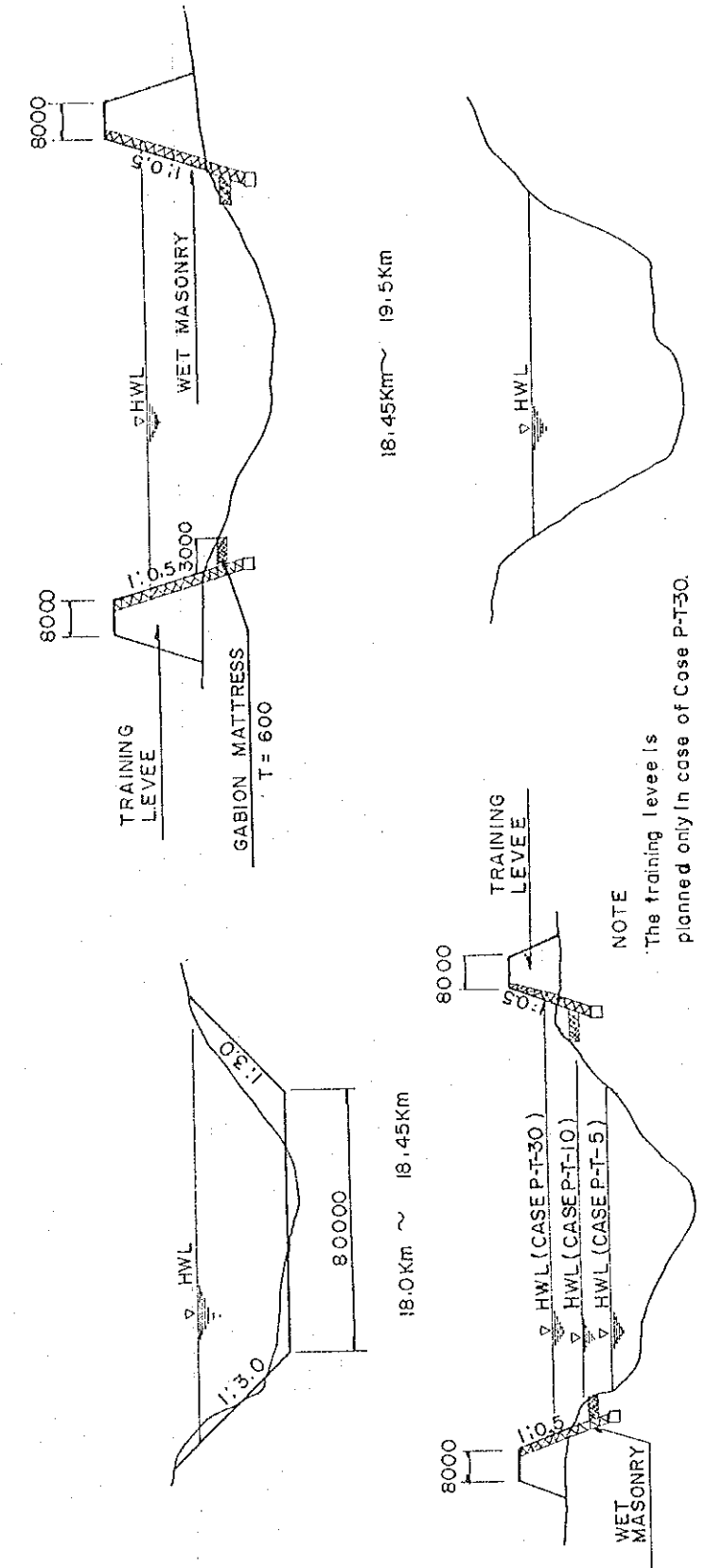
Fig. 6-1 (3/4) GENERAL FEATURES OF COMPARATIVE PLANS (P-E)



NOTE
Site F is proposed only in case of P-T-30 Case



PROFILE



CROSS - SECTION

Fig. 6-1 (4/4) GENERAL FEATURES OF COMPARATIVE PLANS (P-T)

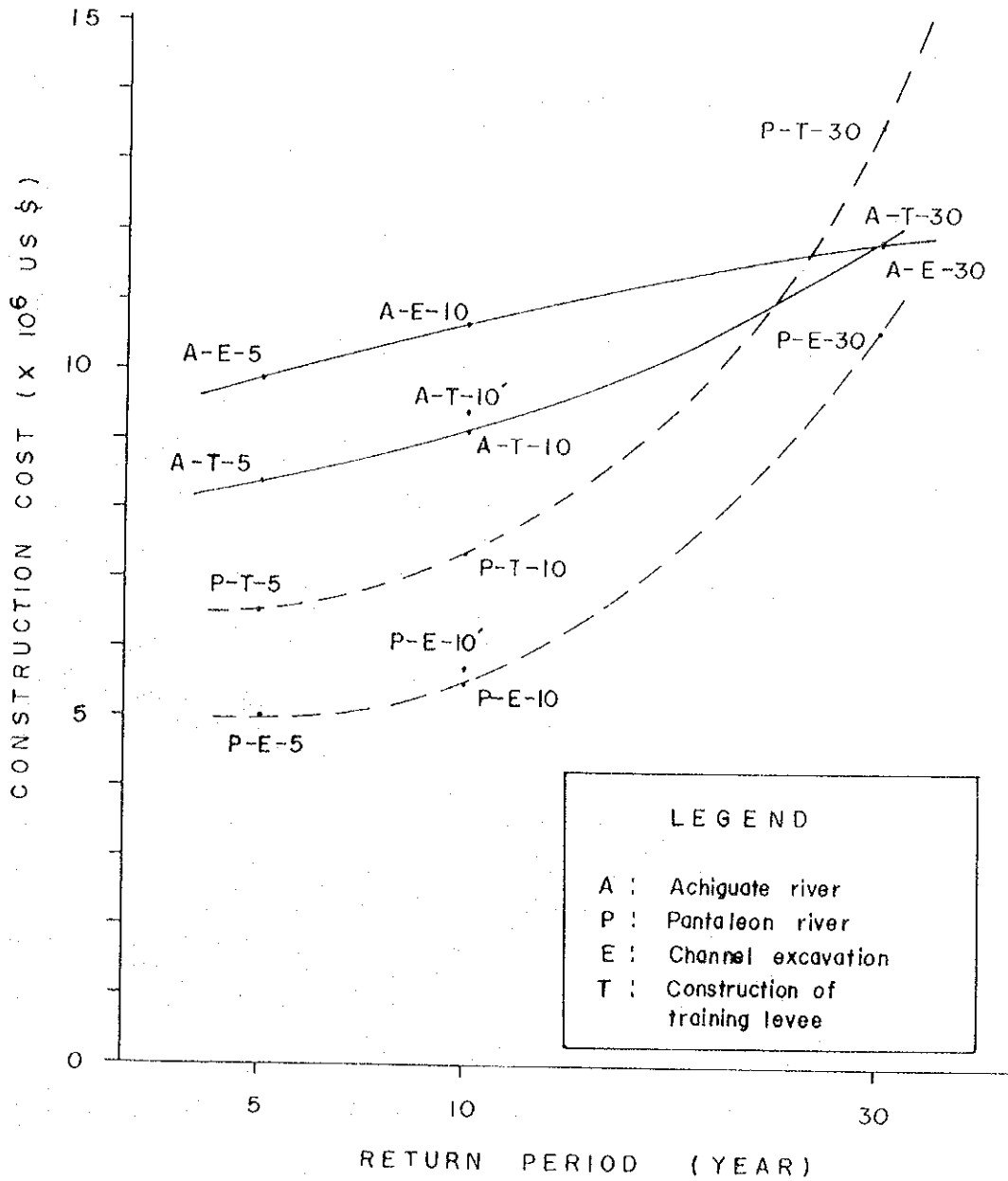


Fig. 6-2 COST COMPARISON FOR RIVER IMPROVEMENT METHODS

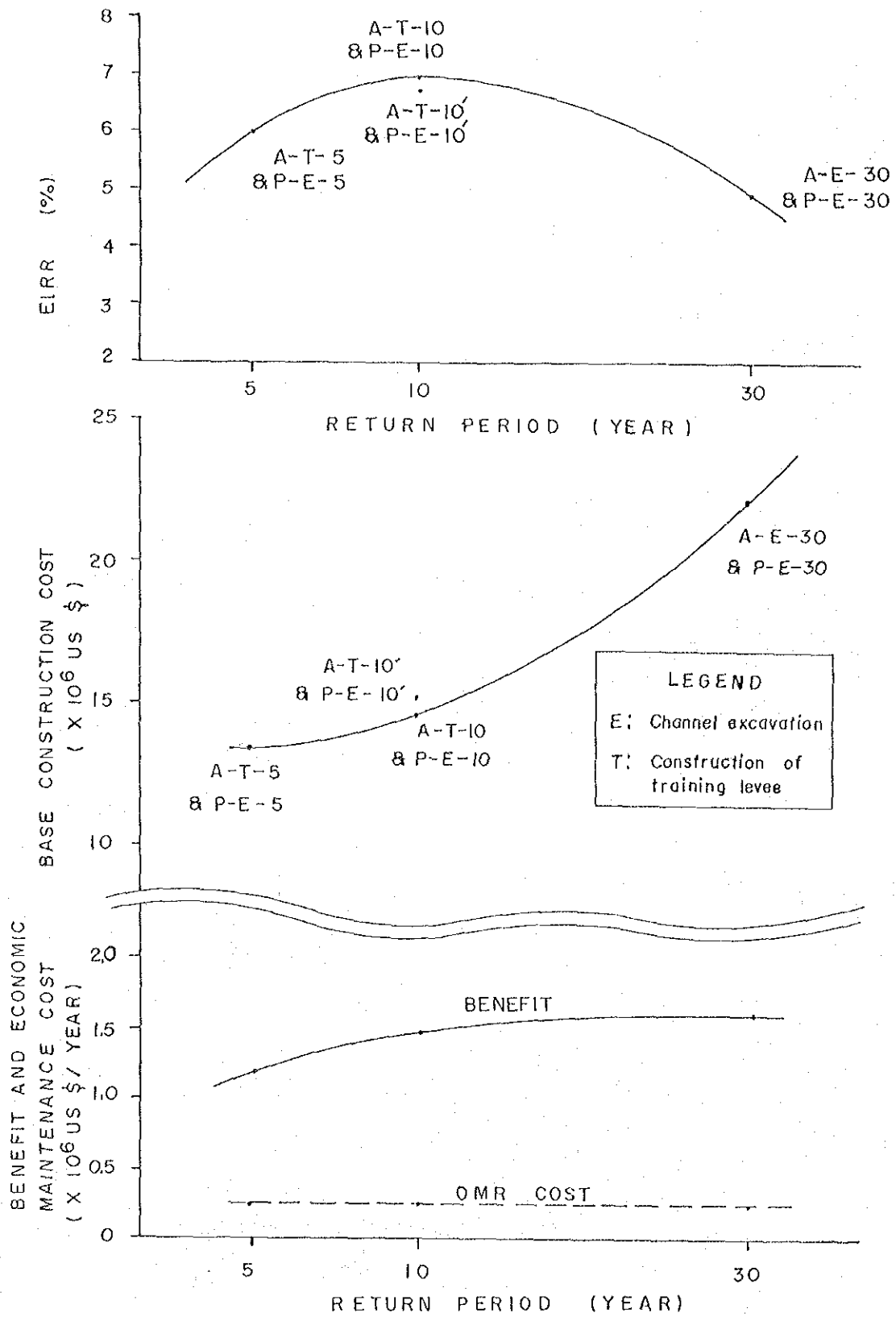
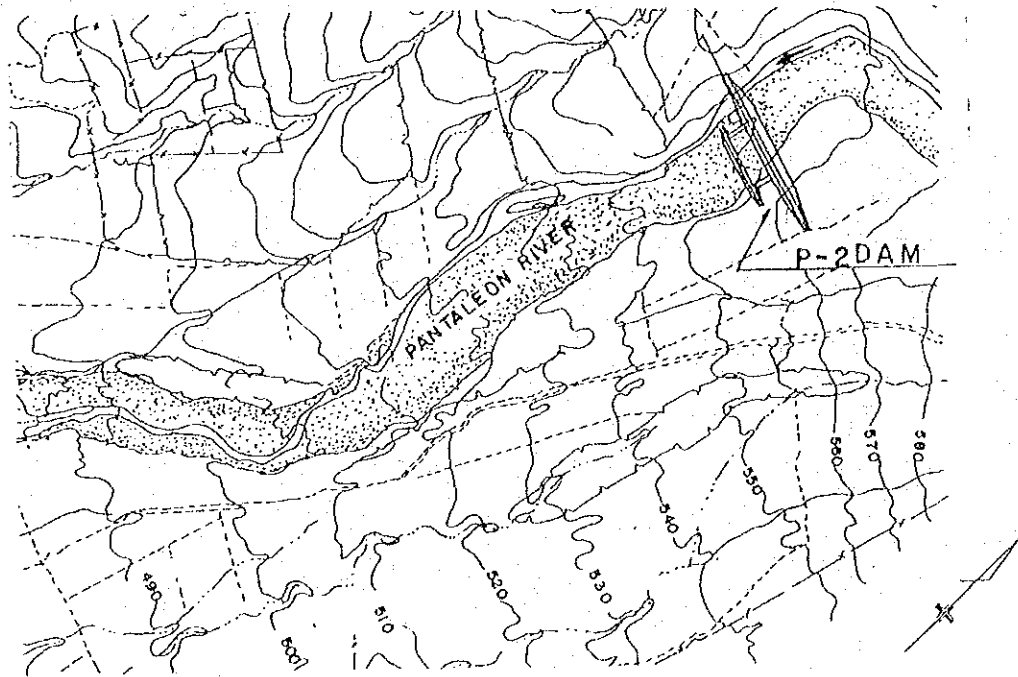
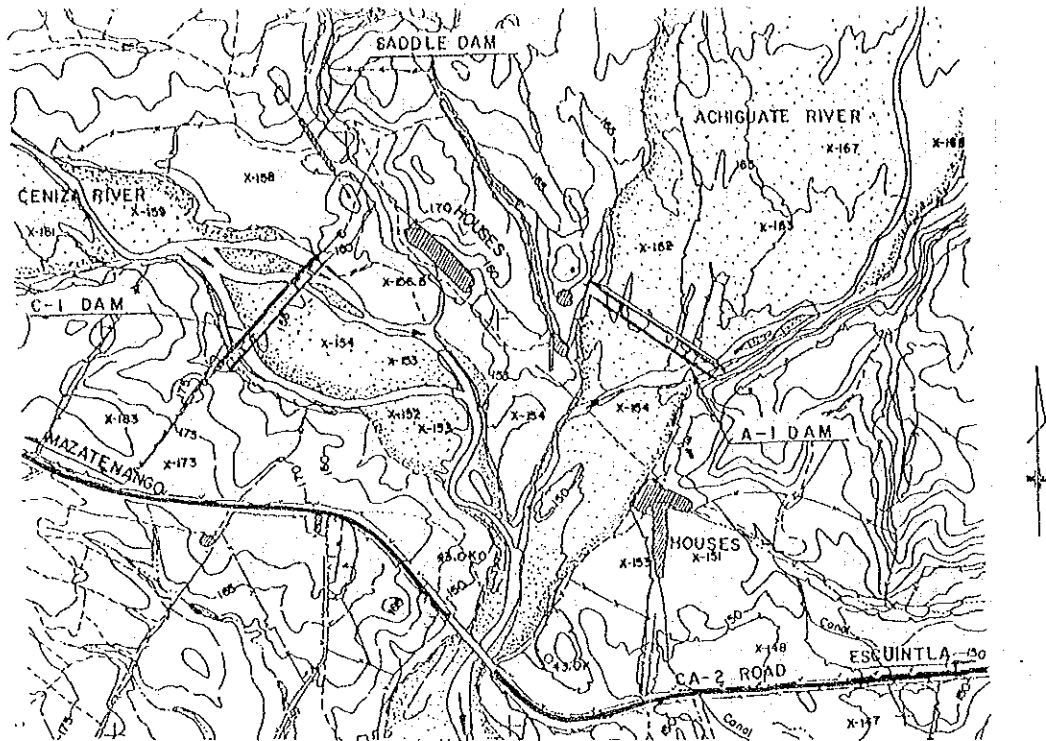


Fig. 6-3 ECONOMIC COMPARISON FOR PROJECT SCALES

Name of River	1930'S										1940'S										1950'S										1960'S										1970'S										1980'S										Numbers Occurrence	Frequency
	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84							
Suchiate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	10 Year											
Naranjo																																																		2	25 Year											
Ocosito																																								0	0	0	0	0	0	0	0	0	0	3	18 Year											
Samalia																																								0	0	0	0	0	0	0	0	0	0	12	5 Year											
Sis-Ican																																								0	0	0	0	0	0	0	0	0	0	3	18 Year											
Nahualate																																								0	0	0	0	0	0	0	0	0	0	2	25 Year											
Madre Vieja																																								0	0	0	0	0	0	0	0	0	0	1	50 Year											
Coyolate																																								0	0	0	0	0	0	0	0	0	0	7	8 Year											
Acome																																								0	0	0	0	0	0	0	0	0	0	1	50 Year											
Achiguate																																								0	0	0	0	0	0	0	0	0	0	18	3 Year											
María Linda																																								0	0	0	0	0	0	0	0	0	0	6	9 Year											
Paso Hondo																																								0	0	0	0	0	0	0	0	0	0	1	50 Year											
Los Escalvos																																								0	0	0	0	0	0	0	0	0	0	3	18 Year											
Paz																																								0	0	0	0	0	0	0	0	0	0	1	50 Year											
Motagua																																								0	0	0	0	0	0	0	0	0	0	10	5 Year											

Fig. 6-4 FLOOD DAMAGE FREQUENCIES OF RIVERS IN GUATEMALA



SCALE 0 500 1000 1500m

Fig. 6-5 LOCATION OF SEDIMENT CONTROL DAMS IN THE PROPOSED URGENT PLAN



NOTE 1. EXPLANATION OF SYMBOL

- | | | | |
|---------|---------|-----|--------------|
| +++++ | RAILWAY | ⌒ | FOREST |
| — — — | ROAD | □ | HOUSE |
| - - - - | PATHWAY | — — | BRIDGE |
| — · — · | STREAM | ⊙ ○ | STATION POST |
| -X-X- | FENCE | □ | BENCH MARK |

0 50 100 150 200 250m
SCALE 1:2,500

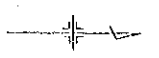
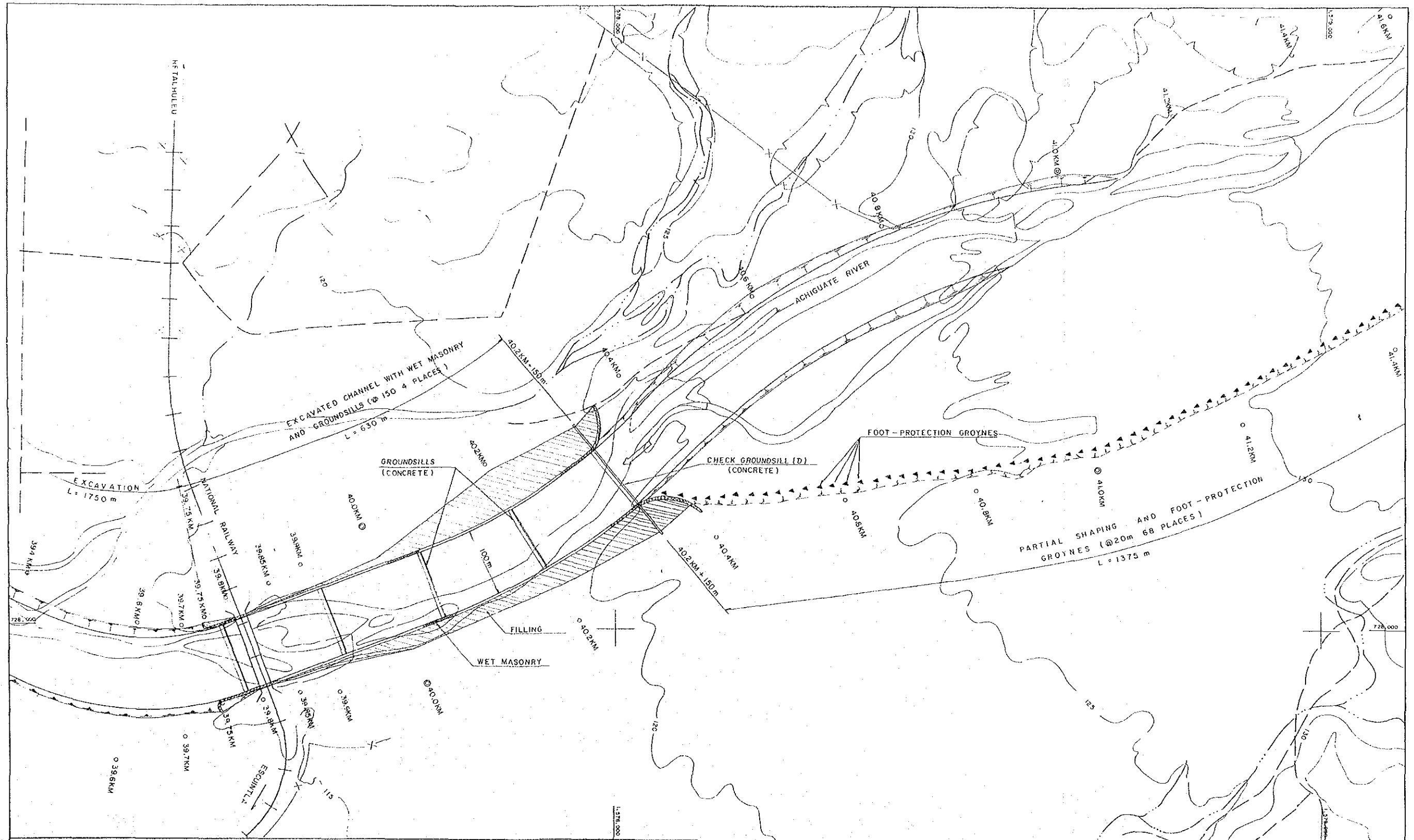


Fig. 6-6 (1/6) PLAN OF RIVER IMPROVEMENT IN THE PROPOSED URGENT PLAN (ACHIGUATE RIVER)



NOTE I. EXPLANATION OF SYMBOL

+++++	RAILWAY	⌒	FOREST
====	ROAD	□	HOUSE
----	PATHWAY	⌒	BRIDGE
----	STREAM	⊙	STATION POST
-X-X-	FENCE	⊠	BENCH MARK

0 50 100 150 200 250m
SCALE 1:2500

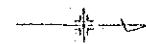
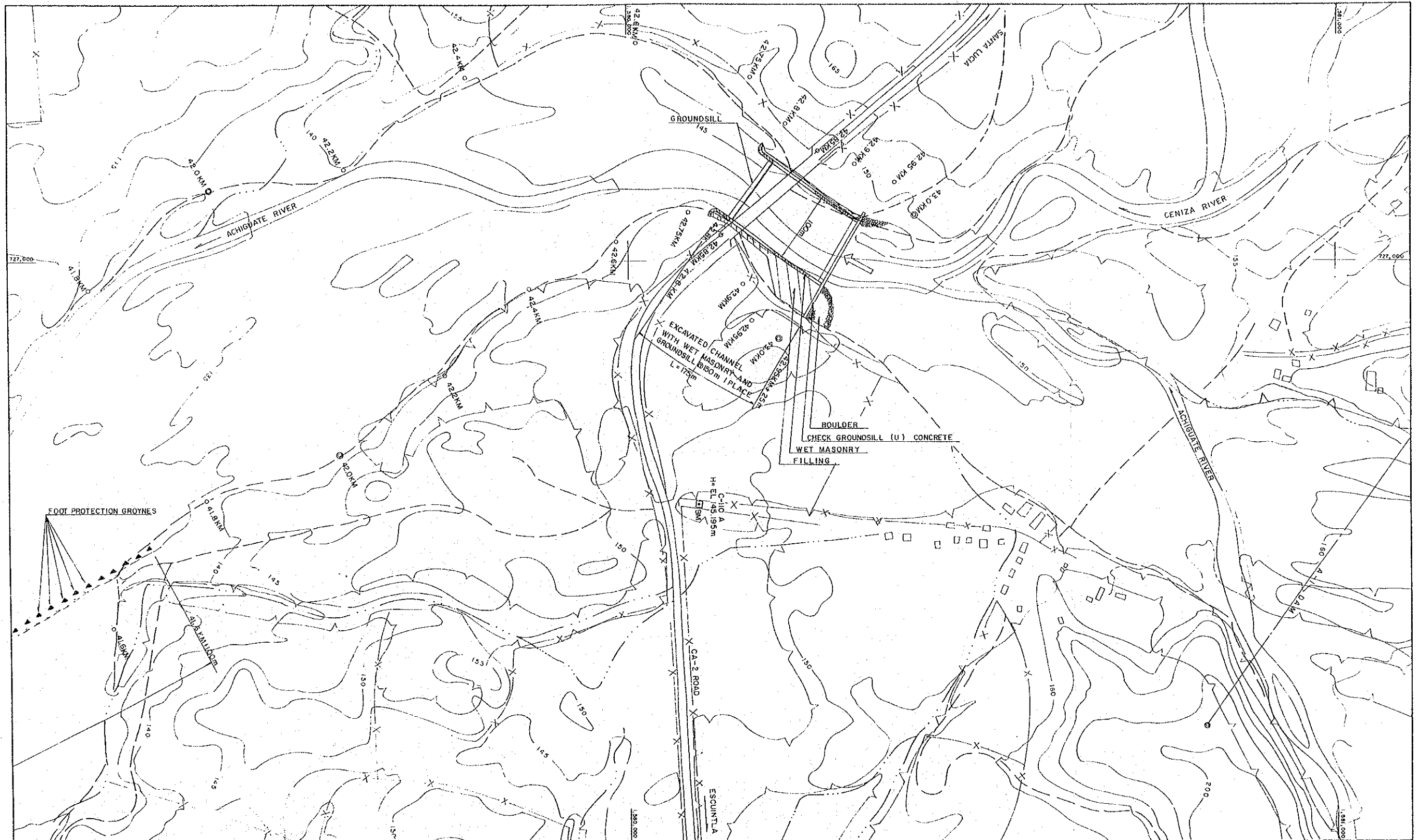


Fig. 6-6 (2/6) PLAN OF RIVER IMPROVEMENT IN THE PROPOSED URGENT PLAN (ACHIGUATE RIVER)



NOTE 1. EXPLANATION OF SYMBOL

++++	RAILWAY	~	FOREST
====	ROAD	□	HOUSE
----	PATHWAY		BRIDGE
----	STREAM	⊙ ○	STATION POST
-X-X-	FENCE	□	BM BENCH MARK

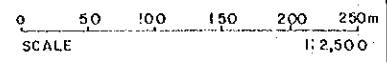


Fig. 6-6 (3/6) PLAN OF RIVER IMPROVEMENT IN THE PROPOSED URGENT PLAN (ACHIGUATE RIVER)



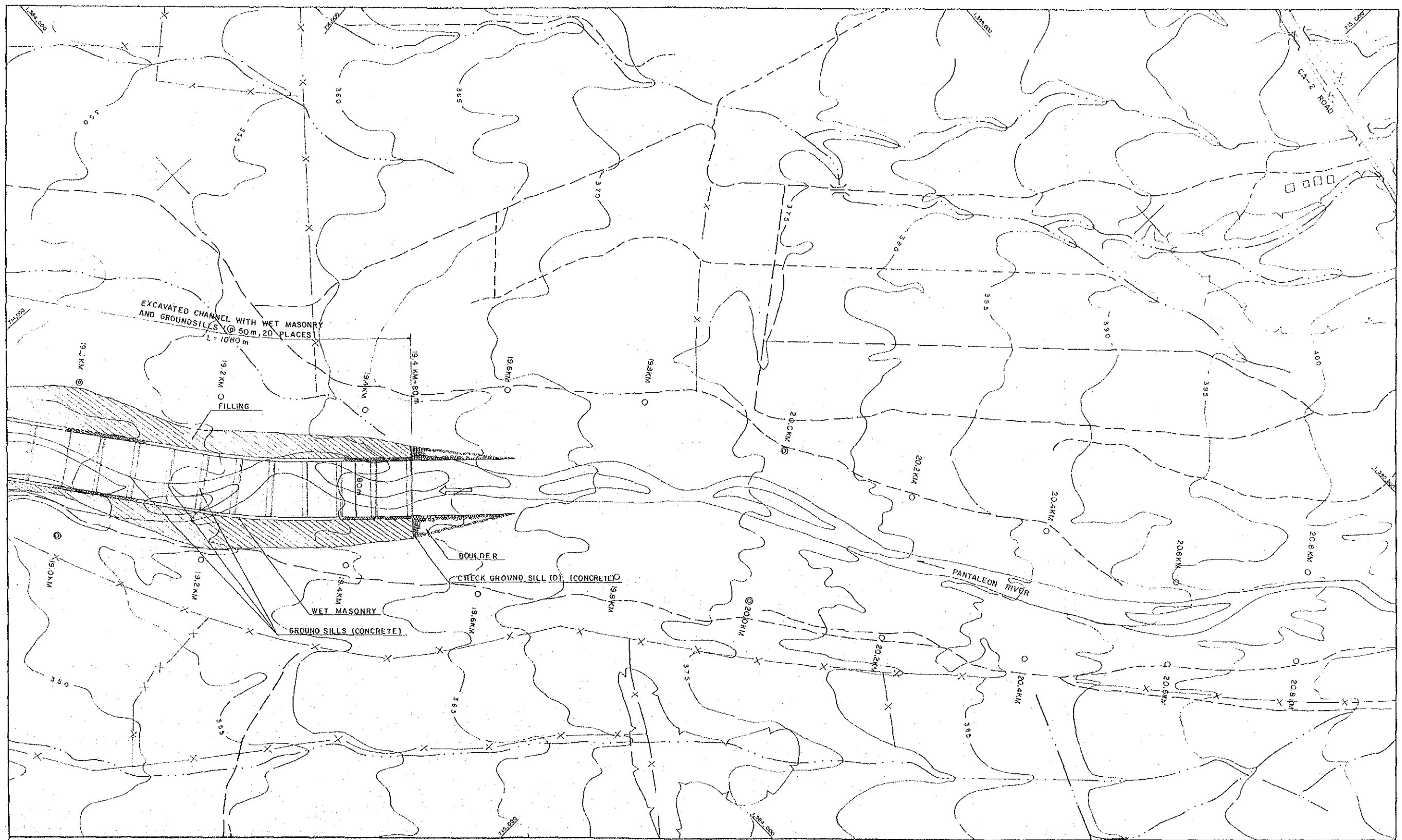
NOTE

I. EXPLANATION OF SIMBOL

+++++	RAILWAY	— — — —	FOREST
====	ROAD	□	HOUSE
----	PATHWAY	— —	BRIDGE
.....	STREAM	⊙ ○	STATION POST
-X-X-	FENCE	□	BENCH MARK

0 50 100 150 200 250m
SCALE 1:2,500

Fig. 6-6 (4/6) PLAN OF RIVER IMPROVEMENT IN THE PROPOSED URGENT PLAN (PANTALEON RIVER)



NOTE

I. EXPLANATION OF SYMBOL

++++	RAILWAY	~~~~~	FOREST
====	ROAD	□	HOUSE
----	PATHWAY	— —	BRIDGE
----	STREAM	⊙ ○	STATION POST
-X-X-	FENCE	□	BENCH MARK

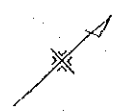
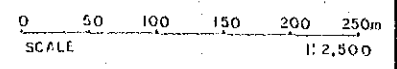
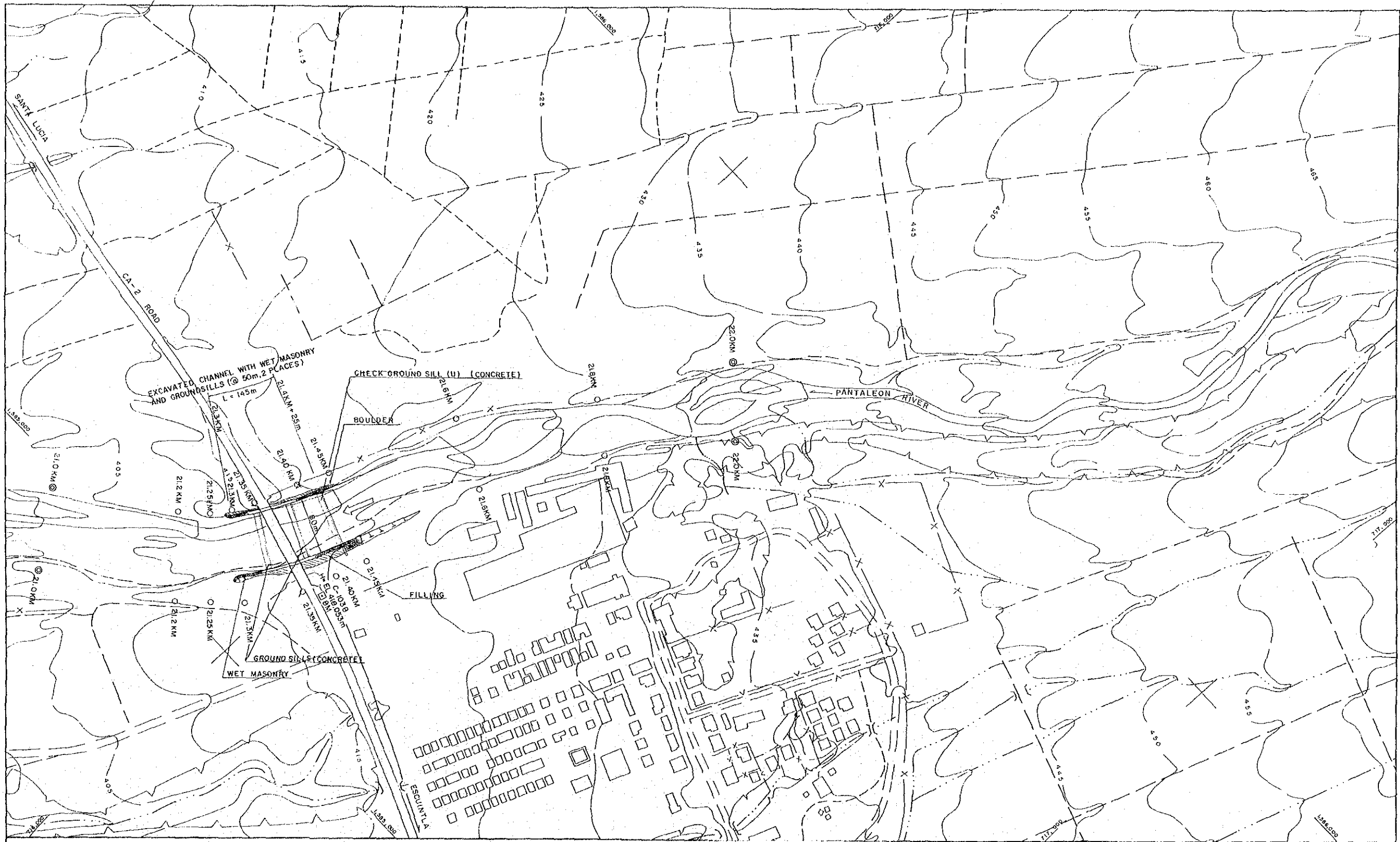


Fig. 6-6 (5/6) PLAN OF RIVER IMPROVEMENT IN THE PROPOSED URGENT PLAN (PANTALEON RIVER)



NOTE 1. EXPLANATION OF SYMBOL

+++++	RAILWAY	⌋⌋⌋⌋	FOREST
— — —	ROAD	▭	HOUSE
- - - -	PATHWAY	— — —	BRIDGE
⋯ ⋯ ⋯	STREAM	⊙ ○	STATION POST
-X-X-	FENCE	□	BM BENCH MARK

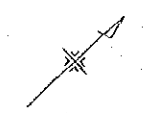
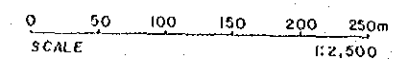
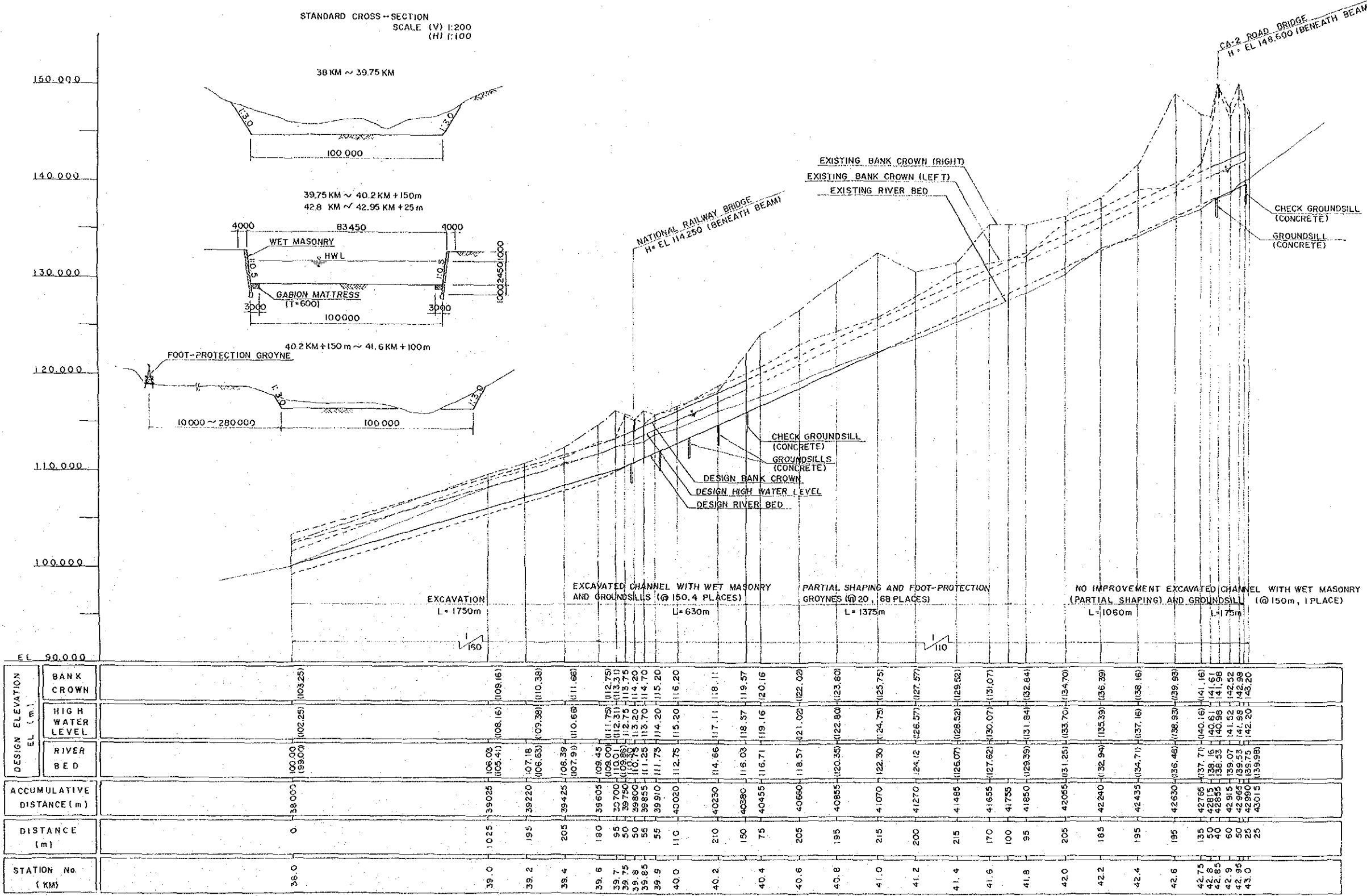


Fig. 6-6 (6/6) PLAN OF RIVER IMPROVEMENT IN THE PROPOSED URGENT PLAN (PANTALEON RIVER)



NOTE

1. The real lines and broken lines in the drawing and also the figures outside () and inside () in the columns are applied to the urgent plan and the comprehensive long-term plan, respectively.

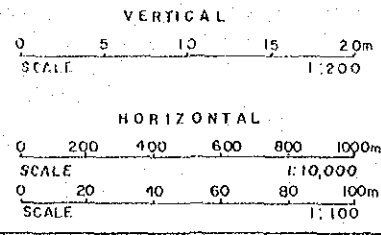
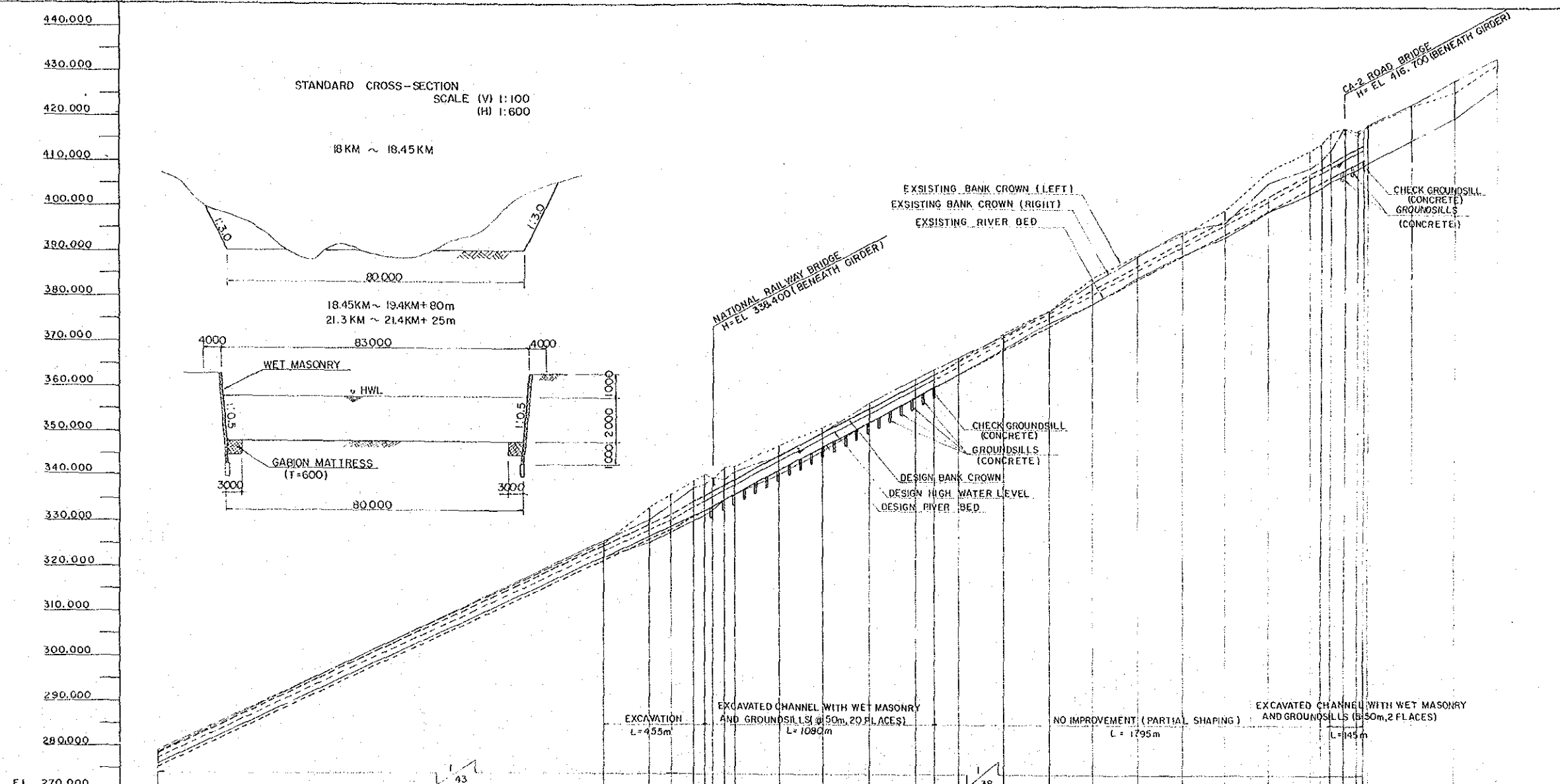


Fig. 6-7 (1/2) DESIGN PROFILE OF RIVER CHANNEL IN THE PROPOSED URGENT PLAN (ACHIGUATE RIVER)



DESIGN ELEVATION EL (m)	BANK CROWN		HIGH WATER LEVEL	RIVER BED	ACCUMULATIVE DISTANCE (m)	DISTANCE (m)	STATION No. (KM)
	()	()					
270.000					6000	0	16.0
320.000					18010	2010	18.0
330.000					18210	200	18.2
340.000					18310	100	18.3
350.000					18415	105	18.4
360.000					18465	50	18.45
370.000					18500	35	18.5
380.000					18535	35	18.55
390.000					18565	50	18.6
400.000					18805	200	18.8
410.000					19000	195	19.0
420.000					19205	205	19.2
430.000					19415	210	19.4
440.000					19495	80	19.45
					19610	115	19.6
					19815	205	19.8
					20020	205	20.0
					20215	195	20.2
					20420	205	20.4
					20620	200	20.6
					20810	190	20.8
					21010	200	21.0
					21200	190	21.2
					21250	50	21.25
					21290	40	21.3
					21350	60	21.35
					21410	60	21.4
					21435	25	21.45
					21460		
					21655	195	21.6
					21850	195	21.8
					22045	195	22.0

NOTE

1. The real lines and broken lines in the drawing and also the figures outside () and inside () in the columns are applied to the urgent plan and the comprehensive long-term plan, respectively.

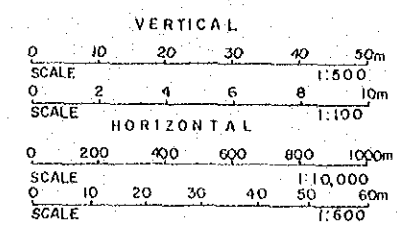


Fig. 6-7 (2/2) DESIGN PROFILE OF RIVER CHANNEL IN THE PROPOSED URGENT PLAN (PANTALEON RIVER)