4. FLOOD CONTROL PLAN FOR PANTAL-SINOCALAN RIVER

4. FLOOD CONTROL PLAN FOR PANTAL-SINOCALAN RIVER

4.1 River Improvement Plan

4.1.1 Basic Concept for Plan Formulation

(1) Outline of Priority Project Plan

The Framework Plan for the Allied Rivers was formulated for the flood control target of a 50-year probable flood with the combination of river improvements and a new Binalonan floodway. The general layout of the Framework Plan is illustrated in Figure 4.1.1.

As a stage development plan of the Framework Plan, the Long Term Plan was formulated with the optimum development scale of a 10-year probable flood. As a step to the Long Term Plan, the river improvement for the downstream stretch of the Pantal-Sinocalan river (27.5 km), the Dagupan river (19.5 km of back levee), and the Ingalera river (10.7 km) was selected as the priority flood control project to be urgently implemented.

The downstream reaches of the Pantal-Sinocalan river subject to river improvement lie in the urban area of Dagupan City. After comparative study of alternative river improvement plans in Section 4.2, the bypass channel plan which serves to minimize technical and socio-economic issues expected to be induced by river improvement thereof was adopted for pursuing the Feasibility Study.

Along this line, the design flood discharge distribution for the Framework Plan and the Priority Project were updated as shown in Figure 4.1.2 and Figure 4.1.3 respectively.

(2) Plan Formulation Criteria

The priority river improvement plan was formulated from the following criteria:

a) The 10-year design flood discharge distribution shown in Figure 4.1.3 is adopted.

b) The present condition for the basis of plan formulation is the one after completion of the DPWH's earthquake damage rehabilitation program.

c) Existing intake facilities which hinder the discharge of 10-year design flood and/or have inadequate structural types are to be improved.

d) Existing bridges which have insufficient dimensions to meet the design elevation of dike crown and/or design river width, are to be improved with the 50-year design flood in principle. In case the 10-year flood can be flown with required freeboard by extension works of existing bridge length, those bridges are to be improved with the 10-year design flood. Reconstruction of foot-bridges for local communities is not covered by the Priority Project.

e) Dagupan city, towns of Calaciao and Santa Barbara, and their neighboring area are subject to flood protection.

f) The following topographic conditions are to be taken into consideration;

. The lower reaches of the junction with the Mitura have not sufficient flow carrying capacity for a 10-year probable flood. In the upper stretch on Santa Barbara, the areas which suffers overbank flooding are confined by the embankment of the ARIS irrigation canal.

. In the Dagupan River stretch, the elevation of the banks in the stretch between the junction with the by-pass channel and the 19 km upstream from the junction is lower than the back water level of the main Pantal River. There exists no configuration of topography or infrastructures which confines the overbanked flood water from spreading to Dagupan city area.

. In the Ingalera River stretch, the elevation of banks in the 3.5 km long upper stretch of the junction with the Sinocalan is lower than the back water level of the Sinocalan River. A part of flooded water in the 9 km long upper stretch of the junction with the Sinocalan may spread to the Calasiao town area.

Further details of the plan formulation criteria is presented in the Supporting Report, River Improvement.

4.1.2 Priority Project Plan

The proposed river improvement plan of the Pantal-Sinocalan River is composed of the following components:

1) Main Pantal-Sinocalan River: from river mouth to upstream of the Catablan River junction (27.5 km)
   a) River improvement in the downstream reach
   b) River improvement in the upstream reach
2) Dagupan River: from Bypass channel junction to upstream of Elang River junction (19.5 km)
3) Ingalera River: from Pantal-River junction to downstream of Bogtong bridge, Sta. I.8 + 0.8 km (10.7 km)
4) Inner Drainage Plan in Dagupan City Area

(1) Main Pantal-Sinocalan River

a) River Improvement in the Downstream Reach

The river improvement works of the downstream reach of the Pantal-Sinocalan River consist of the following two components:

- the Pantal river stretch from the river mouth to the junction with the Sinocalan River
- the bypass channel for the urban stretch of the Sinocalan River (the Marusay River)

Pantal river

The minimum design river width of the Pantal River is set at 400 m with a rectangular cross section. A closure dike having a watergate is provided across the Caloocan River on the left bank. A water gate is provided across the Bolosan River on the right bank. The plan is shown in Figure 4.1.4 (1/4). The longitudinal profile is shown in Figure 4.1.5.

It is assessed that the project will not aggrade the existing condition of the Pantal River mouth in terms of sediments (refer to assessment of river month clogging in Section 2.6).

Bypass channel

The bypass channel plan will divert the flood discharge of the Sinocalan River at the junction with the tributary Ingalera toward the Dagupan river and discharge it finally into the Pantal River downstream of Dagupan City. With this bypass channel the river widening works of the existing urban stretch which involves significant compensation and resettlement issues are avoided.

The length, river width, and bedwidth of the low water channel of the proposed bypass is 3.20 km, 220 m, and 40 m respectively. The plan and the cross section are shown in Figure 4.1.4 (1/4).

Water gates for Marusay stretch

Two water gates are provided for flood control of the urban stretch (Marusay stretch) of the Pantal River: the lower gate at the junction with the Pantal River and the upper gate at the inlet from the bypass channel. These gates are opened during low flow discharge and closed when the flood at the bypass inlet exceeds the 95-day discharge (about 30 m^3/s). The existing carrying capacity of the Marusay stretch is about 300 m^3/s during high tide. The gate size is determined taking into consideration the existing navigation and maintenance of quarter quality.

The design width of the intake channel and the upper closure gate at the inlet is 10 m while the low water channel bed width of the bypass is 40 m. The 10 m wide water gate shown in Figure 4.1.23 is provided as the lower water gate.

In the Marusay stretch, the water quality during the dry season is well controlled by the tidal seawater intrusion while the contribution of fresh water (low flow of about 3.0 m^3/s) to water quality maintenance is minor (refer to the existing water quality in Section 6.2).

Water Use in Marusay stretch

The existing water use in the Marusay stretch is navigation only. There is no water use for irrigation and domestic water supply because the river water in this stretch is affected by seawater intrusion (refer to the water use in Section 6.2).

Navigation in this stretch is mostly community traffic by small boats (about 2,500 person trip/day) and fishing boats with the exception of a few naval ships and dredgers. The community boat transports and small fishing boats can be maintained through the 10 m wide water gate, however, the vertical clearance of the gate is not sufficient for the naval ships and dredgers. A loading yard or pier space is required for these ships, and thus the lower water gate is installed about 100 m upstream from the junction of the Pantal River.

b) River Improvement in the Upstream Reaches of Inglera Junction

The proposed diking system is composed of parallel earthdikes with 200 m river width downstream of the junction with the Quinabalotan River, and an earthdike (left bank only) upstream of the junction.

The proposed low-water channel improvement plan is mainly composed of enlargement of a channel with 30 m wide and a cut-off channel to reduce potential bank erosion. In designing of the sectional form and bed elevation, structural dimensions of the existing syphons and NIA's reconstruction plan of the Sinocalan irrigation dam are considered.

c) Major River Improvement Works for Priority Project

The river improvement works in the main Pantal-Sinocalan River stretch consist of the following components:

- A new 48.5 km long earthdike
- Low-water channel improvement with a total length of 15.85 km including the 3.1 km by-pass channel
- A counterweight earthfill against liquefaction with total length of 32.0 km
- Revetment works; 6.25 km long for a low-water channel, and 7.06 km long for an earthdike
- Groins on secondary channels of 80 m in length
- 17 drainage gates, of which 5 gates for navigation and fish ponds

. 3 intake culverts with a gate for fish cultivation, 1 box culvert with a gate for irrigation, and 1 water gate for maintenance flow
. 5 bridges and demolition of 1 railway bridge and 3 road bridges

(2) Dagupan River

The river improvement works of the Dagupan River consist of the following:

. 19.5 km long diking system (from the outlet with the proposed bypass channel to the stretch D.27 + 0.5 km near San Carlos) having design river width of 100 m to 450 m; 41.9 km long new earthdikes on both banks
. Improvement of the existing low water channel, having a design width of 25 m including short-cuts; 7.0 km length

- Counterweight earthfills against liquefaction with total length of 11.0 km
- Revetment; 0.55 km length for low-water channels and 2.87 km length for earthdikes
- 11 drainage gates
- 16 intake culverts with gates for fish ponds
- 5 bridges and demolition of a road bridge

The required stretch for river improvement with a 10-year design flood is extended to the upstream end of the section affected by back waters due to the design flood of the main Pantal-Sinocalan River. The design plan and the longitudinal profile are shown in Figure 4.1.6 (1/2)-(2/2) and Figure 4.1.7 respectively.

(3) Ingalera River

The river improvement works of the Ingalera River consist of the following:

. 10.7 km long diking system (from the junction with the Pantal-Sinocalan river to the stretch I.18 + 0.8 km, upstream of Malasiqui downstream of Bogtong bridge) having design river widths of 100 m to 120 m; 19.0 km long new earthdikes on both banks

. Improvement of the existing low water channel, having design widths of 15 m to 20 m including short-cuts; 10.7 km length including 3.0 km for cut-offs

- Counterweight earthfill against liquefaction with total of 1.1 km
- Revetment; 0.80 km length for low-water channels and 0.93 km length for earthdikes
- 3 drainage gates
- 4 bridges
- Demolition of 2 road bridges

The river stretch for improvement works is also determined based on the design concept mentioned above. The design plan and the longitudinal profile are shown in Figure 4.1.8 (1/2)-(2/2) and Figure 4.1.9 respectively.

(4) Inner Drainage Plan in Dagupan City Area

The rain water drainage system in the urban area of Dagupan City was damaged by the earthquake on July 16, 1990. The rehabilitation and improvement are now underway as shown in Figure 4.1.10.

Construction of a new by-pass channel is proposed in the flood control plan. The flood flow from the upstream basin is discharged into the Dagupan river through a new by-pass channel and no flood inflow is allowed in the urban stretch of Dagupan City. In this respect, the inner drainage capacity of the closed Marusay stretch shown in Figure 4.1.11 is preliminary reviewed for the Dagupan City area with a drainage area of 6.33 km^2.

For the review study, the following conditions are considered:

a)	Flood discharge of inland area	:	5-year probable flood discharge
b)	Tide level	:	El.0.00 m, the mean sea level
c)	Flood water level in Dagupan river	:	2 cases of 5-year and 10-year probable floods
d)	Dimension of gate	:	width of 10 m, bed elevation of El. -4.40 m
e)	The lowest ground level in the low land	:	El. 0.50 m

f) Effective storage : channel storage above the mean sea level El. 0.00 m and ground elevation above El. 0.50 m

A preliminary hydraulic simulation analysis was conducted for the following two cases with combinations of different probable flood occurrences. The simulation results are summarized below:

Case	Probable flood		Maximum inundation level (El. m)		
	Inner water	Outer land	Natural drainage	With Pump Capacity of $5m^3/s$	With Pump Capacity of $10m^3/s$
Case-1	5-year flood	5-year flood	0.76	0.68	-
Case-2	5-year flood	10-year flood	0.91	0.74	0.66
Case-3	10-year flood	10-year flood	1.00	0.77	0.72

The inner pumping drainage system with an installed capacity of 8.0 m^3/sec is required based on the following design criteria:

a) Hydrological condition of Case-2 is adopted.
b) Allowable maximum inundation water depth in the low land area (El. 0.5 m) is set at 0.3 m (El. 0.80 m) which corresponds to level of building floors in the urban area.
c) Allowable duration of inundation is 24 hours.

The cost of the pumping facilities is estimated to be about 88 million pesos, but is not included in the cost of the Priority Project because it is not feasible (EIRR = 2.5%).

4.1.3 Principal Design Features

(1) Design Channel Features of River Improvement Plan

Principal design features of the proposed river improvement plan are shown in Table 4.1.1 and are summarized below:

Main Pantal-Sinocalan River

River/Stretch	Pantal-Sinocalan		
	River mouth - Ingalera R.	Ingalera R. - Catablan R.(P59)	P 59 - P 70
Design discharge (m^3/s)	2,000-1,250	1,250-650	650-350
River width (m)	600-220	200-150	100
Gradient of channel bed	1/2,350	1/1,850	1/1,150
Channel bed width (m)	60-40	30	25
Design water depth (m)	6.6	6.6-5.95	5.95-5.14

Dagupan and Ingalera Rivers

River/Stretch	Dagupan R.		Ingalera R.	
	By-pass - Capangbogan R.	Capangbogan R. - Elang R.	Sinocalan R. - Marasiqui	Marasiqui - I.
Design discharge (m^3/s)	700-550	400	360	260
River width (m)	450-150	100	120	100
Gradient of channel bed	1/10,000	1/5,800	1/5,000-2,500	1/1,800
Channel bed width (m)	Existing	25	20	15
Design water depth (m)	6.6-6.0	6.0-6.6	6.6-6.3	6.1

The typical cross-sections are shown in Figures 4.1.12 to 4.1.14.

The standard design features of dikes, revetment, water gates, sluice and other related structures adopted for the Pantal-Sinocalan River improvement works are shown in the figures listed in Table 4.1.2.

(2) Work Items and Quantities

The items of the river improvement works are summarized below:

Major Work Items	Pantal-Sinocalan R.	Dagupan R.	Ingalera R.
. New earth dike (km)	48.50	41.90	19.00
. Channel improvement (km)	15.85	7.00	10.70
. Protection works of low-water channel (km)	6.25	0.55	0.80
. Protection works of dike and dike foundation (km)	7.06	2.87	0.93
. Drainage gates (pcs.)	17	11	3
. Bridges (pcs.)	5	5	4
. Water intake (pcs.)	5	16	0

The work quantities are summarized in Table 7.3.3.

4.2 Alternative Study for Dagupan Urban Stretch

4.2.1 Problems Identified in the Urban Stretch of Sinocalan River

In the original Framework Plan, the downstream stretch of the Sinocalan River occupies the urban area of Dagupan City with a planned river width of 120 m and length of 1.5 km; from the confluence with the Dagupan River to the stretch located about 300 m upstream from the Magsaysay bridge (refer to Figure 4.2.1). The existing carrying capacity of the Sinocalan River is not sufficient for the 10-year flood as shown in Figure 2.9.2, and thus the river width needs to be expanded from 60 m - 80 m to at least 120 m. For the river width of 120 m, the dike height is planned at 3.2 m.

On the other hand the geotechnical data, the new topographic map (scales of 1/25,000 and 1/5,000) and the river cross-sections have been made available in this stage and the following technical and socio-economic issues have been identified.

a) The foundation soils in this area are loose sand from the ground surface to a depth of 5 m while a soft silty soil layer exists under the sand layer below elevation minus 15 m. Seepage, liquefaction, and consolidation settlement problems are highly probable. In short, the 120 m river width needs to be further expanded to a width of 150 - 220 m and/or the dike height needs to be made lower to facilitate a stable foundation for the earthdike.

b) For widening the river width from the original 60 - 80 m to 120 m - 220 m, commercial areas along the stretch need to be acquired. The number of commercial buildings and houses is roughly estimated as follows:

. Case with a river width of 120 m : 730

. Case with a river width of 220 m : 1060

4.2.2 Alternative Plans

To resolve the foregoing issues of the urban stretch of the Sinocalan River, bypass and floodway alternatives were formulated for comparison. The design flood distribution diagrams of alternatives are shown in Figure 4.2.2.

Alternative 1: Sole River Improvement Plan

This plan increases the discharge capacity of the urban stretch solely by enlarging the river width of the existing channel up to 220 m.

Alternative 1A = The original river improvement plan with a 120 m wide urban stretch (refer to Figure 4.2.3).

Alternative 1B = A modified river improvement plan with a 220 m wide urban stretch (refer to Figure 4.2.4).

Alternative 2: Dagupan Bypass Plan

This plan diverts the majority of the food discharge of the Sinocalan River towards the Dagupan River through a bypass and discharges it finally into the Pantal River downstream of Dagupan City. With this bypass channel the river widening works for the urban stretch can be minimized.

Alternative 2A = Dagupan bypass and closing the urban stretch with inlet and outlet gates (refer to Figure 4.2.5).

Alternative 2B = Dagupan bypass and a 120 m wide urban stretch (refer to Figure 4.2.6).

Alternative 3A: Sinocalan Floodway Plan (refer to Figure 4.2.7)

This plan diverts the majority of the flood discharge of the Sinocalan River directly into the Lingayen Gulf through a floodway. With this

floodway the water level of the Pantal River can be lowered to an appropriate level at the junction with the Sinocalan River because the flood discharge of the Dagupan River also can be directly discharged to the sea.

Alternative 4A: Dagupan Floodway Plan (refer to Figure 4.2.8)
This plan lowers the flood water level of the Sinocalan River at the junction with the Dagupan River by providing a floodway which diverts the flood discharge of Dagupan River directly to the sea instead of passing through the Pantal River. With this floodway the flood water level of the urban stretch of the Sinocalan River can be lowered to an appropriate level.

The technical features of these alternatives and the corresponding number of affected buildings and houses of each alternative are listed in Table 4.2.1. The degree of impact on the identified problems is assessed qualitatively for these alternatives as shown in Table 4.2.2.

The project costs of these alternatives are estimated in Table 4.2.3, and the corresponding work quantities are summarized in Table 4.2.4.

Upon approval by DPWH, Alternative 2A (the Dagupan bypass channel) was adopted for the Feasibility Study because of its lowest project cost, less social issues and higher stability of the dike structures and river channel.

Table 4.1.1 PRINCIPAL DESIGN FEATURES OF PANTAL-SINOCALAN RIVER (1/2)

River: Main Pantal-Sinocalan R.
Design Flood: 10-yr

Item	Unit	Pantal R.	By-Pass		Sinocalan R.
		R.M-D.O	D.O-P.1	P.1-S.21+0.4k	S.21+0.4k -S.47+0.3k
Discharge	m3/s	2000	1850	1250	900
Length of Stretch	m	2840	1910	4000	10950
Gradient of H.W.L	-	1/2350	1/2350	1/2350	1/1850
River Width	m	600-400	400	220	200
Width of Channel Bed	m	60	40	40	30
Gradient of H.W.L	m	1/2350	1/2350	1/2350	1/1850
Dike Height (Ave.)	m	3.0	3.8	4.0	3.8
Water Depth	m	6.6	6.6	6.6	6.6
Low Channel Depth (Ave.)	m	4.8	4.0	3.8	3.8

Item	Unit	Sinocalan R		
		S.47+0.3k -S.58+1.0k	S.58+1.0k -S.65	S.65 -S.70
Discharge	m3/s	650	650	350
Length of Stretch	m	7780	5270	4500
Gradient Channel Bed	-	1/1600	1/1150	1/900
River Width	m	150	100	100
Width of Channel Bed	m	30	30	20
Gradient of H.W.L	-	1/1850	1/1150	1/1150
Dike Height (Ave.)	m	2.8	2.5	2.3
Water Depth	m	6.6-5.95	5.95	5.95-5.14
Low Channel Depth (Ave.)	m	4.5	4.5	4.0

Table 4.1.1 PRINCIPAL DESIGN FEATURES OF PANTAL-SINOCALAN RIVER (2/2)

River: Dagupan R
Design Flood: 10-yr

Item	Unit	Dagupan R.		
		D.3-D.12B+0.3k	D.12B+0.3k -D16+0.3k	D.16+0.3k -D.27+0.45k
Discharge	m3/s	700	550	400
Length of Stretch	m	5250	4500	9750
Gradient of Channel Bed	-	1/10000	1/10000	1/10000
River Width	m	450-250	250-150	100
Width of Channel Bed	m	Existing	Existing	25
Gradient of H.W.L	-	Level	1/10000	1/5800
Dike of Height (Ave.)	m	2.8	2.8	2.8
Water Depth	m	6.5	6.5	6.0
Low Channel Depth (Ave.)	m	Existing	Existing	4.0

River: Ingalera R.
Design Flood: 10-yr

Item	Unit	Ingalera R.		
		I.1-I.8	I.8-I.13	I.13-I.18
Discharge	m3/s	360	360	260
Length of Channel Bed	m	9920	4690	4390
Gradient of Channel Bed	-	1/5000	1/2500	1/1800
River Width	m	120	120	100
Width of Channel Bed	m	20	20	15
Gradient of H.W.L	m	1/5000	1/3400	1/1800
Dike of Height (Ave.)	m	0.9	0.6	0.5
Water Depth	m	6.6	6.3	6.1
Low Channel Depth (Ave.)	m	6.5	6.5	6.4

Table 4.1.2 DESIGN FEATURES OF FLOOD CONTROL FACILITIES FOR PANTAL-SINOCALAN RIVER (1/2)

Classification	Title	Description	Figure No.
Dike	- STANDARD DESIGN SECTION OF PANTAL-SINOCALAN RIVER EARTH DIKE	- Standard sections applied to the main river and its tributaries	4.3.15
	- STANDARD DESIGN OF COUNTERWEIGHT FILL AGAINST LIQUEFACTION (PANTAL-SINOCALAN RIVER)	- Determined by the slip circular stability and liquefaction analysis. Horizontal seismic coefficient 0.15.	4.3.16
Dike and Revetment	- STANDARD DESIGN OF CLOSING DIKE ACROSS BOLOSAN, MARUSAY AND CALOOCAN RIVERS	- Sectional features and necessary protection works	4.3.17
	- PROTECTION WORKS FOR CLOSING DIKE IN SINOCALAN RIVER	- Applied to the dike built along the short cut channels in the upper Sinocalan	4.3.18
	- PROTECTION WORKS FOR PANTAL RIVER MOUTH DIKE	- Designed to resist both flood and wave action.	4.3.19
Revetment	- STANDARD DESIGN SECTION OF REVETMENT	- Applied to all portions except closing dikes.	4.3.20
Groyne	- STANDARD DESIGN OF GROYNE (PILE TYPE)	- The same groyne type for the Agno River	4.3.21

Table 4.1.2 DESIGN FEATURES OF FLOOD CONTROL FACILITIES FOR PANTAL-SINOCALAN RIVER (2/2)

Classification	Title	Description	Figure No.
Groundsill	- GROUNDSILL ON BYPASS CHANNEL OF SINOCALAN RIVER	- Provided to stabilize the river bed around the way out portion of By-pass.	4.3.22
Water Gate	- STANDARD DESIGN OF WATER GATE (I)	- The water gates to be constructed on the closing dike of the Marusay and Caloocan rivers.	4.3.23
	- STANDARD DESIGN OF WATER GATE (II)	- The water gate to be constructed on the closing dike of the Bolosan river.	4.3.24
	- STANDARD DESIGN OF WATER GATE (III)	- The small scale water gates to be constructed at the junction of tributaries. (Refer to the table on the figure)	4.3.25
Sluice Way	- STANDARD DESIGN OF SLUICE WAY (TYPE B-2)	- Drainage and intake sluices were classified into 5 types; A, B1, B-2, B-3, and C. depending on discharge capacity. Planned number of sluice way = 54	4.3.26
Bridge	- STANDARD DESIGN OF BRIDGE	- 5 bridge types in terms of bridge length; L = 220.0m, 200.0m, 150.0m, 120.0m, 100.0m, The elevation of the girder has a freeboard over the H.W.L. of 100-year probable flood.	4.3.27

Table 4.2.1 FEATURES OF ALTERNATIVES AND AFFECTED BUILDINGS AND HOUSES IN AND AROUND DAGUPAN CITY

	River Improvement Only		River Improvement + Dagupan Bypass		River Improvement + Sinocalan Floodway	River Improvement + Dagupan Floodway
	Alternative 1A	Alternative 1B	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 4A
1. Features of Alternatives						
(1) Design Flood (probable 50-year, m3/sec)						
Pantal River	2,900	2,900	2,900	2,900	700	1,850
Sinocalan River	1,650	1,650	-	500	500	1,650
Bypass Channel	-	-	1,650	1,150	-	-
Floodway	-	-	-	-	1,150	1,200
(2) Type of Dike						
Pantal River	earth dike	earth dike	earth dike	earth dike	earth dike	earth dike
Urban Stretch (S6-S14)	earth dike	earth dike	(original)	earth dike	concrete wall	earth dike
Middle Sinocalan (S14-S17a)	earth dike	earth dike	(original)	earth dike	earth dike	earth dike
Bypass Channel	-	-	earth dike	earth dike	-	-
Floodway	-	-	-	-	earth dike	earth dike
(3) River Width (m)						
Pantal River	400	400	400	400	400	400
Urban Stretch (S6-S14)	120	220	(original)	120	100	120
Middle Sinocalan (S14-S17a)	220	220	(original)	120	120	220
Bypass Channel	-	-	220	220	-	-
Floodway	-	-	-	-	220	250
2. Affected Buidings and Houses *						
(1) Pantal River						
Right Bank	180	180	180	180	180	180
Left Bank	260	260	260	260	120	260
(2) Urban Stretch (S6-S14)						
Right Bank	450	750	-	300	20	450
Left Bank	280	310	-	240	20	280
(3) Middle Sinocalan (S14-S17a)						
Right Bank	170	170	-	30	30	170
Left Bank	200	200	-	70	70	200
(3) Bypass Channel & Dagupan River	-	-	480	480	-	-
(4) Floodway	-	-	-	-	500	200
Total	1,540	1,870	920	1,560	940	1,740

Note : * Estimated from 1/5000 Map. Upstream stretch from section S17a is not included.

Table 4.2.2 IMPACT ASSESSMENT OF ALTERNATIVES

Problems	River Improvement only		Bypass		Floodway	
	1A	1B	2A	2B	3A	4A
. Affected building	(730 lots)	(1060 lots)	(0)	(540 lots)	(40 lots)	(730 lots)
in the urban area	3	4	0	2	1	3
. Affected buildings	(810 lots)	(810 lots)	(920 lots)	(540 lots)	(900 lots)	(1,010 lots)
in the other area	3	3	3	2	3	3
. Affected fish ponds	(68 ha)	(68 ha)	(77 ha)	(80 ha)	(147 ha)	(102 ha)
	2	2	2	2	4	3

Note for degree of impact

4 : Serious impact, 3 : high impact, 2 : medium impact, 1 : low impact,
0 : no impact

Table 4.2.3 PROJECT COST COMPARISON OF ALTERNATIVES FOR URBAN STRETCH OF PANTAL-SINOCALAN RIVER

Alternatives — mil.Pesos

Items	1A	1B	2A	2B	3A	4A
Main Works	1,113	1,059	1,145	1,144	1,318	1,245
Preparatory Works	111	105	114	114	132	124
Miscelleneous Works	184	175	189	189	217	205
Main Construciton	1,408	1,340	1,448	1,448	1,667	1,575
Compensation Cost	1,077	1,501	224	875	365	1,121
Total	3,226	3,656	2,251	3,036	2,721	3,507

Table 4.2.4 WORK QUANTITIES OF ALTERNATIVES FOR URBAN STRETCH OF PANTAL-SINOCALAN RIVER

Work Items	Ref.No	Unit	ALT 1-A	ALT 1-B	ALT2-A	ALT2-B	ALT3-A	ALT4-A
Earth Works								
Excavation Common		10^3m3	901,772	901,772	1,383,600	1,470,772	2,372,897	2,835,956
	EX-1	10^3m3	270,532	270,532	415,080	441,232	711,869	1,448,416
Dredging	DW	10^3m3	144,938	144,938	127,500	142,518	106,223	143,244
Embankment Excavated	EM-1-R	10^3m3	2,440,236	2,381,500	2,716,641	29,189,201	3,109,590	1,387,540
Others								
Bridge	BC	m2	4,790	9,730	9,157	11,557	11,657	7,290
Concrete Dike	CF1	m3					10,222	
Revetment & Bank Protection	Total	m	26,410	10,060	11,030	13,430	10,610	30,110
River Mouth	PS.R-1	m	850	850	850	850		850
Closing Dike L.W.C	PS.R-2	m	200	250	300	300	1,450	1,500
Closing Dike H.W.C	PS.R-3	m	700	700	700	700	700	700
Dike on River-Bed	PS.R-4	m	300	300	300	300		400
Closing Dike	PS.R-5	m	1,000	1,000	780	780	1,500	2,000
H.W. Revetment	PS.R-6	m	12,350	4,450	4,990	6,090	4,750	13,050
L.W. Revetment (Type A)	PS.R-7	m	2,010	2,010	2,660	3,960	2,210	11,610
L.W. Revetment (Type B)	AG.R-1	m	9,000	500	450	450		
Concrete Pile Groyne = 30 m	GR-1	pcs.	39	39	39	39	39	39
Sluice	Total	pcs.	33	33	31	35	32	30
Type-A	PS.S-1	pcs.	23	24	20	26	24	22
Type-B-1	PS.S-2-1	pcs.	3	2	5	2	1	1
Type-B-2	PS.S-2-2	pcs.	5	5	4	5	5	5
Type-B-3	PS.S-2-3	pcs.	1	1	1	1	1	1
Type-C	PS.S-3	pcs.	1	1	1	1	1	1
Water Gate (2nd)	Total	pcs.	5	5	7	5	5	5
10m x 5m x 1	WG-1	pcs.	1	2	2	1	1	1
10m x 5m x 1	WG-2	pcs.	1	1	1	1	1	1
15m x 4m x 1	WG-3	pcs.	1	1	1	1	1	1
5m x 3m x 1	WG-4-2	pcs.	2	1	3	2	2	2
Ground Sill	PS.GS	pcs.	0		1	1	1	
Compensation	COM-F	1000 p	1,077,000	1,510,000	224,000	875,000	365,000	1,121,000

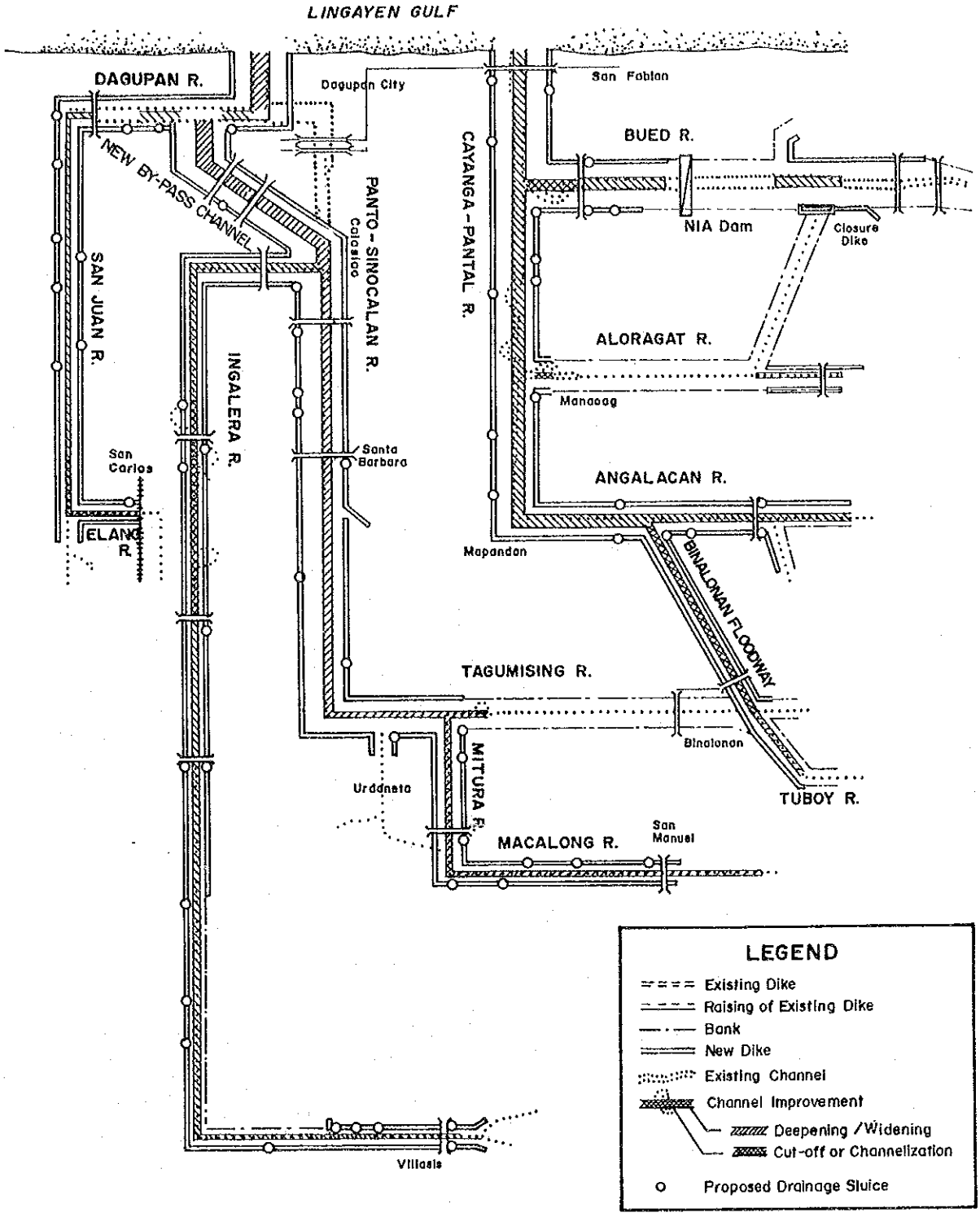


Fig. 4.1.1 GENERAL LAYOUT OF ALLIED RIVER IMPROVEMENT PLAN FOR FRAMEWORK PLAN

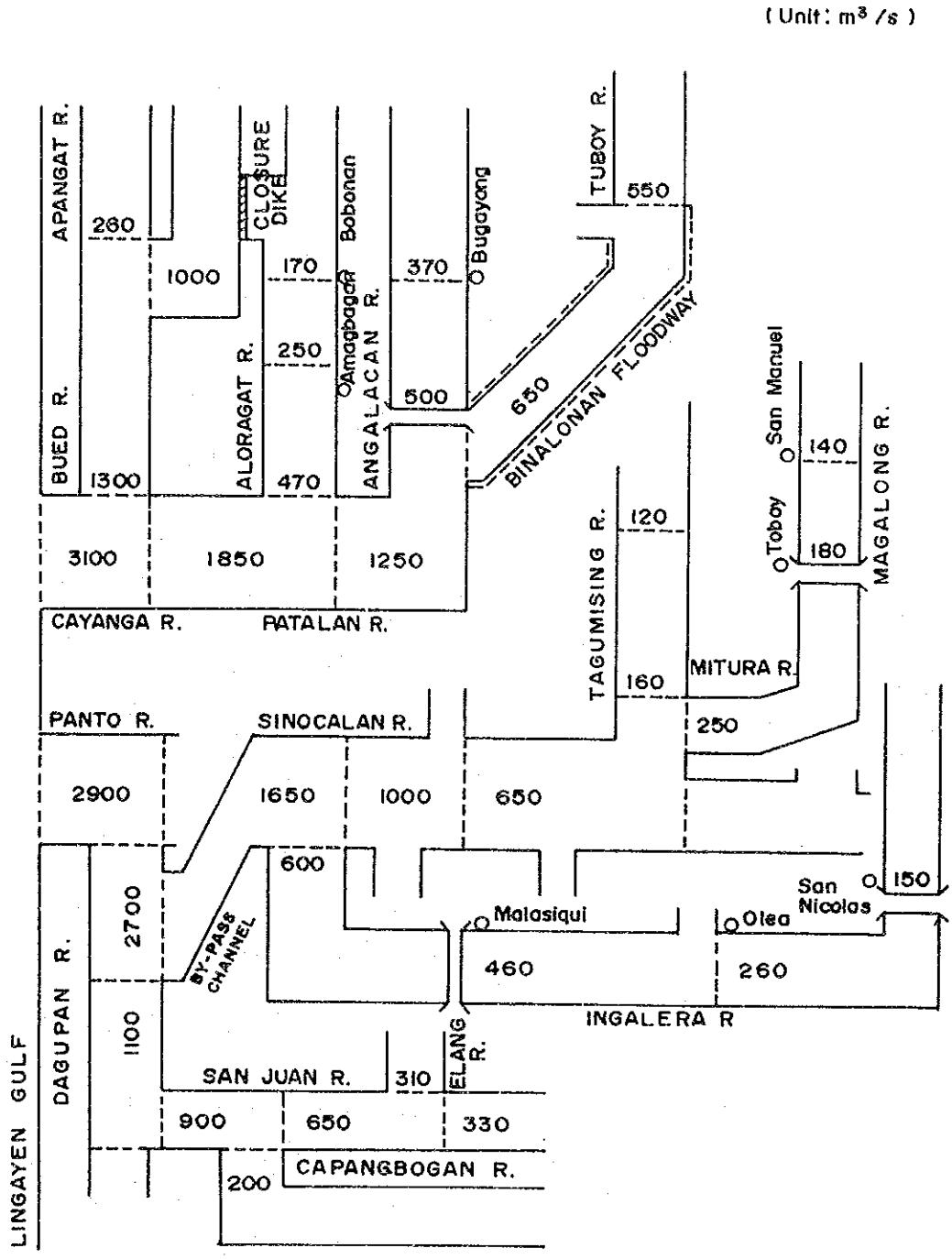


Fig. 4.1.2 DESIGN FLOOD DISCHARGE DISTRIBUTION OF FRAMEWORK PLAN (50-YR) OF ALLIED RIVERS

(Unit: m³/s)

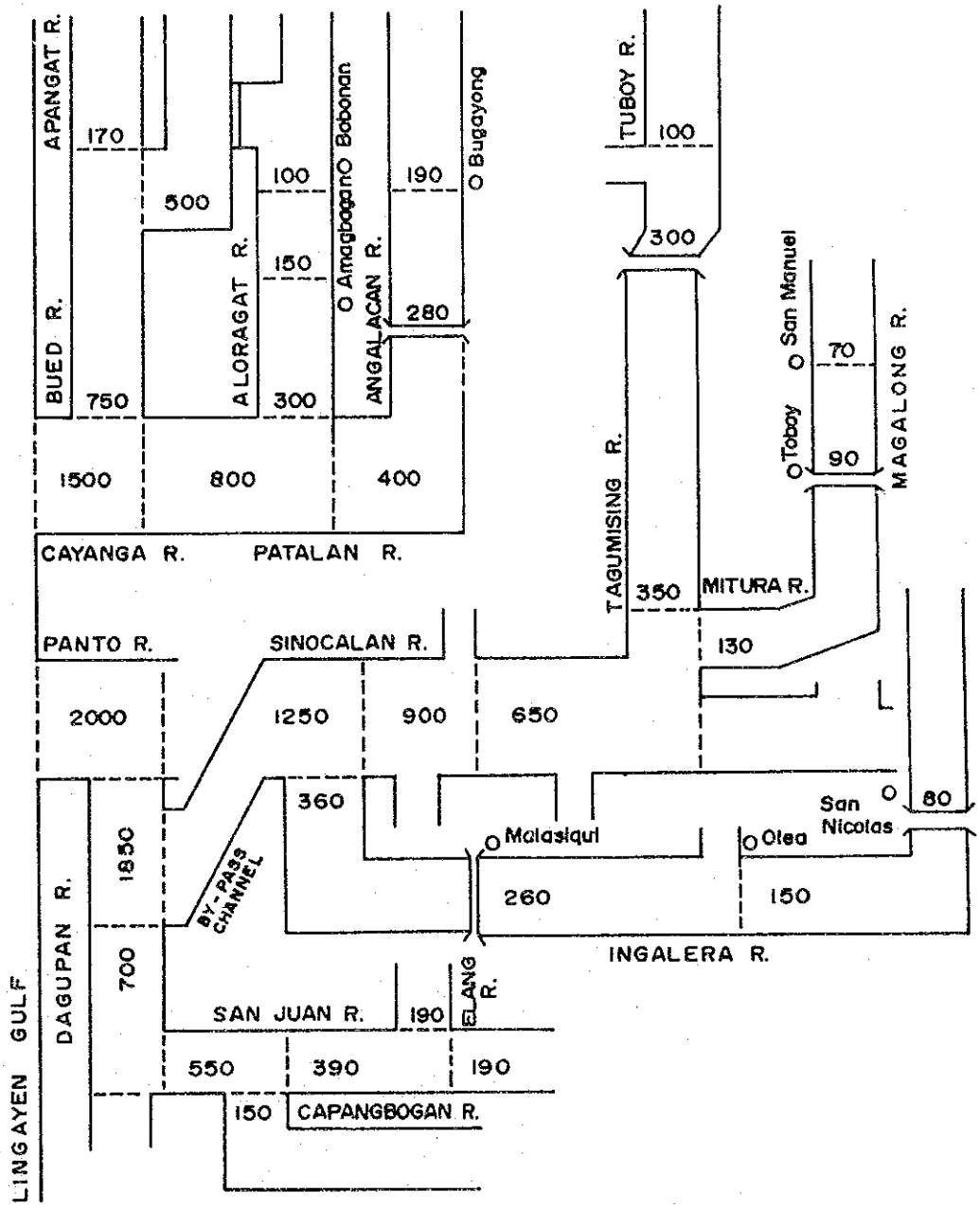


Fig. 4.1.3 DESIGN FLOOD DISCHARGE DISTRIBUTION OF PRIORITY PROJECTS OF ALLIED RIVERS

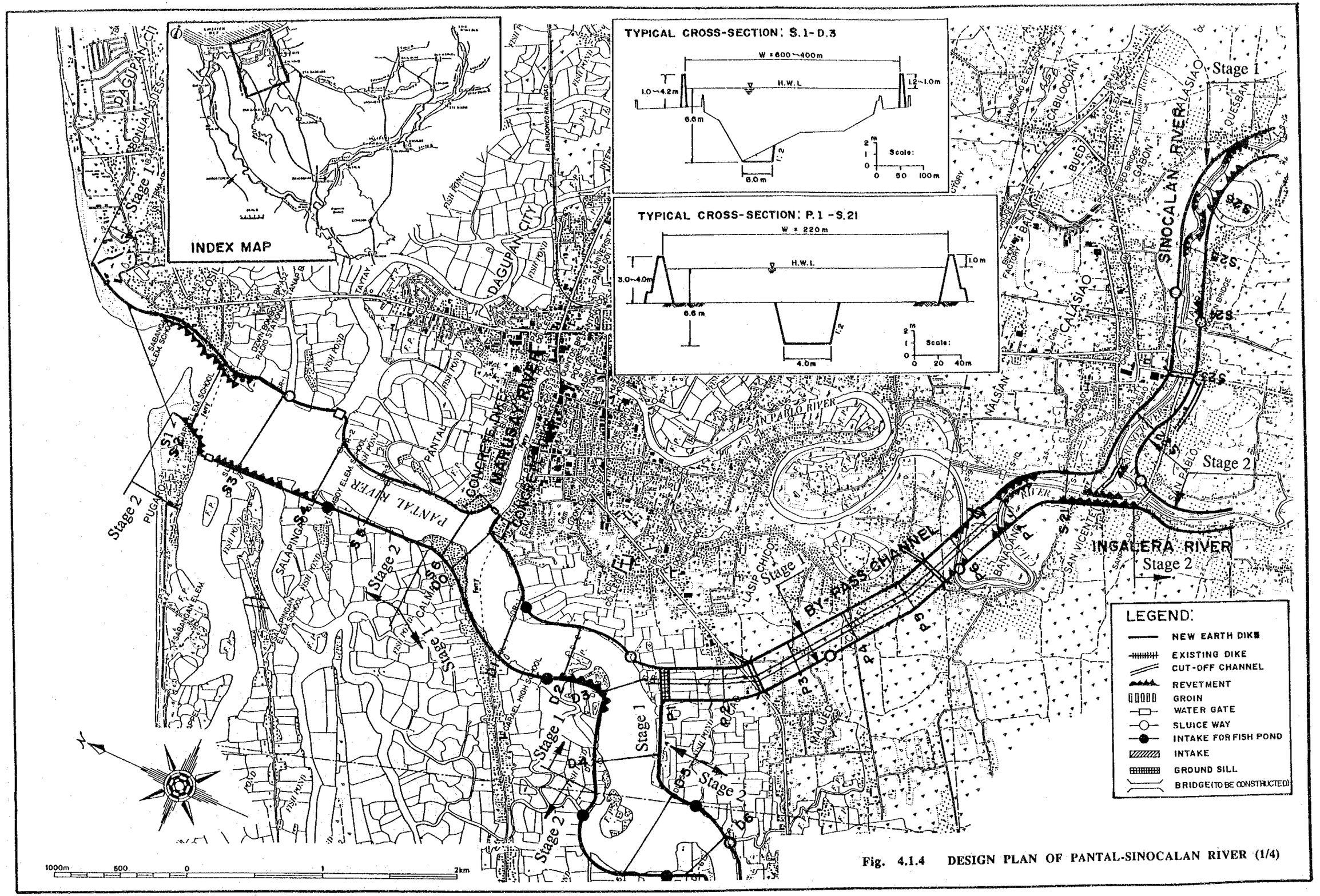


Fig. 4.1.4 DESIGN PLAN OF PANTAL-SINOCALAN RIVER (1/4)

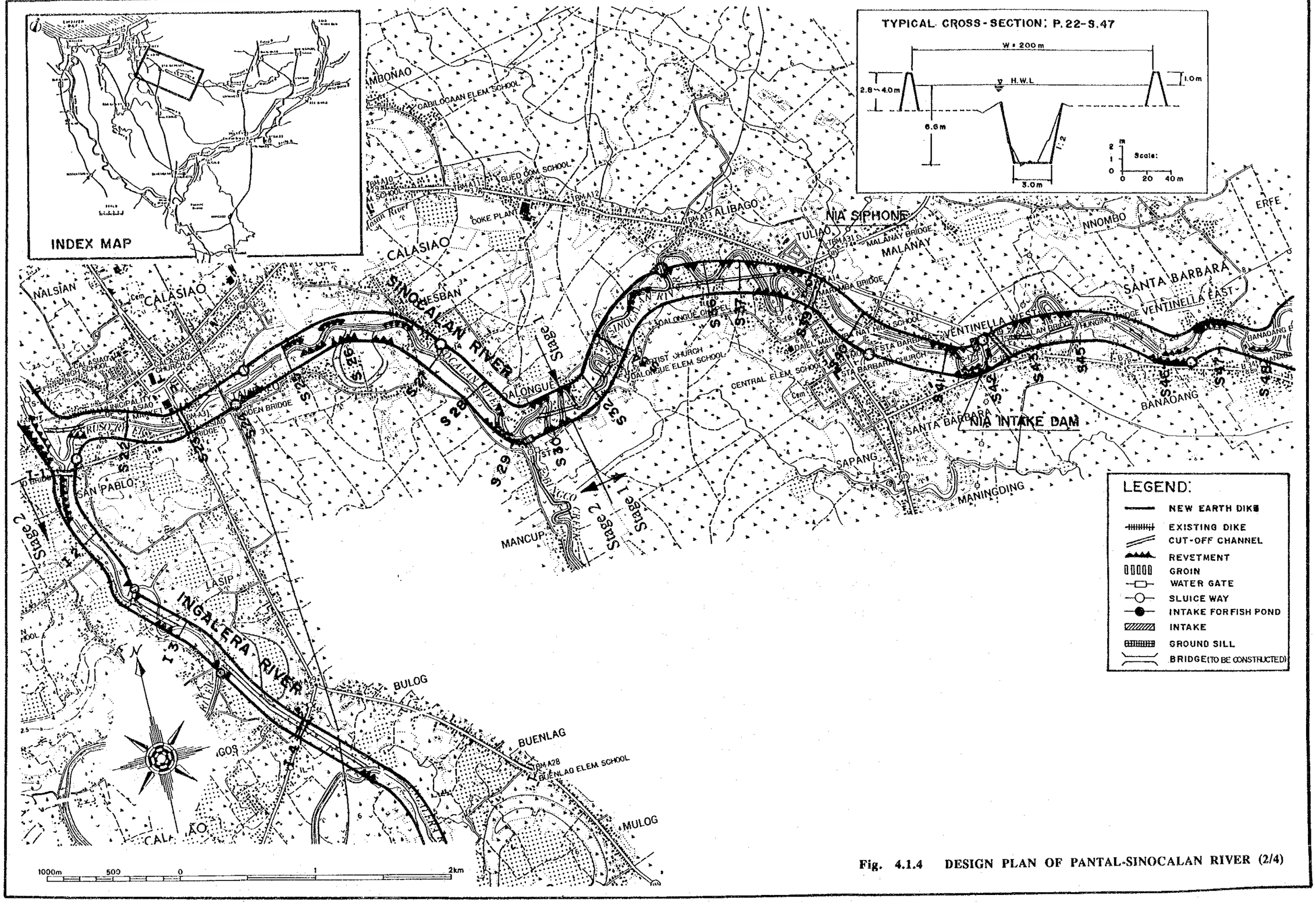
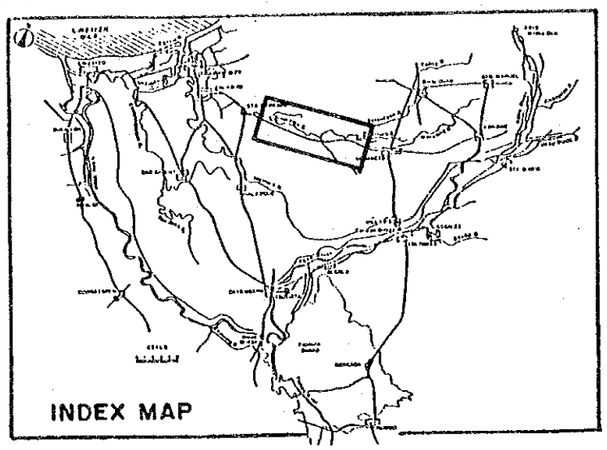
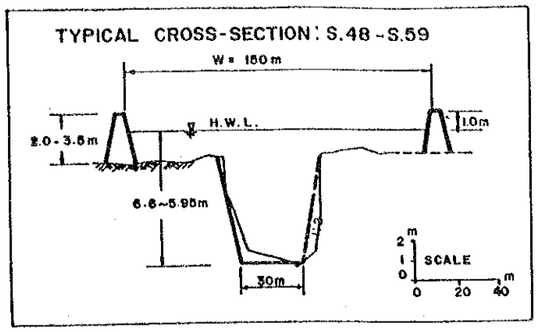
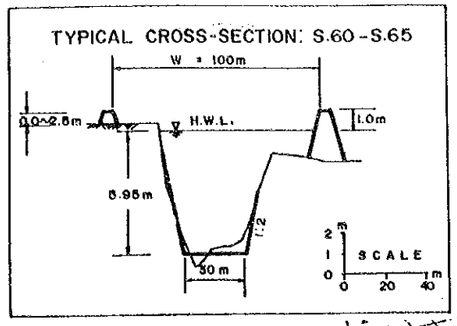
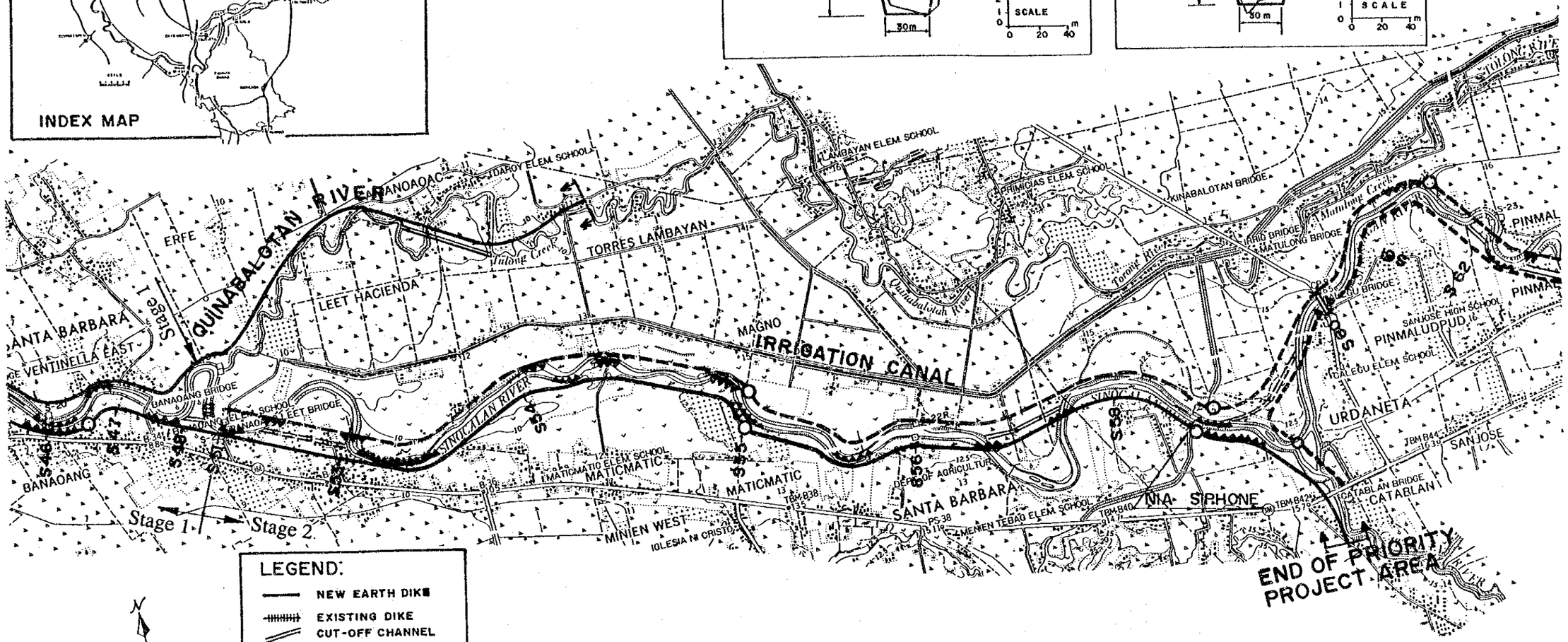


Fig. 4.1.4 DESIGN PLAN OF PANTAL-SINOCALAN RIVER (2/4)









LEGEND:

- NEW EARTH DIKE
- EXISTING DIKE
- CUT-OFF CHANNEL
- REVETMENT
- GROIN
- WATER GATE
- SLUICE WAY
- INTAKE FOR FISH POND
- INTAKE
- GROUND SILL
- BRIDGE (TO BE CONSTRUCTED)

N

1000m 600 0 1 2km

Fig. 4.1.4 DESIGN PLAN OF PANTAL-SINOCALAN RIVER (3/4)

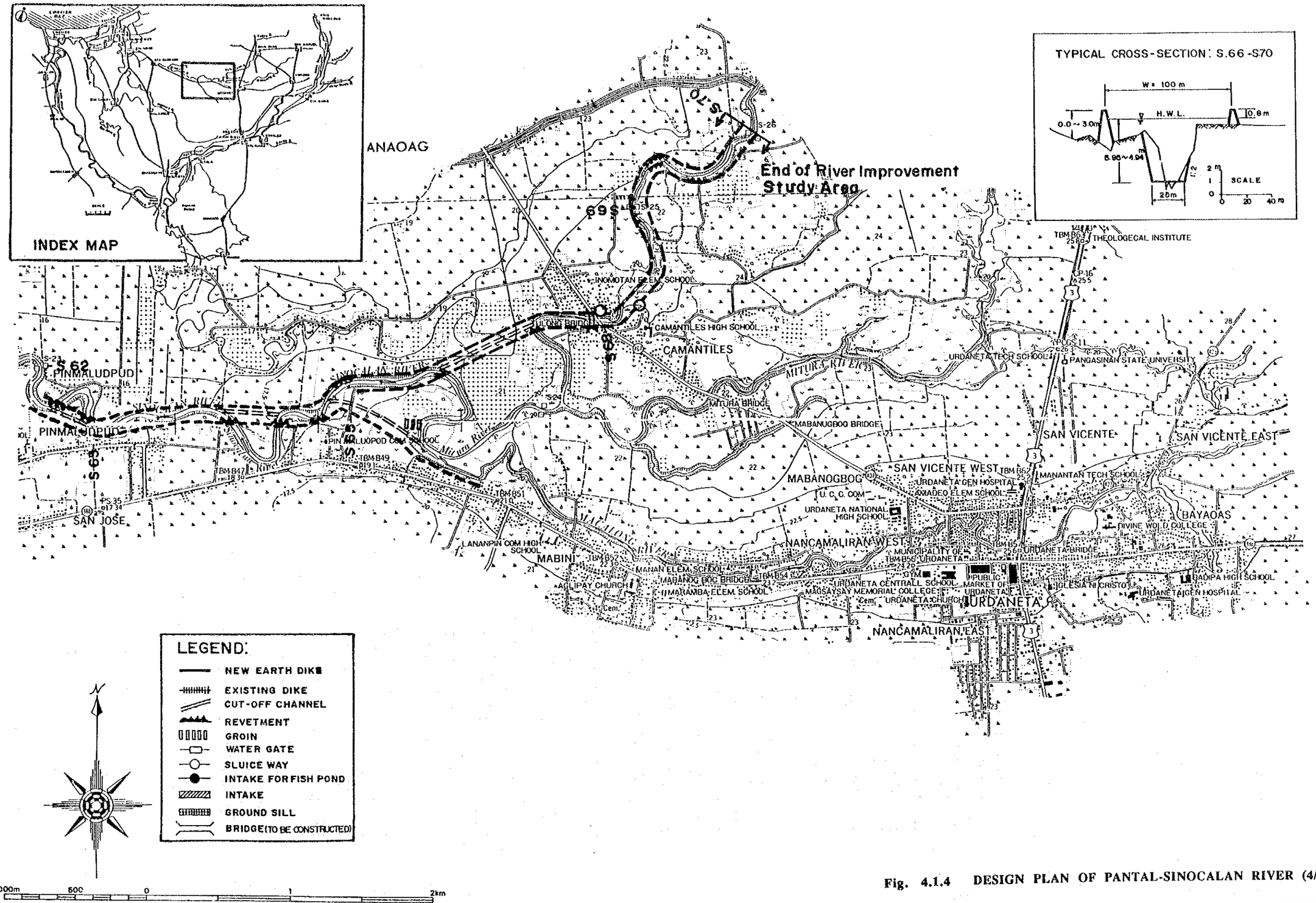


Fig. 4.1.4 DESIGN PLAN OF PANTAL-SINOCALAN RIVER (4/4)

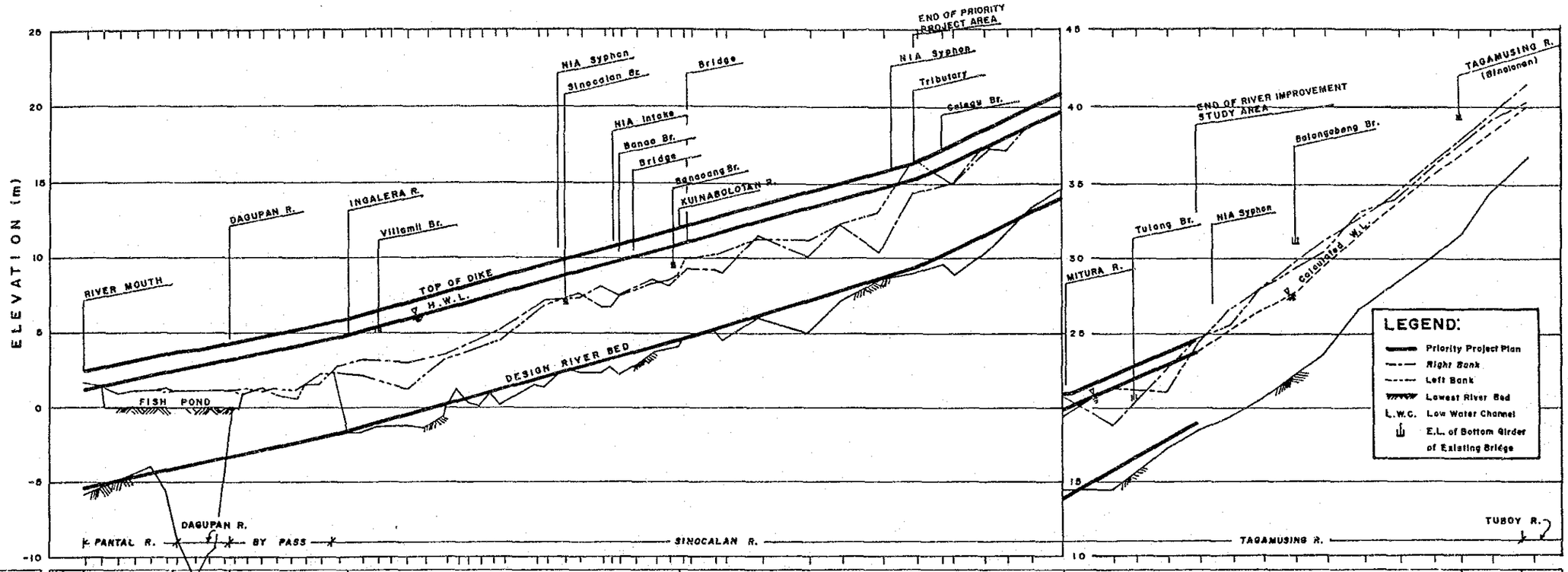


Fig. 4.1.5 LONGITUDINAL PROFILE OF PANTAL-SINOCALAN RIVER

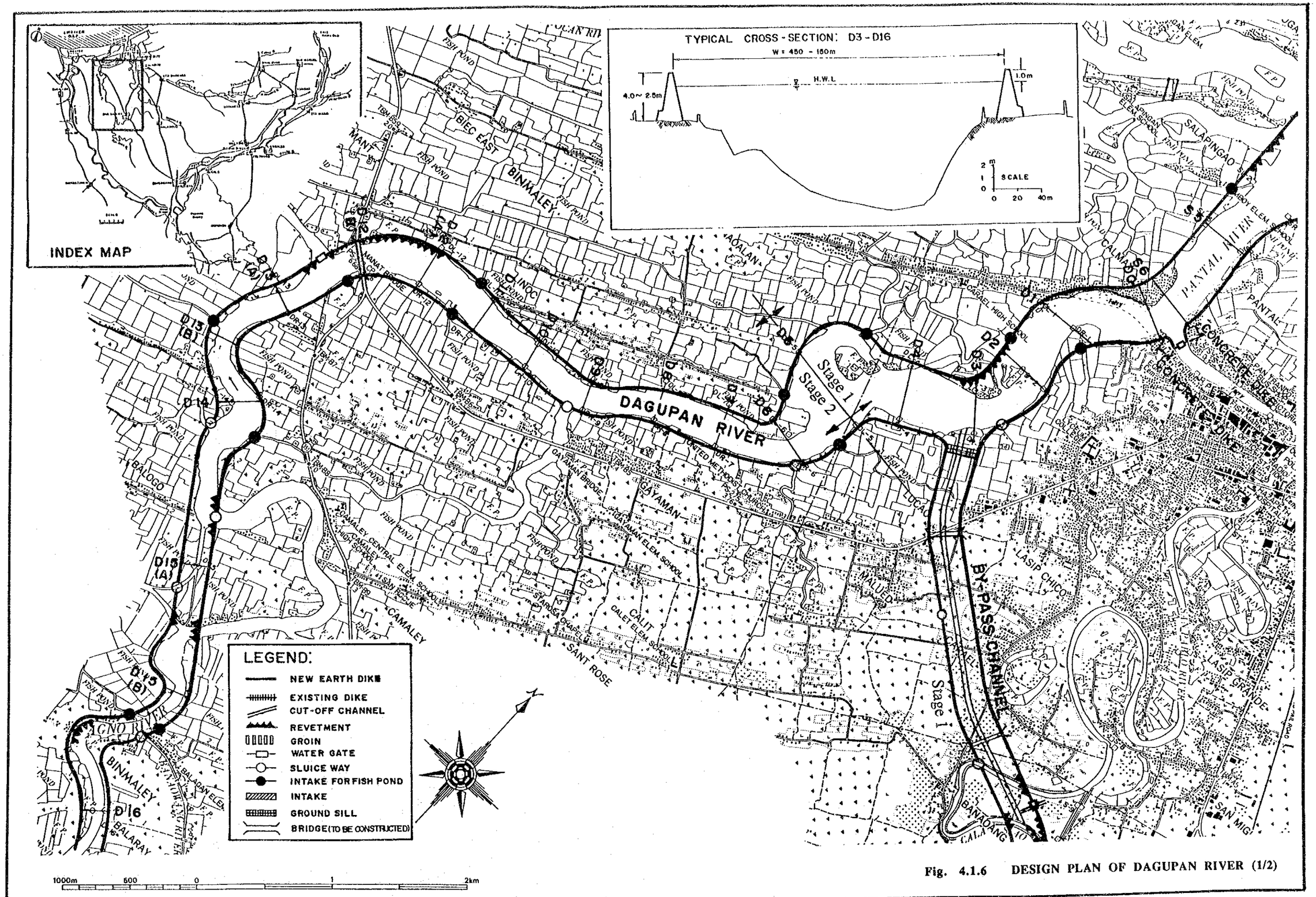
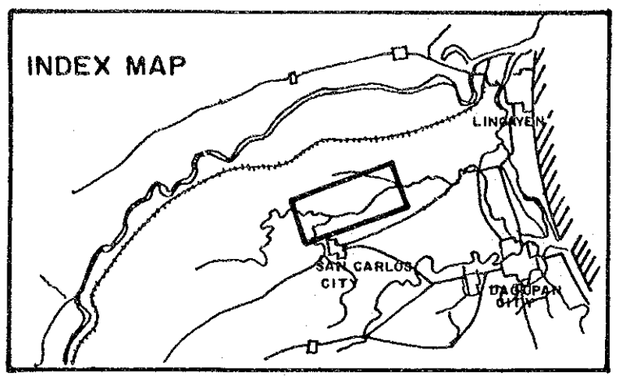
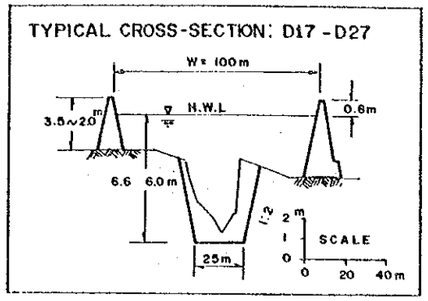


Fig. 4.1.6 DESIGN PLAN OF DAGUPAN RIVER (1/2)





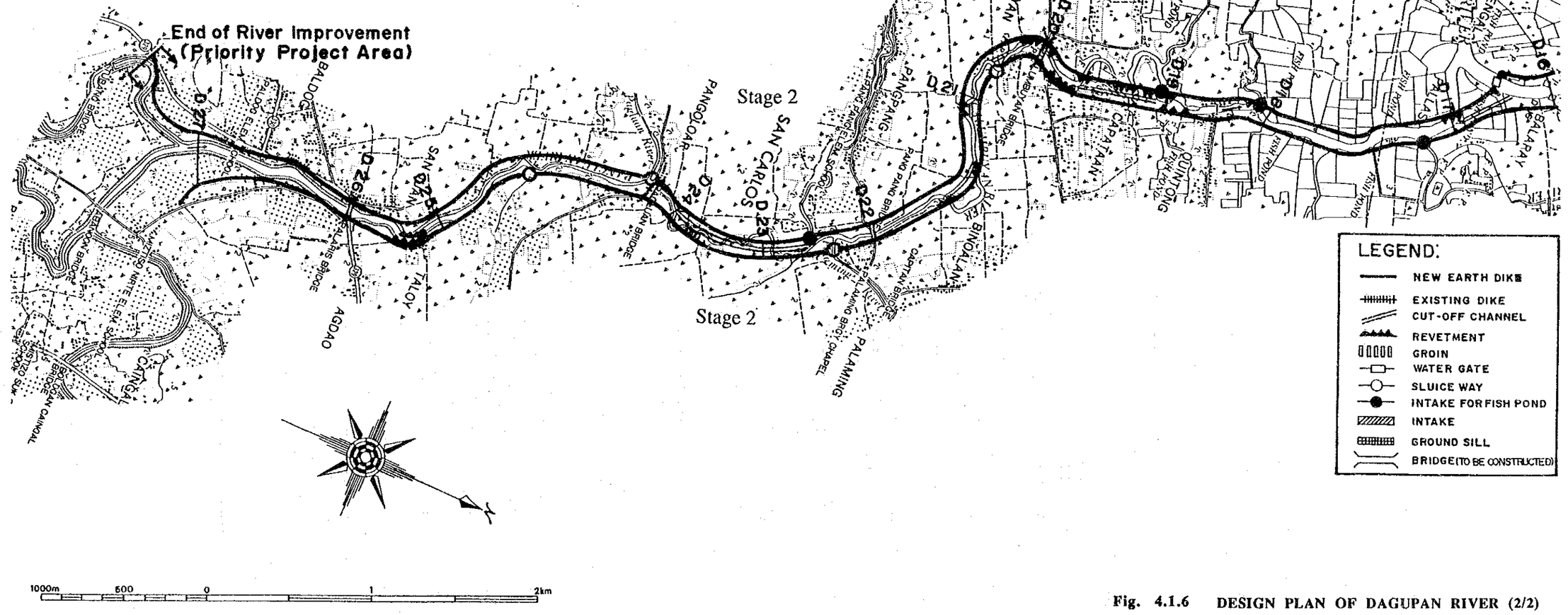
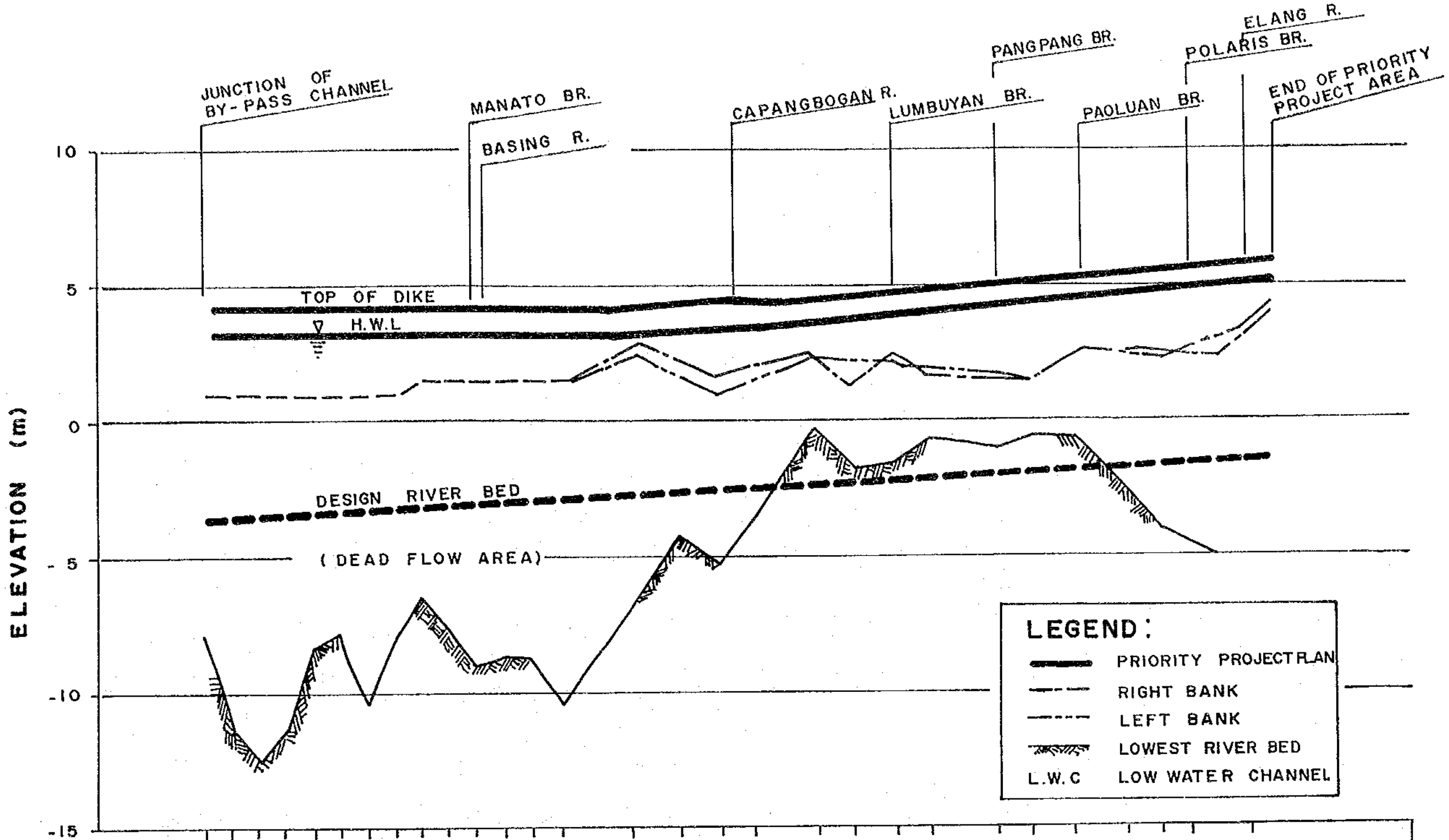


Fig. 4.1.6 DESIGN PLAN OF DAGUPAN RIVER (2/2)



DESIGN IN FLOOD DISCHARGE (m^3/s): 700 | 550 | 400

GRADIENT OF H.W.L: (LEVEL) | 1/10 000 | 1/5800

GRADIENT OF RIVER BED: 1/10 000

SECTION NO.	DISTANCE (Km)	CHANNEL BED (El. m)	H.W.L. (El. m)	TOP OF DIKE (El. m)
D 3	0.00	-3.58		
D 4	0.50	-3.53	3.10	4.10
D 5	1.00	-3.48	3.10	4.10
D 6	1.45	-3.43	3.10	4.10
D 7	2.00	-3.38	3.10	4.10
D 8	2.50	-3.33	3.10	4.10
D 9	3.00	-3.28	3.10	4.10
D 10	3.50	-3.23	3.10	4.10
D 11	3.95	-3.18	3.10	4.10
D 12(A)	4.45	-3.13	3.10	4.10
D 12(B)	4.95	-3.08	3.10	4.10
D 13(A)	5.55	-3.03	3.10	4.10
D 13(B)	6.05	-2.97	3.10	4.10
D 14	6.55	-2.92	3.10	4.10
D 15(A)	7.80	-2.80	3.20	4.20
D 15(B)	8.70	-2.71	3.29	4.29
D 16	9.45	-2.63	3.37	4.37
D 17	10.05	-2.57	3.43	4.43
D 18	11.20	-2.46	3.63	4.43
D 19	11.85	-2.39	3.74	4.54
D 20	12.65	-2.31	3.88	4.68
D 21	13.25	-2.25	3.98	4.78
D 22	14.45	-2.13	4.19	4.99
D 23	15.10	-2.07	4.30	5.10
D 24	15.85	-2.00	4.43	5.23
D 25	17.50	-1.83	4.71	5.53
D 26	18.05	-1.77	4.81	5.61
D 27	19.05	-1.67	4.98	5.78
	19.50			

Fig. 4.1.7 LONGITUDINAL PROFILE OF DAGUPAN RIVER

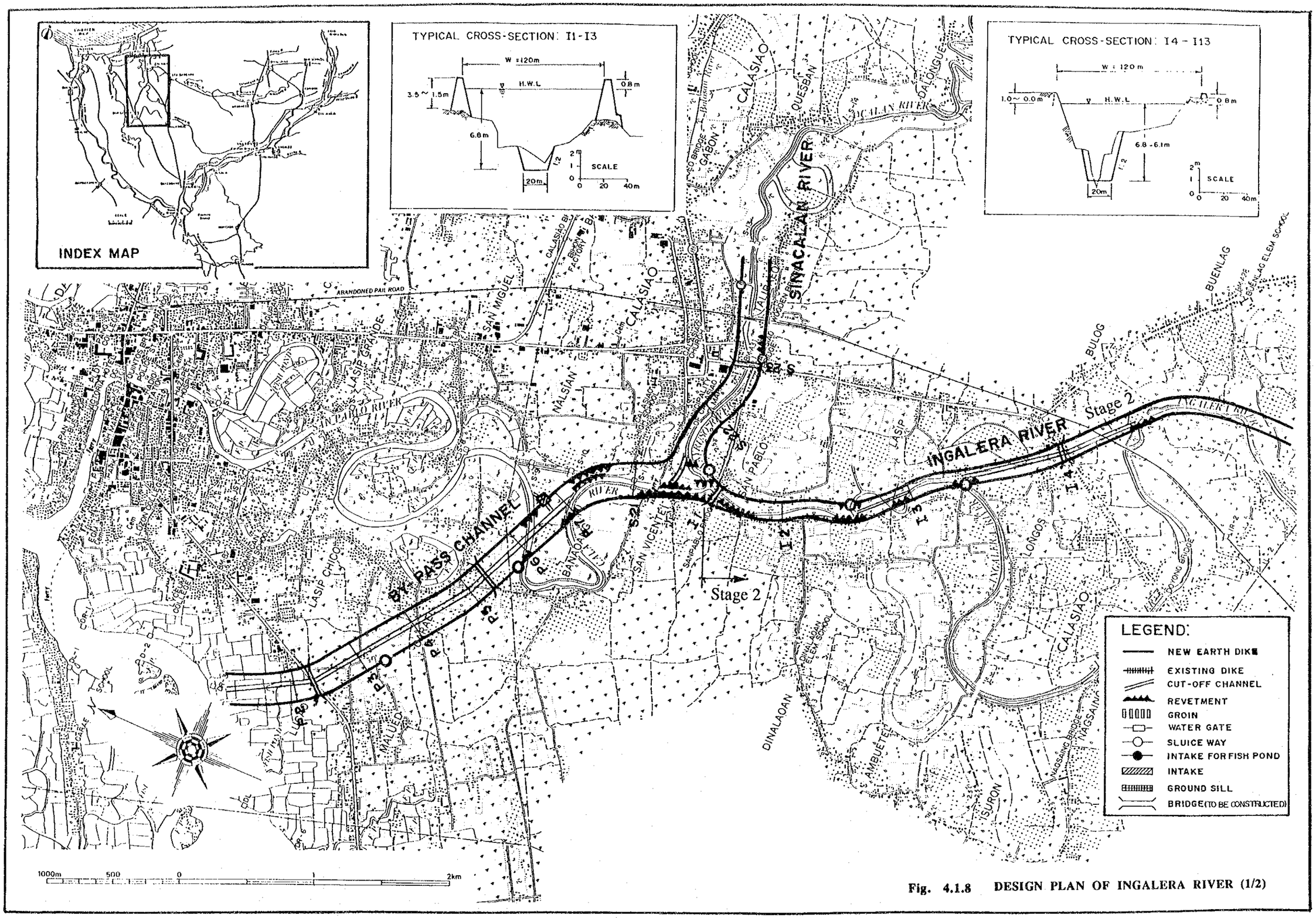


Fig. 4.1.8 DESIGN PLAN OF INGALERA RIVER (1/2)

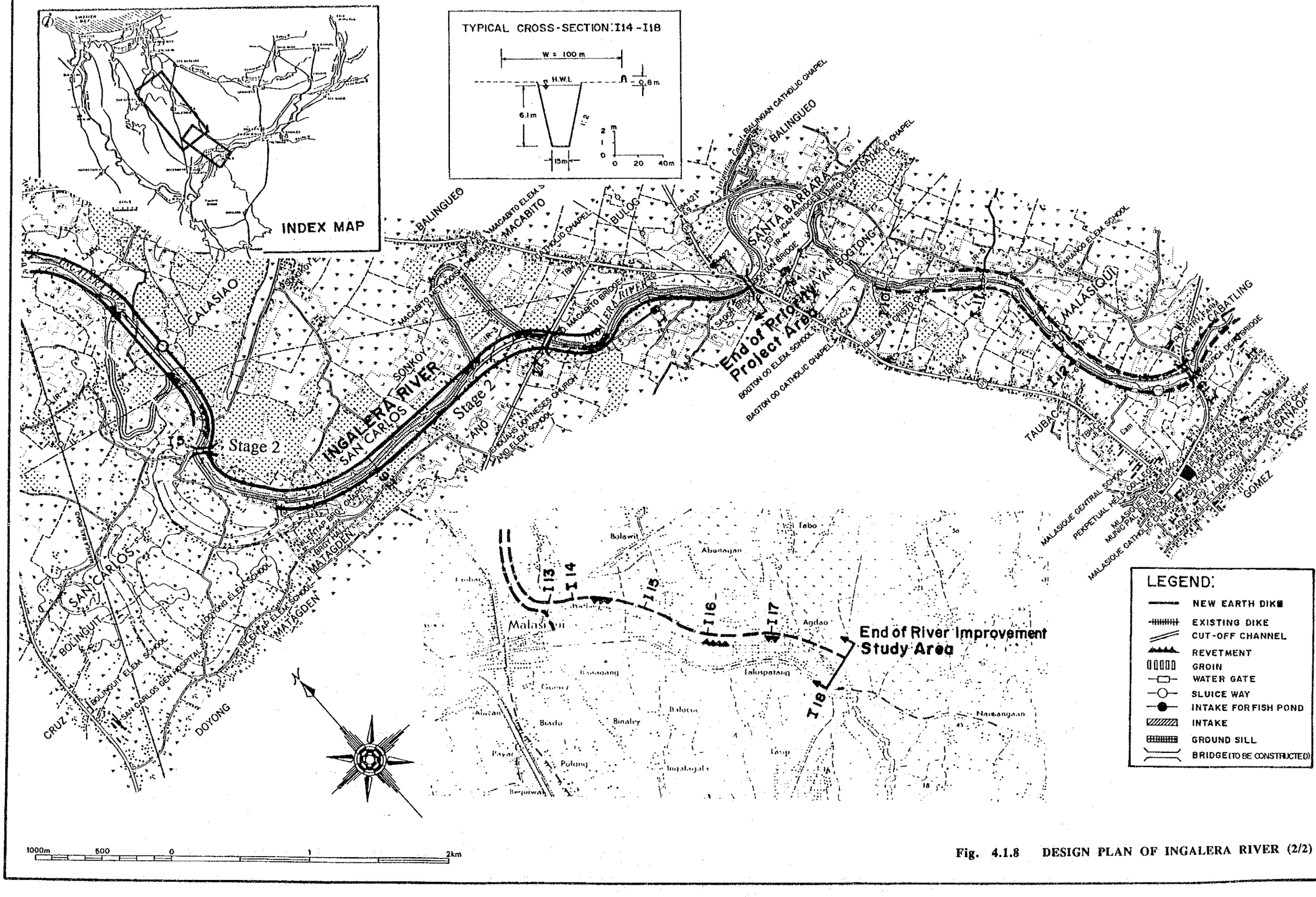
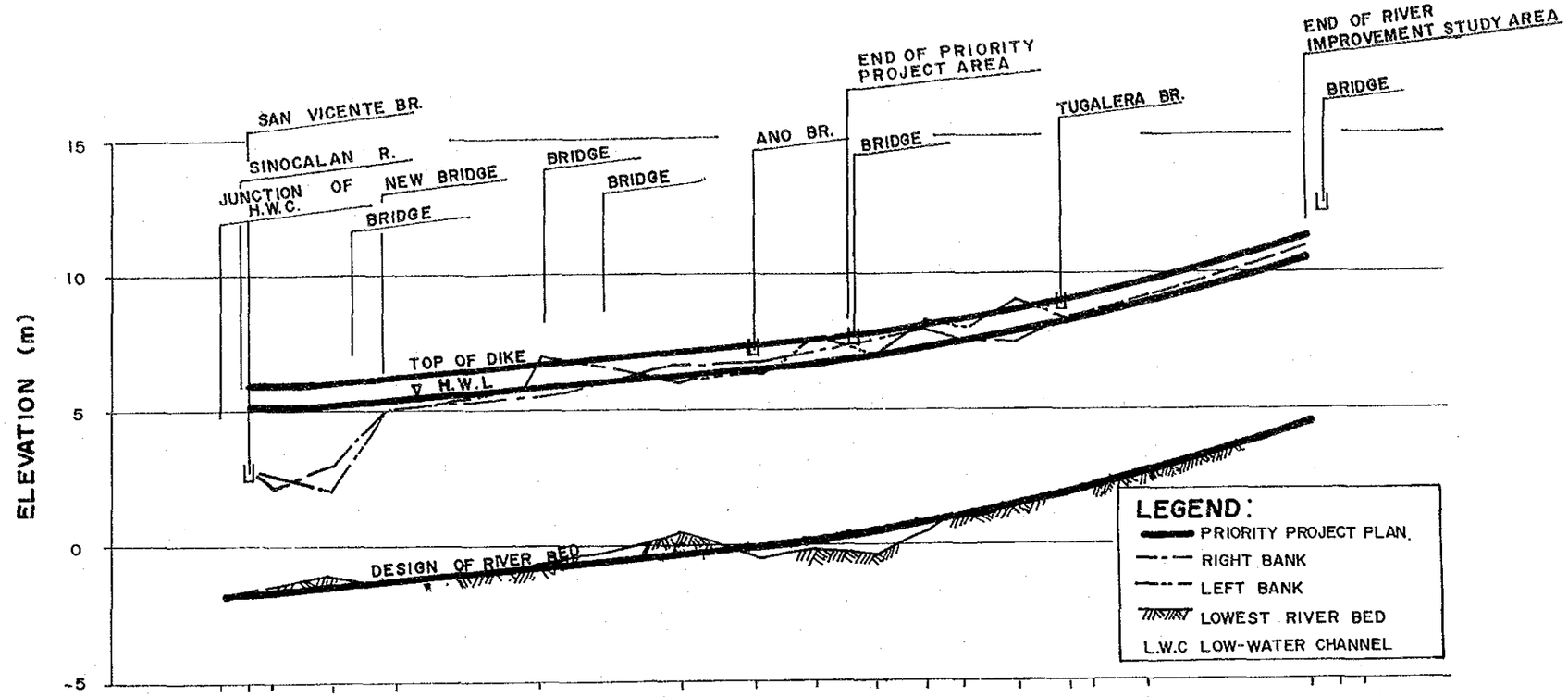
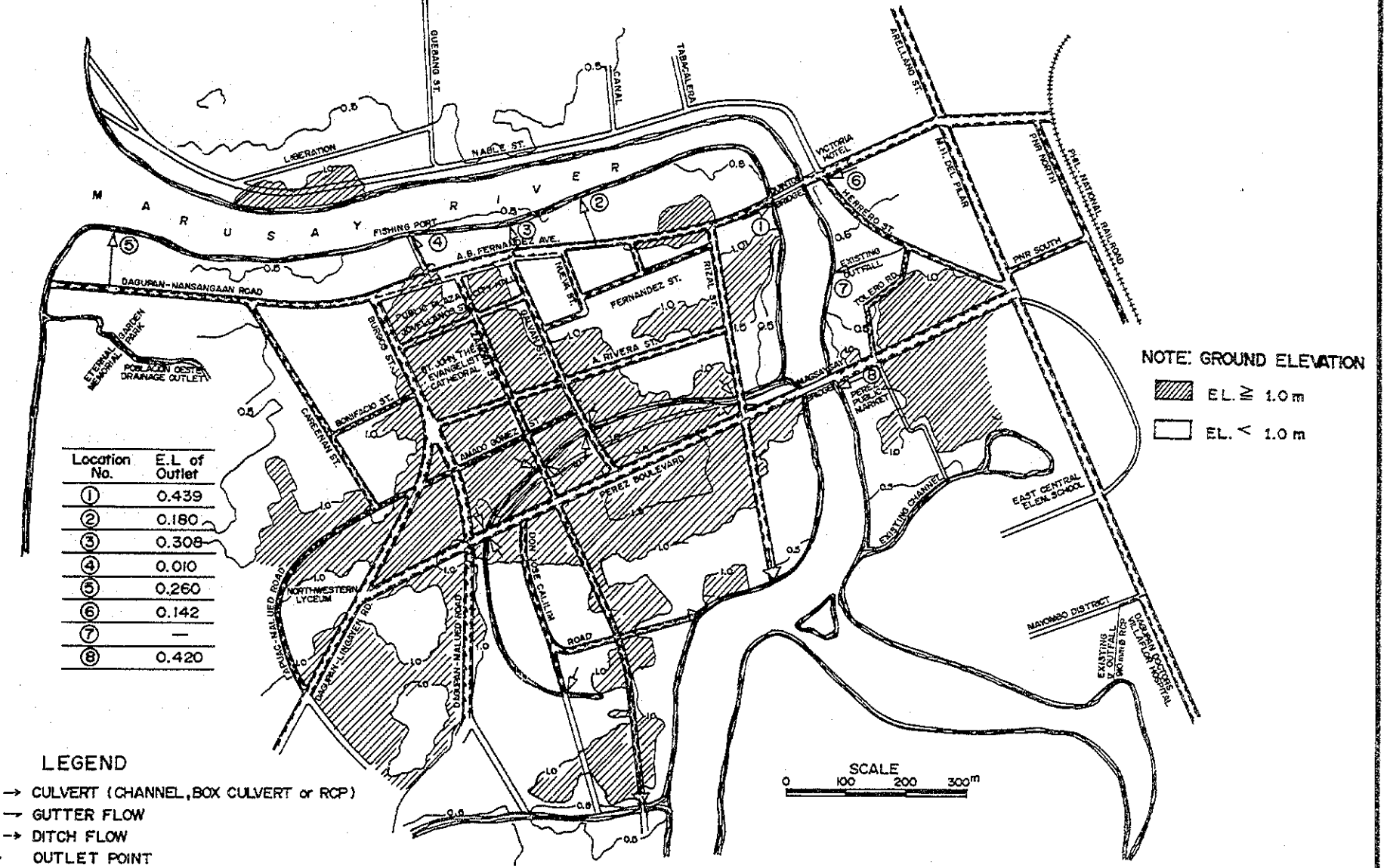


Fig. 4.1.8 DESIGN PLAN OF INGALERA RIVER (2/2)



DESIGN IN FLOOD DISCHARGE (m^3/s)	360												260							
GRADIENT OF H.W.L.	1/5000							1/3400					1/1800							
GRADIENT OF RIVER BED	1/5000							1/2500					1/1800							
TOP OF DIKE (El. m)	5.80	5.80	5.93	6.16	6.69	7.01	7.27	7.50	7.79	8.11	8.31	8.60	8.86	9.10	9.61	10.21	10.76	11.32	11.49	11.87
H.W.L. (El. m)	5.00	5.00	5.13	5.36	5.89	6.21	6.47	6.70	6.99	7.31	7.51	7.80	8.08	8.30	8.81	9.41	9.96	10.32	10.69	11.07
CHANNEL BED (El. m)	-1.88	-1.80	-1.69	-1.47	-1.24	-0.71	-0.38	-0.12	0.10	0.55	0.93	1.20	1.60	1.98	2.20	2.71	3.31	3.86	4.42	4.59	4.97
DISTANCE (Km)	0.00	0.41	0.93	2.04	3.19	5.86	7.48	8.78	9.92	11.04	11.98	12.67	13.66	14.61	15.00	16.00	17.00	18.00	19.00	19.30	20.00
SECTION NO.	I-1	I-2	I-3	I-4	I-5	I-6	I-7	I-8	I-9	I-10	I-11	I-12	I-13	I-14	I-15	I-16	I-17	I-18	I-19		

Fig. 4.1.9 LONGITUDINAL PROFILE OF INGALERA RIVER



Location No.	E.L of Outlet
①	0.439
②	0.180
③	0.308
④	0.010
⑤	0.260
⑥	0.142
⑦	—
⑧	0.420

Fig. 4.1.10 GENERAL LAYOUT OF DRAINAGE MASTER PLAN IN DAGUPAN CITY

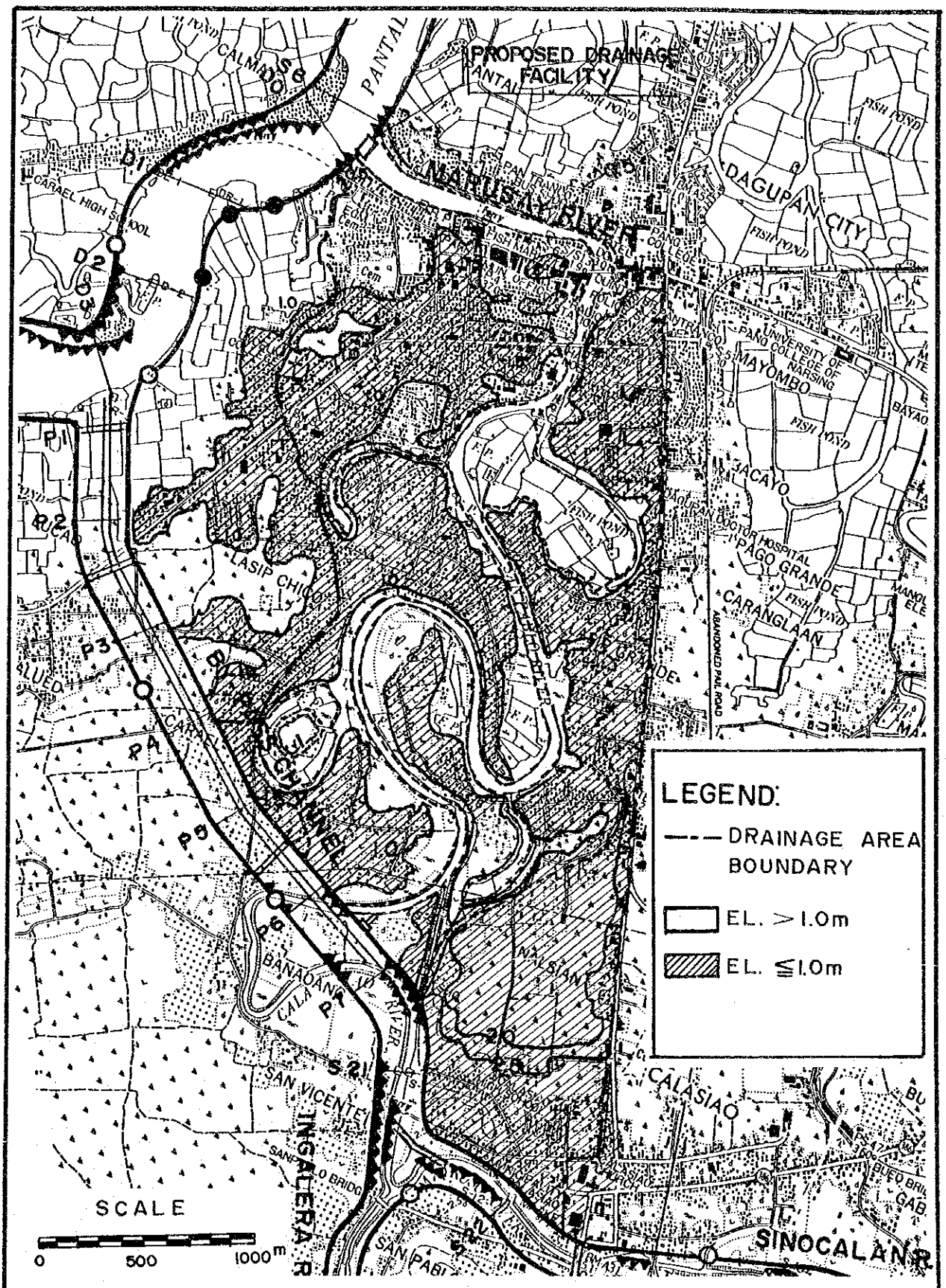
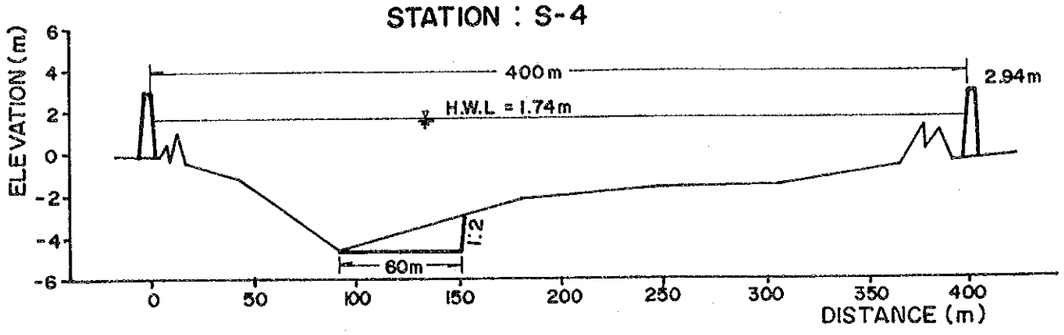
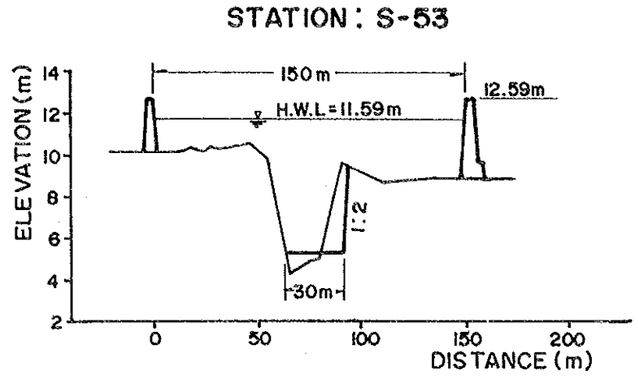
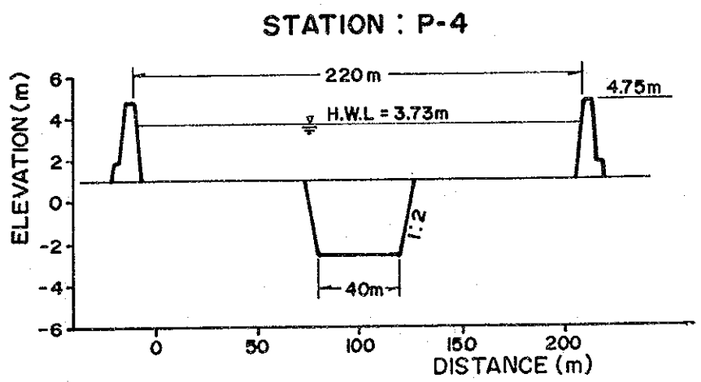
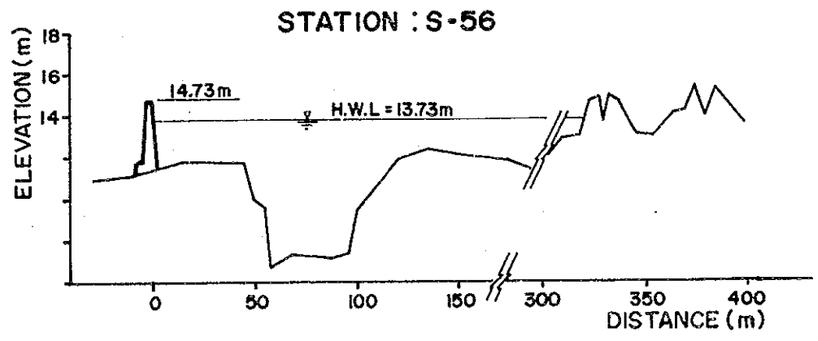


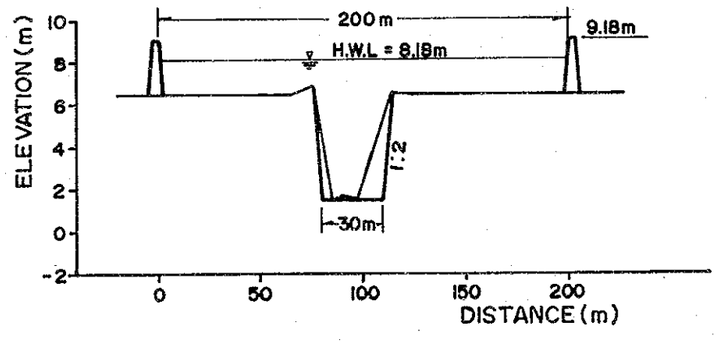
Fig. 4.1.11 DRAINAGE AREA IN DAGUPAN CITY

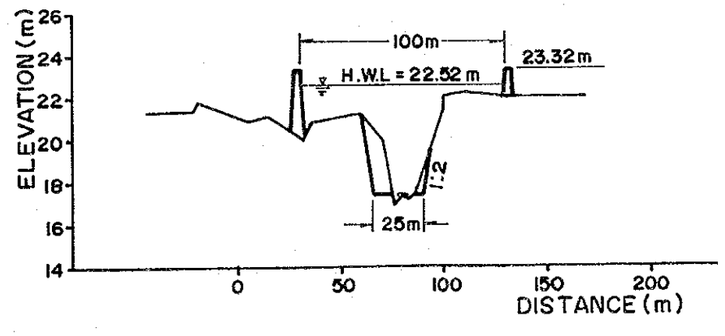












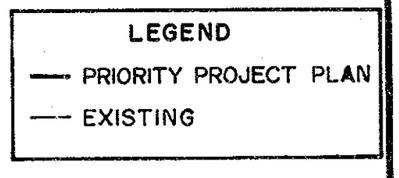
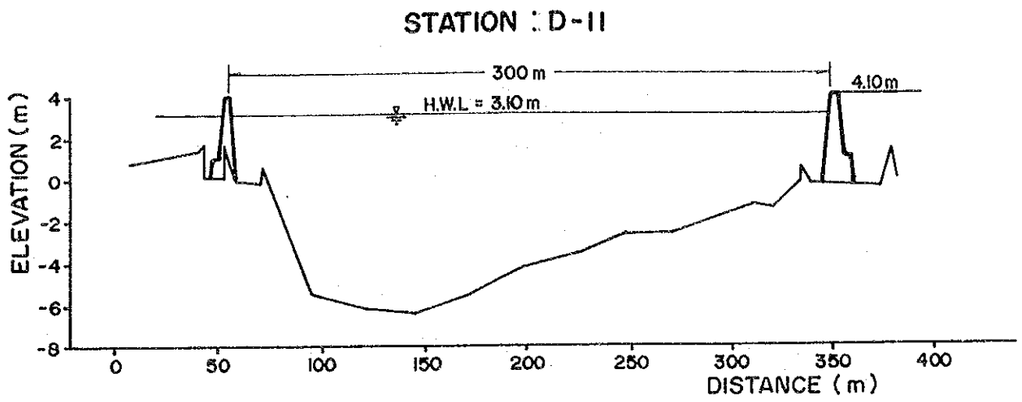
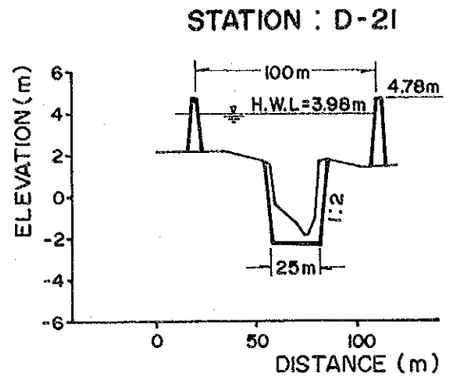
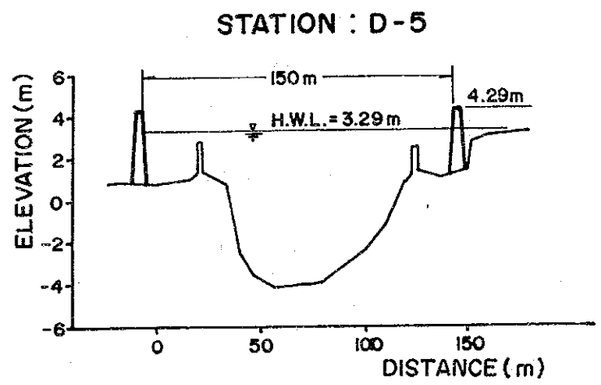
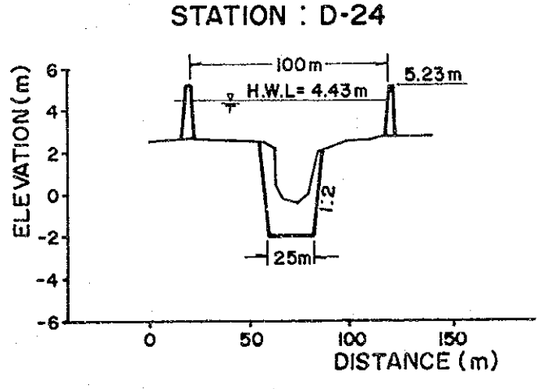


Fig. 4.1.12 TYPICAL CROSS-SECTION OF PANTAL-SINOCALAN RIVER









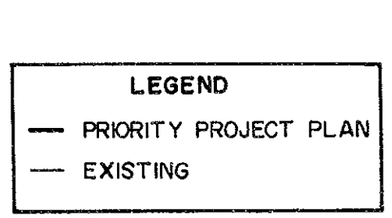
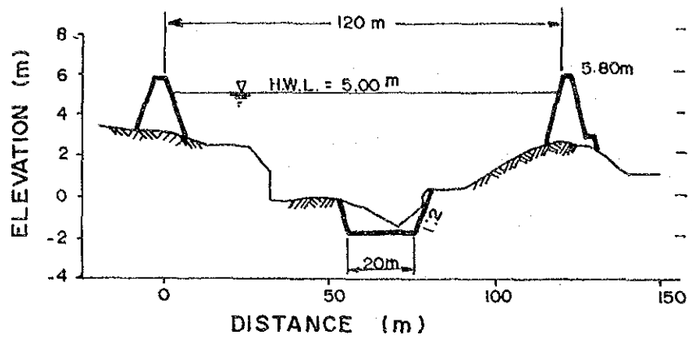
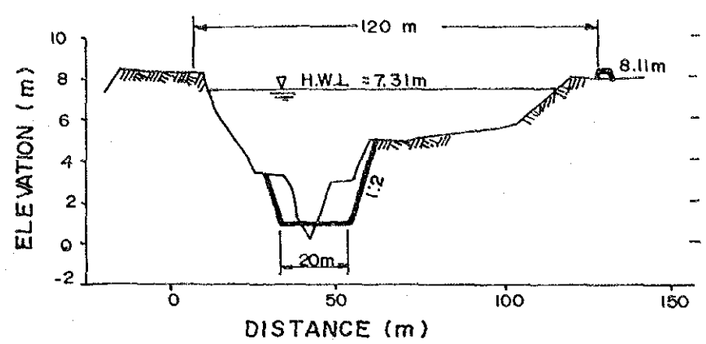


Fig. 4.1.13 TYPICAL CROSS-SECTION OF DAGUPAN RIVER

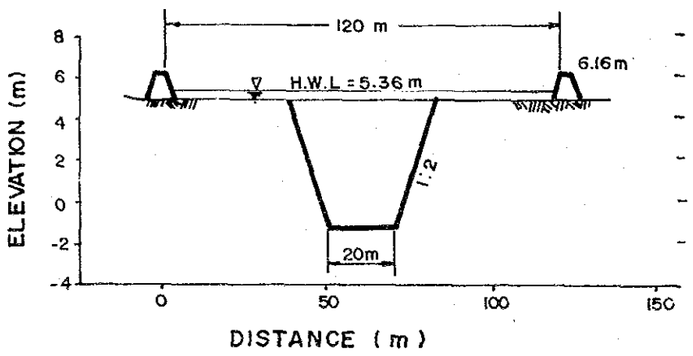
STATION: I-2



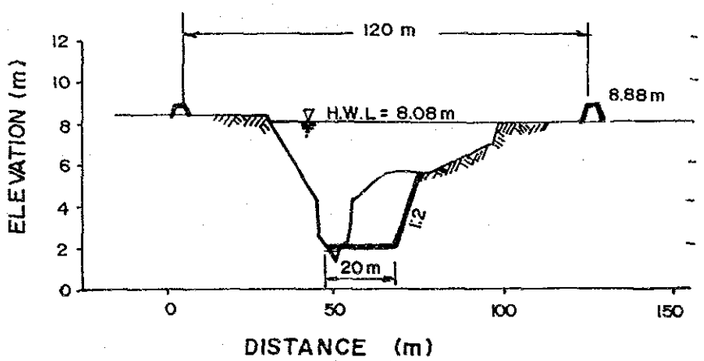
STATION: I-10



STATION: I-4



STATION: I-13 (Ingalera Br.)



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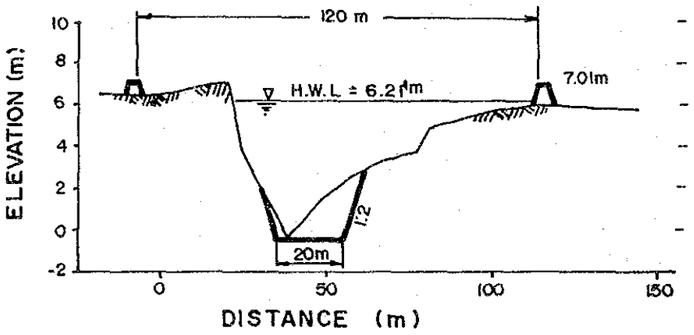


STATION: I-15

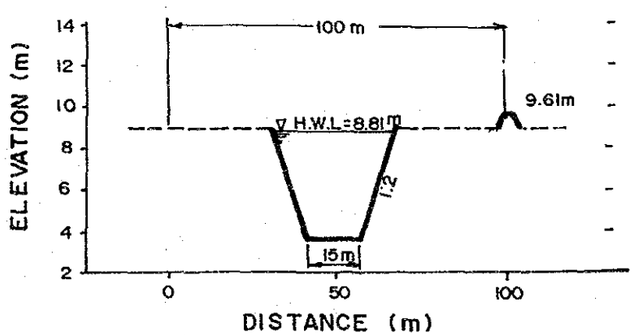


Fig. 4.1.14 TYPICAL CROSS-SECTION OF INGALERA RIVER

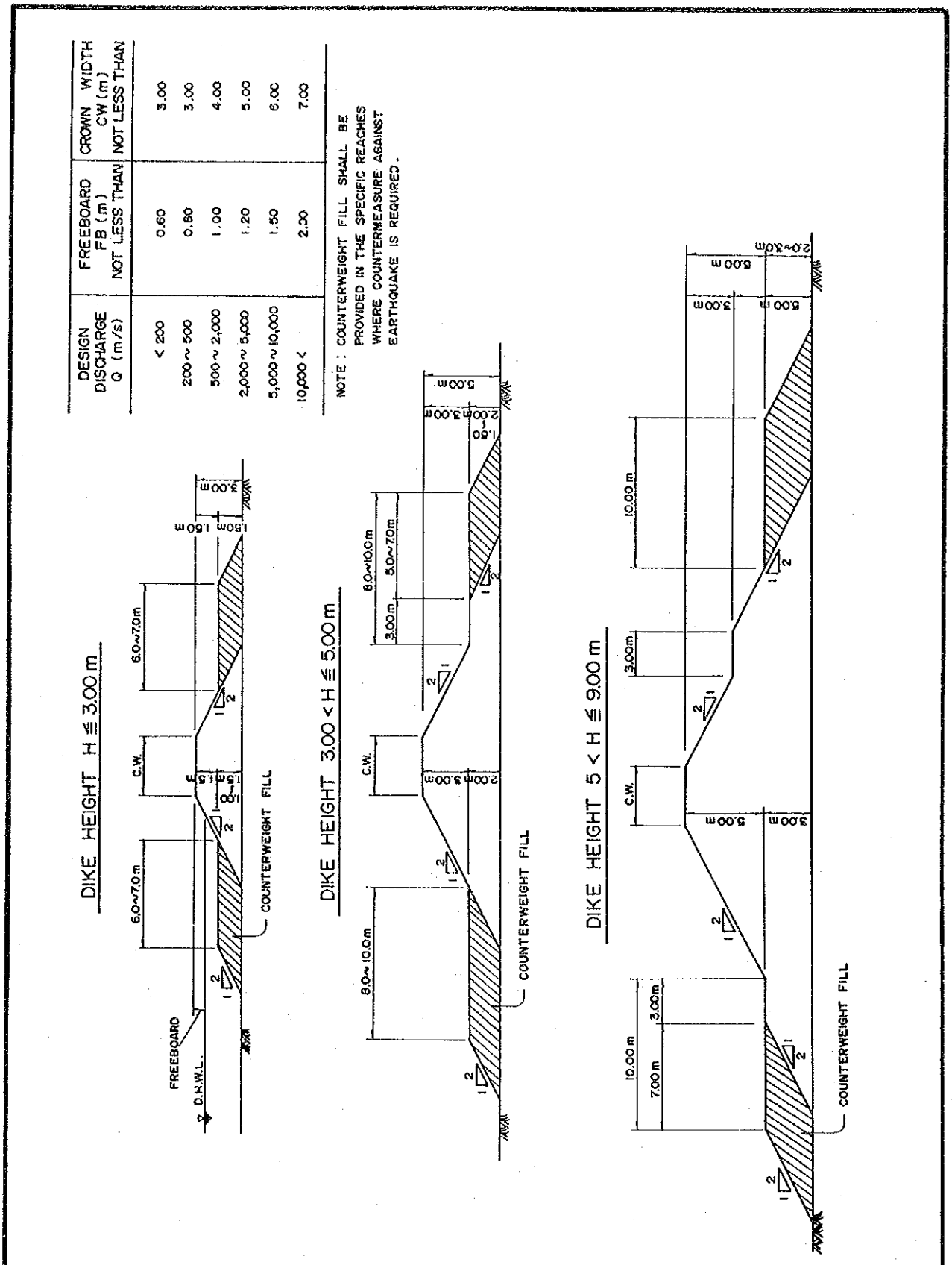


Fig. 4.1.15 STANDARD DESIGN SECTION OF PANTAL-SINOCALAN RIVER EARTHDIKE

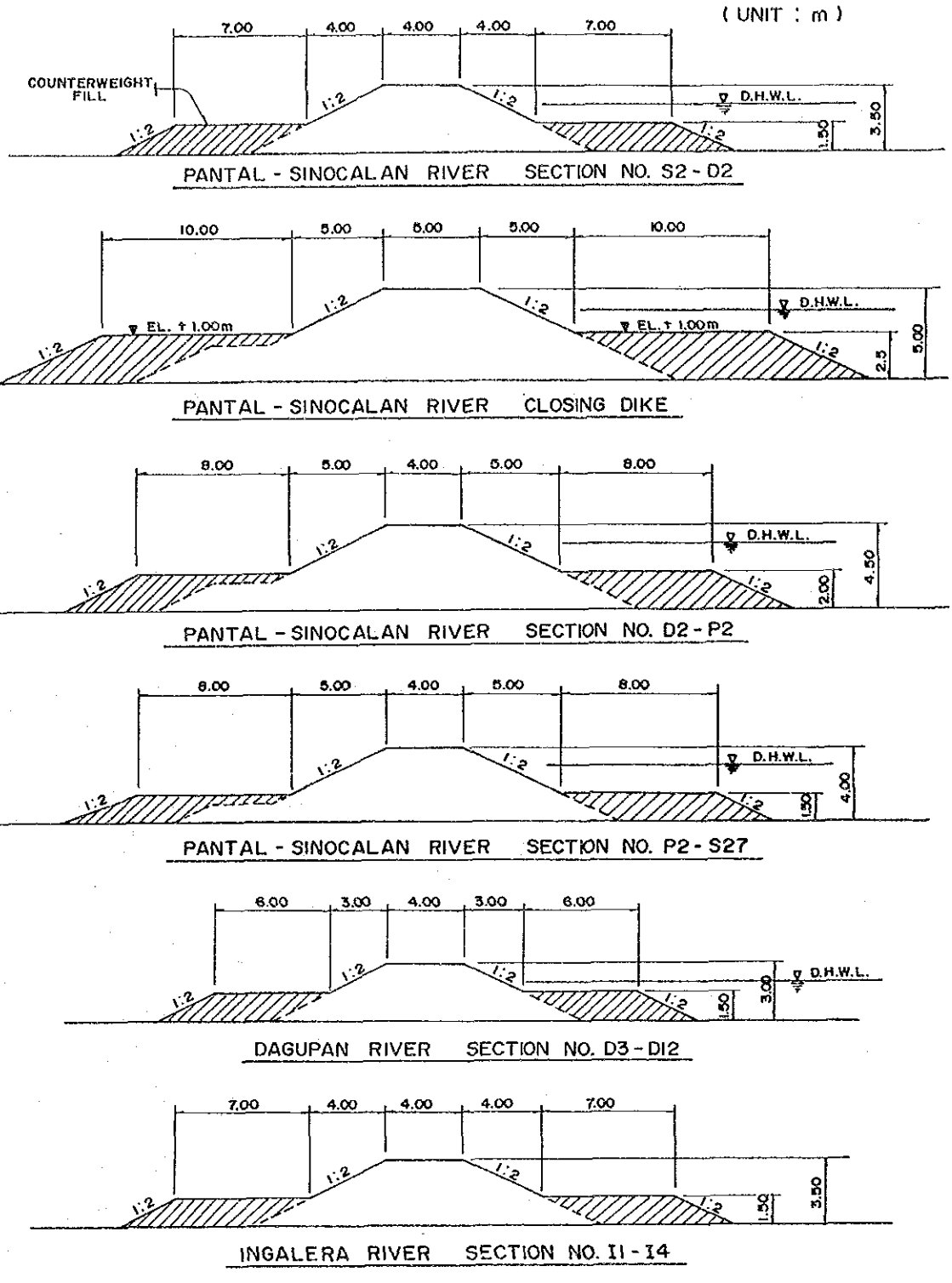


Fig. 4.1.16 STANDARD DESIGN OF COUNTERWEIGHT FILL AGAINST LIQUEFACTION (PANTAL-SINOCALAN RIVER)

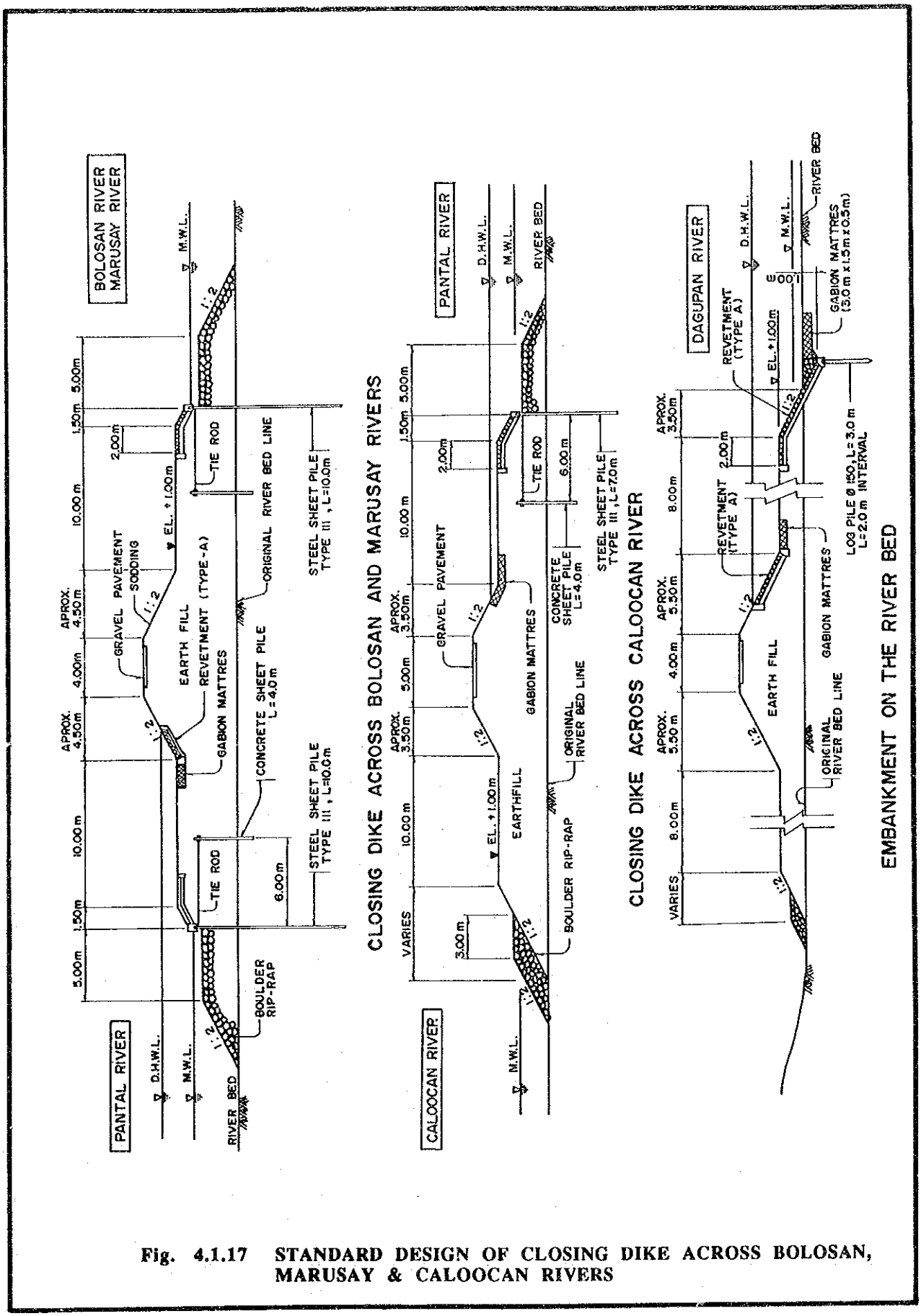


Fig. 4.1.17 STANDARD DESIGN OF CLOSING DIKE ACROSS BOLOSAN, MARUSAY & CALOOCAN RIVERS

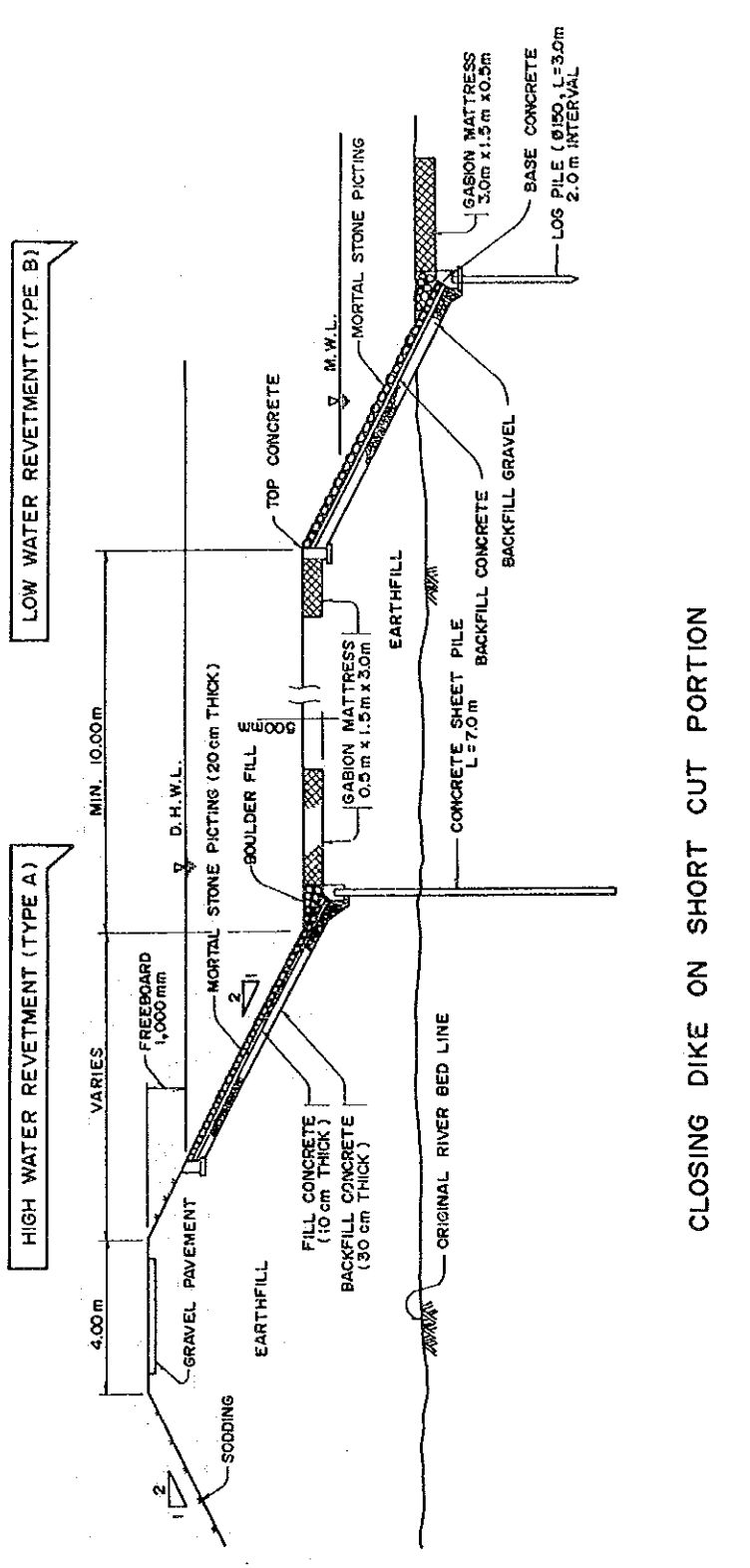


Fig. 4.1.18 PROTECTION WORKS FOR CLOSING DIKE IN SINOCALAN RIVER

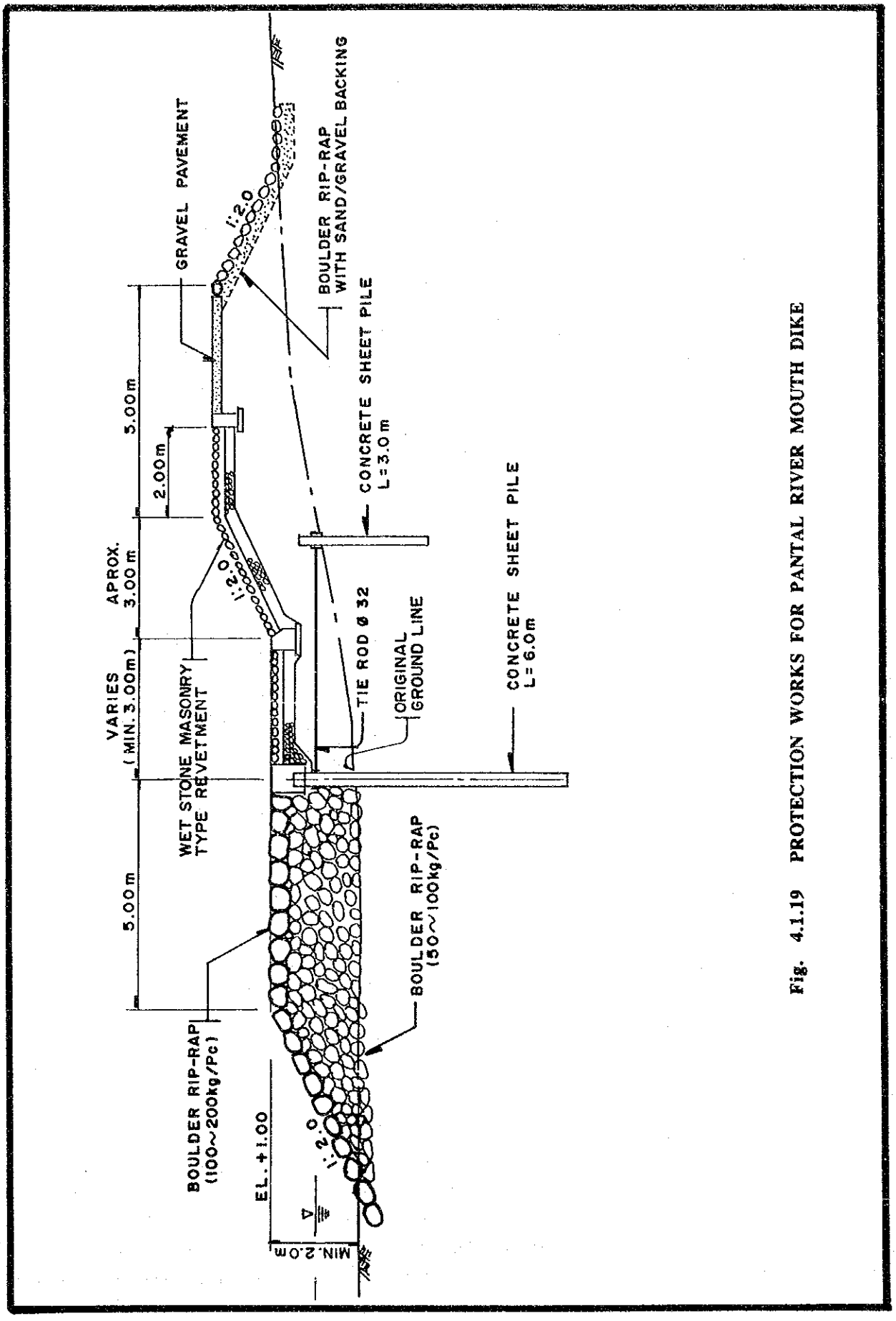
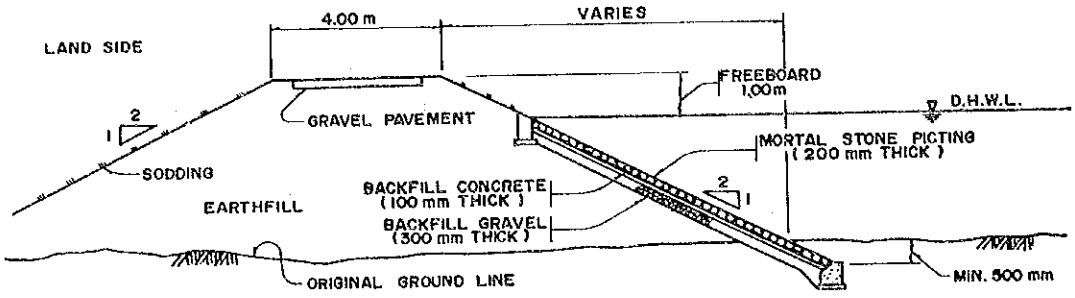
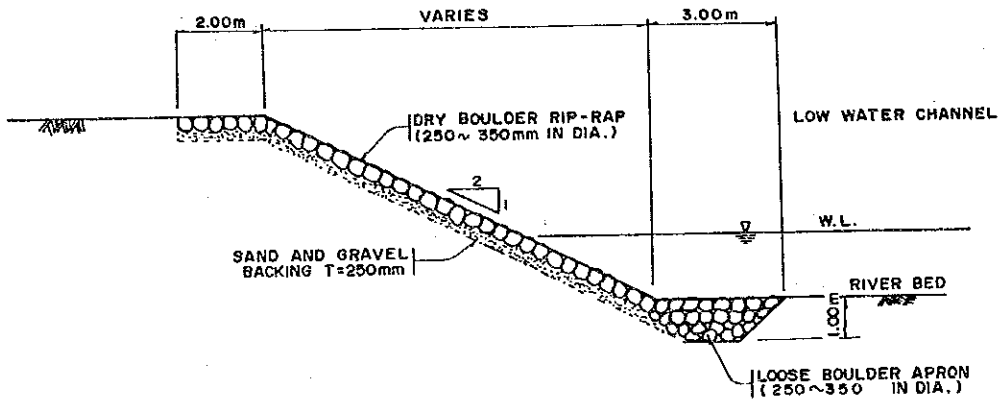


Fig. 4.1.19 PROTECTION WORKS FOR PANTAL RIVER MOUTH DIKE



HIGH WATER CHANNEL REVETMENT (TYPE A)



LOW WATER CHANNEL REVETMENT (TYPE A)

Fig. 4.1.20 STANDARD DESIGN SECTION OF REVETMENT

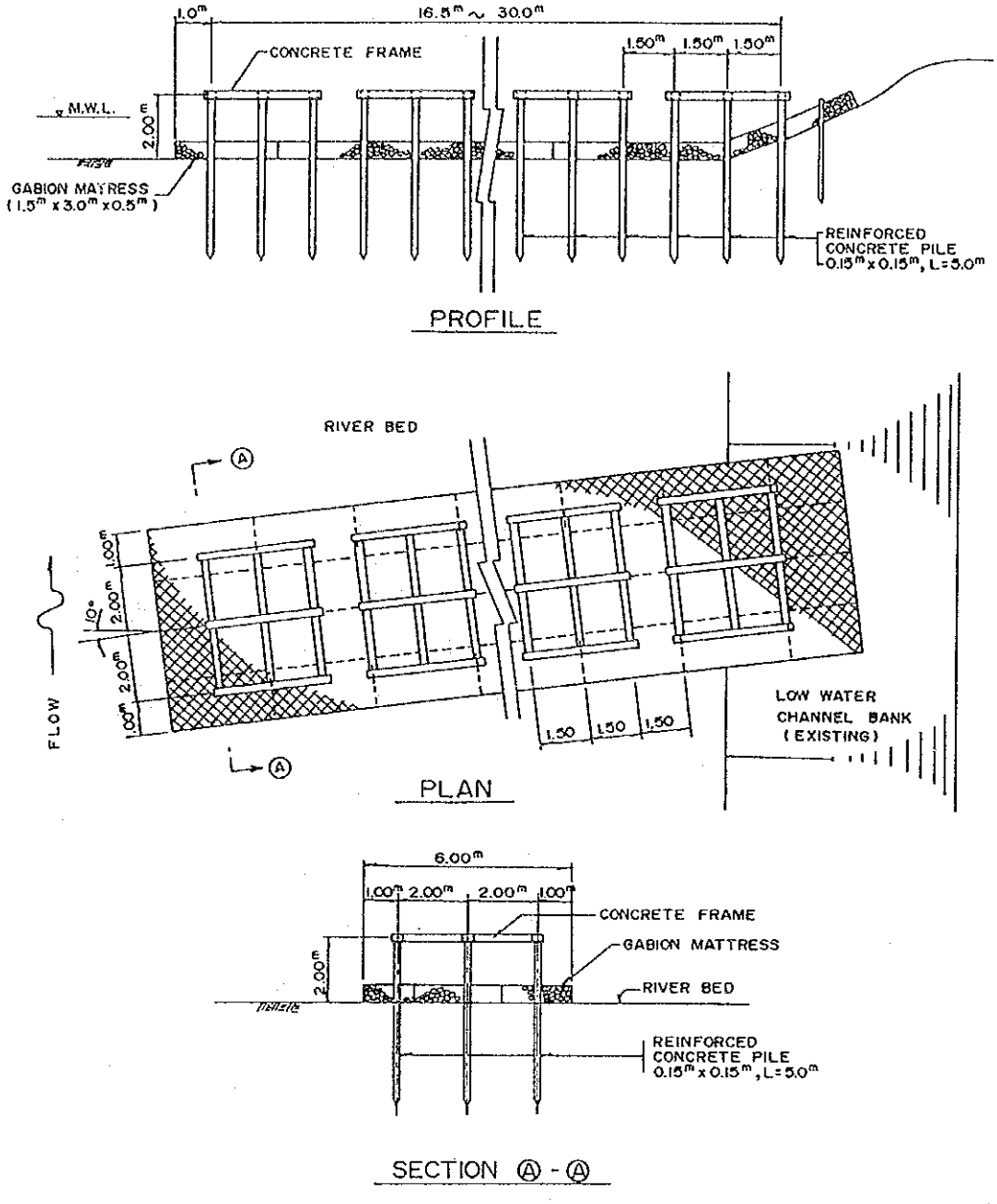


Fig. 4.1.21 STANDARD DESIGN OF GROYNE (PILE TYPE)

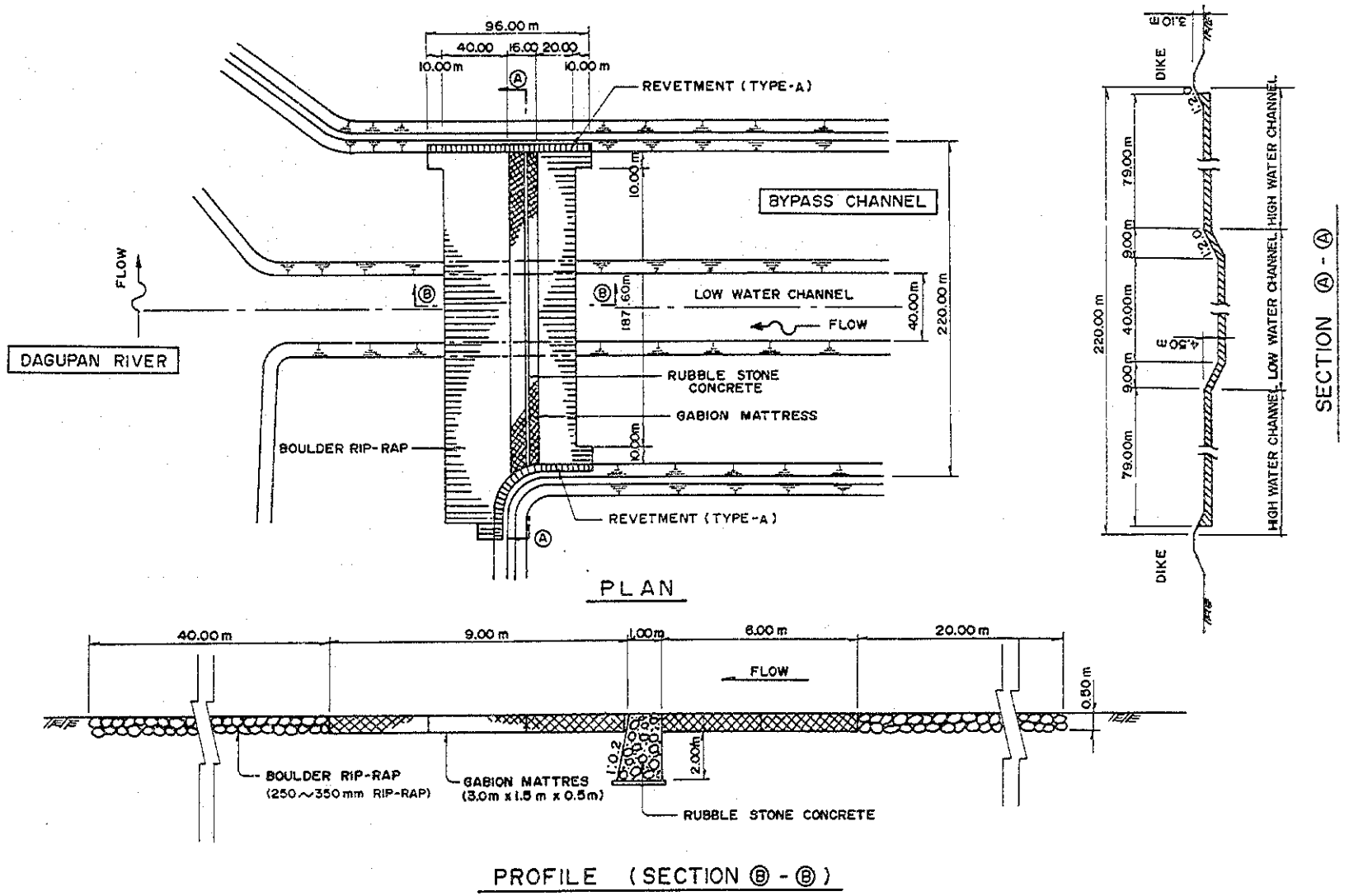


Fig. 4.1.22 GROUNDSILL ON BYPASS CHANNEL OF SINOCALAN RIVER

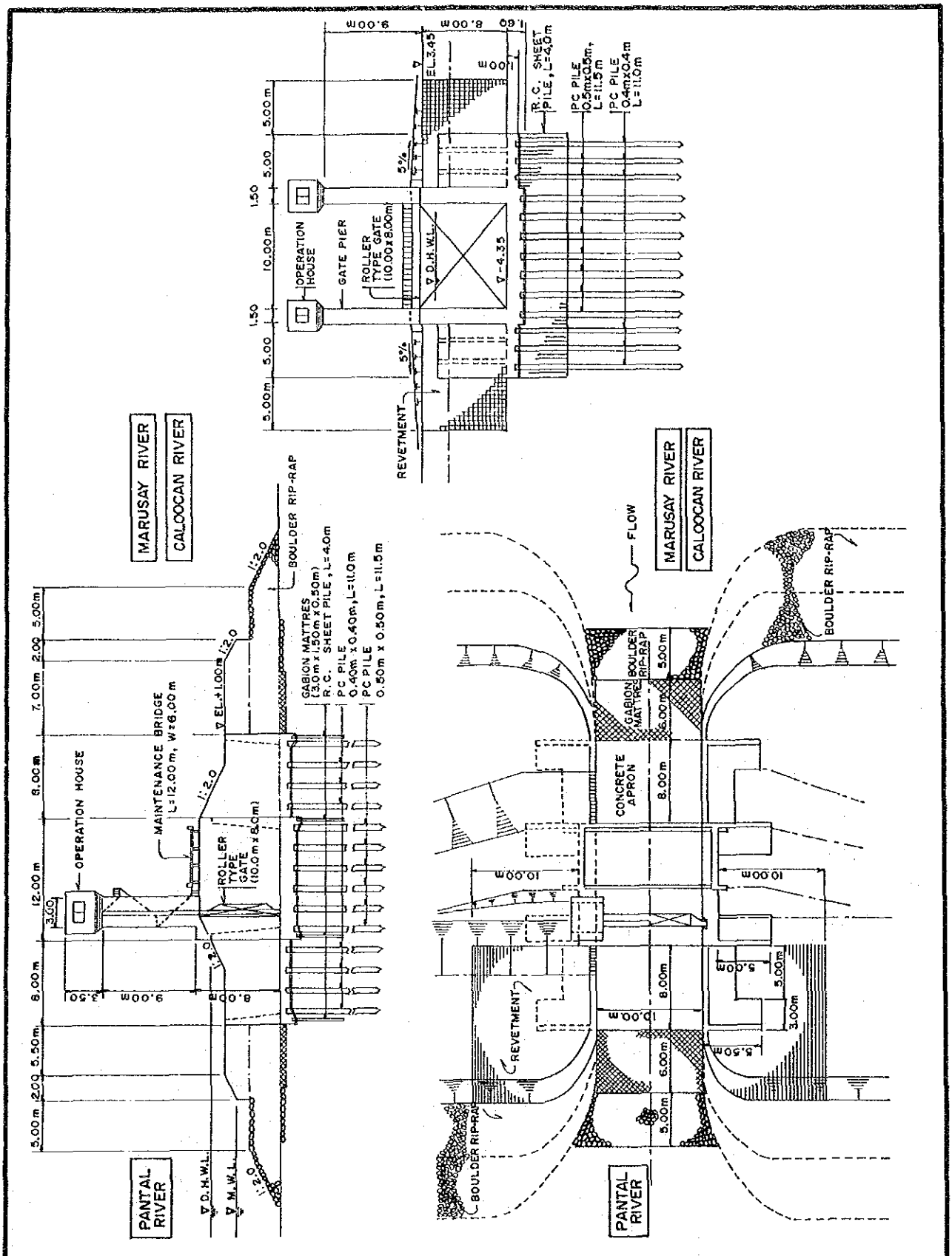


Fig. 4.1.23 STANDARD DESIGN OF WATER GATE (PANTAL-SINOCALAN RIVER TYPE - I)

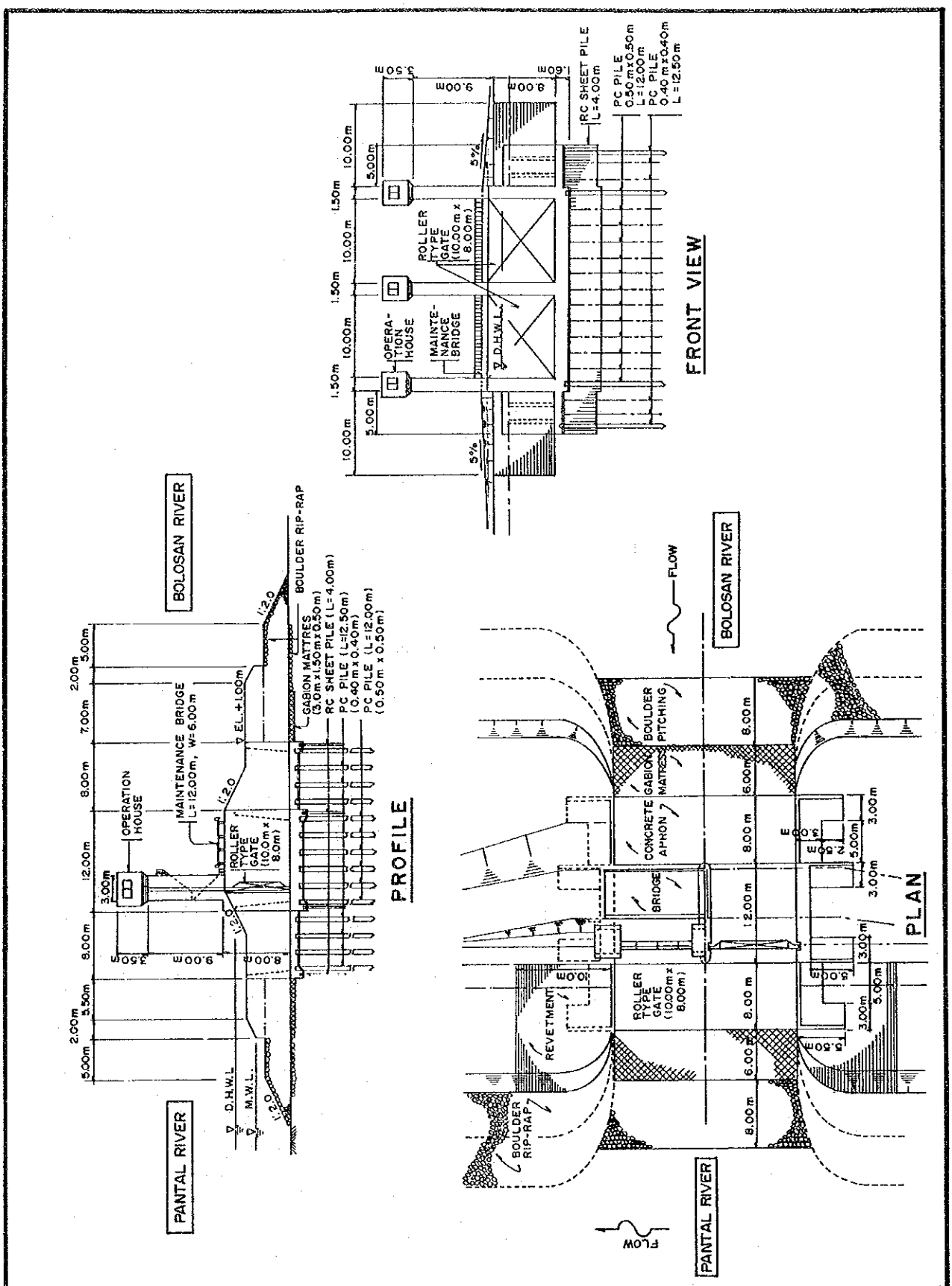


Fig. 4.1.24 STANDARD DESIGN OF WATER GATE (PANTAL-SINOCALAN RIVER TYPE - II)

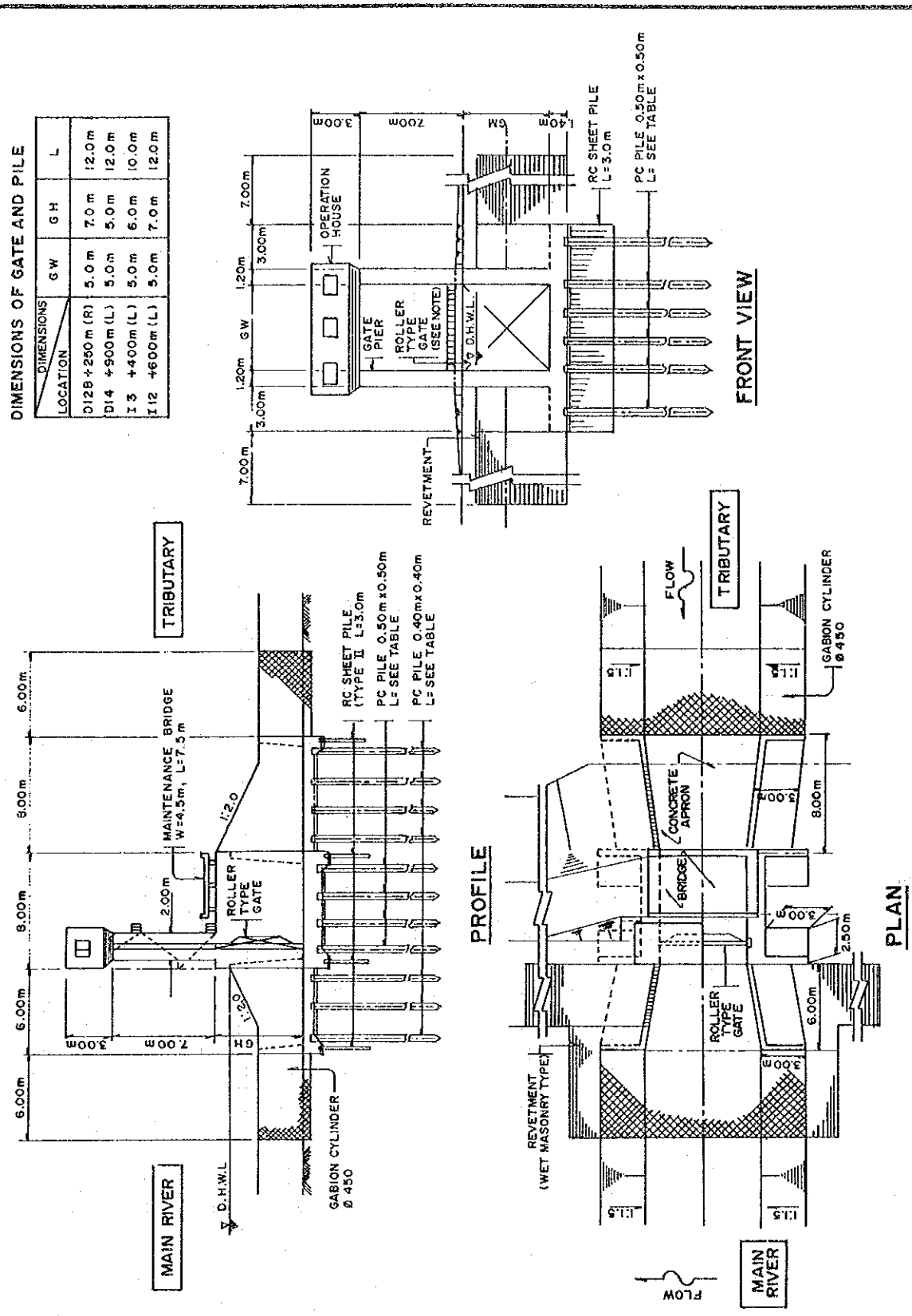


Fig. 4.1.25 STANDARD DESIGN OF WATER GATE (PANTAL-SINOCALAN RIVER TYPE - III)

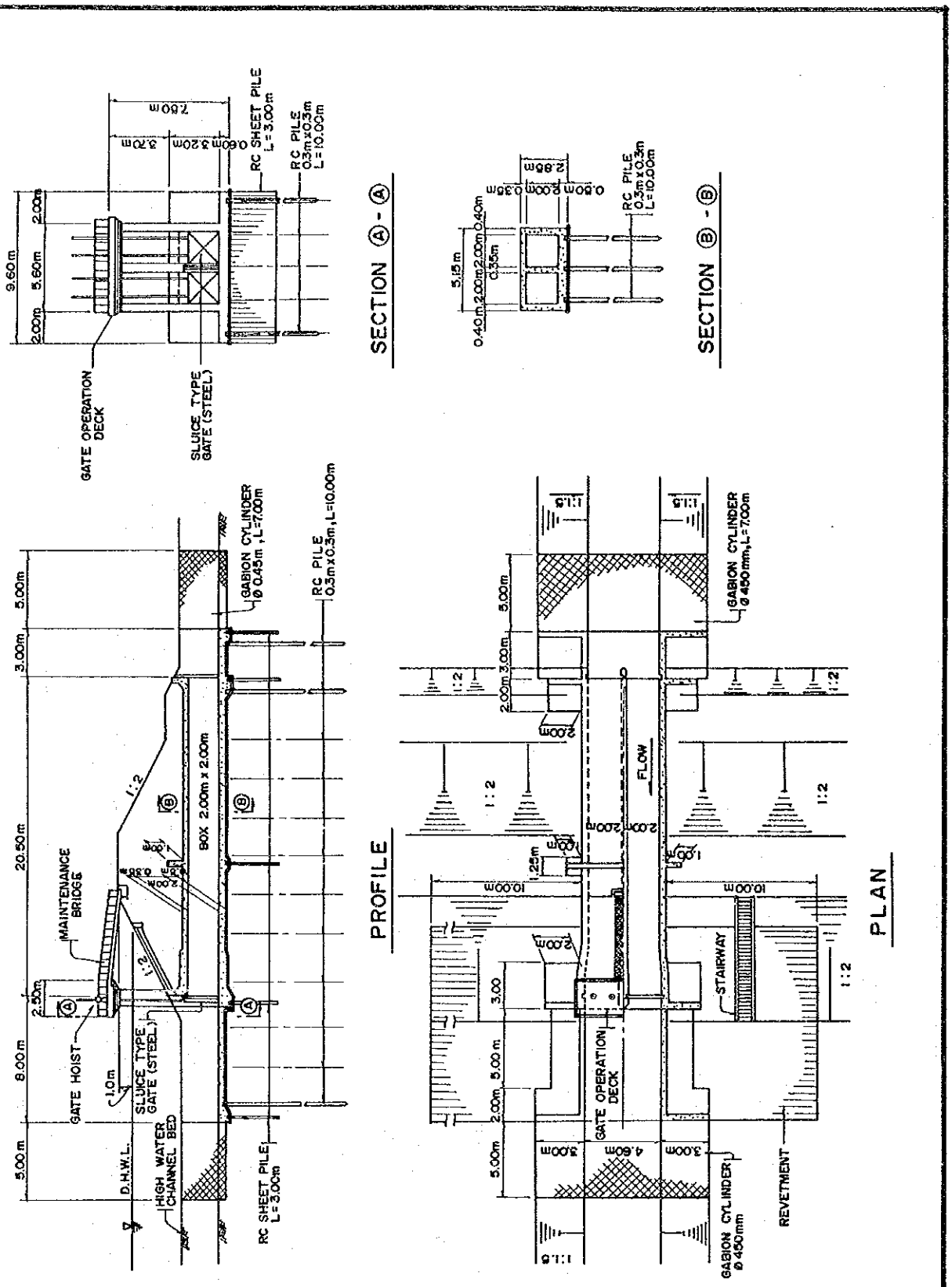


Fig. 4.1.26 STANDARD DESIGN OF SLUICE WAY IN PANTAL-SINOCALAN RIVER (TYPE B-2)

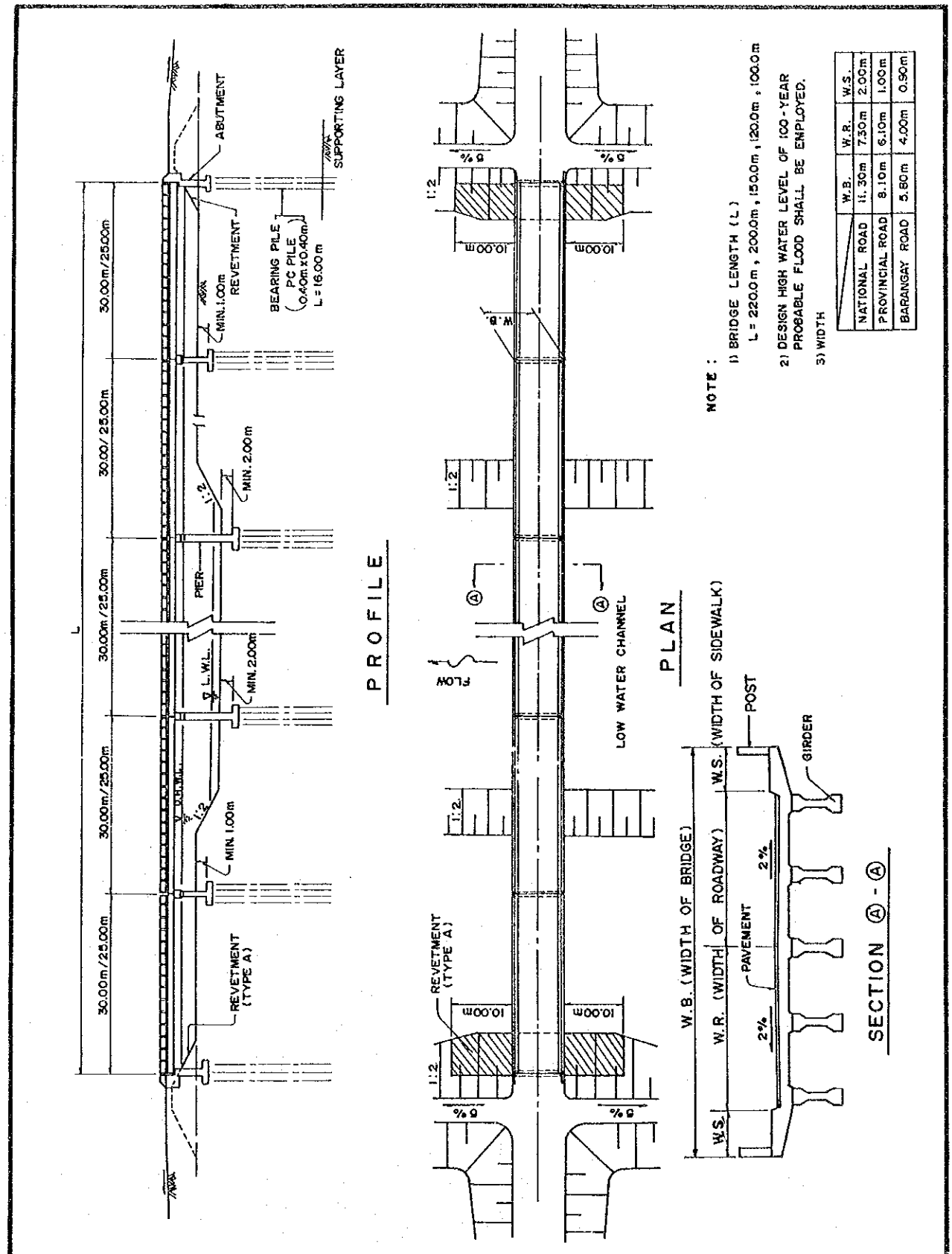
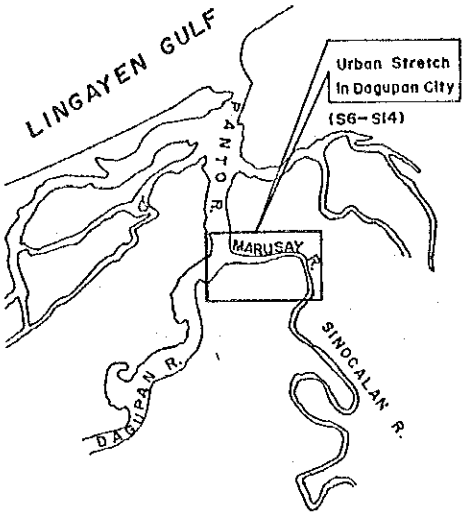
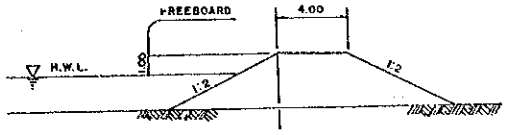


Fig. 4.1.27 STANDARD DESIGN OF BRIDGE

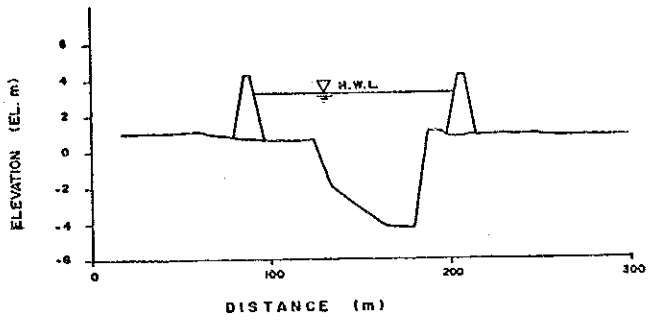


LOCATION MAP

- DESIGN DISCHARGE (PROBABLE 50-YEAR FLOOD)
  - PANTO RIVER 2,900 m^3/sec.
  - URBAN STRETCH 1,650 m^3/sec.
- RIVER CHANNEL WIDTH OF URBAN STRETCH 120 m



TYPICAL SECTION OF EARTH DIKE



TYPICAL CROSS SECTION OF RIVER CHANNEL

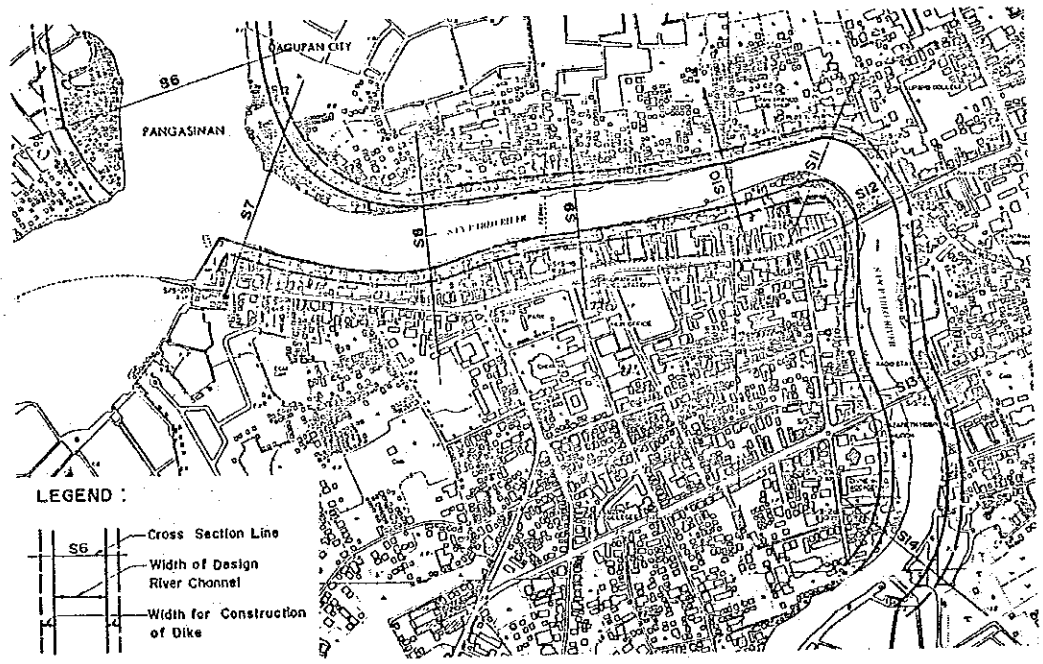
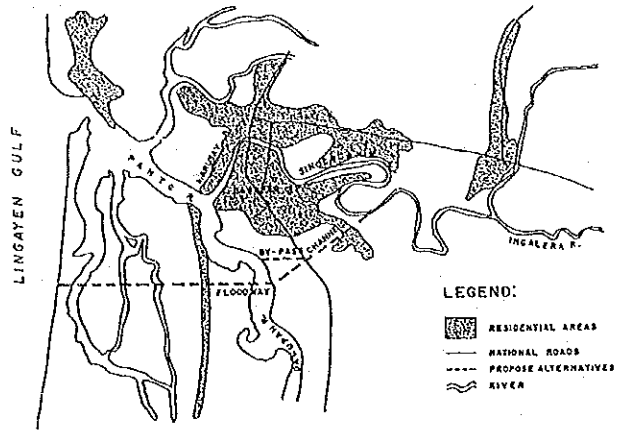


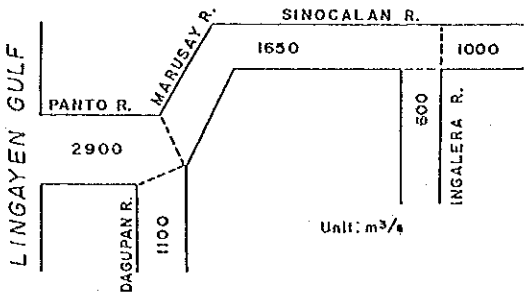
Fig. 4.2.1 AFFECTED AREA AND TYPICAL SECTIONS OF ALTERNATIVE-1A : URBAN STRETCH OF SINOCALAN RIVER FOR 120M RIVER WIDTH

LOCATION MAP

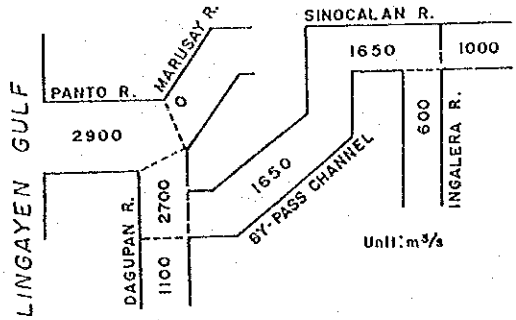


DESIGN FLOOD DISCHARGE DISTRIBUTION
(with BINALONAN FLOODWAY 50-yr FLOOD)

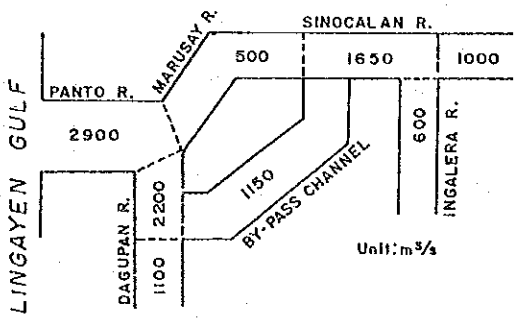
RIVER IMPROVEMENT ONLY



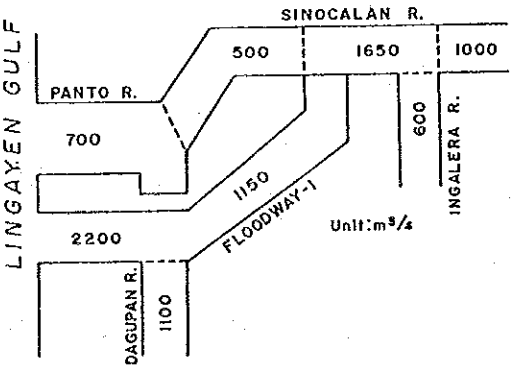
BY-PASS CHANNEL - 1



BY-PASS CHANNEL - 2



FLOODWAY - 1



FLOODWAY - 2

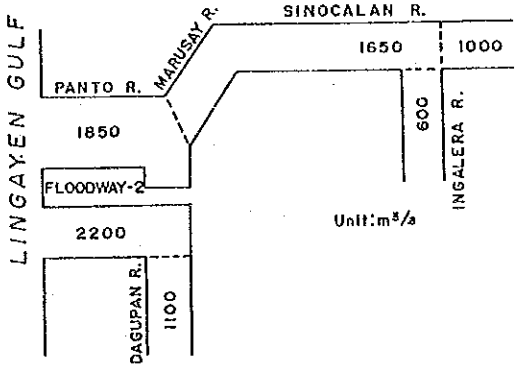


Fig. 4.2.2 DESIGN FLOOD DISTRIBUTION OF ALTERNATIVES FOR URBAN STRETCH OF PANTAL-SINOCALAN RIVER

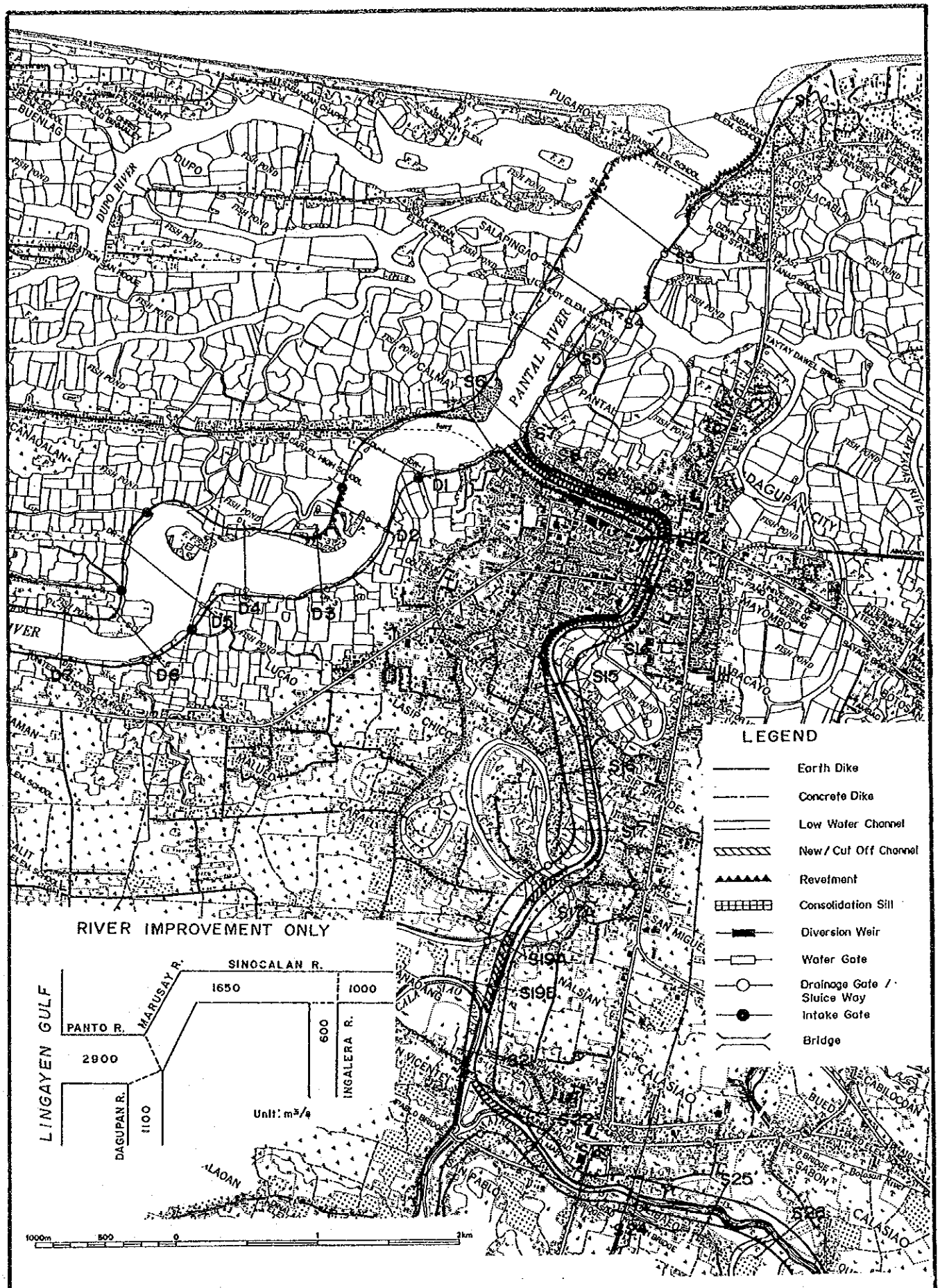


Fig. 4.2.3 LAYOUT OF ALTERNATIVE-1A SOLE RIVER IMPROVEMENT

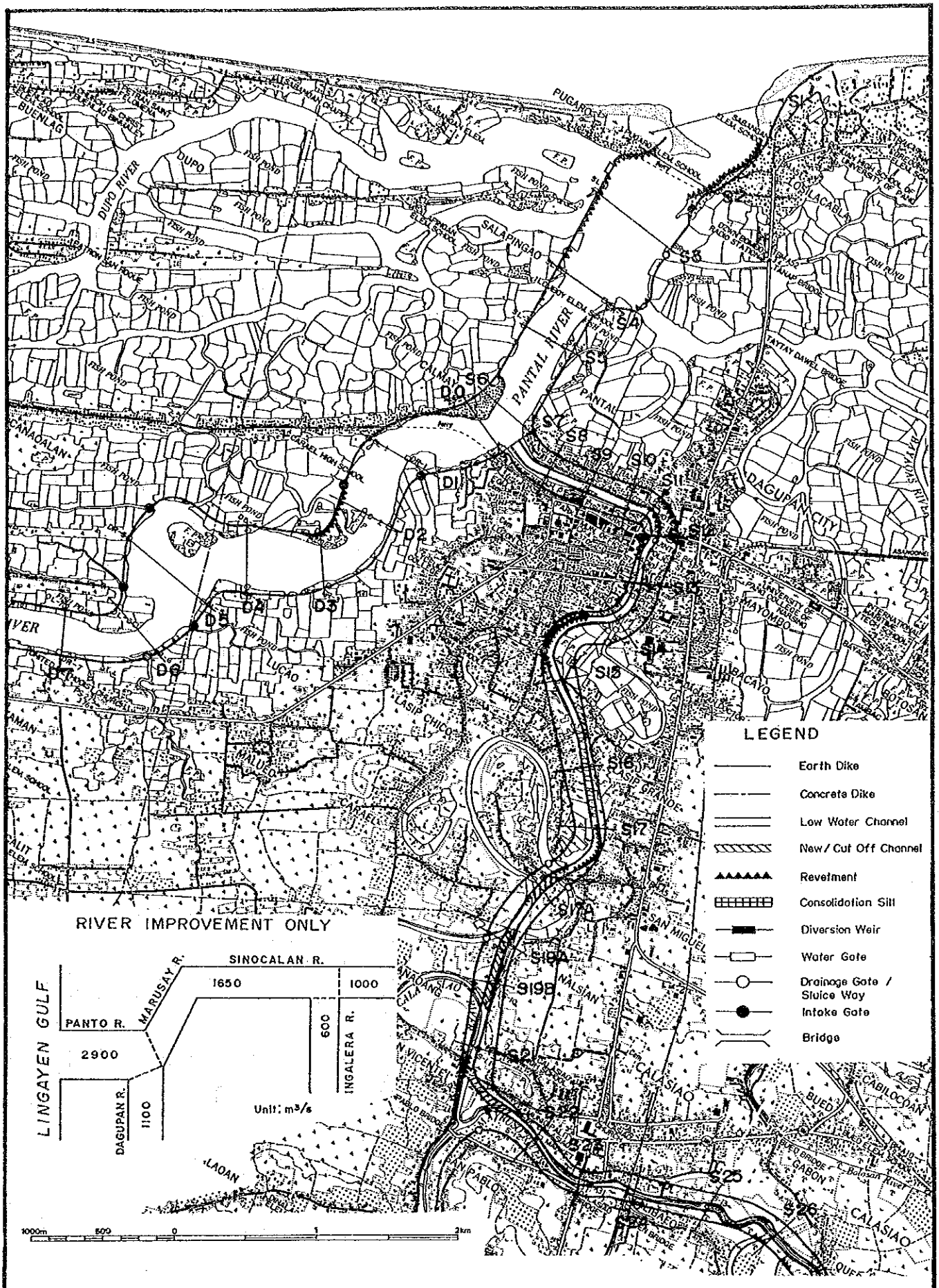


Fig. 4.2.4 LAYOUT OF ALTERNATIVE-1B SOLE RIVER IMPROVEMENT

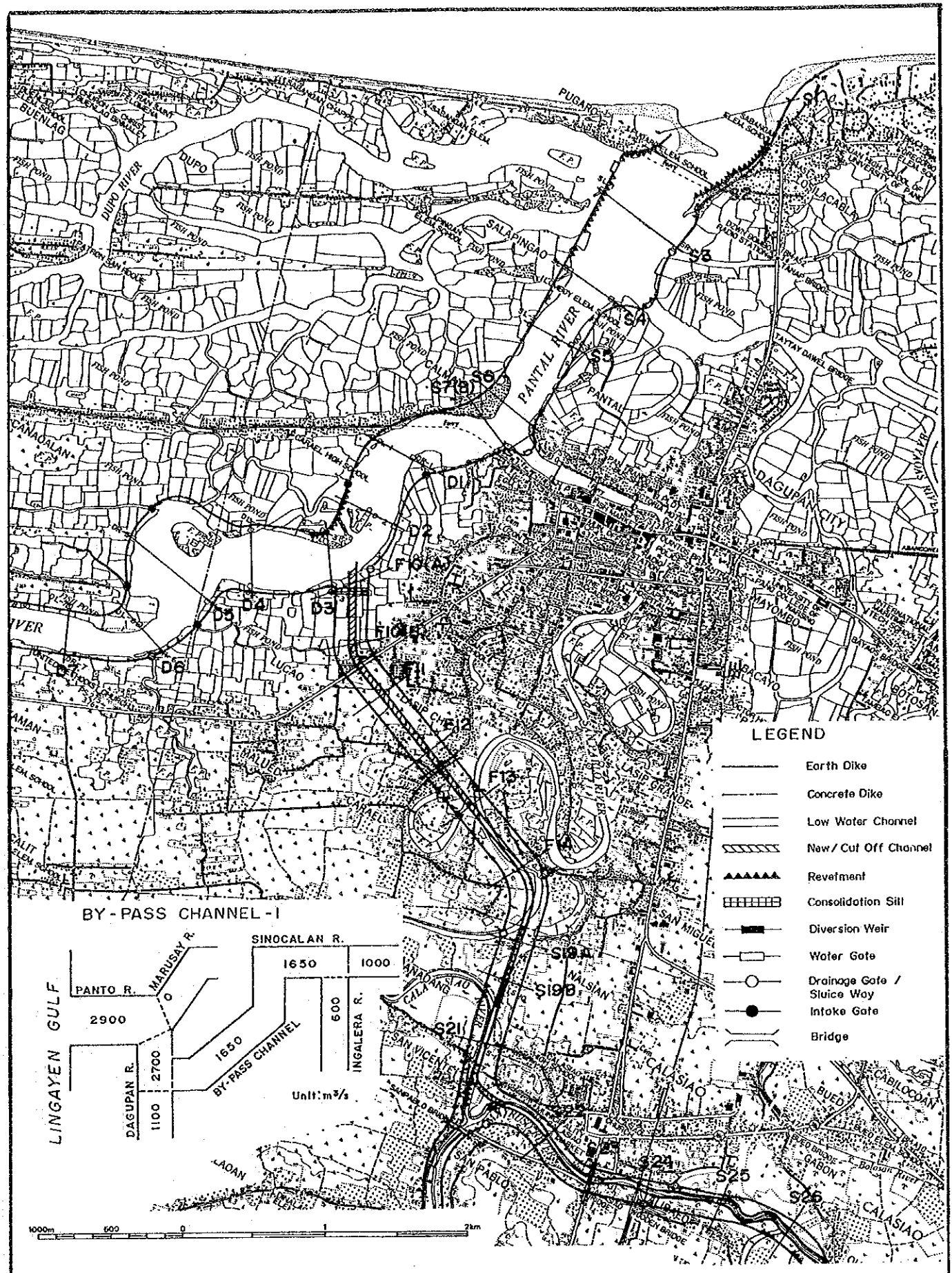


Fig. 4.2.5 LAYOUT OF ALTERNATIVE-2A BY-PASS CHANNEL

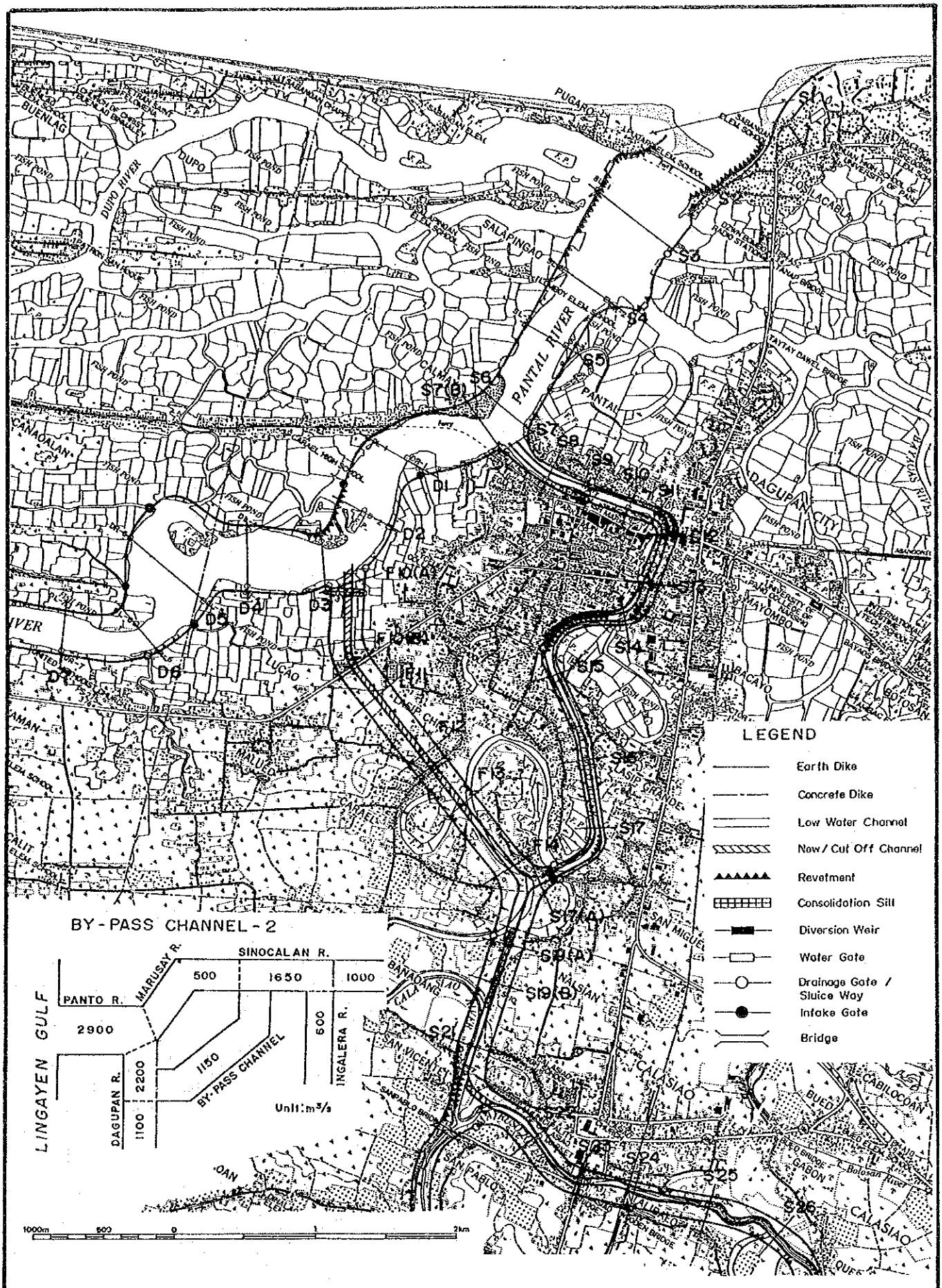


Fig. 4.2.6 LAYOUT OF ALTERNATIVE-2B BY-PASS CHANNEL

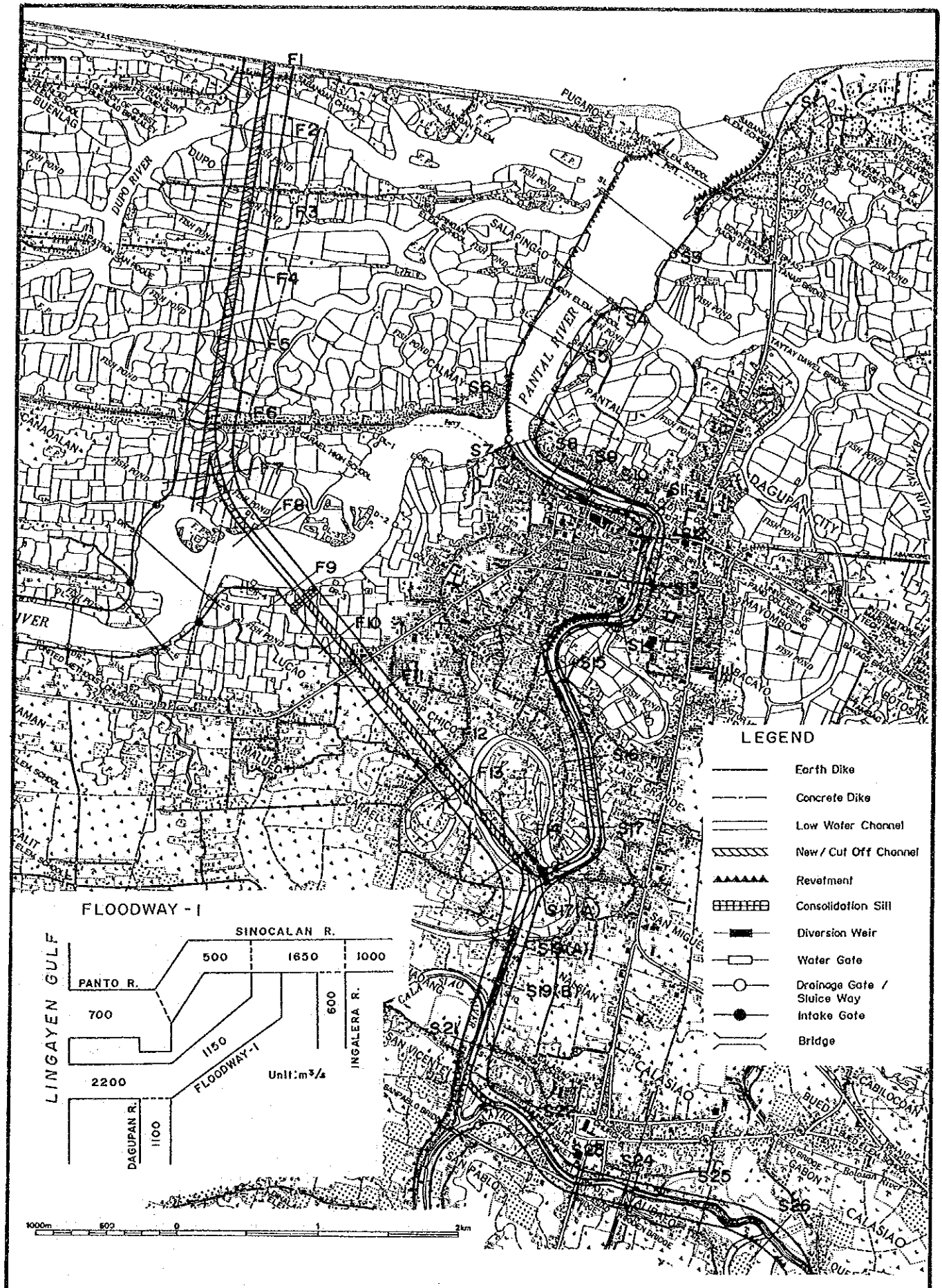


Fig. 4.2.7 LAYOUT OF ALTERNATIVE-3A SINOCALAN FLOODWAY

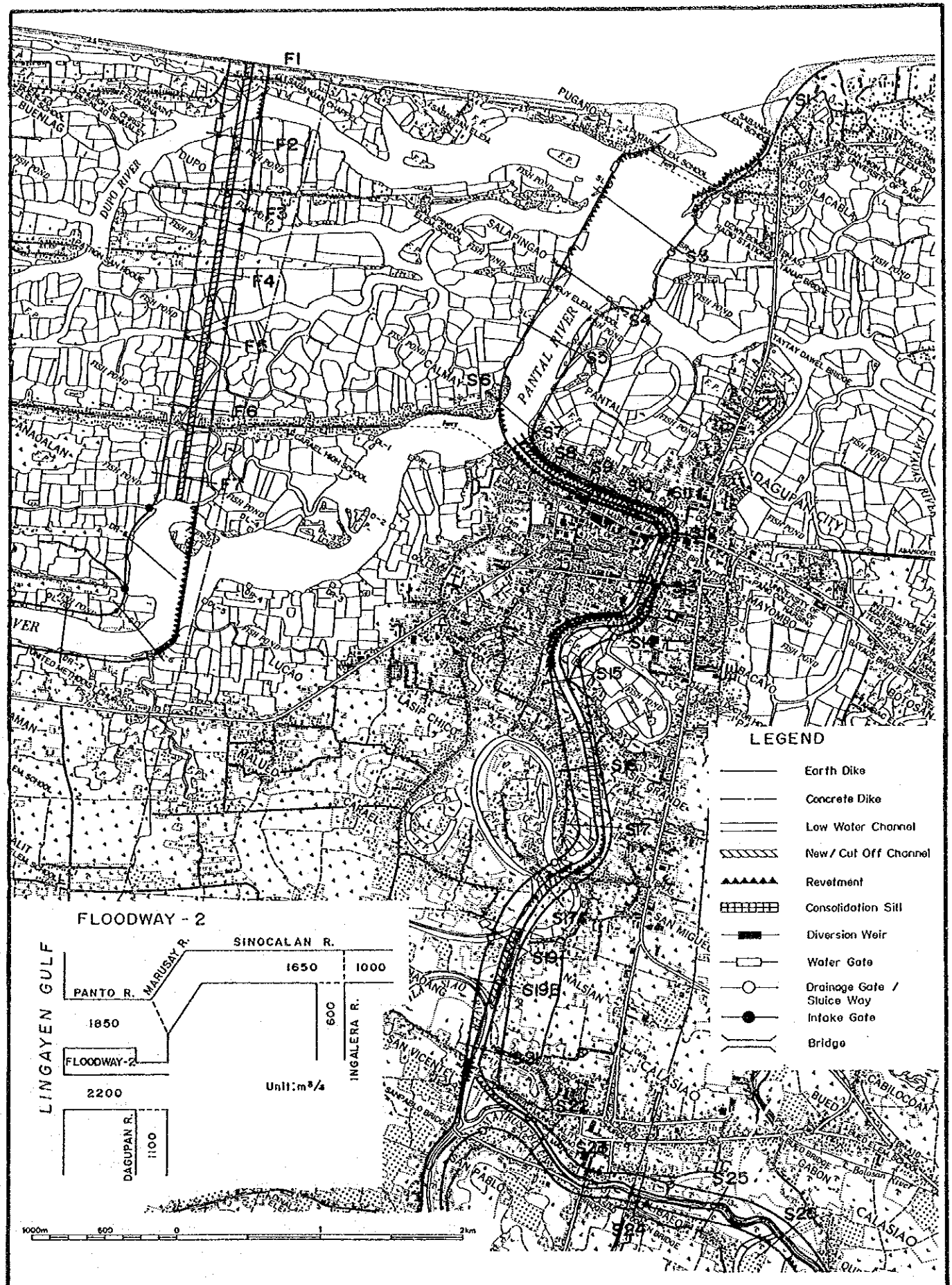


Fig. 4.2.8 LAYOUT OF ALTERNATIVE-4A DAGUPAN FLOODWAY