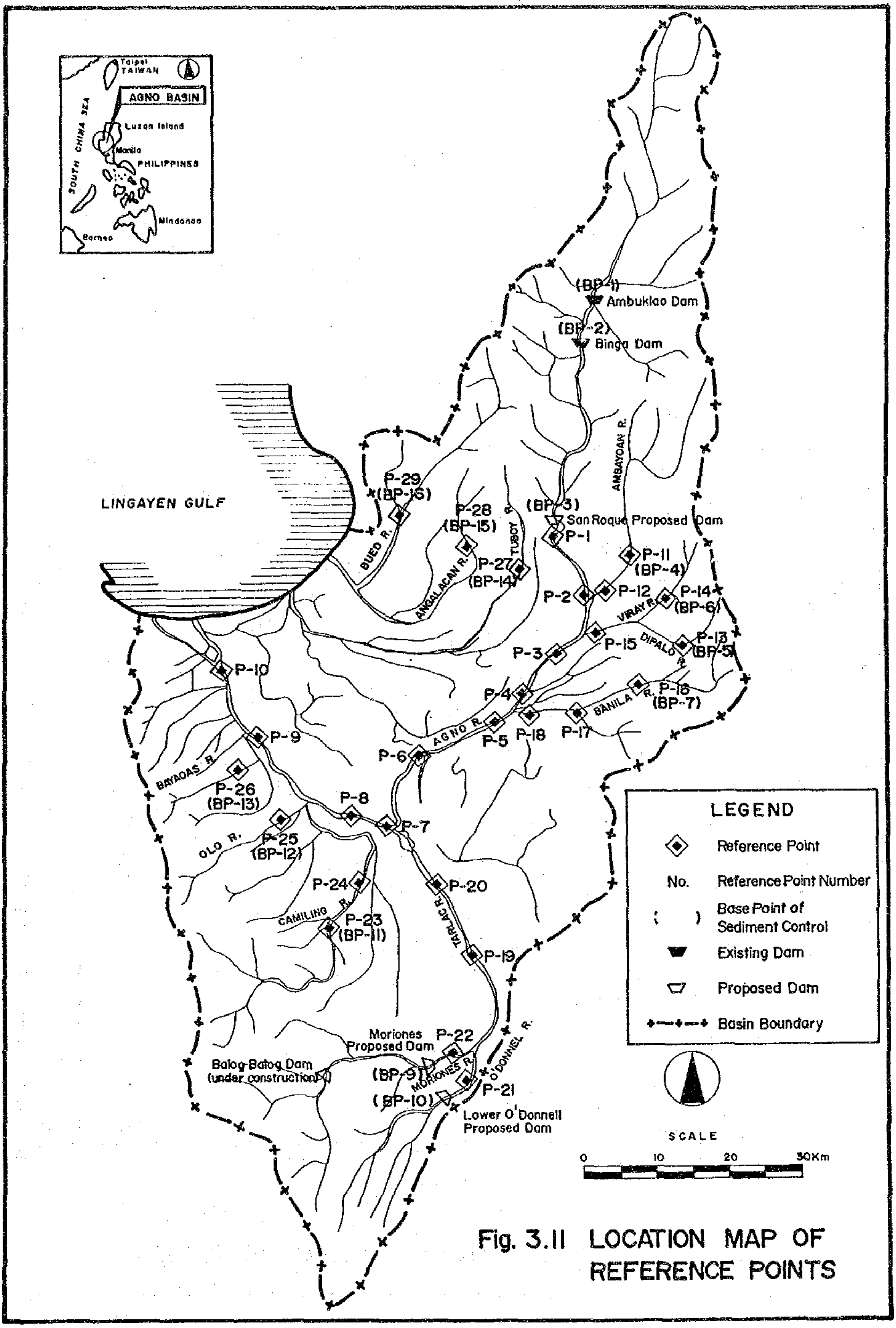


Fig. 3.11 LOCATION MAP OF REFERENCE POINTS

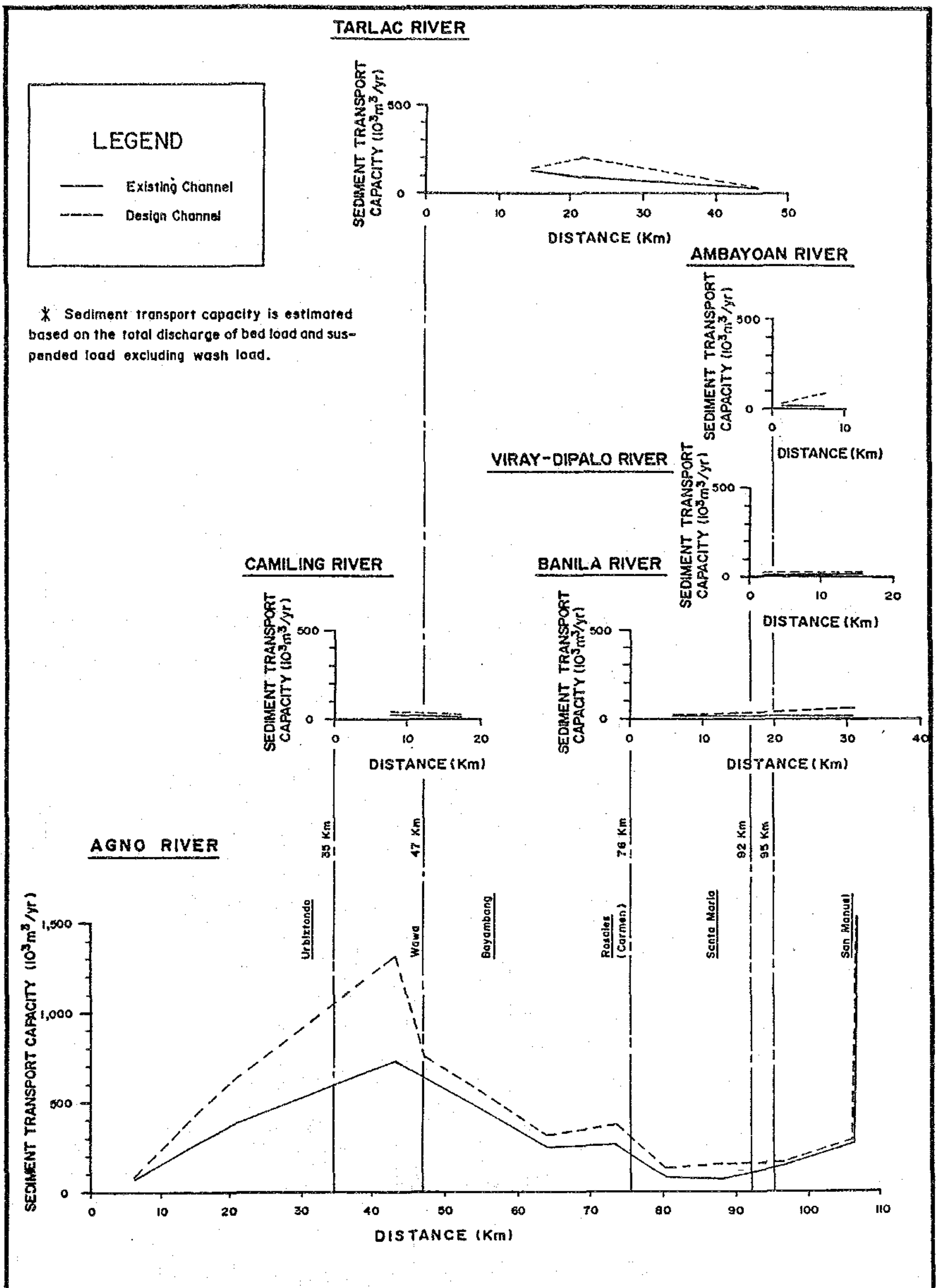


Fig. 3.12 ANNUAL SEDIMENT TRANSPORT CAPACITY

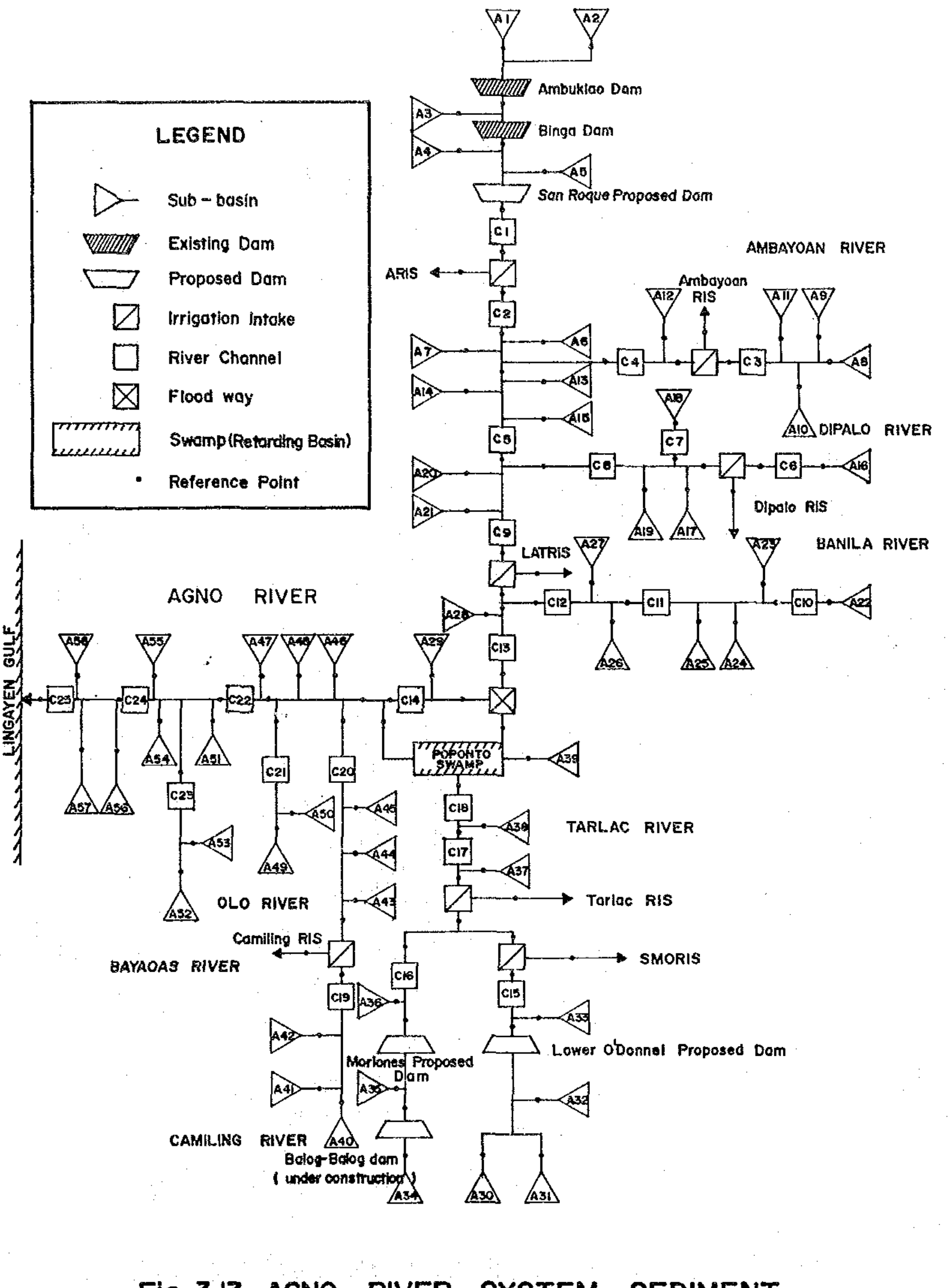


Fig. 3.13 AGNO RIVER SYSTEM SEDIMENT BALANCE MODEL

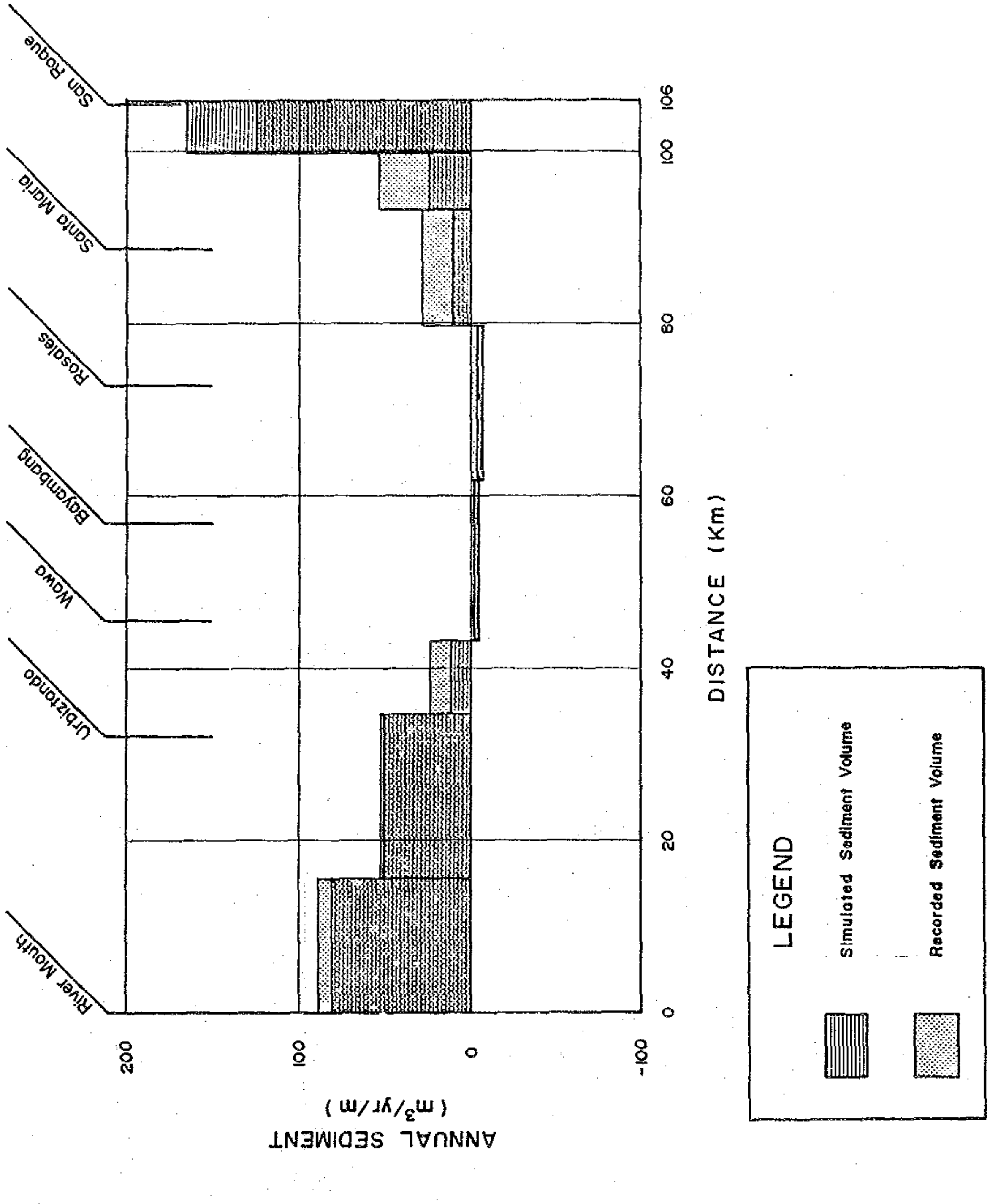


Fig. 3.14 COMPARISON OF ANNUAL SEDIMENT IN AGNO RIVER BETWEEN SIMULATED AND RECORDED

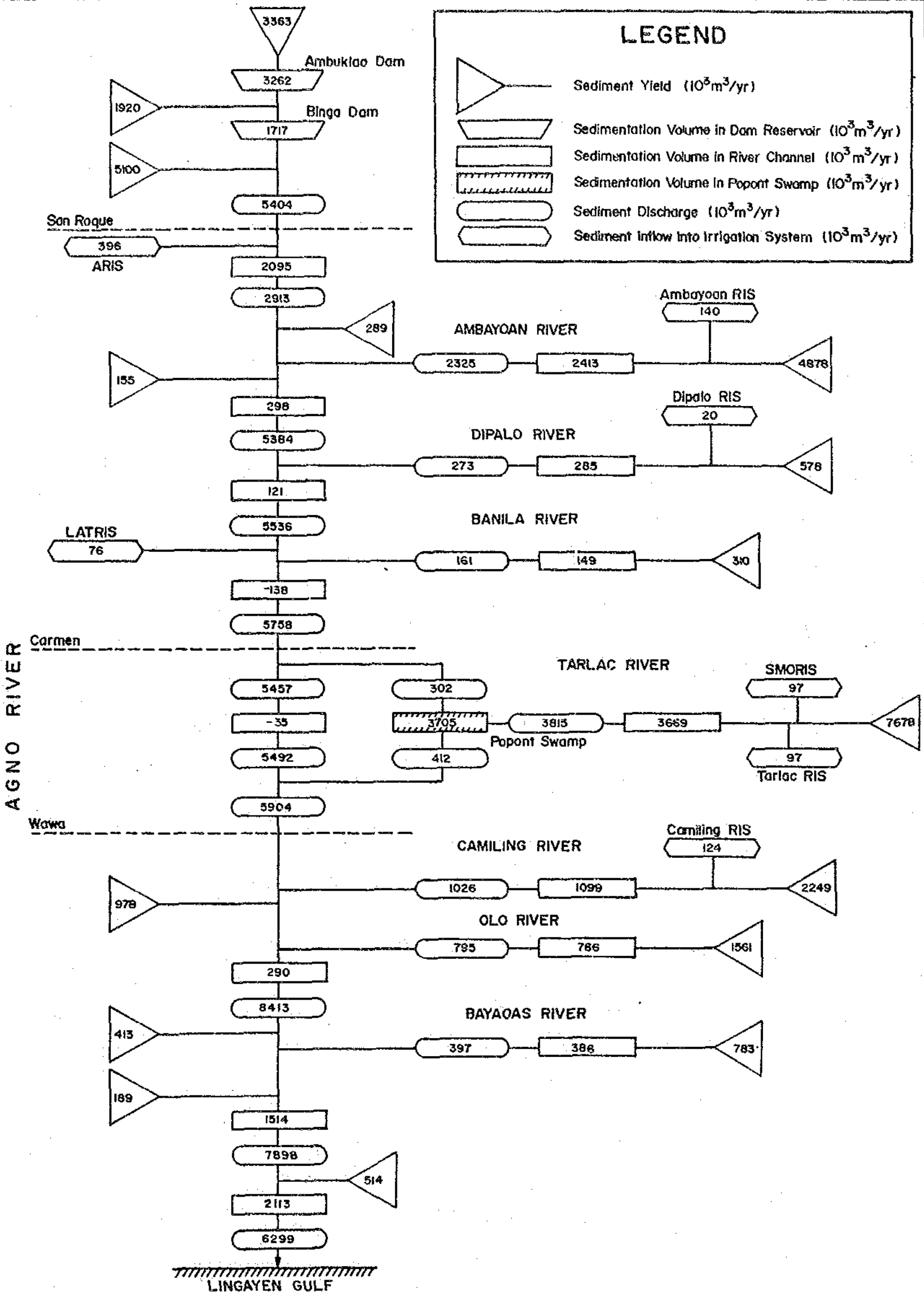


Fig. 3.15 ANNUAL SEDIMENT BALANCE UNDER PRESENT CONDITION

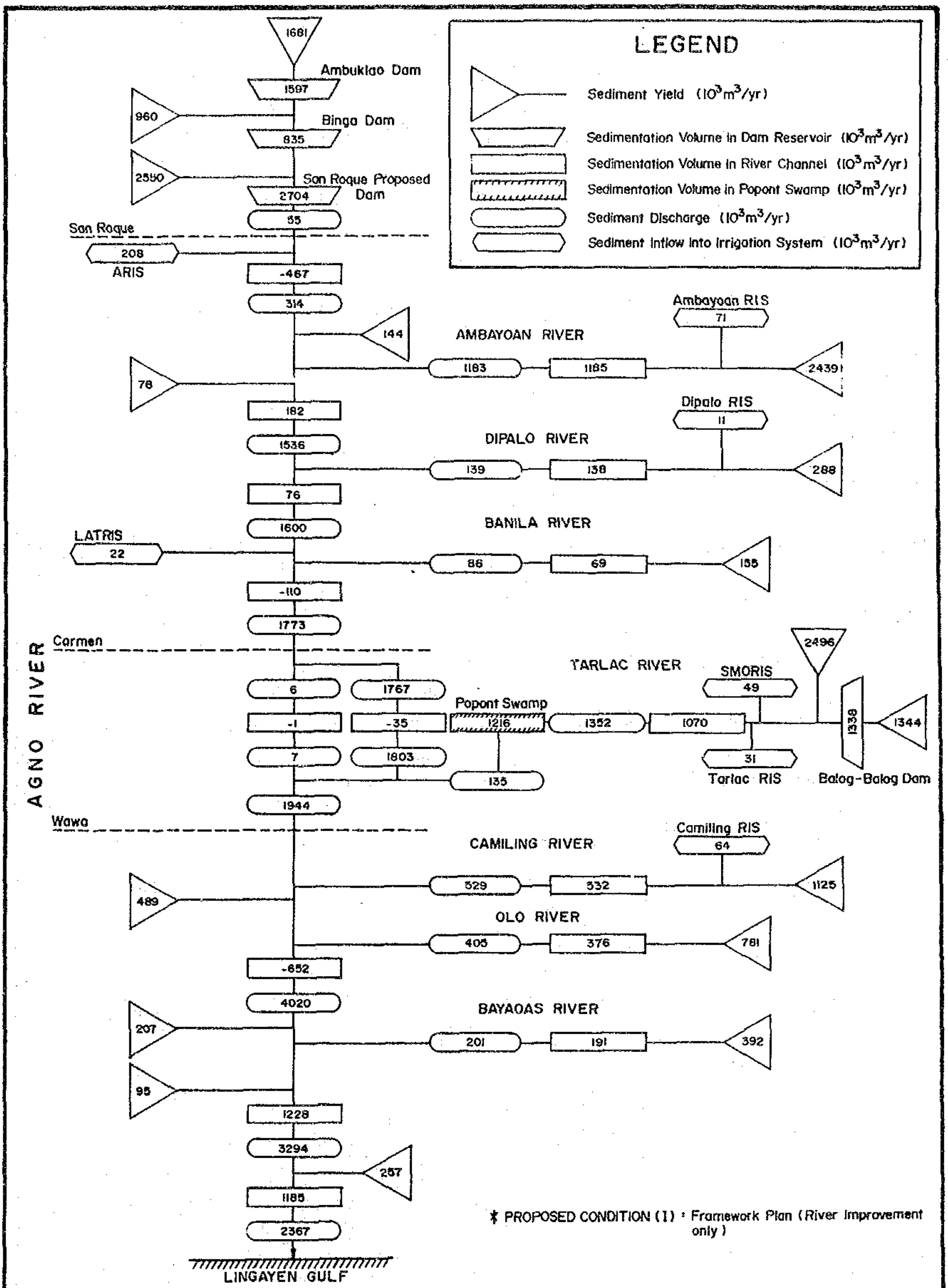


Fig. 3.16 ANNUAL SEDIMENT BALANCE UNDER PROPOSED CONDITION (I) *

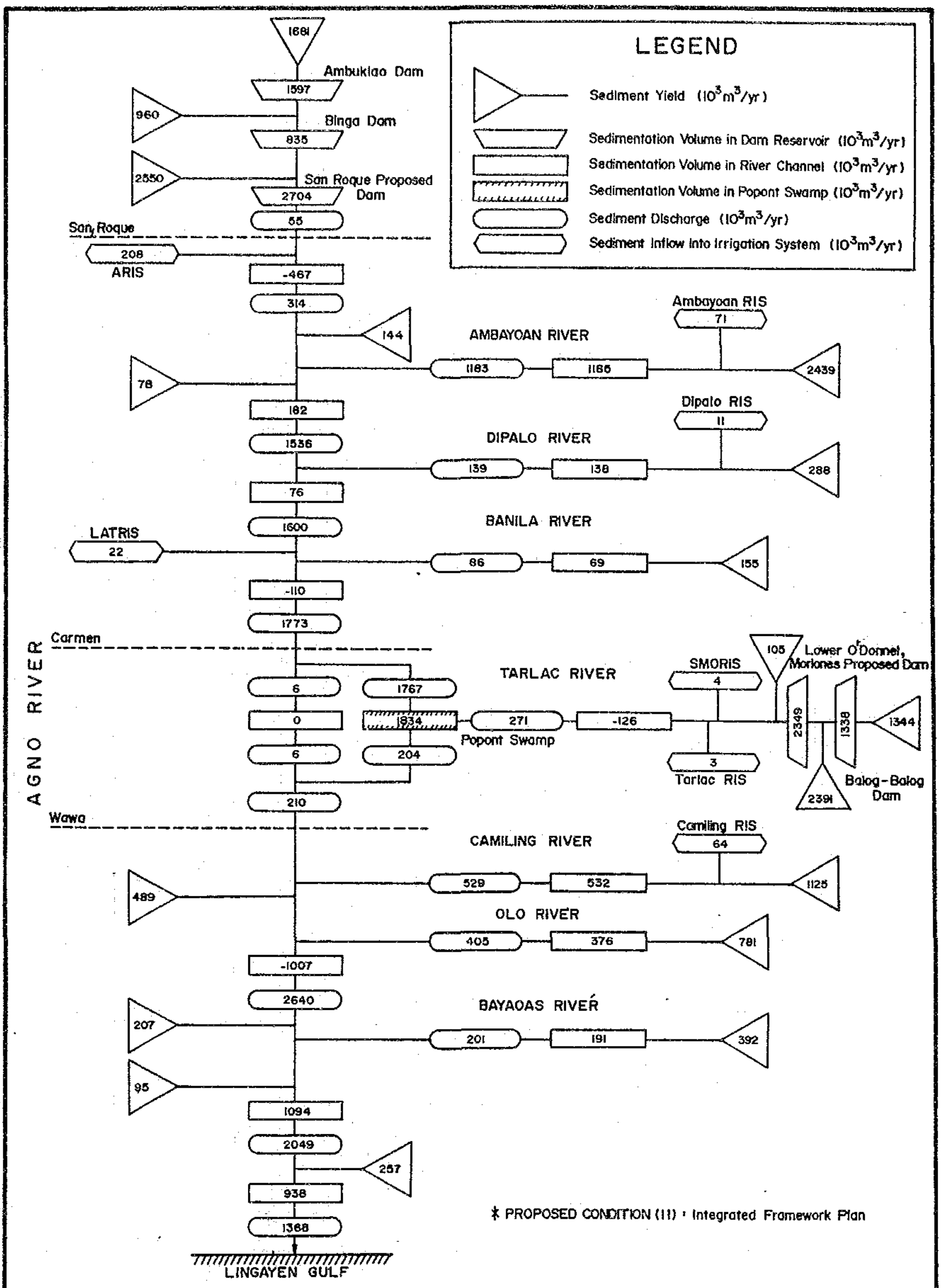


Fig. 3.17 ANNUAL SEDIMENT BALANCE UNDER PROPOSED CONDITION (II) *

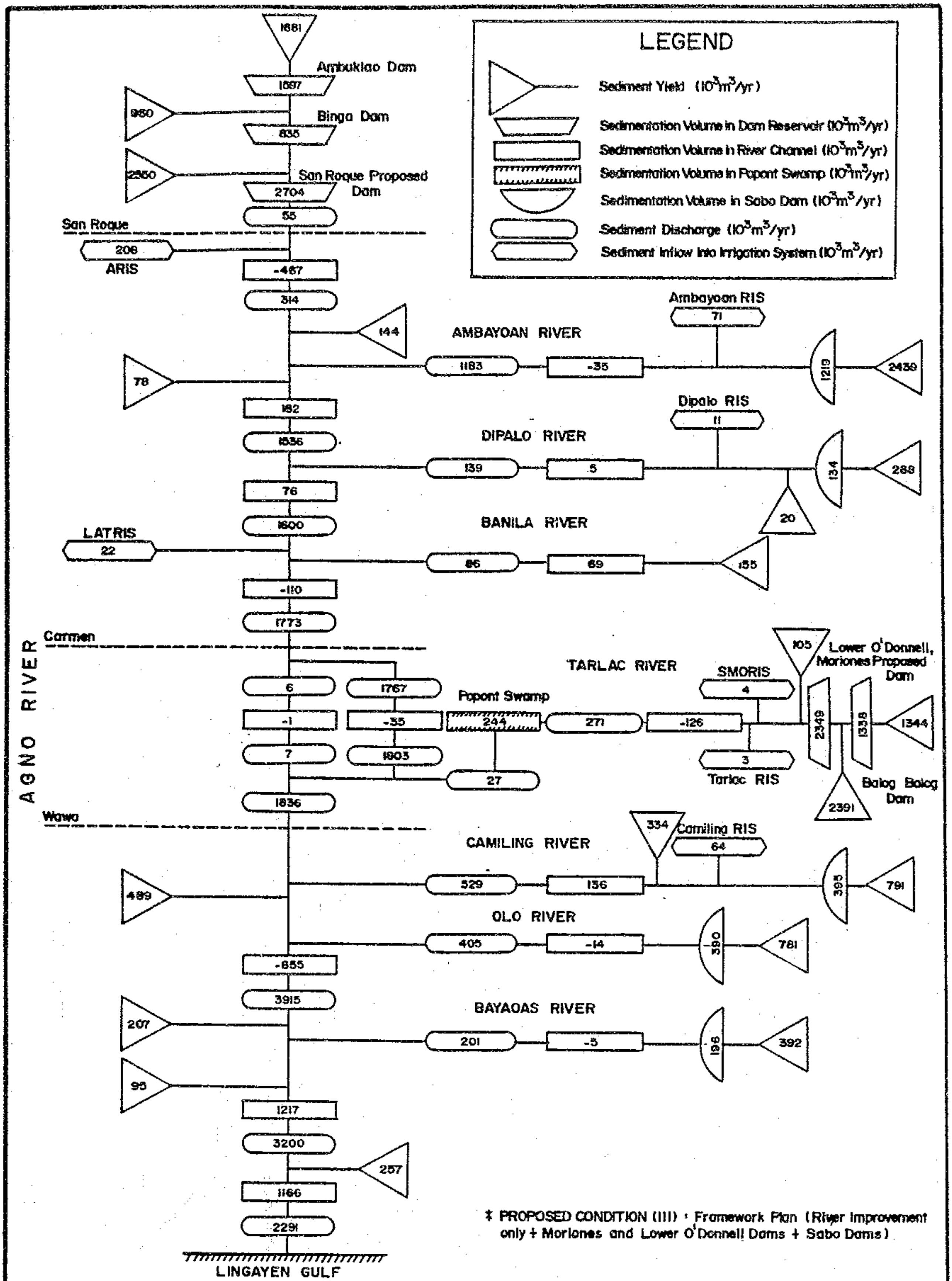


Fig. 3.18 ANNUAL SEDIMENT BALANCE UNDER PROPOSED CONDITION (III) *

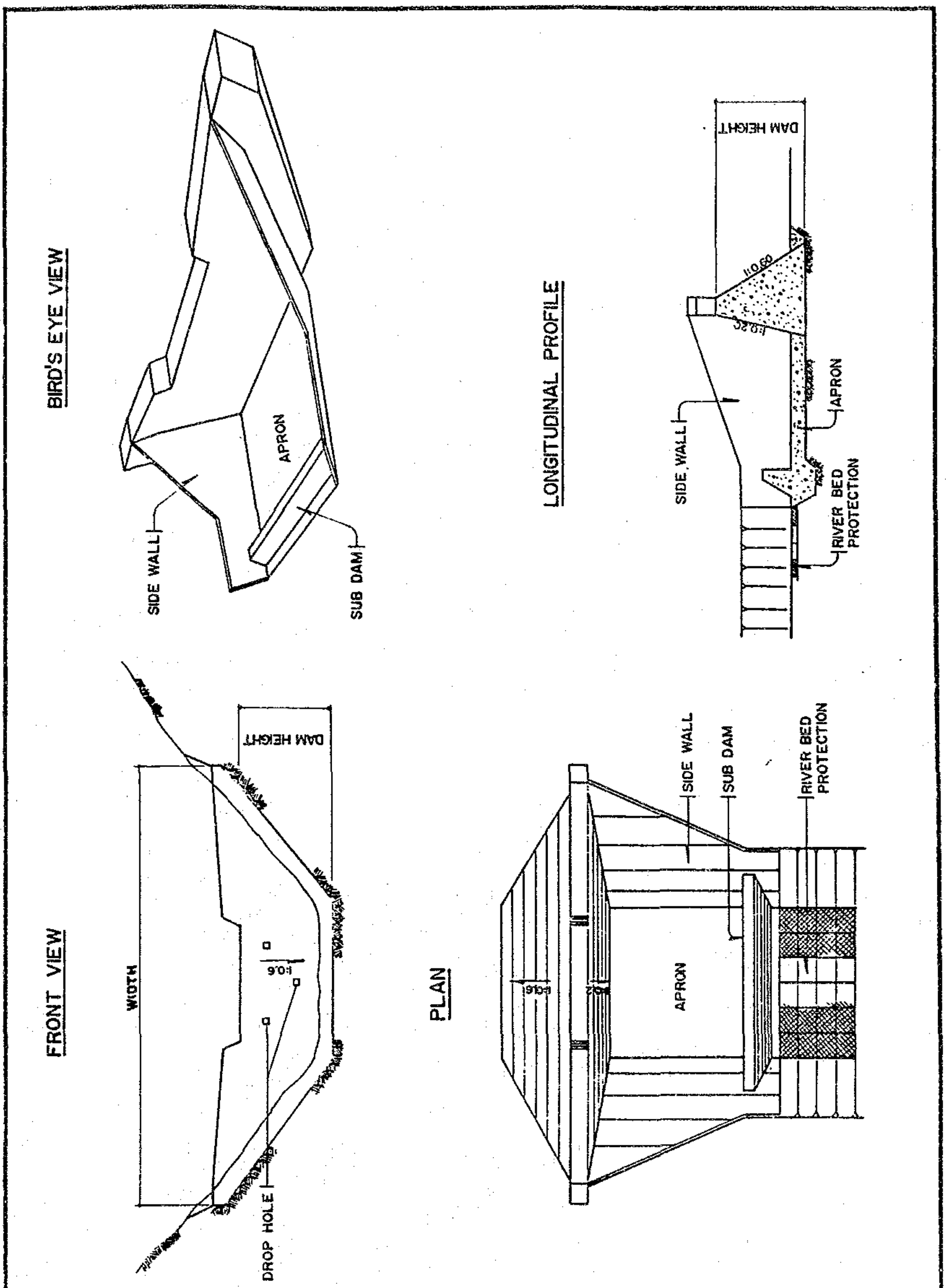


Fig. 5.1 TYPICAL DESIGN OF SABO DAM

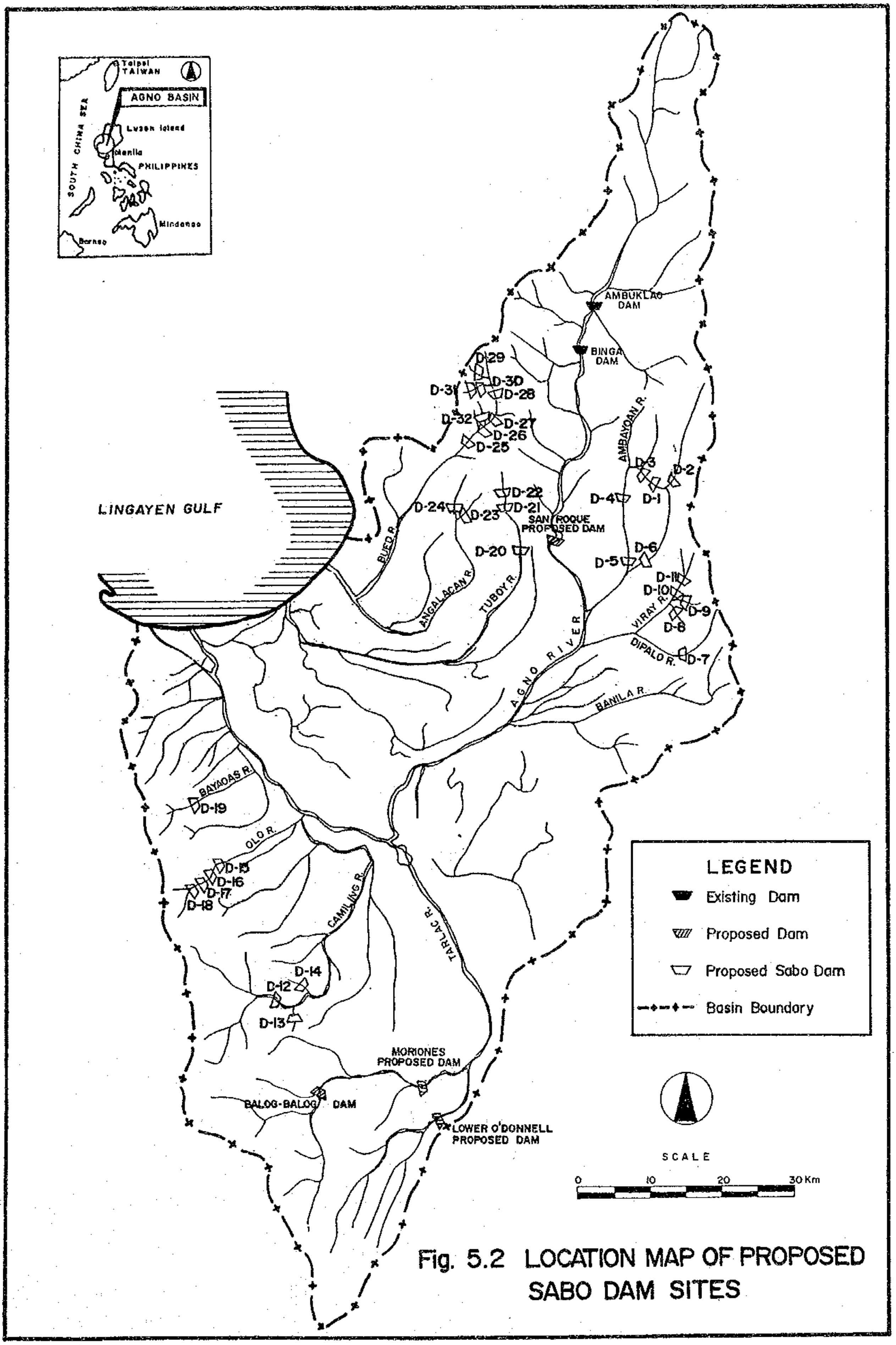
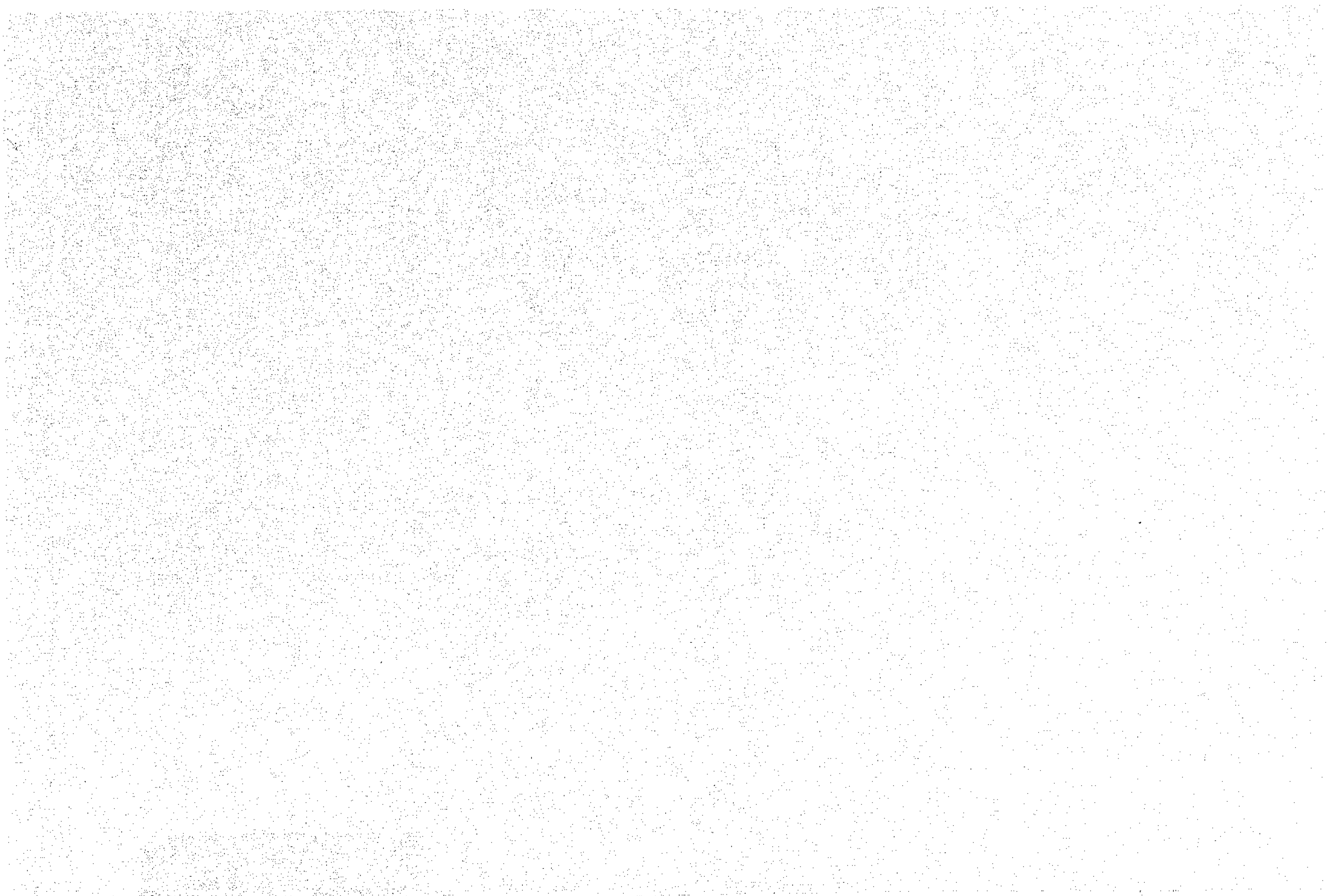


Fig. 5.2 LOCATION MAP OF PROPOSED SABO DAM SITES



7. RV

7. RV
RIVER IMPROVEMENT
PLAN

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ABBREVIATIONS

1. NAME OF PHILIPPINE GOVERNMENT AGENCIES

GOP	Government of the Philippines
DPWH	Department of Public Works and Highways
DPWH-PMO	DPWH Project Management Office
NIA	National Irrigation Administration
NAPOCOR	National Power Corporation
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
NAMRIA	National Mapping and Resource Information Authority
BFAR	Bureau of Fishery and Aquatic Resources
AFCS	Agno River Flood Control System
ARIS	Agno River Irrigation System

2. NAME OF JAPANESE GOVERNMENT AND OTHER OFFICIAL AGENCIES AND ORGANIZATION

GOJ	Government of Japan
JICA	Japan International Cooperation Agency
MOC	Ministry of Construction, Japan
OECF	Overseas Economic Cooperation Fund, Japan
UN	United Nations

3. MEASUREMENT UNITS

(Length)		(Weight)	
mm	millimeter(s)	gr(grs)	gramme(s)
cm	centimeter(s)	kg(kgs)	kilogramme(s)
m	meter(s)	ton(s)	ton(s), eq'vt to 1,000kg
km	kilometer(s)		

(Area)		(Time)	
mm^2	square millimeter(s)	sec	second(s)
cm^2	square centimeter(s)	min	minute(s)
m^2	square meter(s)	hr(hrs)	hour(s)
km^2	square kilometer(s)	dy(dys)	day(s)
ha(has)	hectare(s)	mth(mths)	month(s)
		yr(yrs)	year(s)

(Volume)

cm^3	cubic centimeter(s)
m^3	cubic meter(s)
ltr	liter(s)

1. INTRODUCTION

This Supporting Report presents the result on the study of the present river condition, river improvement and floodway plans for the Framework Plan and Long Term Plan.

For the present river condition study, the following items were carried out.

- Characteristics of river form and longitudinal and cross-sectional form.

- Carrying capacity of existing river channel.

- Condition of river bed fluctuation and scouring of banks and dikes.

- Existing river facilities.

Regarding the river improvement and floodway plans for the Framework Plan and Long Term Plan, the following studies were carried out.

- River improvement only as one plan of the alternative Framework Plans.

- Conceivable floodway plan to be incorporated in the alternative Framework Plan.

- River improvement and floodway plan for the selected Framework Plan.

- River improvement and floodway plan for Long Term Plan as a stage development plan for Framework Plan.

2. PRESENT RIVER CONDITIONS

2.1 River Systems

The Agno River basin subject to the Study is surrounded by the Cordillera Central Mountains on the north and the Zambales Mountains on the southwest and is adjoining the Pampanga River basin on the southeast, thus it forms the northern part of the Central Plains of Luzon.

In the Study area are the basins of the Agno River and its neighboring rivers named as Allied Rivers as shown in Fig. 2.1. The total basin area is about 7,640 km^2. The river system diagram and the physical features of rivers are shown in Fig. 2.2 and Table 2.1 respectively.

The Agno River is ranked as the fifth largest scale river in the country with a basin area of about 5,910 km2 and river length of 221 km. It originates in the Cordillera Central Mountains and flows southward in the mountainous area. Then it debauches into a vast alluvial plain and flows down toward Bayambang, located about 50 km upstream from the rivermouth, collecting runoff from the left bank tributaries and joins the Tarlac River, a major tributary of the Agno River.

The confluence of the Agno and Tarlac Rivers forms a depression known as the Poponto swamp. These areas are usually flooded during the rainy season and function as a natural retarding basin thus somehow aiding in reducing flood peak to the downstream.

After joining the Tarlac River, the Agno River turns to the northwestward, collecting runoff from the northeastern slope of the Zambales Mountains, and finally empties into the Lingayen Gulf.

The principal tributaries of Agno River are the Ambayaoan, Viray-Dipalo, Banila and Camiling Rivers which drain from the north.

The catchment area and river length at major points of these rivers are as follows:

River	Catchment area (km^2)	River length (km)
Agno River		
Whole river basin	5,907	221.0
Poponto floodway site	2,477	119.0
Major tributaries		
Ambayaoan	367	62.2
Viray-Dipalo	135	21.2
Banila	309	39.0
Tarlac	1896	93.0
Camiling	604	64.0

The Allied Rivers, independent rivers from the Agno River, mainly consist of the Cayanga-Patalan and the Panto-Sinocalan River systems. The catchment areas of these rivers are 618 km^2 and 1,115 km^2 respectively. The streams of the Allied Rivers are called by different names in each municipality area.

The Cayanga-Patalan River originates in the northern mountains near Baguio City and flows southwest before turning on a northwestern course, and finally empties into the Lingayen Gulf. After debauching into the plain, it is joined by the Aloragat and Bued Rivers which also drain from the northern mountainous area. The Bued River is one of the major tributaries of the Cayanga-Patalan River, having about 45% of the total basin area. At a point about 16 km upstream of the Bued River from the confluence with the Cayanga-Patalan River, the Bued River is naturally connected with the Aloragat River. A part of flood water of the Bued River is thus diverted.

The Panto-Sinocalan River heads in the northern mountains and takes the same flow direction as the Cayanga-Patalan River, and also empties into the Lingayen Gulf. The River holds the tributaries such as; the Macalong, Ingalera and Dagupan Rivers which drain from its left bank. The major portion of the watershed of these tributaries is located in the plain area.

The catchment area and river length at major points of the Allied Rivers are as follows:

River	Catchment area (km^2)	River length (km)
Cayanga-Patalan-Angalacan River		
Whole river basin	618	61.0
Aloragat	116	31.0
Bued	286	54.0
Pantal-Sinocalan-Tagamusing River		
Whole river basin	1,115	75.5
Mitura-Macalong	141	31.0
Ingalera	197	32.5
Dagupan	273	32.0

2.2 Channel Conditions

2.2.1 General Features of Stream Channels

From a viewpoint of stream form, river channel condition may be classified into meandering, braided and straight ones. Through the site inspection together with the data of river cross sections and topographical maps, channel condition and river bed configuration of the Agno and the Allied Rivers might be roughly described as follows:

Straight channels are only found in the short stretches near the rivermouth and cut-off channels of the Agno River. Braided channels are readily observed in the upper reaches of the main Agno between the confluences with the Viray-Dipalo River and the ARIS dam, in the Ambayaoan River, in the upper reaches of the Viray-Dipalo and the Banila Rivers, and in the Bued and Tuboy Rivers. These stretches are formed of randomly interconnected channels separated by bars and therefore stream flow tends to be wide spread and water depth becomes relatively shallow. The lower reaches of the main Agno between 5 km upstream of the rivermouth and the confluence with the Tarlac River shows a meandering channel. The upper main Agno between the inlet of Poponto floodway and the confluence with the Viray-Dipalo River and the Talrac River have also a meandering channel with developed sand bars. Other meandering channels are observed in the Camiling, the main Cayanga-Patalan, and in the main Pantal-Sinocalan Rivers. Fig. 2.3 shows the historic shifting of the river course of the main Agno River from 1947 based on several topographic maps.

The general features of present river channels of the Agno River and its major tributaries and the Allied Rivers are summarized below:

River	Stretch	River width (m)	Low Water width (m)	Channel depth (m)	River Bed Slope
Agno	(Mouth-Tarlac)	4,000-1,500	550-100	8.0-4.0	1/7,000-1,650
	(Tarlac-ARIS dam)	2,400-450	350- 75	5.5-3.0	1/1,650- 200
Tarlac	(8 kmUs-Tarlac town)	1,500-600	550- 60	3.5-2.5	1/1,200- 750
Ambayaoan	(Ds.end-9 kmUs)	450-150	75- 60	2.5-1.5	1/200- 150
Viray-Dipalo	(Ds.end-8km Us.)	450-250	120- 55	4.0-3.0	1/400- 250
Banila	(Ds.end-30km Us.)	120- 30	120- 25	4.0-1.5	1/850- 100
Camiling	(Camiling-Mayantoc)	120- 50	120- 50	6.0-5.0	1/2,000- 250
Pantal-Sinocalan-Tagamusing		300- 35	160- 10	7.0-1.5	1/1,750- 70
Cayanga-Patalan-Angalacan		300- 35	170- 20	6.0-2.0	1/1,300- 140

Note: Ds. : Downstream Us. : Upstream

2.2.2 Carrying Capacity

The carrying capacity of the existing river channel is estimated for the Agno River, its major tributaries and the Allied Rivers by means of non-uniform flow or uniform flow calculations.

The carrying capacity is herein defined as the discharge at the water level below the dike crest or the bank by a free board.

The estimated carrying capacity is shown in Figs. 2.4 and 2.5, and is summarized below:

River/stretch	Carrying Capacity Discharge (m^3/s)	Return Period (yr)
Agno River		
River mouth-19km Us.	2,500 - 8,000	2 - 25
19km Us. - 44km Us.	4,500 - 13,500	5 - 40
44km Us. - 50km Us. (Bayambang)	1,000 - 2,000	3 - 5
50km Us. - 90km Us.	1,500 - 14,000	2 - 100
90km Us. - 99km Us.	1,000 - 11,000	2 - 100
Tarlac River		
8km Us. - 33km Us.	600 - 7,500	3 - 100
33km Us. - 37km Us.	3,200 - 5,800	60 - 100
Camiling River		
Camiling-Mayantoc	500 - 1,400	5 - 50
Banila River		
Ds. end - 24km Us.	70 - 400	2 - 6
Viray - Dipalo River		
Ds. end - 8km Us.	400 - 1,500	10 - 100
Ambayaoan River		
Ds. end - 9km Us.	800 - 1,800	6 - 100
Pantal-Sinocalan-Tagamusing River		
River mouth - 49km Us.	120 - 500	1 - 3
Cayanga Patalan River		
River mouth - 38km Us.	180 - 830	1.5 - 3

Note: Us.: Upstream Ds.: Downstream

2.2.3 River Bed Fluctuation and Caving

<u>River bed fluctuation</u>

River bed fluctuation was studied by using data of river flow at water level gauging stations and the river cross-section surveys in 1981 and 1989. Fig.2.6 shows secular variation of annual lowest water level at stations and change of deepest river bed estimated based on the cross-section data.

In regards to the tendency of the longitudinal variation of the main Agno, it seems that river bed in the lower reaches from confluence of the Tarlac River and the upper reaches from the confluence of the Banila River is aggradating, while the middle reaches is degradating but their change is not so high. In the Tarlac River, aggradation is observed in the stretch from the confluence of main Agno up to 15 km upstream.

Caving

The existing dike and bank are eroded by severe scouring action for almost the whole stretches. The condition of breaches, gaps and scours caused by past floods in the period from 1984 to 1986 is summarized in Table 2.2. These locations are shown in Fig.2.7.

As shown in Fig.2.7, many banks located in the stretches having braided form and meandering with developed bars have caved.

2.2.4 Sediment

Fig.2.8 shows sediment deposition volume in the Agno and Tarlac Rivers, which is estimated by comparing river cross-section data surveyed in 1981 and 1989 with due consideration of the excavated volume for dredging works conducted so far.

As shown in the above Figure, the Agno main river course is broadly divided into sediment deposition and transportation stretches; the former is located at stretches from the river mouth to the confluence with the Tarlac River and from the confluence with the Banila River to foot of mountain near the ARIS dam, and the latter is observed at stretches between the confluences of the Tarlac River and the Banila River. The Tarlac River has a tendency that the sediment transported from the upstream basin is deposited copiously around the Poponto swamp.

Sediment transport capacity in the existing channel is estimated as presented in Fig.2.9. The estimation is carried out by the use of sediment formula based on the data on river bed materials and hydraulic character on each channel condition. Sato-Kikkawa-Ashida's formula for the bed load and Lane-Kalinske's formula for the suspended load are employed for the calculation of sediment discharge. Details of sediment calculation is described in the Supporting Report (SD). Annual transport capacity of the Agno is summarized as follows:

- From river mouth to junction with the Tarlac : $80x10^3$-$700x10^3m^3$/yr
- From junction with the Tarlac to one with the Banila : $700x10^3$-$100x10^3m^3$/yr
- From junction with the Banila to ARIS dam : $100x10^3$-$220x10^3m^3$/yr

2.2.5 Rivermouth Clogging

No serious problems about rivermouth clogging has been reported for the Agno River and the Allied Rivers, but sand bars are developing at the rivermouth of the left course of the Agno River and the Cayanga River.

The following are findings through field investigations for the rivermouth clogging.

Agno River Main Course

The Agno River bifurcates into the left and main courses at about 5 km upstream from its rivermouth. The rivermouth of the main course at present is 400 - 500 m in width and the river bed near the rivermouth is aggradating. However a rivermouth clogging is not reported.

According to the interview survey with the residents near the rivermouth, before 1940 the channel of present main courses was narrow with a width of about 50 m and most of the flood water flowed into the Lingayen Gulf through the present left course and the Pantal River. After dredging and widening of the main course conducted around 1940, flood water flowed into the main course and thus the channel gradually became wider.

Moreover, a large quantity of sediment from the upstream is deposited and the rivermouth is moved towards the sea. The annual extension rate of sand bar estimated by comparing the aerophotos taken in 1964 and 1989 is about 40 m/yr at the left side.

As for the left course of the Agno River, the shoreline near the rivermouth is coming near the land since the supply of sediment from the upstream was reduced by the change of main flow to the present main course. Comparing the aerophotos taken in 1964 and 1989, the withdrawal of the shoreline of this left side is about 200 m for 25 years. In order to prevent further erosion, a breakwater is at present being constructed along the shoreline. Dredging was conducted from 1981 to 1984 to remove a sand bar developed from the left side, but the sand bar at the right side is developing and has narrowed the river width to only 10 m at present.

Pantal River

The width of the rivermouth of the Pantal River is stable at about 300 m. However, the water depth sometimes becomes shallow due to sedimentation. From 1987 to 1988, the river channel 1,500 m in length was dredged from 400 m upstream of the rivermouth.

Cayanga River

A sand bar is developing on the right side narrowing the rivermouth to a width of about 50 m. In the ensuing interview survey with the residents it was found out that there is a big difference in the width of rivermouth between the dry and the wet season. The river width is only 15 m in the dry season, but it becomes 85 m in the wet season. However, no inundation caused by rivermouth clogging has been experienced yet because the sand bar is washed out during floods.

2.3 River Facilities and Structures

Existing river facilities for flood control in the Agno and Allied Rivers are earth and concrete dikes, groins, revetments and diversion channels. Location and length of the major facilities are shown in Fig. 2.10 and Table 2.3 respectively.

Diking system is one of the most progressive flood control facilities in the Agno River. The length of existing dike of major rivers are summarized below:

River	Stretch	Length of diking system (km)	
		Right bank	Left bank
Agno River			
Main Agno	River mouth-Bayambang (50km Us.)	40.50	16.30
	Bayambang-ARIS Dam (99km Us.)	47.80	28.80
Ambayaoan	Confluence-8.7km Upstream	0.00	3.50
Viray-Dipalo	Confluence-8.5km Upstream	5.70	7.40
	Viray River stretch (L=3.9km)	3.30	0.00
	Dipalo River stretch (L=8.1km)	0.00	7.00
Banila	Confluence-30.9km Upstream	0.00	9.30
Tarlac	Confluence-TARIS Dam (37.0km Us.)	29.60	25.50
Camiling	Confluence-Mayantoc (20.8km Us.)	0.00	0.00
Allied Rivers			
Cayanga-Patalan	River mouth-37.5 km Upstream	0.00	0.00
	Tributaries	0.00	0.00
Pantal-Sinocalan	River mouth-49.4km Upstream	2.50	1.30
	Tributary	0.00	0.00

The by-pass floodway channel was designed to divert a part of flood water of the main Agno to the Poponto swamp to improve the hydraulic bottle-neck of the existing river channel at Bayambang. Construction works was commenced in 1975. The major structures of the floodway are a pilot channel, overflow concrete spillway and parallel dikes. The dimension of existing structures are as follows:

Floodway :	Length of stretch	5,000	m
	Width of floodway	800-1000	m
	Width of low waterchannel	30-50	m
	Length of Dike stretch (Right)	5,000	m
	- ditto - (Left)	4,500	m
Spillway :	Length	1,020	m
	Crest elevation	18.75	EL.m
	Crest height	3.55	m

The other river facilities in the study stretches are bridges and intake water facilities. The location and main features of existing bridges are described in the Supporting Report (DS). Fig. 2.11 shows the location of irrigation area and intake water facilities.

3. REVIEW OF PREVIOUS RIVER CONTROL WORKS AND PLAN

3.1 Previous River Control Works

As early as the 1930's Government of the Philippines started flood control study on the Pampanga and Agno River basins. Due to habitual flooding in the Agno River basin in the 1930's, construction works of earth dike was commenced on the downstream reaches of the Agno River in 1938. By the year 1960, construction of earthdike 100 km in length, improvement works of 65 km of river channels and 10 km of revetment were completed. Tables 3.1 and 3.2 shows the completed river control projects since 1968, and the work quantities and construction costs since 1972 respectively.

3.2 On-going River Control Works and Five-Year Program

Major flood control plans for on-going river improvement works in the Agno River are comprised of:

(1) Master Plan of Agno Flood Control System
(2) Five-year DPWH Infrastructure Program
(3) Regular Infrastructure Program
(4) Rehabilitation Program

Despite of these plans, a master plan with overall and long-term goals on the Agno River basin has not yet been established. At present, it might be said that these plans mainly focus on rehabilitation and maintenance works of existing river channels.

According to the Five-year DPWH Infrastructure Program (1989-1993), on-going river control works planned are 22 projects in the Agno River, 10 projects in major tributaries and 9 projects in the Allied Rivers. Almost all of the projects are the small-scale works to be implemented urgently, and these works mainly consists of bank protection ones.

The proposed projects in the Five-year DPWH Infrastructure Program are listed in Table 3.3.

4. PLAN FORMULATION METHODOLOGY AND DESIGN CRITERIA

4.1 Methodology of Plan Formulation

The Master Plan is composed of the two stage plans, Framework Plan and Long Term Plan. The Framework Plan is defined as a master plan with overall and long-range goals of basin-wide flood control plan, taking into account the social and economic conditions in the Agno River basin, which is to be achieved in an unspecified future. The Long Term Plan is defined as an stage development plan of the Framework Plan which is to be achieved at the target year of 2010.

Under the channel phase of flood control, the river improvement measures contemplated are the following:

- Improvement of channel alignment including short-cut
- Construction of diking system
- Deepening and widening of river channel
- Protection of bank and dike from erosion
- Other appropriate facilities

Another measure is flood diversion system to reduce flood discharge in the lower reaches.

4.2 River and its Stretches Subject to Master Plan

The flood control target by structural measures of river improvement and floodway are specified below.

River	Planning Scale (Return Period)
Framework Plan	
- Main Agno River and Tarlac River	100 year
- Other major tributaries of Agno River	50 year
- Allied Rivers	50 year
Long Term Plan	
- Agno River	Feasible scale
- Allied Rivers	Feasible scale

River stretches subject to Master Plan are shown in Table 4.1, and the length of stretches are as follows:

River	Length of Subject Stretch (km)
Agno River	
- Main Agno	98.85
- Tarlac River	37.05
- Camiling River	20.00
- Banila River	30.90
- Viray-Dipalo River	20.05
- Ambayaoan River	8.70
Allied Rivers	
- Cayanga-Patalan-Angalacan River	37.50
- Bued River	19.80
- Aloragat River	19.70
- Pantal-Marusay-Sinocalan-Tagamusing-Tuboy River	49.40
- Dagupan-San Juan-Elang River	27.60
- Ingalera River	37.50
- Mitura-Macalong River	21.00

4.3 Design Criteria of River Improvement and Floodway

The following are the criteria applied to the design of river improvement plans and floodway.

(1) Design flood

- Agno River : A return period of 100-year is adopted for main Agno and Tarlac Rivers, and the floodway in these rivers. The 50-year flood for other tributaries.

- Allied Rivers : A return period of 50 years is adopted for main streams, tributaries and floodway in these rivers.

(2) River bed profile

- Average river bed profile under present condition is considered as the designed river profile. (Average river bed elevation but not the deepest bed is considered as the planned river bed.)

(3) Channel section

- Compound section with high-water and low-water channels confined by dikes are adopted in principle.

(4) River width (High-Water Channel)

- River width should be decided referring to the data on rivers in Japan shown in Fig. 4.1 and by Regime theory.

- Ideal river width thus calculated should be planned as the future river alignment (Framework Plan) for stable stretches of channel in case the existing river width is larger than the above, However for the upper reaches having braided stream pattern the existing river width should be maintained.

- In case existing river width is less than the above, it should be widened.

- High-water channel elevation is set at present channel or ground level.

(5) Low-water channel (width of bed)

- Low water channel is designed with its capability to carry an approximate 2.0-year flood.

- In case the existing low-water channel has less than a 2.0-year flood capacity, the existing channel should be widened.

- In case the existing low-water channel has a greater than 2.0-year flood capacity, the existing river channel should be maintained as it is.

(6) Alignment of low-water channel (cut-off channel)

- Cut-off channel should be adopted in case the existing channel length is more than 2.5 times of the proposed cut-off channel length.

(7) High water level

- High water level is decided by hydraulic calculation.

- With regard to Manning's coefficient of roughness for water level calculation, 0.028 to 0.035 for low-water channel and 0.040 to 0.045 for high-water channel are adopted for the channel conditions. (Refer to Table 4.2 and Fig. 4.2.)

(8) Dike

- Type: Earth embankment is adopted in principle in case there is no special restriction of available land area for constructing earth dikes.
  Existing concrete dike should be maintained as it is. (Concrete parapet wall in Bayambang for example)

- Free board: In accordance with the Standard for River and Sabo Engineering by MOC of Japan. (Refer to Fig. 4.4.)

- Crown width: Ditto

- Slope: Ditto

(9) Revetment

- Type: Concrete revetment in principle for both the low-water and high-water level channels

- Height (LW channel): From river bed up to the top of low-water channel in case of low-water revetment

- Height (HW channel): From high-water channel bottom up to Flood Water level below dike crest and its free board

- Length: In principle, the total length of revetment is assumed at 20% of twice the length of river channel, while in the Upper Agno it is 40% of 2 times the length of the river channel.

(10) Groin

-Type: Wooden pile groin in principle except for special site.
Concrete pile groin or concrete block groin in case of heavy scouring and meandering sites.

- Length/Interval: In accordance with the Standard for River and Sabo Engineering by MOC of Japan. (50m interval and 30m length)

(11) Other structures

- Bridges: Existing bridges should be raised together with the necessary free board if it is found to be insufficient.

- Water intake: Replacement or modification of existing intake structures should be considered when necessary.

5. RIVER IMPROVEMENT ONLY AS ALTERNATIVE PLAN FOR FRAMEWORK PLAN

5.1 Features of River Improvement Only Alternative

5.1.1. Design Flood Discharge

The design flood discharge distribution for the river improvement only alternative plan for the Framework Plan is shown in Fig. 5.1.

5.1.2. Features of Design Channel

(1) Agno River

The river improvement only alternative plan of the Agno River system comprises of low-water channel improvement (river training), construction of diking system, structures for bank and dike protection and drainage facilities such as sluice way and water gate.

The following are principal features of this plan.

River	Improvement of L.W.C (km)	Diking system (km)		
		New dike	Heightening	Existing
Main Agno	98.85	82.50	98.50	3.00
Tarlac	37.04	17.50	49.00	6.50
Camiling	18.80	31.50	0.00	0.00
Banila	23.90	46.10	1.90	7.40
Viray-Dipalo	20.10	0.00	7.40	16.80
Ambayoan	8.70	12.50	3.50	0.00

Note; L.W.C.: Low-water channel

THere exists in the main Agno a hydraulic bottle-neck point at Bayambang between the confluence with the Tarlac River and the inlet of the Poponto floodway. In this stretch, all of the flood water of the 100-yr probable flood should be diverted to the Poponto swamp through the floodway and a closure dike should be constructed at the upper and lower end of the river channel at Bayambang. The reason for this is that the river flow cannot be controlled due to high back-water levee at the confluence of the Tarlac

River.

At river stretches between 5.0 km downstream and 1.5 km upstream of the Plaridel bridge in Carmen, backward displacement of the right dike with a length of 2.8 km is planned in order to obtain a sufficient river width the design discharge.

Principal features of designed channel of the Agno river system are summarized in Tables 5.1 and 5.2. The longitudinal profiles of the main Agno and the Tarlac Rivers are presented in Figs. 5.2 and 5.3 respectively. For the profiles of other tributaries, refer to Figs. 7.11 to 7.14.

(2) Allied Rivers

Principal features of the river improvement plan for the Allied River system are summarized as follows:

In this plan formulation, the Bued closure dike is proposed so as not to divert the flood flow to the Aloragat River. Basic concept of this plan is discussed in succeeding Chapter 6.

River	Improvement of L.W.C (km)	Diking system (km) New dike	Diking system (km) Heightening
Cayanga-Patalan-Angalacan River			
Main stream	37.50	70.30	0.00
Bued	15.10	21.10	0.00
Aloragat	19.70	8.50	0.00
Pantal-Sinocalan-Tagamusing River			
Main stream	49.40	89.10	3.80
Dagupan	21.70	56.00	0.00
Ingalera	37.50	63.00	0.00
Macalong	21.00	40.00	0.00

Principal features of designed channel of the Allied Rivers system are summarized in Table 5.3. The longitudinal profiles of the two main streams are presented in Figs. 5.4 and 5.5. For the profiles of tributaries, refer to Figs. 7.24 to 7.30.

5.2 Work Quantities and Construction Cost

(1) Agno River

The work quantities and economic cost of river improvement only alternative plan for the Agno River system are summarized below:

Items	Unit	Main Agno	Tarlac River	Other Tributaries
Excavation	1,000m^3	28,225	5,050	2,083
Dredging	1,000m^3	17,075	0	0
Embankment	1,000m^3	25,651	4,302	3,370
Revetment	1,000m^2	517	97	190
Groin	PC.	958	244	1,070
Drainage facility	PC	20	3	26
Bridge	PC	5	3	14
Fixed weir	PC	0	0	0
Intake facility	PC	0	0	4
Main construction cost (Economic)	Million Pesos	7,710	1,067	1,293

The details of the above work quantities and construction cost are shown in Tables 7.1 and 7.3 respectively.

(2) Allied Rivers

The work quantities and economic cost of river improvement only alternative plan for the Cayanga-Patalan and Panto-Sinocalan River systems are summarized below:

Item	Unit	Cayanga-Patalan R.	Pantal-Sinocalan R.
Excavation	$1,000m^3$	2,221	6,376
Dredging	$1,000m^3$	390	113
Embankment	$1,000m^3$	1,331	8,058
Revetment	$1,000m^2$	194	400
Groin	PC.	1,095	960
Drainage facility	PC.	16	39
Bridge	PC.	8	26
Main construction cost (Economic)	Million Pesos	777	1,897

The details of the above work quantities and construction cost are shown in Tables 7.2 and 7.4 respectively.

6. FLOODWAY ALTERNATIVE PLANS FOR FRAMEWORK PLAN

6.1 Identification of Floodway Alternatives

The following floodway schemes are studied for the purpose of reducing flood discharge of the existing channel in the lower reaches.

(1) Agno Floodway: To divert the flood from the Allied Rivers gathered in the Agno River to Lingayen Gulf.

(2) San Manuel Floodway: To divert the Tuboy River flood (upstream of Sinocalan River) to the Agno River.

(3) Binalonan Floodway: To divert the Tuboy River flood to the Angalacan River, a tributary of the Cayanga River.

(4) Aloragat Floodway: To divert the Aloragat River flood to the Angalacan River.

(5) Bued Closure dike: To prevent the excess flood water from the Bued River to flow into the Aloragat River.

Diagram of the above conceivable schemes is shown in Fig. 6.1.

6.2 Features of Floodway Alternatives

6.2.1 Design Flood Discharge

The design flood discharge distribution of the floodway alternatives are shown in Figs. 6.2 to 6.6. As for levels of design flood, the Agno Floodway is adopted for a 100-yr flood and the other four floodways for 50-yr flood.

6.2.2 Features of Designed Floodways

Principal features of the floodway alternatives are summarized below:

Agno Floodway

This floodway intends to divert flood runoff of 6,400 m^3/s from the upper Agno at the point 2.0 km downstream of existing ARIS Dam, directly into Lingayen Gulf through diversion channel consisting of new channel stretch of 20 km long and improvement channel stretches of 24 km long of Upper Sinocalan River and middle and lower Cayanga River. The river width and width of low-water channel bed 1,000 m and at 80-60 m respectively. Fig. 6.7 shows principal features of the design channel.

San Manuel Floodway

This floodway intends to divert flood runoff of 550 m^3/s from the Tuboy River at the point 8.0 km upstream of Binalonan town into the Agno River. The length of whole floodway is 12.5 km. The river width and width of low-water channel bed ranges 80-60 m and 25-10 m respectively. Fig. 6.3 shows the principal features of the design channels.

Binalonan Floodway

This floodway intends to divert flood runoff of 650 m^3/s from the Tuboy River at the point 7.0 km upstream of Binalonan, into the Angalacan River through diversion channel having length of 6.7 km. The river width and width of low-water channel bed is 60 m and 15 m respectively. Fig. 6.4 shows the principal features of the design channel.

Aloragat Floodway

This floodway intends to divert flood runoff of 750 m^3/s from the Aloragat River at the point 7.5 km upstream of confluence with the Cayanga-Patalan River, into the Angalacan River through diversion channel having a length of 1.5 km. The river width and width of low-water channel bed is 80 m and 25 m respectively.

Bued Closure Dike

This scheme intends to enable flood water of the Bued River to flow down through the main stream of the Bued by constructing a 2 km long closure dike at the left bank connecting naturally with the Aloragat River.

The effect of reduction of flood discharge by the closure dike is expected for the stretches of whole main Aloragat and the main Patalan between the confluence with the Aloragat and the Bued. The total length of the stretches is a 31.8 km. On the other hand, on a 16.5 km long stretch of the Bued, flood water increases.

6.2.3 Work Quantities and Construction Cost

The work quantities and economic cost of each floodway alternative shown in Tables 6.1 to 6.5.

6.3 Selection of Floodway Plan for Alternative Framework Plans

Main construction cost of the floodway alternatives are given below in comparison with the river improvement only alternative plan.

	Economic Cost (Mill. Pesos)				
Alternatives	Floodway	Main Agno	Cayanga	Pantal	(Total)
- River improvement only*	0	7,706	777	1,897	10,380
- Agno floodway*	4,423	5,948	330	1,540	12,241
- San Manuel floodway*	342	7,845	777	1,540	10,504
- Binalonan floodway*	166	7,706	837	1,549	10,258
- Aloragat floodway	31	7,706	912	1,897	10,546
- Without Bued closure dike	-	7,706	928	1,897	10,531

Note; *: With Bued closure dike

As seen in the above summary, the Binalonan floodway and Bued closure dike schemes would be competitive with river improvement only alternative.

Therefore, these two schemes are incorporated in the alternative Framework Plans. All other schemes are excluded from the alternative plans for Framework Plan.

7. RIVER IMPROVEMENT AND FLOODWAY PLAN FOR FRAMEWORK PLAN

7.1 Alternative Framework Plans

7.1.1 Selected Alternative Plans

Combining river improvement, floodway, retarding basins and dams selected as a conceivable flood control method by sectorial studies, the following alternative plans were examined.

(1) Agno River

- Alternative-AG1 : A plan consisting of river improvement only
- Alternative-AG2 : A plan consisting of river improvement and Poponto natural retarding basin
- Alternative-AG3 : A plan consisting of river improvement, Poponto natural retarding basin and Moriones-O'Donnell dam
- Alternative-AG4 : A plan consisting of river improvement and Moriones-O'Donnell dam

(2) Allied rivers

- Alternative-AL1 : A plan consisting of river improvement and Bued closure dike
- Alternative-AL2 : A plan consisting of river improvement, Bued closure dike and Binalonan Floodway

7.1.2 Design Flood Discharge

The design flood discharge distribution for each alternative plan is shown in Fig. 7.1.

7.1.3 Comparison of River Improvement Plan for Alternative Plans

(1) Principal features of design channel for each alternative plan

For the Agno River, the design features on river width, low water channel, river bed profile and bank protection works of low water channel are similar to those of the river improvement only alternative plan. The difference of design channel features for each alternative plan depends on high-water level, dike section and other facilities related to high-water level.

For the Allied Rivers, river width and low water channel is designed for each alternative plan, because the design discharge of each alternative plan has great difference.

(2) Work quantities for each alternative plan

The work quantities for the Agno and the Allied Rivers are shown in Tables 7.1 and 7.2, and are summarized below:

<u>Agno River</u>

Items	Unit	Alternative -AG1	-AG2	-AG3	-AG4
Excavation	1,000 m^3	35,358	36,008	35,258	34,608
Dredging	1,000 m^3	17,075	17,075	17,075	17,075
Embankment	1,000 m^3	33,323	26,731	25,095	30,436
Revetment	1,000 m^2	805	878	874	799
Groin	PC.	2,272	2,272	2,272	2,277
Drainage facility	PC	49	46	46	49
Bridge	PC	22	22	22	22
Fixed weir	PC	0	1	1	0
Intake facility	PC	4	4	4	4

Allied Rivers

Items	Unit	Alternative -AL1	-AL2
Excavation	1,000 m^3	8,597	8,073
Dredging	1,000 m^3	503	478
Embankment	1,000 m^3	9,389	8,287
Revetment	1,000 m^2	593	664
Groin	PC.	2,057	1,849
Drainage facility	PC	69	63
Bridge	PC	34	33
Fixed weir	PC	0	0
Intake facility	PC	0	4

(3) Construction cost

The estimated economic construction costs for each alternative plan are shown in Tables 7.3 and 7.4 and are summarized below:

Agno River

(million Pesos)

River		Alternative - AG1	- AG2	- AG3	- AG4
Main Agno	(1/100)	11,472	10,700	10,485	11,202
Tarlac R.	(1/100)	1,587	1,288	1,061	1,265
Other tributaries	(1/50)	1,925	1,925	1,925	1,925
Total		14,984	13,913	13,471	14,392

Note: Construction cost for river improvement and/or floodway only

Allied Rivers

(million Pesos)

River	Alternative -AL1	-AL2
Pantal-Sinocalan R.(1/50)	2,824	2,305
Cayanga-Patalan R. (1/50)	1,158	1,246
Binalonan Floodway (1/50)	0	248
Total	3,982	3,799

7.2 Features of River Improvement and Floodway Plan for Framework Plan

7.2.1 Design Flood Discharge

The design flood discharge distribution for the Framework Plan is shown in Fig. 7.2.

7.2.2 Features of Design Channel and Floodway

(1) Main Agno

The outline of river improvement and floodway plan of Main Agno is as follows:

In the lower reaches from the river mouth to the confluence with the Tarlac River, river improvement works over a 43.8 km long stretch comprises of the following.

- Channel improvement on the main stream over a length of 43.8 km including cut-off channel on the three stretches with a total length of over 6.0km and bank protection works.

- Diking system the both banks of the main stream over a total length of 86.6 km and a 38km long in the back-water stretches for the small scale tributaries.

- Included in the above diking system along the main stream is the construction and heightening of the dike on the right bank over 23.5 km long and 19.9 km long respectively, and on the left bank over 33.9 km long and 9.3 km long respectively.

- In the stretch 3.7km upstream of the river mouth to the junction with the Bayaoas River, a 19km right bank is newly constructed creating a 1.5km river width, and the existing dike in the stretch is planned as a secondary dike.

- Reconstruction of 10 sluice ways, 2 water gates and 4 bridges in connection with the river improvement.

In the middle reaches between the junction with the Tarlac River and the inlet of Poponto floodway, the said floodway is planned as a main channel. On the other hand, the existing main channel at Bayambang will replace as a by-pass channel in order to divert a part of flood water from upstream of the Agno directly to the junction with the Tarlac River. The improvement of the 10.7 km long floodway and the 10.5 km long existing main channel comprise of the following works:

- Channel improvement on Poponto floodway over a length of 10.7km and a 1.0 km channel of downstream of the existing main channel including bank protection works.

- Diking system on the right bank over a length of 7.8 km and on the left bank over a length of 4.8 km at the Poponto floodway, and on the back-water stretches of the existing main channel over a total length of 20.3 km.

- Construction of new dike on the floodway over a 3.8 km long right dike and raising of a 4.0 km long existing right dike and a 4.8 km long existing left dike, and new dike on both bank along the existing main channel over a total length of 9.0 km.

- Construction of a fixed weir with a 3.2 km closure dike on the right bank of upstream of the Poponto floodway, and demolition of the existing side overflow weir at the inlet of the floodway.

- Construction of 2 sluice ways.

In the upper reaches from the inlet of Poponto floodway to ARIS dam, the river improvement over a 44.4 km long stretch comprises the following works:

- Channel improvement on the main stream over a length of 44.4 km including bank protection works.

- Diking system on the right bank over a length of 44.4 km and on the left bank over a length of 37.4 km.

- Backward displacement of the right dike with a total length of 2.8km at Carmen, Rosales.

- Construction of new dike on the right bank over a 9.8 km long and on the left bank over 7.5 km long, and heightening of a 30.6 km long existing right dike and a 29.9 km long existing left dike.

- In the upstream from the open levee at Asingan, the right dike is designed as a super-dike with a 50m wide dike crown and also considering removal of surplus soils.

- Construction of 4 sluice ways and raising of Plaridel bridge at Carmen, Rosales.

Alignment, longitudinal profile and typical cross-section of the Agno River improvement plans are shown in Figs. 7.4, 7.9 and 7.15 respectively. Principal features of the design channel and the floodway are summarized in Table 7.5.

(2) Tarlac River

Tarlac River improvement over a 37.0 km long stretch is composed of the following works:

- Channel improvement on the main stream over a length of 28.9km including bank protection works, and on the natural retarding stretch over a 8.1 km long low-water channel.

- Diking system over a length of 28.9km on the right bank through the whole stretch from 8.1km upstream of the confluence with the Agno to TARIS dam and on the left bank over a length of 27.9 km.

- To be incorporated to the above diking system is the heightening of the existing dike on the right bank over a length of 23.3 km and on the left bank over a length of 22.2 km, and construction of a 1.3 km new dike.

- Construction of 2 sluice ways and 3 bridges in connection with river improvement.

Alignment, longitudinal profile and typical cross-section of the Tarlac river improvement plans are shown in Figs. 7.5, 7.10 and 7.16 respectively. Principal features of the design channel are summarized in Table 7.6.

(3) Camiling River

Camiling river improvement works over a 20.0 km long stretch is composed of the following:

- Improvement of the confluence with the Agno River at 3.5km downstream of the junction with the Tarlac River.

- Channel improvement on the main stream over a length of 18.8km including cut-off channel on the two stretches over a total length of 1.5km and bank protection works.

- Construction of diking System on the right bank over a length of 15.3 km and on the left bank over a length of 16.2 km. In the downstream from the confluence with the Bayating River and in the upstream from the confluence with the Mamair River, diking system is planned on one side of the bank only.

- Construction of 4 sluice ways and Camiling bridge in connection with the river improvement.

Alignment, longitudinal profile and typical cross-section of the Camiling river improvement plans are shown in Figs. 7.6, 7.11 and 7.17 respectively. Principal features of the design channel are summarized in Table 7.6.

(4) Banila River

Banila river improvement over a 30.9 km long stretch is composed of the following works:

- Improvement of alignment of the confluence with the Agno.

- Channel improvement on the main stream over a length of 23.9 km and bank protection works.

- Diking system on the right bank over a length of 24.5 km and on the left bank over a length of 30.9km. In the upper reach, from 2.5km down stream of Banila bridge at Umingan, only left dike is planned considering the present condition of landuse, insufficient effect of flood mitigation by confining dike due to run-off from slope of mountain area on the right bank, and characteristics of regime of the main stream.

- Included also to the above diking system is the construction of dike over a total length of 48.0 km including the heightening of a 2.0 km existing dike.

- Construction of 14 sluice ways, 4 intake facilities and 7 bridges in connection with the river improvement.

Alignment, longitudinal profile and typical cross-section of the Banila river improvement plans are shown in Figs. 7.7, 7.12 and 7.18 respectively. Principal features of the design channel are summarized in Table 7.6.

(5) Viray-Dipalo River

Viray-Dipalo river improvement over a 20.1 km long stretch is composed of the following works:

- Channel improvement on the Viray-Dipalo River over a length of 7.9 km, on the Viray River over a length of 4.5 km and on the Dipalo River over a length of 7.7 km including bank protection works.

- Diking system on both banks of the Viray-Dipalo River over a length of 13.0 km, on the right bank of the Viray River over a length of 4.1 km and on the left bank of the Dipalo River over a length of 7.1 km.

- From among the preceeding stretches, a 7.4 km long dike is to be raised in the existing one.

- Construction of 4 sluice ways and 4 bridges in connection with the river improvement.

Alignment, longitudinal profile and typical cross-section of the Viray-Dipalo river improvement plans are shown in Figs.7.8, 7.13, and 7.19 respectively. Principal features of the design channel are summarized in Table 7.6.

(6) Ambayaoan River

Ambayaoan River improvement over a 8.7 km long stretch is composed of the following works:

- Channel improvement on the main stream over a length of 8.7 km including bank protection works.

- Construction of diking system on both banks over a total length of 16.0km including the heightening of a 3.5km existing left dike.

- Construction of 4 sluice ways and the bridge at San Nicolas in connection with the river improvement.

Alignment, longitudinal profile and typical cross-section of the Ambayaoan river improvement plans are shown in Figs. 7.8, 7.14 and 7.20 respectively. Principal features of the design channel are summarized in Table 7.6.

(7) Cayanga-Patalan-Angalacan River system

This river improvement is composed of the following works:

Cayanga-Patalan-Angalacan River

- Channel improvement on the main stream over a length of 37.5 km including bank protection works.

- Construction of diking system on the whole stretch of the Cayanga-Patalan River over a total length of 29.6 km, and in the Angalacan River a 22.7 km long right dike and a 18.0 km long left dike.

- Construction of 16 sluice ways and 6 bridges in connection with the river improvement.

Bued River

- Channel improvement on the main stream over a length of 19.8 km including bank protection works. On a 4.7 km long portion upstream the NIA dam, only a bank protection work is to be done.

- Construction of diking system on the right bank over a length of 14.1 km and on the left bank over a length of 7.0 km including a 2.0 km long closure dike.

- Construction of 6 sluice ways and San Vicente bridge in connection with the river improvement.

Aloragat River

- Channel improvement on the Aloragat River over a length of 19.7 km including bank protection works.

- Construction of diking system on the Bobonan River new main stream after construction of Bued closure dike, over a total length of 8.5 km.

- Reconstruction of two bridges in connection with the river improvement.

Alignment, longitudinal profile and typical cross-section are shown in Fig.7.22, Figs. 7.23 to 25 and Figs. 7.31 to 7.33 respectively. Principal features of the design channel are summarized in Table 7.7.

(8) Pantal-Sinocalan River System

This river improvement is composed of the following works:

<u>Pantal-Sinocalan - Tagamusing River</u>

- Channel improvement on the main Pantal-Sinocalan channel over a length of 33.0 km including bank protection works and on the whole stretch of the Tagamusing River, only bank protection works.

- Construction of diking system on both banks of the stretch of the Pantal-Sinocalan River over a total length of 68.0 km including heightening of the 3.8 km existing dike.

- Construction of 16 sluice ways and 6 bridges in connection with the river improvement.

<u>Binalonan Floodway and Tuboy River</u>

- Construction of a 6.7 km long diversion channel with the parallel dike over a total length of 13.4 km.

- Construction of 2 sluice ways and a new bridge at the inlet of the floodway.

- Channel improvement on the Tuboy River over a length of 5.9 km including bank protection works.

- Construction of diking system on the left bank of Tuboy over a length of 5.9 km.

<u>Dagupan-San Juan-Elang River</u>

- Channel improvement on the main Dagupan-San Juan River over a length of 21.7 km and on the downstream of the Elang over a length of 5.9 km including bank protection works.

- Construction of diking system on the above stretches over a total length of 56.0 km.

- Construction of 7 sluice ways and 6 bridges in connection with the river improvement.

Ingalera River

- Channel improvement on the main stream over a length of 37.5 km including bank protection works.

- Construction of a 25.0 km long right dike and a 38.0 km long left dike.

- Construction of 8 sluice ways and 8 bridges in connection with the river improvement.

Mitura-Macalong River

- Channel improvement on the mainstream over a length of 21.0 km including bank protection works.

- Construction of a 19 km long right dike and a 21.0 km long left dike.

- Construction of 8 sluice ways and 3 bridges in connection with the river improvement.

Alignment, longitudinal profile and typical cross-section are shown in Fig. 7.22, Figs. 7.26 to 7.30 and Fig. 7.34 to 7.38 respectively. Principal features of the design channel are summarized in Table 7.7.

7.3 Work quantities and Construction Cost

(1) Agno River

The work quantities and economic cost of the river improvement plan for the Agno River system are summarized below:

Items	Unit	Main Agno	Tarlac River	Other tributaries
Excavation	$1,000m^3$	28,875	4,300	2,083
Dredging	$1,000m^3$	17,075	0	0
Embankment	$1,000m^3$	20,370	1,355	3,370
Revetment	$1,000m^2$	588	96	190
Groin	Pc.	958	244	1,070
Drainage facility	Pc.	18	2	26
Bridge	Pc.	5	3	14
Fixed weir	Pc.	1	0	0
Intake facility	Pc.	0	0	4
Main construction cost	Million Pesos	7,046	713	1,293
Total cost	Million Pesos	10,485	1,061	1,925

The details of the above are shown in Tables 7.1 and 7.3.

(2) Allied Rivers

The work quantities and economic cost of the river improvement and floodway plan for the Cayanga-patalan and Pantal-Sinocalan River systems are summarized belows:

Items	Unit	Cayanga-Patalan River	Pantal-Sinocalan River
Excavation	$1,000m^3$	2,361	5,712
Dredging	$1,000m^3$	440	38
Embankment	$1,000m^3$	1,773	6,515
Revetment	$1,000m^2$	194	470
Groin	Pc.	1,095	754
Drainage facility	Pc.	22	41

Bridge	Pc.	9	24
Intake facility	Pc.	0	4
Main construction cost	Million Pesos	837	1,715
Total cost	Million Pesos	1,246	2,553

The details of the above are shown in Tables 7.2 and 7.4.

8. RIVER IMPROVEMENT AND FLOODWAY PLAN FOR LONG TERM PLAN

8.1 Features of River Improvement and Floodway Plan

8.1.1 Design Flood Discharge

The design flood discharge distribution for Long Term Plan is shown in Fig. 8.1.

8.1.2 Features of Design Channel and Floodway

Principal feature of the river improvement and floodway plan for Long Term Plan are summarized below.

(1) Main Agno

<u>Lower reaches</u>

- Stretch of river improvement	: 43.8 km long
- Channel improvement	: 43.8 km long
- Diking system	: 43.4 km long on the right bank
	: 43.2 km long on the left bank
Right bank	: New dike of 5.0 km long
	Heightening of 27.4 km long
	Existing dike of 11.0 km long
Left bank	: New dike of 33.9 km long
	Heightening of 8.8 km long
	Existing dike of 0.5 km long
- Construction of other facilities	: 10 sluice ways 2 water gates for intake water 4 bridges

<u>Middle reaches</u>

- Length of stretch	: 10.7 km long on the Poponto floodway
	10.5 km long on the existing main stream
- Channel improvement	: 10.7 km long on the floodway
	: 1.0 km long on the existing main stream
- Diking system along the floodway	: 7.8 km long on the right bank
	4.8 km long on the left bank

Right bank	: New dike of 3.8 km long Heightening of 4.0 km long
Left bank	: Heightening of 4.8 km long
- Diking system along the existing main channel	: 11.7 km long on the right bank 8.6 km long on the left bank
Right bank	: New dike of 4.3 km long (on the back-water stretch) Existing dike of 7.4 km long
Left bank	: New dike of 4.2 km long (on the back-water stretch) Existing dike of 4.4 km long
- Construction of other facilities	: 1 fixed weir with a 3.2 km long dike 2 sluice ways

Upper reaches

- Stretch of river improvement	: 44.4 km long
- Channel improvement	: 44.4 km long
- Diking system	: 44.4 km long on the right bank 37.4 km long on the left bank
Right bank	: New dike of 9.8 km long including backward displacement of 2.6 km dike. Heightening of 27.2 km long Existing dike of 7.4 km long
Left bank	: New dike of 7.5 km long Heightening of 26.4 km long Existing dike of 3.5 km long
- Construction of other facilities	: 4 sluice ways 1 bridge

Alignment, longitudinal profile and typical cross-section of the Agno river improvement plans are shown in Figs. 7.4, 7.9 and 7.15 respectively. Principal features of the design channel and floodway are summarized in Table 8.1.

(2) Tarlac River

- Stretch of river improvement	: 37.0 km long including the stretch with the low-water channel improvement only on the retarding area (L = 8.1 km)

- Channel improvement : 37.0 km long
- diking system : 28.9 km long on the right bank
  27.9 km long on the left bank
  - Right bank : Heightening of 23.3 km long
    Existing dike of 5.6 km long
  - Left bank : New dike of 1.3 km long
    Heightening of 22.2 km long
    Existing dike of 4.4 km long
- Construction of other facilities : 2 sluice ways
  3 bridges

Alignment, longitudinal profile and typical cross-section of the Tarlac river improvement plans are shown in Figs. 7.5, 7.10 and 7.16 respectively. Principal features of the design channel are summarized in Table 8.2.

(3) Camiling River

- Stretch of river improvement : 20.0 km long
- Channel improvement : 18.8 km long including 1.5 km long cut-off channel
- Diking system : 15.1 km long on the right bank (new dike)
  16.0 km long on the left bank (new dike)
- Construction of other facilities : 4 sluice ways
  1 bridge

Alignment, longitudinal profile and typical cross-section of the Camiling River improvement plan are shown in Figs. 7.6, 7.11 and 7.17 respectively. Principal features of the design channel are summarized in Table 8.2.

(4) Banila River

- Stretch of river improvement : 30.9 km long
- Channel improvement : 23.9 km long
- Diking system : 24.5 km long on the right bank
  30.9 km long on the left bank
  - Right bank : New dike of 24.5 km long
  - Left bank : New dike of 21.6 km long
    Heightening of 1.7 km long
    Existing dike of 7.6 km long

- Construction of other facilities : 14 sluice ways
  7 bridges

Alignment, longitudinal profile and typical cross-section of the Banila River improvement plan are shown in Figs. 7.7, 7.12 and 7.18 respectively. Principal features of the design channel are summarized in Table 8.2.

(5) Viray-Dipalo River

- Stretches of river improvement : 7.9 km long on the Viray-Dipalo
  : 4.5 km long on the Viray
  : 7.7 km long on the Dipalo
- Channel improvement : The above whole stretch over a total length of 20.1 km
- Diking system : 13.0 km long on both banks of the Viray-Dipalo
  4.1 km long on the right bank of the Viray
  7.1 km long on the left bank of the Dipalo
  - Right bank : Heightening of 3.6 km long
    Existing dike 7.0 km long
  - Left bank : Heightening of 3.6 km long
    Existing dike 10.0 km long
- Construction of other facilities : 4 sluice ways
  4 bridges

Alignment, longitudinal profile and typical cross-section of the Viray-Dipalo River improvement plans are shown in Figs. 7.8, 7.13 and 7.19 respectively. Principal features of the design channel are summarized in Table 8.2.

(6) Ambayaoan River

- Stretch of river improvement : 8.7 km long
- Channel improvement : 8.7 km long
- Diking system : 8.0 km long on the right bank
  8.0 km long on the left bank
  - Right bank : New dike of 8.0 km long

Left bank	:	New dike of 4.5 km long Heightening of 3.5 km long
- Construction of other facilities	:	4 sluice ways 1 bridge

Alignment, longitudinal profile and typical cross-section of the Ambayaoan River improvement plans are shown in Figs. 7.8, 7.14 and 7.20 respectively. Principal features of the design channel are summarized in Table 8.2.

(7) Cayanga-Patalan-Angalacan River system

<u>Cayanga-Patalan-Angalacan River</u>

- Stretch of river improvement	:	37.5 km long
- Channel improvement	:	37.5 km long
- Diking system (new dike)	:	37.5 km long right dike 32.6 km long left dike
- Construction of other facilities	:	16 sluice ways 6 bridges

<u>Bued River</u>

- Stretch of river improvement	:	19.8 km long
- Channel improvement	:	15.1 km long
- Diking system (new dike)	:	14.1 km long right dike 7.0 km long left dike including a 2.0 km closure dike
- Construction of other facilities	:	6 sluice ways 1 bridge

<u>Aloragat River</u>

- Stretch of river improvement	:	19.7 km long
- Channel improvement	:	19.7 km long
- Diking system (new dike)	:	4.3 km long right dike 4.2 km long left dike
- Construction of other facilities	:	2 bridges

Alignment, longitudinal profile and typical cross-section of the river improvement plans for the Cayanga River system are shown in Fig. 7.22, Figs. 7.23, 7.25 and Figs. 7.31 to 7.33 respectively. Principal features of the design channel are summarized in Table 8.3.

(8) Pantal-Sinocalan-Tagamusing River system

Pantal-Sinocalan-Tagamusing River

- Stretch of river improvement	:	43.5 km long
- Channel improvement	:	33.0 km long
- Diking system	:	34.0 km long right dike 34.0 km long left dike
Right bank	:	New dike of 31.5 km long Heightening of 2.5 km long
Left bank	:	New dike of 32.7 km long Heightening of 1.3 km long
- Construction of other facilities	:	16 sluice ways 6 bridge

Dagupan-San Juan-Elang River

- Stretch of river improvement	:	27.6 km long
- Channel improvement	:	27.6 km long
- Diking system (new dike)	:	27.6 km long right dike 27.6 km long left dike
- Construction of other facilities	:	7 sluice ways 6 bridges

Ingalera River

- Stretch of river improvement	:	37.5 km long
- Channel improvement	:	37.5 km long
- Diking system (new dike)	:	21.0 km long right dike 34.0 km long left dike
- Construction of other facilities	:	8 sluice ways 8 bridges

Mitura-Macalong River

- Stretch of river improvement	:	21.0 km long
- Channel improvement	:	21.0 km long
- Diking system (new dike)	:	15 km long right dike 17 km long left dike
- Construction of other	:	8 sluice ways
facilities	:	2 bridges

Alignment, longitudinal profile and typical cross-section are shown in Fig. 7.22, Figs. 7.26 to 7.30 and Figs. 7.34 to 7.38 respectively. Principal features of the design channel are summarized in Table 8.3.

8.2 Work Quantities and Construction Cost

(1) Agno River

The work quantities and financial cost of river improvement plan for the Agno River system are summarized below:

Items	Unit	Main Agno	Tarlac River	Other Tributaries
Excavation	$1{,}000m^3$	24,673	4,300	1,200
Dredging	$1{,}000m^3$	13,027	0	0
Embankment	$1{,}000m^3$	15,269	1,355	2,581
Revetment	$1{,}000m^2$	514	96	190
Groin	Pc.	958	244	1,070
Drainage facility	Pc.	18	2	26
Bridge	Pc.	5	3	14
Fixed weir	Pc.	1	0	0
Intake facility	Pc.	0	0	4
Foreign currency	Million Pesos	6,047	903	937
Local currency	Million Pesos	3,338	518	703
Total cost	Million Pesos	9,385	1,421	1,640

The details of the above rivers are shown in Tables 8.4, and 8.6.

(2) Allied Rivers

The work quantities and economic cost of the river improvement and floodway plan for the Cayanga-Patalan and Pantal-Sinocalan River systems are summarized below:

Items	Unit	Cayanga-Patalan River	Pantal-Sinocalan River
Excavation	$1,000m^3$	1,842	4,216
Dredging	$1,000m^3$	260	38
Embankment	$1,000m^3$	718	4,012
Revetment	$1,000m^3$	193	373
Groin	Pc.	1,095	952
Drainage facility	Pc.	22	39
Bridge	Pc.	9	22
Intake facility	Pc.	0	4
Foreign currency	Million Pesos	615	1,311
Local currency	Million Pesos	511	849
Total cost	Million Pesos	1,126	2,160

The details of the above rivers are shown in Tables 8.5 and 8.7.

9. REVIEW OF AGNO RIVER IMPROVEMENT PLAN FOR FRAMEWORK AND LONG TERM PLANS

9.1 Review of River Improvement Plan Required

The Master Plan Study was executed in the period, May 1989 - February 1990. After this study the following inspection and survey were conducted; 1) Inspection of earthquake damages which occurred on July 16, 1990 and 2) Additional topographic and cross-section survey for Feasibility Study area selected.

In accordance with the assessment of results of the above inspection and additional survey, the following study for review of Master Plan is required;

- Review of the selection of Feasibility Study area in consideration of the earthquake-damaged river facilities

- Review of the storage function of Poponto natural retarding basin based on the new topographic map

- Review of the probable flood discharge in the downstream reach of Agno River and revision of that design flood discharge distribution

- Review of the comparative study for alternatives of Agno flood control plan based on the revised probable flood discharge.

9.2 Proposed River Improvement Study Stretches for Feasibility Study

Among the earthquake-damaged river facilities the most serious damages have been identified over the diking system of the middle and upper reaches of the main Agno River and the whole reaches of the Tarlac River. In the Allied Rivers the damaged river facilities were bank protection ones. The extent of dike damaged in the Agno River Basin in summarized as follows:

River/Stretch (Right/Left Bank)		River Length (km)	Length of Damage Extent(km) Earth dike	Conc. dike/ Revetment
Main Agno River				
River mouth - Wawa	(R)	45.0	2.32	0.11
	(L)		0	0.99
Wawa - ARIS dam	(R)	54.0	16.60	0.20
	(L)		19.56	0.99
Poponto Floodway	(R/L)	6.0	1.31	0
Tarlac River	(R/L)	37.0	44.92	0.50
Camiling River	(R/L)	20.0	0	3.74
Banila River	(R/L)	30.9	2.12	0
Viray-Depalo River	(R/L)	20.1	1.30	0
Ambayoan River	(R/L)	8.7	0	0

PMO-AFCS Flood Control Program for Earthquake-Damage Rehabilitation/ Restoration was formulated in order to rehabilitate all the damaged flood control facilities, especially dikes to the original conditions before the flood season of 1991.

Therefore, the Feasibility Study areas selected in the Master Plan Study are adopted unchanged; i.e., the Upper Agno River and the Pantal-Sinocalan River.

9.3 Revision of the Probable Flood Discharge in the Downstream of Main Agno River

The storage function of the Poponto natural retarding basin was reviewed by using the new topographic map with scale of 1/25,000 and the revised design high water level is as follows:

- Framework Plan (100-year) : H.W.L = 16.70
- Long Term Plan (25-year) : H.W.L = 16.00

The revised design flood discharge distribution of Framework and Long Term Plans are shown in Figs. 9.1 and 9.2 respectively.

9.4 Review of the Comparative Study of Alternatives for Agno Flood Control Plan

Based on the revised probable flood discharge, the comparative study on least costly alternative of Agno River were reviewed, and the result is described in the Main Report.

Of the four alternatives for the Agno River, the combination plan of river improvement, the Poponto natural retarding basin and the Moriones-O'Donnel dam which was selected originally as the Framework Plan, is reassessed to be the case of least project cost.

9.5 Modification in Agno River Improvement Plan for Framework and Long Term Plans

The features of the modified part of the design channel of Agno River Improvement Plan for Framework and Long Term Plans are summarized in Tables 9.1 and 9.2 respectively.

The modified parts are as bellow:

- In the downstream reach from the Poponto natural retarding basin, the design high water level and the design elevation of dike crown are heightened due to increase of the design flood discharge.

- In the upstream reach, the followings are modified;
  1) The design high water level in the back-water stretch in Bayambang due to the revised design high water level of the Poponto natural retarding basin.
  2) The design river width of the Poponto floodway (Set-back levee plan proposed) in consideration of the channel and dike stabilization.
  3) The design dike alignment from Asingan to San Manuel in consideration of dike stabilization.

Figs. 9.3 and 9.4 show the modified design plan which covers the upper stretch of the Poponto natural retarding basin, and the revised design longitudinal profile in the whole study area.

TABLES

Table 2.1 PHYSICAL FEATURES OF RIVER BASIN

RIVER	CATCHMENT AREA (km2)	RIVER LENGTH (km)
AGNO RIVER BASIN		
AGNO RIVER		
Ambuklao Dam	617	58.5
Binga Dam	860	73.5
San Roque Dam	1,250	119.0
Poponto Floodway Site	2,477	165.0
River Mouth (Whole)	5,907	221.0
TARLAC RIVER		
O'Donnell River	303	50.3
Moriones River	558	64.8
(Whole)	1,896	93.0
AMBAYOAN RIVER	367	62.2
VIRAY-DIPALO RIVER		
Viray River	70	8.0
Dipalo River	65	14.0
(Whole)	135	21.2
BANILA RIVER	309	39.0
CAMILING RIVER	604	64.0
OLO RIVER	140	35.7
BAYAOAS RIVER	72	21.2
ALLIED RIVER BASIN		
CAYANGA-PATALAN RIVER		
(Whole)	618	61.0
Angalacan River	144	25.5
Aloragat River	116	31.0
Bued River	286	54.0
PANTO-SINOCALAN RIVER		
(Whole)	1,115	75.5
Mitura-Macalalong River	141	31.0
Tagumising River	182	44.5
Ingalera River	197	32.5
Dagupan River	273	32.0

Table 2.2 SUMMARY OF BREACHES/GAPS AND SCOURS CAUSED BY FLOODS (1984-1988)

RIVER (Reaches)	DAMAGE TYPE		1984-FLOOD Aug. 28-30 ("Maring")		1985-FLOOD June 22-24 ("Kuring") June 28-30 ("Daling")		1986-FLOOD July 9-11 ("Gading") Aug.30-Sept. 5 ("Miding")	
AGNO RIVER (Upper)	EARTHDIKE/REVET.	(Site, m)	8	2,760	8	2,290	10	5,340
	BREACHES/GAPS	(P:1,000)		52,972		17,888		55,402
	SCOURED	(Site, m)	0	0	0	0	3	2,900
		(P:1,000)		0		0		2,750
	DAMAGED SPURDIKE	(Site, Unit)	2	56	0	0	7	188
		(P:1,000)		1,400		0		3,812
AGNO RIVER (Lower)	EARTHDIKE/REVET.	(Site, m)	1	110	0	0	1	500
	BREACHES/GAPS	(P:1,000)		20,000		0		12,000
	SCOURED	(Site, m)	0	0	0	0	0	0
		(P:1,000)		0		0		0
	DAMAGED SPURDIKE	(Site, Unit)	0	0	0	0	1	4
		(P:1,000)		0		0		8,120
TARLAC RIVER	EARTHDIKE/REVET.	(Site, m)	0	0	3	70	5	490
	BREACHES/GAPS	(P:1,000)		0		660		5,845
	SCOURED	(Site, m)	0	0	0	0	0	0
		(P:1,000)		0		0		0
	DAMAGED SPURDIKE	(Site, Unit)	0	0	0	0	3	46
		(P:1,000)		0		0		1,280
TRIBUTARIES OF AGNO RIVER	EARTHDIKE/REVET.	(Site, m)	0	0	3	140	7	1,080
	BREACHES/GAPS	(P:1,000)		0		1,000		8,300
	SCOURED	(Site, m)	0	0	0	0	0	0
		(P:1,000)		0		0		0
	DAMAGED SPURDIKE	(Site, Unit)	0	0	0	0	8	61
		(P:1,000)		0		0		1,744
ALLIED RIVER	EARTHDIKE/REVET.	(Site, m)	4	976	1	40	9	1,820
	BREACHES/GAPS	(P:1,000)		8,166		231		8,767
	SCOURED	(Site, m)	0	0	0	0	0	0
		(P:1,000)		0		0		0
	DAMAGED SPURDIKE	(Site, Unit)	0	0	2	10	3	48
		(P:1,000)		0		576		997
TOTAL COST TO RESTORE		(P:1,000)		82,538		20,355		109,017

SOURCE : AGNO FLOOD CONTROL SYSTEM OFFICE, Rosales

Table 2.3 EXISTING RIVER CONTROL FACILITIES

PROJECT	EARTH-DIKE (km)	REVET./ GRAVITY WALL (km)	CUT-OFF CHANNEL /RIVER IMPV'T. (1968-88) (km)	REMARKS (Construction of Earthdike, 1968-88) (km)
1. AGNO RIVER CONTROL PROJECT				
(UPPER REACHES)				
Bayambang-Baby Dike Section	0.98 (R)	-	-	0.98
Bayambang-Villasis Earthdike Section	18.37 (R)	1.89	-	-
Villasis-Asingan Earthdike Section	12.00 (R)	0.40	-	12.00
Asingan-Sn. Manuel Earthdike Section	17.40 (R)	2.20	-	7.50
Anulid-Bautista Earthdike Section	5.80 (L)	-	-	5.80
Anulid-Poponto Earthdike/Flood Way	4.67 (L)	-	1.02 km(Spillway)	4.67
	6.03 (R)	-	10.85	6.03
Alcala-Sto. Tomas Dike Section	7.20 (L)	4.73	0.99	1.02
Rosales-Lagasit Dike Section	4.00 (L)	1.20	-	
Lagasit-Sta. Maria Section	12.06 (L)	-	-	
Sta. Maria-Tayug Section	- (L)	-	-	
(LOWER REACHES)				
Lingayen-Urbiztondo-Bayambang	40.50 (R)	-	-	8.50
Bugallon-Labrador Earth Section	0.53 (L)	-	-	0.53
Bugallon-Aguilar Earthdike Section	11.35 (L)	-	-	11.35
Cupang Parallel Earthdike Section	2.05 (L)	-	-	2.05
	1.84 (R)	-	-	1.84
Sobol Parallel Earthdike Section	1.60 (L)	-	-	1.60
	1.80 (R)	-	-	1.80
2. AMBAYOAN RIVER CONTROL PROJECT	2.50 (L)	-	-	2.50
3. VIRAY-DIPALO RIVER CONTROL PROJECT	14.44 (L)	-	8.80	14.44
	9.00 (R)	-	-	9.00
4. TOTONOGEN RIVER CONTROL PROJECT	2.50(L+R)	-	-	2.50
5. BANILA RIVER CONTROL PROJECT	9.33 (L)	-	-	9.33
6. TARLAC RIVER CONTROL PROJECT	22.54 (L)	3.00	-	22.54
	25.00 (R)	4.62	-	-
7. O'DONNELL RIVER CONTROL PROJECT	9.33 (R)	-	-	9.33
8. MORIONES RIVER CONTROL PROJECT	-	-	-	-
9. BATACAN RIVER CONTROL PROJECT	-	0.30	-	-
10. OLO RIVER CONTROL PROJECT	3.45	-	-	3.45
11. BAYAOAS RIVER CONTROL PROJECT	-	-	-	-
12. BEI RIVER CONTROL PROJECT	0.85	-	0.84	-
13. PANTAL RIVER CONTROL PROJECT	-	-	-	0.85
14. CAYANGA RIVER CONTROL PROJECT	-	1.10 (R)	-	-
		0.80 (R)	-	-
15. BUED RIVER CONTROL PROJECT	-	3.69 (R)	-	-
16. ANGALACAN RIVER CONTROL PROJECT	-	-	-	-
17. ALORAGAT RIVER CONTROL PROJECT	-	-	-	-
18. PANTO RIVER CONTROL PROJECT	-	-	-	-
19. MARUSAY RIVER CONTROL PROJECT	2.50 (R)	-	1.60	2.50
20. SINOCALAN RIVER CONTROL PROJECT	1.26	-	-	1.26
21. TAGAMUSING RIVER CONTROL PROJECT	-	0.78(L+R)	-	-
22. MITURA RIVER CONTROL PROJECT	-	0.22 (R)		-

Note ; R : Right Bank, L : Left Bank

Table 3.1 (1/2) LIST OF COMPLETED RIVER CONTROL PROJECTS 1968-1988
(EARTHDIKE/CUT-OFF CHANNEL/RIVER IMPROVEMENT WORKS)

PROJECT	LOCATION	YEAR	REMARKS
1 STO.TOMAS EARTHDIKE	Sta. 3.000-10.662	1968	
	Sta. 9.550- 9.745	1973	(Raising)
	Sta. 10.380-11.360	1973	(-ditto-)
2 ASINGAN-SAN MANUEL EARTHDIKE	Sta. 18.200-23.220	1978	
(SETBACK LEVEE)	Sta. 23.220-25.700	1982	
3 VILLASIS-ASINGAN SETBANK	Sta. 0.000-12.000	1973/74	
4 BAYAMBANG BABY DIKE	Sta. 19.400-20.383	1980/81	
5 STA.MARIA-TAYUG EARTHDIKE	Sta. 0.000-12.000	1975/76	
6 ALCALA EARTHDIKE	Sta. 10.662-11.680	1972	
7 ALCALA CUT-OFF CHANNEL	Sta. 0.000- 0.992	1981	
8 POPONT SWANP FLOODWAY(SPILLWAY)	Sta. 0.000- 1.020	1977	
9 ANULID-POPONT PILOT CHANNEL	Sta. 0.000- 7.000	1978	
10 ANULID-POPONT RIGHT EARTHDIKE	Sta. 0.000- 4.780	1975/76	
	Sta. 4.780- 5.840	1983	
	Sta. 5.840- 6.025	1984	
11 ANULID-POPONT LEFT EARTHDIKE	Sta. 11.000-13.500	1975/76	
	Sta. 13.500-15.390	1978/79	
	Sta. 15.390-15.674	1988	
12 ANULID-BAUTISTA EARTHDIKE	Sta. 0.000- 4.920	1975/76	
	Sta. 5.120- 5.800	1978	
13 ROSARIO-LINGAYEN EARTHDIKE	Sta. 32.000-40.500	1973/74	
14 AGUILAR-BUGALLON EARTHDIKE	Sta. 0.000-11.355	1976/77	
15 SOBOL PARALLEL EARTHDIKE	Sta. 0.000- 1.600(L)	1979	
	Sta. 0.000- 1.800(R)	1979	
16 CUPANG PARALLEL EARTHDIKE	Sta. 0.000- 2.050	1980/81	
	Sta. 0.000- 1.840	1980/81	
17 BUGALLON-LABRADOR EARTHDIKE	Sta. 11.500-12.025	1979/80	
18 AMBAYOAN EARTHDIKE	Sta. 3.000- 3.400	1977/78	
19 VIRAY-DEPALO EARTHDIKE	Sta.(-)3.000-6.000(R)	1975/76	
	Sta.(-)2.840-6.930	1975/76	
20 VIRAY-DEPALO PILOT CHANNEL	Sta. 0.000- 6.800	1980	
21 SN.QUINTIN EARTHDIKE(DEPALO R.)	Sta.(-)3.340-(-)8.620(L)	1979/80	
22 SN.QUINTIN PILOT CHANNEL	Sta.(-)3.340-(-)5.340	1980	

SOURCE : YEAR-END REPORTS AND/OR LIST OF COMPLETED PROJECTS, AFCS OFFICE

Table 3.1 (2/2) LIST OF COMPLETED RIVER CONTROL PROJECTS 1968-1988
(EARTHDIKE/CUT-OFF CHANNEL/RIVER IMPROVEMENT WORKS)

PROJECT	LOCATION	YEAR	REMARKS
23 TOTONOGEN EARTHDIKE	Sta. 0.000- 1.150	1988	
	Sta. 0.000- 1.350	1988	
	Sta. 10.380-11.360	1973	
24 BANILA EARTHDIKE	Sta. 0.000- 9.332	1977/78	
25 TARLAC LEFT DIKE	Sta. 0.000- 1.350	1970	
	Sta. 1.350- 1.780	1972/73	
	Sta.(-)0.000-(-)2.000	-	
	Sta. 1.780- 5.000	-	
	Sta. 5.000- 8.000	1974	
	Sta.4.260-5.240/5.380-5.440/6.320-8.000	1982	(Raising)
	Sta. 8.000- 9.780	1982/83	
	Sta. 9.000-19.000	1988	
	Sta.(-)2.000-(-)3.355	1988	
25 ARMENIA EARTHDIKE(O'DONNELL R.)	Sta. 0.000- 5.530	1974	
	Sta. 5.530- 9.300	1988	
26 SAPANG PILOT CHANNEL	Sta. 0.000- 4.000	1977/78	
27 CALAPAN CUT-OFF CHANNEL	Sta. 0.000- 1.680	1979/80	
28 TABLANG-BACAO R.I.	Sta. 0.000- 4.000	1979/80	
29 CAMANGAAN-CALAPAN R.I.	Sta. 0.000- 5.080	1979/80	
30 CUT-OFF CHANNEL	Sta. 0.000- 0.560	1979/80	
31 OLO RIVER EARTHDIKE	Sta. 1.380- 2.160	1981	
	Sta. 0.000- 1.380	1982	(Raising)
	Sta. 1.160- 2.640	1981	
	Sta. 2.640- 3.450	1982	
32 BEI EARTHDIKE	Sta. 0.800- 1.650	1984/85	
33 BEI CUT-OFF CHANNEL	Sta. 0.420- 0.861	1988	
34 SOBOL CREEK EARTHDIKE	(L=2,170m)	1979	
35 QUIBAOL CUT OFF CHANNEL	Sta. 0.000- 1.750	1979/80	
36 MARUSAY EARTHDIKE	Sta. 0.000- 1.260	1983	
(STA.BARBARA-CALASIAO)	Sta. 1.260- 1.360	1984	
37 MARUSAY CUT-OFF CHANNEL	Sta. 4.740- 5.160	1982	
(CALASIAO)	Sta. 5.184- 5.470	1982	
	Sta. 7.620- 8.230	1983	
38 SINOCALAN EARTHDIKE	Sta. 0.000- 1.260	1983	
	Sta. 0.000- 0.400	1986	
	Sta. 0.400- 1.100	1988	

SOURCE : YEAR-END REPORTS AND/OR LIST OF COMPLETED PROJECTS, AFCS OFFICE

Table 3.2 SUMMARY OF ACCOMPLISHMENT OF RIVER CONTROL WORKS (1972-1988)

YEAR	EARTH DIKE (m)	W/BOULDER FACING/ APRON (m)	REVETMENT GRAVITY WALL (m)	BOULDER SPUR DIKE (UNIT)	BOULDER DIKE (m)	GRAVEL SUR-FACING (m)	CUT-OFF CHANNEL (m)	DRAINAGE GATE (UNIT)	SPILLWAY (m)	TOTAL COST (P)
1972	3,234	0	225	3	0	15,000	0	0	0	305,956
1973	3,322	0	-	155	0	0	0	0	0	12,186,174
1974	28,855	0	3,852	0	0	1,452	7,000	1	0	4,211,700
1975	69,915	0	2,765	1	0	10,248	460	2	0	22,006,479
1976	12,015	2,050	3,100	83	0	12,142	0	1	0	16,043,439
1977	12,607	0	75	26	0	0	3,500	1	1,020	19,157,660
1978	25,295	0	116	0	180	65,816	8,100	1	0	23,651,927
1979	20,631	0	0	29	720	0	0	4	0	9,099,154
1980	6,993	1,160	1,999	30	0	4,250	8,740	0	0	8,610,694
1981	10,805	0	843	0	0	0	992	0	0	8,492,994
1982	5,686	0	1,176	85	0	32,887	12,021	2	0	12,104,140
1983	10,484	0	856	138	0	280	9,599	0	0	15,859,494
1984	2,091	-	441	52	-	18,788	10,000	-	-	10,603,756
1985	1,304	194	2,458	64	-	0	7,426	0	0	11,583,600
1986	3,965	1,524	922	120	759	48,395	600	2	0	22,252,572
1987	7,750	3,633	1,910	182	686	-	4,703	2	0	33,933,000
1988	4,235	9,492	2,347	387	793	0	5,896	0	0	40,763,288
TOTAL	229,187	18,053	23,085	1,355	3,138	209,258	79,037	16	1,020	270,866,027

SOURCE: AGNO FLOOD CONTROL SYSTEM OFFICE, Rosales

Table 3.3(1/2) FIVE-YEAR INFRASTRUCTURE PROGRAM OF AGNO FLOOD CONTROL SYSTEM

PROJECT LOCATION	SCOPE OF WORK AND PHYSICAL TARGET	STATUS	FUNDING REQUIREMENTS (10^6P) '89	'90	'91	'92	'93
AGNO RIVER CONTROL PROJECT							
1. Asingan-Sn. Manuel	Restoration of damaged dike Spur dike, apron	Const./Impv't./ Rehab.ON-GOING	4.75	5.00	5.40	5.60	5.90
2. Villasis	Spur dike, Revetment	-ditto-	1.20	1.30	1.90	1.20	1.50
3. Sto. Tomas	Restoration of boulder dike	-ditto-	1.20	1.20	2.10	2.40	2.50
	Bank protection, Spur dike	-ditto-	2.70	2.00	2.60	1.00	0.60
4. Alcala	Restoration of damaged dike Bank protection, Spur dike	-ditto-	2.70	2.00	2.60	1.00	0.60
5. Urbiztondo	Spur dike, Concrete revetment, River improvement	-ditto-	2.70	2.80	3.30	0.60	2.20
6. Brgy. Sanchez, Asingan	Earthdike, Spur dike	-ditto-	1.00	1.00	1.10	1.30	0.90
7. Alcala - Bayambang	Earthdike, Spur dike, Bank protection	-ditto-	0.90	-	1.20	1.30	1.30
8. Brgy. Daraoey, Bayambang	Spur dike, Drainage system, Bank protection	-ditto-	1.20	-	-	1.30	1.30
9. Brgy. Quibad, Bayambang	Cut-off channel (COC), Spur dike	Const./Impv't./ Rehab. NEW PROJECT	1.40	1.40	-	-	1.50
10. Brgy. Quibad, Lingayen	Spur dike, Channel impv't.	Const./Impv't./ Rehab. ON-GOING	2.90	2.00	2.00	2.30	2.30
11. Urbiztondo	Bank protection	-ditto-	-	2.00	-	-	2.00
12. San Carlos City	COC, Spur dike	-ditto-	1.00	1.00	1.00	1.00	1.50
13. Rosales-Sta. Maria	Protec. of damaged dike with boulder spur dike	-ditto-	1.20	1.30	1.30	1.40	-
14. Rosales	Spur dike	-ditto-	0.50	0.50	0.40	0.40	0.50
15. Sto. Tomas-Alcala	Spur dike, COC	-ditto-	1.20	1.40	1.50	1.50	-
16. Bautista	COC, Spur dike, Flood gate	-ditto-	0.90	2.90	2.20	2.30	2.50
17. Bugallon	Earthdike, COC, Flood gate	-ditto-	-	0.50	1.20	1.40	1.50
18. Bugallon-Labrador	Earthdike, Spur dike, Flood gate	-ditto-	1.20	1.20	-	1.40	1.60
19. Sta. Maria	Spur dike, Channel impv't.	-ditto-	-	1.20	-	1.00	1.20
20. Brgy. Pantal, Bugallon	Spur dike, Channel impv't.	-ditto-	-	1.00	-	1.00	1.20
21. Aguilar	COC, Spur dike	-ditto-	0.50	1.20	-	1.00	1.20
22. Brgy. Domalanoan, Lingayen	COC, Spur dike	-ditto-	-	0.80	1.50	-	1.80
AMBAYOAN R.C.P.							
23. Sn. Nicolas	Spur dike, Channel imprv't.	Const./Impv't./ Rehab. ON-GOING	1.00	1.00	1.00	1.20	1.20
VIRAY-DIPALO R.C.P.							
24. Tayug-Natividad	Restoration of damaged dike Spur dike, Channel impv't.	-ditto-	1.20	1.20	1.40	1.40	1.50
25. San Quintin	Rest. of damaged dike with Spur dike	-ditto-	1.20	1.20	1.20	1.40	1.50
TOTONOGEN R.C.P							
26. Rosales	Revetment, Spur dike	-ditto-	-	0.90	0.90	0.90	1.00
BANILA R.C.P.							
27. Umingan	Spur dike, Channel impv't.	-ditto-	0.50	0.40	0.50	0.60	0.70
28. Balungao	Bank protection, Spur dike, River impv't., Earthdike	-ditto-	1.00	1.00	1.00	1.00	1.00

Source : AGNO FLOOD CONTROL SYSTEM OFFICE, Rosales

Table 3.3(2/2) FIVE-YEAR INFRASTRUCTURE PROGRAM OF AGNO FLOOD CONTROL SYSTEM

PROJECT LOCATION	SCOPE OF WORK AND PHYSICAL TARGET	STATUS	FUNDING REQUIREMENTS (10^6P) '89	'90	'91	'92	'93
TARLAC R.C.P.	Concrete revetment, floodgate boulder apron, earthdike		39.45	39.45	-	-	-
O'DONNEL R.C.P.	Earthdike, River impv't		8.66	8.30	-	-	-
MORIONES R.C.P.	Concrete revetment		3.50	3.50	-	-	-
OLO R.C.P.							
Mangatarem	Earthdike, River impv't.	-ditto-	1.50	-	-	1.00	1.00
BAYAOAS R.C.P.							
Aguilar	Concrete revetment with boulder apron	-ditto-	-	0.40	-	0.50	0.50
BEI R.C.P.							
Bugallon	Earthdike, Spur dike	-ditto-	0.20	0.20	-	0.30	0.50
CAYANGA R.C.P.							
Sn. Fabian	COC, Concrete revetment	Const./Impv't./ Rehab. ON-GOING	1.00	1.00	1.00	1.00	-
BUED R.C.P.							
Sison	Revetment	-ditto-	-	-	2.00	2.00	-
Sn. Fabian	Concrete revetment, Bank protec.	-ditto-	0.90	-	1.35	-	0.90
BUED-ALORAGAT R.C.P.							
-	Bank protection, Spur dike	-ditto-	0.50	0.50	0.50	1.20	1.30
ANGALACAN R.C.P.							
Mapandan	Spur dike, Bank protection	-ditto-	0.50	0.90	0.80	0.90	-
Mapandan	Spur dike, Concrete revetment	-ditto-	0.55	0.50	-	1.10	-
-	Spur dike, River impv't.	-ditto-	0.50	-	-	0.70	0.80
SINOCALAN R.C.P.							
Sta. Barbara-Urdaneta	Spur dike, COC	Const./Impv't./ Rehab. NEW PROJECT	1.00	-	1.50	2.00	-
MARUSAY R.C.P.							
Sta. Barbara	Earthdike, Spur dike, Bank protection	Const./Impv't./ Rehab. ON-GOING	-	1.00	2.10	2.20	-
TAGAMUSING R.C.P.							
Sumabnit	Spur dike, Revetment, River impv't.	-ditto-	-	1.20	-	1.10	-
Binalonan	Spur dike, Concrete revetment,	-ditto-	1.50	1.00	0.50	0.40	-
TOLONG-MITURA R.C.P.							
Urdaneta	Revetment, Spur dike	-ditto-	0.40	1.00	0.90	-	-
TUBOY R.C.P.							
San. Manuel	Spur dike	-ditto-	-	0.50	0.40	0.40	-

Source : AGNO FLOOD CONTROL SYSTEM OFFICE, Rosales

Table 4.1 RIVER STRETCHES SUBJECT TO MASTER PLAN

River System	River and Stretch		Length (km)
Agno	Main Agno	: From rivermouth to the ARIS dam	98.85
	Tarlac	: From confluence with the Agno to the TARIS dam	37.05
	Camiling	: From the 15km Upstream of the confluence with the Agno to the Mayantoc	20.00
	Banila	: From confluence with the Agno to mountain-foot	30.90
	Viray-Dipalo	: From confluence with the Agno to the 8.5km Upstream (Main river)	7.90
		From confluence with the Dipalo to mountain-foot (Viray river)	4.45
		From confluence with the Viray to mountain-foot (Dipalo river)	7.70
	Ambayoan	: From confluence with the Agno to mountain-foot	8.70
Cayanga	Main Cayanga (Cayanga-Patalan-Angalacan River)	: From rivermouth to the 37.5km Upstream	37.50
	Bued	: From confluence with the Cayanga to the 0.9km Upstream of Bued bridge	19.80
	Aloragat	: From confluence with the Patalan to the 2km Upstream of Bobonan bridge	19.70
Panto	Main Panto (Panto-Marusay-Sinocalan-Tagumising-Tuboy River)	: From rivermouth to mountain-foot	49.40
	Dagupan (Dagupan-San Juan-Elang River)	: From confluence with the Panto to San Carlos	27.60
	Ingalera	: From confluence with the Sinocalan to the 1.5km Upstream of San Nicolas bridge	37.50
	Mitura-Macalong	: From confluence with the Sinocalan to San Manuel	21.00

Table 4.2 APPLIED MANNING'S COEFFICIENT BY RIVER STRETCH

River/Stretch	Manning's Coefficient	
	Low-water Channel	High-water Channel
Main Agno River		
Rivermouth - Conf. of Olo River	0.028	0.040
Conf. of Olo River - Conf. of Viray-Dipalo River	0.030	0.040
Conf. of Viray-Dipalo River - Conf. of Ambayoan River	0.033	0.040
Conf. of Ambayoan River - San Roque Dam	0.035	0.045
Tarlac River		
Conf. of Agno River - Conf. of O'Donnell River	0.030	0.040
O'Donell River	0.033	0.040
Camiling River	0.030	0.040
Banila River		
Conf. of Agno River - Conf. of Karayogan River	0.033	0.040
Upstream of Conf. of Karayogan River	0.035	0.045
Viray - Dipalo River		
Conf. of Agno River - Conf. of Dipalo River	0.033	0.040
Upstream of Conf. of Dipalo River	0.035	0.045
Ambayoan River	0.035	0.045
Cayanga River - Patalan River		
Rivermouth - Conf. of Bued River	0.028	0.040
Conf. of Bued River - Conf. of Angalacan River	0.030	0.040
Bued River		
Cayanga River - San Fabian Weir	0.033	0.040
Upstream of San Fabian Weir	0.035	0.045
Aloragat River		
Conf. of Patalan River - Amagbagan	0.033	0.040
Upstream of Amagbagan	0.035	0.045
Angalacan River		
Conf. of Patalan River - Maraboc	0.033	0.040
Upstream of Maraboc	0.035	0.045
Panto River Sinocalan River		
Rivermouth - Conf. of Ingalera River	0.028	0.040
Conf. of Ingalera River - Conf.of Tagamusing River	0.030	0.040
Tagamusing River		
Conf. of Sinocalan River - Yatyat	0.030	0.040
Yatyat - Cili	0.033	0.040
Upstream of Cili	0.035	0.045
Mitura River	0.030	0.040
Magalong River	0.030	0.040
Ingalera River	0.030	0.040
Dagupan River	0.028	0.040
Capangbogan River	0.030	0.040

Table 5.1 FEATURES OF DESIGN CHANNEL OF AGNO RIVER FOR RIVER IMPROVEMENT ONLY ALTERNATIVE

River: AGNO RIVER
Design Flood: 100-yr

Item	Unit	Agno R.				
		R.M - AG45	AG45 - AG65	AG65 - AG109	AG109 - AG177	AG177 - AG180+1.4k
Design Discharge	m3/s	17400	17400	17400	15700	14900
Distance	m	6850	9050	15150	10500	2800
Gradient of River Bed	-	1/6500	1/6500	1/3500	1/2000	1/2000
River Width	m	1500	1500	1500	1500	1500
Width of Channel Bed	m	400-300	300	240	200	200
Dike Height (Ave.)	m	6.6	7.0	7.5	6.8	6.5
Water Depth	m	9.23-11.13	11.13-12.0	12.0	12.0-10.66	10.66-10.38
Low Channel Height (Ave.)	m	6.5	6.5	6.5	6.5	6.0

Item	Unit	Flood way	Agno R.			
		AG180+1.4k - AG324	AG324 - AG351	AG351 - AG367	AG367 - AG414	AG414 - AG453
Design Discharge	m3/s	9200	9200	8200	8200	8200
Distance	m	12100	12300	7650	7700	5300
Gradient of River Bed	-	1/1550	1/1550	1/1000	1/700	1/370
River Width	m	1000-830	900-2500	1000-3200	1050-2500	1250-2400
Width of Channel Bed	m	180	180	180	180	150
Dike Height (Ave.)	m	6.5	5.5	5.2	4.0	3.3
Water Depth	m	10.38-8.0	8.0	8.0-5.5	5.5	4.3
Low Channel Height (Ave.)	m	4.5	4.0	3.0	3.0	3.0

Item	Unit	Agno R.	
		AG453 - AQG459	AG459 - AG473
Design Discharge	m3/s	6400	6400
Distance	m	3000	6450
Gradient of River Bed	-	1/370	1/210
River Width	m	1000-1900	300-1300
Width of Channel Bed	m	150	150
Dike Height (Ave.)	m	2.8	2.8-4.0
Water Depth	m	4.3	4.3-5.5
Low Channel Height (Ave.)	m	3.0	3.0

Table 5.2(1/2) FEATURES OF DESIGN CHANNEL OF TRIBUTARIES OF AGNO RIVER FOR RIVER IMPROVEMENT ONLY ALTERNATIVE

River: TARLAC RIVER
Design Flood: 100-yr

Item	Unit	Tarlac R. AG180+0.8k - TA187	TA187 - TA200	TA200 - TA227	TA227 - TA251	TA251 - TARIS DAM
Design Discharge	m3/s	6800	4000	4000	4000	3200
Distance	m	2050	6050	13000	11800	4150
Gradient of River Bed	-	1/1850	1/1850	1/1300	1/760	1/692
River Width	m	1000	1000	1700-640	1600-600	600-270
Width of Channel Bed	m	180	160	160	160	140
Dike Height (Ave.)	m	7.5	7.4	5.0	4.2	2.5
Water Depth	m	10.3-9.49	9.49-6.22	6.22-4.7	4.7	4.7-4.4
Low Channel Height (Ave.)	m	5.0-4.0	4.0-2.0	2.0	2.0	3.5

River: CAMILING RIVER
Design Flood: 50-yr

Item	Unit	Camiling R. AG143+1.0k CA156+0.3k	CA156+0.3k - CA162	CA162 - CA167	CA167 - CA172	CA172 - CA173	CA173 - CA175
Design Discharge	m3/s	2200	1550	1550	1550	1150	1150
Distance	m	3550	4650	4300	4950	1300	2050
Gradient of River Bed	-	1/2000	1/2000	1/1000	1/550	1/300	Existing
River Width	m	250	180	180	180	130	130
Width of Channel Bed	m	60	50	50	50	35	Existing
Dike Height (Ave.)	m	6.8	5.0	3.6	2.8	1.8	1.8-0.0
Water Depth	m	10.11-8.96	8.96-7.5	7.5-7.1	7.1-5.42	5.42-5.22	5.22-4.8
Low Channel Height (Ave.)	m	4.7	4.7	4.7	4.5	4.5	4.0

River: BANILA RIVER
Design Flood: 50-yr

Item	Unit	Banila R. AG349- AG349+3.7k	AG349+3.7k - BN381	BN381 - BN386	BN386 - BN394	BN394 - BN397	BN397 - BN401
Design Discharge	m3/s	1400	1400	950	440	440	340
Distance	m	3700	8050	4550	7600	2900	4100
Gradient of River Bed	-	1/1295	1/835	1/520	1/265	Existing	Existing
River Width	m	180	180	120	120	120	120
Width of Channel Bed	m	30	30	20	10	Existing	Existing
Dike Height (Ave.)	m	3.6	3.2	2.9	2.4	2.1	1.3
Water Depth	m	7.6	7.0	7.0-6.42	6.42-3.14	3.14-1.5	1.5
Low Channel Height (Ave.)	m	5.0	4.8	4.8	4.8-2.5	1.0	1.0

Table 5.2(2/2) FEATURES OF DESIGN CHANNELEL OF TRIBUTARIES OF AGNO RIVER FOR RIVER IMPROVEMENT ONLY ALTERNATIVE

River: VIRAY-DIPALO RIVER
Design Flood: 50-yr

Item	Unit	Viray-Dipalo R. AG414-VD425	VD425-VD428	VD428-VD430	VD430-VD430+0.6k	Viray R. VD430+0.6k-VD433	VD433-VD434+0.5k
Design Discharge	m3/s	750	750	750	750	370	370
Distance	m	2800	3100	2000	600	2400	1450
Gradient of River Bed	-	1/375	1/300	1/250	1/127	1/127	1/75
River Width	m	300-290	320-270	320-260	300	150	150
Width of Channel Bed	m	30	30	30	30	15	15
Dike Height (Ave.)	m	1.7	1.7	1.7	1.7	0.9	0.9
Water Depth	m	4.0	4.0	4.0	4.0	2.9	2.9
Low Channel Height (Ave.)	m	3.3	3.3	3.3	3.3	2.8	2.8

Item	Unit	Dipalo R. VD430+0.6k-VD436	VD436-VD437	VD437-VD439	VD439-VD441	VD441-VD442
Design Discharge	m3/s	350	350	210	210	210
Distance	m	1500	700	1950	1950	1000
Gradient of River Bed	-	1/170	1/125	1/125	1/80	1/68
River Width	m	100	100	100	100	100
Width of Channel Bed	m	15	15	10	10	10
Dike Height (Ave.)	m	2.6	2.6	2.3	2.1	1.9
Water Depth	m	3.8	3.0	2.5	2.3	2.1
Low Channel Height (Ave.)	m	2.0	1.2	1.0	1.0	1.0

River: AMBAYOAN RIVER
Design Flood: 50-yr

Item	Unit	Ambayoan R. AG461-AM444+0.5k	AM444+0.5k - AM448	AM448 - AM451+0.4k
Design Discharge	m3/s	1750	1750	1750
Distance	m	1800	3350	3350
Gradient of River Bed	-	1/390	1/205	1/150
River Width	m	400	400	400
Width of Channel Bed	m	50	50	50
Dike Height (Ave.)	m	4.2	2.2	2.0
Water Depth	m	5.5	3.7	3.5
Low Channel Height (Ave.)	m	2.8	2.5	2.5

Table 5.3(1/3) FEATURES OF DESIGN CHANNEL OF ALLIED RIVERS FOR RIVER IMPROVEMENT ONLY ALTERNATIVE

River: CAYANGA-PATALAN-AN-ANGALACAN-RIVER
Design Flood: 50-yr (with Closure Dike)

Item	Unit	Cayanga R. R.M - Bued R.	Patalan R. Bued R.- Aloragat R.	Angalacan River Aloragat R. - 21.0 k	21.0 k- Maraboc	Maraboc - 27.0 k	27.0 k - Bugayong
Design Discharge	m3/s	2600	1300	700	700	500	500
Distance	m	6500	8300	6200	2800	3200	3300
Gradient of River Bed	-	1/1300	1/1100	1/650	1/460	1/460	1/230
River Width	m	500	150	120	100	100	80
Width of Channel Bed	m	60	40	30	30	25	20
Dike Height (Ave.)	m	2.7	2.8	1.4	1.1	0.7	0.3
Water Depth	m	8.0	6.8	5.4	5.1	4.7	4.3
Low Channel Height (Ave.)	m	6.5	5.0	5.0	5.0	5.0	4.0

Item	Unit	Angalacan River Bugayong -Killo Br.	Killo Br. -37.5k
Design Discharge	m3/s	370	370
Distance	m	2700	4500
Gradient of River Bed	-	1/190	1/140
River Width	m	60	50
Width of Channel Bed	m	15	15
Dike Height (Ave.)	m	0.4	1.1
Water Depth	m	3.6	3.3
Low Channel Height (Ave.)	m	4.0	3.0

River: BUED RIVER
Design Flood: 50-yr (with Closure Dike)

Item	Unit	Bued River Junction - 2.0 k	2.0 k - 4.0 k	4.0 k - NIA Dam	NIA Dam 11.9 k	11.9 k - 16.5 k	16.5 k - 19.7 k
Design Discharge	m3/s	1300	1300	1300	1300	1000	1000
Distance	m	2000	2000	3300	4600	4600	3200
Gradient of River Bed	-	1/400	1/280	1/170	1/143	1/140	1/70
River Width	m	400	400	400	400	400	400
Width of Channel Bed	m	30	20	20	20	20	20
Dike Height (Ave.)	m	4.2-2.0	2.1	2.1	1.9	1.9	1.4
Water Depth	m	8.0-5.8	5.6	3.3	2.4	2.1	1.9
Low Channel Height (Ave.)	m	5.0	3.5	2.0	1.5	1.5	1.5

Table 5.3(2/3) FEATURES OF DESIGN CHANNEL OF ALLIED RIVERS FOR RIVER IMPROVEMENT ONLY ALTERNATIVE

River: ALORAGAT RIVER
Design Flood: 50-yr (with Bued Closure Dike)

Item	Unit	ALORAGAT RIVER Junction -7.0k	7.0k- 11.5k	11.5k- 17.0k	17.0k- 19.7k
Design Discharge	m3/s	470	470	250	170
Distance	m	7000	4500	5500	2700
Gradient of River Bed	-	1/680	1/355	1/355	1/185
River Width	m	90	80	50	45
Width of Channel Bed	m	30	20	10	10
Dike Height (Ave.)	m	0.0	0.0	1.3	1.4
Water Depth	m	6.8-4.2	4.0	4.0	2.8
Low Channel Height (Ave.)	m	5.5	5.0	3.5	2.0

River: PANTO-MARUSAY-SINOCALAN-TUBOY RIVER
Design Flood: 50-yr

Item	Unit	PANTO R. R.M- Dagupan R.	MARUSAY R. Dagupan R. -4.0k	4.0k - Ingalera R.	SINOCALAN R. Ingalera R. -18.0k	18.0k- 25.5k	25.5k- Mitura R
Design Discharge	m3/s	3300	2250	2250	1650	1250	1250
Distance	m	2500	1500	4300	9700	7500	5500
Gradient of River Bed	-	1/1750	1/1750	1/1750	1/1750	1/1450	1/1100
River Width	m	400	120	250	250	200	150
Width of Channel Bed	m	80	80	60	40	40	30
Dike Height (Ave.)	m	3.9	3.6	3.6	3.4	3.3	3.2
Water Depth	m	8.2	7.9	7.9	7.9	7.8	7.2
Low Channel Height (Ave.)	m	5.5	5.5	5.5	5.5	5.5	5.0

Item	Unit	TAGUMISING R. Mitura R. -36.7k	36.7k- Sta. Maria	Sta. Maria -43.5k	TUBOY R. 43.5k- 47.4k	47.4k- 49.8
Design Discharge	m3/s	800	800	650	550	550
Distance	m	5700	4700	2100	3900	2000
Gradient of River Bed	-	1/700	1/430	1/350	1/190	1/143-1/67
River Width	m	100	100	80	60	60
Width of Channel Bed	m	20	20	20	15	15-10
Dike Height (Ave.)	m	2.5	2.3	1.7	1.7	1.7-0.3
Water Depth	m	6.5	5.8	5.2	4.7	4.7-3.3
Low Channel Height (Ave.)	m	5.0	4.5	4.5	4.0	4.0

Table 5.3(3/3) FEATURES OF DESIGN CHANNEL OF ALLIED RIVERS FOR RIVER IMPROVEMENT ONLY ALTERNATIVE

River: DAGUPAN RIVER
Design Flood: 50-yr

Item	Unit	DAGUPAN R. Junction -7.5K	SAN JUAN R. 7.5K- 12.7K	SAN JUAN R. 12.7K- Elang R.	ELANG R. San Juan -27.6k
Design Discharge	m3/s	1100	900	650	310
Distance	m	7500	5200	9000	5900
Gradient of River Bed	-	1/5000	1/5000	1/5000	1/5000
River Width	m	250	100	100	50
Width of Channel Bed	m	60	30	30	20
Dike Height (Ave.)	m	3.9-3.2	3.6	4.1	3.3
Water Depth	m	8.2-7.7	7.6	7.6	7.0
Low Channel Height (Ave.)	m	5.5	5.0	4.5	4.5

River: INGALERA RIVER
Design Flood: 50-yr

Item	Unit	INGALERA RIVER Junction -Malasigui	Malasigui - 26.0k	26.0k - 32.0k	32.0k- San Nicols	San Nicolas -37.5k
Design Discharge	m3/s	600	460	260	260	150
Distance	m	13300	12700	6000	4000	1500
Gradient of River Bed	-	1/3600	1/1800	1/1000	1/700	1/700
River Width	m	100	60	50	50	40
Width of Channel Bed	m	25	15	15	10	10
Dike Height (Ave.)	m	3.6-3.0	2.2	1.3	1.7	1.3
Water Depth	m	7.9-7.5	6.9	5.5	4.9	4.2
Low Channel Height (Ave.)	m	5.5	5.5	5.0	4.0	3.5

River: MITURA-MAGALONG RI RIVER
Design Flood: 50-yr

Item	Unit	MITURA R. Junction -5.3k	MAGALONG RIVER 5.3k- Taboy	MAGALONG RIVER Taboy - 19.0k	MAGALONG RIVER 19.0k - 21.0k
Design Discharge	m3/s	250	250	180	140
Distance	m	5300	8900	4800	2000
Gradient of River Bed	-	1/800	1/460	1/460	1/250
River Width	m	50	40	35	30
Width of Channel Bed	m	10	8	6	4
Dike Height (Ave.)	m	3.0-1.0	1.5	1.4	1.3
Water Depth	m	7.2-5.2	4.7	4.3	3.7
Low Channel Height (Ave.)	m	5.0	4.0	3.5	3.0

Tabel 5.4 SUMMARY OF WORK QUANTITIES OF RIVER IMPROVEMENT ONLY ALTERNATIVE

	Work Item	Unit	Main Agno	Tarlac River	Tributaries of Agno	Allied 1> Rivers
(1)	Excavation 1	cu.m	25,375,000	5,050,000	1,949,000	8,408,800
	Excavation 2	cu.m	2,850,000	0	134,000	188,000
	Total of (1)	cu.m	28,225,000	5,050,000	2,083,000	8,596,800
(2)	Dredging	cu.m	17,075,000	0	0	503,000
(3)	Embankment 1					
	Left Dike	cu.m	5,647,100	1,630,000	1,667,400	4,634,200
	Right Dike	cu.m	4,055,100	2,671,700	1,689,900	4,634,200
	Embankment 2					
	Left Dike	cu.m	6,820,000	0	13,000	39,600
	Right Dike	cu.m	9,129,000	0	0	80,600
	Total of (3)	cu.m	25,651,200	4,301,700	3,370,300	9,388,600
(4)	Sodding	sq.m	6,547,000	1,667,690	1,670,200	4,844,300
(5)	Revetment (L.W.C.)					
	Type-A	sq.m	232,100	76,700	170,700	319,100
	Type-B	sq.m	130,200	12,100	3,500	235,900
	Revetment (H.W.C.)					
	Type-A	sq.m	63,700	8,300	16,020	38,000
	Type-B	sq.m	91,300	0	0	0
	Total of (5)	sq.m	517,300	97,100	190,220	593,000
(6)	Groin (L.W.C.)					
	Type-A	pc.	658	244	1,070	2,057
	Type-B	pc.	0	0	0	0
	Groin (H.W.C.)					
	Type-A	pc.	148	0	0	0
	Type-B	pc.	152	0	0	0
	Total of (6)	pc.	958	244	1,070	2,057
(7)	Sluice Way			0		
	Type-A	pc.	7	2	23	52
	Type-B	pc.	11	0	3	3
	Total of (7)	pc.	18	2	26	55
(8)	Water Gate			0		
	Type-A	pc.	0	0	0	0
	Type-B	pc.	2	1	0	0
	Total of (8)	pc.	2	1	0	0
(9)	Bridge			0		
	Newly Const.	sq.m	51,750	13,500	20,100	20,471
	Rehabilit.	sq.m	0	0	0	3,426
	Demolishment			0		
	Concrete	cu.m	9,600	2,500	4,200	10,720
	Metal	ton	2,360	0	0	0
(10)	Fixed Weir	pc.	0	0	0	0
(11)	Others	L.S	1	0	1	1

1> : River Improvement + Bued Closure Dike

Table 6.1 SUMMARY OF WORK QUANTITIES AND COST FOR AGNO FLOODWAY ALTERNATIVE

Item	Unit	Cayanga-Patalan R.			Sinocalan R.	Agno R.
		Agno Floodway	Bued River	Aloragat River	(Whole)	Main Agno
Work Quantities						
Excavation	1,000 m3	11,157	372	300	5,125	41,700
Embankment	1,000 m3	5,327	235	0	6,115	14,150
Sodding	1,000 m2	2,600	152	0	3,400	3,900
Revetment (L.W.C)	1,000 m2	651	40	41	361	333
(H.W.C)	1,000 m2	62	2	0	25	145
Groin	Pc.	542	281	272	740	732
Sluiceway	Pc.	40	6	0	33	46
Water Gate	Pc.	0	0	0	0	3
Bridge	Pc.	8	1	2	23	3
	100 m2	850	30	3	142	456
Intake	Pc.	17	0	0	0	0
Others	Pc.	0	1	0	0	1
Main Construction Cost (Economic)	Million Pesos	4,423	240	90	1,540	5,948

Note : Main Construction Cost = Preparatory Works + Main Works + Misellaneus Works

Table 6.2 SUMMARY OF WORK QUANTITIES AND COST FOR SAN MANNUEL FLOODWAY ALTERNATIVE

Item	Unit	Cayanga-Patalan R.	Sinocalan R.		Agno R.
		(Whole)	San Mannuel Floodway	Other Stretch	Main Agno
Work Quantities					
Excavation	1,000 m3	2,611	1,312	5,125	45,300
Embankment	1,000 m3	1,331	1,084	6,115	26,550
Sodding	1,000 m2	690	488	3,400	6,776
Revetment (L.W.C)	1,000 m2	186	115	361	362
(H.W.C)	1,000 m2	8	0	25	160
Groin	Pc.	1,095	0	740	958
Sluiceway	Pc.	16	2	33	18
Water Gate	Pc.	0	0	0	2
Bridge	Pc.	8	1	23	4
	100 m2	71	30	142	518
Intake	Pc.	0	3	0	0
Others	Pc.	1	0	0	1
Main Construction Cost (Economic)	Million Pesos	777	342	1,540	7,845

Note : Main Construction Cost = Preparatory Works + Main Works + Misellaneus Works

Table 6.3 SUMMARY OF WORK QUANTITIES AND COST FOR BINALONAN FLOODWAY ALTERNATIVE

Item	Unit	Cayanga-Patalan R. (Whole)	Sinocalan R. Binalonan Floodway	Sinocalan R. Other Stretch	Agno R. Main Agno
Work Quantities					
Excavation	1,000 m3	2,801	605	5,145	45,300
Embankment	1,000 m3	1,773	308	6,207	25,651
Sodding	1,000 m2	883	107	3,419	6,547
Revetment (L.W.C)	1,000 m2	186	77	369	362
(H.W.C)	1,000 m2	8	0	25	155
Groin	Pc.	1,095	0	754	958
Sluiceway	Pc.	16	2	31	18
Water Gate	Pc.	0	0	0	2
Bridge	Pc.	9	1	23	4
	100 m2	74	8	142	518
Intake	Pc.	0	4	0	0
Others	Pc.	1	0	0	1
Main Construction Cost (Economic)	Million Pesos	837	166	1,549	7,706

Note : Main Construction Cost = Preparatory Works + Main Works + Misellaneus Works

Table 6.4 SUMMARY OF WORK QUANTITIES AND COST FOR ALORAGAT FLOODWAY ALTERNATIVE

Item	Unit	Cayanga-Patalan R.				Sinocalan R.	Agno R.
		Main Stream	Bued River	Aloragat Floodway	Aloragat River	(Whole)	Main Agno
Work Quantities							
Excavation	1,000 m3	2,130	372	168	300	6,490	45,300
Embankment	1,000 m3	1,440	85	48	437	8,058	25,651
Sodding	1,000 m2	615	38	19	175	4,154	6,547
Revetment (L.W.C)	1,000 m2	106	40	26	36	369	362
(H.W.C)	1,000 m2	6	2	0	0	35	155
Groin	Pc.	542	281	0	250	962	958
Sluiceway	Pc.	10	6	1	3	39	18
Water Gate	Pc.	0	0	0	0	0	2
Bridge	Pc.	5	1	1	2	26	4
	100 m2	39	30	5	3	167	518
Intake	Pc.	0	0	0	0	0	0
Others	Pc.	0	0	0	0	0	1
Main Construction Cost (Economic)	Million Pesos	551	223	31	138	1,897	7,706

Note : Main Construction Cost = Preparatory Works + Main Works + Misellaneus Works

Table 6.5 SUMMARY OF WORK QUANTITIES AND COST FOR BUED CLOSURE DIKE ALTERNATIVE

Item	Unit	Cayanga-Patalan R. Main Stream	Cayanga-Patalan R. Bued River	Cayanga-Patalan R. Aloragat River	Sinocalan R. (Whole)	Agno R. Main Agno
Work Quantities						
Excavation	1,000 m3	2,130	372	300	6,490	45,300
Embankment	1,000 m3	1,380	85	643	8,058	25,651
Sodding	1,000 m3	590	38	260	4,154	6,547
Revetment (L.W.C)	1,000 m3	106	40	41	369	362
(H.W.C)	1,000 m3	6	2	0	35	155
Groin	Pc.	542	281	272	962	958
Sluiceway	Pc.	10	6	3	39	18
Water Gate	Pc.	0	0	0	0	2
Bridge	Pc.	5	1	2	26	4
	100 m2	39	30	3	167	518
Intake	Pc.	0	0	0	0	0
Others	Pc.	0	0	0	0	1
Main Construction Cost (Economic)	Million Pesos	546	223	159	1,897	7,706

Note : Main Construction Cost = Preparatory Works + Main Works + Misellaneus Works

Table 7.1 (1/5) WORK QUANTITIES OF RIVER IMPROVEMENT OF AGNO RIVER FOR ALTERNATIVE FRAMEWORK PLANS

River : Agno and Tarlac rivers
Study : Framework Plan
Alternative : River Improvement Only (AG-1)
Return Period : 1/100 - year

Work Item	Unit	Agno River Main Stream						Tarlac River		
		Lower Agno	Poponto Stretch			Upper Agno	Total of	Confluence	Upper Stretch	Total of
		RH-AG282 (1)	Bayambang (2)	Floodway (3)	Sub-total (2)+(3)=(4)	AG309-AG473 (5)	Agno River (1)+(4)+(5)	AG180-TA200 (6)	TA200-TA265 (7)	Tarlac River (6)+(7)
(1) Excavation 1	cu.m	15,275,000	0	6,800,000	6,800,000	3,300,000	25,375,000	2,600,000	2,450,000	5,050,000
Excavation 2	cu.m	0	0	0	0	2,850,000	2,850,000	0	0	0
Totoal of (1)	cu.m	15,275,000	0	6,800,000	6,800,000	6,150,000	28,225,000	2,600,000	2,450,000	5,050,000
(2) Dredging	cu.m	17,075,000	0	0	0	0	17,075,000	0	0	0
(3) Embankment 1										
Left Dike	cu.m	2,392,000	483,500	1,609,600	2,093,100	1,162,000	5,647,100	936,000	694,000	1,630,000
Right Dike	cu.m	1,499,000	0	852,100	852,100	1,704,000	4,055,100	1,755,000	916,700	2,671,700
Embankment 2										
Left Dike	cu.m	6,377,000	0	0	0	443,000	6,820,000	0	0	0
Right Dike	cu.m	6,629,000	0	0	0	2,500,000	9,129,000	0	0	0
Totoal of (3)	cu.m	16,897,000	483,500	2,461,700	2,945,200	5,809,000	25,651,200	2,691,000	1,610,700	4,301,700
(4) Sodding	cu.m	3,838,000	0	717,700	717,700	1,991,300	6,547,000	523,890	1,143,800	1,667,690
(5) Revetment (L.W.C.)										
Type-A	sq.m	40,000	0	59,800	59,800	132,300	232,100	18,400	58,300	76,700
Type-B	sq.m	130,200	0	0	0	0	130,200	12,100	0	12,100
Revetment (H.W.C.)										
Type-A	sq.m	0	0	0	0	63,700	63,700	0	8,300	8,300
Type-B	sq.m	67,600	23,700	0	23,700	0	91,300	0	0	0
Totoal of (5)	sq.m	237,800	23,700	59,800	83,500	196,000	517,300	30,500	66,600	97,100
(6) Groin (L.W.C.)										
Type-A	pc.	460	0	0	0	198	658	0	244	244
Type-B	pc.	0	0	0	0	0	0	0	0	0
Groin (H.W.C.)										
Type-A	pc.	0	0	0	0	148	148	0	0	0
Type-B	pc.	0	0	0	0	152	152	0	0	0
Totoal of (6)	pc.	460	0	0	0	498	958	0	244	244
(7) Sluice Way										0
Type-A	pc.	2	1	1	2	3	7	0	2	2
Type-B	pc.	8	2	0	2	1	11	0	0	0
Totoal of (7)	pc.	10	3	1	4	4	18	0	2	2
(8) Water Gate										0
Type-A	pc.	0	0	0	0	0	0	0	0	0
Type-B	pc.	2	0	0	0	0	2	1	0	1
Totoal of (8)	pc.	2	0	0	0	0	2	1	0	1
(9) Bridge										0
Newly Const.	sq.m	45,000	0	0	0	6,750	51,750	0	13,500	13,500
Rehabilit.	sq.m	0	0	0	0	0	0	0	0	0
Demolishment										0
Concrete	cu.m	5,800	0	0	0	3,800	9,600	0	2,500	2,500
Metal	ton	1,060	0	0	0	1,300	2,360	0	0	0
(10) Fixed Weir	pc.	0	0	0	0	0	0	0	0	0
(11) Others	L.S	1	0	0	0	0	1	0	0	0

(File cord : WQ-AGNF1)

Table 7.1 (2/5) WORK QUANTITIES OF RIVER IMPROVEMENT OF AGNO RIVER FOR ALTERNATIVE FRAMEWORK PLANS

River : Agno and Tarlac rivers
Study : Framework Plan
Alternative : River Improvement and Natural Retarding Baisn (AG-2)
Return Period : 1/100 - year

Work Item	Unit	Agno River Main Stream						Tarlac River		
		Lower Agno	Poponto Stretch			Upper Agno	Total of	Confluence	Upper Stretch	Total of
		RH-AG282 (1)	Bayambang (2)	Floodway (3)	Sub-total (2)+(3)=(4)	AG309-AG473 (5)	Agno River (1)+(4)+(5)	AG180-TA200 (6)	TA200-TA265 (7)	Tarlac River (6)+(7)
(1) Excavation 1	cu.m	15,275,000	650,000	6,800,000	7,450,000	3,300,000	26,025,000	2,600,000	2,450,000	5,050,000
Excavation 2	cu.m	0	0	0	0	2,850,000	2,850,000	0	0	0
Totoal of (1)	cu.m	15,275,000	650,000	6,800,000	7,450,000	6,150,000	28,875,000	2,600,000	2,450,000	5,050,000
(2) Dredging	cu.m	17,075,000	0	0	0	0	17,075,000	0	0	0
(3) Embankment 1										
Left Dike	cu.m	1,812,700	343,000	288,100	631,100	1,162,000	3,605,800	936,000	694,000	1,630,000
Right Dike	cu.m	934,400	374,000	1,431,900	1,805,900	1,704,000	4,444,300	0	916,700	916,700
Embankment 2										
Left Dike	cu.m	4,754,200	0	0	0	443,000	5,197,200	0	0	0
Right Dike	cu.m	5,067,100	0	0	0	2,500,000	7,567,100	0	0	0
Totoal of (3)	cu.m	12,568,400	717,000	1,720,000	2,437,000	5,809,000	20,814,400	936,000	1,610,700	2,546,700
(4) Sodding	cu.m	3,156,000	237,200	402,000	639,200	1,991,300	5,786,500	523,890	1,143,800	1,667,690
(5) Revetment (L.W.C.)										
Type-A	sq.m	40,000	3,150	59,800	62,950	132,300	235,250	18,400	58,300	76,700
Type-B	sq.m	130,200	4,670	0	4,670	0	134,870	12,100	0	12,100
Revetment (H.W.C.)										
Type-A	sq.m	0	0	0	0	63,700	63,700	0	8,300	8,300
Type-B	sq.m	53,300	23,700	79,800	103,500	0	156,800	0	0	0
Totoal of (5)	sq.m	223,500	31,520	139,600	171,120	196,000	590,620	30,500	66,600	97,100
(6) Groin (L.W.C.)										
Type-A	pc.	460	0	0	0	198	658	0	244	244
Type-B	pc.	0	0	0	0	0	0	0	0	0
Groin (H.W.C.)										
Type-A	pc.	0	0	0	0	148	148	0	0	0
Type-B	pc.	0	0	0	0	152	152	0	0	0
Totoal of (6)	pc.	460	0	0	0	498	958	0	244	244
(7) Sluice Way										0
Type-A	pc.	2	1	1	2	3	7	0	2	2
Type-B	pc.	8	0	0	0	1	9	0	0	0
Totoal of (7)	pc.	10	1	1	2	4	16	0	2	2
(8) Water Gate										0
Type-A	pc.	0	0	0	0	0	0	0	0	0
Type-B	pc.	2	0	0	0	0	2	1	0	1
Totoal of (8)	pc.	2	0	0	0	0	2	1	0	1
(9) Bridge										0
Newly Const.	sq.m	45,000	0	0	0	6,750	51,750	0	13,500	13,500
Rehabilit.	sq.m	0	0	0	0	0	0	0	0	0
Demolishment										0
Concrete	cu.m	5,800	0	0	0	3,800	9,600	0	2,500	2,500
Metal	ton	1,060	0	0	0	1,300	2,360	0	0	0
(10) Fixed Weir	pc.	0	0	1	1	0	1	0	0	0
(11) Others	L.S	1	0	0	0	0	1	0	0	0

(File cord : WQ-AGNF2)

Table 7.1 (3/5) WORK QUANTITIES OF RIVER IMPROVEMENT OF AGNO RIVER FOR ALTERNATIVE FRAMEWORK PLANS

River : Agno and Tarlac rivers
Study : Framework Plan
Alternative : River Improvement, Natural Retarding Baisn and Dams (AG-3)
Return Period : 1/100 - year

Work Item	Unit	Agno River Main Stream: Lower Agno	Agno River Main Stream: Poponto Stretch			Agno River Main Stream: Upper Agno	Total of Agno River	Tarlac River: Confluence	Tarlac River: Upper Stretch	Total of Tarlac River
		RM-AG282 (1)	Bayambang (2)	Floodway (3)	Sub-total (2)+(3)=(4)	AG309-AG473 (5)	Agno River (1)+(4)+(5)	AG180-TA200 (6)	TA200-TA265 (7)	(6)+(7)
(1) Excavation 1	cu.m	15,275,000	650,000	6,800,000	7,450,000	3,300,000	26,025,000	2,600,000	1,700,000	4,300,000
Excavation 2	cu.m	0	0	0	0	2,850,000	2,850,000	0	0	0
Totoal of (1)	cu.m	15,275,000	650,000	6,800,000	7,450,000	6,150,000	28,875,000	2,600,000	1,700,000	4,300,000
(2) Dredging	cu.m	17,075,000	0	0	0	0	17,075,000	0	0	0
(3) Embankment 1										
Left Dike	cu.m	1,754,400	343,000	288,100	631,100	1,162,000	3,547,500	558,000	315,500	873,500
Right Dike	cu.m	849,900	374,000	1,431,900	1,805,900	1,704,000	4,359,800	0	481,600	481,600
Embankment 2										
Left Dike	cu.m	4,586,900	0	0	0	443,000	5,029,900	0	0	0
Right Dike	cu.m	4,932,800	0	0	0	2,500,000	7,432,800	0	0	0
Totoal of (3)	cu.m	12,124,000	717,000	1,720,000	2,437,000	5,809,000	20,370,000	558,000	797,100	1,355,100
(4) Sodding	cu.m	3,265,500	237,200	402,000	639,200	1,991,300	5,896,000	153,200	979,800	1,133,000
(5) Revetment (L.W.C.)										
Type-A	sq.m	40,000	3,150	59,800	62,950	132,300	235,250	18,400	58,300	76,700
Type-B	sq.m	130,200	4,670	0	4,670	0	134,870	12,100	0	12,100
Revetment (H.W.C.)										
Type-A	sq.m	0	0	0	0	63,700	63,700	0	6,800	6,800
Type-B	sq.m	50,600	23,700	79,800	103,500	0	154,100	0	0	0
Totoal of (5)	sq.m	220,800	31,520	139,600	171,120	196,000	587,920	30,500	65,100	95,600
(6) Groin (L.W.C.)										
Type-A	pc.	460	0	0	0	198	658	0	244	244
Type-B	pc.	0	0	0	0	0	0	0	0	0
Groin (H.W.C.)										
Type-A	pc.	0	0	0	0	148	148	0	0	0
Type-B	pc.	0	0	0	0	152	152	0	0	0
Totoal of (6)	pc.	460	0	0	0	498	958	0	244	244
(7) Sluice Way										0
Type-A	pc.	2	1	1	2	3	7	0	2	2
Type-B	pc.	8	0	0	0	1	9	0	0	0
Totoal of (7)	pc.	10	1	1	2	4	16	0	2	2
(8) Water Gate										0
Type-A	pc.	0	0	0	0	0	0	0	0	0
Type-B	pc.	2	0	0	0	0	2	0	0	0
Total of (8)	pc.	2	0	0	0	0	2	0	0	0
(9) Bridge										0
Newly Const.	sq.m	45,000	0	0	0	6,750	51,750	0	13,500	13,500
Rehabilit.	sq.m	0	0	0	0	0	0	0	0	0
Demolishment										0
Concrete	cu.m	5,800	0	0	0	3,800	9,600	0	2,500	2,500
Metal	ton	1,060	0	0	0	1,300	2,360	0	0	0
(10) Fixed Weir	pc.	0	0	1	1	0	1	0	0	0
(11) Others	L.S	1	0	0	0	0	1	0	0	0

(File cord : WQ-AGNF3)

Table 7.1 (4/5) WORK QUANTITIES OF RIVER IMPROVEMENT OF AGNO RIVER FOR ALTERNATIVE FRAMEWORK PLANS

River : Agno and Tarlac rivers
Study : Framework Plan
Alternative : River Improvement and Dams
Return Period : 1/100 - year, Q=16,200 m3/sec

Work Item	Unit	Agno River Main Stream						Tarlac River		
		Lower Agno	Poponto Stretch			Upper Agno	Total of	Confluence	Upper Stretch	Total of
		RH-AG282 (1)	Bayambang (2)	Floodway (3)	Sub-total (2)+(3)=(4)	AG309-AG473 (5)	Agno River (1)+(4)+(5)	AG180-TA200 (6)	TA200-TA265 (7)	Tarlac River (6)+(7)
(1) Excavation 1	cu.m	15,275,000	0	6,800,000	6,800,000	3,300,000	25,375,000	2,600,000	1,700,000	4,300,000
Excavation 2	cu.m	0	0	0	0	2,850,000	2,850,000	0	0	0
Totoal of (1)	cu.m	15,275,000	0	6,800,000	6,800,000	6,150,000	28,225,000	2,600,000	1,700,000	4,300,000
(2) Dredging	cu.m	17,075,000	0	0	0	0	17,075,000	0	0	0
(3) Embankment 1										
Left Dike	cu.m	2,259,500	483,500	1,609,600	2,093,100	1,162,000	5,514,600	558,000	315,500	873,500
Right Dike	cu.m	1,341,600	0	852,100	852,100	1,704,000	3,897,700	1,046,000	481,600	1,527,600
Embankment 2										
Left Dike	cu.m	6,003,000	0	0	0	443,000	6,446,000	0	0	0
Right Dike	cu.m	6,306,200	0	0	0	2,500,000	8,806,200	0	0	0
Totoal of (3)	cu.m	15,910,300	483,500	2,461,700	2,945,200	5,809,000	24,664,500	1,604,000	797,100	2,401,100
(4) Sodding	cu.m	3,776,300	0	717,700	717,700	1,991,300	6,485,300	437,800	979,800	1,417,600
(5) Revetment (L.W.C.)										
Type-A	sq.m	40,000	0	59,800	59,800	132,300	232,100	18,400	58,300	76,700
Type-B	sq.m	130,200	0	0	0	0	130,200	12,100	0	12,100
Revetment (H.W.C.)										
Type-A	sq.m	0	0	0	0	63,700	63,700	0	6,800	6,800
Type-B	sq.m	63,200	23,700	0	23,700	0	86,900	0	0	0
Totoal of (5)	sq.m	233,400	23,700	59,800	83,500	196,000	512,900	30,500	65,100	95,600
(6) Groin (L.W.C.)										
Type-A	pc.	460	0	0	0	198	658	0	244	244
Type-B	pc.	0	0	0	0	0	0	0	0	0
Groin (H.W.C.)										
Type-A	pc.	0	0	0	0	148	148	0	0	0
Type-B	pc.	0	0	0	0	152	152	0	0	0
Totoal of (6)	pc.	460	0	0	0	498	958	0	244	244
(7) Sluice Way										0
Type-A	pc.	2	1	1	2	3	7	0	2	2
Type-B	pc.	8	2	0	2	1	11	0	0	0
Totoal of (7)	pc.	10	3	1	4	4	18	0	2	2
(8) Water Gate										0
Type-A	pc.	0	0	0	0	0	0	0	0	0
Type-B	pc.	2	0	0	0	0	2	1	0	1
Totoal of (8)	pc.	2	0	0	0	0	2	1	0	1
(9) Bridge										0
Newly Const.	sq.m	45,000	0	0	0	6,750	51,750	0	13,500	13,500
Rehabilit.	sq.m	0	0	0	0	0	0	0	0	0
Demolishment										0
Concrete	cu.m	5,800	0	0	0	3,800	9,600	0	2,500	2,500
Metal	ton	1,060	0	0	0	1,300	2,360	0	0	0
(10) Fixed Weir	pc.	0	0	0	0	0	0	0	0	0
(11) Others	L.S	1	0	0	0	0	1	0	0	0

(File cord : WQ-AGNF4)

Table 7.1(5/5) WORK QUANTITIES OF RIVER IMPROVEMENT OF AGNO RIVER FOR ALTERNATIVE PLANS

Filename : Tributaries of Agno River
Study : Framework Plan
Alternative : River Inprovement Only
Return Period : 50 - year

Work Item	Unit	Tributaries of Agno River				
		Camiling River	Banila River	Viray-Dipalo River	Ambayaoan River	Total of Tributaries
(1) Excavation 1	cu.m	845,000	919,000	185,000	0	1,949,000
Excavation 2	cu.m	0	49,000	0	85,000	134,000
Total of (1)	cu.m	845,000	968,000	185,000	85,000	2,083,000
(2) Dredging	cu.m	0	0	0	0	0
(3) Embankment 1						
Left Dike	cu.m	642,600	797,200	62,800	164,800	1,667,400
Right Dike	cu.m	586,200	854,600	81,400	167,700	1,689,900
Embankment 2						
Left Dike	cu.m	0	13,000	0	0	13,000
Right Dike	cu.m	0	0	0	0	0
Total of (3)	cu.m	1,228,800	1,664,800	144,200	332,500	3,370,300
(4) Sodding	cu.m	537,100	827,200	134,400	171,500	1,670,200
(5) Revetment (L.W.C.)						
Type-A	sq.m	48,100	67,000	39,700	15,900	170,700
Type-B	sq.m	0	0	0	3,500	3,500
Revetment (H.W.C.)						
Type-A	sq.m	11,800	0	220	4,000	16,020
Type-B	sq.m	0	0	0	0	0
Total of (5)	sq.m	59,900	67,000	39,920	23,400	190,220
(6) Groin (L.W.C.)						
Type-A	pc.	276	420	286	88	1,070
Type-B	pc.	0	0	0	0	0
Groin (H.W.C.)						
Type-A	pc.	0	0	0	0	0
Type-B	pc.	0	0	0	0	0
Total of (6)	pc.	276	420	286	88	1,070
(7) Sluice Way						
Type-A	pc.	1	14	4	4	23
Type-B	pc.	3	0	0	0	3
Total of (7)	pc.	4	14	4	4	26
(8) Water Gate						
Type-A	pc.	0	0	0	0	0
Type-B	pc.	0	0	0	0	0
Total of (8)	pc.	0	0	0	0	0
(9) Bridge						
Newly Const.	sq.m	2,300	8,600	6,200	3,000	20,100
Rehabilit.	sq.m	0	0	0	0	0
Demolishment						
Concrete	cu.m	1,100	2,300	600	200	4,200
Metal	ton	0	0	0	0	0
(10) Fixed Weir	pc.	0	0	0	0	0
(11) Others	L.S	0	1	0	0	1

(File cord : WQ-AGT50)

Table 7.2 (1/2) WORK QUANTITIES OF RIVER IMPROVEMENT OF ALLIED RIVER FOR ALTERNATIVE FRAMEWORK PLANS

River : Allied rivers
Study : Framework Plan
Alternative : River Improvement with Bued Closure Dike (AL-1)
Return Period : 1/50 - year

Work Item	Unit	Allied River										Total of Allied River
		Panto - Sinocalan River						Cayanga - Patalan River				
		*Panto-Sinocalan R.	Dagupan River	Ingalera River	Macalong River	Binalonan Floodway	Sub-total	**Cayanga-Patalan R.	Bued River	Aloragat River	Sub-total	
(1) Excavation 1	cu.m	2,968,000	1,399,000	1,815,000	194,000	0	6,376,000	1,549,000	183,800	300,000	2,032,800	8,408,800
Excavation 2	cu.m	0	0	0	0	0	0	0	188,000	0	188,000	188,000
Total of (1)	cu.m	2,968,000	1,399,000	1,815,000	194,000	0	6,376,000	1,549,000	371,800	300,000	2,220,800	8,596,800
(2) Dredging	cu.m	113,000	0	0	0	0	113,000	390,000	0	0	390,000	503,000
(3) Embankment 1												
Left Dike	cu.m	1,508,000	1,428,100	871,600	221,300	0	4,029,000	547,800	57,400	0	605,200	4,634,200
Right Dike	cu.m	1,508,000	1,428,100	871,600	221,300	0	4,029,000	547,800	57,400	0	605,200	4,634,200
Embankment 2												
Left Dike	cu.m	0	0	0	0	0	0	0	39,600	0	39,600	39,600
Right Dike	cu.m	0	0	0	0	0	0	0	80,600	0	80,600	80,600
Total of (3)	cu.m	3,016,000	2,856,200	1,743,200	442,600	0	8,058,000	1,095,600	235,000	0	1,330,600	9,388,600
(4) Sodding	cu.m	1,489,600	1,228,000	1,179,500	257,000	0	4,154,100	538,700	151,500	0	690,200	4,844,300
(5) Revetment (L.W.C.)												
Type-A	sq.m	73,000	33,800	18,900	37,700	0	163,400	75,200	39,700	40,800	155,700	319,100
Type-B	sq.m	38,000	43,400	124,200	0	0	205,600	30,300	0	0	30,300	235,900
Revetment (H.W.C.)												
Type-A	sq.m	30,500	0	0	0	0	30,500	5,800	1,700	0	7,500	38,000
Type-B	sq.m	0	0	0	0	0	0	0	0	0	0	0
Total of (5)	sq.m	141,500	77,200	143,100	37,700	0	399,500	111,300	41,400	40,800	193,500	593,000
(6) Groin (L.W.C.)												
Type-A	pc.	566	100	242	54	0	962	542	281	272	1,095	2,057
Type-B	pc.	0	0	0	0	0	0	0	0	0	0	0
Groin (H.W.C.)												
Type-A	pc.	0	0	0	0	0	0	0	0	0	0	0
Type-B	pc.	0	0	0	0	0	0	0	0	0	0	0
Total of (6)	pc.	566	100	242	54	0	962	542	281	272	1,095	2,057
(7) Sluice Way												
Type-A	pc.	16	4	8	8	0	36	10	6	0	16	52
Type-B	pc.	0	3	0	0	0	3	0	0	0	0	3
Total of (7)	pc.	16	7	8	8	0	39	10	6	0	16	55
(8) Water Gate												
Type-A	pc.	0	0	0	0	0	0	0	0	0	0	0
Type-B	pc.	0	0	0	0	0	0	0	0	0	0	0
Total of (8)	pc.	0	0	0	0	0	0	0	0	0	0	0
(9) Bridge												
Newly Const.	sq.m	8,000	3,905	3,900	193	0	15,998	1,200	3,000	263	4,463	20,461
Rehabilit.	sq.m	338	0	0	413	0	751	2,675	0	0	2,675	3,426
Demolishment												
Concrete	cu.m	4,590	1,200	1,700	1,030	0	8,520	1,700	300	200	2,200	10,720
Metal	ton	0	0	0	0	0	0	0	0	0	0	0
(10) Fixed Weir	pc.	0	0	0	0	0	0	0	0	0	0	0
(11) Others	L.S.	0	0	0	0	0	0	0	1	0	1	1

Remarks: * Panto-Sinocalan River Consists of Panto, Marusay, Sinocalan, Taguntsing and Tuboy Rivers.
** Cayanga-Patalan River consists of Cayanga, Patalan and Angalacan Rivers.

(File cord : WQ-ALEA1)

Table 7.2 (2/2) WORK QUANTITIES OF RIVER IMPROVEMENT OF ALLIED RIVER FOR ALTERNATIVE FRAMEWORK PLANS

River : Allied rivers
Study : Framework Plan
Alternative : River Improvement with Bued Closure Dike/Binalonan Floodway (AL-2)
Return Period : 50 - year

Work Item	Unit	Allied River										Total of Allied River
		Panto - Sinocalan River						Cayanga - Patalan River				
		*Panto-Sinocalan R.	Dagupan River	Ingalera River	Macalong River	Binalonan Floodway	Sub-total	**Cayanga-Patalan R.	Bued River	Aloragat River	Sub-total	
(1) Excavation 1	cu.m	1,699,000	1,399,000	1,815,000	194,000	604,800	5,711,800	1,689,500	183,800	300,000	2,173,300	7,885,100
Excavation 2	cu.m	0	0	0	0	0	0	0	188,000	0	188,000	188,000
Total of (1)	cu.m	1,699,000	1,399,000	1,815,000	194,000	604,800	5,711,800	1,689,500	371,800	300,000	2,361,300	8,073,100
(2) Dredging	cu.m	38,000	0	0	0	0	38,000	440,000	0	0	440,000	478,000
(3) Embankment 1												
Left Dike	cu.m	660,400	1,350,000	871,600	221,300	154,000	3,257,300	768,800	57,400	0	826,200	4,083,500
Right Dike	cu.m	660,400	1,350,000	871,600	221,300	154,000	3,257,300	768,800	57,400	0	826,200	4,083,500
Embankment 2												
Left Dike	cu.m	0	0	0	0	0	0	0	39,600	0	39,600	39,600
Right Dike	cu.m	0	0	0	0	0	0	0	80,600	0	80,600	80,600
Total of (3)	cu.m	1,320,800	2,700,000	1,743,200	442,600	308,000	6,514,600	1,537,600	235,000	0	1,772,600	8,287,200
(4) Sodding	cu.m	821,000	1,161,000	1,179,500	257,000	107,000	3,525,500	731,600	151,500	0	883,100	4,408,600
(5) Revetment (L.W.C.)												
Type-A	sq.m	73,000	33,800	18,900	37,700	76,800	240,200	75,200	39,700	40,800	155,700	395,900
Type-B	sq.m	38,000	43,400	124,200	0	0	205,600	30,300	0	0	30,300	235,900
Revetment (H.W.C.)												
Type-A	sq.m	24,600	0	0	0	0	24,600	6,100	1,700	0	7,800	32,400
Type-B	sq.m	0	0	0	0	0	0	0	0	0	0	0
Total of (5)	sq.m	135,600	77,200	143,100	37,700	76,800	470,400	111,600	41,400	40,800	193,800	664,200
(6) Groin (L.W.C.)												
Type-A	pc.	358	100	242	54	0	754	542	281	272	1,095	1,849
Type-B	pc.	0	0	0	0	0	0	0	0	0	0	0
Groin (H.W.C.)												
Type-A	pc.	0	0	0	0	0	0	0	0	0	0	0
Type-B	pc.	0	0	0	0	0	0	0	0	0	0	0
Total of (6)	pc.	358	100	242	54	0	754	542	281	272	1,095	1,849
(7) Sluice Way												
Type-A	pc.	8	4	8	8	2	30	10	6	0	16	46
Type-B	pc.	0	3	0	0	0	3	0	0	0	0	3
Total of (7)	pc.	8	7	8	8	2	33	10	6	0	16	49
(8) Water Gate												
Type-A	pc.	0	0	0	0	0	0	0	0	0	0	0
Type-B	pc.	0	0	0	0	0	0	0	0	0	0	0
Total of (8)	pc.	0	0	0	0	0	0	0	0	0	0	0
(9) Bridge												
Newly Const.	sq.m	6,195	3,905	3,900	193	780	14,973	1,135	3,000	263	4,398	19,371
Rehabilit.	sq.m	0	0	0	413	0	413	3,040	0	0	3,040	3,453
Demolishment												
Concrete	cu.m	3,430	1,200	1,700	1,030	400	7,760	1,150	300	200	1,650	9,410
Metal	ton	0	0	0	0	0	0	0	0	0	0	0
(10) Fixed Weir	pc.	0	0	0	0	0	0	0	0	0	0	0
(11) Others	L.S.	0	0	0	0	1	1	0	1	0	1	2

Remarks: * Panto-Sinocalan River Consists of Panto, Marusay, Sinocalan, Tagumising and Tuboy Rivers.
** Cayanga-Patalan River consists of Cayanga, Patalan and Angalacan Rivers.

(File cord : WQ-ALEA2)

Table 7.3(1/2) PROJECT ECONOMIC COST OF AGNO RIVER FOR ALTERNATIVE FRAMEWORK PLANS

(Unit : Million Pesos)

Return Period	Alternatives	Main Agno River					Tarlac River			Dams	
		Lower Agno River RM-AG282	Poponto Stretch		Upper Agno Rive AG309-AG473	Total of Agno River	Confluence		Total of Tarlac River	Moriones and L'Odonnell	Grand Total
			Bayambang	Poponto Floodway			AG180-TA200	TA200-TA265			
1/100	Alternative-AG1 River Improvement	8,070	93	1,027	2,282	11,472	741	846	1,587	-	13,059
1/100	Alternative-AG2 River Improvement and Natural Retarding Basin	7,170	166	1,082	2,282	10,700	442	846	1,288	-	11,988
1/100	Alternative-AG3 River Improvement, Natural Retarding Basin and Dams	6,955	166	1,082	2,282	10,485	393	668	1,061	1,811	13,357
1/100	Alternative-AG4 River Improvement and Dams	7,800	93	1,027	1,027	11,202	597	668	1,265	1,811	14,278

(CE-AG100)

Table 7.3(2/2) PROJECT ECONOMIC COST OF AGNO RIVER FOR ALTERNATIVE FRAMEWORK PLANS

(Unit: Million Pesos)

Return Period		Work Item	Camiling River	Banila River	Viray-Dipalo River	Ambayoan River	Total
1/50	I.	Main Construction Cost					
		1. Preparatory Works	24	54	15	9	102
		2. Main Works	239	543	148	92	1,022
		3. Miscellaneous Works	40	90	24	15	169
		Total of I.	303	687	187	116	1,293
	II.	Compensation	30	69	19	12	130
	III.	Administration	17	38	10	6	71
	IV.	Engineering Services	48	110	30	19	207
	V.	Physical Contingency	53	119	32	20	224
		Grand Total	451	1,023	278	173	1,925

Table 7.4(1/2) PROJECT ECONOMIC COST OF ALLIED RIVERS FOR ALTERNATIVE FRAMEWORK PLANS

Alternative-AL1: River Improvement with Bued Closure Dike
River : Panto-Sinocalan River

(Unit: Million Pesos)

Return Period		Work Item	Panto-Sinocalan River	Dagupan River	Ingalera River	Macalong River	Total
1/50	I.	Main Construction Cost					
		1. Preparatory Works	65	40	38	7	150
		2. Main Works	652	401	375	71	1,499
		3. Miscellaneous Works	108	66	62	12	248
		Total of I.	825	507	475	90	1,897
	II.	Compensation	83	51	48	9	191
	III.	Administration	45	28	26	5	104
	IV.	Engineering Services	132	81	76	14	303
	V.	Physical Contingency	143	88	82	16	329
		Grand Total	1,228	755	707	134	2,824

River: Cayanga-Patalan River

(Unit: Million Pesos)

Return Period		Work Item	Cayanga-Pataran River	Bued River	Aloragat River	Total
1/50	I.	Main Construction Cost				
		1. Preparatory Works	35	19	7	61
		2. Main Works	354	190	71	615
		3. Miscellaneous Works	58	31	12	101
		Total of I.	447	240	90	777
	II.	Compensation	45	24	9	78
	III.	Administration	25	13	5	43
	IV.	Engineering Services	72	38	14	124
	V.	Physical Contingency	78	42	16	136
		Grand Total	667	357	134	1,158

Table 7.4(2/2) PROJECT ECONOMIC COST OF ALLIED RIVERS FOR ALTERNATIVE FRAMEWORK PLANS

Alternative-AL2: River Improvement with Bued Closure Dike and Binalonan Floodway
River : Panto-Sinocalan River

(Unit: Million Pesos)

Return Period		Work Item	Panto-Sinocalan River	Dagupan River	Ingalera River	Macalong River	Binalona Floodway	Total
1/50	I.	Main Construction Cost						
		1. Preparatory Works	39	39	38	7	13	136
		2. Main Works	389	389	375	71	131	1,355
		3. Miscellaneous Works	64	64	62	12	22	224
		Total of I.	492	492	475	90	166	1,715
	II.	Compensation	49	49	48	9	17	172
	III.	Administration	27	27	26	5	9	94
	IV.	Engineering Services	79	79	76	14	27	275
	V.	Physical Contingency	85	85	82	16	29	297
		Grand Total	732	732	707	134	248	2,553

River: Cayanga-Patalan River

(Unit: Million Pesos)

Return Period		Work Item	Cayanga-Patalan River	Bued River	Aloragat River	Total
1/50	I.	Main Construction Cost				
		1. Preparatory Works	40	19	7	66
		2. Main Works	401	190	71	662
		3. Miscellaneous Works	66	31	12	109
		Total of I.	507	240	90	837
	II.	Compensation	51	24	9	84
	III.	Administration	28	13	5	46
	IV.	Engineering Services	81	38	14	133
	V.	Physical Contingency	88	42	16	146
		Grand Total	755	357	134	1,246

Table 7.5 FEATURES OF DESIGN CHANNEL OF AGNO RIVER FOR FRAMEWORK PLAN

River: AGNO RIVER
Design Flood: 100-yr

Item	Unit	Agno R.				
		RM - AG45	AG45 - AG65	AG65 - AG109	AG109 - AG177	AG177 - AG180+0.8k
Design Discharge	m3/s	12300	12300	12300	11100	9900
Distance	m	6850	9050	15150	10500	2200
Gradient of River Bed	-	1/6500	1/6500	1/3500	1/2000	1/2000
River Width	m	1500	1500	1500	1500	1500
Width of Channel Bed	m	400-300	300	240	200	200
Dike Height (Ave.)	m	4.7	5.3	6.2	5.6	4.8
Water Depth	m	8.73-9.57	9.57-10.7	10.7	10.7-9.41	9.41-9.14
Low Channel Height(Ave.)	m	6.5	6.5	6.5	6.5	6.0

Item	Unit	Retarding 1>	Floodway	Bayanbang 2>		Agno R.
		AG180+0.8k -AG314	AG314 - AG320(b)	AG282(a)- AG307	AG320(b) -AG351	AG351 - AG367
Design Discharge	m3/s	-	8200	1000	9200	8200
Distance	m	6100	3600	10450	15300	7650
Gradient of River Bed	-	1/1550	1/1550	Existing	1/1550	1/1000
River Width	m	-	1000-830	Existing	900-2500	1000-3200
Width of Channel Bed	m	180	180	Existing	180	180
Dike Height (Ave.)	m	5.4	4.8	4.5-0.0	5.5	5.2
Water Depth	m	9.14-7.66	7.66-8.00	8.0-4.0	8.0	8.0-5.5
Low Channel Height(Ave.)	m	4.5	4.5	5.0	4.0	3.0

1>:Retarding Basin Stretch 2>:Bayanbang Stretch of Agno R.

Item	Unit	Agno R.			
		AG367 AG414	AG414 - - AG453	AG453 - AG495	AG459 - AG473
Design Discharge	m3/s	8200	8200	6400	6400
Distance	m	7700	5300	3000	6450
Gradient of River Bed	-	1/700	1/370	1/370	1/210
River Width	m	1050-2500	1250-2400	1000-1900	300-1300
Width of Channel Bed	m	180	150	150	150
Dike Height	m	4.0	3.3	2.8	2.8-4.0
Water Depth	m	5.5	4.8	4.3	4.3-5.5
Low Channel Height	m	3.0	3.0	3.0	3.0

Table 7.6(1/2) FEATURES OF DESIGN CHANNEL OF TRIBUTARIES OF AGNO RIVER FOR FRAMEWORK PLAN

River: TALRAC RIVER
Design Flood: 100-yr

Item	Unit	Retarding Basin	Tarlac R.		
		AG180+0.8k TA200	TA200 - TA227	TA227 - TA251	TA251 - TARIS DAM
Design Discharge	m3/s	-	2600	2600	1750
Distance	m	8100	13000	11800	4150
Gradient of River Bed	-	1/1850	1/1300	1/760	1/692
River Width	m	-	1700-640	1600-600	600-270
Width of Channel Bed	m	160	160	160	140
Dike Height (Ave.)	m	8.2	3.9	3.5	1.5
Water Depth	m	8.9-4.82	4.82-4.0	4.0	4.0-3.5
Low Channel Height(Ave.)	m	5.0-2.0	2.0	2.0	3.5

River: CAMILING RIVER
Design Flood: 50-yr

Item	Unit	Camiling R.					
		AG143+1.0k CA156+0.3k	CA156+0.3k - CA162	CA162 - CA167	CA167 - CA172	CA172 - CA173	CA173 - CA175
Design Discharge	m3/s	2200	1550	1550	1550	1150	1150
Distance	m	3550	4650	4300	4950	1300	2050
Gradient of River Bed	-	1/2000	1/2000	1/1000	1/550	1/300	Existing
River Width	m	250	180	180	180	130	130
Width of Channel Bed	m	60	50	50	50	35	Existing
Dike Height (Ave.)	m	5.3	4.2	3.6	2.8	1.8	1.8-0.0
Water Depth	m	8.86-7.71	7.71-7.5	7.5-7.1	7.1-5.42	5.42-5.22	5.22-4.8
Low Channel Height(Ave.)	m	4.7	4.7	4.7	4.5	4.5	4.0

River: BANILA RIVER
Design Flood: 50-yr

Item	Unit	Banila R.					
		AG349- AG349+3.7k	AG349+3.7k - BN381	BN381 - BN386	BN386 - BN394	BN394 - BN397	BN397 - BN401
Design Discharge	m3/s	1400	1400	950	440	440	340
Distance	m	3700	8050	4550	7600	2900	4100
Gradient of River Bed	-	1/1295	1/835	1/520	1/265	Existing	Existing
River Width	m	180	180	120	120	120	120
Width of Channel Bed	m	30	30	20	10	Existing	Existing
Dike Height (Ave.)	m	3.5	3.2	2.9	2.4	2.1	1.3
Water Depth	m	7.5	7.0	7.0-6.42	6.42-3.14	3.14-1.5	1.5
Low Channel Height (Ave.)	m	5.0	4.8	4.8	4.8-2.5	1.0	1.0

Table 7.6(2/2) FEATURES OF DESIGN CHANNEL OF TRIBUTARIES OF AGNO RIVER FOR FRAMEWORK PLAN

River: VIRAY-DIPALO RIVEIVER
Design Flood: 50-yr

Item	Unit	Viray-Dipalo R.				Viray R.	
		AG414-VD425	VD425-VD428	VD428-VD430	VD430-VD430+0.6K	VD430+0.6k-VD433	VD433-VD434+0.5k
Design Discharge	m3/s	750	750	750	750	370	370
Distance	m	2800	3100	2000	600	2400	1450
Gradient of River Bed	-	1/375	1/300	1/250	1//127	1/127	1/75
River Width	m	380-290	320-270	320-260	300	150	150
Width of Channel Bed	m	30	30	30	30	15	15
Dike Height (Ave.)	m	1.7	1.7	1.7	1.7	0.9	0.9
Water Depth	m	4.0	4.0	4.0	4.0	2.9	2.9
Low Channel Height (Ave.)	m	3.3	3.3	3.3	3.3	2.8	2.8

Item	Unit	Dipalo R.				
		VD430+0.6k-VD436	VD436-VD437	VD437-VD439	VD439-VD441	VD441-VD442
Design Discharge	m3/s	350	350	210	210	210
Distance	m	1500	700	1950	1950	1000
Gradient of River Bed	-	1/170	1/125	1/125	1/80	1/68
River Width	m	100	100	100	100	100
Width of Channel Bed	m	15	15	10	10	10
Dike Height (Ave.)	m	2.6	2.6	2.3	2.1	1.9
Water Depth	m	3.8	3.0	2.5	2.3	2.1
Low Channel Height (Ave.)	m	2.0	1.2	1.0	1.0	1.0

River: AMBAYOAN RIVER
Design Flood: 50-yr

Item	Unit	Ambayoan R.		
		AG461-AM444+0.5k	AM444+0.5k-AM448	AM448-AM451+0.4k
Design Discharge	m3/s	1750	1750	1750
Distance	m	1800	3550	3350
Gradient of River Bed	-	1/390	1/205	1/150
River Width	m	400	400	400
Width of Channel Bed	m	50	50	50
Dike Heightn (Ave.)	m	4.2	2.2	2.0
Water Depth	m	5.5	3.7	3.5
Low Channel Height (Ave.)	m	2.8	2.5	2.5

Table 7.7(1/4) FEATURES OF DESIGN CHANNEL OF ALLIED RIVERS FOR FRAMEWORK PLAN

River: CAYANGA-PATALAN-ANGALACAN RIVER
Design Flood: 50-yr (with Closure Dike)

Item	Unit	Cayanga R.	Patalan R.	Angalacan River			
		R.M - Bued R.	Bued R.- Aloragat R.	Aloragat R. - 21.0 k	21.0 k- Maraboc	Maraboc - 27.o k	27.0 k - Bugayong
Design Discharge	m3/s	3100	1850	1250	1250	500	500
Distance	m	6500	8300	6200	2800	3200	3300
Gradient of River Bed	-	1/1300	1/1100	1/650	1/460	1/460	1/230
River Width	m	500	200	150	120	100	80
Width of Channel Bed	m	65	45	40	35	25	20
Dike Height	m	2.9	3.3	2.2	2.1	0.7	0.3
Water Depth	m	8.2	7.3	6.2	6.1	4.7	4.3
Low Channel Height	m	6.5	5.0	5.0	5.0	5.0	4.0

Item	Unit	Angalacan R.	
		Bugayong -Killo Br.	Killo Br. -37.5k
Design Discharge	m3/s	370	370
Distance	m	2700	4500
Gradient of River Bed	-	1/190	1/140
River Width	m	60	50
Width of Channel Bed	m	15	15
Dike Height (Ave.)	m	0.4	1.1
Water Depth	m	3.6	3.3
Low Channel Height (Ave.)	m	4.0	3.0

River: BUED RIVER
Design Flood: 50-yr (with Closure Dike)

Item	Unit	Bued River					
		Junction -2.0k	2.0k- 4.0k	4.0k- NIA Dam	NIA Dam -11.9k	11.9k- 16.5k	16.5k- 19.7k
Design Discharge	m3/s	1300	1300	1300	1300	1000	1000
Distance	m	2000	2000	3300	4600	4600	3200
Gradient of River Bed	-	1/400	1/280	1/170	1/143	1/140	1/70
River Width	m	400	400	400	400	400	400
Width of Channel Bed	m	30	20	20	20	20	20
Dike Height (Ave.)	m	4.4-2.0	2.1	2.1	1.9	1.6	1.4
Water Depth	m	8.2-5.8	5.6	3.3	2.4	2.1	1.9
Low Channel Height (Ave.)	m	5.0	3.5	2.0	1.5	1.5	1.5

Table 7.7(2/4) FEATURES OF DESIGN CHANNEL OF ALLIED RIVERS FOR FRAMEWORK PLAN

River: ALORAGAT RIVER
Design Flood: 50-yr (with Closure Dike)

Item	Unit	ALORAGAT RIVER Junction -7.0k	7.0k- 11.5k	11.5k- 17.0k	17.0k- 19.7k
Design Discharge	m3/s	470	470	250	170
Distance	m	7000	4500	5500	2700
Gradient of River Bed	-	1/680	1/355	1/355	1/185
River Width	m	90	80	50	45
Width of Channel Bed	m	30	20	10	10
Dike Height (Ave.)	m	2.8-0.0	0	1.3	1.4
Water Depth	m	7.3-4.2	4.0	4.0	2.8
Low Channel Height (Ave.)	m	5.5	5.0	3.5	2.0

River: PANTO-MARUSAY-SINSINOCALAN-TUBOY RIVER
Design Flood: 50-yr (with Floodway)

Item	Unit	PANTO R.	MARUSAY R.		SINOCALAN R.		
		R.M- Dagupan R.	Dagupan R. -4.0k	4.0k - Ingalera R.	Ingalera R. -18.0k	18.0k- 25.5k	25.5k- Mitura R.
Design Discharge	m3/s	2700	1650	1650	1000	650	650
Distance	m	2500	1500	4300	9700	7500	5500
Gradient of River Bed	-	1/1750	1/1750	1/1750	1/1750	1/1450	1/1100
River Width	m	400	120	220	220	150	100
Width of Channel Bed	m	70	60	50	30	30	25
Dike Height (Ave.)	m	3.7-3.4	3.0	3.0	2.6	2.4	2.0
Water Depth	m	8.0-7.7	7.5	7.5	7.1	6.9	6.0
Low Channel Height (Ave.)	m	5.5	5.5	5.5	5.5	5.5	5.0

Item	Unit	TAGUMISING R. Mitura R. -36.7k	36.7k- Sta. Maria	Sta. Maria -43.5k
Design Discharge	m3/s	160	160	120
Distance	m	5700	4700	2100
Gradient of River Bed	-	1/700	1/430	1/350
River Width	m	100	80	80
Width of Channel Bed	m	10	10	10
Dike Height	m	0	0	0
Water Depth	m	4.0	3.3	3.0
Low Channel Height	m	5.0	4.5	4.5

Table 7.7(3/4) FEATURES OF DESIGN CHANNEL OF ALLIED RIVERS FOR FRAMEWORK PLAN

River: DAGUPAN RIVER
Design Flood: 50-yr

Item	Unit	DAGUPAN R.	SAN JUAN R.		ELANG R.
		Junction -7.5k	7.5k- 12.7k	12.7k- Elang R.	San Juan - 27.6k
Design Discharge	m3/s	1100	900	650	310
Distance	m	7500	5200	9000	5900
Gradient of River Bed	-	1/5000	1/5000	1/5000	1/5000
River Width	m	250	100	100	50
Width of Channel Bed	m	60	30	30	20
Dike Height (Ave.)	m	3.2	3.6	4.1	3.3
Water Depth	m	7.7	7.6	7.6	7.0
Low Channel Height (Ave.)	m	5.5	5.0	4.5	4.5

River: INGALERA RIVER
Design Flood: 50-yr

Item	Unit	INGALERA RIVER				
		Junction -Malasigui	Malasigui - 26.0k	26.0k - 32.0k	32.0k- San Nicolas	San Nicolas -37.5k
Design Discharge	m3/s	600	460	260	260	150
Distance	m	13300	12700	6000	4000	1500
Gradient of River Bed	-	1/3600	1/1800	1/1000	1/700	1/700
River Width	m	100	60	50	50	40
Width of Channel Bed	m	25	15	15	10	10
Dike Height (Ave.)	m	3.0	2.2	1.3	1.7	1.3
Water Depth	m	7.5	6.9	5.5	4.9	4.2
Low Channel Height (Ave.)	m	5.5	5.5	5.0	4.0	3.5

River: MITURA-MAGALONG RIVER ER
Design Flood: 50-yr

Item	Unit	MITURA R.		MAGALONG RIVER	
		Junction -5.3k	5.3k- Taboy	Taboy - 19.0k	19.0k - 21.0k
Design Discharge	m3/s	250	250	180	140
Distance	m	5300	8900	4800	2000
Gradient of River Bed	-	1/800	1/460	1/460	1/250
River Width	m	50	40	35	30
Width of Channel Bed	m	10	8	6	4
Dike Height (Ave.)	m	2.0-1.0	1.5	1.4	1.3
Water Depth	m	6.0-5.2	4.7	4.3	3.7
Low Channel Height (Ave.)	m	5.0	4.0	3.5	3.0

Table 7.7(4/4) FEATURES OF DESIGN CHANNEL OF ALLIED RIVERS FOR FRAMEWORK PLAN

River: BINALONAN FLOODWAY/TUBOY RIVER
Design Flood: 50-yr

Item	Unit	Binalonan Floodway		Tuboy R.	
		Junction -1.8k	1.8k- 6.7k	6.7k- 10.6k	10.6k- 12.2k
Design Discharge	m3/s	650	650	550	550
Distance	m	1800	4900	3900	2000
Gradient of River Bed	-	1/400	1/355.5	1/190	1/143-1/67
River Width	m	60	60	60	60
Width of Channel Bed	m	15	15	15	15-10
Dike Height (Ave.)	m	2.5	2.4	1.7	1.7-0.3
Water Depth	m	6.1-6.0	6.0-5.7	4.7	4.7-3.3
Low Channel Height (Ave.)	m	4.5	4.5	4.0	4.0

Table 8.1 FEATURES OF DESIGN CHANNEL OF AGNO RIVER FOR LONG TERM PLAN

River: AGNO RIVER
Design Flood: 25-yr

Item	Unit	Agno R. Rivermouth -AG45	AG45 - AG65	AG65 - AG109	AG109 - AG177	AG177 - AG180+0.8k
Design Discharge	m3/s	9000	9000	9000	8100	7500
Distance	m	6850	9050	15150	10500	2800
Gradient of River Bed	-	1/6500	1/6500	1/3500	1/2000	1/2000
River Width	m	1500	(1500)	(1500)	(1500)	(1500)
Width of Channel Bed	m	360-250	240	200	200	200
Dike Height (Ave.)	m	3.6	4.2	5.1	4.5	4.1
Water Depth	m	8.1-9.0	9.0-10.1	10.1	10.1-8.8	8.8-8.4
Low Channel Height(Ave.)	m	6.5	6.5	6.5	6.5	6.0

Item	Unit	Retarding 1> AG180+0.8k -AG314	Floodway AG314 - AG320(b)	Bayambang 2> AG282(a) - AG307	Agno R. AG320(b) - AG351	AG351 - AG367
Design Discharge	m3/s	-	5200	600	5800	5100
Distance	m	6100	3600	10450	15300	7650
Gradient of River Bed	-	1/1550	1/1550	Existing	1/1550	1/1000
River Width	m	-	1000-830	160-2000	600-2500	100-3200
Width of Channel Bed	m	180	180	Existing	180	180
Dike Height (Ave.)	m	4.7	4.0	4.1-0.0	4.4	4.4
Water Depth	m	8.4-7.0	7.0	7.6-3.4	6.9	6.9-4.8
Low Channel Height(Ave.)	m	4.5	4.5	5.0	4.0	3.0

1>:Retarding Basin Stretch 2>:Bayambang Stretch of Agno R.

Item	Unit	Agno R. AG367 - AG414	AG414 - AG453	AG453 - AG459	AG459 - AG473
Design Discharge	m3/s	5100	5100	3800	3800
Distance	m	7700	5300	3000	6450
Gradient of River Bed	-	1/700	1/370	1/370	1/210
River Width	m	1050-2500	1250-2400	1000-1900	300-1300
Width of Channel Bed	m	180	150	150	150
Dike Height (Ave.)	m	3.3	2.8	2.0	2.0-3.0
Water Depth	m	4.8	4.3	3.8	3.8-4.8
Low Channel Height (Ave.)	m	3.0	3.0	3.0	3.0