REPUBLIC OF THE PHILIPPINES

STUDY

ON

ILOG - HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT

MASTER PLAN REPORT

VOLUME II : SUPPORTING REPORT

JULY 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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1. NATIONAL DEVELOPMENT PLAN

The Medium-Term Philippine Development Plan, 1987-1992, which was approved and adopted by the Government, is a blueprint aiming at economic recovery in the short run, as well as sustainable growth in the long run. Following a 3-year implementation schedule, updating works are being undertaken by the authorities concerned.

1.1 Development Targets

During the Plan period, real Gross National Product (GNP), or the sum of goods and services produced by the country, is targeted to increase by 6.8% on the average. GNP at current prices is expected to reach ₱1,438.0 billion by 1992, resulting in a per capita income of ₱22,378. In real terms, this represents an average annual increase in per capita income of 4.4% during the period, higher than the recorded increase in real per capita income in 1961-1980. (Refer to Table I-1-1.)

Agriculture (including fishery and forestry), is estimated to increase in real terms at an average annual rate of 5.0%. To complement the growth of agricultural output, industrial output is projected to increase at an average annual rate of 8.8% in real terms. Meanwhile, the services sector is projected to grow at an average annual real rate of 6.6% during the Plan period. (Refer to Table I-1-2.)

1.2 Obstacles to Developement

The agricultural and rural sectors are expected to lead the development process in the national development plan. With a public investment program supportive of employment in the rural areas, agricultural productivity would rise, and incomes in turn would increase. As a result, demand would increase not only for food and other agricultural products, but also for industrial goods and services. Increased incomes in the rural areas would stimulate investment, and change consumption patterns toward products of industries that are more labor-intensive and of enterprises that are small and medium scale. In the development plan, the following are indicated as obstacles to the regional development:

(1) Persistence of Poverty in the Regions

Poverty has been identified as a critical problem in some regions in the country. Despite the assistance and programs directed toward low-income groups, the situation has not remarkably improved in recent years.

(2) Low Productivity in the Regions

Low productivity characterizes some of the regions in the country. Productivity in agriculture is even lower, per worker, for the entire country.

(3) Insurgency Problem in the Regions

At present, some municipalities in the country face serious insurgency problems. The situation has created uncertainties in the business, economic and political climate and has disrupted the development and growth of communities.

1.3 Regional Development

In accordance with the national development plan, regional development plans for the respective regions were incorporated . These regional development plans present the specific problems, strategies and programs of the individual regions, thus establish the direction of their development.

Among these regional development plans, Region VI (Western Visayas) and VII (Central Visayas), where the Ilog-Hilabangan River Basin lies, show typical development problems mentioned in the national plan. In some cases, such problems seem to disturb Region VI and VII much more severely than the other regions.

2. REGIONAL ECONOMY

2.1 Gross Regional Domestic Product

The gross regional domestic product (GRDP) in Region VI and VII where the Ilog-Hilabangan River Basin is located figured at ₱7,155 and ₱8,085 million (at 1972 constant price) in 1989, respectively. These regions show a contrast in annual growth rate of GRDP as summarized below:

Region	1972-1982	1982-1989
Philippines	5.79%	0.78%
Region VI	3.56%	-1.60%
Region VII	5.72%	1.45%

Region VII shows a growth rate equivalent to or higher than the national average in any period, probably because this Region contains Cebu Province, the second biggest in the Philippines in terms of population. Meanwhile, Region VI has achieved only low or negative economic growth; especially in the agricultural sector, which has not recovered the highest production of ₱3,387 million (at 1972 constant prices) achieved in 1982, although it has increased from the bottom of ₱2,766 million hit in 1987. The industrial sector decreased by more than ₱1,100 million from 1983 to 1987 (47.6% decline). Only the service sector recorded a new high of ₱2,969 million in 1989 after the recession. In Region VII, each sector has gained the new high in 1989 after the recession. (Refer to Table I-2-1.)

2.2 Economic Framework

The economic framework in these two regions also presents a contrast in terms of GRDP share by industrial sector. In Region VI, the agricultural sector has been keeping a dominant position, having a share of more than 40% in the GRDP, which is much higher than the national average of 27% (in 1988 and 1989). On the contrary, the share of the industrial sector figured at only about 18% (in 1988 and 1989), much lower than the national average of 33% for the same period. The GRDP in Region VII is, however, dependent on the services sector, sharing around 46% in these years, even higher than the national average of 40%, and this difference of 6% is shared by the agricultural sector. (Refer to Table I-2-2.)

The breakdown of GRDP share by more detailed industrial origin shows the following important facts. The subsector of fishery (in the agricultural sector) and mining/quarrying (in the industrial sector) in both regions contribute much to the national economy on the subsectoral basis. The fishery subsector has a share of 15% and 11%, while the mining/quarrying subsector has 11% and 33% in Region VI and Region VII, respectively. These figures are much higher than the contribution ratio of the whole GRDP to the GDP of the country; 6.7% in Region VI and 7.5% in Region VII in 1989. (Refer to Table I-2-3.)

2.3 Per Capita Gross Domestic Product

Per capita gross domestic product (GDP) of the Philippines in 1989 reached ₱16,040 at current prices and ₱1,783 at 1972 constant prices, but it has not surpassed/equalled yet the highest amount of ₱1,949 achieved in 1982. During the period from 1983 to 1986, per capita GDP of all regions continued declining, but most of them rebounded slightly in 1987 after hitting the bottom in 1986. No region has as yet regained their highest level reached in 1981 or 1982. (Refer to Table I-2-4.)

Per capita GDP of Region VI, though not the lowest among all the regions, figured at only ₱1,288 in 1989, while that in Region VII, ₱1,785 in the same year, kept the same level as the national average. In the past, however, both regions have been below the national average, even less than half of that in NCR, especially the decrease between 1982 and 1986 in Region VI, which was 28.8%, the largest in percentage. It is believed that the drastic fall of international prices of agricultural commodities and the political disorderly situation have knocked out the regional economy severely.

2.4 Average Annual Family Income

Both Region VI and VII gained an average annual family income of ₱31,164 and ₱27,972 at current prices in 1988, respectively, which were lower than the national average of ₱40,408 and far less than even a half of that in NCR. (Refer to Table I-2-5.)

Although the family income in Region VI exceeds that of Region VII, its saving ratio stands at the lowest level (12.8%) among all the regions, while Region VII shows a saving ratio of 20.8% which is higher than the national level of 19.5%.

3 DEMOGRAPHY

3.1 Population in the River Basin

The Ilog-Hilabangan River Basin lies administratively in nine (9) and six (6) municipalities in Negros Oriental and Negros Occidental provinces, respectively, as shown in Fig. I-3-1, though some are only partially covered by the basin. According to the census results in 1970 and 1980 (recent demographic data are not yet available although census was held in 1990), population in these 15 municipalities increased from 525,037 in 1970 to 676,155 in 1980 with an average annual growth rate of 2.6% that is almost the same as the national average of 2.7%.

Population density is calculated at 102 persons/km^2 in 1970 and 131 persons/km^2 in 1980 in these municipalities. These figures indicate that the basin is sparsely populated in comparison with the national average of 122 and 160 persons/km^2 in 1970 and 1980, respectively. Based on the density, population in the river basin with a catchment area of 2,162 km^2 is estimated at some 284,000 in 1980. (Refer to Table I-3-1.)

Demographic conditions in and around the river basin are also characterized by a distribution ratio between the urban and rural population, which is much different from the national level as summarized in the following table (refer to Table I-3-2):

Region	1970 Urban	1970 Rural	1980 Urban	1980 Rural
Philippines	31.8%	68.2%	37.5%	62.5%
The River Basin	12.5%	87.5%	15.5%	84.5%

The annual growth rates of population in the urban and rural areas in the basin-related municipalities in Negros Oriental were calculated at 2.93% and 2.30% during 1970 to 1980, and those of Negros Occidental side were at 6.45% and 2.10%, respectively.

3.2 Demographic Projection

Demographic projections on the regional basis have been provided until the year 2030 in the 1989 Philippine Statistical Yearbook, NSCB. Based on its medium assumption (moderate fertility and moderate mortality decline), future population in the river basin was estimated as presented in Table I-3-3, and summarized below, together with a distribution ratio in urban and rural areas.

Year	Population (x 1000) Urban	Rural	Total	Distribution Urban	Rural
1990	69.99	276.71	346.70	20.2%	79.8%
2000	106.43	310.41	416.80	25.5%	74.5%
2010	126.12	345.88	472.00	26.7%	73.3%
2020	144.99	374.11	519.10	27.9%	72.1%
2030	160.77	400.66	561.40	28.6%	71.4%

3.3 Labor Force and Unemployment

The number of labor force or household population 15 years old and above accounts for about two-thirds of the total population in Regions VI and VII, slightly higher than the national level. It has increased at the average annual rate of 2.7% in the Philippines and 2.3% in both Regions VI and VII during the period 1980 to 1988. These figures nearly coincide with the population growth in any region. It is noted that in Region VI, labor force has been increasing in spite of a negative growth of its GRDP during the said period, and this brought about a rapid rise of unemployment.

Unemployment rates in these two regions figured at 5.6% and 4.4%, respectively, on the average during the same period, which are much lower than the national average of 7.1%. Unemployment rate in Region VI jumped up to 10.8% in 1986 due to the rapid fall of international prices of agricultural commodities such as sugar, and has maintained a high level since then (8.0% in 1987 and 7.3% in 1988). Meanwhile, Region VII peaked at 7.2% in 1987, but still less than the national average of 9.1% and rapidly decreased down to 5.7% in 1988. The difference between these regions is deemed to be due to their distinctive economic structures, that is, Region VI is dependent on the agricultural sector by about 40% and Region VII on the service sector by about 45% as discussed in Subsection 2.2. (Refer to Table I-3-4.)

4. LAND USED IN THE RIVER BASIN

The Ilog-Hilabangan river basin is mostly covered by hilly and mountainous lands, according to the terrain slope classification as shown in the following table and Fig. I-4-1.

Category	Slope Degree	Areas (km^2)	Share
Slope Category 1	0 to 3%	245	11%
Slope Category 2	3 to 8 %	346	16%
Slope Category 3	8 to 15%	780	36%
Slope Category 4	15% and more	791	37%
Total		2,162	100%

Slope categories 1 and 2 are made up of almost level and gently sloping areas, which are, in general, suitable for irrigation and cultivation of agricultural crops. Areas under the other categories hardly produce agricultural crops continuously without losing surface soil.

In the Ilog-Hilabangan river basin as presented in the above table, the land suitable for cultivation of crops in the lower reaches has a share of only 27%. The bulk of the basin, the remaining 73%, has difficulties in intensive agricultural production. Intensive utilization of land is thus concentrated in the lower reaches, which is covered mainly by lands cultivated for sugarcane, palay and some other grain crops, including fishpond. In the upper reaches of the river, dominantly situated are forests, pasture/grassland and upland grain crops.

The land use and vegetation map prepared by BSWM (refer to Fig. I-4-2) indicates that about one-fourth of the land area is used for paddy and sugarcane cultivation, one-fourth for upland crops and about one-half is covered by forest and pasture. Land uses is summarized as follows (refer to Table I-4-1 for details):

Generalized Land Use Item	Areas (km^2)	Share
Lowland/upland paddy area	138	6%
Area planted to sugarcane	369	17%
Diversified upland grain crops	545	25%
Predominantly coconut	20	1%
Pasture and grassland	537	25%
Forest area (primarily second growth)	448	21%
Fishpond, marshes and mangrove	27	1%
Residential	35	2%
River reservation	43	2%
Total	2,162	100%

Mapping of the flood-prone areas in the down-reaches (lower than the confluence between the Ilog and Hilabangan rivers, including a part of the Binicuil river basin) has been conducted by JICA at the scale of 1:5000. These maps indicate the land use classifications that have been actually measured as summarized in the following table. The land use generalized by mesh unit is presented in Fig. I-4-3.

Generalized Land Use Item	Areas (km^2)	Share
Lowland paddy area	15.6	12.5%
Area planted to sugarcane	56.6	45.3%
Fishpond	25.4	20.3%
Coconut, Nipa	9.6	7.7%
Orchard	0.4	0.3%
Forest	0.5	0.4%
Residential	5.9	4.7%
River reservation	5.6	4.5%
Unused (marshes, mangrove)	5.4	4.3%
Total	125.0	100%

5. INFRASTRUCTURE

5.1 Transportation

The road network of Negros Occidental Province has a total length of 4,670 km as of 1986, including concrete or cemented roads by only 5% and asphalted roads by 16% as presented in Table I-5-1. This road network accounts for less than 60% of the requirement of 7,926 km, which was calculated on the basis of the national standard of 1 km for every 100 ha. The major national road, running in parallel to the shoreline around Negros Island, is considered to be in a generally good condition, at least from Kabankalan located in the lower reaches of Ilog River to Escalante in the north of the island. (Refer to Fig. I-5-1)

In the Ilog-Hilabangan River Basin, Poblacion Kabankalan plays a junction point in the road network, connecting the coastal municipalities/cities in Negros Occidental and also Poblacion Bias in Negros Oriental by crossing the island through the mountainous areas. In its lower reaches exist three (3) bridges, the Malabong and Talubangui concrete bridges and the Hilabangan wooden bridge.

The Southern Negros Development Corporation (SONEDCO) operates and maintains a railway system of about 40 km in the municipality of Kabankalan, which is used for transporting sugarcane from the fields to mill plants.

Negros Occidental Province has four (4) major seaports; namely, the Pulupandan Port, the Banago Port, the Bacolod Real Estate Development Corporation (BREDCO) Port in Bacolod City, and the San Carlos City Port, all of which serve and accommodate passenger-cargo movements.

5.2 Water Supply System

There exist two (2) water supply systems in the lower reaches, i.e., in the poblacions of Kabankalan and Ilog. The main water sources of the Kabankalan water supply system are two (2) deep wells and one (1) spring. The deep wells fill up one (1) elevated tank with a capacity of 75,000 gallons, and the spring water is stored in a ground reservoir of 117,000 gallon capacity. The total water production for the last seven (7) months (January 1990 to July 1990) amounted to 387,169 m^3, but only 61% of this amount was distributed because of leakage, meter tampering, illegal connection, etc. The number of concessionaires or users during the period were 1,687 households or a population of 11,809 distributed in Poblacion Kabankalan, Sitio Overflow, part of Binicuil and part of Sitio Naga.

The sources of water supply for Ilog Poblacion are spring developments in the sloping side of the mountain. Two (2) intake boxes were constructed and provided with a transmission pipeline (102 mm diameter) that transmits the water down by gravity flow to a reservoir with a capacity of 45,000 gallons at the foot of the mountain. At present the system is serving 128 households for five (5) hours a day, consuming 25,000 gallons per day, more or less. Water consumption of concessionaires are not metered yet, so that the water charge is on a flat rate basis of ₱30 per month per household.

5.3 Power Supply

The existing generating plants in Negros Island (as of June 1988) have an aggregate installed capacity of 156.3 MW as shown in the following table:

Plant Name	Installed Cap. (MW)
Bacolod CENECO Diesel 2-3	2 x 3.0 = 6.0
Bacolod CENECO Diesel 4	2 x 5.45 = 10.9
Talisay CENECO Diesel 1	1 x 3.6 = 3.6
Talisay CENECO Diesel 2-3	2 x 5.5 = 11.0
Amlan NPC Hydro 1-2	2 x 0.4 = 0.8
Amlan NPC Diesel	1 x 5.5 = 5.5
Palinpinon NPC Pilot Geo	4 x 1.5 = 6.0
Palinpinon NPC Geo I	3 x 37.5 = 112.5
Total	156.3

The major transmission lines of the National Power Corporation (NAPOCOR) installed in the island are (1) Mabinay - Bacolod 138 kV line, (2) Mabinay - Kabankalan 69 kV line, and (3) Bacolod - San Enrique 69 kV line (refer to Fig. I-5-2). The bulk of electric power used in Negros Occidental Province is supplied from Bacolod and Mabinay Substations with capacities of 80,000 kVA and 10,000 kVA, respectively. These two substations derive power from the Palipion Geothermal Power Plant. The distribution of power to different parts of the province is being carried out by three (3) electric cooperatives; namely, the Central Negros Electric Cooperative (CENECO) in the central part of the province, Victorias Rural Electric Service Cooperative (VRESCO) in the north and the Negros Occidental Electric Cooperative (NOCECO) in the southern part.

In the municipalities of Kabankalan and Ilog, the number of residential consumers is 3,989 and 2,223 with diffusion ratios of 17% and 27%. The consumption per household is averaged at 46.6 KWH and 29.3 KWH per month, respectively.

5.4 Telecommunications

Telephone services in Negros Occidental are provided by the branch of Philippine Long Distance Telephone Company based in Bacolod City. Direct local calls reach as far as Silay City in the northern portion of the province. In the farther northern parts such as Victorias and Cadiz City, calls are considered long distance and are facilitated via microwave. In the southern portion, Kabankalan is the farthest municipality that can be reached via long distance call.

The province has a total of 34 radio/telegraph stations, consisting of eight (8) radio stations, four (4) radio telegraph stations and 22 telegraph stations. Messages from local stations intended for the province are relayed to the Provincial Communication Center (Bacolod Message Center) which assumes the responsibility of distributing the messages to their respective destinations.

6. PROJECTS RELATED TO THE STUDY

6.1 Flood Control

Public works authorities have made efforts to mitigate flood damages such as the ones inflicted by the flood of 1949. Examples of the projects undertaken are as follows:

(1) In 1957, public works authorities conducted six (6) alternative studies including those for the Bungul diversion channel and cut-off channel Nos. 1, 2 and 3. Eventually, the construction of Bungul diversion was started in 1957 and completed in 1959.

(2) In 1974, public works authorities started the construction of a cut-off channel to increase the flow capacity of the Ilog River. The construction was completed in 1975, though the old Ilog River was naturally clogged afterwards.

(3) Revetment along the Ilog river course at Talubangi and Kabankalan were provided in 1979 and 1984, respectively.

(4) In 1988, the proposal for expansion of the existing cut-off channel was accepted and the project will start as soon as funds become available. The construction cost of this cut-off channel is estimated at 26 million pesos at 1989 prices.

6.2 Power Supply

(1) Expansion of Transmission Lines

The National Power Corporation (NPC) constructed the Negros-Panay interconnection project which was started in late 1988 and completed in late 1989. The project includes the installation of 18 kms of submarine cables (138 kV). The new transmission line of

167 kms was installed in line with the expansion of the Mabinay and Bacolod substations.

(2) Bago Hydroelectric Plant

To cope with the future demand in consonance with the expansion of transmission lines, NPC is planning to develop the Bago Hydroelectric Plant, of which feasibility study was terminated in 1982 and detail design works is ongoing, proposing the maximum installed capacity of 183 MW. Based on the feasibility study, the outline of the project is given as follows:

(a) Main structures include a 125 m dam with a catchment area of 402 km^2 and a 5 km power tunnel to a 3 x 53 MW power facility.

(b) The reservoir has a total storage volume of 168 MCM and an active storage volume of 134 MCM above minimum drawdown elevation.

(c) Average annual energy generated by the project is 410 Gwh.

(d) The capital cost at end 1981 price level including contingencies and engineering but excluding interest is ₱1,463 million.

(e) Construction period is scheduled for 6 years including detail design works.

6.3 Water Resources Development

To develop much water resources in this basin, the study on the Hilabangan Irrigation Project for the lower basin was carried out in 1975. The Tambolan Communal Irrigation Project for the upper basin is under study by the National Irrigation Administration (NIA).

(1) Hilabangan River Irrigation Project

The development plan of the project envisages irrigation of about 5,900 ha in the dry and wet seasons. The proposed development area along the Ilog River is divided into the left bank area of 3,000 ha and the right bank area of 2,900 ha. The diversion dam site with a drainage area of approximately 430 km^2 is located at Barrio Lupni, 4 km upstream of the confluence with the Ilog River. The proposed diversion dam will be concrete gravity overflow with a height of about 2.5 m above the riverbed and 140 m

long. Although the study was once reviewed in 1983, this project has not progressed to the further stage as of 1990.

(2) Tambolan Communal Irrigation Project

In this project, it is proposed that intake facilities be provided at Barangay Casoloning with the catchment area of 30 km2 upstream of the Hilabangan River. The irrigation area to be covered by this project is approximately 600 ha.

6.4 Road Improvement

DPWH is currently implementing the Improvement and Reconstruction of the Southern Negros Roads Project (between Kabankalan and Maaslom; refer to Fig. I-5-1) financed under ADB loan. The road is around 74 km in total length and the construction schedule is approximately three (3) years. In the Ilog-Hilabangan river basin, the route of this road is generally aligned along the right bank of the artery of the Ilog River up to Mabinay from Kabankalan.

The bridge which is proposed to cross the Hilabangan River at Barangay Overflow is a permanent concrete bridge with the design live load of HS-20-44. The bridge length is 170 m, and the width is 6 m in the first stage and 10 m in the second stage.

TABLES

Table I-1-1 GROSS NATIONAL PRODUCT AND PER CAPITA GNP, 1986-92

Item	Estimate	Targets						Annual Average
	1986	1987	1988	1989	1990	1991	1992	1987-92
Gross National Product (in billion pesos, at constract 1972 prices)	89.4	95.3	101.9	108.6	116.2	124.3	132.7	113.2
Growth rate	1.1%	6.5%	6.9%	6.7%	7.0%	6.9%	6.7%	6.8%
Gross National Product (in billion pesos, at current prices)	619.6	697.3	811.6	927.3	1,075.7	1,253.2	1,438.0	1,033.9
Inflation Rate	2.0%	5.2%	8.7%	7.0%	8.3%	8.9%	7.4%	7.6%
Per Capita GNP (in pesos, at constant 1972 prices)	1,597	1,661	1,734	1,808	1,891	1,977	2,064	1,856
Growth rate	-1.3%	4.0%	4.4%	4.3%	4.6%	4.5%	4.4%	4.4%
Per Capita GNP (in pesos, at current prices)	11,063	12,157	13,825	15,430	17,497	19,934	22,378	16,870

Sources : NEDA and NCSO
Note : Estimates and targets as of November 5, 1986

Table I-1-2 GROSS DOMESTIC PRODUCT BY INDUSTRIAL ORIGIN, 1986-92
(In billion pesos, at constrant 1972 prices)

Item	Estimate	Targets						Annual Average
	1986	1987	1988	1989	1990	1991	1992	1987-92
Gross Domestic Product	90.9	96.9	103.8	110.8	118.7	126.9	135.3	115.4
Growth rate	0.4%	6.7%	7.1%	6.7%	7.1%	6.9%	6.7%	6.9%
Agriculture, Fishery and Forestry	26.8	27.9	29.1	30.6	32.2	34.0	35.9	31.6
Growth rate	3.0%	4.0%	4.5%	5.0%	5.5%	5.5%	5.5%	5.0%
Industry	28.4	31.0	33.7	36.5	39.5	42.9	47.1	38.4
Growth rate	-1.6%	9.1%	8.9%	8.2%	8.3%	8.5%	9.7%	8.8%
Manufacturig	21.7	23.2	24.8	26.7	28.8	31.1	33.7	28.1
Growth rate	0.3%	7.0%	7.0%	7.5%	7.8%	8.0%	8.4%	7.6%
Mining and quarrying	1.8	1.9	1.9	2.0	2.1	2.2	2.3	2.1
Growth rate	3.0%	3.0%	3.5%	4.0%	4.6%	4.9%	5.0%	4.2%
Construction	3.6	4.5	5.5	6.2	6.9	7.7	9.0	6.6
Growth rate	-15.1%	25.5%	20.9%	12.7%	11.7%	12.0%	16.1%	16.5%
Electricity, gas and water	1.3	1.4	1.5	1.6	1.8	1.9	2.1	1.7
Growth rate	4.0%	6.5%	8.0%	8.0%	9.0%	9.0%	10.0%	8.4%
Services	35.7	38.1	41.0	43.8	46.9	50.0	52.2	45.3
Growth rate (%)	0.3%	6.8%	7.6%	6.7%	7.2%	6.5%	4.9%	6.6%

Source : NEDA

Table I-2-1 GROSS REGIONAL DOMESTIC PRODUCT BY MAJOR INDUSTRIAL ORIGIN IN THE PHILIPPINES, REGION VI AND REGION VII, AND ANNUAL GROWTH RATE, 1972-1989

Unit : million Peso at 1972 price

Area/Sector	Gross Regional Domestic Product								Annual Growth Rate	
	1972	1982	1983	1984	1985	1987	1988	1989	'72-'82	'82-'89
Philippines	56,464	99,102	99,920	94,214	90,470	95,373	101,450	107,144	5.79%	0.78%
Agriculture, Fishery & Forestry	16,135	25,378	24,845	25,409	26,010	26,834	27,793	28,986	4.63%	1.34%
Industry	18,068	35,806	35,955	32,159	28,880	30,499	33,235	35,534	7.08%	-0.08%
Services	22,261	37,918	39,120	36,646	35,580	38,040	40,422	42,624	5.47%	1.18%
REGION VI	5,926	8,410	8,171	7,817	7,241	6,608	6,913	7,155	3.56%	-1.60%
Agriculture, Fishery & Forestry	2,238	3,387	3,058	3,253	2,926	2,766	2,847	2,906	4.23%	-1.52%
Industry	1,594	2,361	2,380	2,010	1,850	1,247	1,247	1,280	4.01%	-5.94%
Services	2,094	2,662	2,733	2,554	2,465	2,595	2,819	2,969	2.43%	1.10%
REGION VII	4,013	7,000	7,101	6,804	6,332	6,989	7,514	8,085	5.72%	1.45%
Agriculture, Fishery & Forestry	930	1,484	1,527	1,527	1,534	1,548	1,578	1,837	4.78%	2.16%
Industry	1,202	2,460	2,436	2,271	1,846	2,263	2,451	2,572	7.42%	0.45%
Services	1,881	3,056	3,138	3,006	2,952	3,178	3,485	3,676	4.97%	1.86%

Source: Medium-Term Western Visayas Region Development Plan, 1987-1992, NEDA
Medium-Term Central Visayas Region Development Plan, 1987-1992, NEDA
Gross Regional Domestic Product Summary (1987 to 1989), NSCB

Table I-2-2 PERCENTAGE DISTRIBUTION OF GROSS REGIONAL DOMESTIC PRODUCT BY MAJOR INDUSTRIAL ORIGIN IN THE PHILIPPINES, REGION VI AND REGION VII, 1972-1989

Area/Sector	Percentage Distribution of GRDP							
	1972	1982	1983	1984	1985	1987	1988	1989
Philippines	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Agriculture, Fishery & Forestry	28.6%	25.6%	24.9%	27.0%	28.7%	28.1%	27.4%	27.1%
Industry	32.0%	36.1%	36.0%	34.1%	31.9%	32.0%	32.8%	33.2%
Services	39.4%	38.3%	39.2%	38.9%	39.3%	39.9%	39.8%	39.8%
REGION VI	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Agriculture, Fishery & Forestry	37.8%	40.3%	37.4%	41.6%	40.4%	41.9%	41.2%	40.6%
Industry	26.9%	28.1%	29.1%	25.7%	25.5%	18.9%	18.0%	17.9%
Services	35.3%	31.7%	33.4%	32.7%	34.0%	39.3%	40.8%	41.5%
REGION VII	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Agriculture, Fishery & Forestry	23.2%	21.2%	21.5%	22.4%	24.2%	22.1%	21.0%	22.7%
Industry	30.0%	35.1%	34.3%	33.4%	29.2%	32.4%	32.6%	31.8%
Services	46.9%	43.7%	44.2%	44.2%	46.6%	45.5%	46.4%	45.5%

Source: Medium-Term Western Visayas Region Development Plan, 1987-1992, NEDA
Medium-Term Central Visayas Region Development Plan, 1987-1992, NEDA
Gross Regional Domestic Product Summary (1987 to 1989), NSCB

Note : Figures may not add up to the totals due to rounding.

Table I-2-3 GROSS REGIONAL DOMESTIC PRODUCT BY DETAILED INDUSTRIAL ORIGIN, PERCENT DISTRIBUTION AND CONTRIBUTION TO NATION, 1989

Unit : million Peso at 1972 constant price

Industry/Sector	GRDP by Region			Percentage Distribution			Contribution to Nation	
	Philippines	Region VI	Region VII	Philippines	Region VI	Region VII	Region VI	Region VII
Agriculture, Fishery & Forestry	28,986	2,906	1,837	27.1%	40.6%	22.7%	10.0%	6.3%
- Agricultural crops	17,019	1,441	765	15.9%	20.1%	9.5%	8.5%	4.5%
- Livestock & poultry	6,289	691	510	5.9%	9.7%	6.3%	11.0%	8.1%
- Fishery	5,046	774	560	4.7%	10.8%	6.9%	15.3%	11.1%
- Forestry	632	0	2	0.6%	0.0%	0.0%	0.0%	0.3%
Industry	35,534	1,279	2,572	33.2%	17.9%	31.8%	3.6%	7.2%
- Mining & quarrying	1,563	165	519	1.5%	2.3%	6.4%	10.6%	33.2%
- Manufacturing	26,886	917	1,759	25.1%	12.8%	21.8%	3.4%	6.5%
- Construction	4,947	133	212	4.6%	1.9%	2.6%	2.7%	4.3%
- Elec., gas, water	2,137	64	82	2.0%	0.9%	1.0%	3.0%	3.8%
Services	42,624	2,969	3,676	39.8%	41.5%	45.5%	7.0%	8.6%
- Transportation	5,761	217	476	5.4%	3.0%	5.9%	3.8%	8.3%
- Trade	16,795	1,620	2,112	15.7%	22.6%	26.1%	9.6%	12.6%
- Finance & housing	6,843	373	334	6.4%	5.2%	4.1%	5.5%	4.9%
- Private services	6,766	453	515	6.3%	6.3%	6.4%	6.7%	7.6%
- Government services	6,458	305	238	6.0%	4.3%	2.9%	4.7%	3.7%
Gross Regional Domestic Product	107,144	7,154	8,086	100.0%	100.0%	100.0%	6.7%	7.5%

Source : Gross Regional Domestic Product Summary (1987 to 1989), NSCB

Note : Figures may not add up to totals due to rounding.

Table I-2-4 PER CAPITA GROSS DOMESTIC PRODUCT BY REGION, 1981-1989

Unit : Peso at 1972 constant price

Region	* 1981	* 1982	* 1983	* 1984	* 1985	* 1986	** 1987	** 1988	** 1989
Philippines	1,942	1,949	1,920	1,760	1,644	1,628	1,663	1,728	1,783
NCR Metro Manila	4,968	4,984	4,968	4,339	3,842	3,724	3,865	4,108	4,281
CAR Cordillera Administrative Region	---	---	---	---	---	---	1,360	1,404	1,477
I Ilocos Region	1,044	1,082	1,079	1,020	1,026	1,072	956	982	981
II Cagayan Valley	1,160	1,140	1,081	979	941	887	848	869	872
III Central Luzon	1,680	1,698	1,630	1,466	1,405	1,320	1,339	1,392	1,465
IV Southern Tagalog	2,081	2,073	2,027	1,939	1,822	1,868	1,759	1,791	1,821
V Bicol Region	882	878	891	827	795	762	767	794	801
VI Western Visayas	1,684	1,728	1,638	1,519	1,292	1,219	1,241	1,271	1,288
VII Central Visayas	1,807	1,764	1,745	1,626	1,497	1,514	1,602	1,690	1,785
VIII Eastern Visayas	800	803	788	730	739	734	929	946	945
IX Western Mindanao	1,286	1,267	1,245	1,145	1,138	1,150	1,213	1,236	1,271
X Northern Mindanao	1,629	1,632	1,531	1,503	1,516	1,533	1,572	1,635	1,684
XI Southern Mindanao	1,731	1,737	1,762	1,685	1,673	1,698	1,766	1,774	1,809
XII Central Mindanao	1,487	1,471	1,461	1,351	1,351	1,417	1,387	1,417	1,459

Source *: 1989 Philippine Statistical Yearbook, NSCB
**: Gross Regional Domestic Product Summary (1987 to 1989), NSCB

Table I-2-5 NUMBER OF FAMILIES, AVERAGE ANNUAL INCOME AND EXPENDITURE, SAVINGS AND SAVING RATIO BY REGION, 1988

Unit : Peso at current price

Region	No. of Families (x1000)	Average Income (Peso)	Average Expendit (Peso)	Savings (Peso)	Saving Ratio
Philippines	10,534.9	40,408	32,521	7,887	19.5%
NCR Metro Manila	1,435.4	79,314	60,355	18,959	23.9%
CAR Cordillera Administrative Region	213.6	33,838	28,722	5,116	15.1%
I Ilocos Region	624.7	34,031	27,670	6,361	18.7%
II Cagayan Valley	437.9	32,939	24,582	8,357	25.4%
III Central Luzon	1,038.2	46,855	38,660	8,195	17.5%
IV Southern Tagalog	1,284.5	37,978	32,058	5,920	15.6%
V Bicol Region	738.0	26,570	23,253	3,317	12.5%
VI Western Visayas	956.6	31,164	27,162	4,002	12.8%
VII Central Visayas	829.5	27,972	22,157	5,815	20.8%
VIII Eastern Visayas	598.5	25,345	20,533	4,812	19.0%
IX Western Mindanao	539.3	31,984	24,624	7,360	23.0%
X Northern Mindanao	606.8	35,801	28,865	6,936	19.4%
XI Southern Mindanao	737.8	37,132	30,061	7,071	19.0%
XII Central Mindanao	493.1	35,090	27,696	7,394	21.1%
Negros Island	526.4	25,116	22,541	2,575	10.3%
- Negros Occidental Province	347.8	26,389	24,175	2,214	8.4%
- Negros Oriental Province	178.6	22,637	19,360	3,277	14.5%

Source : 1988 Family Income & Expenditures Survey, NSO

Note : Figures exclude data for Rizal Province.

Table I-3-1 POPULATION, DENSITY AND AVERAGE ANNUAL GROWTH IN ILOG-HILABANGAN RIVER BASIN, 1970 AND 1980

	Provice/ Municipality	Municipality Area (km2)	1970 Population	1970 Density	1980 Population	1980 Density	Average Annual Growth
	NEGROS ORIENTAL						
1	Ayungon	153.6	23,165	150.8	27,656	180.1	1.8%
2	Bais City	316.9	40,095	126.5	49,301	155.6	2.1%
3	Bawayan	722.5	44,615	61.8	71,153	98.5	4.8%
4	Bindoy	173.7	18,334	105.5	23,638	136.1	2.6%
5	Jimalalud	139.5	18,568	133.1	18,863	135.2	0.2%
6	Mabinay	142.6	33,785	236.9	46,871	328.7	3.3%
7	Manjuyod	264.6	20,545	77.6	26,257	99.2	2.5%
8	Tanjay	539.3	51,458	95.4	57,299	106.2	1.1%
9	Tayasan	154.2	20,132	130.6	21,473	139.3	0.6%
	Sub-total/Ave.	2,607	270,697	103.8	342,511	131.4	2.4%
	NEGROS OCCIDENTAL						
10	Candoni	191.7	10,258	53.5	10,831	56.5	0.5%
11	Cauayan	519.9	52,508	101.0	70,017	134.7	2.9%
12	Himamaylan	384.2	53,663	139.7	70,467	183.4	2.8%
13	Ilog	281.7	30,573	108.5	38,956	138.3	2.5%
14	Kabankalan	726.4	72,567	99.9	92,109	126.8	2.4%
15	Sipalay	442.7	34,771	78.5	51,264	115.8	4.0%
	Sub-total/Ave.	2,547	254,340	99.9	333,644	131.0	2.8%
	Total/Ave.	5,154	525,037	101.9	676,155	131.2	2.6%

SOURCE : NCSO, Special Report No.3

NOTE : Calculation of the basin population in 1988 is as follows:

Province	Area (km2)	Population Density	Population
Negros Occidental	1,211	131.0	158,623
Negros Oriental	951	131.4	124,985
Total	2,162		283,608

Table I-3-2 URBAN AND RURAL POPULATION IN ILOG-HILABANGAN RIVER BASIN IN 1970 AND 1980

Provice/ Municipality	1970 Urban	(%)	Rural	(%)	Total	1980 Urban	(%)	Rural	(%)	Total
NEGROS ORIENTAL										
1 Ayungon	0	0.0%	23,165	100.0%	23,165	1,455	5.3%	26,201	94.7%	27,656
2 Bais City	6,809	17.0%	33,286	83.0%	40,095	8,225	16.7%	41,076	83.3%	49,301
3 Bawayan	8,115	18.2%	36,500	81.8%	44,615	8,618	12.1%	62,535	87.9%	71,153
4 Bindoy	0	0.0%	18,334	100.0%	18,334	2,233	9.4%	21,405	90.6%	23,638
5 Jimalalud	2,248	12.1%	16,320	87.9%	18,568	2,378	12.6%	16,485	87.4%	18,863
6 Mabinay	1,567	4.6%	32,218	95.4%	33,785	1,815	3.9%	45,056	96.1%	46,871
7 Manjuyod	875	4.3%	19,670	95.7%	20,545	988	3.8%	25,269	96.2%	26,257
8 Tanjay	12,012	23.3%	39,446	76.7%	51,458	17,020	29.7%	40,279	70.3%	57,299
9 Tayasan	1,674	8.3%	18,458	91.7%	20,132	1,702	7.9%	19,771	92.1%	21,473
Sub-total	33,300	12.3%	237,397	87.7%	270,697	44,434	13.0%	298,077	87.0%	342,511
NEGROS OCCIDENTAL										
10 Candoni	1,902	18.5%	8,356	81.5%	10,258	2,701	24.9%	8,130	75.1%	10,831
11 Cauayan	4,994	9.5%	47,514	90.5%	52,508	5,762	8.2%	64,255	91.8%	70,017
12 Himamaylan	6,636	12.4%	47,027	87.6%	53,663	9,207	13.1%	61,260	86.9%	70,467
13 Ilog	4,741	15.5%	25,832	84.5%	30,573	5,649	14.5%	33,307	85.5%	38,956
14 Kabankalan	14,154	19.5%	58,413	80.5%	72,567	20,208	21.9%	71,901	78.1%	92,109
15 Sipalay	0	0.0%	34,771	100.0%	34,771	17,051	33.3%	34,213	66.7%	51,264
Sub-Total	32,427	12.7%	221,913	87.3%	254,340	60,578	18.2%	273,066	81.8%	333,644
Total	65,727	12.5%	459,310	87.5%	525,037	105,012	15.5%	571,143	84.5%	676,155

Source : NCSO, Special Report No.4

Table I-3-3 POPULATION PROJECTIONS FOR NEGROS ISLAND AND ILOG-HILABANGAN RIVER BASIN, 1980 - 2030

Unit : thousand persons

Year	Region VI*	Region VII*	Negros Island			River Basin		
			Occidental	Oriental	Total	Occidental	Oriental	Total
1980	4,538	3,796	1,930.3 **	819.4 **	2,749.7	158.6	125.0	283.6
1981	4,645	3,873	1,975.8	836.0	2,811.8	162.3	127.5	289.9
1982	4,756	3,952	2,023.0	853.1	2,876.1	166.2	130.1	296.4
1983	4,866	4,032	2,069.8	870.3	2,940.2	170.1	132.8	302.8
1984	4,979	4,113	2,117.9	887.8	3,005.7	174.0	135.4	309.5
1985	5,092	4,195	2,166.0	905.5	3,071.5	178.0	138.1	316.1
1986	5,207	4,278	2,214.9	923.4	3,138.3	182.0	140.9	322.9
1987	5,323	4,362	2,264.2	941.6	3,205.8	186.0	143.6	329.7
1988	5,439	4,446	2,313.6	959.7	3,273.3	190.1	146.4	336.5
1989	5,556	4,531	2,363.3	978.1	3,341.4	194.2	149.2	343.4
1990	5,572	4,616	2,370.1	996.4	3,366.5	194.7	152.0	346.7
1991	5,789	4,701	2,462.4	1,014.8	3,477.2	202.3	154.8	357.1
1992	5,905	4,786	2,511.8	1,033.1	3,544.9	206.4	157.6	364.0
1993	6,021	4,870	2,561.1	1,051.2	3,612.3	210.4	160.4	370.8
1994	6,136	4,954	2,610.0	1,069.4	3,679.4	214.4	163.1	377.6
1995	6,250	5,037	2,658.5	1,087.3	3,745.8	218.4	165.9	384.3
1996	6,363	5,120	2,706.6	1,105.2	3,811.8	222.4	168.6	391.0
1997	6,474	5,201	2,753.8	1,122.7	3,876.5	226.3	171.3	397.5
1998	6,584	5,282	2,800.6	1,140.2	3,940.8	230.1	173.9	404.0
1999	6,693	5,362	2,847.0	1,157.4	4,004.4	233.9	176.6	410.5
2000	6,800	5,441	2,892.5	1,174.5	4,067.0	237.7	179.2	416.8
2005	7,302	5,811	3,106.0	1,254.4	4,360.4	255.2	191.4	446.6
2010	7,728	6,131	3,287.2	1,323.4	4,610.6	270.1	201.9	472.0
2015	8,119	6,425	3,453.5	1,386.9	4,840.4	283.8	211.6	495.3
2020	8,521	6,720	3,624.5	1,450.6	5,075.1	297.8	221.3	519.1
2025	8,910	7,000	3,790.0	1,511.0	5,301.0	311.4	230.5	541.9
2030	9,264	7,216	3,940.6	1,557.6	5,498.2	323.8	237.6	561.4

SOURCE * : 1989 Philipine Statistical Yearbook, NSCB
** : 1980 Census of Population, NCSO

NOTE * : Based on Medium Assumption - Moderate Fertility and Moderate Mortality Decline.

Table I-3-4 HOUSEHOLD POPULATION 15 YEARS OVER AND EMPLOYMENT STATUS

Item/Region	1980	1981	1982	1983	1984	1985	1986	1987	1988	Remarks
Projected Household Population 15 years old and over :										
1. Number (in thousand)										
Philippines	28,967	29,847	30,748	31,676	32,382	33,646	33,838	34,840	35,865	2.7%*
Region VI	2,702	2,776	2,851	2,927	3,001	3,073	3,067	3,150	3,234	2.3%*
Region VII	2,276	2,342	2,408	2,476	2,543	2,609	2,605	2,670	2,736	2.3%*
2. Percent in the labor force										
Philippines	59.8%	61.7%	60.1%	64.1%	64.2%	63.4%	63.8%	65.7%	65.4%	63.1%**
Region VI	63.1%	63.4%	62.8%	70.4%	65.6%	64.7%	64.6%	66.7%	64.9%	65.1%**
Region VII	62.4%	66.0%	63.7%	69.3%	68.7%	66.9%	68.6%	68.3%	68.0%	66.9%**
Percent of labor force :										
1. Employment Rate										
Philippines	95.0%	94.7%	94.0%	94.6%	93.8%	92.9%	88.9%	90.9%	91.7%	92.9%**
Region VI	95.8%	95.8%	95.8%	97.2%	95.5%	95.5%	89.2%	92.0%	92.7%	94.4%**
Region VII	96.4%	96.6%	95.8%	95.7%	97.5%	96.6%	94.4%	92.8%	94.3%	95.6%**
2. Unemployment Rate										
Philippines	5.0%	5.3%	6.0%	5.4%	6.2%	7.1%	11.1%	9.1%	8.3%	7.1%**
Region VI	4.2%	4.2%	4.2%	2.8%	4.5%	4.5%	10.8%	8.0%	7.3%	5.6%**
Region VII	3.6%	3.4%	4.2%	4.3%	2.5%	3.4%	5.6%	7.2%	5.7%	4.4%**

Source : 1989 Philippine Statistical Yearbook, NSCB

Note * : Average annual growth rate
*' : Average

Table I-4-1 PRESENT LAND USE IN ILOG-HILABANGAN RIVER BASIN

Unit : km2

Land Use	Upper Basin	Lower Basin	Total
Mangrove	2.0	0.0	2.0
Fish Pond	24.0	0.0	24.0
Lowland Paddy	17.0	21.0	38.0
Upland Paddy	10.0	90.0	100.0
Sugarcane	70.0	299.0	369.0
Upland Crop	15.0	530.0	545.0
Coconut	1.0	19.0	20.0
Grassland	20.0	517.0	537.0
Forest/Shrubs	33.0	415.0	448.0
Residential	5.0	30.0	35.0
River Reservation	6.0	38.0	44.0
Total	203.0	1,959.0	2,162.0

Source : BSWM, Calclulated by JICA Study Team

Table I-5-1 EXISTING ROADS CLASSIFIED ACCORDING TO PAVEMENT AND ADMINISTRATIVE JURISDICTION IN NEGROS OCCIDENTAL, 1986

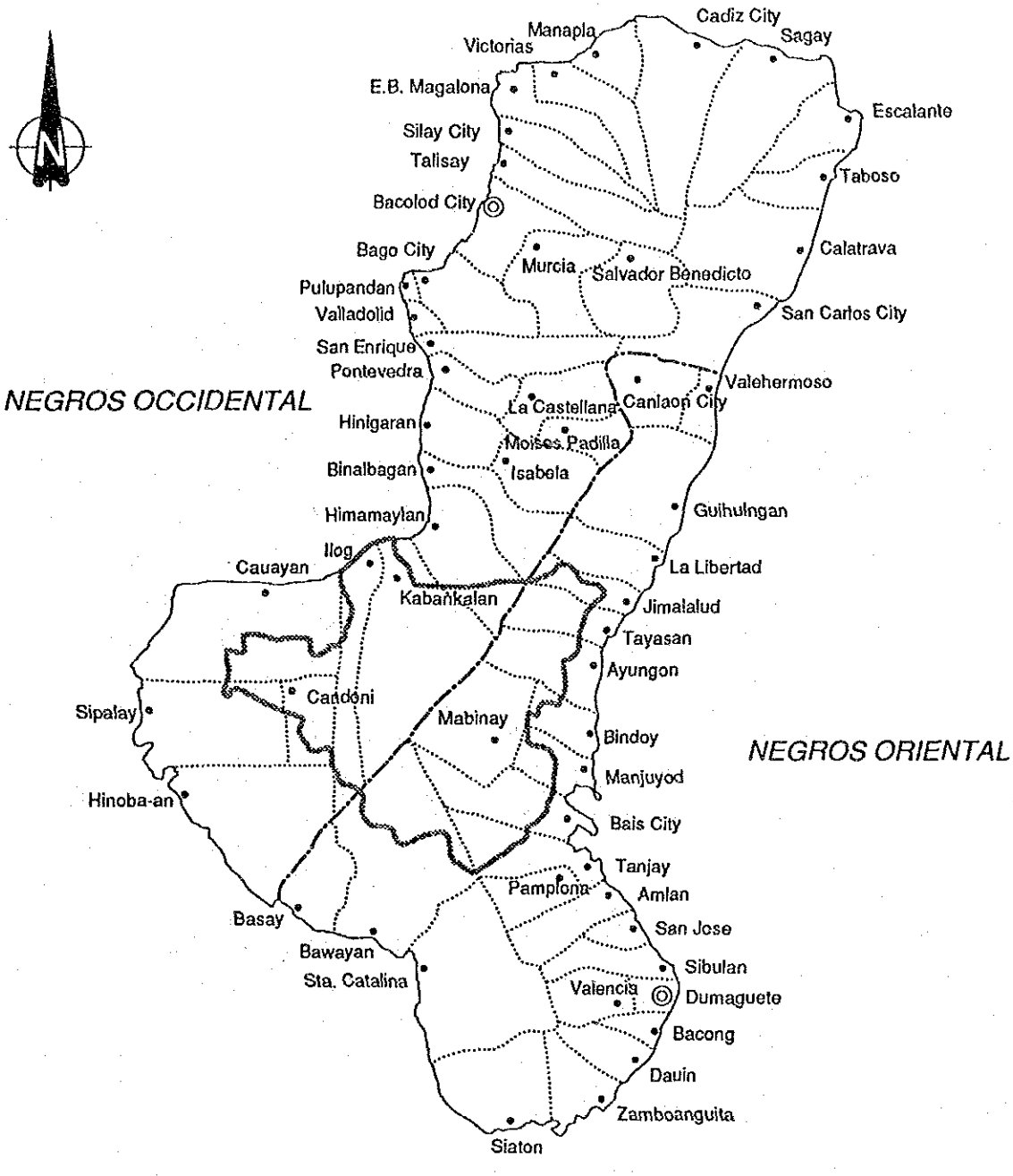
Unit : m

Administrative Office	Concrete	%	Asphalt	%	Gravel/ Earth	%	Total Length	Total Percent
1. National	102,745	2.20%	292,027	6.25%	482,135	10.32%	876,907	18.78%
- 1st Highway Engineering District	36,730	0.79%	79,865	1.71%	102,790	2.20%	219,385	4.70%
- 2nd Highway Engineering District	29,605	0.63%	106,482	2.28%	324,995	6.96%	461,082	9.87%
- Cities	36,410	0.78%	105,680	2.26%	54,350	1.16%	196,440	4.21%
2. Provincial	28,410	0.61%	54,830	1.17%	839,860 **	17.98%	923,100	19.77%
3. Cities	57,143	1.22%	151,233	3.24%	42,545 *	0.91%	250,921	5.37%
4. Manicipalities	19,088	0.41%	113,797	2.44%	107,074 *	2.29%	239,959	5.14%
5. Barangay	33,039	0.71%	145,887	3.12%	2,200,362	47.12%	2,379,288	50.95%
- 1st Highway Engineering District	0	0.00%	0	0.00%	570,299 *	12.21%	570,299	12.21%
- 2nd Highway Engineering District	650	0.01%	4,640	0.10%	1,059,650 *	22.69%	1,064,940	22.80%
- Cities	32,389	0.69%	141,247	3.02%	570,413 *	12.21%	744,049	15.93%
T o t a l	240,425	5.15%	757,774	16.23%	3,671,976	78.63%	4,670,175	100.00%

Source : Provincial Planning and Development Office

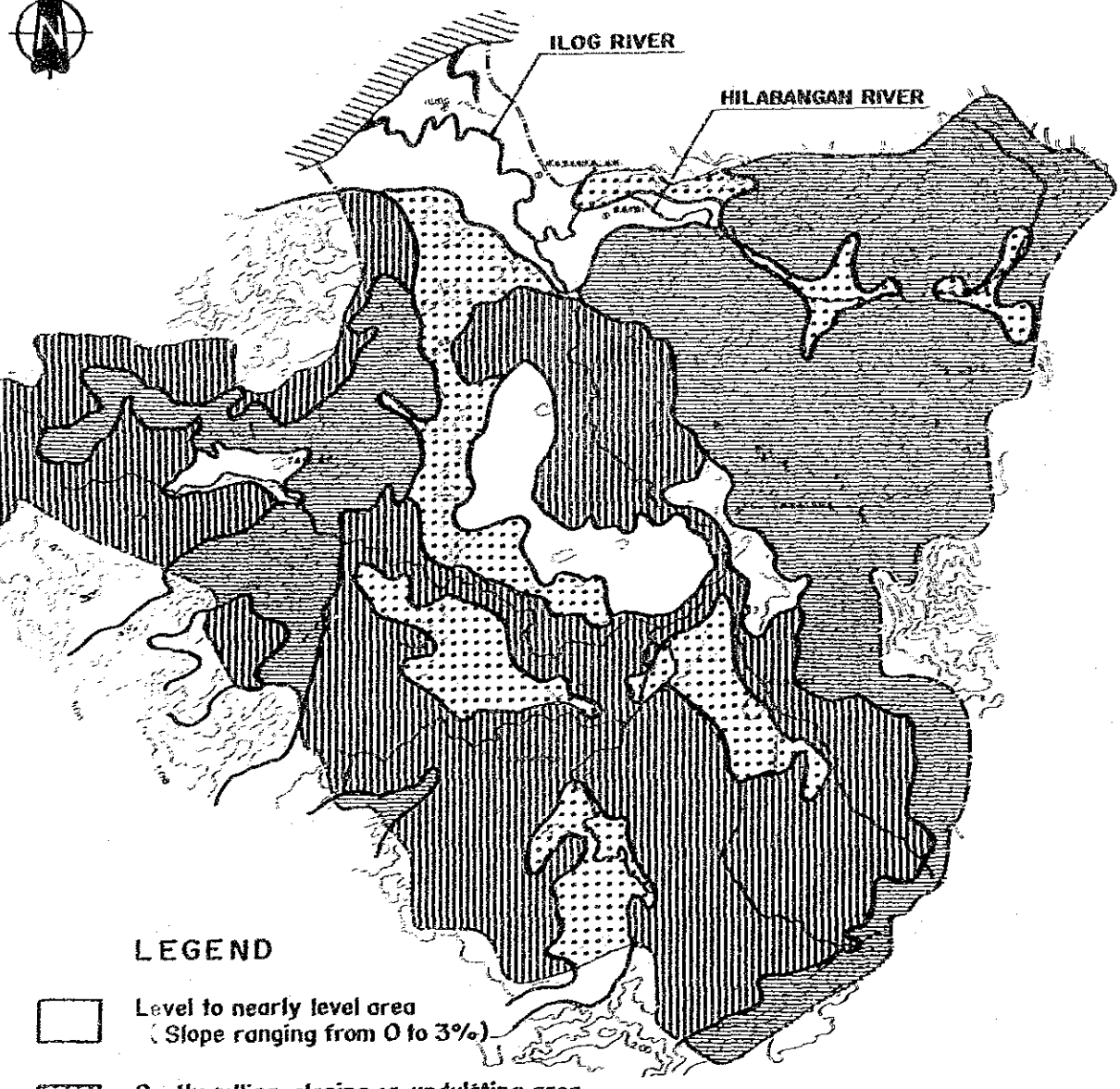
Note * : Not good roads.
** : 70% are not good roads.

FIGURES



SOURCES: MEDIUM-TERM WESTERN VISAYAS REGIONAL DEVELOPMENT PLAN, 1987-1992, REPUBLIC OF THE PHILIPPINES;
MEDIUM-TERM CENTRAL VISAYAS REGIONAL DEVELOPMENT PLAN, 1987-1992, REPUBLIC OF THE PHILIPPINES

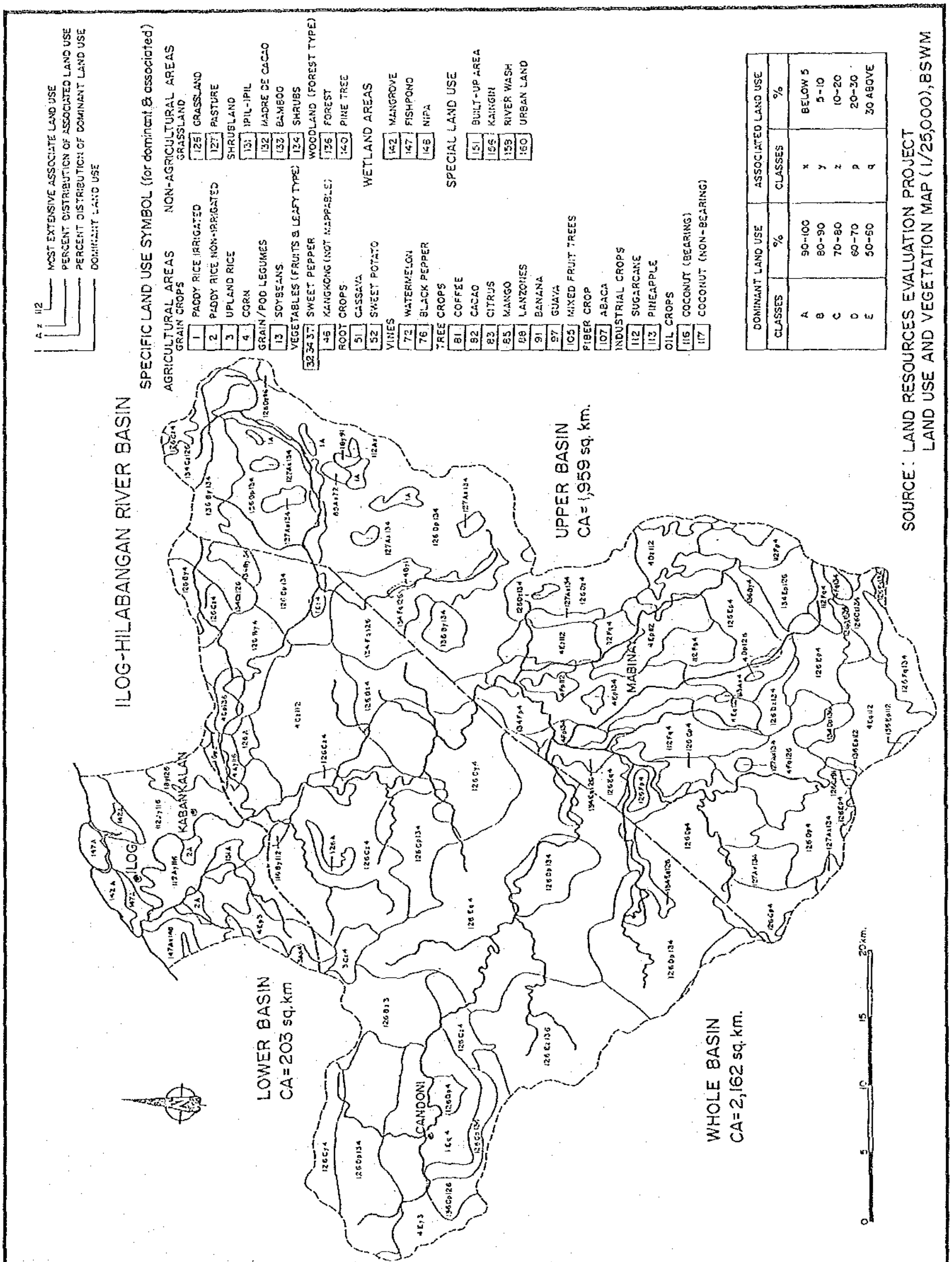
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. I-3-1 PROVINCIAL BOUNDARY IN NEGROS ISLAND



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. I-4-1 GENERALIZED SLOPE



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig. I-4-2 LAND USE AND VEGETATION MAP
JAPAN INTERNATIONAL COOPERATION AGENCY	

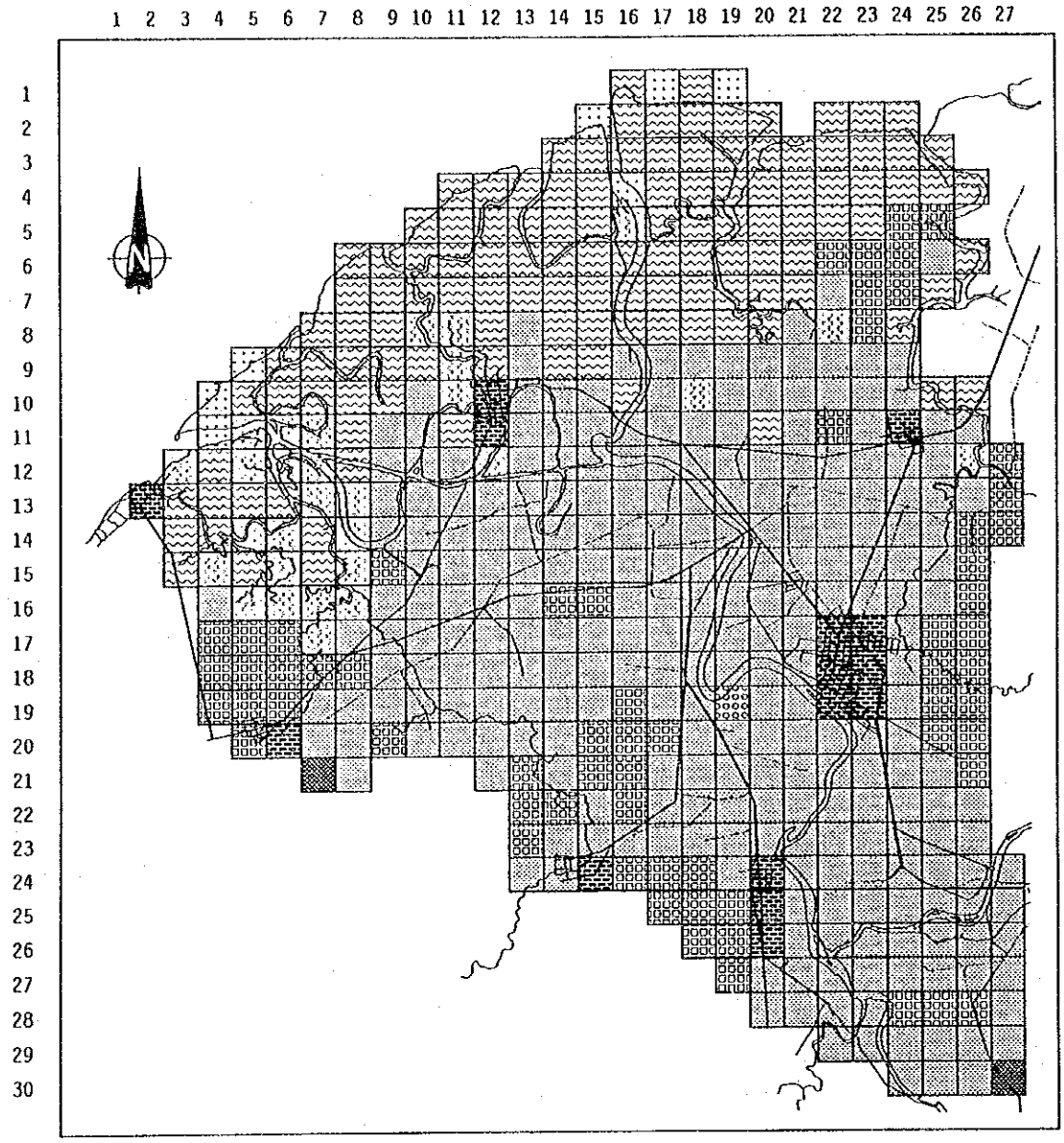


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Fig. I-4-3 GENERALIZED LAND USE IN THE FLOOD PRONE AREA

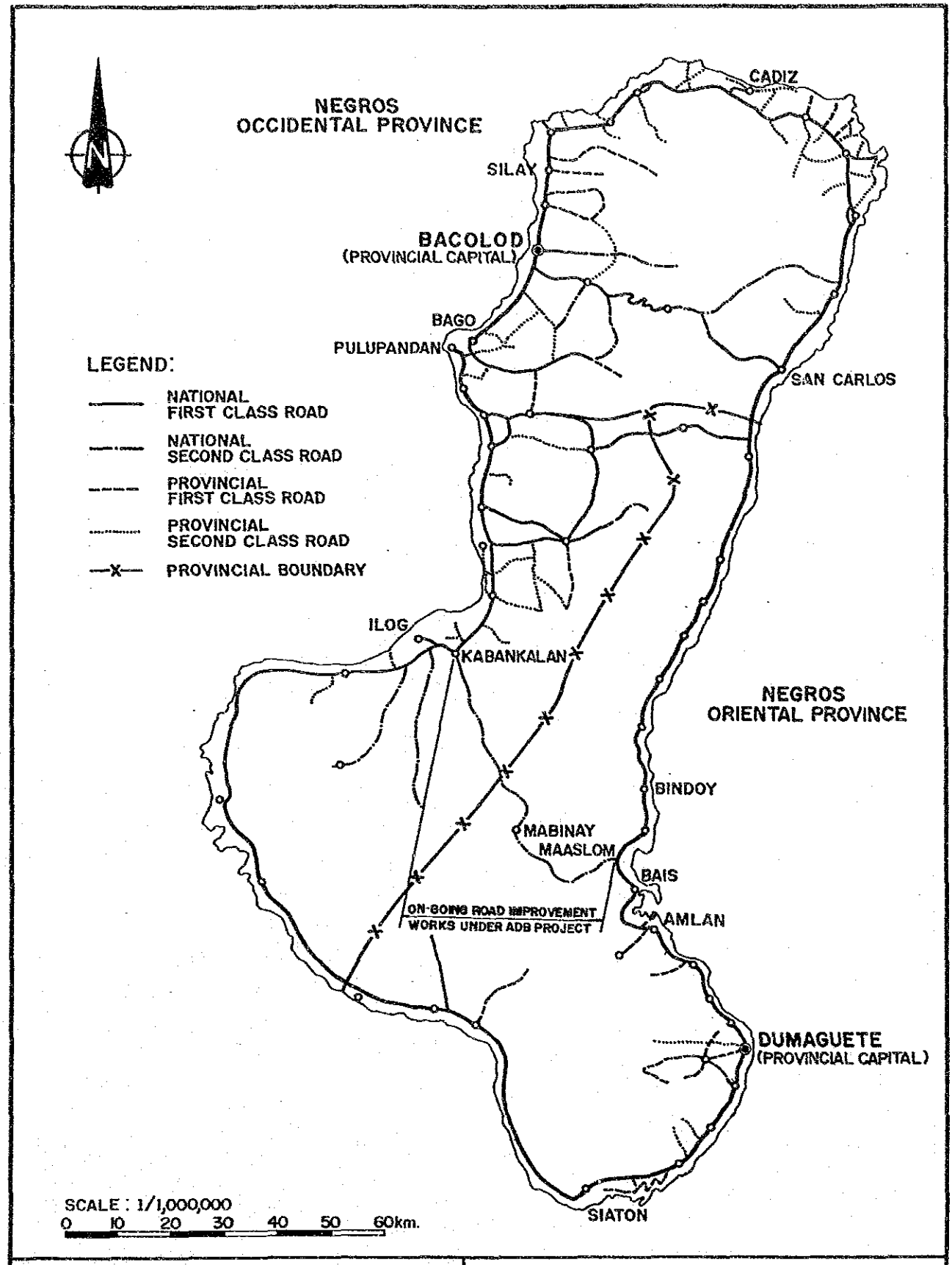

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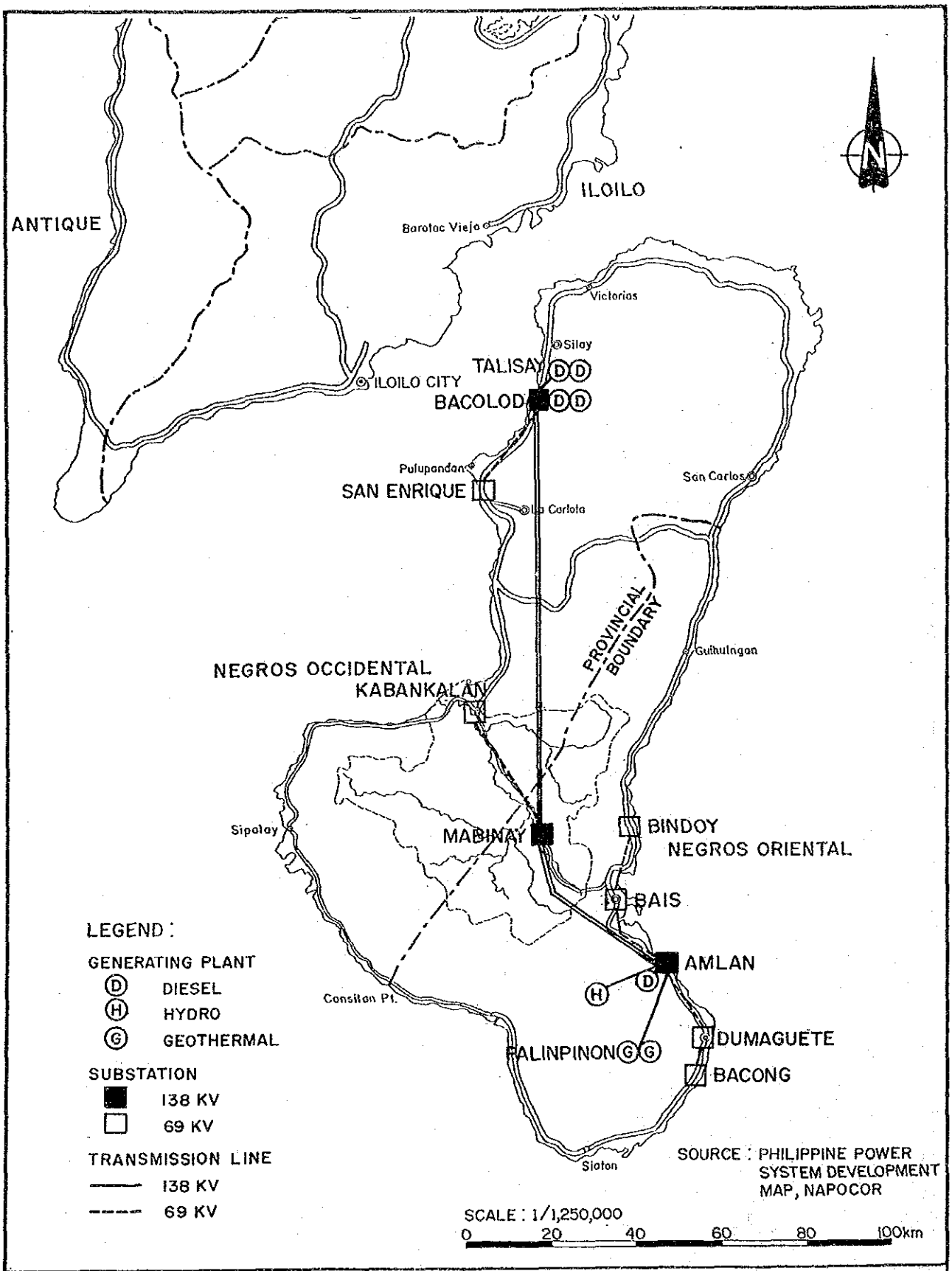
Fig. I-5-1 ROAD NETWORK IN NEGROS ISLAND



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. I-5-2 POWER SUPPLY SYSTEM IN NEGROS ISLAND

II. HYDROLOGY

STUDY

ON

ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT

SUPPORTING REPORT II. HYDROLOGY

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1. AVAILABLE DATA

The meteorological and rainfall stations in Negros Island and neighboring areas are listed in Table II-1-1, and the streamwater gauging stations in the Ilog-Hilabangan River Basin are listed in Table II-1-2. The location of these stations are presented in Figs. II-1-1 and II-1-2, respectively.

A chart of the available data at these stations is shown in Figs. II-1-3 and II-1-4. The data observed at these stations reveal the following meteorological and hydrological conditions.

2. METEOROLOGICAL AND HYDROLOGICAL CONDITIONS

2.1 Meteorology

The most important factors affecting the climate of the Philippines aside from geomorphological conditions are semi-permanent cyclones and anticyclones, air streams, ocean currents, linear systems and tropical cyclones. Global distribution of semi-permanent cyclones and anticyclones, e.g., a large anticyclone centered over Siberia in January, produce air streams and ocean currents which greatly affect the climate of the Philippines.

The principal air streams which significantly affect the Philippines are the Northeast Monsoon, the Southwest Monsoon and the North Pacific Trades. The Northeast Monsoon affects the area during the months of October to March; most dominant during January and February. The Southwest Monsoon occurs at the time of high solar altitude from May to October when the Intertropical Convergence Zone (ITCZ) moves over the area, and the air mass is warm and very humid.

The main ocean current affecting the Philippines is the North Equatorial Current moving westward across the North Pacific Ocean. Surface temperature in the vicinity of the Philippines is 27.3 degrees Centigrade, and this value is quite uniform.

The linear systems which significantly affect the climate of the Philippines are the ITCZ, a tail end of cold fronts, and easterly waves. ITCZ affects the Philippines from May to October and is usually characterized by distributed weather conditions of widespread cloudiness, convective type precipitation, and moderate and strong winds.

Tropical cyclones largely contribute to the rainfall in the Philippines from June to December. Rainfall abnormalities such as prolonged flood conditions are mostly due to the occurrence

of tropical cyclones, and draught conditions are also attributed to the occurrence of less than the expected number of tropical cyclones.

Since there is no significant change in meteorological conditions, i.e., temperature, relative humidity, etc., the climate of the Philippines is usually classified according to rainfall pattern. Fig. II-2-1 shows the modified Corona's climate classification.

The basin falls in Type I and Type III of the modified Corona's climate classification. Type I in which the southwest portion lies, is characterized as two pronounced seasons, dry and wet; heavy rain period is from June to September during the prevalence of the southwest monsoon season. Type III is characterized with not very pronounced heavy rain period with a short dry season lasting only from one to three months.

Monthly variations of meteorological data such as temperature, relative humidity, pan-evaporation, cloudiness, etc., at Iloilo City are tabulated in Table II-2-1, and some of these items are also illustrated in Fig. II-2-2. There is no significant variation in temperature and relative humidity; monthly average temperature varies from 25.9 degrees Centigrade in January to 28.8 degrees Centigrade in May. Relative humidity varies from 74% in April to 85% in August.

Tropical cyclones that passed through Negros Island from 1948 to 1988 are presented in Table II-2-2, while monthly frequency of tropical cyclones obtained from the same record are listed in Table II-2-3. According to the tables, more than 60% of the tropical cyclones which hit Negros Island occurred in November and December.

2.2 Annual and Monthly Rainfall

Annual rainfall for stations in Negros Island and neighboring areas are compared in Table II-2-4. An annual rainfall isohyetal map for the 1981-84 period is shown in Fig. II-2-3. The said map shows that the higher rainfall zone is around Bacolod and annual rainfall amount decreases to the south, though annual variation is too large to characterize the annual rainfall distribution in this area.

Average monthly rainfall distribution of the same stations are presented in Table II-2-5 and illustrated in Fig. II-2-4. The characteristics of the modified Corona's climate classification are seen in the illustration, and rainfall pattern at Kabankalan presents the intermediate characteristics of Type I and Type III.

Monthly rainfalls observed at Kabankalan are presented in Table II-2-6. The monthly rainfall correlation coefficient between Kabankalan and other stations are presented in Fig. II-2-5. As shown in the figure, the correlation coefficient is low for all stations, and it is difficult to supplement the lacking rainfall data of Kabankalan from the other stations.

2.3 River Discharge

The monthly average discharges of the Ilog and Hilabangan rivers at the following stations are shown in Tables II-2-7 and II-2-8.

River	Station	Catchment Area (km^2)
Ilog	Pandan, Orong	1,453
Hilabangan	Pangsud	431

The average annual runoff height of the rivers at these stations is around 1,400 mm, and this amount seems appropriate in consideration of the annual rainfall and the presumed evapotranspiration amount. This value corresponds to the specific discharge of 4.5 $m^3/s/100\ km^2$.

The average flow duration curve of the Ilog River at Pandan, Orong, for the 1956-79 period, has been drawn as shown in Fig. II-2-6. This duration curve has been developed based on the available daily discharge duration curves for years in the following table and considering adjustment by the annual average discharge for 24 years for the 1956-79 period. Discharges with 95-day, 185-day, 275-day and 355-day probability and the minimum discharge for years with available daily discharge duration curves are as follows:

Unit: m^3/s

Year	95-day	185-day	275-day	355-day	Min.	Ave.
1970	80.0	33.8	21.5	15.2	14.1	68.1
1972	78.8	48.9	29.1	14.7	11.5	68.7
1973	24.0	13.4	8.30	6.35	6.15	44.2
1976	23.0	8.20	6.75	5.40	5.15	45.2
1977	10.4	7.80	6.45	5.75	5.20	46.1
1978	20.0	9.70	6.10	4.80	4.80	37.0
Ave.	39.4	20.3	13.0	8.70	7.80	51.5
Adjusted 1956-79 period Ave.	50.6	26.1	16.7	11.2	10.0	66.2

3. RAINFALL ANALYSIS

3.1 Rainfall Data

As explained in the preceding chapter, there is one rainfall station in Kabankalan and thirteen rainfall stations in the neighboring areas with relatively long periods of daily rainfall data. The stations installed by the Study Team during the study period have hourly data; however, the period covered by the data is limited to only a few months. A long period of data is required to calculate the probable value, and hourly rainfall data is required to develop the hyetograph.

Of these daily rainfall stations, Iloilo and La Granja stations have relatively long periods of data starting in 1949 and 1956, respectively. Most of the other stations including the one in Kabankalan started observation in 1971 and accordingly available data are less than those of the two stations. Since monthly rainfall correlation between Kabankalan, the only station in the subject river basin, and the other stations is not clear as shown in Fig. II-2-5, supplementation of data from the other stations was not considered even though the data period is somehow short at 19 years. Kabankalan has been accordingly selected as a representative station for estimation of the probable value. Hourly rainfall data observed at automatic rainfall stations installed by the Study Team were used to develop the rainfall intensity - duration curve.

3.2 Duration of Design Rainfall

Duration of design rainfall is usually determined considering the following items:

(a) Scale of the Catchment Area
(b) Duration of Flood
(c) Rainfall Characteristics

Duration of design rainfall for the present study has been determined at 2-day on the basis of the following considerations:

(1) Scale of the Catchment Area

Duration of design rainfall depends upon the scale of the catchment area; namely, the smaller the catchment area the shorter the period. In Japan, almost all principal river basins (catchment area of 1,500 to 12,000 km^2) adopt 2-day for design rainfall

duration. Considering that the catchment area of the Ilog-Hilabangan River Basin is approx. 2,000 km^2, 2-day for design rainfall duration is appropriate.

(2) Duration of Flood

Review on the available data and interview survey at the site verified that floods of the Ilog-Hilabangan River usually last from 1 to 2 days and rarely exceed 2 days. Therefore, the 2-day design rainfall is appropriate.

(3) Rainfall Characteristics

Rainfall which cause flood in the Study Area is mostly of tropical cyclones and of cold fronts of the Intertropical Convergence Zone. Rainfall which lasts more than 3 days is rare in the area.

Cover rates of 1-day and 2-day rainfall to a series of rainfall which is defined as rainfall of more than 200 mm per 3-day based on the daily rainfall data observed at Kabankalan are as follows:

(a) Cover rate of 1-day rainfall : 54%
(b) Cover rate of 2-day rainfall : 82%

This means that a 2-day rainfall can cover almost all rainfalls. A duration of 24 hours is sometimes applied for design rainfall. In the case of the Study Area, time of heavy rainfall occurrence is not fixed, e.g., in the morning or in the afternoon, and daily rainfall in the Philippines is defined as rainfall from 8:00 a.m. of the subject date to 8:00 a.m. of the following day, and thus 2-day rainfall covers 24-hour rainfall.

3.3 Annual Maximum Rainfall

Based on the daily rainfall record at Kabankalan, the annual maximum 2-day continuous rainfall from 1971 to 1989 has been picked up and presented in Table II-3-1. The annual maximum 1-day rainfall which will be used to develop the model hyetograph is also shown in the table. The maximum observed 2-day rainfall is 233.8 mm in 1982. Monthly occurrences and rate of the annual maximum 2-day rainfall are tabulated in Table II-3-2.

3.4 Probable Rainfall

Probable rainfall for the Ilog-Hilabangan River Basin was obtained on the basis of the probable point rainfalls, considering areal and altitude adjustment.

(1) Point Rainfall

The annual maximum rainfall was plotted on a log-probability chart, and the probable point rainfalls at Kabankalan by return period were obtained as follows:

Unit: mm

	Return Period (year)					
Duration	100	50	25	10	5	2
2-day	324	291	258	214	178	122
1-day	250	217	188	150	121	79

(2) Conversion of Point Rainfall to Areal Rainfall

Probable rainfalls were obtained from the data at Kabankalan and accordingly, these values are of point rainfalls. These point rainfalls have to be converted into areal rainfalls for probable hydrograph calculation.

Since there is no sufficient data to obtain areal rainfall of the basin, Holton's formula, the most popular one, were applied. Constants which were determined for the neighboring area, the Panay River Basin, were applied. The formula is:

$$P = P_o \cdot EXP[-0.1 \cdot (0.386 \cdot A)^{0.31}]$$

where,

P : Areal Rainfall

P_o: Point Rainfall

A : Area (km^2)

(3) Adjustment of Rainfall by Altitude

Since the calculated probable rainfall is based on the data at Kabankalan (altitude is approx. EL. 10 m), this value has to be adjusted by altitude to the rainfall in mountainous areas.

The Team checked rainfall - altitude relation for the Study Area using the rainfall data observed at 9 stations in the catchment; however, clear correlation was not obtained because the number of data is too small.

The following rainfall - altitude relation has been developed in the Nationwide River Dredging Program using data in the Philippines.

$$FL = EXP\ [\ h/1480\ ]$$

where,
FL : altitude adjustment coefficient
h : altitude (m)

According to this formula, the adjustment rate per 100 m is 7%. On the other hand, the Japanese standard says 5 to 10% (average 7.5%) increase per 100 m altitude increase. Accordingly, 7.5% per 100 m was adopted for the present study.

(4) Probable Rainfall in the Ilog-Hilabangan River Basin

Probable rainfall in the Ilog-Hilabangan River Basin was accordingly calculated as follows:

Unit: mm

	Return Period (year)					
Duration	100	50	25	10	5	2
2-day	202	181	161	133	111	76
1-day	156	135	117	93	75	49

3.5 Model Hyetograph

The actual rainfall pattern during a flood is commonly used for rainfall pattern to obtain the probable hydrograph. Hourly rainfall data in the Study Area is available only after May 1990, and there is no sufficient data; hence, a model hyetograph was applied.

Rainfall intensity - duration curve which will be used to develop a model hyetograph were prepared from the data of rainfall which exceeded 100 mm per 24 hours. The curve is presented in Fig. II-3-1. The centralized model hyetograph was accordingly developed as shown in Fig. II-3-2.

4. RUNOFF ANALYSIS

4.1 Runoff Model

The storage function model is applied as a runoff model for this study. This storage function model is commonly used for major river systems in the Philippines and is also widely used in Japan. Constants for the Ilog-Hilabangan River Basin were determined through simulation.

The storage function model was developed to express the non-linear characteristics of runoff phenomena, introducing the following function between the storage volume (S_l) of a basin and the discharge (Q_l) from the same.

$$S_l = K \cdot Q_l^P$$

where,
K and P are constants

This equation is used with the equation of motion which expresses runoff as proportional to the exponent of storage volume. In this equation, runoff phenomena is considered to be similar to the runoff from the notch of a container filled with water.

Runoff calculation was performed in combination with the following equation of continuity for basin.

$$\frac{dS_l}{dt} = \frac{1}{3.6} \cdot f \cdot r_{ave} \cdot A - Q_l$$

where,

S_l : apparent storage volume in the basin ($m^3/s/hr$)
f : inflow coefficient
r_{ave} : basin's average rainfall (mm/hr)
A : area of the basin (km^2)
$Q_l(t) = Q(t+T_l)$: direct runoff height with lag time (m^3/s)
T_l : lag time (hr)

The storage function of the channel is expressed as follows:

$$S_l = K \cdot Q_l^P - T'_l \cdot Q_l$$

where,

K and p : constants
T'_l : lag time for river channel

4.2 Division of Basin

The entire Ilog-Hilabangan River Basin was divided into 25 subbasins as shown in Fig. II-3-3. Division was made on 1/50,000 topo-map considering factors, e.g., area of subbasins, shape of basin, topography and other conditions. It was also made considering possible structures, i.e., dams and a retarding basin.

Based on this division of the basin, a river system diagram was developed as shown in Fig. II-3-4. The model is composed of 25 subbasins, 13 river channels and 4 dams. The characteristics of each subbasin and channel are presented in Tables II-3-3 and II-3-4, respectively.

4.3 Estimation of Constants

(1) Initial Settings

Initial settings of constants for sub-basins and channels were made as follows:

(a) K, p and T_l of Basin

As discussed before, basin's storage function is expressed as follows:

$$S_l = K \cdot Q_l^p$$

The initial value for K, p and T_l of basin were determined from an experimental formula (*Tone River* Formula) developed in Japan:

$$K = 118 / (I^{-1})^{0.3}$$
$$p = 0.175 \cdot (I^{-1})^{0.235}$$
$$T_l = 0.0470 \cdot L - 0.56 \quad (L > 11.9 \text{ km})$$
$$T_l = 0 \qquad (L < 11.9 \text{ km})$$

where,

K and p : constants
I : average gradient of the catchment
T_l : lag time (hour)
L : distance from the point under consideration to the farthest point in the basin along the river course

(b) Base Flow

Base flow for each subbasin was calculated from the actually observed discharge at Talubangi applying the catchment area's ratio.

(c) Primary Runoff Rate ($f1$) and Saturation Rainfall Depth *(Rsa)*

Primary runoff rate: $f1$ was fixed at 0.5 which is the value generally applied. Saturation rainfall depth: *Rsa* was determined from rainfall - runoff height relation.

(d) K, p and T_l of River Channel

K and p for river channels were determined assuming the flow as Manning's uniform flow.

(2) Objective Flood for Verification

(a) Objective Flood

The objective flood for verification of the runoff model was selected from a series of hydrographs observed by an automatic water level gauge. The following floods were selected for verification.

Date	Peak Discharge (m^3/s) Orong	Talubangi
May 20-22	1,000	1,028
Aug. 12-15	838	1,152
Sep. 30 - Oct. 2	1,039	1,039
Oct. 10-1	437	473

(b) Verification Point

Verification of the model was conducted at the following points where water level record is available.

River	Point	Catchment Area (km^2)
Ilog	Orong	1,432
Hilabangan	Overflow	445
Ilog	Talubangi	1,960

(c) Rainfall During Flood

Observed hourly rainfalls at automatic rainfall gauging stations during the flood in August are presented in Table II-3-5 and in Fig. II-3-5 as an example. Tiesen polygon method was applied to calculate the rainfall of each subbasin.

(3) Verification of Runoff Model

Verification of the model was conducted by comparing observed and simulated hydrographs. The simulated hydrograph was calculated by applying observed rainfall to the model by trial and error changing constants.

Comparison of hydrographs based on the final constants are as presented in Fig. II-3-6. Conformity degree was calculated by the following formula at 0.009. It is generally said that if S^2 is smaller than 0.03, conformity degree is good.

$$S^2 = \frac{1}{n} \sum_{i=1}^{n} \left(\frac{Q_o(i) - Q_c(i)}{Q_{op}} \right)^2$$

where,

$Q_o(i)$: observed discharge at time (i)

$Q_c(i)$: calculated discharge at time (i)

Q_{op} : peak value of observed discharge

n : calculation time

(4) Summary of Parameters

Summaries of parameters for the storage function model for river basins and river channels determined through the verification are presented in Tables II-3-6 and II-3-7, respectively.

4.4 Probable Flood Hydrograph

(1) Basic Consideration

Basic considerations to obtain the probable flood hydrograph are as follows:

(a) Storage function model with final parameters were applied to calculate hydrograph from probable design hyetograph.

(b) *Rsa* for calculation of probable hydrograph is set at 20 mm which is an average value for floods during rainy season.

(2) Probable Flood Hydrograph

Probable flood hydrographs were obtained for the following portions:

(a) in the Ilog River, at the downstream portion of the confluence with the Hilabangan River,
(b) in the Ilog River, at the upstream portion of the confluence with the Hilabangan River, and
(c) in the Hilabangan River, at the upstream portion of the confluence with the Ilog River.

Of these portions, the center of design rainfall for (a) and (b) was located at the center of catchment of the entire Ilog-Hilabangan River; for the case of (c), the design rainfall was applied only for the catchment of the Hilabangan River.

The following table shows peak discharges by return period at reference points, and hourly discharges are presented in Table II-3-8.

Unit: m^3/s

Reference Point	Return Period (year) 100	50	25	10	5	2
Confluence of Ilog & Hilabangan	5,430	4,540	3,690	2,630	1,880	920
Ilog	4,270	3,510	2,920	2,090	1,510	750
Hilabangan	2,900	2,380	1,930	1,410	980	460

Fig. II-3-7 shows probable flood hydrograph for a 100-year return period at the downstream portions of the confluence of the Ilog and Hilabangan rivers with a peak discharge of 5,430 m3/s together with hydrographs at the Ilog and Hilabangan Rivers before the confluence, and a probable flood hydrograph for the same return period for the Hilabangan River.

(3) Appropriateness of the Calculated Probable Discharge

(a) Check by Specific Discharge

The peak discharge of 100-year return period at the reference point (catchment area: 1,960 km^2) is 5,430 m^3/s, and this value corresponds to a specific discharge of 2.8 $m^3/s/km^2$.

Fig. II-3-8 shows a specific discharge plot for 100-year return period probable discharge in the Philippines. Specific discharge of 2.8 m^3/s for 1,960 km^2 is an appropriate value.

(b) Verification by Inundation Condition

Flow capacity of the present river course of the Ilog River is as follows:

River Course	Flow Capacity	Corresponding Probability
Downstream Area (Bungol Div. Channel)	500	less than 2-year
Midstream Area (Kabankalan City Area)	1,800-2,000	approx. 5-year
Upstream Area (Just downstream of Ilog-Hilab. junction)	1,000	approx. 2-year

These values seem appropriate in view of the fact that (1) inundations occur every year in the downstream area, (2) flood occurred 8 times in 42 years (1949-90) in the midstream area and this corresponds to once in 5 years, and (3) floods occur once in two years in the area downstream of the Ilog-Hilabangan junction.

TABLES

Table II-1-1(1/2) LIST OF METEOROLOGICAL AND RAINFALL STATIONS

(1) Stations under PAGASA

Code	Station Name	Coordinates		Type	Remarks
		Longitude(E)	Latitude(N)		
056	La Granja, La Carlota, Negros Occ.	122-56'	10-24'	AG	Data are the same with those at 0613
0607	Barotac Viejo, Iloilo	122-57'	11-03'	OR	
0611	Sagay, Negros Occ.	123-30'	10-56'	OR	Contains many unreliable data
0612	Kabankalan, Negros Occ.	122-49'	09-59'	OR	
0613	La Granja Exp. Stn La, Negros Occ.	122-59'	10-25'	CR	
0614	Pulupandan, Negros Occ.	122-48'	10-31'	VSS	Contains many unreliable data especially after 1980
0615	San Carlos City, Negros Occ.	123-25'	10-29'	OR	
0616	Silay Hawaiian Central, Negros Occ.	122-58'	10-48'	CC	
0617	Sipalay, Negros Occ.	122-24'	09-45'	OR	
0618	Victorias, Negros Occ.	123-05'	10-55'	CC	
0719	Guihulngan, Negros Oriental	123-16'	10-07'	OR	Contains many unreliable data
0720	Nonas, Bayawan, Negros Oriental	122-48'	09-22'	OR	
0721	Siaton, Negros Oriental	123-02'	09-04'	OR	Contains many unreliable data especially after 1984
637	Iloilo City, Iloilo	122-34'	10-42'	SY	

Note SY : Synoptic Station
AG : Agromet Station
OR : Official Rainfall Station
CR : Cooperative Rainfall Station
CC : Cooperative Climate Station
VSS : Visual Storm Signal

Table II-1-1(2/2) LIST OF METEOROLOGICAL AND RAINFALL STATIONS

(2) Automatic Rainfall Gauging Stations installed by the Study Team

No.	Name	Coordinates		Approx. Elevation (EL m)	Location
		Longitude(E)	Latitude(N)		
1.	Caningay	122-40'36"	09-50'26"	160	in Bgy. farmland of Bgy. Caningay, Negros Occidental
2.	Magballo	122-44'04"	09-46'05"	140	In the Bgy. plaza of Bgy. Magballo, Negros Occidental
3.	Bugay	122-47'48"	09-40'49"	200	in private farm in Bgy. Bugay (outside the Bgy. proper), Negros Oriental
4.	Tara	122-52'51"	09-39'53"	210	in the elementary school compound in Bgy. Tara, Negros Oriental
5.	Mabinay	122-56'00"	09-43'30"	80	behind Dept. of Agriculture Office in Municipality of Mabinay (inside town proper), Negros Oriental
6.	Tibyawan	123-05'08"	09-53'49"	420	in farmland of Vice-Mayor of Municipality of Ayungon, Negros Oriental
7.	Carol-an	122-57'42"	09-51'53"	490	in Bgy. proper of Bgy. Carol-an, Negros Occidental
8.	NOAC	122-53'10"	09-50'57"	100	in the compound of Negros Occidental Agricultural School (NOAC) in Bgy. Camingawan, Negros Occidental
9.	Kabankalan	122-48'24"	10-00'00"	5	in the house lot of Vice-Mayor of Kabankalan, Negros Occidental

Table II-1-2 LIST OF STREAMWATER GAUGING STATIONS

(1) Stations under NWRB

No.	River	Station Name	Coordinates Long.(E)	Coordinates Lat.(N)	Catchment Area (km2)	Observation Period
I-1	Ilog	Camugao	122-48'30"	9-59'15"	1,959	1964 - 1979
I-2	Ilog	San Juan	122-48'15"	9-58'00"	1,947	1964 - 1979
I-3	Ilog	Pandan, Orong	122-50'20"	9-55'30"	1,453	1956 - 1979
I-4	Ilog	Dahile	122-50'40"	9-53'20"	1,390	1962 - 1978
I-5	Ilog	Inapoy	122-52'20"	9-49'42"	1,245	1965 - 1979
H-1	Hilabangan	Pangsud	122-50'10"	9-58'06"	431	1955 - 1979
H-2	Hilabangan	Tagbac	122-56'12"	9-56'58"	392	1962 - 1979

(2) Automatic Water Level Gauging and Discharge Measurement Stations Installed by the Team

No.	River	Station Name	Coordinates Long.(E)	Coordinates Lat.(N)	Catchment Area (km2)	Location
1.	Ilog	Orong	122-49'50"	9-55'42"	1,432.2	3.9km upstream from junction with Hilabangan River in Bgy. Orong
2.	Hilabangan	Overflow	122-50'07"	9-58'09"	444.6	4.6km upstream from junction with Ilog River in Bgy. Overflow
3.	Ilog	Talubangi Brdg.	122-47'58"	10-00'36"	1,981.0	just downstream of Talubangi Bridge on Ilog River in Bgy. Talubangi

Note : Observation started in May 1990.

(3) Water Level Staff Gauging Stations Installed by the Team

No.	River	Station Name	Coordinates Long.(E)	Coordinates Lat.(N)	Location
1.	Ilog	Malabon Div. Channel	122-47'03"	10-01'29"	Pier of Malaban Bridge
2.	Ilog	Cutoff Channel	122-46'11"	10-01'05"	At the bridge
3.	Ilog	Old Ilog No.1	122-46'08"	10-01'32"	Pier of the Session Hall of Ilog Municipality
4.	Ilog	Old Ilog No.2	122-45'46"	10-01'35"	Pier of the bridge
5.	Binicuil	Binicuil	122-49'48"	10-01'35"	Pier of the bridge

Note : Observation started in May 1990.

Table II-2-1 MONTHLY VARIATINS OF METEOROGICAL DATA AT ILOILO CITY

I t e m	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
1. Temperature (degree centigrade)													
Ave. Daily Max.	29.3	29.9	31.2	32.5	32.3	31.3	30.6	30.2	30.5	30.7	30.4	29.8	30.7
Ave. Daily Min.	22.5	22.5	23.2	24.4	25.3	24.4	24.2	24.4	24.2	24.0	23.8	23.4	23.9
Daily Average	25.9	26.2	27.2	28.2	28.8	27.9	27.3	27.3	27.4	27.4	27.2	26.6	27.3
2. Relative Humidity (%)													
Maximum	94.0	96.0	94.0	94.0	95.0	98.0	97.0	95.0	96.0	97.0	98.0	97.0	95.9
Minimum	71.0	67.0	67.0	65.0	69.0	62.0	83.0	81.0	77.0	77.0	75.0	75.0	72.4
Average	81.2	79.2	75.9	73.4	77.4	81.9	86.4	85.0	85.4	85.4	86.1	85.5	81.9
3. Prevailing Wind													
Dir./Speed(m/s)	NE/5	NE/6	NE/5	NE/5	NE/5	SW/3	SW/3	SW/4	SW/3	NE/3	NE/4	NE/5	NE/4
4. Cloudiness													
Octus	6	6	5	5	6	8	8	8	8	7	7	7	7
5. Pan Evaporation (mm)													
Iloilo City	172	179	221	220	207	169	156	160	154	154	149	163	2,104
Kabankalan	129	152	195	200	163	122	116	115	135	145	128	118	1,719
6. Rainfall													
Amount (mm)	49	28	34	71	98	302	324	359	323	294	173	88	2,143
Rainy Days (day)	8	6	5	5	11	18	20	20	19	18	14	13	157
7. Tropical Cyclones Passing Negros Island													
Occurrence (%)	0	0	14	4	7	4	0	0	4	7	32	29	100

Tablle II-2-2 SUMMARY OF TROPICAL CYCLONES WHICH PASSED THROUGH NEGROS ISLAND (1948-88)

No.	Year	Class	Name	Date	Max. Winds Observed			Min. SLP Observed			Max. 24 hrs. Rainfall		
					m/s	Place	Date	mmbar	Place	Date	mm	Place	Date
1	1949	T.S.	NONE	NOV. 04-08	10.8	LAHUG	0	996.0	OVERWATER	0	142.2	SURIGAO	0
2	1949	T.Y.	NONE	OCT.31-NOV.3	44.4	LAHUG	1	1006.6	OVERWATER	0	213.6	SURIGAO	0
3	1949	T.S.	RENA	NOV. 10-13	28.9	APARRI	11	1002.7	MANILA	12	241.3	DALA.CEBU	11
4	1950	T.Y.	DINAH	OCT. 18-20	0.0	NONE	0	0.0	NONE	0	0.0	NONE	0
5	1950	T.Y.	DELILAH	NOV. 18-22	33.6	SURIGAO	20	1000.2	OVERWATER	0	355.1	DALA.CEBU	0
6	1951	T.Y.	AMY	DEC. 05-16	44.7	CEBU	9	978.0	CEBU	9	518.0	CEBU	9
7	1954	T.Y.	RUBY	NOV. 05-09	42.2	CASIGURAN	8	0.0	NONE	0	368.0	ILAGAN	8
8	1954	T.S.	NONE	DEC. 23-27	23.3	HINATUAN	24	986.0	OVERWATER	0	215.0	BAGONEG.OC	24
9	1954	T.Y.	NONE	MAR. 01-04	10.4	HINATUAN	3	1007.0	BASCO	4	177.0	MAM.CAM.IS	3
10	1954	T.Y.	ELSIE	MAY. 05-09	31.1	SURIGAO	7	1002.6	OVERWATER	0	356.0	DALA. CEBU	6
11	1954	T.Y.	TILDA	NOV. 27-30	26.9	ILOILOCUYO	29	998.2	OVERWATER	0	170.0	CEBU	29
12	1958	T.D.	NONE	NOV. 24-25	17.8	ILOILO	24	1004.3	BORONGAN	24	133.1	CATARMAN	24
13	1960	T.Y.	KAREN	APR. 20-26	18.1	SURIGAO	21	1001.9	SURIGAO	21	173.0	SURIGAO	21
14	1967	T.Y.	BEBENG	MAR. 02-05	33.3	SURIGAO	3	1000.6	SURIGAO	3	94.0	BASCO	5
15	1970	T.D.	ANING	NOV. 24-25	9.2	BORONGAN	24	1007.2	SURIGAO	26	71.4	VIRAC	24
16	1971	T.Y.	GOYING	OCT. 19-22	27.8	CEBU	20	990.8	SURIGAO	20	85.5	CEBU	21
17	1971	T.D.	HOBING	NOV. 02-05	12.5	SAURIGAO	4	1005.4	SURIGAO	4	54.5	CAG.DE ORO	6
18	1972	T.Y.	UNDANG	DEC. 01-08	30.6	CUYO	4	997.3	HINATUAN	3	199.5	CUYO	10
19	1974	T.D.	KADING	DEC. 14-17	13.9	BALER	15	1003.3	MASBATE	16	162.5	BALER	15
20	1975	T.Y.	AURING	MAR. 22-25	30.6	MACTAN	24	984.9	SURIGAO	24	102.2	BALER	25
21	1976	T.D.	KAYANG	DEC. 29-30	13.1	CUYO	30	1005.4	DAVAO	30	150.5	DAVAO	29
22	1977	T.Y.	KURING	JUN. 13-14	41.7	OVERWATER	0	976.0	OVERWATER	0	44.0	SCI GARDEN	16
23	1978	T.D.	GARDING	DEC. 13-16	26.4	VIRAC/RADA	0	1001.6	CAG.DE SUL	0	1469.0	VIRAC	13
24	1979	T.Y.	BARANG	DEC. 09-13	41.7	RECON	11	1007.9	CATBALOGAN	11	22.0	INFANTA	10
25	1979	T.S.	KARING	MAY 10-16	18.1	S.FRANCIS	16	1005.5	TAGBILARAN	0	128.5	CASIGURAN	13
26	1982	T.Y.	BISING	MAR. 23-29	45.0	MAASIN	26	991.9	MAASIN	26	157.2	MAASIN	26
27	1983	T.D.	DADANG	DEC. 18-19	18.1	JFJB	18	1005.0	EREI	19	69.1	HIMATUAN	19
28	1984	T.Y.	NITANG	AUG.31-SEP.4	60.0	SURIGAO	1	993.6	ILOILO	2	221.6	CUYO	2

Source : Climatological Normal & Extremes of Tropical Cyclones in the Philippines, May 1989, PAGASA

TABLE II-2-3 MONTHLY NUMBER OF TROPICAL CYCLONES WHICH PASSED THROUGH NEGROS ISLAND (1948-88)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
1949											3		3
1950										1	1		2
1951												1	1
1952													0
1953													0
1954			1		1						2	1	5
1955													0
1956													0
1957													0
1958											1		1
1959													0
1960				1									1
1961													0
1962													0
1963													0
1964													0
1965													0
1966													0
1967			1										1
1968													0
1969													0
1970											1		1
1971										1	1		2
1972												1	1
1973													0
1974												1	1
1975			1										1
1976												1	1
1977						1							1
1978												1	1
1979					1							1	2
1980													0
1981													0
1982			1										1
1983												1	1
1984									1				1
Total	0	0	4	1	2	1	0	0	1	2	9	8	28
Ave.	0.00	0.00	0.11	0.03	0.06	0.03	0.00	0.00	0.03	0.06	0.25	0.22	0.78
(%)	0	0	14	4	7	4	0	0	4	7	32	29	100
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year

Source : Climatological Normal & Extremes of Tropical Cyclones
in the Philippines, May 1989, PAGASA

Table II-2-4 ANNUAL RAINFALL COMPARISON IN NEGROS ISLAND AND NEIGHBORING AREAS

Unit : mm

Year	Station No.										
	0607	0612	0613	0614	0615	0616	0617	0618	0720	0721	637-
1966	**	**	**	**	**	**	**	**	**	**	**
1967	**	**	2,650	**	**	**	**	**	**	**	**
1968	**	**	2,947	**	**	**	**	**	**	**	**
1969	**	**	2,657	**	**	**	**	**	**	**	**
1970	**	**	2,458	**	**	**	**	**	**	**	**
1971	**	**	2,830	**	**	2,862	**	3,218	**	2,220	1,433
1972	1,477	**	3,288	1,813	1,256	2,510	**	3,263	**	1,346	2,472
1973	1,324	2,668	2,767	2,472	1,744	3,151	2,754	3,625	**	1,737	**
1974	1,578	2,329	2,772	**	1,327	2,627	3,758	2,573	**	2,491	2,117
1975	2,056	**	3,260	2,625	**	2,566	3,879	2,712	**	1,575	2,051
1976	1,954	1,699	3,555	1,832	1,789	3,133	3,454	2,799	**	1,875	2,295
1977	1,349	936	**	1,420	1,078	2,629	2,731	2,669	**	1,799	1,596
1978	1,543	1,360	**	1,031	**	2,151	3,056	2,102	**	1,856	1,878
1979	1,126	959	2,638	1,279	1,145	2,228	3,046	**	**	1,743	**
1980	1,313	**	**	**	1,483	**	2,507	**	**	**	**
1981	**	1,914	**	669	1,436	2,662	**	2,410	2,192	1,847	1,757
1982	746	2,614	2,689	381	1,102	**	1,725	2,249	1,274	1,952	2,411
1983	573	2,391	1,892	174	1,136	3,104	1,119	2,296	829	1,644	1,827
1984	996	3,082	2,781	**	**	2,687	2,232	2,409	1,995	971	3,142
1985	683	4,195	**	**	1,499	2,241	2,468	2,716	**	598	2,371
1986	**	3,868	2,512	**	**	**	1,998	**	2,368	581	2,365
1987	**	2,494	**	361	835	1,312	1,604	2,227	**	**	1,833
1988	1,293	4,729	2,269	**	1,460	1,981	**	3,011	**	**	2,586
1989	878	2,370	**	**	1,621	**	1,049	**	**	**	**

Note 0607 : Barotac Viejo, Iloilo
0612 : Kabankalan, Negros Occ.
0613 : La Granja Exp. Stn La, Negros Occ.
0614 : Pulupandan, Negros Occ.
0615 : San Carlos City, Negros Occ.
0616 : Silay Hawaiian Central, Negros Occ.
0617 : Sipalay, Negros Occ.
0618 : Victorias, Negros Occ.
0720 : Nonas, Bayawan, Negros Oriental
0721 : Siaton, Negros Oriental
637- : Iloilo City, Iloilo

Table II-2-5 MONTHLY AVERAGE RAINFALL BY STATION

Unit : mm

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
0607	64	39	31	36	90	115	156	116	132	188	169	123	1,259
0612	115	53	44	72	189	319	372	283	311	363	275	111	2,507
0613	98	42	40	105	217	370	435	346	351	432	216	120	2,771
0614	65	16	12	49	97	204	309	311	258	214	113	134	1,782
0615	84	47	60	41	86	116	127	129	148	190	186	138	1,351
0616	142	101	58	77	116	250	247	200	257	327	389	360	2,523
0617	27	19	26	69	172	359	426	449	375	353	140	78	2,492
0618	206	116	85	86	168	219	241	195	270	354	392	352	2,685
0720	35	14	12	26	71	238	235	432	240	295	104	29	1,732
0721	18	11	9	16	70	224	283	318	255	287	86	38	1,616
637-	49	28	34	71	98	302	324	359	323	294	173	88	2,142

Note; 0607 : Barotac Viejo, Iloilo
0612 : Kabankalan, Negros Occ.
0613 : La Granja Exp. Stn La, Negros Occ.
0614 : Pulupandan, Negros Occ.
0615 : San Carlos City, Negros Occ.
0617 : Sipalay, Negros Occ.
0618 : Victorias, Negros Occ.
0720 : Nonas, Bayawan, Negros Oriental
0721 : Siaton, Negros Oriental
637- : Iloilo City, Iloilo

Table II-2-6 MONTHLY RAINFALL AT KABANKALAN

Unit : mm

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1971	*	*	*	*	*	*	*	1,195	692	771	382	232	*
1972	174	52	137	47	416	412	179	336	*	92	126	255	*
1973	46	29	5	27	126	308	313	387	355	322	559	191	2,668
1974	70	88	75	49	206	241	274	172	124	647	184	199	2,329
1975	*	101	29	108	99	253	227	120	164	283	79	108	*
1976	86	95	58	29	234	180	165	186	320	112	152	82	1,699
1977	55	54	28	15	57	61	218	133	179	70	52	15	936
1978	65	16	13	93	44	174	188	184	162	237	117	67	1,360
1979	23	13	14	26	52	131	189	94	98	151	103	66	959
1980	105	*	17	46	174	545	299	383	236	421	332	113	*
1981	69	31	17	9	119	119	385	379	252	220	191	124	1,914
1982	97	62	81	99	115	257	526	677	229	238	168	66	2,614
1983	35	16	6	0	12	168	228	220	484	554	483	185	2,391
1984	160	82	129	110	222	576	434	219	308	397	316	131	3,082
1985	295	50	51	268	372	553	687	349	466	564	392	148	4,195
1986	397	84	58	58	231	452	508	359	556	495	484	186	3,868
1987	112	62	27	19	111	403	551	357	372	158	282	40	2,494
1988	134	47	37	63	687	667	446	375	514	1,079	567	115	4,729
1989	83	66	61	218	241	493	466	157	254	204	80	49	2,370
Average	115	53	44	72	189	319	372	283	311	363	275	111	2,507

Source : PAGASA
Note : Average calculation is based on the years with full data.
Figures may not add up to totals due to rounding.

Table II-2-7 MONTHLY AVERAGE DISCHARGE OF THE ILOG RIVER AT PANDAN, ORONG
(C.A.=1,453km2)

Unit: m3/s

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
1956	23.6	19.8	11.3	26.9	35.7	57.2	208.2	195.9	93.0	165.4	49.2	206.5	91.8
1957	64.3	16.9	10.8	8.3	11.3	30.9	85.3	130.3	150.7	64.4	32.5	11.9	51.7
1958	8.3	6.8	5.9	6.8	15.6	24.9	33.5	62.3	97.6	75.5	104.6	26.2	39.1
1959	13.6	9.8	9.8	11.0	16.7	37.7	214.1	167.8	105.3	199.7	51.8	25.7	72.6
1960	12.9	11.2	9.0	14.3	32.1	120.8	105.8	113.5	122.4	208.7	50.9	16.2	68.4
1961	12.0	9.4	8.7	7.5	14.1	111.0	108.7	201.5	85.0	101.8	46.2	20.4	60.9
1962	13.1	10.6	9.9	24.4	12.5	48.8	175.5	211.4	108.0	56.8	53.3	35.6	63.8
1963	11.3	9.9	9.6	6.8	13.4	64.0	58.0	182.9	119.1	139.6	28.8	52.7	58.4
1964	24.7	23.8	16.3	23.8	80.0	100.2	141.3	90.6	146.9	111.0	262.0	99.5	93.3
1965	60.6	30.9	28.4	23.8	45.7	123.3	272.5	176.7	132.2	87.8	38.5	20.5	87.3
1966	15.3	10.3	7.1	9.9	61.6	92.3	165.5	117.2	99.6	130.7	106.4	84.4	75.5
1967	86.5	57.5	70.4	47.8	67.3	75.1	243.6	194.7	165.8	270.2	220.4	73.1	131.7
1968	60.7	59.0	54.1	50.0	87.8	112.9	174.4	194.5	194.3	136.0	170.8	45.5	111.7
1969	31.8	25.7	21.7	20.1	34.8	68.0	128.7	85.8	12.8	88.2	39.3	39.5	50.1
1970	25.6	22.8	18.8	16.0	23.7	70.7	148.9	93.1	72.9	216.4	69.0	32.8	68.0
1971	31.0	33.2	26.6	19.9	66.3	124.3	136.1	163.4	90.1	374.0	112.6	64.8	103.4
1972	55.4	31.3	15.8	27.7	67.6	114.9	81.0	72.1	206.8	74.2	39.4	40.4	68.8
1973	11.4	9.5	7.2	6.5	7.2	15.9	45.6	73.6	81.2	60.5	194.3	17.9	44.2
1974	15.9	15.3	12.3	10.6	14.4	71.4	89.1	37.7	29.0	90.3	54.2	29.8	39.3
1975	52.0	28.6	20.8	19.5	19.4	15.5	24.3	93.3	16.4	39.0	8.0	6.5	28.8
1976	7.6	5.6	6.6	6.8	79.2	17.9	69.2	74.0	84.9	172.2	7.1	6.7	45.2
1977	8.5	8.2	7.2	6.5	6.2	11.5	9.0	244.2	208.7	16.0	19.7	6.5	46.1
1978	6.7	5.8	5.3	5.1	10.1	20.2	47.8	40.4	85.3	131.3	66.0	11.2	36.4
1979	5.8	5.7	5.6	5.4	20.7	100.3	213.2	101.7	43.4	41.4	23.3	20.2	49.3
Average	27.4	19.5	16.6	16.9	35.1	67.9	124.1	129.5	106.3	127.1	77.0	41.4	66.1
Runoff Height (mm)	51	33	31	30	65	121	229	239	190	234	137	76	1,435

Table II-2-8 MONTHLY AVERAGE DISCHARGE OF THE HILABANGAN RIVER AT PANGSUD
(C.A.=431km2)

Unit: m3/s

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
1955	26.3	11.7	7.8	7.4	7.2	10.3	39.4	32.6	36.3	33.5	136.4	44.4	32.8
1956	9.3	7.5	7.6	13.8	16.9	34.0	59.8	48.9	27.0	33.3	16.9	98.3	31.3
1957	***	***	***	***	***	***	***	***	***	***	***	***	***
1958	***	***	***	***	***	***	***	***	***	***	***	***	***
1959	***	***	***	***	***	***	***	***	***	***	***	7.5	***
1960	***	***	***	***	***	***	***	***	***	***	***	***	***
1961	***	***	***	***	***	***	***	***	***	***	***	***	***
1962	5.5	5.2	5.1	5.0	5.4	11.6	27.0	32.6	25.8	15.0	28.6	26.9	16.2
1963	17.0	14.1	14.6	9.5	9.2	23.6	28.1	47.7	13.2	20.1	4.7	6.5	17.4
1964	10.4	4.0	3.5	5.9	16.9	28.9	33.8	27.8	26.1	32.3	111.2	37.6	28.2
1965	22.3	14.9	16.9	15.9	8.4	45.2	57.0	40.9	38.3	23.2	7.1	5.6	24.7
1966	4.1	5.2	4.8	4.4	8.6	10.1	27.1	22.2	12.9	19.5	9.8	6.3	11.3
1967	26.2	12.2	11.3	7.9	8.0	7.9	15.9	22.1	19.1	37.8	84.1	8.3	21.7
1968	***	***	***	***	***	***	***	***	***	***	***	***	***
1969	***	***	***	***	***	***	***	***	***	***	***	***	***
1970	***	***	***	***	***	***	***	***	***	***	89.9	45.1	***
1971	***	***	***	***	***	***	***	***	***	***	***	***	***
1972	***	***	***	***	***	***	***	***	***	***	***	***	***
1973	***	***	***	***	***	***	***	***	***	***	***	76.0	***
1974	12.3	***	***	***	***	***	***	***	***	59.8	32.5	14.0	***
1975	30.8	13.1	7.2	6.2	6.1	6.8	10.2	6.4	6.9	9.7	7.6	5.6	9.7
1976	6.5	16.6	12.1	9.2	8.7	11.2	17.4	25.1	***	11.1	7.8	7.9	***
1977	6.9	5.9	5.0	4.6	4.6	5.4	6.1	7.4	10.3	11.5	8.0	8.9	7.1
1978	8.5	6.5	6.2	8.6	6.7	7.5	10.3	14.8	26.2	***	22.1	11.7	***
1979	7.0	6.1	5.8	5.8	8.0	11.0	17.7	14.6	10.3	22.8	9.1	6.7	10.5
Average	15.1	9.1	8.1	7.9	9.0	17.7	29.3	27.6	20.6	23.5	38.5	23.2	19.2
Runoff Height (mm)	94	51	51	47	56	107	182	171	124	146	232	144	1,404

Table II-3-1 ANNUAL MAXIMUM 2-DAY AND 1-DAY RAINFALL AT KABANKALAN

Unit : mm

Year	Annual Maximum Rainfall	
	1-Day Rainfall	2-Day Continuous Rainfall
1971	142.4	189.0
1972	123.2	230.4
1973	89.6	135.8
1974	85.6	143.5
1975	54.8	85.5
1976	62.5	80.8
1977	28.4	52.3
1978	50.8	65.1
1979	26.9	49.5
1980	68.8	113.0
1981	82.0	136.8
1982	117.3	233.8
1983	57.4	105.0
1984	56.1	94.8
1985	98.7	147.2
1986	180.8	216.3
1987	79.3	111.4
1988	194.5	216.4
1989	70.0	90.6

Table II-3-2 MONTHLY OCCURRENCE OF ANNUAL MAXIMUM 2-DAY AND 1-DAY RAINFALL AT KABANKALAN

Month	Occurrence	
	Number	Rate (%)
January	1	5.3
February	0	0.0
March	0	0.0
April	0	0.0
May	0	0.0
June	2	10.5
July	2	10.5
August	3	15.8
September	3	15.8
October	3	15.8
November	4	21.0
December	1	5.3
Total	19	100.0

Table II-3-3 CHARACTERISTIC FEATURES OF SUB-BASIN

Sub-Basin No.	Catchment Area (km2)	Longest Stream (km)	Maximum Elevation (El.m)	Minimum Elevation (El.m)	Altitude Difference	Average Gradient (1/I)
1	109.7	15.6	520	156	364	42.9
2	53.5	6.6	500	143	357	18.5
3	118.3	19.6	400	112	288	68.1
4	62.2	22.8	558	114	444	51.4
5	83.8	11.6	280	101	179	64.8
6	63.1	16.6	544	150	394	42.1
7	69.8	11.3	400	134	266	42.5
8	112.0	26.9	650	102	548	49.1
9	71.8	16.8	395	102	293	57.3
10	54.2	19.8	333	57	276	71.7
11	88.0	18.5	960	197	763	24.2
12	24.2	3.7	280	160	120	30.8
13	16.2	4.0	140	40	100	40.0
14	99.7	14.5	620	95	525	27.6
15	51.4	10.8	420	67	353	30.6
16	76.7	13.9	778	25	753	18.5
17	125.8	16.1	239	12	227	70.9
18	84.8	11.3	840	15	825	13.7
19	75.1	15.6	700	10	690	22.6
20	66.8	21.2	360	10	350	60.6
21	98.1	16.7	1,260	330	930	18.0
22	100.4	13.6	1,350	240	1,110	12.3
23	118.8	28.0	885	190	695	40.3
24	50.3	11.0	1,120	87	1,033	10.6
25	84.3	16.3	1,350	60	1,290	12.6
Sub-Total	1,959.0					
26	31.1	12.8	340	10	330	38.8
27	11.4	7.6	200	10	190	40.0
Total	2,001.5	-	-	-	-	-

Table II-3-4 CHARACTERISTIC FEATURES OF RIVER CHANNEL

Channel No.	Upstream Elevation (El.m)	Downstream Elevation (El.m)	Channel Length (km)	Average Gradient (1/I)	Average Width (m)
1	156	140	12.6	787.5	50
2	140	110	19.7	656.7	70
3	110	38	21.7	301.4	100
4	150	75	16.8	224.0	70
5	102	75	9.7	359.3	70
6	75	38	7.6	205.4	100
7	197	40	15.2	96.8	70
8	38	25	7.0	538.5	100
9	95	25	16.4	234.3	70
10	25	10	20.7	1380.0	100
11	10	2.5	13.2	1760.0	150
12	330	190	14.2	101.4	100
13	87	2	18.6	218.8	100

Table II-3-5 HOURLY RAINFALL OBSERVED DURING THE FLOOD, AUG.12-16, 1990

Date	Time	Station 1 Caningay	Station 2 Magballo	Station 3 Bugay	Station 4 Tarra	Station 5 Mabinay	Station 6 Tibyawan	Station 7 Carolan	Station 8 NOAC	Station 9 Kabankalan
Aug. 12	9	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	10	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	11	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	12	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	13	39.0	0.0	-	0.0	0.0	0.5	0.0	0.0	0.0
	14	21.0	0.0	-	0.0	0.0	19.5	0.0	0.0	0.0
	15	1.0	0.5	-	0.0	0.0	1.0	31.0	1.0	1.5
	16	2.0	0.0	-	0.0	2.0	0.0	3.0	2.5	1.5
	17	0.0	0.5	-	0.0	0.0	0.0	5.0	3.0	1.0
	18	0.0	0.0	-	0.0	0.0	0.0	0.0	0.5	0.0
	19	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	20	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	21	0.0	0.0	-	0.0	0.0	0.0	0.5	1.5	0.0
	22	0.0	0.0	-	1.0	0.0	0.0	0.0	0.0	19.5
	23	0.0	1.0	-	5.0	0.5	0.0	1.5	0.0	5.5
	24	0.5	0.5	-	0.5	0.5	2.5	0.0	0.0	0.5
Aug. 13	1	0.5	0.0	-	4.0	0.0	0.0	0.5	0.0	0.0
	2	11.5	8.0	-	8.0	3.5	0.0	0.0	0.0	5.5
	3	14.0	5.0	-	0.0	1.5	0.0	2.5	2.5	9.0
	4	3.5	1.0	-	0.5	0.5	1.5	1.5	5.5	2.5
	5	0.5	0.0	-	0.0	0.0	0.0	0.0	2.0	0.5
	6	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	7	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	8	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	9	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	10	0.5	0.0	-	0.0	1.0	0.0	0.0	0.0	0.0
	11	3.5	6.0	-	0.5	0.0	0.0	3.0	0.0	4.5
	12	3.5	3.0	-	2.5	2.0	3.5	10.5	0.0	2.0
	13	11.0	0.0	-	4.5	4.0	1.0	1.0	9.5	1.0
	14	21.5	11.0	-	7.0	9.0	3.5	10.5	2.5	9.5
	15	1.0	4.5	-	4.5	4.0	8.0	13.5	4.0	3.0
	16	10.0	1.5	-	5.0	0.5	2.5	5.5	20.5	3.5
	17	34.0	2.0	-	3.0	4.0	4.5	11.5	8.5	2.5
	18	13.0	7.5	-	0.5	2.0	3.5	7.0	1.0	4.5
	19	2.5	5.5	-	6.5	8.0	4.0	8.5	7.0	3.0
	20	18.5	4.0	-	3.5	3.5	3.0	8.0	7.5	7.5
	21	2.5	2.5	-	9.5	7.5	1.5	7.5	3.5	4.5
	22	3.5	2.0	-	4.5	1.5	1.0	2.5	4.5	4.5
	23	1.5	0.5	-	1.0	1.0	0.5	1.5	3.5	0.5
	24	1.0	0.5	-	0.0	0.5	0.0	0.5	2.5	1.0
Aug. 14	1	3.5	5.5	-	9.5	8.5	1.5	7.0	2.0	2.0
	2	5.0	6.5	-	7.0	7.5	1.0	9.0	0.5	4.0
	3	6.0	0.5	-	1.5	3.5	2.0	5.5	2.5	0.5
	4	3.0	5.0	-	5.5	7.0	0.5	7.0	4.5	1.0
	5	0.5	0.5	-	1.0	1.0	3.0	7.5	6.5	0.0
	6	0.5	0.0	-	0.0	0.5	0.0	0.5	5.0	0.0
	7	0.0	0.5	-	0.0	0.5	0.0	0.0	8.5	0.0
	8	0.0	0.0	-	0.5	0.0	0.0	1.0	0.5	0.0
Aug. 14	9	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	10	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	1.0
	11	8.5	3.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	12	0.5	0.5	-	0.5	0.5	0.0	4.5	0.0	2.0
	13	4.5	1.0	-	0.0	0.0	0.5	1.0	0.0	0.0
	14	0.0	0.5	-	11.5	5.0	0.0	2.5	0.5	1.5
	15	1.0	5.0	-	3.5	6.0	0.0	1.0	2.0	2.5
	16	0.0	0.5	-	3.5	4.0	1.5	9.5	1.5	1.0
	17	0.0	0.0	-	0.0	1.0	0.0	1.5	1.0	0.0
	18	5.0	5.0	-	2.5	1.5	1.0	1.0	2.5	9.0
	19	0.5	0.5	-	7.0	3.0	0.0	4.5	8.5	4.0
	20	0.5	0.0	-	4.0	3.0	0.5	2.0	3.5	1.0
	21	0.0	0.5	-	0.5	1.5	0.0	0.5	3.0	0.5
	22	0.0	0.0	-	1.0	1.0	0.0	0.5	1.0	0.0
	23	0.0	0.0	-	0.0	0.5	0.0	0.5	0.5	1.0
	24	0.0	0.0	-	0.5	0.5	0.0	1.0	0.0	0.5
Aug. 15	1	0.0	0.0	-	0.0	0.0	0.0	0.0	0.5	0.0
	2	0.0	0.0	-	0.0	0.0	0.0	0.0	0.5	0.0
	3	0.0	0.0	-	0.0	0.0	0.0	0.0	0.5	0.0
	4	0.5	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	5	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.5
	6	0.0	0.0	-	4.0	1.5	0.0	0.0	0.0	0.0
	7	0.0	0.0	-	0.0	0.5	0.0	0.5	0.0	0.0
	8	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	9	0.0	0.0	-	0.5	0.0	0.0	0.0	0.0	0.0
	10	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	11	0.0	1.0	-	3.0	1.0	0.0	0.0	0.0	0.0
	12	1.0	0.0	-	0.5	0.5	0.5	2.5	0.5	0.0
	13	0.0	0.0	-	0.0	0.0	0.0	0.5	0.0	0.0
	14	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	15	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	16	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	17	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	18	0.0	0.0	-	0.0	0.0	0.0	0.0	0.5	0.0
	19	3.0	3.0	-	0.0	0.0	0.0	0.0	0.0	1.5
	20	0.5	0.5	-	1.5	4.0	0.5	2.0	0.0	0.0
	21	0.0	0.0	-	0.0	0.0	0.0	1.0	0.0	0.0
	22	0.0	0.0	-	0.5	1.0	0.0	2.0	0.0	1.0
	23	0.0	0.0	-	0.5	0.0	0.0	0.5	0.0	0.0
	24	3.0	5.0	-	0.0	0.5	0.0	0.5	1.0	0.5
Aug. 16	1	0.5	8.0	-	7.0	4.0	4.5	14.5	0.5	0.0
	2	0.5	0.0	-	0.5	0.0	1.5	0.5	0.5	0.5
	3	6.0	2.5	-	1.5	4.0	0.0	0.0	0.5	0.0
	4	3.5	0.5	-	1.0	2.0	3.0	5.5	1.0	5.5
	5	1.0	0.5	-	0.0	0.0	2.0	3.0	0.5	1.0
	6	0.0	0.0	-	0.0	0.0	0.5	1.0	10.5	0.0
	7	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0
	8	0.0	0.0	-	0.0	0.0	0.0	0.0	0.5	0.0

Table II-3-6 SUMMARY OF PARAMETERS OF STORAGE FUNCTION MODEL FOR RIVER BASINS

Sub-Basin No.	Catchment Area (km2)	Rsa (mm)	f1	f2	K	p	Tl
1	109.7	20.0	0.5	1.0	32.4	0.423	0.17
2	53.5	20.0	0.5	1.0	41.8	0.347	0.00
3	118.3	20.0	0.5	1.0	28.2	0.472	0.36
4	62.2	20.0	0.5	1.0	30.7	0.442	0.51
5	83.8	20.0	0.5	1.0	28.6	0.466	0.00
6	63.1	20.0	0.5	1.0	32.6	0.422	0.22
7	69.8	20.0	0.5	1.0	32.5	0.422	0.00
8	112.0	20.0	0.5	1.0	31.1	0.437	0.70
9	71.8	20.0	0.5	1.0	29.7	0.453	0.23
10	54.2	20.0	0.5	1.0	27.8	0.478	0.37
11	88.0	20.0	0.5	1.0	38.4	0.370	0.31
12	24.2	20.0	0.5	1.0	35.8	0.392	0.00
13	16.2	20.0	0.5	1.0	33.1	0.416	0.00
14	99.7	20.0	0.5	1.0	37.0	0.382	0.12
15	51.4	20.0	0.5	1.0	35.8	0.391	0.00
16	76.7	20.0	0.5	1.0	41.7	0.347	0.09
17	125.8	20.0	0.5	1.0	27.8	0.476	0.20
18	84.8	20.0	0.5	1.0	45.6	0.324	0.00
19	75.1	20.0	0.5	1.0	39.2	0.364	0.17
20	66.8	20.0	0.5	1.0	29.2	0.459	0.44
21	98.1	20.0	0.5	1.0	42.0	0.345	0.22
22	100.4	20.0	0.5	1.0	47.2	0.315	0.08
23	118.8	20.0	0.5	1.0	33.0	0.417	0.76
24	50.3	20.0	0.5	1.0	49.2	0.305	0.00
25	84.3	20.0	0.5	1.0	46.7	0.318	0.21

Note Rsa : Saturation rainfall depth
f1 : Primary runoff ratio
f2 : Secondary runoff ratio
K,p : Constants of storage function model
Tl : Lag time

Table II-3-7 SUMMARY OF PARAMETERS OF STORAGE FUNCTION MODEL FOR RIVER CHANNELS

Channel No.	Channel Length (km)	Average Gradient (1/1)	K	p	Tl	Tlz
1	12.6	787.5	15.1	0.6	0.260	0.260
2	19.7	656.7	25.6	0.6	0.372	0.372
3	21.7	301.4	25.7	0.6	0.277	0.277
4	16.8	224.0	15.8	0.6	0.185	0.185
5	9.7	359.3	10.5	0.6	0.135	0.135
6	7.6	205.4	8.0	0.6	0.080	0.080
7	15.2	96.8	11.1	0.6	0.110	0.110
8	7.0	538.5	9.9	0.6	0.120	0.120
9	16.4	234.3	15.6	0.6	0.185	0.185
10	20.7	1,380.0	38.7	0.6	0.566	0.566
11	13.2	1,760.0	31.2	0.6	0.408	0.408
12	14.2	101.4	12.1	0.6	0.105	0.105
13	18.6	218.8	20.0	0.6	0.203	0.203
14	9.0	3,000.0	33.0	0.6	0.363	0.363

Note K,p : Constants of storage function model
Tl : Lag time
Tlz : Lag time in river channel

Table II-3-8(1/3) PROBABLE FLOOD HYDROGRAPH
(Ilog-Hilabangan Junction)

Unit : m3/s

Hour	Probable Flood by Return Period					
	100-Year	50-Year	25-Year	10-Year	5-Year	2-Year
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.1	0.1	0.0	0.0	0.0	0.0
3	0.2	0.1	0.1	0.1	0.0	0.0
4	0.3	0.3	0.2	0.1	0.1	0.0
5	0.6	0.5	0.4	0.2	0.2	0.1
6	0.9	0.7	0.5	0.4	0.2	0.1
7	1.3	1.0	0.8	0.5	0.3	0.2
8	1.8	1.4	1.1	0.7	0.5	0.2
9	2.5	1.9	1.5	0.9	0.6	0.3
10	3.4	2.6	1.9	1.2	0.8	0.3
11	4.6	3.5	2.6	1.6	1.0	0.4
12	6.2	4.6	3.4	2.1	1.3	0.5
13	8.5	6.3	4.5	2.7	1.7	0.7
14	11.7	8.6	6.1	3.6	2.2	0.9
15	16.1	11.7	8.3	4.9	3.0	1.1
16	22.2	16.0	11.2	6.5	3.9	1.5
17	30.3	21.7	15.0	8.6	5.1	1.8
18	41.0	29.1	20.0	11.3	6.6	2.3
19	56.5	39.8	27.1	15.1	8.7	3.0
20	79.8	55.8	37.8	20.8	11.9	4.1
21	118.0	82.0	55.0	30.0	17.1	5.8
22	183.7	127.2	84.8	45.6	25.6	8.6
23	305.0	211.5	140.2	74.4	41.3	13.6
24	678.4	473.6	315.0	166.5	91.7	30.0
25	1,613.7	1,133.8	754.1	391.2	208.0	62.4
26	3,048.1	2,193.7	1,486.8	779.2	409.2	113.6
27	4,480.3	3,363.8	2,365.3	1,283.4	680.7	184.2
28	5,347.9	4,263.8	3,189.3	1,856.1	1,015.6	271.8
29	5,425.4	4,543.4	3,647.4	2,353.8	1,386.8	381.6
30	5,097.5	4,402.7	3,686.0	2,608.2	1,693.3	517.2
31	4,669.9	4,111.0	3,511.6	2,630.2	1,852.2	662.8
32	4,219.1	3,762.4	3,267.5	2,531.2	1,878.4	787.6
33	3,792.0	3,417.2	3,007.2	2,387.2	1,831.1	870.5
34	3,415.6	3,102.3	2,758.0	2,231.9	1,753.0	911.5
35	3,096.4	2,828.5	2,533.9	2,081.4	1,664.9	922.1
36	2,829.1	2,594.8	2,337.7	1,942.5	1,576.2	914.2
37	2,602.7	2,394.3	2,166.3	1,816.2	1,490.8	895.9
38	2,407.8	2,220.2	2,015.6	1,702.1	1,410.4	872.1
39	2,238.9	2,068.3	1,882.8	1,599.3	1,335.6	845.6
40	2,092.3	1,935.6	1,765.8	1,507.2	1,266.9	818.3
41	1,965.4	1,820.0	1,663.1	1,425.0	1,204.3	791.1
42	1,855.8	1,719.5	1,573.0	1,351.9	1,147.7	764.8
43	1,761.2	1,632.2	1,494.2	1,287.0	1,096.6	739.7
44	1,679.5	1,556.3	1,425.3	1,229.6	1,050.7	716.1
45	1,608.8	1,490.3	1,364.9	1,178.7	1,009.5	694.1
46	1,547.5	1,432.7	1,311.8	1,133.5	972.5	673.7
47	1,494.2	1,382.3	1,265.1	1,093.4	939.3	654.8
48	1,447.7	1,338.1	1,223.9	1,057.6	909.4	637.4
49	1,400.1	1,293.6	1,182.8	1,022.3	880.0	620.1
50	1,342.9	1,241.4	1,136.0	983.3	848.2	601.6
51	1,275.2	1,180.8	1,082.5	939.8	813.3	581.5
52	1,200.2	1,114.3	1,024.3	893.0	776.0	560.0
53	1,121.9	1,044.8	963.7	844.4	737.3	537.7
54	1,043.9	975.4	902.9	795.5	698.2	514.7
55	968.9	908.3	843.8	747.6	659.6	491.7
56	898.7	845.3	787.9	701.8	622.3	469.0
57	834.3	786.9	735.9	658.7	586.9	446.9
58	775.5	733.4	687.9	618.6	553.7	425.7
59	722.3	684.7	643.9	581.5	522.7	405.5
60	674.1	640.4	603.7	547.4	493.9	386.4
61	630.4	600.1	567.1	516.0	467.3	368.5
62	590.8	563.5	533.5	487.1	442.6	351.6
63	554.8	530.1	502.9	460.5	419.8	335.8
64	522.1	499.6	474.8	436.1	398.7	321.0
65	492.2	471.7	449.1	413.6	379.1	307.1
66	464.9	446.2	425.4	392.8	361.0	294.0
67	439.9	422.7	403.6	373.5	344.1	281.8
68	416.9	401.1	383.5	355.7	328.4	270.4
69	395.7	381.1	364.9	339.2	313.8	259.6
70	376.1	362.7	347.7	323.8	300.2	249.5
71	358.1	345.6	331.7	309.5	287.5	239.9
72	341.3	329.8	316.8	296.1	275.6	230.9
73	325.8	315.0	303.0	283.7	264.4	222.5
74	311.3	301.3	290.0	272.0	254.0	214.5
75	297.8	288.5	278.0	261.1	244.1	206.9
76	285.2	276.5	266.6	250.8	234.9	199.8
77	273.4	265.3	256.0	241.2	226.2	193.0
78	262.4	254.7	246.1	232.1	218.0	186.6
79	252.1	244.9	236.7	223.5	210.2	180.5
80	242.4	235.6	227.9	215.5	202.9	174.7
81	233.2	226.8	219.6	207.9	196.0	169.2
82	224.6	218.6	211.8	200.7	189.4	164.0
83	216.5	210.8	204.4	193.9	183.2	159.0
84	208.8	203.4	197.3	187.4	177.3	154.3
85	201.6	196.5	190.7	181.3	171.7	149.7
86	194.7	189.9	184.4	175.5	166.3	145.4
87	188.2	183.6	178.4	169.9	161.2	141.3
88	182.0	177.7	172.8	164.7	156.4	137.4
89	176.2	172.1	167.4	159.7	151.8	133.6
90	170.6	166.7	162.3	154.9	147.4	130.0
91	165.3	161.6	157.4	150.4	143.2	126.5
92	160.3	156.8	152.7	146.0	139.1	123.2
93	155.5	152.1	148.3	141.9	135.3	120.0
94	150.9	147.7	144.0	137.9	131.6	117.0
95	146.6	143.5	140.0	134.1	128.1	114.0
96	142.4	139.5	136.1	130.5	124.7	111.2
97	138.4	135.6	132.4	127.0	121.5	108.5
98	134.6	131.9	128.8	123.7	118.4	105.9
99	131.0	128.4	125.4	120.5	115.4	103.4
100	127.5	125.0	122.1	117.4	112.5	101.0
101	124.1	121.7	119.0	114.5	109.8	98.6
102	120.9	118.6	116.0	111.7	107.1	96.4
103	117.8	115.6	113.1	108.9	104.6	94.2
104	114.9	112.8	110.3	106.3	102.1	92.1
105	112.0	110.0	107.7	103.8	99.7	90.1

Table II-3-8(2/3) PROBABLE FLOOD HYDROGRAPH
(Ilog River)

Unit : m3/s

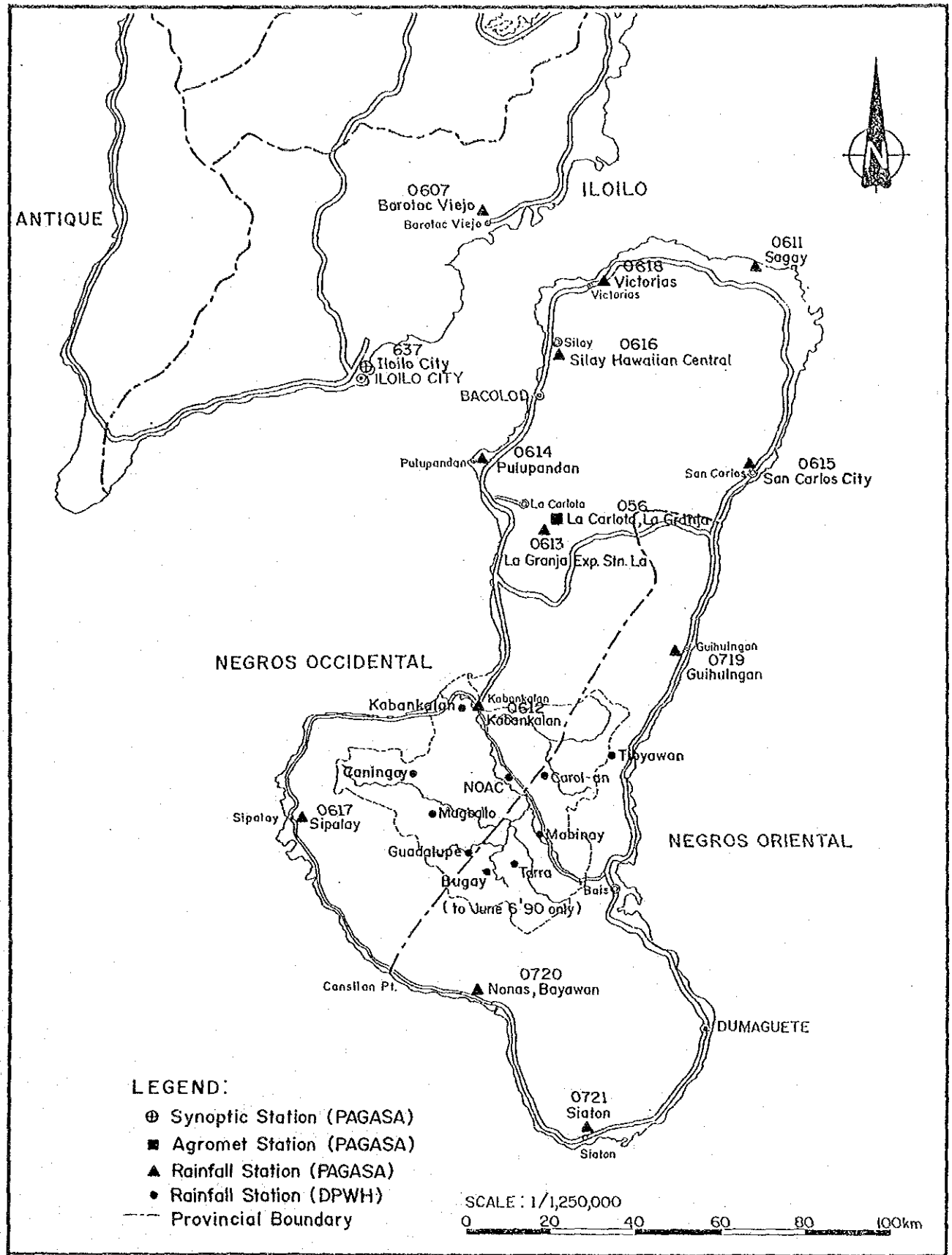
Hour	Probable Flood by Return Period					
	100-Year	50-Year	25-Year	10-Year	5-Year	2-Year
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.1	0.1	0.0	0.0	0.0	0.0
3	0.2	0.1	0.1	0.1	0.0	0.0
4	0.3	0.3	0.2	0.1	0.1	0.0
5	0.5	0.4	0.3	0.2	0.2	0.1
6	0.8	0.6	0.5	0.3	0.2	0.1
7	1.1	0.9	0.7	0.5	0.3	0.1
8	1.5	1.2	0.9	0.6	0.4	0.2
9	2.0	1.6	1.2	0.8	0.6	0.3
10	2.4	2.0	1.5	1.0	0.7	0.3
11	3.0	2.4	1.9	1.3	0.9	0.4
12	3.6	2.9	2.2	1.5	1.0	0.5
13	4.4	3.5	2.7	1.8	1.3	0.6
14	5.5	4.4	3.4	2.3	1.6	0.7
15	6.8	5.4	4.2	2.8	1.9	0.9
16	8.5	6.6	5.1	3.4	2.3	1.1
17	10.8	8.2	6.2	4.1	2.8	1.3
18	14.1	10.4	7.6	4.9	3.3	1.5
19	20.0	14.2	10.0	6.2	4.1	1.8
20	30.3	20.6	14.0	8.4	5.4	2.4
21	48.7	32.3	21.2	12.1	7.6	3.3
22	81.1	53.0	34.0	18.5	11.3	4.8
23	140.4	91.8	58.0	30.3	17.8	7.3
24	307.8	207.5	134.3	71.4	42.1	17.1
25	674.1	450.3	285.2	143.0	79.3	29.9
26	1,467.7	973.5	599.2	272.8	133.0	40.6
27	2,793.0	1,952.2	1,247.9	565.5	252.8	56.5
28	3,935.2	3,011.3	2,123.2	1,080.2	501.6	90.4
29	4,271.5	3,510.9	2,747.1	1,646.9	871.5	160.3
30	4,098.3	3,514.3	2,915.0	1,998.6	1,228.4	277.8
31	3,787.4	3,323.2	2,825.5	2,090.4	1,440.6	427.1
32	3,437.9	3,060.2	2,651.4	2,042.2	1,505.7	569.0
33	3,095.6	2,786.9	2,449.9	1,939.8	1,487.3	670.9
34	2,785.7	2,529.0	2,247.6	1,817.8	1,431.4	726.3
35	2,517.8	2,299.8	2,060.6	1,693.6	1,360.5	746.5
36	2,291.8	2,102.5	1,895.1	1,576.5	1,285.9	745.0
37	2,101.6	1,934.1	1,751.0	1,470.2	1,213.4	731.6
38	1,939.8	1,789.5	1,625.7	1,374.8	1,145.4	712.1
39	1,800.2	1,663.9	1,515.7	1,289.3	1,082.5	689.8
40	1,678.6	1,553.8	1,418.7	1,212.7	1,024.6	666.4
41	1,572.6	1,457.3	1,332.9	1,144.0	971.8	642.9
42	1,480.5	1,373.0	1,257.4	1,082.6	923.7	620.0
43	1,400.7	1,299.4	1,191.1	1,028.0	880.3	598.1
44	1,331.6	1,235.4	1,132.9	979.5	841.2	577.5
45	1,271.8	1,179.6	1,081.8	936.4	806.1	558.2
46	1,219.8	1,130.8	1,037.0	898.2	774.6	540.3
47	1,174.6	1,088.2	997.5	864.2	746.2	523.8
48	1,135.2	1,050.8	962.7	834.0	720.8	508.6
49	1,097.3	1,015.1	929.5	805.2	696.6	493.9
50	1,057.5	978.2	895.8	776.5	672.5	479.3
51	1,013.4	938.1	859.9	746.6	647.9	464.5
52	963.1	893.2	820.3	714.4	621.9	449.2
53	907.2	843.7	777.1	679.7	594.1	433.0
54	848.4	791.6	731.7	643.3	564.9	416.0
55	789.9	739.4	685.9	606.4	535.3	398.4
56	733.8	689.2	641.6	570.3	505.9	380.7
57	681.5	642.0	599.6	535.7	477.6	363.2
58	633.5	598.4	560.6	503.2	450.7	346.1
59	589.7	558.4	524.6	473.0	425.4	329.7
60	549.9	521.9	491.5	445.0	401.8	314.1
61	513.7	488.6	461.3	419.1	379.8	299.4
62	481.0	458.3	433.6	395.3	359.5	285.5
63	451.2	430.7	408.3	373.4	340.6	272.4
64	424.1	405.5	385.1	353.3	323.1	260.1
65	399.4	382.5	363.8	334.7	307.0	248.6
66	376.8	361.3	344.3	317.5	292.0	237.8
67	356.1	341.9	326.3	301.6	278.0	227.7
68	337.1	324.1	309.7	286.9	265.1	218.2
69	319.6	307.6	294.3	273.3	253.0	209.3
70	303.5	292.5	280.1	260.6	241.8	200.9
71	288.6	278.4	267.0	248.9	231.3	193.0
72	274.8	265.3	254.7	237.9	221.5	185.6
73	262.0	253.2	243.4	227.6	212.3	178.6
74	250.1	241.9	232.7	218.0	203.7	172.0
75	239.1	231.4	222.8	209.1	195.6	165.8
76	228.7	221.6	213.6	200.7	188.0	159.9
77	219.1	212.4	204.9	192.8	180.9	154.4
78	210.0	203.8	196.7	185.4	174.2	149.1
79	201.6	195.7	189.1	178.4	167.8	144.1
80	193.6	188.1	181.9	171.8	161.8	139.3
81	186.2	180.9	175.1	165.6	156.2	134.8
82	179.1	174.2	168.7	159.7	150.8	130.6
83	172.5	167.9	162.6	154.1	145.7	126.5
84	166.2	161.9	156.9	148.9	140.9	122.6
85	160.3	156.2	151.5	143.9	136.3	118.9
86	154.7	150.8	146.4	139.2	132.0	115.4
87	149.5	145.7	141.5	134.7	127.8	112.0
88	144.4	140.9	136.9	130.4	123.9	108.8
89	139.7	136.3	132.5	126.3	120.1	105.7
90	135.2	132.0	128.4	122.5	116.5	102.8
91	130.9	127.9	124.4	118.8	113.1	100.0
92	126.8	123.9	120.6	115.3	109.9	97.3
93	122.9	120.2	117.0	111.9	106.8	94.7
94	119.2	116.6	113.6	108.7	103.8	92.2
95	115.7	113.2	110.3	105.6	100.9	89.8
96	112.3	109.9	107.2	102.7	98.2	87.5
97	109.1	106.8	104.2	99.9	95.6	85.3
98	106.0	103.8	101.3	97.2	93.1	83.2
99	103.0	101.0	98.6	94.6	90.6	81.2
100	100.2	98.2	95.9	92.2	88.3	79.3
101	97.5	95.6	93.4	89.8	86.1	77.4
102	94.9	93.1	91.0	87.5	84.0	75.6
103	92.4	90.7	88.7	85.3	81.9	73.8
104	90.1	88.4	86.4	83.2	79.9	72.1
105	87.8	86.1	84.3	81.2	78.0	70.5

Table II-3-8(3/3) PROBABLE FLOOD HYDROGRAPH
(Hilabangan River)

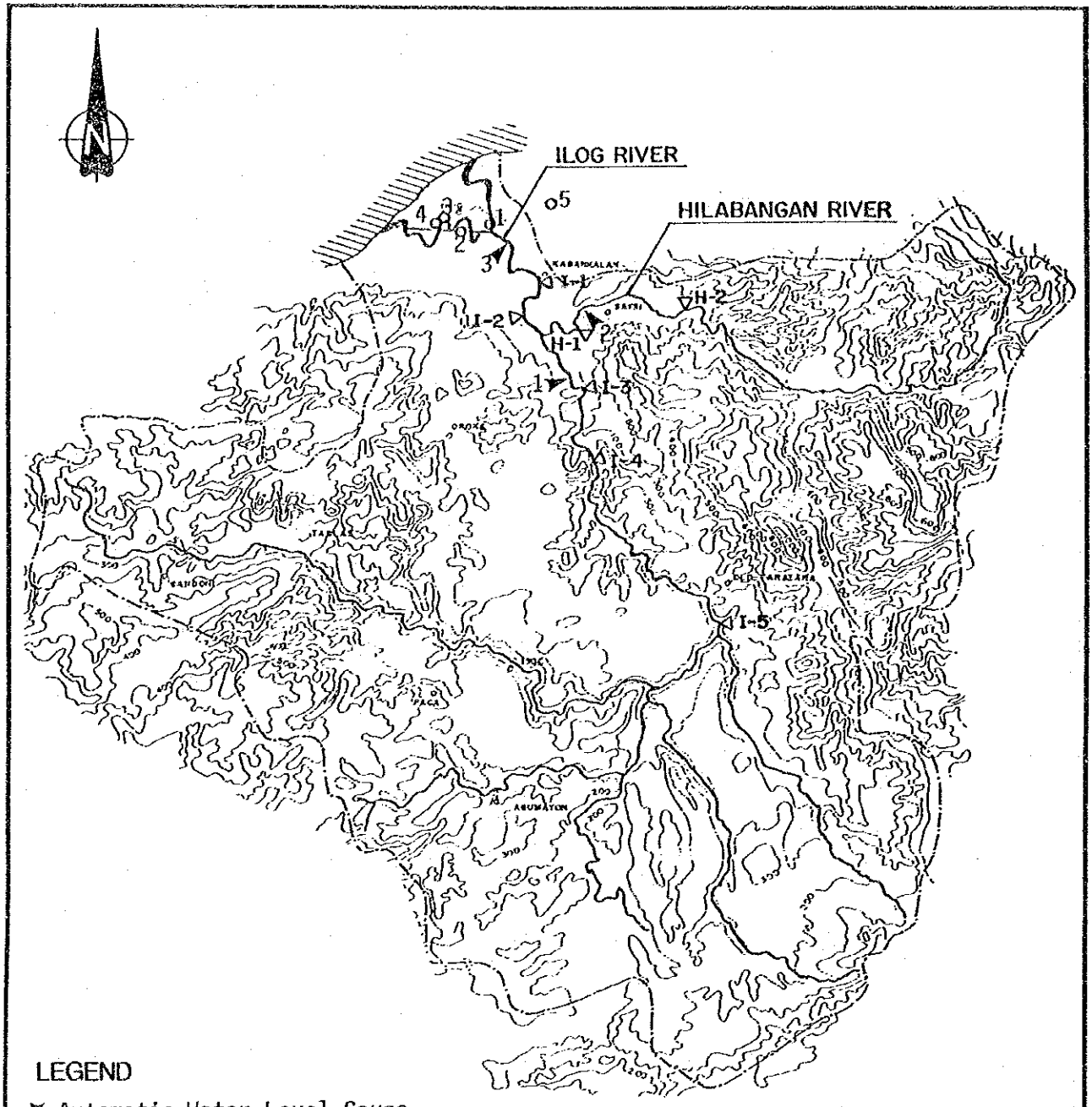
Unit : m3/s

Hour	Probable Flood by Return Period					
	100-Year	50-Year	25-Year	10-Year	5-Year	2-Year
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0
6	0.1	0.1	0.0	0.0	0.0	0.0
7	0.2	0.1	0.1	0.0	0.0	0.0
8	0.5	0.3	0.2	0.1	0.0	0.0
9	1.1	0.7	0.4	0.2	0.1	0.0
10	2.1	1.3	0.8	0.4	0.2	0.0
11	3.7	2.4	1.5	0.7	0.3	0.1
12	6.4	4.2	2.6	1.2	0.6	0.1
13	10.5	6.9	4.2	2.0	0.9	0.2
14	16.8	11.0	6.8	3.2	1.5	0.3
15	25.9	17.2	10.8	5.1	2.4	0.5
16	38.5	25.9	16.5	7.8	3.8	0.8
17	54.7	37.6	24.2	11.8	5.7	1.3
18	74.5	52.2	34.3	17.0	8.4	1.9
19	98.4	70.3	47.2	24.1	12.0	2.8
20	130.2	94.7	64.7	33.9	17.3	4.1
21	179.6	132.1	91.6	49.0	25.4	6.1
22	265.3	196.7	137.7	74.8	39.3	9.6
23	425.5	318.0	224.6	123.7	65.8	16.2
24	998.4	743.6	523.2	285.9	150.6	35.9
25	2,253.9	1,752.6	1,281.6	738.2	404.6	99.9
26	2,902.9	2,375.9	1,923.9	1,257.9	769.6	225.5
27	2,630.7	2,290.2	1,933.4	1,410.1	971.1	358.2
28	2,198.5	1,960.1	1,701.6	1,317.6	979.6	438.8
29	1,836.5	1,659.4	1,466.9	1,174.7	911.5	464.3
30	1,551.9	1,415.8	1,267.0	1,038.7	828.7	458.2
31	1,325.5	1,217.6	1,099.6	917.6	747.7	438.0
32	1,136.0	1,049.7	955.3	808.9	670.7	411.3
33	985.5	914.4	836.9	716.6	602.4	383.3
34	873.6	812.3	745.9	643.5	546.3	357.5
35	790.6	735.6	676.5	586.2	501.1	335.2
36	726.0	675.4	621.5	540.1	464.0	315.9
37	671.2	624.3	574.8	500.6	431.9	298.5
38	622.7	579.3	533.6	465.7	403.3	282.5
39	581.2	540.5	497.9	435.2	378.0	267.8
40	546.6	508.0	467.9	409.1	356.1	254.7
41	518.3	481.2	442.8	387.2	337.4	243.1
42	495.0	459.0	421.9	368.6	321.3	232.9
43	475.8	440.5	404.4	352.7	307.5	223.9
44	459.8	425.0	389.5	339.2	295.6	215.9
45	446.3	411.9	376.9	327.6	285.2	208.8
46	435.0	400.8	366.1	317.6	276.2	202.4
47	425.5	391.3	356.9	308.8	268.2	196.8
48	417.3	383.2	348.9	301.3	261.3	191.7
49	404.6	371.5	338.1	291.9	253.2	186.2
50	379.2	349.3	319.0	276.6	240.9	178.6
51	344.6	319.3	293.3	256.4	224.8	168.9
52	309.6	288.5	266.6	235.1	207.8	158.4
53	278.2	260.6	242.1	215.3	191.6	148.1
54	251.1	236.2	220.5	197.4	176.9	138.5
55	227.8	215.1	201.6	181.6	163.7	129.7
56	207.8	196.8	185.2	167.7	151.9	121.6
57	190.5	181.0	170.8	155.5	141.5	114.3
58	175.4	167.1	158.1	144.6	132.1	107.6
59	162.2	154.9	146.9	134.9	123.7	101.6
60	150.5	144.0	137.0	126.2	116.1	96.1
61	140.2	134.4	128.1	118.4	109.3	91.0
62	131.0	125.8	120.1	111.3	103.1	86.4
63	122.7	118.0	112.9	105.0	97.5	82.1
64	115.2	111.0	106.4	99.2	92.3	78.2
65	108.5	104.7	100.4	93.9	87.6	74.6
66	102.4	98.9	95.0	89.0	83.3	71.3
67	96.8	93.6	90.1	84.6	79.3	68.1
68	91.7	88.8	85.6	80.5	75.6	65.3
69	87.0	84.4	81.4	76.7	72.2	62.6
70	82.8	80.3	77.5	73.2	69.0	60.0
71	78.8	76.5	74.0	70.0	66.0	57.7
72	75.2	73.0	70.7	66.9	63.3	55.5
73	71.8	69.8	67.6	64.1	60.7	53.4
74	68.6	66.8	64.8	61.5	58.3	51.4
75	65.7	64.0	62.1	59.1	56.1	49.6
76	63.0	61.4	59.6	56.8	54.0	47.9
77	60.4	59.0	57.3	54.6	52.0	46.2
78	58.1	56.7	55.1	52.6	50.1	44.7
79	55.8	54.5	53.1	50.7	48.4	43.2
80	53.7	52.5	51.1	48.9	46.7	41.9
81	51.8	50.6	49.3	47.2	45.2	40.6
82	49.9	48.8	47.6	45.6	43.7	39.3
83	48.2	47.2	46.0	44.1	42.3	38.1
84	46.5	45.6	44.5	42.7	40.9	37.0
85	45.0	44.1	43.0	41.4	39.7	35.9
86	43.5	42.6	41.7	40.1	38.5	34.9
87	42.1	41.3	40.4	38.9	37.3	33.9
88	40.8	40.0	39.1	37.7	36.2	33.0
89	39.5	38.8	38.0	36.6	35.2	32.1
90	38.3	37.6	36.8	35.5	34.2	31.3
91	37.2	36.5	35.8	34.5	33.3	30.4
92	36.1	35.5	34.8	33.6	32.4	29.7
93	35.1	34.5	33.8	32.7	31.5	28.9
94	34.1	33.5	32.9	31.8	30.7	28.2
95	33.2	32.6	32.0	31.0	29.9	27.5
96	32.3	31.7	31.1	30.1	29.1	26.8
97	31.4	30.9	30.3	29.4	28.4	26.2
98	30.6	30.1	29.6	28.6	27.7	25.6
99	29.8	29.4	28.8	27.9	27.1	25.0
100	29.1	28.6	28.1	27.3	26.4	24.4
101	28.3	27.9	27.4	26.6	25.8	23.9
102	27.6	27.2	26.8	26.0	25.2	23.4
103	27.0	26.6	26.1	25.4	24.6	22.9
104	26.3	26.0	25.5	24.8	24.1	22.4
105	25.7	25.4	24.9	24.2	23.5	21.9

FIGURES



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. II-1-1 LOCATION MAP OF METEOROLOGICAL AND RAINFALL STATIONS



LEGEND

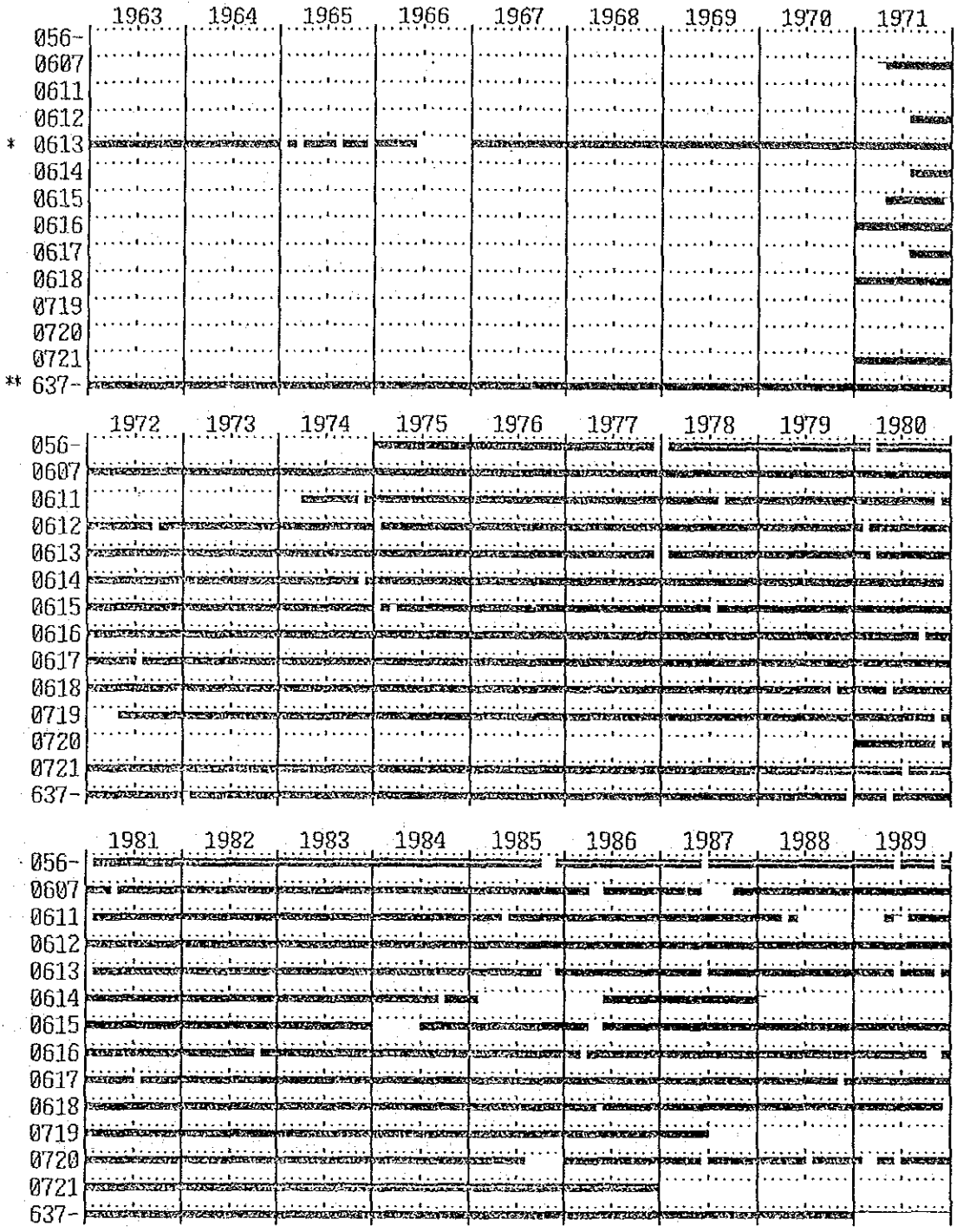
- ▼ Automatic Water Level Gauge
  1. Orong, Ilog River
  2. Overflow, Hilabangan River
  3. Talubangi Bridge, Ilog River
- o Water Level Staff Gauge
  1. Malabon Div. Channel, Ilog River
  2. Cutoff Channel, Ilog River
  3. Old Ilog No.1, Ilog River
  4. Old Ilog No.2, Ilog River
  5. Binicuil River

- ▽ Water Level Staff Gauge (NWRB)
  - I-1 Camugao, Ilog River
  - I-2 San Juan, Ilog River
  - I-3 Orong, Ilog River
  - I-4 Dahile, Ilog River
  - I-5 Inapoy, Ilog River
  - H-1 Pangsud, Hilabangan River
  - H-2 Tagbac, Hilabangan River

SCALE : 1/400,000

0 5 10 15 20 25 30km

THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. II-1-2 LOCATION MAP OF STREAMWATER GAUGING STATIONS



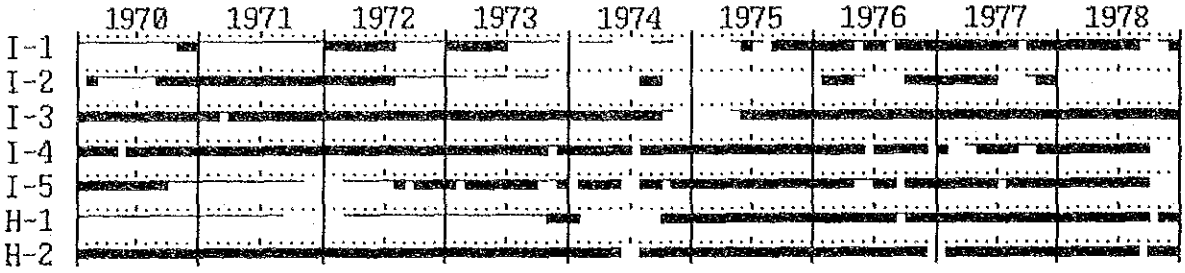
056- : La Granja, La Carlota, Negros Occ.
0607 : Barotac Viejo, Iloilo
0611 : Sagay, Negros Occ.
0612 : Kabankalan, Negros Occ.
0613 : La Granja Exp. Stn La, Negros Occ.
0614 : Pulupandan, Negros Occ.
0615 : San Carlos City, Negros Occ.
0616 : Silay Hawaiian Central, Negros Occ.
0617 : Sipalay, Negros Occ.
0618 : Victorias, Negros Occ.
0719 : Guihulngan, Negros Oriental
0720 : Nonas, Bayawan, Negros Oriental
0721 : Siaton, Negros Oriental
637- : Iloilo City, Iloilo

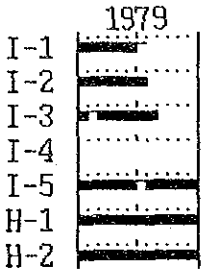
NOTE * : Observation Started in 1956
** : Observation Started in 1949

THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. II-1-3 AVAILABLE DATA PERIOD CHART OF DAILY RAINFALL

DAILY AVERAGE DISCHARGE

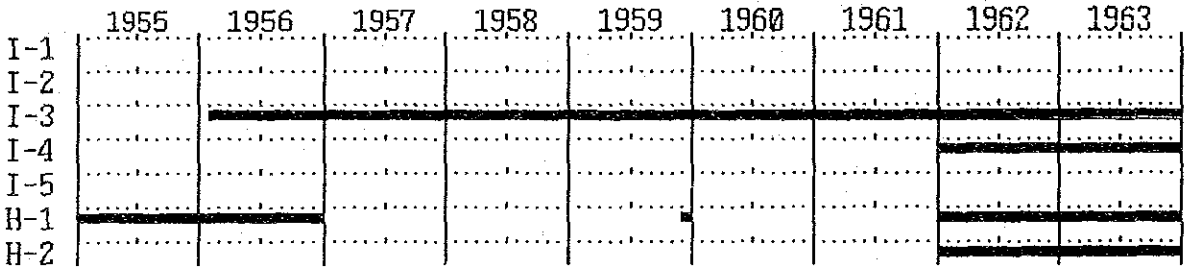


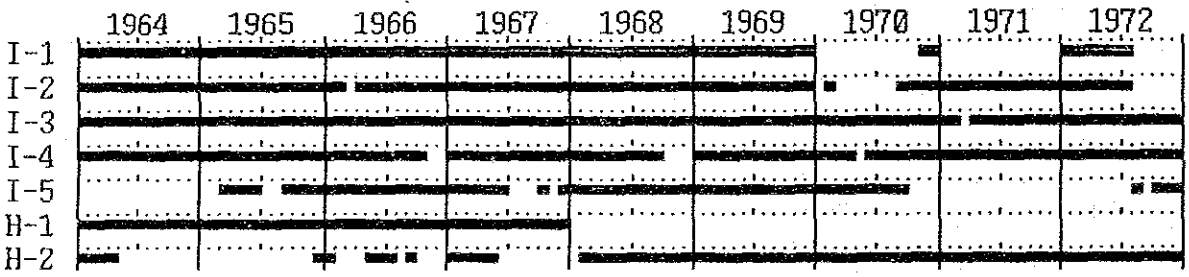


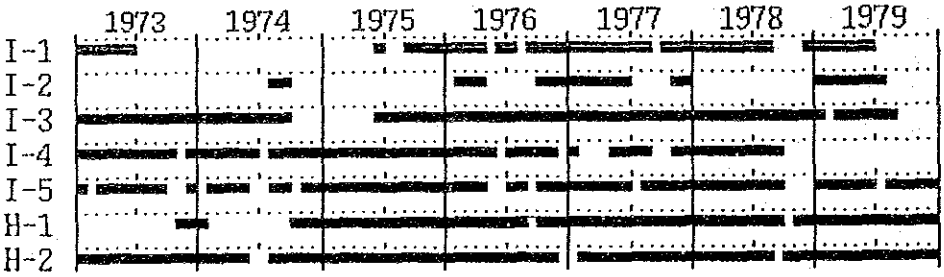
Stations

I-1 : Camugao, Ilog River (1,959km2)
I-2 : San Juan, Ilog River (1,947km2)
I-3 : Pandan, Orong, Ilog River (1,453km2)
I-3 : Dahile, Ilog River (1,390km2)
I-5 : Inapoy, Ilog River (1,245km2)
H-1 : Pangsud, Hilabangan River (431km2)
H-2 : Tagbac, Hilabangan River (392km2)

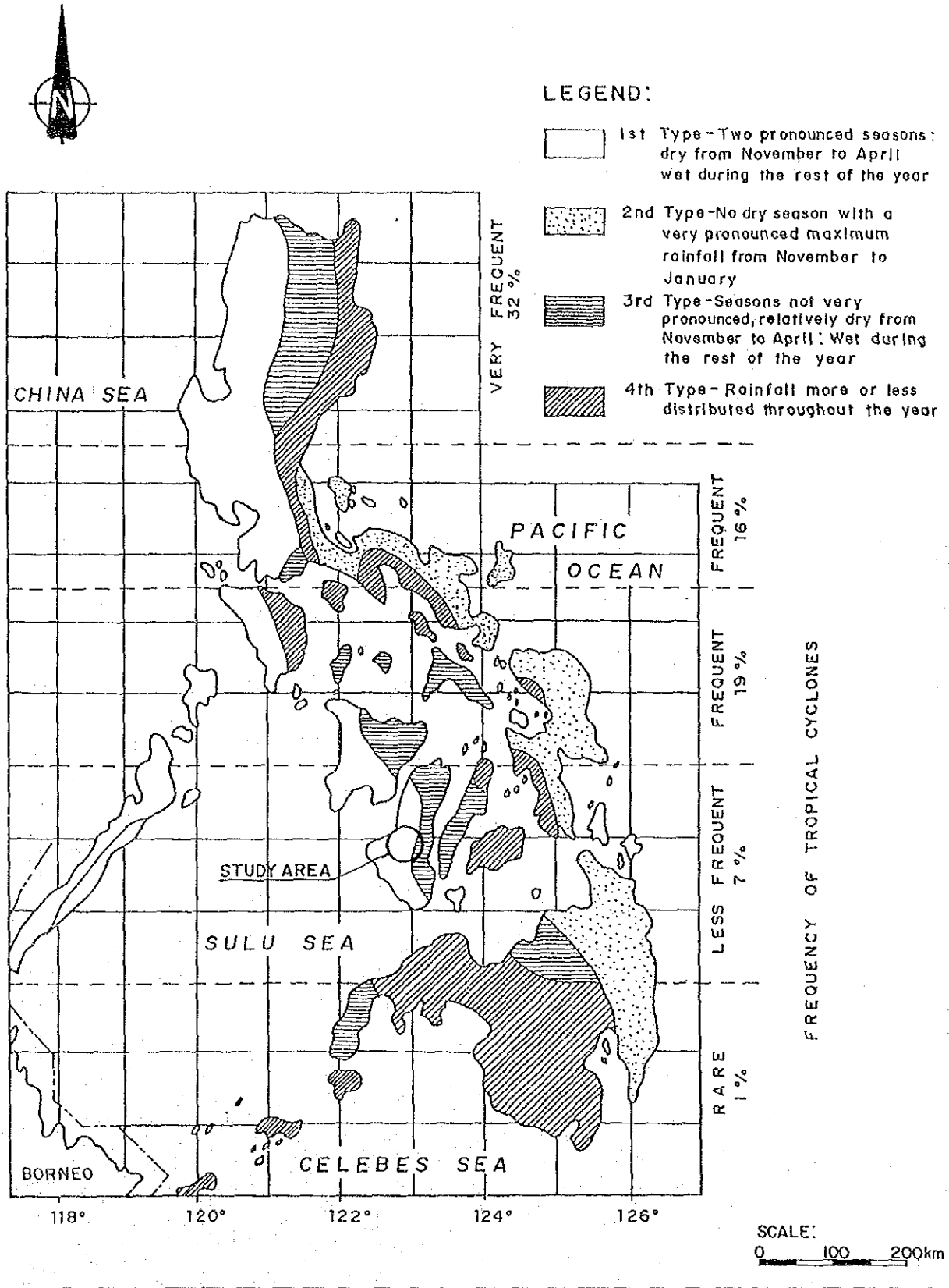
MONTHLY AVERAGE DISCHARGE







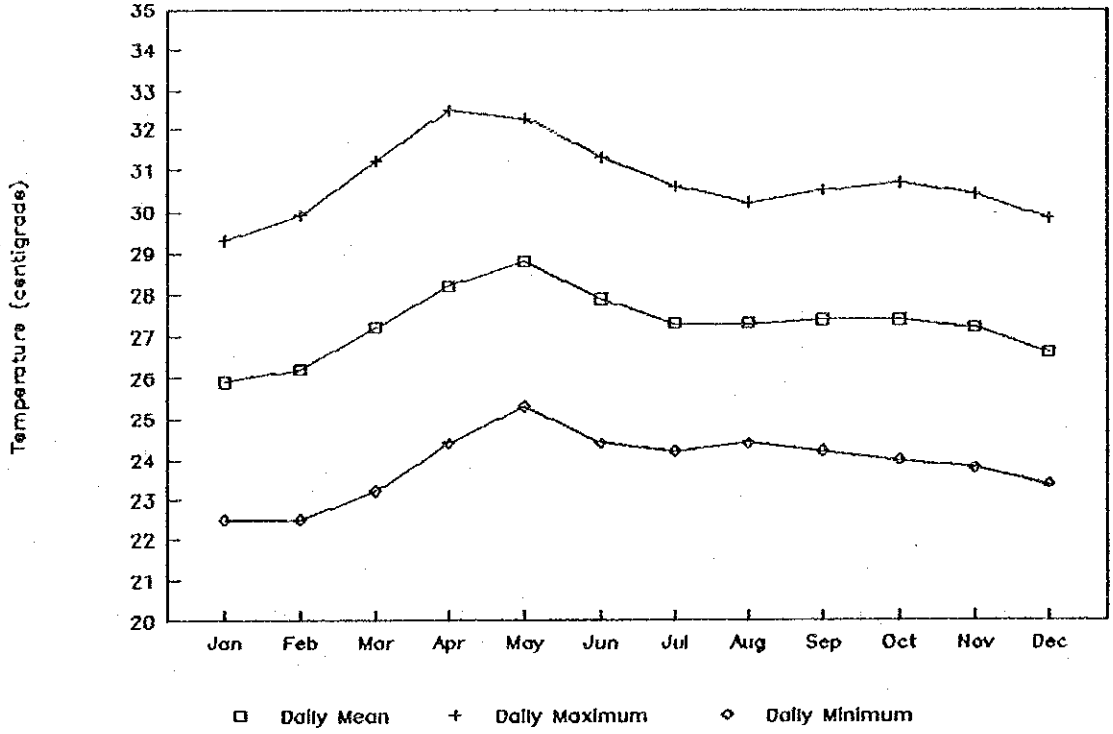
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.II-1-4 AVAILABLE DATA PERIOD CHART OF RIVER DISCHARGE



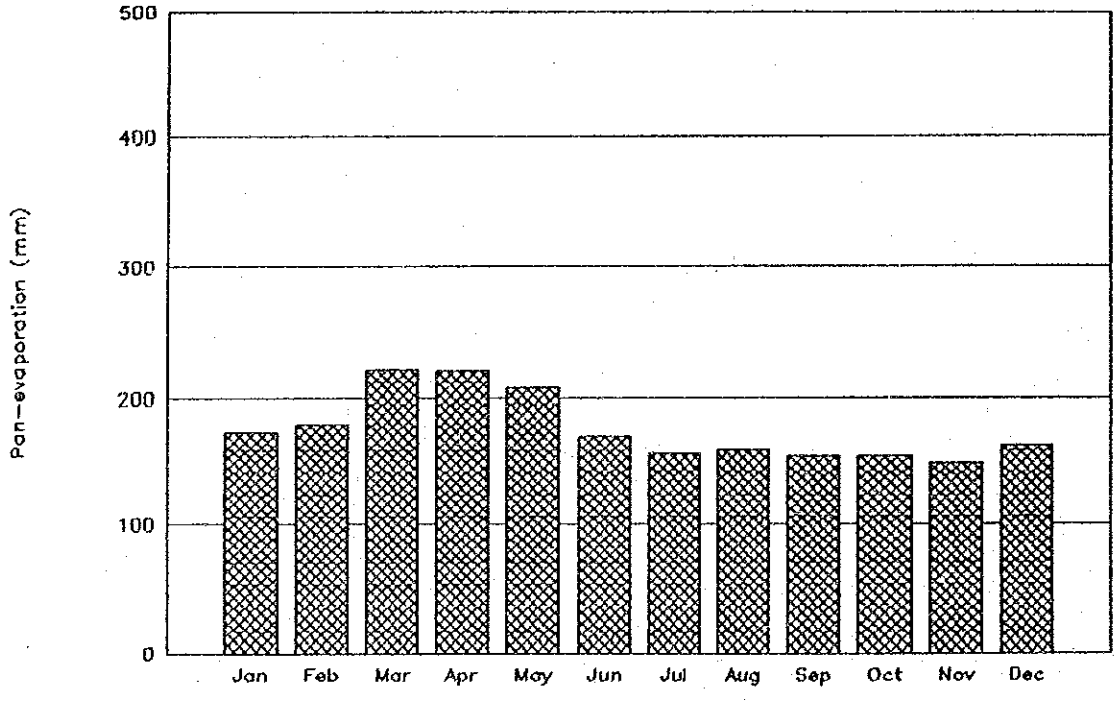
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. II-2-1 MODIFIED CORONA'S CLIMATE CLASSIFICATION

SOURCE : ILOILO CITY (PAGASA)

Daily Average Temperature



Monthly Pan-evaporation



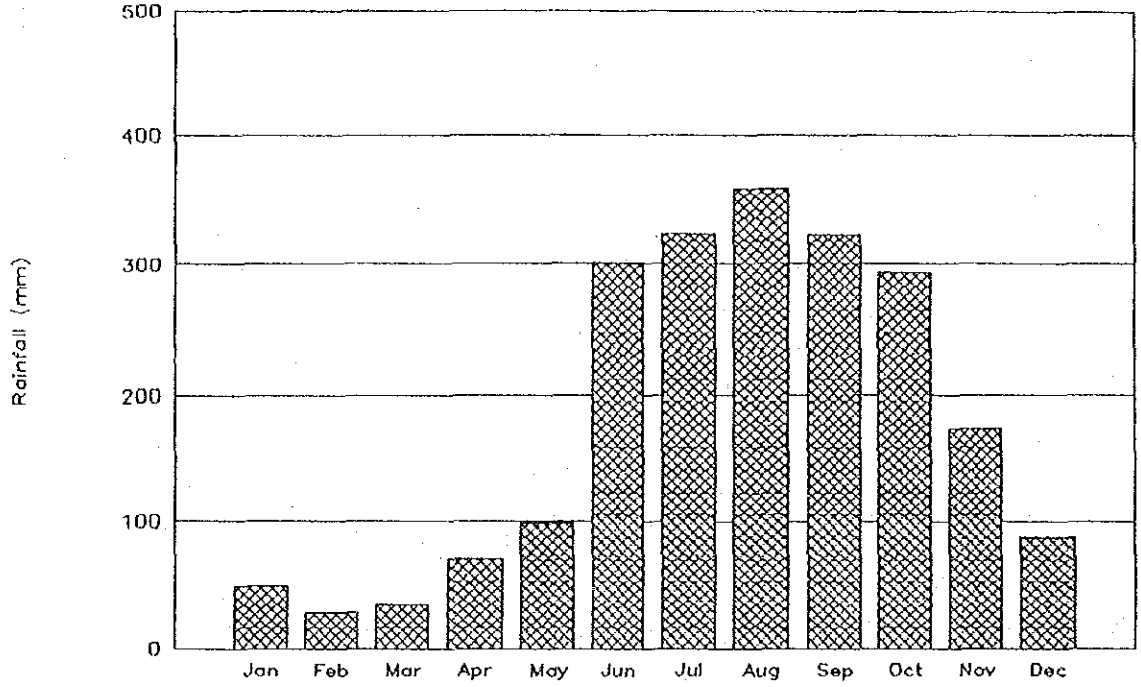
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

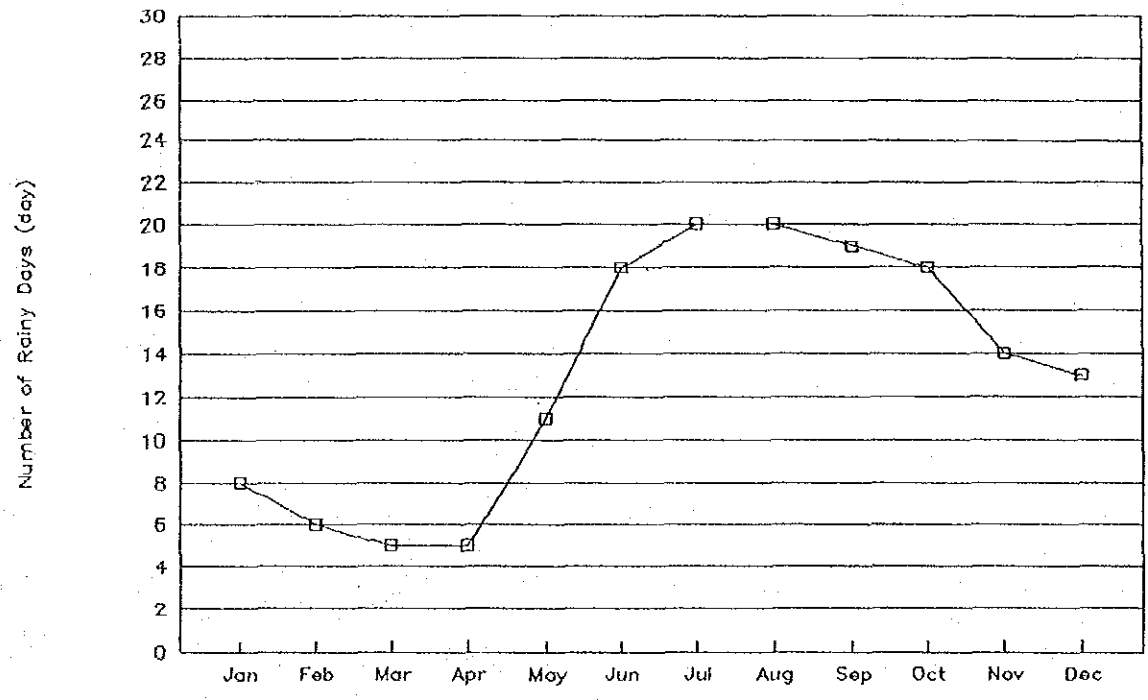
Fig. II-2-2 (1/2) MONTHLY VARIATION OF METEOROLOGICAL DATA AT ILOILO CITY

SOURCE : ILOILO CITY (PAGASA)

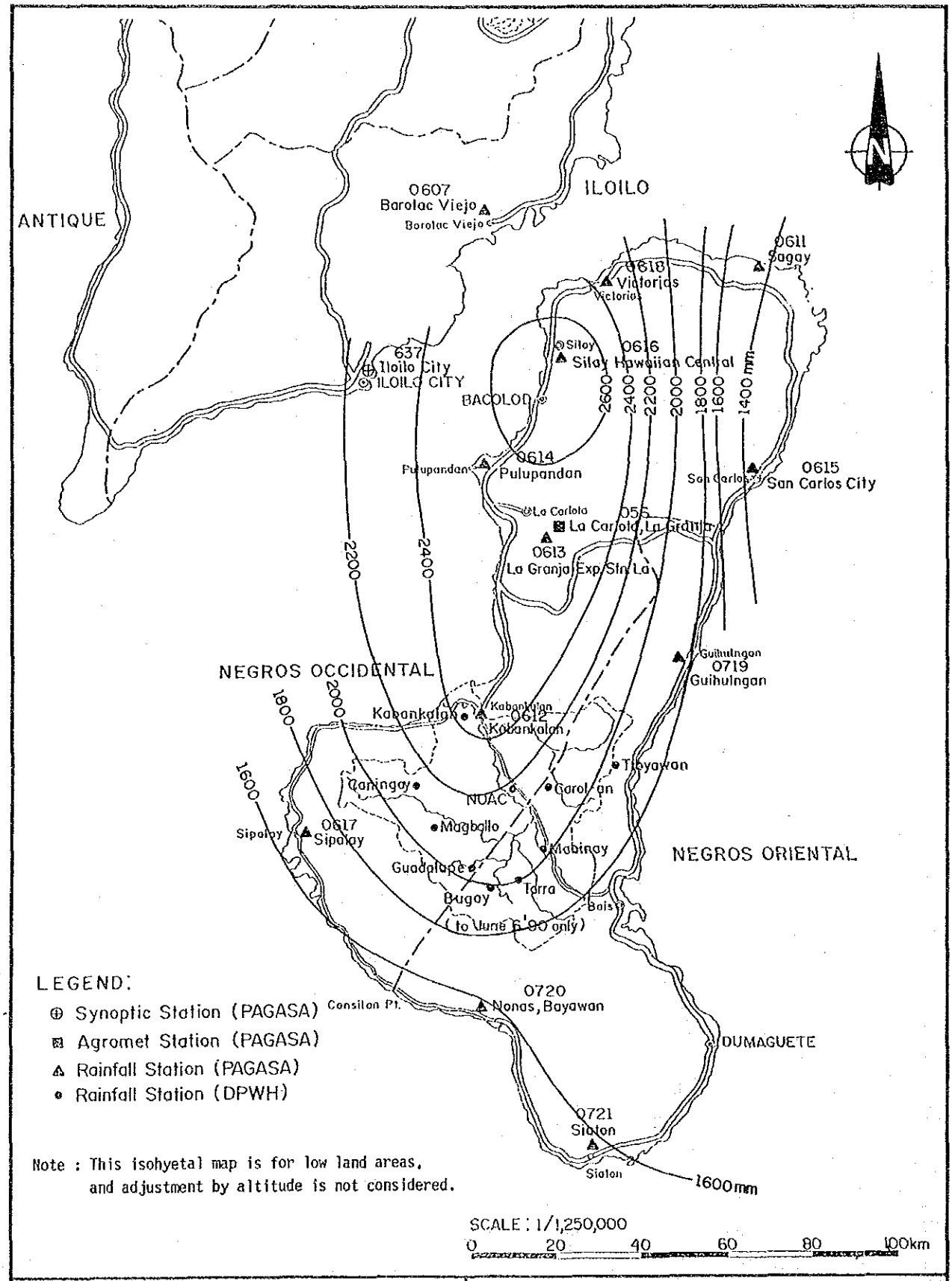
Monthly Rainfall



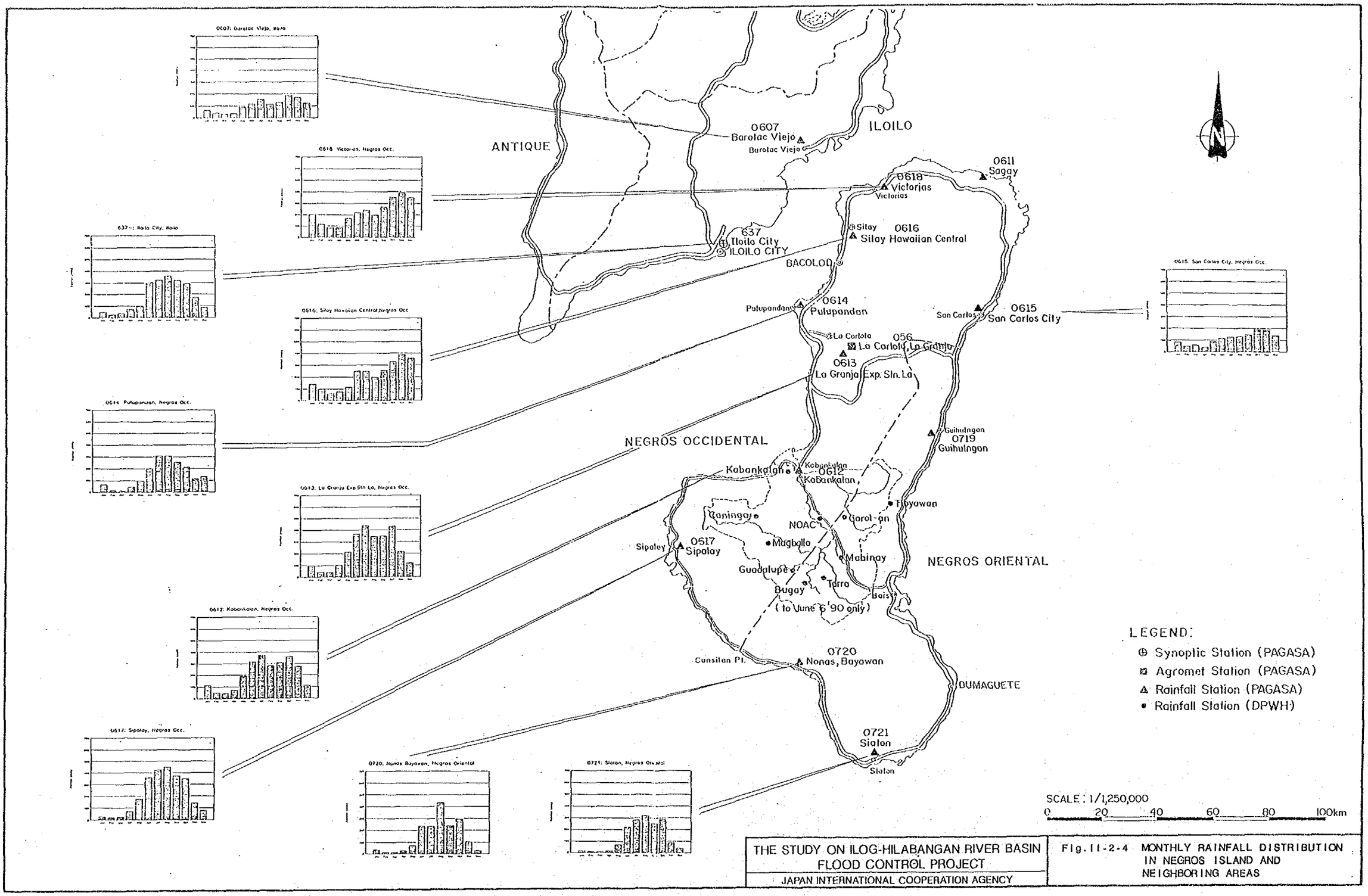
Monthly Number of Rainy Days



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. II-2-2 (2/2) MONTHLY VARIATION OF METEOROLOGICAL DATA AT ILOILO CITY



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. II-2-3 ISOHYETAL MAP OF AVERAGE ANNUAL RAINFALL FOR 1981-84



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. II-2-4 MONTHLY RAINFALL DISTRIBUTION IN NEGROS ISLAND AND NEIGHBORING AREAS