No.

PAGASA (Philippine Atmosphreric, Geophysical
and Astronomical Services Administration)
Republic of the Philippines

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR UPGRADING OF FLOOD FORECASTING AND WARNING SYSTEM IN THE PAMPANGA AND AGNO RIVER AND BASINS IN REPUBLIC OF THE PHILIPPINES

March 2007

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO.,LTD

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ON
THE PROJECT FOR
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PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct a basic design study on the Project for Upgrading of Flood Forecasting and Warning System in the Pampanga and Agno River Basins and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Philippines a study team from October 17 to December 6, 2006.

The team held discussions with the officials concerned of the Government of the Philippines, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to the Philippines in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of the Philippines for their close cooperation extended to the teams.

March 2007

Masafumi KUROKI
Vice-President
Japan International Cooperation Agency

March 2007

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Upgrading of Flood Forecasting and Warning System in the Pampanga and Agno River Basins in the Republic of the Philippines.

This study was conducted by Nippon Koei Co., Ltd., under a contract to JICA, during the period from October 2006 to March 2007. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of the Philippines and formulated the most appropriate basic design for the project under Japan's Grant Aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Masato OKUDA

Chief Consultant,
Basic design study team on
The Project for Upgrading of Flood Forecasting and Warning System in the Pampanga and Agno River and Basins
Nippon Koei Co., Ltd.

Summary

Summary

1. Background

The Republic of the Philippines is located in the subtropical monsoon zone and prone to damages from rainstorms caused by the monsoons and typhoons every year. In particular, Luzon Island, the largest and most populated island of the Philippines that is the center of the country’s economic activities, suffers from serious damages from such storms.

With grant and loan aids provided by the Government of Japan, the Philippines has been developing flood forecasting and warning systems for the basins of major rivers in Luzon Island including the Pampanga, Agno, Cagayan and Bicol, in order to alleviate the damages caused by floods. Such flood forecasting and warning systems have contributed to mitigation of flood damages in these basins.

Concerning the systems in the Pampanga and Agno River basins for which the assistance is currently requested, equipment is 10 to 30 years old and faces severe deterioration and acute shortage of spare parts. In addition, these systems were damaged also by natural disasters such as the volcanic mudflows from the eruption of Mount Pinatubo and Baguio earthquake in the 1990s, and have lost their original functionalities.

Under such circumstances, the Philippine government has requested that Japan provide it with grant aid for the equipment maintenance needed to rehabilitate the flood forecasting and warning systems for the Pampanga and Agno River basins.

In response, the Japanese government conducted a preliminary study in November 2003 to determine the urgency and appropriateness of the request. The result indicated that, while the necessity and rationality of the project were recognized, the following two conditions must be met before the basic designing is carried out;

- The counterpart organization must be monitored for its improvement to ensure that it is fully capable of managing the operation and maintenance (including budget); and
- VAT (Value Added Tax) issue must be solved.

Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), the counterpart agency, has conducted a technical assistance project under the Grand Aid since then, and demonstrated its organizational and technical improvement. The Philippine government also initiated its efforts to solve the VAT issue. In response, the Ministry of Foreign Affairs of Japan (MOFA) announced the resumption of the basic design survey for the grant aid in the meeting with the Secretary of Foreign Affairs of the Philippines on April 4, 2006.

As previously mentioned, the systems currently face problems such as deterioration of the equipments and shortage of spare parts. In addition, the existing Backbone Multiplex Radio Network that connects gauging stations or regional monitoring offices (sub-centers) and the central monitoring center (DIC: Data Information Center) in Manila has become unstable with frequent network interruption caused by interference with the mobile phones that have been increasingly used in recent years. Real-time monitoring at the central monitoring center is disrupted and accurate flood data cannot be promptly delivered. As a result, timely and appropriate information is not provided to the local residents, delaying the evacuation and aggravating the damage.

2. Description of the project

Japan International Cooperation Agency (JICA) dispatched a basic design study team to the project site for the period between October 17 and December 6, 2006. The study team had a consultation with relevant parties from the Philippine government and conducted a field study in the areas of the planned project. After the study team returned to Japan, the findings were analyzed and a summery report of the basic design was prepared. The study team was dispatched to the project site for the period between March 13 and 21, 2007 to explain the basic design to the local parties.

The Philippines originally requested assistance for the rehabilitation of the existing systems. According to the report of preliminary study, the Japanese side, however, concluded that the rehabilitation alone would be inadequate for the flood forecasting and warning systems. Thus, the Philippine side notified the equipment required including a categorized list within the framework of a general grant aid project at the time of the field study for the basic design study.

The Japanese study team has conducted the basic design for the proper project implementation. Brief description of the concepts of the basic design is the following;

(1) Improvement of the existing FFWS (Flood Forecasting and Warning System)

The existing FFWS systems will be improved in order to achieve easy maintenance and cost effectiveness realized through replacement of the equipments.

(2) Placement of gauging stations

The Gauging stations will be placed in the way which meets the social and technical needs as well as the development situation in the cities in the basins.

<table>
<tr><th>Type</th><th>Basin</th><th colspan="2">No. of stations</th></tr>
<tr><td rowspan="2">Rainfall gauging station</td><td>Pampanga River</td><td>6</td><td rowspan="2">8</td></tr>
<tr><td>Agno River</td><td>2</td></tr>
<tr><td rowspan="2">Rainfall and water level gauging stations</td><td>Pampanga River</td><td>10</td><td rowspan="2">18</td></tr>
<tr><td>Agno River</td><td>8</td></tr>
<tr><td rowspan="2">Rainfall gauging stations in repeater station</td><td>Pampanga River</td><td>1</td><td rowspan="2">2</td></tr>
<tr><td>Agno River</td><td>1</td></tr>
</table>

(3) Improvement of Backbone Multiplex Radio Network

While the Backbone Multiplex Radio Network was developed for the communication between Sub-Centers and Data Information Center (DIC) and with the relevant agencies, it lacks reliability due to the interference with the mobile phones which share the same frequency. A reliable communication network is essential particularly for the relevant agencies to promptly collect and provide accurate information for disaster prevention. The improvement of the channel reliability is planned to be achieved, therefore, by changing the frequency of the existing Backbone Multiplex Radio Network to 7.5 GHz. The network within the relevant agencies which are located closer to one another, will be built on 18 GHz channels.

(a) 7.5GHz band

Pampanga river basin:

Science Garden – San Rafael – Gapan – Cabanatuan – Pantabangan Dam – San Rafael– San Fernando

Agno river basin:

Cabanatuan – Tarlac – Rosales

(b) 18GHz band: Science Garden – National Irrigation Administration (NIA) – Office of Civil Defense (OCD)

(4) Placement of Sub-Centers

The Sub-Centers monitor the hydrological and meteorological conditions of their assigned basins, issue flood forecasts and warnings, provide information and coordinate operations with relevant organizations in their community-based disaster prevention activities. In the Pampanga River basin, however, no Sub-Center is in place. The Pampanga area has been identified as being fully in need of a Sub-Center, for which the building and facility construction will be undertaken by the Philippines and necessary equipment will be provided by the Japanese side.

Type	Basin	Name of Station	New/Renew
Central monitoring center	To cover four basins	DIC (Data Information Center) monitoring station	Renew
Basin sub-center	Pampanga river	San Fernado Sub-Center	New
	Agno river	Rosales Sub-Center	Renew

(5) Equipment provided to relevant agencies

Since the information exchange with relevant agencies such as DIC, Department of Public Works and Highways (DPWH) and OCD is very important in the disaster prevention activities, monitoring equipment and other devises will also be included.

(6) Improvement of information to be provided

The existing warning information on floods and other disasters is not sufficient because the information from the gauging stations is inaccurate and limited. Technical support will be planned to help collect accurate and extensive observation information, improve the accuracy of the flood forecast model and provide more specific and comprehensible flood warning information. New flood forecast model is expected to facilitate the use of the effective flood-control measures such as hazard maps.

(7) Improvement of existing facilities

The existing facilities shall be improved in the following manner in order to enhance the current FFWS;

- The existing towers shall be heightened and reinforced for the new Backbone Multiplex Radio Network.
- The works shall be conducted for improvement of the river banks to place water level sensors in case the appropriate piers of the bridge to be attached cannot be secured for this device.

(8) Other considerations

The warning patrol vehicles requested by Philippine side can not be provided under this project. The objective of this project is to promptly disseminate the accurate flood-related information to the local residents. In order to achieve this goal, the Philippine side should be responsible in improving its capability of communicate the information and strengthening of the disaster related organization. The warning patrol vehicles are expected to play a vital role not only in information gathering but also in disseminating the information to the remote villages, and thereby create some synergy effect with the Project. Thus, these vehicles should be procured by the Philippine government as soon as possible

4. Implementation Schedule and Cost

This project will develop a telemetry system on relatively large scale involving 28 gauging stations (including two rainfall repeater stations), five repeater stations, backbone multiplex radio in seven sections and seven relevant agencies. The flood forecasting and warning systems must be continuously operated during flood seasons. Furthermore, the civil engineering works which need to precede other tasks will have schedule constraints since they must avoid rainy seasons to ensure safety and control the construction cost. Taking into account the above, the plan is to divide this project into two construction periods.

The estimated period of the implementation schedule for the project is approximately 32 months from the Exchange of Notes between the Government of Philippine and the Government of Japan to the completion of the Project.

The total project cost is estimated to be approximately 1,229 million Japanese Yen (Japanese side: approx. ¥1,168 million, Philippine side: approx .¥60.9 million).

5. Effect of the project

(1) Direct effect

- Missing rate of the data collection in the telemetry system will be improved form the current 50 % to 3.6 %.
- Observation time will be reduced to about 10 minutes from about 2 hours required for visual inspection conducted due to unavailability of the telemetry equipment.
- “Soft Component Plan” will ensure the effective operations of the FFWS among the relevant agencies, and facilitate dissemination of the clear and accurate flood forecast warning information by hazard map for the local inhabitants.

(2) Indirect effect

- Dissemination of the clear and accurate flood forecast warning information will prolong the lead time for the evacuation and thereby contribute to alleviation of damages to people and property.

- Development of hazard maps will specify the levels of danger in the areas as well as evacuation places and routs, which will ensure the swift and safe evacuation.

6. Recommendations

(1) Thorough inspection and maintenance to retain the observation accuracy

Inaccuracy of the observed information obtained and provided will impair the reliability of the flood forecasting and warning systems, and the maintenance procedures, including the following, must be completely implemented to prevent such consequences. This requires sufficient maintenance budget to be allocated.

- Prepare and use the sensors and observation equipment to acquire precise observation information.
- Periodically inspect the systems to maintain full function.
- Measure the flood flows to improve the accuracy of water-level forecasts.

(2) Seeking ways to provide comprehensible information

The information provided must be relevant and comprehensible to the residents. Means to provide local, specific, representative and clear information must be sought through consultation with BDCC (Barangay Disaster Coordinating Council) in charge of regional disaster prevention and other relevant parties. Referring to the post-flood surveys conducted by PAGASA and BDCC and hazard maps is an example of an effective way to consider the information to be provided.

(3) Building more effective systems of cooperation with the organizations involved in disaster prevention, including regional Disaster Coordinating Councils

Currently, JOMC (Joint Operation and Management Committee) led by PAGASA, which is the management committee for the agencies involved in dam operation, is already functioning; however, more frequent and extensive deliberations with relevant agencies must be held in an attempt to build an effective system of cooperation. PAGASA must lead the efforts to establish active communication, not only with JOMC, but with parties involved in natural disasters.

(4) Points to consider for smooth execution of the Project.

Delay in construction of Sub-Center will hinder the equipment installation and lead to modification of the system configuration, which will surely have the enormous effect on the

Project. Delay in acquiring permissions/approvals from DPWH for the construction work will cause negative impact on the schedule of the construction part.

Regarding the civil works, high water season (June to September) should be avoided taking into consideration the construction cost and safety issues. Strict control shall be put in place for the schedule in order to carry out the construction works of water level supporting and river protection works during low water season (January to May).

In addition, shutdown time for operation of the existing FFWS shall be minimized to secure the observation operation of the FFWS during typhoon and rain seasons.

Basic Design Report
on
The Project for Upgrading of Flood Forecasting and Warning System
in
the Pampanga and Agno River and Basins
in
Republic of The Philippines

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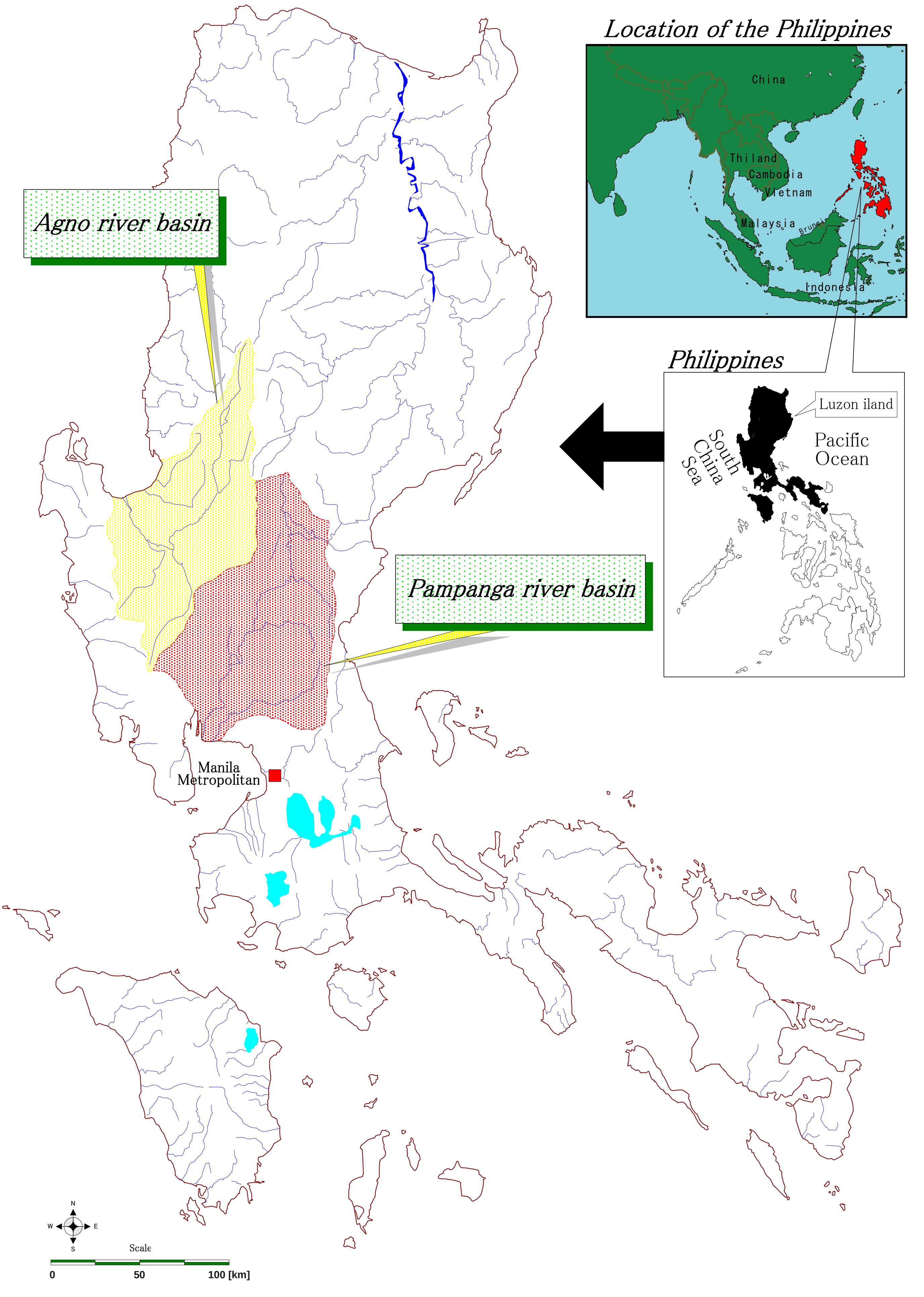
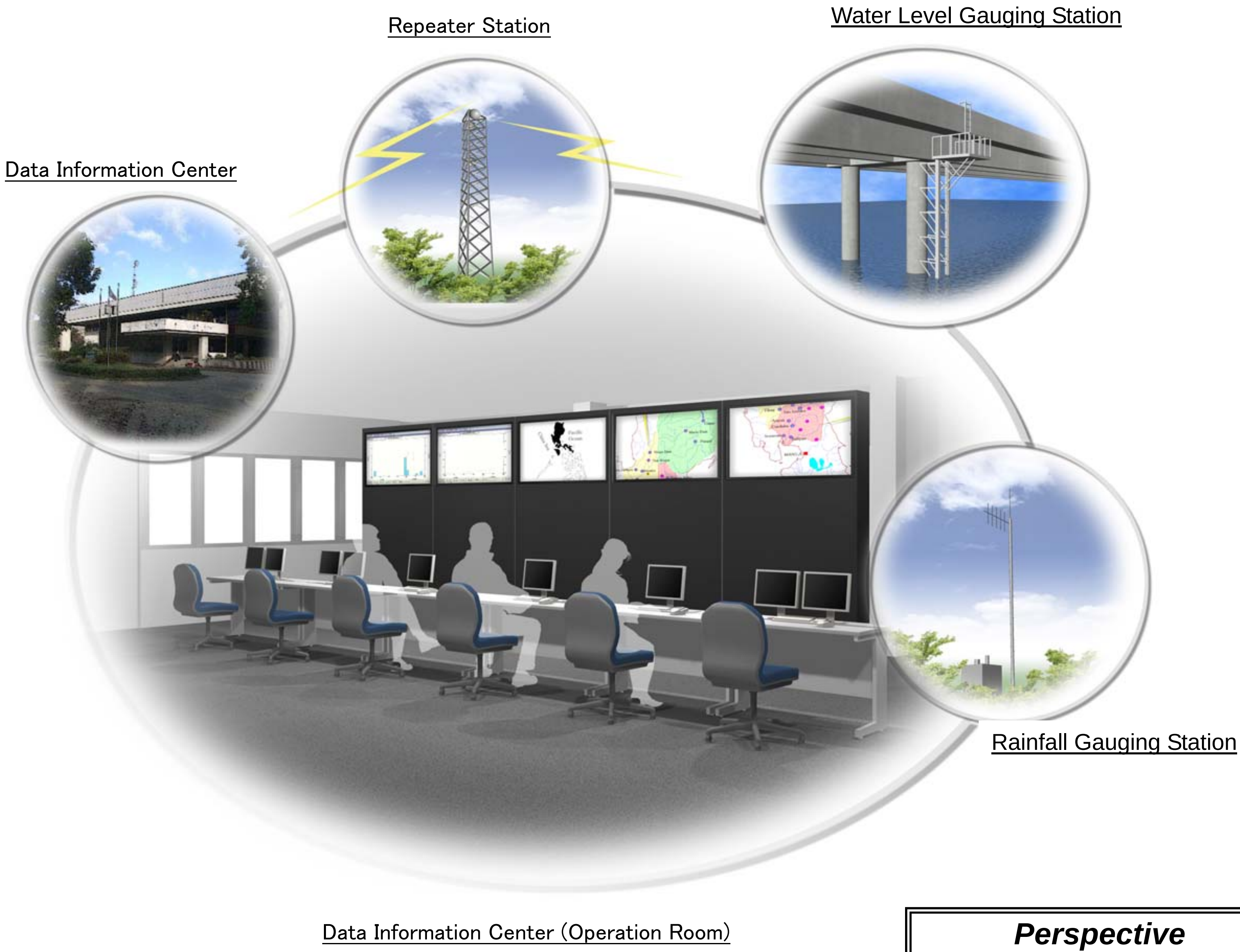


Location Map



Perspective

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Abbreviations

ADRS	:	Automatic Data Recording System
BDCC	:	Barangai Disaster Coordinating Council
B/D	:	Basic Design
CDCC	:	City Disaster Coordinating Council
DENR	:	Department of Environmental and Natural Resources
DG/DEG	:	Diesel Engine Generator
DIC	:	Data Information Center
DOST	:	Department of Science and Technology
DPWH	:	Department of Public works and Highways
D/U	:	Desired / Un-desired
ECES	:	Electronics & Communications Engineering Section
EIA	:	Environmental Impact Assessment
EMD	:	Engineering & Maintenance Division
E/N	:	Exchange of Notes
FFB	:	Flood Forecasting Branch
FFWS	:	Flood Forecasting and Warring System
FOB	:	Free on Board
FWA	:	Fixed Wireless Access
GDP	:	Gross Domestic Product
GL	:	Ground Level
GNI	:	Gross National Income
GPS	:	Global Positioning System
GSM	:	Global System for Mobile communication
HISS	:	Hydrometeology Investigation & Special Studies Section
IP	:	Internet Protocol
ITU		International Telecommunication Union
ITU-R	:	International Telecommunication Union- Radio communication sector
ITU-T	:	International Telecommunication Union- Telecommunication standardization sector
JBIC	:	Japan Bank for International Cooperation
JICA	:	Japan International Cooperation Agency
JOMC	:	Joint Operation and Management Committee
KOICA	:	Korea International Cooperation Agency
LAN	:	Local Area Network
LCD	:	Liquid Crystal Display
L2-SW	:	Layer 2 Switch
L3-SW	:	Layer 3 Switch

MDCC	:	Municipality l Disaster Coordinating Council
MUX	:	Multiplexer
NDCC	:	National Disaster Coordinating Council
NTC	:	National Telecommunication Commission
NIA	:	National Irrigation Administration
NPC	:	National Power Corporation
NEDA	:	National Economic and Development Authority
OCD	:	Office of Civil Defense
OJT	:	On the Job Training
OH	:	Over-the-Horizon
O/M	:	Operation and Maintenance
PAGASA	:	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PBX	:	Private Branch eXchange
PCM	:	Project Cycle Management
PDCC	:	Provincial Disaster Coordinating Council
PHIVOLCS	:	Philippine Institute of Volcanology and Seismology
PC	:	Prestressed Concrete
RC	:	Reinforced Concrete
RDCC	:	Regional Disaster Coordinating Council
REC	:	Rural Electric Cooperatives
SAPS	:	Special Assistance for Project Sustainability
TSS	:	Telemetry System Service Section
UHF	:	Ultra High Frequency
UPS	:	Uninterrupted Power Supply
VAT	:	Value Added Tax
VHF	:	Very High Frequency
VoIP	:	Voice over IP (Internet Protocol)
WB	:	World Bank
WLL	:	Wireless Local Loop

Units / Measurements

Length	mm	:	Millimeters
	cm	:	Centimeters (10.0 mm)
	m	:	Meters (100.0 cm)
	km	:	Kilometers (1,000.0 m)
Area	cm^2	:	Square-centimeters (1.0 cm x 1.0 cm)
	m^2	:	Square-meters (1.0 m x 1.0 m)
	km^2	:	Square-kilometers (1.0 km x 1.0 km)
Volume	cm^3	:	Cubic-centimeters (1.0 cm x 1.0 cm x 1.0 cm)
	m^3	:	Cubic-meters (1.0 m x 1.0 m x 1.0 m)
Weight	g	:	grams
	kg	:	kilograms (1,000 g)
	ton	:	Metric ton (1,000 kg)
Time	sec.	:	Seconds
	min.	:	Minutes (60 sec.)
	hr.	:	Hours (60 min.)
Pressure	pa		Pascal
Currency	PhP/PHP	:	Philippine Peso
	US$	:	United State Dollars
Frequency	MHz	:	Mega (10^6) Hertz
	GHz	:	Giga (10^9) Hertz
Transmission	kbps	:	kilo bit per second
	Mbps	:	Mega bit per second
Electricity	DC	:	Direct Current

Chapter 1

Background of the Project

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1.1 Background of the Project

(1) Overall Goal and Project Objectives

The Republic of the Philippines is located in the subtropical monsoon zone and prone to damages from rainstorms caused by the monsoons and typhoons every year. In particular, Luzon Island, the largest and most populated island of the Philippines that is the center of the country's economic activities, suffers from serious damages from such storms.

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(2) Project Objectives

Japan International Cooperation Agency (JICA) dispatched a basic design study team to the project site for the period between October 17 and December 6, 2006. The study team had a consultation with relevant parties from the Philippine government and conducted a field study in the areas of the planned project. After the study team returned to Japan, the findings were analyzed and a summery report of the basic design was prepared. The study team was dispatched to the project site for the period between March 13 and 21, 2007 to explain the basic design to the local parties.

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Table 1.1-1 Request made at the time of field study for the basic design

Category	Remarks
1.Telemetering system	
(1) Telemetry gauging station	Water-level gauge, rainfall gauge, telemetry equipment, antenna, power supply equipment, and gauging station building
(2) Repeater Station	Repeater equipment and antenna
(3) Sub-center	Telemetry monitoring equipment, antenna, screen monitoring system,

	power supply system, sub-center building, and warning patrol car
(4) DIC (Data Information Center)	Display panel monitoring system and power supply system
(5) DPWH (Department of Public Works and Highways)	Monitoring equipment
(6) OCD (Office of Civil Defense)	Monitoring equipment
2. Main multiplex radio network	
(1) Wireless system options	400MHz/1.4GHz/7.5GHz/High Frequency/NPC Backbone
(2) Wireless system composition	Antenna, antenna tower, power supply system and repeater station building
3. Pantabangan Dam	
(1) Telemetry gauging station	Water-level gauge, rainfall gauge, telemetry system, antenna, power supply equipment, and gauging station building
(2) Discharge warning station	Alarm, telemetry system, antenna, power supply equipment and gauging station building
(3) Dam management office	Monitoring equipment, telemetry controller, discharge warning operation device and antenna
4.Other	
(1) New run-off river analysis model	

1.2 Natural Conditions

(1) Rainfall Pattern

The Philippines belongs to the tropics and has distinct dry and rainy seasons in general. However, climate conditions vary regionally with terrain, monsoon directions and typhoon courses. The annual average temperature is from 28 ºC to 36 ºC, and the average relative humidity is generally between 70% to 80%. The average annual rainfall is around 2,030mm, and approximately a half of it is brought by typhoons.

Typically, most of the 20 typhoons that form in the Pacific per year move towards the Philippines, and about ten of them strike the country directly. The east coasts of the archipelago of the Philippines, apart from Mindanao Island, have normally been affected more often and more seriously than other regions. Not only typhoons but also frontal deluges have caused significant flood damage in many cases every year. The typhoon courses and its rate by month are shown in a figure below.

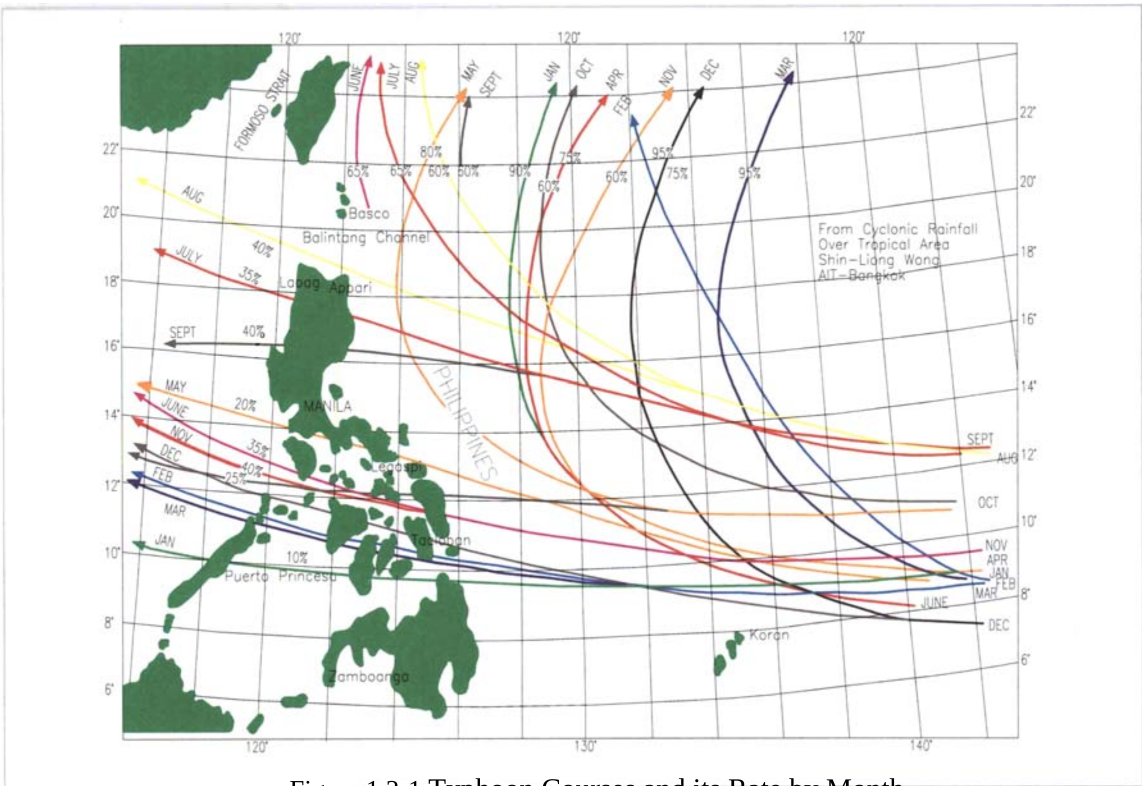

Figure 1.2-1 Typhoon Courses and its Rate by Month

In the study area (the Pampanga/Agno River Basins), the rainy and dry seasons can be obviously divided due to being affected by the south-west monsoon and typhoon. The period of dry season generally continues from November to April, and the other rainy season period is from May to October. Annual rainfall pattern of the study area (administrative Region I & II) are shown in the following table:

Table 1.2-1 Annual Rainfall and Rainfall Pattern of the Study Area

Region	Province	Climate Type	River Basin	Month												Annual Rainfall (mm)		
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Wet	Dry	Total
I	Ilocos Norte	I	-													2,157	123	2,280
	Ilocos Sur	I	-													2,048	82	2,130
	Launion	I	-													2,096	153	2,249
	Pangasinan	I	A													2,233	193	2,426
III	Bataan	I	-													2,236	178	2,414
	Bulacan	I	P													1,797	273	2,070
	Nueva Ecija	I	P													1,669	304	1,973
	Pampanga	I	P													1,844	225	2,069
	Tarlac	I	A, P													1,735	211	1,946
	Zambales	I	-													3,378	160	3,538

A : Agno River Basin
P : Pampnaga River Basin
: Study Area of Pampanga - Agno River Basin
: Monthly Rainfall less than 50 mm
: Monthly Rainfall from 50 mm to 150 mm
: Monthly Rainfall more than 150 mm

From the above table, an average annual rainfall of the provinces in the Pampanga River Basin is estimated to be 2,015 mm, on others an average annual rainfall of the Pangasinan and Tarlac provinces covering almost of all the Agno River Basin is estimated to be 2,186 mm. These average annual rainfall data are the nearly same.

Rainfall by month of the both river basins shows as follows that rainfall reaches its peak in August throughout the year, and it almost never rain in the dry season especially from January to April.

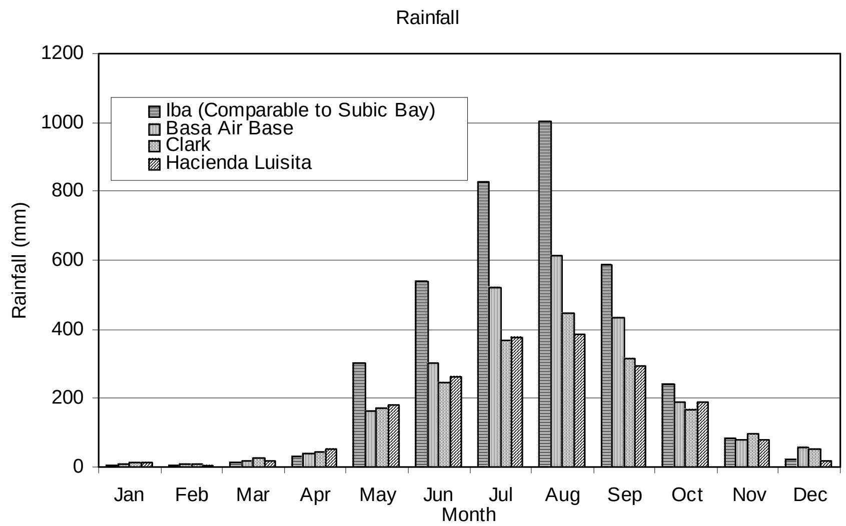

Figure 1.2-2 Monthly Rainfall in the Study Area

(2) River Basin Conditions

(a) Topography and Geology

The river basins covers the 6 provinces, Pampanga, Bulacan, Nueva Ecija, Tarlac, and Pangasinan, in which the land extends with quite gentle slope from the downstream to the upstream. Accordingly, the average river slopes are quite gentle, and then alluvial fan and delta are formulated from the middle reach to the downstream, in which many small river networks also exit.

<u>Pampanga River Basin</u>

The basin extends over the Caraballo Mountains and Sierra Madre Range located in the eastern basin, and in the part of western and southern basin the Zambares Mountains and Mt. Pinatubo are located. The river originates in the Caraballo Mountains in the northern basin, and flows southward almost directly through the basin, and finally into the Manila Bay. The basin, a catchment area of 10,540 km2 and the length of 260 km, is the fourth largest in the Philippines and the second largest in the Luzon Island. The average river slope is as follows:

- River slope (Pampanga River): Upstream – Middle reach 1/2500
  Middle reach – Downstream 1/10,000

<u>Agno River Basin</u>

The Agno River Basin, a catchment area of 5,952 km2 and the length of 270 km, is the third largest in the Luzon Island, the fifth largest in the Philippine, and next to the Pampanga River Basin, which originates in the Cordillera Mountains and flows into the Lingayen Gulf. The average river slope is as follows:

- River slope (Agno River): Upstream – Middle reach 1/2000
  Middle reach – Downstream 1/7,000

<u>Geology of the Pampanga/Agno River Basin</u>

The area is underlain by Mesozoic and Tertiary strata, and Tertiary and Quaternary volcanic rock. Plain and swap areas are characterized by the alluvial deposit.

(b) Features of Runoff

The Pampanga/Agno River Basins is classified into the Type-I according to the general climate classification of the Philippines, in which the dry season continues from

November to April. Although the dry season ordinarily commences in November and ends in April, the following figure indicates that river water level starts to lower in January and to reach its lowest level in May, beginning of the rainy season, by which a 2 to 3 months time lag between rainfall and runoff during dry season is confirmed.

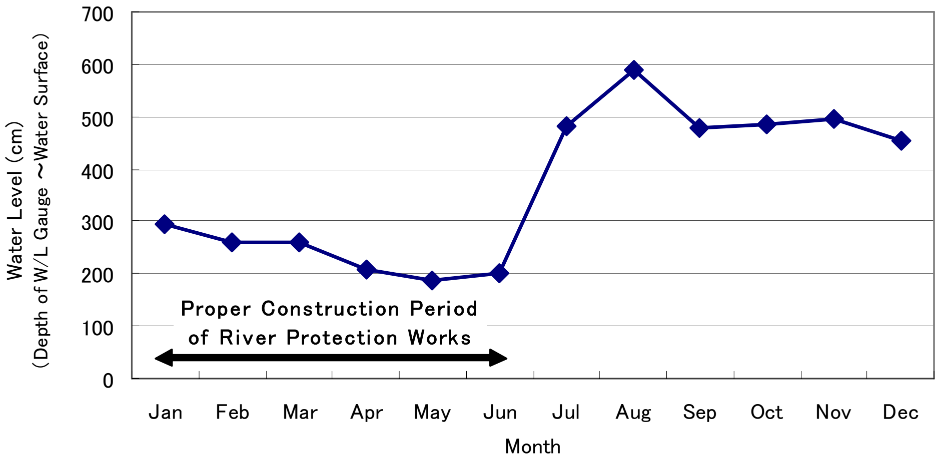

Figure 1.2-3 Annual Variation of River Water Level

(Sta. Barbara Hydrological Station, Agno River Basin)

(3) Deformation of Riverbed

The deformations of riverbed in the both river basins have been proceeded due to a large volume of sedimentation from landslide and lahar materials, which are caused by the Luzon earthquake and the Mt. Pinatubo Eruption.

Nine (9) stations in a total, 5 hydrological stations in the Pampanga River Basin, and 4 hydrological stations in the Agno River Basin, are not operational to gauge water level accurately due to the deformations of riverbed.

(4) Flood Damages

Almost all of the river basins lie on alluvial plain and delta with gentle riverbed slope of 1/10,000 to 1/2,000. The flood damages in such alluvial/delta area have been generally caused by flood inundation, in which the flood flow can not flow quickly and smoothly due to low land and tidal effect to the area. The flood damages occur seriously in city areas located in an extent from the downstream to the middle reach.

1.3 Summary of Natural Conditions Survey

The surveys were conducted to obtain the topographic and geologic data for preparation of design, cost estimate, construction plan, technical specifications (civil, architecture, and apparatus/facilities of metal works), and reference of environmental assessment.

The following survey works were implemented at the existing/proposed water level gauging stations, 16 sites in the both river basins in a total, 9 sites of the Pampanga River Basin, and 7 sites of the Agno River Basin.

(1) River Cross Section Survey

Several lines of the river cross section survey, maximum 5 lines at each site, were conducted to obtain ground level, and then to set design levels of water level sensor on bridge pier and foundation/floor level of the hydrological stations.

Basically at least one cross section survey crossing along the bridge was conducted at each site, in addition 2 to 3 cross section surveys were made in upstream/downstream from the bridge with 50 meter intervals.

(2) Topographic Survey

The topographic survey (70 m x 70 m = 4900 m2/site) was conducted at each site, in which new hydrological stations are to be designed. It will be used for standard design and arrangement of the monitoring houses, and river bank protection works.

(3) Boring Survey and Laboratory Test

The boring surveys, 10 to 15 m depth, were performed at 7 sites as follows to estimate the bearing capacity of foundation based on its core drill in laboratory tests.

Table 1.3-1 Bearing Capacity of Foundation of Hydrological Stations

No.	Name of Station / Location (Province)	Bearing Capacity (Kpa)
1	Sta. Maria, Pangasinan	175
2	Peneranda, Nueva Ecija	175
3	Zaragoza, Nueva Ecija	90
4	Candaba, Pampamga	100
5	San Isidro, Pampanaga	175
6	Arayat, Pampanga	134

As the results, it is concluded that the foundation work of each station should be placed at 1 to 2 m depth based on N-value of standard penetration test, and be to installed with the concrete piles for its sufficient stability.

1.4 Summary of Social Condition Survey

(1) Purpose of the Survey

The flood forecasting and warning system need not only structural measures but also non-structural measure to reduce flood damage as follows:

(a) Structural Measures

- Gauging/Monitoring System of hydrological data (apparatus/facilities, and operation system).

(b) Non-Structural Measures

- Communication of flood forecasting information; and
- Assistance in evacuation of people, and support to refugee.

Regarding to structural measure item i) mentioned above, renew and upgrade of the apparatus/facilities of the existing flood forecasting and warning system is scheduled to conduct in this project.

However, if the non-structural measures mentioned above in ii) and iii) become functional sufficiently during flood, the structural measures which are to be renewed and upgraded will be effective well.

For investigation whether the present non-structural measures is functional or not for the structural measures, interview survey to the people and the governmental agencies was conducted accordingly.

(2) Survey Item

The interview surveys were conducted to identify the followings:

- Recognition/Consciousness of people and government agencies to flood and evacuation;
- Methods/Measures of information transmission for evacuation during flood;
- Patterns of actions of people and governments during flood evacuation; and
- Preparation of flood hazard map.

The total number of respondents of the interview survey is follows:

A. People: 300 Households

B. Barangay Captain: 20 Barangay Captains

C. Disaster Coordination Committee (DCC): 2 Regional DCCs
5 Provincial DCCs
3 City DCCs
7 Municipal DCCs

D. Community Based FFWS (CBFFWS): 60 Households
4 Barangay Captains

The locations in which the interview surveys were conducted are summarized below:

Table 1.4-1 Respondents and Administrative Area of Interview Survey

Classification of Respondents	Number of Respondents / Administrative Area of the Interview Survey	
	Pampanga River Basin	Agno River Basin
A. People 300 Respondents B. Organization (1) (Barangay Captains) 20 Barangay Captains (20 Barangay DCCs)	-150 Households - 10 Barangay Captains Nueva Ecija Province 1. Cabanatuan City 2. Laur Pampanga Province 3. Candaba 4. Guagua Bulacan Province 5. Norzagaray	- 150 Households - 10 Barangay Captains Pangasinan Province 1. Dagupan City 2. Pozorrubio 3. San Mannuel 4. Bayanbang Tarlac Province 5. Tarlac City
C. Organization (2) (DCC) *1 2 Regional DCCs 5 Provincial DCCs 3 City DCCs 7 Municipal DCCs In a total of 17 organizations	- One (1) Region - Three (3) Provincial Coordination Committees - One (1) City office - Four (4) Municipal offices Region-III Province Nueva Ecija, Pampanga, and Bulacan City Cabanatuan	- One (1) Region - Two (2) Provincial Coordination Committees - Two (2) City offices - Three (3) Municipal offices Region-I Province Pangasinan, Tarlac City Dagupan, Tarlac
D. CBFFWS *2	non	60 Households 4 Barangay Captains 2 Municipalities Pangasinan Province 1. Pozorrubio 2. Villasis

Note: *1: DCC (Disaster Coordination Committees of each local administration)

*2: CBFFWS (Community-Based Flood Forecasting and Warning System)

(3) Conclusions

The followings were confirmed through the interview surveys:

1) People and local governments understood well the dangerousness of flood inundation, and importance of flood forecasting and evacuation activities.
2) In view of communication system of flood information and support to people's evacuation and refugee by the government, the office of civil defense (OCD) under the Ministry of Defense, and the local disaster coordination committees have contributed to various disaster prevention systematically before/during/after the disaster.
3) Almost all of the local administrations in which the interview surveys were carried out, 14 local agencies out of 17 agencies, hold the flood hazard map. The recognition of importance of the flood hazard map spread widely through the study area, people and each government agency, in view of prevention of flood damages. The Community Based Flood Forecasting and Warning System (CSFFWS) has gradually became popular with people in the Agno River basin.

The flood forecasting and warning system of the PAGASA is quite essential for assistance to the disaster prevention activities by the government agencies and people, which need to improve its performance and accuracy, and issue of the flood bulletin in more properly and timely.

(4) Result of social Condition Survey

Interview surveys which were conducted with people living in the Pampanga/Agno River Basins obtained the following results:

(a) Consciousness of people and government agencies to flood and evacuation

<u>Flood Inundation Area and Evacuation Places</u>

- More than 90% of respondent know location of flood inundation in their areas.
- Source of information of the flood inundation area: 74% understands by means of basis of their experience, and 32% get the information from Barangay office/staff.
- Evacuation place: 85% recognize their evacuation places such as school, more safe house/area, Barangay Office, Church, and Evacuation center.

<u>Timing of Evacuation</u>

- Source of Information of Flood Warning: 52% get the information from the Barangay Disaster Coordinating Council (BDCC).
- Decision of Evacuation: 53% of the respondents start evacuation on the basis of their experience, and 40% follow advice from the BDCC. Nearly a half of the respondents rely on the BDCC's advice for their escape from flooding/flood damages.

Recognition of Flood Forecasting and Warning System

- 85% know that the PAGASA is conducting the flood forecasting and warning activities.
- 80% recognize that the flood forecasting and warning performed by the PAGASA is quite effective to avoid flood damages.

(b) Methods/Measures of communication system for evacuation during flood

Information Transmission of Typhoon and Flood Forecasting

Flood information from PAGASA such as issue of flood bulletin: advice of evacuation, and alarm/alert/critical river water levels is provided to the Office of Civil Defense (OCD) of Ministry of Defense, National Disaster Coordinating Committee through telephone and facsimile, in addition each River Basin Center inform the Local Disaster Coordinating Committees (RDCC, PDCC, CDCC, MDCC, BDCC) about these information.

Role of Local Disaster Coordinating Committee

Provincial Disaster Coordinating Committees (PDCC) conducts the following:

- To communicate flood information for the local disaster coordinating committees (Ciry, Municipal, and Barangay Disaster Coordinating Committee) during flood;
- To control evacuation of the people, supervise restoration works, and support victims of flood damages during/after flood; and
- To collect and arrange flood damage reports/records after typhoon/flood.

Subject of Operation of Flood Forecasting and Warning System

As results of the interview survey, 73% of the respondents commence evacuation based on the flood information from the PAGASA through the BDCC and mass media such as television and radio broadcasting station, and these local disaster coordinating committees request the PAGASA to provide the flood forecasting and warning more quickly and accurately.

(c) Patterns of actions of people and governments during flood evacuation

Evacuation during Flood

Almost all of respondents understand the BDCC's activities, and 87 % recognize that the BDCC perform their activities quite functionally, and then 45% request the BDCC to provide more detailed and accurate typhoon/flood information (date of its attacking, advice of evacuation etc.). People demand the BDCC's activities during typhoon/flood as follows:

- To communicate typhoon/flood information to people: 32 %

- To organize a team for urgent disaster prevention works: 24 %
- To transport and distribute floods and emergency goods: 16 %
- To communicate advice of evacuation to people: 13 %

From the above results, it is concluded that the PAGASA should set up more detailed and accurate typhoon/flood forecasting and warning system from the view of flood damage mitigation.

<u>Support victims after Flood</u>

Almost all of 276 respondents (87 % of the total respondents) have been supported by the government agencies concerned before, and the others have been supported by the followings:

- 45 respondents (14.2 %) by private companies;
- 26 respondents (8.2 %) by NGO; and
- 24 respondents (7.6 %) by other agencies.
- Forty percent (40%) request the BDCC to organize an emergency team for supporting to people, restoration/rehabilitation works, and transportation and distribution of foods and goods during typhoon/flood.

(d) Preparation of flood hazard map

It is confirmed that almost all administrative agencies in which the interview surveys were conducted, 2 regions, 5 provinces, 3 cities, and 7 municipalities, have already prepared flood hazard maps, and utilize them for planning of the disaster prevention and evacuation, and restoration works during disaster attack as shown below.

Table 1.4-2 Existing Condition of Preparation of Flood Hazard Map by Local Governments

Existence of Flood Hazard Map	Region	Province	City	Municipality
Number of Target of the Survey	2 Regions	5 Provinces	3 Cities	7 Municipalities
Available	I(A) III *(P)*	Pangasinan *(A)* Tarlac *(A)* Nueva Ecija *(P)* Bulacan *(P)*	Dagupan *(A)* Tarlac *(A)* Cabanatuan *(P)*	Pozorrubio *(A)* Bayambang *(A)* Candaba *(P)* Guagua *(P)* Norzagaray *(P)*
Not Available	-	Pampanga *(P)*	-	San Manuel *(P)* Laur *(P)*

Note: (A): the Agno River Basin (P): the Pampanga River Basin

As the results of the interview survey, 4 provinces and 3 cities which have been habitually damaged by flood every year had already prepared the flood hazard map. Accordingly it is concluded that people and each local government agency recognize importance of the hazard map for prevention/mitigation of flood damages.

1.5 Social Environmental

There are no factors to affect natural environmental and resettlement matters by installation of water level gauge equipment and construction of hydrological stations, therefore it is not so difficult to obtain the approval in view of the purpose of the project; flood damage mitigation, even if the Environmental Impact Assessment (EIA) is required.

When an official approval letter, Certificate of Non-Coverage (CNC), is obtained from Ministry of Environmental, the EIA dose not need to be carried out. The PAGASA should take the CNC/EIA before the detailed design stage accordingly.

Land acquisition is expected to be settled without any resettlement for the project, the PAGASA should conduct the land acquisition in tight cooperation with the local governments concerned.

1.6 Present Situation of Flood Damage

(1) Cost of Flood Damage

The most of flood damages in river basins are cased by flood inundation which is produced by the topographic conditions such as alluvial area, low land, and high tidal affect. The flood damages frequently occur in the downstream area as shown in Figure 1.6-1.

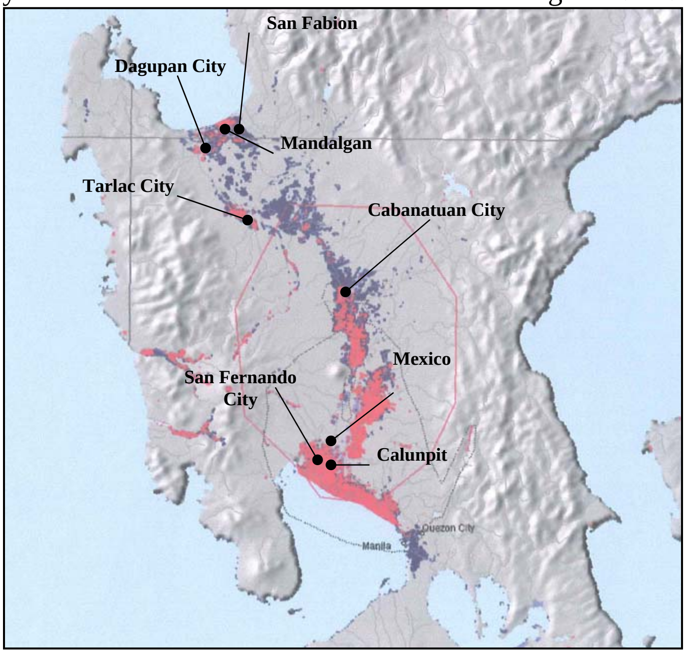

Figure1.6-1 Flood Inundation Area by Typhoons in 2003
(Blue: July 2003, Red: August 2003)

The flood inundation areas in the Pampanga/Agno River Basins extend two (2) administrative regions, Region-I and Region-III. The Region-I and Region-III are situated in the Agno River Basin and the Pampanga River Basin respectively.

The costs of flood damages of Region-I and the Region-III from 1980 to 2001 located are shown in Figure 1.6-2. The flood damages have been increasing from 1980, especially whose annual cost exceeded Philippine Pesos (PHP) 8 billion in 1995, and reached PHP 18 billion in 1998.

The tendency of the flood damage increase may be affected by population increase in the both river basins mentioned below:

<u>Pampanga Province (Pampanga River Basin)</u>

The population has increased nearly twofold, by 100%, from 890,000 in 1975 to 1,620,000 in 2000.

<u>Pangasinan Province (Agno River Basin)</u>

The population has increased by 60% from 1,520,000 in 1975 to 2,430,000 in 2000.

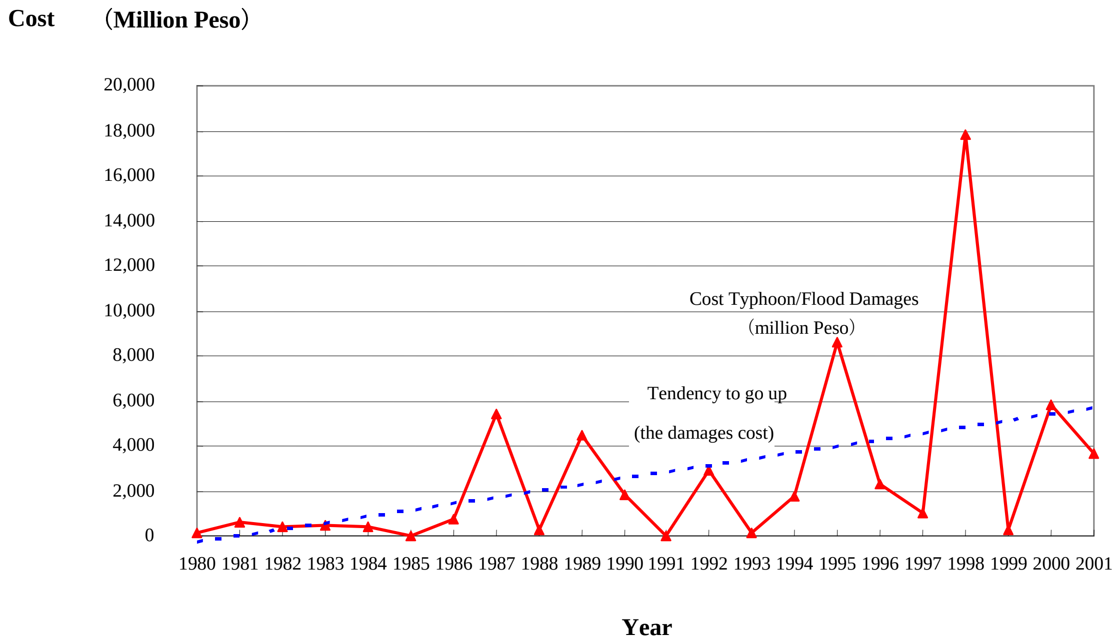

Figure 1.6-2 Cost of Typhoon and Flood Damages (Region I & III)

The flood damages of San Fernando City which is located in the flood prone area of downstream of the Pampanga River Basin, and the capital of Pampanga Province, is shown in Table 1.5-2 The rate of flood damage is about 0.5% to 0.6% to a total of the flood damage amount of Region-I and III in 2000 and 2001, namely the total amount from PHP20 million to PHP30 million.

The population of each municipality in the flood prone area is shown in below according to statistical records of 2002.

<u>Pampanga River Basin</u>

- City of San Fernando (Capital of Pampanga Province, the population of 220 thousand)
- City of Cabanatuan (Nueva Ecija Province, the population of 220 thousand)
- Municipality of Mexico (Pampanga Province, the population of 110 thousand)
- Municipality of Calumpit (Bulacan Province, the population of 80 thousand)

<u>Agno River Basin</u>

- City of Tarlac (Capital of Tarlac Province, the population of 250 thousand)
- City of Dagupan (Pangasinan Province, the population of 130 thousand)
- Municipality of Mangaldan (Pangasinan Province, the population of 80 thousand)
- Municipality of San Fabion (Pangasinan Province, the population of 70 thousand)

(2) Riverbed Aggradation

The riverbed levels in the both river basins have rapidly risen due to great volume of sedimentation and lahar inflow from the upstream, which are caused by the Luzon Earthquake in 1990 and Mt. Pinatubo Eruption in 1991. The following flood damages and potential risks have been increasing due to the aggradation of riverbed in the both river basins:

(a) Downstream to Middle reach:

Enlargement of inundation area, extend of flood inundation time

(b) Middle reach to Upstream:

Flood overflowing from dike occurred in the Tarlac River, the tributary of the Agno River in 2004, and produced erosion and damage to dike and other river facilities.

The potential risk of flood inundation in Cabanatuan City (the population of 220 thousand) and Tarlac City (the population of 250 thousand) are increasing due to the riverbed aggradation.

(3) Flood Control Plans

Flood damages in the river basins are caused by the followings:

- Downstream to Middle Basin: Flood inundation (damages to house, farmland, and infrastructure in town area)
- Middle to Upstream Basin: Riverbed aggradation of (erosion of dike and river bank protection)

The government of the Philippines is proceeding the river improvement projects particularly in middle and downstream of the both river basins to protect the city and surrounding areas, such as San Fernando City (Pampanga River Basin), Dagupan City (Agno River Basin), and Tarlac City (Agno River Basin), against flood.

The government have formulated the flood control plans, diversion channel, dike, retarding basin, pumping station, raising of infrastructures (road, bridge and residential land), and dredging of river channel etc., to mitigate flood damage in the both river basins.

The ongoing/completed flood control projects are summarized below:

(a) On-going/completed Flood Control Projects:

Pampanga River Basin

- The Pampanga Delta River Improvement Project (Phase-I): River improvement works on 10km downstream from Calunpit, completed
- The Pinatubo Disaster Prevention Project (Phase-I): River improvement works in Sacobia-Bangban River Basin (Rehabilitation of existing dike, River dredging, river channel enlargement, Construction of three (3) bridges), completed
- The Pinatubo Disaster Prevention Project (Phase-II): River improvement works in Pasig-Potolero River Basin (Rehabilitation of existing dike, Construction of new dike), completed

Agno River Basin

- River Improvement Project in the Agno River (Phase-I):
  River improvement works between river mouth and the confluence of the Tarlac River and the Agno River, ongoing

However, the others there are many pending projects as follows due to difficulties of land acquisition, and technical and economical aspects for construction works:

(b) Pending Flood Control Projects:

Pampanga River Basin

- The Pampanga Delta River Improvement Project (Phase-II):
  River improvement works on upstream from Calunpit, pending
- The Pinatubo Disaster Prevention Project (Phase-III and IV):
  River and drainage improvement works in Municipalities of Guagua and Lubao, and San Fernando City, pending

Agno River Basin

- River Improvement Project in the Agno River (Phase-II): River improvement works from the confluence of the Tarlac River and the Agno River to upstream of the Tarlac River, pending
- River Improvement Project in the Agno River (Phase-III): River improvement works from the confluence of the Tarlac River and the Agno River to upstream of the Agno River, pending
- River Improvement Project in the Allied River Basin: Flood Control Projects in Dagupan City and around areas, pending

Chapter 2

Contents of the Project

Chapter 2 Contents of the Project

2.1 Basic Concept of the Project

This project aims to restore the functions of the existing flood forecasting and warning systems, which have been malfunctioning due to damage and deterioration of observation and communication facilities and interference caused to the main multiplex-radio network by mobile phone frequencies, so as to allow speedy and accurate observation and data transmission and to expand and improve such systems to facilitate more efficient and effective disaster prevention. The Project consists of the following components:

1) Improvement of the existing FWFS (Flood Forecasting and Warning System)

   The existing FFWS systems shall be improved considering easy maintenance and economical efficiency for the replacement of the equipments.

2) Placement of gauging stations

   Placement of stations is planned to suit the current social and technical environment.

3) Improvement of backbone multiplex radio network

   The backbone multiplex radio network deteriorated by the radio interference shall be improved so as to upgrade the transmission capacity.

4) Placement of Sub Centers

   New Pampanga Sub Center will be constructed.

5) Equipment provided to relevant agencies

   Monitoring equipment to watch the data processed and analyzed at DIC shall be provided at the relevant agencies.

6) Improvement of information to be provided

   Application to achieve fixed quantity and accurate flood forecast shall be provided, and new run-off model software shall be also provided to foresee the flood area and flood water height.

7) Improvement of existing facilities

   The existing facilities shall be improved in the following manner in order to enhance the current FFWS;

   - The existing towers shall be heightened and reinforced for the new Backbone Multiplex Radio Network.
   - The works shall be conducted for improvement of the river banks to place water level sensors in case the appropriate piers of the bridge to be attached cannot be secured for this device.

2.2 Basic Design of the Requested Japanese Assistance

2.2.1 Design Policy

(1) Basic Policy for the Project

(a) Improvement of the flood forecasting and warning systems

The improvement of the entire flood forecasting and warning systems will be designed to make the maintenance easy and economical view of equipment renewal economical. A specific improvement measure is to maintain duplicate functions and backup data in the core part of the systems, including the wireless equipment and data recording function, so that a equipment failed due to power outage or other causes would be replaced by another equipment with the same functions to continue the data collection and measurement, which will improve the reliability of the entire system. In view of cost reduction, the systems will be developed using general network technology (IP technology) and information delivery technology (Web technology) to reduce the cost of equipment maintenance and renewal. In addition, the conventional float-type water-level gauges that require regular maintenance will be replaced by pressure-type gauges that will allow easy and less costly maintenance.

(b) Establishment of new gauging stations

The rainfall and water-level gauging stations for the existing flood forecasting and warning systems were founded 30 years ago when the physical measures for flood control such as riverbanks and distribution of population and economic infrastructure were different from the present day. The social needs and awareness of flood forecast and warning information are likely to have been lower at that time. For this reason, the placement of the gauging stations will be reviewed to adapt to the current social and economic needs and the development of the basin urban areas when planning for the new gauging stations.

(c) Improvement of the backbone multiplex radio network

The backbone multiplex radio network has used the frequencies of 800 MHz and 2 GHz to serve the communication between the Sub Centers and central monitoring center (DIC) and the contact with relevant agencies such as National Disaster Coordinating Council (NDCC). Real-time monitoring of flood data at the DIC and communication with the relevant agencies, however, have been disrupted by the interference from mobile phone networks that use the same 800 MHz and 2 GHz frequencies. The backbone multiplex radio network should be reliable and function accurately in a disaster and other emergencies. It shall be utilized for disaster management communication that meets global standards, unlikely to be affected by interference from the mobile phone networks in the future and use frequencies (7.5 and 18 GHz) capable of transmitting the amount of data needed for flood forecasting and warning.

(d) Equipment at new Pampanga Sub Center

The Sub Center is responsible for collecting information on the local river conditions and providing it in real time to the local communities and government agencies. The Sub Center will function effectively in promoting efficient and active disaster mitigation activities if placed in the regional area close the river basin. The Pampanga Sub Center is currently included in the central monitoring center building in Manila outside the basin and is planned to be relocated into the basin. The Pampanga Sub Center building will be constructed by the PAGASA, which is the counterpart agency in the Philippines. This project is to prepare the flood forecasting and warning equipment to be placed in the Sub Center.

(e) Improvement of the system of providing information to relevant agencies

At present, the means of providing information to the principal agencies engaging in flood control measures such as, the National Disaster Coordinating Council (NDCC), National Power Corporation (NPC), National Irrigation Administration (NIA), Department of Public Works and Highways (DPWH) and major dam operators, is limited to telephone communication due to the absence of monitors to confirm the flood data at each agency. At these major agencies involved in disaster prevention, therefore, will be equipped with monitors to directly access the information collected and analyzed by PAGASA. This will allow fast and accurate disaster control efforts at such agencies.

(f) Improvement of the accuracy of flood forecasting and warning information

Providing the relevant agencies and residents in the basins with quantitative and comprehensible information will require data processing software that analyzes the collected observation data. The existing outflow forecasting software for which Japan has been providing technical instruction will be improved for this project to perform quantitative and accurate flood forecasting. Also, new runoff analysis software (called overflow analysis software) will be added to facilitate the prediction of overflow locations and inundation levels.

The improvement of the existing outflow forecasting software and operational and technical instruction for the overflow analysis software will be incorporated into the "Soft Component Plan".

(g) Improvement of existing facilities

Those existing radio towers without sufficient height to change the frequencies of the main multiplex communication network will be improved such as by raising their height. The tower height extension will be designed according to the National Structural Code of the Philippines (2001) enforced in the country. Further, the water-level gauges without nearby suitable pier of the bridges will be built on a river bank after the protection work is made.

(2) Policy for Natural Environmental Conditions

(a) Geographical features

Both basins have created alluvial plains and the entire areas of the basins are generally flat. Because the downstream land is low and affected by tides, most of the damage is caused by flood inundation by insufficient drainage or so on. Since the 1990s, mad from volcanic mudflows and landslides accumulated along the river channels has rapidly raised the riverbeds, increasing the threat of flooding even in the midstream and upstream basins. For this reason, rainfall and water-level observation networks in the extensive area covering from the downstream to upstream basins shall be developed.

(b) Rainfall characteristics

Most of the rain that causes flood damage in the Philippines is brought by wide-area weather phenomena including primarily typhoons and fronts. Typhoons develop over the sea east of the Philippines and tend to bring rain from the eastern shore of Luzon Island to the western inland as they move along the course. Early detection of rain that causes flooding is beneficial for flood forecasting in the basins. In particular, an additional rainfall observation network established on the east side of the paths of typhoons and fronts will be useful.

(3) Policy for Social Economic Conditions

(a) Social needs for flood forecast and warning information

The river conditions have changed since the existing systems were placed due to the earthquake in Bagio and Mount Pinatubo eruption. The form of river management has also changed, which now includes the San Roque Dam operation. The population increase and growth of cities and urban areas have diversified the locations to be protected by priority. Further, the social needs and awareness of flood forecast and warning information have been growing

(4) Policy for Local Construction Conditions

(a) Policy on construction materials

Equipment and materials such as, concrete, cement, structural steel and construction machinery for civil and steel tower construction works can be procured locally.

Concerning the electrical equipment and materials, while some local manufacturers provide power cables, electric wires and the like, there seems to be no company that manufactures coaxial cables, fiber optic cables and other communication cables and waveguides in the Philippines.

(b) Policy on procured equipment, materials and consumables

Procurement methods for the equipment and materials that can be acquired in the Philippines will be determined, taking into account the performance, maintenance and cost. Some of the equipment, materials and consumables relevant to this project that are available in the Philippines are water level gauges, UPS and batteries.

(i) Water Level gauge

There is one company in the Philippines that manufacturers water level gauge (pressure type), which as a result of a survey, has been ruled out at this stage for the following reasons:

- Experienced only one gauging station in the Bicol River basin managed by PAGASA that has been in operation for only approximately one year since the construction in December 2005, and although the station continues to be operated, this does not constitute adequate experience as a company.
- Its bit error rate is 2.5%, which is considerably high.

(ii) Digital recorder

A digital recorder will be placed at the gauging stations at the sites as a backup for the telemetry channels in case of failure. As of now, such recorders are not produced and must thus be developed.

(iii) UPS (Uninterrupted Power System)

Power supply equipments such as small UPS products are offered by several companies. All of such companies are distributors that procure products of third countries rather than manufacturing on their own. For the following reasons, power supply equipments will be acquired locally.

- Relatively inexpensive
- UPS products with an output voltage of 220 V are rare in Japan.
- Locally supplied products can be serviced by local suppliers in case of failure and maintained more easily.

(iii) Batteries

Consumable batteries currently purchased and used are those for trucks that are sold in the Philippines because the equipment originally installed at most of the gauging stations are already unusable. One unit of such truck batteries is 3,500 pesos (approx. 8,400 Japanese yen), which is relatively inexpensive; however, the capacity is not sufficient and the life of the battery is only one or two years due to its charge and discharge characteristics, thus inappropriate as a power supply equipment for a disaster-prevention system. The battery equipment for the telemetry gauging stations, in particular, must continuously work for 30 days without sunlight, which is not possible for a truck battery.

Meanwhile, a long-life MSE lead-acid battery manufactured in Japan, does not require periodical maintenance such as water refilling, has an expected life of approximately 15 years (varies depending on the temperature conditions), and works under the required no-sunlight condition

Concerning the battery equipments, therefore, it should be more reasonable to initially select from those manufactured in Japan and wait for batteries with higher performance to become available in the Philippines and regular budgets to be provided by PAGASA during the life of the initial equipment.

(iv) Warning Patrol Vehicles

The Philippines side requested to provide the flood warning patrol vehicles for the evacuation activities such as smooth dissemination to local people livening in remote area and beyond the range of the sirens, but they can not be provided under this Project due to the limitation of the Grant Grand Aid’s policy.

The objective of this project is to promptly disseminate the accurate flood-related information to the local residents. In order to achieve this goal, the Philippine side should be responsible in improving its capability of communicate the information and strengthening of the disaster related organization. The warning patrol vehicles are expected to play a vital role not only in information gathering but also in disseminating the information to the remote villages, and thereby create some synergy effect with the Project. Thus, these vehicles should be procured by the Philippine government as soon as possible.

(v) Other items

Arrange for the printers, facsimiles and telephones to be procured locally because such equipments with performance equivalent to that of those in Japan are available in the Philippines, which are inexpensive, and the consumables used are easily obtainable.

(5) Policy for the Use of Local Contractors

(a) Civil and construction works

Local building and civil contractors should be able to take charge of the embankment works and construction of gauging station buildings, considering the scale of such work required for this project. In particular, those companies interviewed at the sites have experience in a project conducted under Japanese Grant Aid project and are fully capable of working as a subcontractor.

(b) Telecommunication steel tower construction

Telecommunication steel tower construction can also be carried out by local contractor because structural steel that constitutes the main material can be procured locally and a number of contractors specialized in tower construction are available. A large part of telecommunication in the Philippines uses mobile equipments and mobile phone towers are seen throughout Luzon Island. Most of these towers have been erected by the local contractors in the Philippines, which suggests that the towers for this project could also be constructed by them.

(c) Equipment installation works

Because this project primarily uses system equipment made in Japan (telemetry observation system, monitoring equipment, multiplex-radio system, etc.) that require expertise, the installation should be conducted by local electrical contractors under the supervision of Japanese engineers.

(6) Policy for Operation and Maintenance

(a) Budgets of executing agencies

The labor budget for PAGASA was reduced in 2005 as part of measures to streamline its staff organization. The number of personnel, however, has not decreased, implying that older employees have been replaced by younger ones. While the number of system and telecommunication engineers has not increased, younger hydrology engineers have been employed.

The budget for Repair of government facility is generally stable at approximately 3.5 million pesos (8 million Japanese yen) per annum. This budget is intended for relatively simple and less costly repair work, which does not include the cost of replacing high-priced instruments. The budget system requires that the funds for purchasing equipment to be requested in advance to be provided in the following year, and requests are being submitted in order of priority such as water level sensors and power supply equipments.

PAGASA has indicated that a budget of approximately 3 million pesos (7 million Japanese yen) per annum can easily be provided for the equipment purchase in addition to the cost of maintenance of the aforementioned facilities. The equipment can be continuously maintained even when malfunctioning by requesting and obtaining funds for all equipment purchases and repairs of up to approximately 3 million pesos.

(b) Organization, staff and technical level of executing agencies

TSS (Telemetry System Service Section) is a department in charge of maintaining the observation equipment, telemetry communication systems and multiplex-radio equipments for the flood forecasting and warning systems. Although some observation data has been lost due to interrupted observation caused by a malfunction of a sensor and other equipments and external interference such as crosstalk, the department has been maintaining the equipment including telemeters in continuous and normal operation. Its technical capabilities for maintenance appear to be satisfactory.

(c) Instruction for initial operation and management provided to executing agencies

The specifications of the equipment in this project will be followed by the system of the specifications for telecommunication system No. 21, which is based on the Ministry of land, Infrastructure and Transport in Japan. While the basic system operation principles such as the calling method (e.g., polling) are the same, the maintenance method will be substantially changed such as the components made into chips. In addition, new multiplex-radio systems with 7.5GHz, 18GHz and other bands will be adopted, requiring guidance for the initial operation and management. Hence, Japanese engineers who have installed and adjusted the equipments will provide instruction to the equipment operators in the Philippines for the equipments for which the installation and adjustment have been completed.

(7) Policy for setting the quality of facilities and equipment

This project is positioned as the establishment of disaster prevention systems, which shall be highly reliable. Therefore, telemeters that constitute the main system with basic specifications conforming to the Telecom Specs No. 21 of the Ministry of Land, Infrastructure and Transport (MLIT), Japan's standard specifications for telemetry systems, and multiplex-radio equipments conforming to the ITU-T and ITU-R international standards will be selected.

(8) Policy for construction and procurement methods and period

This project involves 28 gauging stations (including two repeater stations for rainfall), 5 repeater stations, main multiplex-radio networks in 7 sections and 7 relevant organizations, comprising a telemetry system of considerably large scale. The flood forecasting and warning systems shall be continuously operated during flood seasons. Civil works that need to precede other tasks must avoid rainy seasons, considering safety and construction cost control.

Consequently, this project will be planned in two construction phases.

2.2.2 Basic Plan (Construction Plan / Equipment Plan)

(1) Arrangement Plan of Hydrological Stations

In the flood forecasting and warning system, a plan of arrangement of hydrological stations should be prepared with consideration of the followings:

- Existing arrangement of hydrological stations;
- Flood damages in the study area;
- Existing flood control plan; and
- PAGASA's capabilities of for operation and maintenance on the flood forecasting and warning system.

(a) Policy of Arrangement

The basic policy of arrangement of the hydrological stations is as follows:

- To consider the present conditions of budget and staffing in the PAGASA;
- To fulfill minimum requirements for the arrangement under the present social and natural conditions; and
- To minimize the costs of construction and operation/maintenance by utilization of the existing hydrological stations operated by relevant agencies such as NIA, NPA, and San Roque dam: by avoidance of overlapping arrangement of measuring apparatus/ facilities.

The basic concepts for arrangement of the hydrological stations are summarized below with consideration of the present flood control plans, topographic conditions, and flood mechanism:

- To establish new hydrological stations (water level and Rainfall) in city area located in downstream of the river basins in an economic view point, in which the population and economic infrastructures are concentrated;
- To establish new hydrological stations in the upstream of flood damage area to improve the accuracy of the flood forecasting & warning system; and
To establish new rainfall stations in proper locations to forecast flood water level in early stage, and to extend time lag between rainfall and runoff.

To add new rainfall station particularly in the eastern Pampanga River Basin: around the routes of typhoon and seasonal rain front.

(b) Priority of Arrangement

The arrangement plan of hydrological stations was determined based on the following three (3) basic concepts, on which the PAGASA had agreed. The arrangement plans of hydrological station for the Pampanga River Basin and the Agno River Basin are shown in Figures respectively.

(i) Establishment in High Economic Potential Area

Hydrological stations should be established in around city areas in which economic infrastructures have been constructed, especially San Fernando City (Pampanga River Basin) and Dagupan City (Agno River Basin), from view of economical effect reason.

<u>Pampanga River Basin</u>

- A new hydrological station will be established at left abutment of the Abakan Bridge, about 10 km upstream of San Fernando City, 2-3 km upstream of the confluence of the San Fernando River and the Abakan River in Municipality of Mexico.
- A new rainfall station will be established at Municipality of Porac located in upstream of the Porac- Gumain River of the Sasumuan Hydrological Station (existing).

<u>Agno River Basin</u>

- A new hydrological station will be established in the left bank of the Tagamusin Bridge, Municipality of Binalonan, about 30 km upstream from Sta. Barbara Hydrological Station (existing) along the Sinocalan River.
- A new hydrological station will be established at left abutment of the Baloling Bridge, about 10 km upstream of Municipality of Mangaldan along the Patalan River.

For the purpose of establishment of the hydrological stations in high economic potential area, the following new hydrological/rainfall stations should be installed:

- Mexico Hydrological Station (Pampanga River Basin, Abakan River)
- Porac Rainfall Station (Pampanga River Basin, Porac-Gumain River)
- Binalonan Hydrological Station (Agno River Basin, Sinocalan River)
- Mapandan Hydrological Station (Agno River Basin, Patalan River)

(ii) Improvement of Accuracy of the Existing Flood Forecasting & Warning System

<u>Pampanga River Basin</u>

- A new hydrological station will be established in the Peneranda River Basin, its catchment area about 700 km2, a middle reach tributary located in left bank of the Pampanga River.

<u>Agno River Basin</u>

- The San Roqe Hydrological Station should be abolished and transferred from existing place, just downstream of the San Roqe dam, to 20 km downstream of the dam site since the existing station is not able to perform flood forecasting and warning activities effectively due to the flood storage function by the San Roqe Dam.
- Two (2) new rainfall stations will be established in upstream of the Tarlac River Basin, the largest tributary of the Agno River Basin, to improve accuracy and lead time of the flood forecasting for Tarlac City and its downstream area.

For the purpose of improvement of accuracy of the existing flood forecasting & warning system, new hydrological stations to be established are as follows:

- Peneranda Hydrological Station (Pampanga River Basin, Peneranda River)
- Sta.Maria Hydrological Station (Agno River Basin, Agno River) *
- Maasin Rainfall Station (Agno River Basin, Tarlac River)
- Burgos Rainfall Station (Agno River Basin, Tarlac River)

* Abolishment of existing station and installation of new stations.

(iii) Early Flood Forecasting by Additional Rainfall Gauges

Two (2) new rainfall stations will be added in the eastern Pampanga River Basin to improve accuracy of the existing flood forecasting & warning system, and to observe storm rainfall cased by typhoon/seasonal rain front in early stage.

<u>Pampanga River Basin</u>

- Kalaanan Rainfall Station (Pampanga River Basin, Deglama River)
- Palali Rainfall Station (Pampanga River Basin, Cornell River)

The Kalaanan Rainfall Station need to have function of watching of especially occurrence of debris flow by direct flood information/waning system, which will be established in upstream of the Deglama River, upstream of the Pampanga River.

The number of hydrological stations under new arrangement plan is summarized below:

Table 2.2-1 Number of Hydrological Station

River Basin	Type	Existing	Plan	Additional
Pampanga	Rain/Water Level	8	10	2
	Rain	6	7	1
Agno	Rain/Water Level	6	8	2
	Rain	1	3	2
	Water Level	1	−	0
(Total)		22	28	7

(2) Total Plan

The total plan of this project is shown below.

(a) Renew the telemetry observation system and add 28 gauging stations (17 stations in the Pampanga River basin and 11 stations in the Agno River basin)

Type	Basin	No. of stations		Name of station
Rainfall gauging station	Pampanga River	6	8	Munoz, Gabaldon, Sibul Spring, Kalaano, Palali, Porac
	Agno River	2		Maasin, Burgos
Rainfall and water level gauging stations	Pampanga River	10	18	Sapang Buho, Mayapyap, Zaragoza, Penaranda, San Isidro, Candaba, Arayat, Sasmuan, Sulipan, Mexico
	Agno River	8		Santa Maria, Santa Barbara, Banaga, Carmen, Wawa, Tibag, Mapandan, Binalonan
Repeater stations	Pampanga River	1	2	San Rafael
	Agno River	1		Mt.Ampucao

(b) Renew the telemetry monitoring system: three new stations

Type	Basin	Name of station	New/renew
Central monitoring center	-	DIC (Data Information Center) monitoring station	Renew
Basin Sub Center	Pampanga River	San Fernando Sub Center	New
	Agno River	Rosales Sub Center	Renew

(c) Renew the multiplex-radio system

(i) 7.5GHz band

It is to build seven links for Pampanga River Basin:

Science Garden – San Rafael – Gapan – Cabanatuan – Pantabangan Dam, San Rafael - San Fernando

It is to build two links for Agno River Basin:

Cabanatuan – Tarlac – Rosales

(ii) 18GHz band

Two radio links between Science Garden, NIA and OCD will be established.

(d) Renew and newly establish facilities at relevant agencies

- OCD (Office of Civil Defense): New
- DPWH (Department of Public Works and Highways): Renew
- NPC (National Power Corporation): Renew
- NIA (National Irrigation Administration): Renew
- Pantabangan Dam: Renew
- San Roque Dam:: New
- Binga Dam: Renew

(e) Other civil and construction works for gauging stations

- Embankment works: four gauging stations (two gauging stations in the Pampanga River basin and two gauging stations in the Agno River basin)
- Office construction: 15 gauging stations (nine gauging stations in the Pampanga River basin and six gauging stations in the Agno River basin)
- Water level gauge support works: 12 gauging stations (seven gauging stations in the Pampanga River basin and five gauging stations in the Agno River basin)

Type	Basin	No. of stations		Name of station
Embankment works	Pampanga River	2	4	Sapang Buho, Sulipan
	Agno River	2		Santa Barbara, Binalonan
Station house construction	Pampanga River	9	15	Zaragoza, Penaranda, San Isidro, Candaba, Arayat, Mexico, Kalaano, Palali, Porac
	Agno River	6		Santa Maria, Wawa, Mapandan, Binalonan, Maasin, Burgos
Water level gauge support works	Pampanga River	7	12	Zaragoza, Penaranda, San Isidro, Candaba, Arayat, Sasmuan, Mexico
	Agno River	5		Santa Maria, Carmen, Wawa, Tibag, Mapandan,

(f) Steel tower construction and reinforcement works for antenna tower

Location name	Existing tower structure	Reinforcement plan
Science Garden	54 m self-stand	Structural reinforcement
San Rafael	76 m guyed tower	New (76 m self-stand)
Gapan	31 m self-stand	Structural reinforcement
Cabanatuan	31 m guyed tower	New (30 m self-stand)
Tarlac	35 m self-stand	Need to raise the height 10 m, structural reinforcement
Rosales	28 m self-stand	Need to raise the height 25 m New (53 m self-stand)
Pantabangan	55 m guyed tower	Structural reinforcement
San Fernando	-	New (30 m self-stand)

(3) Equipment Plan

The telemetry system transmits the data of rainfall and water level measured at the gauging stations to each basin Sub Center through 150 MHz band radio channels and transfers the data from each Sub Center to DIC (Data Information Center) through 7.5 GHz band multiplex-radio channels. The observation data collected will be computer-processed by the monitoring system and used for flood forecasting and warning operations and provided to relevant agencies.

The existing telemetry systems conform to the standard specifications for the former telemetry equipment (the Telecom Specs No. 1) issued by the Ministry of Land, Infrastructure and Transport (MLIT) in Japan, which are slow in processing data and no longer in production, hence the equipment parts are difficult to be procured. Therefore, the equipments conforming to the MLIT Telecom Spec (No. 21), the latest version of these specifications, will be selected.

The frequencies used for the multiplex radio network that connects the basin Sub Centers, DIC and relevant agencies are 800 MHz and 2 GHz bands. The network, however, is not adequately functioning due to interference from mobile phone networks. Consequently, the project will install a multiplex-radio system that uses the 7.5 GHz band for the network between the basin Sub Centers and DIC and the 18 GHz band for the connection until the relevant agencies which are shorter in distance, taking into account also the discussion with NTC, an agency in charge of managing frequencies in the Philippines.

For the network protocol, the IP (Internet Protocol) will be used in line with the recent trends in communication technology.

(a) Telemetry observation system

The gauging stations import the data of rainfall and water levels measured with a tipping-bucket rain gauge and pressure-type water-level gauge using a telemetry observation system, transmit the data to the monitoring station through a 150 MHz band radio, prepare a data memory equipment in consideration of data loss and structure the equipment to ensure data availability even in case of network failure.

The electric power is generally supplied by solar cells, taking the power supply conditions at the sites and maintenance cost into consideration. In addition, a system to monitor the door opening and closing will be placed to ensure security.

The telemetry gauging stations will consist of the following equipments.

Table 2.2-2 Equipment List of the Telemetry gauging stations

Equipment	Function	Quantity (per station)	Remarks
Telemetry observation system (incl. radio equipment)	Sends observation data according to call signals from the monitoring station.	1	All stations
V-V, μ-V repeater equipment	Transfer observation data to the monitoring station.	1	Only repeater and rainfall gauging stations
Pressure-type water-level gauge (incl. protector and converter)	Detects river water level from water pressure and sends the data to the observation equipment.	1	Only rainfall and water level gauging stations
Tipping-bucket rain gauge	Measures 1 mm rain per tip and sends the data to the observation equipment.	1	All stations
Data memory equipment for rainfall and water levels	Stores observation data in memory for more than 1 year as a backup.	1	All stations
Solar cell panels and switchboard	Converts solar energy into electrical energy and charge storage cells.	1	Except San Rafael station
Lead-acid battery	Secures 30-day operation without sunlight as the power supply for the above equipments.	1	Except San Rafael station

Lead-acid battery	Secures 30-day operation without sunlight as the power supply for the above equipments.	1	Except San Rafael station
Antenna, coaxial lightning arrester, coaxial cable, connector	Connected to a radio for transmission and reception with the monitoring and repeater stations.	1	All stations
Door switch	Indicates whether the doors are open or closed and monitors for trespass.	1	All stations

(b) Telemetry observation system: DIC

A telemeter monitoring system will be installed at DIC to monitor the observation data from Sub Centers, which will have a function to directly access the rainfall or water level gauging stations to collect the data when unable to receive through the normal system.

The system will be designed in such a way that the data collected will be stored in the FFWS server, converted to an HTML format view by the Web server and provided to the LCD equipment and monitoring terminal at DIC and other agencies.

A telephone switching network (IP-PBX, hotline telephone and facsimile) using multiplex-radio channels will be built to ensure good contact with the relevant agencies and Sub Centers even in the event of an emergency such as when a warning is issued.

A network monitor and controller to monitor the entire IP network, ADRS connector to import data from other basins and agencies, GPS synchronizer for clock correction, power supply equipment and other incidental facilities will be placed at DIC.

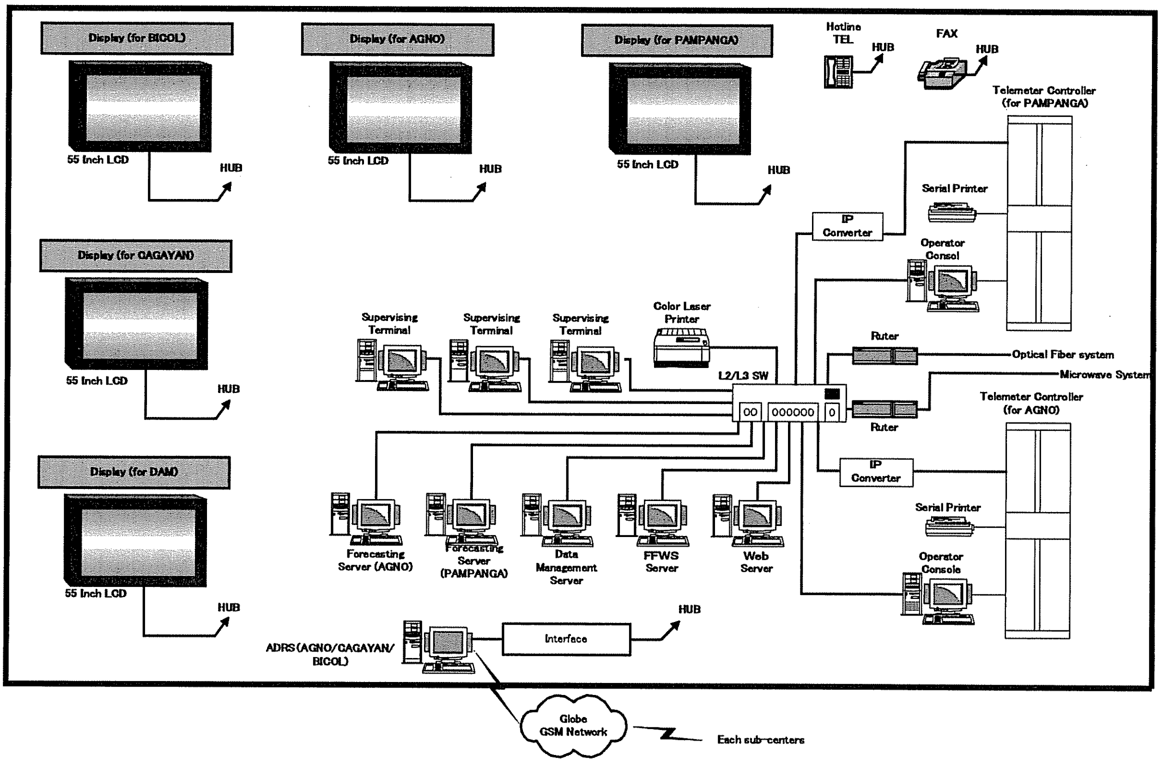

Figure 2.2-1 System Configuration of DIC

The table below shows major equipments to be installed at DIC and their functions.

Table 2.2-3 Equipment List of DIC

Equipment	Function	Quantity	Remarks
Telemetry monitoring system	Accesses rainfall and water level data at certain intervals via Sub Centers and stores the data received in the FFWS server.	2	For Pampanga and Agno river basins
PC-type operation console	PC-type operation equipment for controlling the observatories and repeater stations and collecting observation data	2	For Pampanga and Agno river basins
Serial printer	Prints out raw observation data.	2	For Pampanga and Agno river basins
Data memory reading equipment	Reads the memory data saved as a backup at the observatories.	1	
LCD equipment (55-inch LCD)	Display equipment for viewing the processed data on a large screen	5	For basin and dam monitoring
LCD control terminal	Controls the above LCD screen view.	5	For basin and dam monitoring
FFWS server	Processes and stores collected observation data.	1	
Web server	Converts the computer-processed data into Web data viewable on each display equipment and terminal.	1	
Flood forecast server	Server equipment to run outflow and overflow analysis software	2	For Pampanga and Agno river basins
Data management server	Sores river data such as cross-sectional drawings	1	
Monitoring terminal	Individual terminal equipment for viewing the processed data	3	For Pampanga and Agno river basins
IP-PBX Hotline telephone Facsimile	Used for emergency communication with relevant agencies and Sub Centers when public networks are unavailable.	1 12 3	
L3-SW L2-SW Telemetry IP converter Serial IP converter IP converter	Switching equipments and interface converters for transmitting IP digital data	1 4 1 1 1	
Network monitor and controller	Monitor and control the IP network connector.	1	
Color laser printer	Prints out processed data.	1	
ADRS connector	Connects to the existing ADRS equipment to allow other basin data to be stored in the FFWS server.	2	
GPS synchronizer	Obtains the exact time information from GPS.	1	
UPS	Provides AC load with power without a blackout in case of power outage.	1	
Automatic voltage regulator (AVR)	Provides stable output voltage even when the input voltage fluctuates.	1	
Runoff analysis model software	Software used to forecast runoff in each basin.	1	

(c) Telemetry monitoring system: Sub Centers

The Sub Centers access and collect the data measured at the rainfall and water level gauging stations using the telemetry monitoring system at certain intervals and store the gauging stations using the telemetry monitoring system at certain intervals and store the data collected in the FFWS server.

The data collected will be transferred to DIC through the 7.5 GHz band multiplex-radio channels, used by the FFWS server for preparing trend graphs and other purposes and provided to the LCD equipment and monitoring terminal for viewing.

A flood forecast server will be placed to provide the relevant agencies in the basins with flood forecast and warning information.

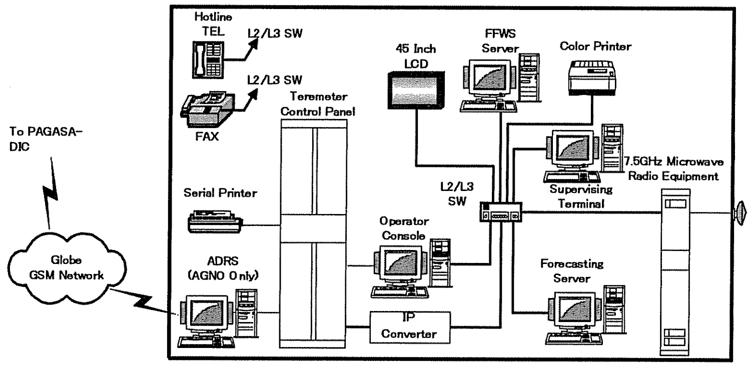

Figure 2.2-2 System Configuration of Sub Center

The Sub Centers will consist of the following equipments.

Table 2.2-4 Equipment List of Sub Center

Equipment	Function	Quantity	Remarks
Telemetry monitoring system (incl. radio equipment)	Accesses rainfall and water level data at certain intervals and stores the data received in the FFWS server.	1	Radio equipment at Rosales station only
Antenna, coaxial lightning arrester, coaxial cable, connector	Connected to a radio for transmission and reception with the gauging stations and repeater stations.	1	Rosales station only
PC-type operation console	PC-type operation equipment for controlling the gauging stations and repeater stations and collecting observation data	1	
Serial printer	Prints out raw observation data.	1	
Data memory reading equipment	Reads the memory data saved as a backup at the gauging stations	1	
LCD equipment (45-inch LCD)	Display equipment for viewing the processed data on a large screen	1	
LCD control terminal	Controls the above LCD screen view.	1	
FFWS server	Processes and stores collected observation data and generates screen views for the Sub Center terminal.	1	
Flood forecast server	Server equipment to run outflow analysis software	1	
Monitoring terminal	Individual terminal equipment for monitoring the processed data	1	
Hotline telephone	Used for emergency communication with DIC	5	

VoIP-Gateway L3-SW L2-SW Telemetry IP converter IP converter	Switching equipments and interface converters for transmitting IP digital data	2 1 1 1 1	
Color laser printer	Prints out processed views.	1	
GPS synchronizer	Obtains the exact time information from GPS.	1	
7.5GHz band multiplex-radio equipment	Main multiplex-radio equipment used for transmitting observation and voice data to DIC and other stations.	1	
7.5GHz antenna	Parabolic antenna for the above multiplex-radio equipment.	2	
	Transformer for preventing damage from a lightning surge	1	
DC 48V power supply	Supplies direct-current power to the monitoring system and other equipments.	1	
Engine generator	Placed in preparation for up to 48 hours of commercial power outage Automatically activated in case of power outage.	1	
UPS	Provides AC load with power without a blackout in case of power outage.	1	

(d) Backbone Multiplex Radio Network

(i) Frequency

The current Backbone multiplex radio network at PAGASA using 800 MHz and 2 GHz frequencies cannot be continuously operated due to interference from the mobile phone networks. Uninterrupted availability of the frequencies in the sections of the Backbone multiplex radio network required for this project shall be ensured for the present and future to develop the Pampanga and Agno River flood forecasting and warning systems. The frequency for the Backbone multiplex radio network has been determined to be 7.5 GHz for the following reasons:

- To ensure that a large amount of data can be transmitted,
- To avoid interference from mobile phone and other communication networks,
- To avoid additional construction of repeater stations, and
- To ensure safe transmission through the fixed network used for the public works.

(ii) Positioning and transmission capacity of the multiplex radio channels

The main multiplex radio channels used by PAGASA must have a capacity sufficient to function as the central disaster prevention network of the Philippines that runs across the Philippine Islands. The project plans to combine meteorological radar communication, data sharing with the relevant agencies and simple transmission of images with the amount of data required for the flood forecasting and warning systems. The following indicates the transmission types and capacity.

- Transmission capacity required for this project: 2 Mbps (planned to be IP-based),

- Nationwide meteorological data (including the laser rainfall system): 1.5/2 – 4 Mbps,
- Information sharing with relevant agencies (NIA, NPC, etc.): 1.5/2 Mbps,
- Image transmission (visual monitoring of flood conditions in the future, etc.): Minimum of 1.5 – 6 M (just enough to show a video; TV conference).

Therefore, the transmission capacity of 13 Mps (equivalent to 192 channels) will be necessary providing the future additional capacity (6.5/8 – 10 Mps).

NTC (National Telecommunication Commission) has permitted the use of 7.5 GHz and 18 GHz for the communication with the relevant organizations in a short distance. Unlike the conventional wireless radio equipment, today's 7.5 GHz multiplex radio systems are compact, some of which are available for purchase at approximately five million yen (the conventional ones were approximately 20 million yen). These are the ones planned to be procured for this project.

(iii) Frequency required for the Backbone multiplex radio network

A high frequency of radio waves can be multiplexed to allow high-capacity, high-speed data transmission. However, such frequency bands are its short transmission distance and strong tendency to move straight (inflexible). A low frequency, on the other hand, is capable of turning (flexible) and has a long transmission distance, however, with limited as lower data transmission capacity and speed. Frequencies below 800 MHz (e.g., 150 – 400 MHz) are technically incapable of transmitting 13 Mbps described above (generally up to approximately 16 kbps). The frequency required will be microwaves band (GHz band).

(iv) Global frequency use

The international framework for the use of radio frequencies is determined by the ITU (International Telecommunication Union), which is respected by each country while allocating frequencies according to the local conditions. The frequency allocation in Japan also conforms to the ITU recommendations.

The use of mobile phones has been rapidly increasing on a global scale, to which more frequencies between 800 MHz and 3 GHz are assigned. In the Philippines, too, mobile phones are to be used in the range between 800 MHz and 2 GHz, and the channels in the 800 MHz and 2 GHz bands among the existing Multiplex Radio Networks of PAGASA interfere with the mobile phone frequencies. In mobile communications, including wireless LANs, the use of 3 to 5 GHz frequencies are expected to increase. The 3 to 5 GHz bands, therefore, cannot be applied to the Backbone Multiplex Radio Networks.

(v) Allocation for fixed transmission in public works

Microwave bands are 3 to 30 GHz, of which the ITU has allocated 6.675 to 7.00 GHz and 7.35 to 8.1 GHz for fixed communications (partly for the mobile).

Meanwhile, Japan has allocated 6.5 to 6.8 GHz and 7.125 to 7.9 GHz for the public works as safe use. The Philippines is in Regional 3, to which Japan also belongs, and has allocated frequencies in a very similar manner. Based on this, frequencies in the 6.5/7.5 GHz band will be assigned to the Backbone multiplex radio channels.

(vi) Frequency bands higher than 6.5 and 7.5 GHz

The higher the frequency, the shorter the transmission distance, and frequencies higher than 7.5 GHz can not transmit longer than 40 kilometers. The channel design on desk indicates that 6.5 and 7.5 GHz will allow the transmission using the existing radio repeater stations. For 12 and 18 GHz, however, new repeater stations would have to be constructed, which would add to the cost.

(viii) Design Policy

The multiplex-radio network will be prepared to have the frequency of 7.5 GHz so as to avoid interference from mobile phone networks, and the IP will be used as the network protocol.

The multiplex-radio repeater station will be equipped with a telephone set as a communication channel for maintenance work and network switches to transmit the IP digital data.

An engine generator, lightning-proof transformer, DC 48V power supply and other incidental facilities for supplying power will be prepared in consideration of the system deterioration and equipment malfunction.

The table below indicates the standard equipment composition at the multiplex-radio repeater station.

Table 2.2-5 Equipment List of the Multiplex Radio Repeater Station

Equipment	Function	Q'ty	Remarks
7.5GHz band multiplex-radio equipment	Main multiplex-radio equipment used for transmitting observation and voice data.	1-3	Quantity varies depending on the number of connection channels.
7.5GHz antenna	Parabolic antenna for the above multiplex-radio equipment.	1-5	(same as above)
Telephone set	Used for voice communication for maintenance work.	1	
VoIP-Gateway L3-SW	Switching equipments and interface converters for transmitting IP digital data	1 (1)	Quantity varies depending on the

L2-SW Connection IP converter		(1) 1 1	number of connection channels and routes.
Insulation transformer	Equipment used to prevent damage from a lightning surge	1	
DC 48V power supply	Supplies direct-current power to the wireless and other equipments.	1	
Engine generator	Placed in preparation for up to 48 hours of commercial power outage Automatically activated in case of power outage.	1	
DC-AC converter	Converts between direct and alternating currents and provides AC load with power from DC power supply equipment without a blackout.	1	

(e) Equipment at relevant agencies

The equipment to be placed at relevant agencies will consist of a LCD equipment (45 inches) used to view the Web data sent from the DIC Web server, LCD control terminal, monitoring terminal, laser printer, 18 GHz multiplex-radio equipment (FWA) installed as a channel connected to DIC and network equipments such as L3-SW.

A hotline telephone and facsimile will be prepared in addition to the monitoring system to establish a network that will prevent the communication from being interrupted in an emergency.

The 45-inch LCD will be placed only at OCD, the agency to issue warnings, and the other agencies will use only the monitoring terminals to monitor the situation.

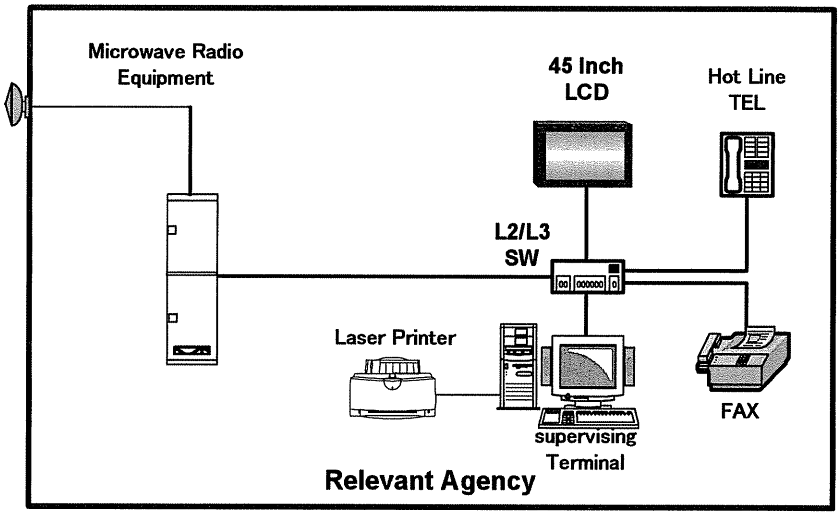

Figure 2.2-3 System Configuration of Relevant Agency

The following are a table indicating the standard equipment composition and a rough drawing

drawing of equipment composition at relevant agencies.

Table 2.2-6 Equipment List of Relevant Agency

Equipment	Function	Q'ty	Remarks
18 GHz band multiplex-radio equipment	Wireless equipment used to transmit various data	(1-2)	Only at OCD and NIA
18 GHz antenna	Parabolic antenna for the above multiplex-radio equipment.	(1-2)	(same as above)
LCD equipment (45 inches)	Displays processed data on a large screen.	(1)	Only at OCD
LCD control terminal	Controls the above LCD screen view.	(1)	Only at OCD
Monitoring terminal	Individual terminal equipment for monitoring the processed data	1	
Color laser printer	Prints out processed views.	1	
Telephone set Facsimile	Used for emergency communication with DIC and relevant agencies when public networks are unavailable.	(3) 1	The number of telephones varies depending on the telephone line capacity.
VoIP-Gateway L3-SW L2-SW Serial IP converter IP converter	Switching equipments and interface converters for transmitting IP digital data	(1) (1) (1) (1) (1)	Quantity required varies for each station.
DC 48V power supply	Supplies direct-current power to the radio and other equipments.	(1)	(same as above)
UPS	Provides AC load with power without a blackout in case of power outage.	(1-2)	(same as above)
DC-AC converter	Converts between direct and alternating currents and provides AC load with power from DC power supply equipment without a blackout.	(1)	(same as above)

(3) Run-off analysis software

The Run-off analysis software is effective program to improve flood warning information displaying possibility of flood, and analyze the flood situation based on the runoff analysis result and geological information/data.

The software will provide advantages as mentioned below, but it is required to study the operational method and utilization of the software in detail before adoption of it.

(a) Basic Functions and Advantages

(i) Basic functions

- Quick analysis on the flood point and time of the flood.
- Analysis on the process, situation and height of the inundation.

(ii) Advantages

- Quick understanding for basic information of evacuation.
- Contribution to determination of warning level and standard of warning

information.
- Contribution to draw effective hazard map.
- Verification of the existing run-off model.

(b) Operation

Following actions are required to use this software at operation effectively.

(i) Development of digital maps

Development and upgrading of the digital map containing accurate present data are required as step-by step stage and continuously by the Philippines side.

(ii) Utilization of hazard map

The hazard map is required to display evacuation places and routes clearly. Result of the flood analysis shall be upgraded in relation to changing situation at site affected by the flood, and monitoring at the site in case of the actual flood shall also be carried out.

In addition, as consequence of the repeating of the analysis of the flood model, making accurate hazard map and enlightenment of prevention of disaster to ordinary people are important actions.

2.2.3 Basic Design Drawings

Basic Design Drawings are complied in Appendix 8.

2.2.4 Implementation Plan

2.2.4.1 Implementation Policy

(1) Equipment Installation

Equipment will be installed after completing the specified civil engineering works, antenna tower construction and building frame construction and receiving the equipment sent from Japan. The equipment installation work consists of delivery to the sites, installation such as placing and fixing at the designated positions and adjustment of such equipment. Following the installation and assembly, each equipment will be tested to check the radio wave reception and communication.

(2) Civil Engineering

River bank protection works will be performed for four of the gauging stations that do not have a pier nearby or are planning to replace the bridge to install water gauges.

(3) Building Works

Construct 15 gauging stations including new ones and those having problems with maintenance when flooding will be constructed.

(4) Water Gauge Support Works

The 12 water level gauging stations near piers will be equipped with a water level gauge by fixing steel materials on the piers, taking into account the accessibility, maintenance and construction cost. When fixing the materials to support the water level gauges, an ultrasonic measuring equipment will be used to confirm the positions of the reinforcing steel bar in the existing piers so as to avoid damage to the steel and the positions to insert anchor bolts will be determined.

(5) Telecommunication Steel Tower Construction

Tower reinforcement for multiplex-radio stations whose tower strength is insufficient for the changed frequencies of the multiplex-radio systems (antenna diameters) and construction of new stations will be performed.

2.2.4.2 Implementation Conditions

(1) Overall Work

This project covers a wide range of engineering work, including civil engineering and building works, tower repairs and construction and installation of various types of equipment, and therefore, shall be carried out in close cooperation in detail on schedule completion. The focus points in the planning of the construction project are as follows:

1) The civil engineering and building works must avoid rainy seasons (June to September), considering safety and construction cost. In particular, the river protection works and installation of water level gauge supports will be conducted during the period between January and May when the water level is low.
2) Minimizing the stopping time of the systems currently in operation is important, and system suspension shall be avoided particularly during the typhoon and rainy seasons.
3) The equipment installation in this project will start at the beginning of September in view of the entire process. Therefore, as the measures mentioned above, the monitoring systems at the Sub Centers shall be arranged first, and the data transfer in both directions between the conventional observatories and the observatories to be renewed shall be allowed, which will then be switched one by one.

(2) Installation to Relevant Organizations

The project also contains to provide many kinds of equipments and facilities for the related organizations such as NPC and NIA. There are following points to concern for the implementation of the project.

(a) Items to be achieved by the recipient side before the construction and procurement

- Secure of the budget for the tax, VAT and other levies
- Allocation of appropriate personnel (engineers etc)
- Secure of the access and access road to the Sites
- Secure of the waste disposal site arising from the construction and installation works such as earth and sand, abandoned concrete and so on.
- Necessary support for the construction and procurement (information, permission and land acquisition)

(b) Items to be achieved by the recipient side during the construction and procurement

- Provision of necessary electricity.
- Secure of land or area for construction of the facilities and installation of equipments.
- Dissemination of the Project to the people living at the concerned area, especially if restraint is occurred to the people.
- Necessary support for the construction and procurement (information, permission and land acquisition).

- If the soft component program is implemented, allocate personnel for attending the training course and cost for trip.

2.2.4.3 Scope of Works

This project encompasses the installation of the telemetry observation, monitoring and multiplex-radio systems, civil engineering, construction works, works for the communication towers and various other tasks that will be implemented simultaneously. The government of the Philippines and the contractors must clearly recognize the demarcation of the SOW and work in close cooperation in the process of the project.

The demarcation of the SOW in this project is as follows:

Japan	Philippines
1. Civil work (river bank protection works)	1. Pampanga Sub Center architectural design and construction
2. Civil work (new gauging stations)	2. Building repair and improvement (reinforcement of existing observatories, etc.)
3. Steel tower construction (all construction incl. new and reinforcement) 4. Equipment placement, installation and adjustment (all stations)	3. Coordination with various relevant agencies and processing following applications: - Land acquisition - Application for frequency acquisition - Customs clearance - Transportation facilities (bridges and roads) - Coordination for traffic control during construction (bridge areas)
5. Equipment removal	4. Other necessary coordination and applications procedures
	5. Dispatching of counterpart
	6. Participation in equipment placement, installation and adjustment
	7. Transportation, storage, reuse and disposal of the equipment removed
	8. Facility removal
	9. Obtaining VAT budget and payments

The contractor will undertake the civil engineering and construction works, material and equipment design, production, factory tests, export packing, transportation to the sites and construction of facilities in the plan according to the specifications prepared by the consultants and verify the status of construction and performance of each equipment and system after production through field tests, upon which the resulting products will be delivered to corresponding parties. In addition, the staff will be trained as necessary during the period of construction and field tests for the technology transfer to the Philippines.

Tasks assigned to the Philippines shall be carried out in a timely manner without delay while coordinating with relevant construction process. Both the Philippines and Japan must collaborate with each other to facilitate the progress of the project and to complete it within the scheduled period.

2.2.4.4 Consultant Supervision

(1) Detailed design for the consultants

A consultancy services agreement will be signed between PAGASA, the counterpart agency of the Philippines, and the consultants from Japan. Detail design included in the consultancy agreement is as follows:

(a) Detailed design and preparing the tender document

Confirm the cost of the construction and define the construction works undertaken by PAGASA through field studies and consultation with the Philippines in view of the results of the basic design study. Develop a detailed design, estimate the cost of construction and formulate the construction plan prior to the preparation of tender document.

(b) Preparation of tender documents

Prepare the tender documents according to the detailed design, construction plan and provisions of the grant system.

The following personnel are required for the preparation of the detailed design and tender document by the consultants.

Position	Task
Project Manager	Prepares the operational design and tender documents, overseas the entire operation concerning the tender and reviews the equipment plan.
Communication Engineer	Designs the flood forecasting and warning system and related communication systems.
Civil Engineer	Designs the civil engineering and construction works for embankment, office building, etc.

(2) Procurement supervision system

Procurement supervision included in the consultancy agreement is as follows:

(a) Tender assistance

The consultants will publicly announce the tender, answer to questions, attend the tender, evaluate the tender result, assist the contract negotiations and attend the signing of contractor agreement.

(b) Construction Supervision

The consultants will hold meeting with the concerned parties involved before the start, approve the design drawings, inspect the equipments before shipment, supervise the installation at the sites, prepare reports during the construction period, issue interim result certificates, inspect and take necessary procedures upon completion.

(c) Supervision operations after the completion of the construction and installation

The supervision operations include the issuance of the certificate of completion of construction, procedures for handing over the completed construction, preparation of the final operational report, etc.

The personnel required for these supervision operations are that this project employs local staff who will assist the procurement and supervision to allow the construction to be carried out simultaneously at multiple locations in an effort to reduce the construction period.

Consultants:

Position	Task
Resident Procurement Supervising Engineer	- Stations at the site throughout the construction period and performs procurement and supervision for the entire project. - Manages quality, progress, payments and safety, holds consultations and negotiations with the Philippines and makes reports. - Manages the progress, quality and safety of the procurement and installation works for the entire flood forecasting and warning system.
Procurement Supervising Engineer (Advance arrangement, inspection and acceptance, delivery, etc.)	- Discusses and arranges equipment transportation in advance. - Attends the inspection, acceptance and delivery.
Procurement Supervising Engineer (communication system engineer)	- Manages the progress, quality and safety of the construction of communication systems.
Procurement Supervising Engineer (civil engineer)	- Manages the progress, quality and safety of the construction of civil engineering works and buildings.
Procurement Supervising Engineer (mechanical engineer)	- Manages the progress, quality and safety of the procurement and installation of mechanical equipment.
Inspection Engineer	- Confirms and verifies the drawings of communication systems and attends the inspections at the factory and before shipment.

Local consultants:

Position	Task
Assistant procurement supervisor	- Organizes the support operations in the overall procurement supervision.
Civil engineer	- Engages in the support operations in the civil engineering and construction works
Mechanical engineer	- Engages in the support operations for the mechanical equipment

2.2.4.5 Procurement Plan

(1) Procurement policy

This project is positioned as the establishment of disaster prevention systems, which shall be highly reliable. Therefore, telemeters that constitute the main system with basic specifications conforming to the Telecom Specs No. 21 of MLIT, Japan's standard specifications for telemetry systems, and multiplex-radio equipments conforming to the ITU-T and ITU-R international standards have been selected.

Because the data processed by the telemetry system is transmitted to each monitoring station (DIC, basin Sub Centers and relevant agencies such as OCD) via LAN built on multiplex-radio communication channels, the interconnection between the telemetry and multiplex-radio equipments shall be taken into consideration.

The unity of the telemetry, multiplex-radio and monitoring equipments, the simplicity of system architecture and the proficiency of the agencies operating the systems in the maintenance operations must consequently be considered, and all major equipment for the electrical and communication systems should thus be procured from a supplier with thorough knowledge and experience in Japan's MLIT specifications in view of ensuring adequate quality, performance and project schedule management.

Meanwhile, the above data processing systems are broadly divided into a data processing server system and processing software, and the server equipment shall be highly reliable. Ordinary personal computers can be purchased in the Philippines; however, the field study has found that factory automation PCs with high reliability for 24 hours a day are yet to be available. Further, the simple installation of the processing software that accompanies the system installation also makes the Japanese products more viable.

The following are examples of equipment and materials sold in the Philippines.

- Small UPS

- Printers and facsimiles
- Telephone sets

Such equipments comply with the specifications that are nearly equivalent to those used in Japan and will thus be procured in the country.

(2) Transportation plan

The equipment acquired in Japan will be shipped by sea, departing from the Japanese port to arrive at the port of Manila. The equipment and materials will be transported by land from the port of discharge to either the DIC monitoring station or Sub Centers (first period: San Fernando; second period: Rosales) at which they will be stored. They will subsequently be delivered to each site according to the construction plan.

The equipment acquired in Japan will be packed for export and delivered to the Japanese port or an equivalent location by the contractor, and be shipped to the Philippines thereafter. Upon the arrival at the port of Manila, personnel in the Philippines will complete the customs clearance and the contracted inland carrier will transport the goods from the port to each storage facility. Subsequently, the goods be delivered from the storages in small lots according to the project process. The field study has indicated that while nearly all of the gauging stations, monitoring stations and multiplex-radio stations are facing major roads, allowing delivery by vehicle, only the Gabaldon rainfall station is located halfway up a mountain and the goods must hence be manually carried from the foot of the mountain.

The Philippine side will be responsible for providing the storage facilities.

2.2.4.6 Quality Control Plan

Quality of the equipment and materials procured for this project and construction will be managed as follows:

(1) Review of drawings

Mandate the contractors to submit the drawings of all equipment, materials and construction plans, and the consultants will verify that the specifications and quality shown in such drawings conform to the contract.

(2) Participation in the inspection at the factory

When the suppliers have completed the equipment and material purchases and confirmed the overall operation of the systems and conformity to the performance and quantities specified in the specifications, attend the inspections at the factory to verify that the performance and quantities.

(3) Inspection before shipment

When the inspections at the factory have been completed and the suppliers have packed all equipment and materials to compete the shipment preparation, inspect the goods before the shipment, check the quantity of packages, type of packing, case marks and other details against the packing list and other documents and ensure that the packages are durable enough for the sea transportation and inland transportation in the Philippines.

(4) Pre-shipment inspection by a third-party agency

Upon the completion of package inspection, a third-party agency will inspect the freight before loading and ensures that the goods have been loaded properly.

(5) Field testing

The installation works at the sites will be inspected and field-tested to confirm the results. The field tests will consist of single testing to ensure the functioning of each unit of the equipment and comprehensive testing to confirm the overall system functions. The field tests will be led by the contractor in the presence of the consultants and PAGASA personnel. Following the comprehensive testing, submit a report on the completion of the inspections to JICA and the government of the Philippines.

(6) Warranty

The suppliers will guarantee the quality of the equipment and materials for one (1) year after taking over the equipment, and will restore the products to their original conditions without delay should a failure occurs.

2.2.4.7 Operational Guidance Plan

(1) Systems and personnel subject to the instruction for an operational guidance plan

(a) Subject of the equipment

The instruction will be provided for the observation equipments, telemetry monitoring system, multi-radio systems, network server systems and power supply systems.

How to use the outflow forecasting software, the overflow analysis software and the entire flood forecasting and warning systems including the telemetry monitoring system will be explained in the training sessions included in the "Software Components Plan" provided separately.

(b) Subject of the personnel

The instruction will be provided primarily to the PAGASA engineers who will operate and manage the flood forecasting and warning systems. Some engineers from other following relevant agencies will also be included in the training.

- NDCC
- NPC
- NIA
- DPWH
- Main dam offices

(2) Description of the instruction

The contractor will provide the instruction, which will include classroom lectures and practical training using the actual equipments, aiming to acquire the following technical skills.

Description
1. Basic technical skills in electrical, communication and information systems
2. Technical skills to accurately and appropriately operate the systems
3. Technical skills to detect system failure at an early stage and an make appropriate judgment in response to the failure
4. Technical skills to inspect the systems

2.2.4.8 Soft Component (Technical Assistance) Plan

(1) Objectives of soft component dispatch

The operation of the improved flood forecasting and warning system will considerably differ from the current system in the following ways.

1) Collaboration with the relevant agencies can be achieved through monitoring information exchange and telephone and facsimile communication.
2) The increased number of gauging stations requires the existing Run-off model analysis model to be updated.
3) A new flood analysis model will be adopted. (It is required to study the operational way and utilization of the software in detail before adoption of it.)

Appropriate and efficient operation of the flood forecasting and warning system requires in-depth learning of the basic operation technology and maintenance procedures that takes the above aspects into consideration. For this reason, technical support will be provided through a soft component grant aid to provide thorough knowledge of the basic operation technology and maintenance methods and to develop human resources that can operate the systems in an appropriate manner.

A designated supplier will separately provide manuals and training for the system and equipment operation and maintenance.

(2) Details and activities of soft component training

The technical assistance provided through the soft component of the grant aid aims to develop human resources that can appropriately operate, manage and maintain the equipment for the flood forecasting and warning systems.

The following are the specific types of personnel to be developed.

Subject	Aim
Engineers who operate and maintain the flood forecasting and warning systems	Learn how to operate and maintain the monitoring equipment and other equipment to facilitate effective disaster control.
Engineers who operate and maintain the outflow forecasting software	Learn how to operate and maintain the outflow forecasting software for accurate forecasting from water level data and continuous updating.
Engineers who operate and maintain the overflow analysis software	Learn how to operate and maintain the overflow analysis software for accurate over flood analysis and continuous updating

(3) Contents of Soft Component

The contents of the soft components are described as follow:

Table 2.2-7 Contents of Soft Components

Item	Contents	Phase	
		1st	2nd
1. Operation of FFWS	(1) Confirmation of the organization and mutual communication *	○	
	(2) Revision and O&M manuals	○	
	(3) Explanation/Guidance on the data management	○	
	(4) Explanation/Guidance on the guideline of the flood warning	○	○
	(5) Explanation on future organization and FFWS *	○	
	(6) Training of the operation *		○
2. Upgrading of the existing outflow forecasting software	(1) Explanation on the existing outflow forecasting software	○	
	(2) Explanation on procedures for the flood forecasting	○	
	(3) Arrangement and analysis on the measured data	○	
	(4) Explanation/Guidance on the existing outflow forecasting model	○	
	(5) Explanation/Guidance on verification of the existing outflow forecasting software		○

	(6) Guidance on the formula of the existing outflow forecasting software		○
	(7) Explanation/Guidance on offering of the flood warning information		○
3. Operation of overflow analysis software	(1) Explanation on the overflow analysis software	○	
	(2) Explanation on procedures for the overflow analysis software	○	
	(3) Arrangement and analysis on the topographic data	○	
	(4) Customizing on the overflow analysis software	○	
	(5) Explanation/Guidance on verification of the existing overflow analysis software		○
	(6) Guidance on procedures of the overflow analysis software		○
	(7) Explanation/Guidance on utilization of the overflow analysis software		○

* These contents will be instructed to the relevant agencies such as NDCC, NPA, NIA, DPWH and main dam offices.

2.2.4.9 Implementation Schedule

(1) Overall process

This project involves 28 observatories (including two rainfall repeater stations), one repeater station, main multiplex-radio equipments in seven sections and four relevant agencies, comprising a telemetry system of considerably large scale. Civil engineering works that need to precede other tasks must avoid rainy seasons, considering safety and construction cost control; therefore, completing the construction in a single year would be difficult.

Consequently, this project will be planned in two construction periods.

This project will be divided into two phases because the civil engineering works shall be suspended during the flood seasons and monitoring shall be continued by the system.

(a) 1st phase

The first phase of the project will consist of the improvement of the existing flood forecasting and warning systems and main multiplex-radio network and the restoration and new establishment of gauging stations (total of 17 locations) in the Pampanga River basin and the preparation of equipment at the new Pampanga Sub Center to be created. Other objectives include the preparation of equipment such as monitors at the central monitoring center and agencies involved in disaster prevention, which will facilitate precise and prompt collection of observation data and monitoring in the Pampanga

River basin, and sharing of flood forecasting and warning information with the disaster prevention agencies.

(b) 2nd phase

The second phase of this project will consist of the improvement of the existing flood forecasting and warning systems and main multiplex-radio network, restoration and new establishment of gauging stations (total of 11 locations) and preparation of equipment at the Agno Sub Center, which aims to expand and improve the flood forecasting and warning systems in the Agno River basin.

(2) Establishment of procurement period

(a) Production period for the equipment to be procured

Nearly all equipment to be procured for this project will be manufactured on order, which requires approximately one month for the preparation of design drawings and six months for the equipment manufacture. A period of approximately 7.5 months, including the time needed for the product inspections, shall be planned for the process from the signing of the contract to shipment.

(b) Duration of transportation and arrival

Local freight forwarders have indicated that the following durations are likely to be required for sea and inland transportation.

Task	Duration
1. Sea transportation (from Japan to Manila)	10 days
2. Inland transportation	2 days
Total	12 days

(c) Time required for the procedures involved

The procedures necessary for this project and time required for such procedures are estimated as shown below.

Activity	Duration
Offshore waiting time, permission to import into the Philippines, customs clearance	5 days
Total	5 days

The Philippine customs should not levy taxes if the proper duty free applications have been filed.

(3) Operation schedule

Table 2.2-8 PROJECT SCHEDULE

2.3 Obligations of recipient country

The following activities will be undertaken by the Philippines in this project.

(1) Acquisition of additional VAT budget

21.2 million pesos for VAT budget and 27.6 million pesos for the taxation on equipment have been allocated for 2007 fiscal year. If the project is launched before the end of fiscal 2007, the funds currently secured will be insufficient. An estimation of the economic assistance for each year (each period) will be provided by Japan and the Philippines will receive additional VAT budget funds.

<u>Deadline</u>

- Confirm the additional budget for fiscal 2007: Before E/N
- Confirm the budget for fiscal 2008: Before end of fiscal 2007

(2) Construction of Pampanga Sub Center building

Construction of the Pampanga Sub Center building will be performed by the Philippines. Equipment for this project will be installed in the building prepared by the Philippines.

<u>Deadline</u>

- Confirm budget: March 2007 (Explanation of draft report)
- Layout design: Before the preparation of the tender document
- Completion of building: Before the notice of tender
- Plan of Stuff and budget: Before the preparation of the tender document

(3) Permission to use frequencies and communication equipment

A letter has just been obtained from the NTC that permits the usage of radio frequencies. Notification of the assigned frequencies shall be received next, followed by permission to use communications equipment.

<u>Deadline</u>

- Frequency usage permission: Obtained in February
- Frequency assignment: Before E/N
- Equipment usage permission: Before equipment installation

(4) Strengthen of Operation and Maintenance capability

In order to ensure the effective operation of the new FFWS System, strengthen of Operation and Maintenance capability is indispensable. The appropriate assignment of competent engineer and the sureness of operation and maintenance budget and sustainable self development are necessary.

Deadline

- Strengthen of organization: Before the end of fiscal 2008

(5) Restoration or repair of existing equipment

The existing DIC buildings, radio repeater station buildings and some gauging houses that will be used in this project shall be restored or repaired so that the new equipment installed can be efficiently and continuously operated. The following repairs will be performed by the Philippines.

Deadline

- Repair work: Before the contract

(a) DIC building

Repair the air conditioning equipment for the communications equipment room, power supply room and control room. Install a duct from the communications equipment room to the power supply room to supply air from the communications equipment room air conditioning.

(b) Radio repeater stations

Currently, asbestos is used in the walls of the power supply room at the radio repeater stations. Remove asbestos in a manner that is not harmful to humans and replace it with an alternate fire resistant, noise reducing wall materials. The Consultants will be notified to verify the asbestos removal method.

(c) Gauging houses

Although some of the existing gauging houses will continue to be used in this project, ceiling concrete has partially come loose and reinforcement bars are exposed. These gauging houses will be repaired so that they will be durable enough for the continuous operation.

(6) Removal or reuse of existing facilities and equipment

The Philippines will remove and disposal of the existing facilities and equipment that will not be reused for this project. The Philippines will submit the plans for the handling of removed equipment such as reuse.

(7) Coordination with relevant agencies in case of interruption in the observation and monitoring for the flood forecasting and warning system

When renewing the flood forecasting and warning system and reinforcing the radio towers, there may be temporary interruptions to observation information or processed information through monitoring. Coordination shall be made with related departments and relevant agencies in order to minimize potential impact.

(8) Licensing and approvals

(a) Permission to install observation equipment on bridge piers

Approval for the installation of water level sensors on bridge piers and access to the observatory abutments shall be obtained from the DPWH in charge of bridge management, from which permission shall be obtained.

<u>Deadline</u>

- Obtaining permission: Before E/N

(b) Permissions related to social environment

Although no aspects of this project involve negative environmental impact or resident relocation, the need for the issuance of a “Certificate of Non-Coverage” shall be confirmed with the Philippine Department of Environment.

<u>Deadline</u>

- CNC issuance: Before E/N

(c) Land acquisition

Some land acquisition is required for new establishment and relocations of water level and rainfall stations. Because the land adjacent to the rivers in which water level stations will be located is inexpensive, many residents already occupy area, some of whom are illegal. Any land acquisition in the region carries the risk of developing into a political issue, and careful handling is required in determining the facility positions.

Because the water level gauging stations are planned to be positioned the closest possible to the bridges not occupied by the residents, residential relocations are not likely; however any land acquisition shall be done only after consulting with the local governments.

<u>Deadline</u>

- Obtaining permission: Before E/N

(d) Tree cutting permission

In establishing or relocating water or rainfall gauging stations, trees that interfere with the antennae, solar panels or rain gauges will need to be trimmed, which will require permission from the local governments.

Deadline

- Obtaining permission: Before E/N

(9) Other procedures

Following procedures shall be executed by the counterpart agency (PAGASA) at the implementation stage:

- Arrangement of bank treatment and issue authorization to pay documentation
- Pay import-related customs clearance fees and complete necessary procedures
- Ensure tax exemption for various equipment brought in by contractors (temporary facilities, test equipment, etc.)
- Ensure tax exemption for Japanese and other foreigners engaging in the project
- Provide temporary storage locations for equipment
- Redirect traffic during construction, etc.
- Permission of antenna tower construction.

(10) Improvement of existing run off analysis model

In order to cope with increasing of gauging station and expansion of basin to be supervised, improvement of existing run off analysis model (outflow forecasting software) is necessary. The method to improve the model will be trained in the soft-component. But, the improvement itself is to be done by PAGASA because the model is owned and managed by PAGASA.

Deadline

- Model improvement: Before start of 2nd soft-component

2.4 Project Operation Plan

(1) Operation and maintenance system and method after implementation of the project

FFB has made operation and maintenance (O & M) works on the existing FFWS. Framework of the FFB is described as follow.

Table 2.4-1 Number of FFB stuff

Place	Nos. of Hydrological Engineer	Nos. of Telecommunication Engineer	Remark
DIC	30	11	Except FFB's division chief
Pampanga Sub Center	6	0 (2)	2 persons will be allocated implementation stage of the Project
Agno Sub Center	6	3	
Bicol Sub Center	6	2	
Cagayan Sub Center	4	1	

(a) New Pampanga Sub Center

Pampanga Sub Center in charge of the Pampanga River basin exists as a shared facility with the Quezon DIC, and management operations are performed from Quezon. While there are five hydrology engineers, none of them are responsible for facility maintenance. This function is performed by the DIC's TSS.

When establishing new Pampanga Sub Center within the basin area, the Sub Center will need to be able to perform maintenance by itself, which will require additional two facility management engineers.

(b) Increased checking tasks due to increase of the gauging stations and etc

The number of gauging stations will increase from 21 to 28, and the equipment at the multiplex-radio stations must also be maintained. Regular inspections are planned to be performed alternately by the Sub Centers and TSS. Checking will be performed by two facility management engineers at the Sub Centers and six engineers at TSS for four basins.

Checking tasks are divided into cleaning or simple daily checks and operational checks. Cleaning and daily inspections at the observatories may be outsourced to appropriate maintenance personnel available in the vicinity; however, PAGASA and local governments have confirmed that local governments will perform these tasks if there is no appropriate administrator nearby or if it would be difficult to reach the observatories.

Numbers of the telemetry gauging stations are increased form 14 to 17 in the Pampnaga river basin and from 8 to 11 in the Agno river basin, i.e., each three stations are increased. Inspection on the operation of the telemetry gauging and repeater stations requires staff as of two staff per 0.5 days. Present DIC's TSS (11 numbers) and Sub Center's staff (2 to 3 members) can cope with this inspection work by interval, which will be made once per 1.5 month.

(c) Operational management to improve the accuracy of the existing outflow forecasting

Operation of the existing flood forecasting models with high accuracy requires the measurement of discharge during floods at water level stations and correction of water level-discharge correlation and upstream rainfall-water level-discharge correlation. However, PAGASA personnel are busy during flood seasons and unable to handle the measurement of flow rates.

To address this issue, additional stuffs for measurement of discharge during floods should be obtained. Or, local consultants may be asked to perform flow measurements. Local consultants should be able to perform this routine work if given proper direction.

(d) Handling new system equipment

Reflecting the technological advances in the market, today's system equipments have a reduced number of parts that are integrated into a smaller housing, and the forecasting and warning system planned in this project is no exception. Although system failure becomes much less likely as a result, any failure is expected to require a replacement of the entire unit by the manufacturer due to limited local capability of recovery.

One of the measures for this may be to employ equipments that are replaceable in the Philippines whenever possible. Any malfunction of parts or unit that cannot be solved in the country would have to be brought to the Japanese manufacturer for repair or replacement, which could be more costly and time-consuming than the existing system.

As noted earlier, the budget system of the Philippines requires that a request for funds for unit replacement that exceed the cost of periodical maintenance be submitted in advance to be granted in the following year, suggesting that the total period required for the funds to be provided and the repair or replacement to be completed in Japan may be one or two years.

Minimizing the number of types of standard parts (or units) and reserving ample spare parts (or spare units) are likely to allow continuous system operation.

(e) Cooperation of relevant organizations

In order to operate the new system effectively, the monitoring and communication equipment will be installed and operated at the relevant organizations such as NPC and NIA. On the other hand, on some gauging station, where PAGASA can not provide the gauge keeper at the station, the gauge keeping task will be done by local government.

(i) Operation and maintenance by relevant organization

The operator will be trained to operate and maintain the monitoring and communication equipment in the soft-component in this project. After the clarification of demarcation, relevant agencies should conduct the operation and maintenance by themselves.

- Make and implement Disaster prevention plan utilizing the facility and equipment
- Strengthening capacity of personnel
- Proper Operation and Maintenance for the facility and equipment
- Keep Close coordination with relevant organization

(2) Personnel Recruitment and Training Plans

Maintenance of telemetry observation equipment and repeater station equipment is performed by Sub Center facilities personnel under the guidance and technical cooperation of DIC's TSS. There are six telecommunications engineers (11 including assistant engineers) in TSS; however, the average age is more than 45 years.

Equipment employing new technologies will be introduced and TSS will be mainly responsible for the maintenance in the technical aspect. In order to ensure appropriate technical succession and continuous maintenance for an extended period of time, younger telecommunications engineers need to be employed mainly at TSS.

Under the policy of replacing the elder with youths, PAGASA retired older employees and recruited a number of young hydrology engineers in 2005 and 2006. TSS, on the contrary, was joined by new hires in 2004 only to see an employee reduction in 2006.

PAGASA has a department called ECES (Electronics and Communication Engineering Section) within its meteorology section that is dedicated to telecommunications. This section has more than 20 employees including six engineers, ten technicians and five assistants, who, among other sections in PAGASA, handle more advanced monitoring and communications technologies than those in FFB with many young engineers to exert their high technical skills.

PAGASA should be able to attract more telecommunications engineers by publicizing its accomplishments and promoting its attractive technology. Internally, PAGASA needs to work in cooperation with ECES for the maintenance of equipment used for flood forecasting and warning so as to learn new technologies, revitalize the workplace and recruit and retain young and highly skilled members.

2.5 Project Cost Estimation

2.5.1 Initial Cost Estimation

In the case of the Project's implementation under Japan's grant aid scheme, the total project cost is estimated to be approximately 1,229 million Japanese Yen. The breakdown of cost based on the division of work between the Japanese and Philippines sides outlined in Sub-Clause 2.2.4.3 (SOW) is mentioned in below.

This cost estimate, however, is provisional and would be further examined by the Government of Japan for approval of the Grant.

(1) Japanese Portion

Estimated Cost of Japanese Portion is approximate 1,168 million Japanese Yen.

(2) Philippines Portion

(a) Budget for the VAT *: PhP15,758,230 (1st phase)

PhP 8,120,719 (2nd phase)

(b) Construction of Pampanga Sub Center: PhP 2,000,000 (1st phase only)

(c) Land acquisition (Tower at San Rafael): Subject to confirmation to NIA

(d) Removing of the disused existing facilities: PhP 120,000 (1st phase only)

(e) Repairing of the existing gauging houses: PhP 50,000 (1st phase only)

(f) Repairing of the existing AC at DIC: PhP 140,000 (1st phase only)

(g) Modification of existing runoff model: PhP 300,000 (1st phase only)

Total: PhP 26,688,949

(3) Estimation Conditions

(a) Date of Estimation: December 2006

(b) Foreign Exchange Rate: US$1 = JPY 116.58

PhP1 = JPY 2.282

(c) Project Period: as described in Sub-section 2.2.4.9

(d) Others: The Project will be implemented in accordance with the Guidelines for Japan's Grant Aid Cooperation

2.5.2 Operation and Maintenance Cost

(1) New Pampanga Sub Center

When establishing new Pampanga Sub Center within the basin area, the Sub Center will need to be able to perform maintenance by itself, which will require additional two facility management engineers. And additional expenses of water and electricity for Sub Center are expected to be included.

Category	Yearly unit cost (PHP)	No.	Yearly cost (PHP)
Additional mid-career facility engineer	200,000	2	400,000
Water and electricity			250,000

(2) Checking tasks required by increased maintenance operation

No. of observatories		Yearly cost (PHP)		Total(PHP)
		Sub Centers	TSS	
Pampanga	17	130,000	150,000	280,000
Agno	11	100,000	140,000	240,000
Total (PHP)		230,000	290,000	520,000

(3) Operational management to improve the accuracy of the existing run off analysis

Local consultants may be asked to perform discharge measurements. Local consultants should be able to perform this routine work if given proper direction.

No. of Water-Level gauging station		Unit cost (PHP)	Total (PHP)
Pampanga	10	20,000	200,000
Agno	8	20,000	160,000
(Total)			360,000

(4) Securement of O & M cost for repairing of equipment

The O & M costs for the equipment can be categorized to (i) provision of consumable cost such as a toner cartridge, paper and (ii) repairing cost such as replacement of unit of outage equipment. The project will provide the consumable and repairing spare units for two year's operation. During two years operation after completion of Project, PAGASA only bear human cost for the O & M cost, mainly for inspection work. But after three years, PAGASA have to bear both the human cost and hardware cost (repairing on units etc). The hardware cost will be replacement of PC boards and consumable equipment such as the battery, which are high failure rate and high aging equipment. PAGASA is requested to secure amount of three million Peso (7 million Japanese Yen) for the O & M cost covering both human and hardware costs.

According to PAGASA's information, currently, the budget for equipment and materials is generally stable at approximately 3.5 million pesos (8 million yen) per year. This budget is intended for relatively simple and less costly repair work, which does not include the cost of replacing high-priced instruments. The budget system requires that the funds for purchasing equipment to be requested in advance to be provided in the following year, and requests are being submitted in order of priority such as water level sensors and power supply equipments. Budget of approximately 3 million pesos (7 million yen) per year shall be acquired for the equipment purchase in addition to the cost of maintenance of the aforementioned facilities.

The budgetary system in the Philippines, the repairing costs can not be allocated for the PAGASA budget. If the repairing and/or renewal of the equipment, which requires expensive cost, such being case, PAGASA can arrange the budget.

(5) Increasing annual O & M costs

Increasing annual O & M costs for the new FFWS (equipments, facilities, and human costs) are summarized as follow.

Table 2.5-1 Increasing Annual O & M costs

Item	Description	Annual O & M cost (Peso)	Subject to financial item
Pampanga Sub Center	Additional the Telecommunication Engineer	400,000	Manpower cost
	Utilities fees (Heat, ventilation, lighting and water etc)	250,000	Utilization cost
Gauging stations	Inspection Engineer (Gate keeper)	180,000	Manpower cost
	Inspection fee	80,000	Traveling cost
Current flow measurements	Measuring Engineer	360,000	Manpower cost
O & M costs for the equipments	Consumable spare parts	500,000	Direct material cost
	Hardware (Repairing units etc)	2,500,000	
Total		4,270,000	

The annual budget for FFB can bear the increasing annual O & M costs because burden rates are very small as mentioned below.

(a) Man power costs: 5% against all annual man power cost

- Additional Telecommunication Engineer
- Inspection Engineer
- Measuring Engineer

(b) Utilities fee: 6% against all annual utilities cost

(c) Inspection fee: 6% against all annual traveling cost

Chapter 3

Project Evaluation and Recommendations

Chapter 3 Project Evaluation and Recommendations

3.1 Project Effect

The effect of this project consists largely of two segments. One is the direct effect achieved through renovation and improvement of the system functions focusing on the information collection for the flood forecasting and warning systems. Other is the indirect effect which is the prompt and accurate information and safe evacuation from the flood forecasting and warning service provided to the residents in the river basins.

Current condition and problems	Measures in the cooperative project	Direct effect and level of improvement	Indirect effect and level of improvement
High rate of missing data	Provide proper functioning of the water-level gauges and telemetry observation equipment. Restore the multiplex radio network	Current rate of missing data of 50% reduced to 3.6%	Lead time for evacuation will increase, allowing to ensure the safety of human lives and property.
Data omission forces manual observation, resulting in inaccurate data and time-consuming data collection.		Data collection requiring approx. 2 hours in the manual observation will be made approx 10 minutes.	

(1) Direct effect

The project will allow the development of the telemetry observation system, which is the information collection system of the flood forecasting and warning systems, restoration of the multiplex radio network and prompt learning of the situation by the relevant agencies. This is thought to bring about the following direct effects.

- Missing rate of the data collection in the telemetry system will be improved form the current 50 % to 3.6 %. (Since it is to be understand that the missing rate will be approximately 0% at actual operation after the upgrading work, 3.6% is the worst case of one gauging station become un-operation).
- Observation time will be reduced to about 10 minutes from about 2 hours required for visual inspection conducted due to unavailability of the telemetry equipment. (10 minute is minimum interval time in the telemetry observation system).

“Soft Component Plan” will ensure the effective operations of the FFWS among the relevant agencies, and facilitate dissemination of the clear and accurate flood forecast warning information by hazard map for the local inhabitants.

(2) Indirect effect

Information obtained must be promptly, accurately and specifically communicated to the residents. Overflow analysis software will be used for this purpose, and instructions to improve the measure of providing the information obtained or analyzed are included in the soft component of this project. This is likely to have the following effects.

- Dissemination of the clear and accurate flood forecast warning information will prolong the lead time for the evacuation and thereby contribute to alleviation of damages to people and property.
- Development of hazard maps will specify the levels of danger in the areas as well as evacuation places and routs, which will ensure the swift and safe evacuation.

3.2 Recommendations

The counterpart of this project has been properly maintaining the existing flood forecasting and warning system partly with the technical support provided by Japan. It is fully capable of managing the new flood forecasting and warning systems in terms of technical skills. Thorough implementation of the following practices will enhance the effect of this project and a system of self-development is likely to be established.

(1) Thorough inspection and maintenance to retain the observation accuracy

Inaccuracy of the observed information obtained and provided will impair the reliability of the flood forecasting and warning systems, and the maintenance procedures, including the following, must be completely implemented to prevent such consequences. This requires sufficient maintenance budget to be allocated.

- Prepare and use the sensors and observation equipment to acquire precise observation information.
- Periodically inspect the systems to maintain full function.
- Measure the flood flows to improve the accuracy of water-level forecasts.

(2) Seeking ways to provide comprehensible information

The information provided must be relevant and comprehensible to the residents. Means to provide local, specific, representative and clear information must be sought through consultation with BDCC (Barangay Disaster Coordinating Council) in charge of regional disaster prevention and other relevant parties. Referring to the post-flood surveys conducted by PAGASA and BDCC and hazard maps is an example of an effective way to consider the information to be provided.

(3) Building more effective systems of cooperation with the organizations involved in disaster prevention, including regional Disaster Coordinating Councils

Currently, JOMC (Joint Operation and Management Committee) led by PAGASA, which is the management committee for the agencies involved in dam operation, is already functioning; however, more frequent and extensive deliberations with relevant agencies must be held in an attempt to build an effective system of cooperation. PAGASA must lead the efforts to establish active communication, not only with JOMC, but with parties involved in natural disasters.

(4) Points to consider for smooth execution of the Project

Delay in construction of Sub-Center will hinder the equipment installation and lead to modification of the system configuration, which will surely have the enormous effect on the Project. Delay in acquiring permissions/approvals from DPWH for the construction work will cause negative impact on the schedule of the construction part.

Regarding the civil works, high water season (June to September) should be avoided taking into consideration the construction cost and safety issues. Strict control shall be put in place for the schedule in order to carry out the construction works of water level supporting and river protection works during low water season (January to May).

In addition, shutdown time for operation of the existing FFWS shall be minimized to secure the observation operation of the FFWS during typhoon and rain seasons.