DEPARTMENT OF
PUBLIC WORKS AND HIGHWAYS
THE REPUBLIC OF THE PHILIPPINES

THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT IN THE REPUBLIC OF THE PHILIPPINES

FINAL REPORT
PART II-C
FEASIBILITY STUDY ON TAGOLOAN RIVER BASIN (TAGOLOAN)

JANUARY 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

CTI ENGINEERING INTERNATIONAL CO., LTD.
in association with
NIPPON KOEI CO., LTD

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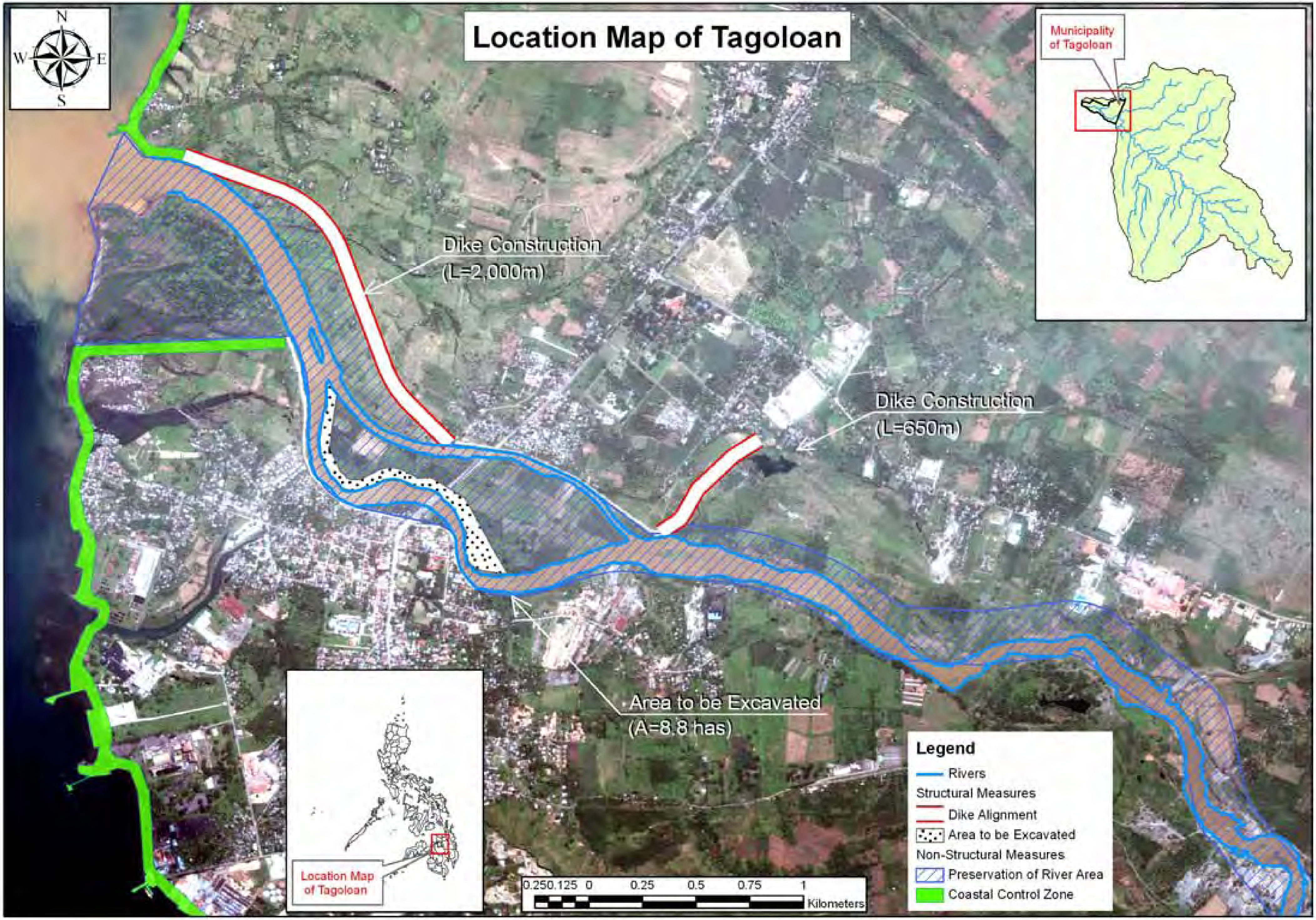

Location Map of Tagoloan
N
W
E
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Municipality of Tagoloan
Dike Construction (L=2,000m)
Dike Construction (L=650m)
Area to be Excavated (A=8.8 has)
Location Map of Tagoloan
0.250.125 0 0.25 0.5 0.75 1 Kilometers
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THE PREPARATORY STUDY
FOR SECTOR LOAN
ON DISASTER RISK MANAGEMENT
IN THE REPUBLIC OF THE PHILIPPINES

FINAL REPORT

PART II-C: F/S ON TAGOLOAN RIVER BASIN (TAGOLOAN)

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CHAPTER 1 INTRODUCTION

1.1 Background of the Study

The Philippines is one of the countries most severely damaged by natural disaster in the East-Asia Region. Among the natural disasters, 92.5% are caused by typhoons that bring heavy rainfall and strong winds. Approximately twenty typhoons a year break out on the sea around the Caroline and Mariana Islands, and most of them pass through the Philippines. These typhoons cause floods, in most cases, by heavy rainfall.

Thus, the Philippines is vulnerable to flood damage. According to the flood damage records from 1970 to 2003, 544 people have died per annum and the number could be 1,487 people per annum if the missing and injured were included. The number of damaged households and disaster-affected persons was 500,000 and 2,800,000, respectively. Out of the 730,000 damaged houses, 70,000 were completely destroyed. The total direct damage was estimated at about 4.6 billion pesos a year; whereas, once in every six years the damage amounts to more than 10 billion pesos.

In the Philippines, master plans for flood control projects of the Major River Basins (12 out of 18) with catchment areas of more than 1,400 km^2 were formulated in 1982. Based on those plans, feasibility studies and projects were implemented with ODA and other international funds together with review on the master plans. Even for the Principal River Basins with catchment areas of more than 40 km^2, urgent flood control projects whenever severe flood damages occurred were implemented. However, the number of river basins where flood control works were so far implemented is very limited.

Under the circumstances, a development study known as “The Nationwide Flood Risk Assessment and the Flood Mitigation Plan for the Selected Areas in the Republic of the Philippines” (hereinafter called as “The Nationwide Flood Risk Assessment Study”) was conducted to formulate the national strategy for flood control projects. In this study, 58 river basins in which flood control projects should be implemented for the period of 26 years between 2009-2034 were selected and the implementation schedule was arranged in the order of priority by dividing the 58 river basins into three (3) groups: one group covering the 26 river basins expected to be financed with foreign funds, while the other group of 30 river basins is to be financed with local funds. The remaining 2 river basins is to be implemented as exceptional rivers for which the implementation of flood control project should be commenced immediately at that time.

On the other hand, the prioritized river basins with middle level priorities have to wait for a long time to receive funds for project implementation when each project is intended to protect the assets of the whole river basin with application for individual loans. Even for the flood control projects in highly prioritized river basins, the implementation might wait for some time since the cost for each proposed project may be so high that the implementation of some projects has to be deferred. Therefore, flood control projects for river basins implemented with local funds may also wait for a longer time judging from the previous practices on flood control projects with local funds, because the limited budget for flood control is expensed ad-hoc, only for restoration works when flood damage is observed. In fact, flood disasters may occur in every river basin even for the middle priority river basins, and the stakeholders in each basin may crave for the implementation of flood protection measures against the future disasters.

Under the circumstances, it has been recognized that there is a necessity for the early implementation of flood control projects, not for the whole river basin but only for the selected core areas that are scattered in the basin (middle level priority river basins). For this purpose, the idea of a "Sector Loan" from New JICA (the merged JICA and JBIC) has been brought up to cover several river basins as a package but only for the protection of core areas. To make arrangements for the Sector Loan, a feasibility study has to be carried out for the selected core area in the each river basin. In line with the above idea, the DPWH has decided to conduct by itself feasibility studies for the 12 river basins belonging to the group financed with local funds.

However, it is required that a conduct or review on the feasibility study has to be executed earlier for the initial implementation of candidate projects for the sector loan. In this connection, a feasibility study for three (3) candidate river basins except the 12 river basins mentioned above is one of the objectives of the Preparatory Study on Sector Loan for Disaster Risk Management conducted by DPWH with New JICA's assistance.

1.2 Objectives of the Study

1.2.1 Objectives of the Sector Loan Project on Disaster Risk Management

The objectives of the sector loan project are to strengthen the capability of Philippine Government agencies concerned in disaster risk management and mitigate flood damage in vulnerable areas through the following:

(1) The implementation of structural and non-structural measures for the improvement of rivers in selected high-risk flood damage areas. Such rivers have been selected as a result of the "Study on the Nationwide Flood Risk Assessment and the Flood Mitigation Plan for the Selected Areas in the Republic of the Philippines."

(2) The improvement of disaster risk management systems, including management of the emergency response fund for flood control.

1.2.2 Objectives of the Preparatory Study

The objective of the Preparatory Study is to prepare the basic materials necessary to implement the projects, including the following:

(1) To select three (3) objective river basins and core areas which really need urgent implementation of a flood control project;

(2) To conduct feasibility studies for the selected core areas in the three (3) river basins;

(3) To arrange the materials for preparation of the Implementation Program (I/P) in connection with the application for a Sector Loan; and

(4) To confirm and recommend, if necessary, the current institutional arrangement to manage the sector loan.

1.3 Composition of the Final Report

The Final Report is to be submitted as the final product of "The Preparatory Study on the Sector Loan for Disaster Risk Management in the Republic of the Philippines" containing the objectives listed above.

In this connection, the Final Report consists of the following six (6) volumes:

Table R 1.1 Composition of the Final Report

Volume No.	Title	Contents
-	Summary	Summary of the results of the entire study
Part I	Main Report	The results of the entire study and the framework and implementing strategy, manner, cooperative agreement and procedure of the Sector Loan.
Part II-A	Feasibility Study on the Lower Cagayan River Flood Control Project for the Sector Loan Application	Results of the review on the Feasibility Study conducted in 2002 and the Structural and Non-structural Measures for the Project Proposed for Sector Loan.
Part II-B	Feasibility Study on the Ilog-Hilabangan River Flood Control Project for the Sector Loan Application	Review of the Master Plan of 1990 and the results of Feasibility Study on the Project Proposed for Sector Loan
Part II-C	Feasibility Study on the Tagoloan River Flood Control Project for the Sector Loan Application	Review of the Master Plan of 1982 and the results of Feasibility Study on the Project Proposed for Sector Loan.
-	Needs Assessment Study on Flood Disasters Caused by Typhoons No.16 (ONDOY) and No.17 (PEPENG)	

As shown above, Volume No. Part II-C presents the result of the Feasibility Study on the Tagoloan River Flood Control Project, which will be used for the Sector Loan Application. The result indicates that the extension of flood protection dike with revetment on the dike slope toward the downstream and upstream stretches along the right bank and excavation work in the towhead area existing in river area between the left and right bank dikes to protect Togoloan as the core area against probable floods lower than a 25-year return period are proposed as structural measures for this Sub-Project under the Sector Loan.

CHAPTER 2 NATURAL CONDITION OF THE STUDY AREA

2.1 Location

The Tagoloan River Basin is one of the eight (8) major basins in Mindanao (Mindanao, Agusan, Tagum-Libuganon, Agos, Davao, Cagayan de Oro, Buayan-Malangun and Tagoloan.). The Tagaloan River Basin, which has a basin area of 1778 km^2, is situated in the northern part of Mindanao Island and the coastal area is developing towards industrialization.

2.1.1 Topography

(1) General

The basin is located mainly in the Province of Misamis Oriental, one of the provinces that comprise the Northern Mindanao Region (Region X). Land in the Tagoloan River Basin consists of forest, grassland and cultivated lands except the lowermost portion, the PHIVIDEC Industrial Area.

The downstream reaches of the Tagoloan River consist of a series of plateaus, hilly terrain, river deltas and valleys. Most of the low-lying areas have developed into residential, crop production, commercial and industrial zones in the Municipality of Tagoloan. North of the town proper (poblacion) is Barangay Sta. Cruz and towards the West and South are the coastal plains of Barangays Baluarte, Gracia, Sugbongcogon and Casinglot. The areas to the East abound with hilly terrain and valleys. The river delta runs along the length of Tagoloan River.

In the municipal territory of Tagoloan whose the boundaries consist mostly of a part of the lower catchments of the Tagoloan River, more than half (58%) has the slope of 0% to 3%. A combined 15.4% are within the 3-8% and 8-18% slope categories, while the remaining 26.2% of the whole jurisdictional area of Tagoloan Municipality have slopes of over 18%, as shown in Table R 2.1.

Table R 2.1 Summary of Slope Classification in the Municipality of Tagoloan

Category	Slope Degree	Area (ha)	Share (%)
Slope Category 1	0 to 3%	4,604.5640	58.00
Slope Category 2	3 to 8%	547.7843	6.90
Slope Category 3	8 to 18%	674.8068	8.50
Slope Category 4	18 to 30%	825.6460	10.40
Slope Category 5	30 to 50%	873.2794	11.00
Slope Category 6	50% above	412.8230	5.20
Total		7,938.9035	100.00

(2) Land Use

Four types of soil cover the lower reaches in the basin. Sandy soil covers the right bank along the coastal area, loam covers the left bank along the Tagoloan River near the coastal area, and clay covers the mid-stream reaches of the Tagoloan River. In such condition, agricultural products in Municipality of Tagoloan are mainly corn and coconut. However, the low-lying areas of the Tagoloan River Basin are to be developed by the Philippine Veterans Industrial Development Corporation Industrial Estate (PHIVIDEC Industrial

Estate or PIE). According to the master plan, PIE will develop most of the low-lying area of the Tagoloan River Basin as part of the 3,000 hectares to be developed (See Chapter 3 and Chapter 4).

(3) Survey Works Newly Conducted

In this JICA Preparatory Study F/S, the following supplemental surveys have been conducted to obtain river data together with the elevation of low-lying areas around the targeted areas.

Table R 2.2 Summary of Survey Works Newly Conducted in the JICA Preparatory Study F/S

No.	Work Items	Work Contents
1	River Profile and Cross Section Survey	Tagoloan River (30 cross sections): 10km
2	Aerial Photography	Area: 36km^2 [(6km (E-W), 6km (N-S)]

Figure R 2.1 Location of Cross Section Survey

2.1.2 Geology and Soil

(1) Basic Geological Condition

Geological conditions in the Tagoloan River Basin have been described in detail in the "Lower Tagoloan River Watershed Characterization Report" in 2008 by DENR. The following description is quoted from the said report.

"The northern part of the watershed belongs to the volcanic Lanao-Bukidnon highland composed of Pliocene-Quarternary Plateau, basalts and pyroclastic deposits. Beneath it is a sequence of Miocene sedimentary layers and basement rocks. The volcanic flows overlay the pyroclastic deposition ally contact with the older formations, sequences of volcanic flows and pyroclastics mainly of volcanic breccia and series of conglomerate sandstone and shales are found in the same areas. This formation is widespread within the area. Metamorphic rocks with green schist facies and ultramafic complex are pinned beneath the Mindanao Central Cordillera."

(2) Distribution of Geology and Rock Types

(a) Sedimentary and Metamorphic Rocks

(i) Pre-Jurassic Rocks

The basement complex of Bukidnon is made up of metamorphic rocks that include the slates and phyllites grading to the green schist fancies. The schist commonly forms narrow ridges deep inside rivers occupying mostly the higher elevations. The largest exposures are found on the western slopes of Mt. Tago bounded by Amusig River on the northwest and Tagoloan River. Other bodies occur as windows along the northern part of Mt. Palaopao, exposed along the sayre highway between Manolo Fortich, Damay and Mangima Canyon, on the western portion of Ala-e–Damilag area. (Pacis et. al, 1962).

(ii) Cretaceous-Paleogene Rocks

Metamorphosed volcanic and sedimentary rocks are found at the inner portion and southern part of Malitbog, Phyllite slates, mylonite, mete-volcanic quartzite, meta-sandstone and shale, cherty ferruginous sedimentary rocks and recrytallized limestone characterize this group. Their contacts with other rocks are defined by the appearance of semi-schistose cherty rocks.

(iii) Pilo-pleistocene Rocks

These rocks are composed of limestone, phyroclastics and clastic such as conglomerates, tuffaceous sandstone, shales and agglomerates. The limestone known as Indahag limestone by Pacis 1962 overlies the older rocks.

As part of the Bukidnon formation, the phyroclastic and clastics occupy the western section of the region. The well-bedded sequence of conglomerates, shales and tuffaceous sandstone to Tagoloan elastics are confined along the stretch of the Tagoloan and Siloo rivers at Tankulan Quadrangle.

(iv) Upper Miocene-Piocene Rocks

Opol formation as mapped by Pacis et. al (1962) extends to the northern portion of Bukidnon. It consists of conglomerates, pebbly and tuffaceous sandstone and tuffed intercalated with agglomerates. This type of rock is well-bedded and slightly folded. Exposures of these rocks are found in the eastern and southern part of the province.

(v) Recent Deposit

Unconsolidated fragments of igneous, sedimentary and metamorphic rocks, including the residual and alluvial fan deposits are confined along major river systems held down through the floodplain areas. These occur in the form of clay, silt, pebbles, cobbles, boulders.

(b) Igneous Rocks

(i) Piocene Quaternary

This rock is one of the prevalent rock foundations in Malitbog based on the geological hazard map. This is composed mainly of pyroclastic and volcanic flows that cover major portions of Barangay Siloo, the northern part of San Luis and the eastern part of Calabugao plain. The other class is represented by porphyritic andesites and covers the northern part of Barangay San Luis in Malitbog, Bukidnon.

(ii) Volcanic

These rocks consist of meta-volcanic, originated mostly from metamorphosed mafic igneous rocks. They occur as massive flows of breccias lying along the boundaries of Bukidnon and Agusan del Sur. This formation supported a part of the Mindanao Central Cordillera.

(iii) Geological Structures

The most prominent structural feature in the surveyed area is the north-eastern part which is underlain by old sedimentary and volcanic rocks dominated by major thrust fault trending either north-south or northwest-southwest through Tagoloan. Clastics, schist, while Siloo Impahanong of Barangay San Luis in Malitnog, Bukidnon may be affected by an active fault line traversing the center of Malitnog extending from north to south.

The course dentrited fragments were supplied from the eroded existing landmass active center and Indahag limestone. This could account for the various cementing materials of clastics, tuffaceous to calcareous presence in the thin layer of tuffaceous beds and presence of almost all kinds of rocks as fragments in the conglomerate-metamorphic, sedimentary and igneous rocks. (MGB Region X, 1983)

(3) Soil

The soil of lower Tagoloan River Watershed was characterized following USDA standard procedures. The Soil Survey Report of Bukidnon by Mariano, et. al (1955) was used as the basis for determining possible soil types/series covering the whole watershed area. Prior to field observation and soil sampling, the possible soil series found in the area was examined from the available soil map and its characteristics were written in the record book and brought to the field for validation. Six (6) soil series and two (2) miscellaneous land types are mapped within the watershed area (see soil map). The soil series comprise the Adtuyon clay, Alimodian clay, Faraon clay, Jassan clay, Kidapawan clay and Umingan sandy clay, while the miscellaneous land types include the Undifferentiated Mountain Soil and Rough Broken Land. About 8 soil profiles representing the mapped soil types/series were evaluated and characterized morphologically using the prescribed format. The existing roadside cuts/eroded slopes were utilized for the purpose. Soil samples were collected from the different horizons of each soil profile and brought to the Soil and Plant Tissue Testing Laboratory of Central Mindanao University, Musuan, Bukidnon for the determination of Particle Size Distribution (Soil Texture) and some chemical properties like Soil pH, percentage of organic matter (O.M), Available Phosphorus (P), and exchangeable Potassium of the topsoil. Particle size distribution was determined by Pipet Method. Soil pH, soil organic matter, available P and Exchangeable K were determined using Gravimetric (1:1 soil: water ratio), Walkley-Black, Bray P_2 and Flame Photometer Methods, respectively.

2.2 Meteo-Hydrology and River System of Ilog-HIlabangan River Basin

2.2.1 Meteorology of Tagoloan River Basin

(1) General

The downstream of basin falls under Type III or Intermediate A climate of which season is not very pronounced consisting of relatively dry season from November to April and wet during the rest of the year. Normal annual precipitation varies from about 1,500mm in the northern part to 2,000mm in the southern part. The estimated annual runoff of the Tagoloan River is about 2,560 x 10^6 m^3.

On the other hand, the climate in Malitbog and Manalo Fortich classified as belonging to Type IV or Intermediate B and are typical throughout the municipality are more likely the same, while the northern part of Sumilao Falls under Type III or Intermediated B which are typical throughout the municipality. In Claveria where two (2) district climatological types prevail on the highly elevated eastern portion, the prevailing climate is Type III where the wet season with pronounced maximum rainfall occurs from the month of November to January. There is normally no dry season under this type of climate, while the western portion of the municipality has the Type II climate classification, which is the major climate type in Misamis Oriental.

(2) Rainfall

The 2003-2007 five years rainfall data from the two stations, namely Cagayan De Oro and Bukindon, shows that data gathered in DMPI appears to have an annual average rainfall of 1,848mm while PAGASA Cagayan de Oro City shows an annual average rainfall 1,523mm for the five consecutive years (2003-2007). Table R 2.3 shows that there is a slight variation among the rainfall data that cover the upper catchment areas which are mainly located in the Province of Bukidnon, while the lower catchment areas appear to have less rainfall occurrences. This shows that relative humidity on the upper catchment is higher compared to the lower catchment.

Table R 2.3 Rainfall Observation at Cagayan de Oro and Bukidnon Rainfall Gauging Stations

Period	Rainfall	
	Cagayan De Oro	Bukidnon
1999	2,211	2,896
2000	2,015	2,582
2001	3,184	3,100
2002	2,598	2,545
2003	1,928	2,436
2004	1,241	2,099
2005	1,609	2,193
2006	1,386	1,939
2007	1,450	2,513
Average	1,523	1,847

Note : *1: PAGASA Station
*2: Meteorological Station DMPI Camps Phillips Manolo Fortich)

(3) Relative Humidity

The relative humidity observation of the two stations from 2003-2007 shows a decreasing trend from January to March and an increasing trend from April to June, while July to December values show similarity of figures with minimal variability.

(4) Wind Speed and Direction

Table R 2.4 below shows the annual wind prepared by PAGASA--Cagayan de Oro for the same period indicating that monthly winds prevail most of the year. Measured wind speed is between 1 to 4 m/s at 99.4% of the time. Monthly winds from the north direction prevail from January to September. Winds shift to Southwesterly from September to November and revert back to Northerly on the last month. Annual average wind speed is 1.2m/s. (Frequency Table (%) of data was provided by PAGASA, Cagayan de Oro City, Misamis Oriental.)

Table R 2.4 Wind Speed and Direction

Direction / Speed (WDS)	N	NNE	NE	ENE	E	ESE	SE	SSE
Calm								
1-4m/s	26.0	5.7	2.1	1.5	1.3	0.4	0.2	1.6
5-8m/s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
>8m/s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	26.9	5.7	2.1	1.5	1.3	0.4	0.2	1.6

Direction / Speed (WDS)	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Calm									0.5
1-4m/s	7.0	7.1	16.0	7.5	1.8	1.4	3.0	16.8	99.4
5-8m/s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
>8m/s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total	7.0	7.1	16.0	7.5	1.8	1.4	3.0	16.9	100.0

Note: Unit: m/s
Source: PAGASA, Cagayan de Oro

2.2.2 River System in Tagoloan River Basin

The Tagaloan River is the main drainage-way of the basin. It originates in the slopes of Mount Kibuwa, and flows in a northwesterly direction before draining into the Macajalar Bay. It has eight major tributaries; namely, Pugaan, Malitbog, Siloo and Amusig on the North, and Ipaon, Atugan, Calaman and Manolo Fortich on the South. **Table R 2.5** shows the river system of the basin.

Table R 2.5 Salient Features of Rivers in Tagoloan River Basin

River	Basin Area (km^2)	River Length (km)	Overall Slope
Tagoloan (Whole)	1,778	106	1/75
Tributaries:			
Pugaan	64	25	1/36
Malitbog	135	31	1/11
Siloo	142	47	1/14
Amusig	227	53	1/13
Ipaon	89	27	1/20
Atugan	518	61	1/11
Calamuan	153	61	1/12
Manolo Fortich	151	78	1/17

Tagoloan River flows year round. It emanates from the Bukidnon Plateau in the southeast and flows northeastward for 106 kilometers towards Macajalar Bay along a structurally controlled path. Tagoloan River is the 13th largest river system in the Philippines in terms of basin size, as classified by the NWRB. It has an estimated drainage area of 1, 704 km^2 covering the provinces of Bukidnon and Misamis Oriental. The Malitbog River joins the main Tagoloan River Channel in the vicinity of Barangay Maribojoc at the section where the latter begins to meander and forms a delta.

The river system is rather simple running almost straightly from the upper mountainous reaches to the sea. The pilot channel of a diversion work connecting the Pugaan River with the Tagaloan has been constructed. The former was originally an independent river which had caused flooding in the low-lying area. The average annual flood damage in the plain is estimated at 7.4 million pesos under the present condition of land use based on the River Dredging Project II, Nationwide Flood Control Plan and River Dredging Program, which have been verified in this F/S.

The Tagoloan River splits into two channels, each 30 to 40 meters wide, at about 800 meters upstream of the Tagoloan-Villanueva Highway. The two channels join again after 840 meters, creating a river enclosed piece of land of 42.8 hectares. Dike of 1.10 kilometers on the north bank and another of 1.7 kilometers on the south bank near the Tagoloan River Bridge have been constructed to mitigate the floods generated during and after heavy rainfall.

2.3 Flood

Flooding along the Tagaloan River is limited to the low-lying areas in the lower reaches. River bank erosion associated with sediment deposition in the lower reaches seems to be one of the problems in the Tagaloan River. The flood prone area of Tagaloan, which extends to about 1,300 ha, covers the said developing industrialization areas including the Municipality of Tagoloan. The potential flooding in this area including the Municipality of Tagoloan is a paramount concern, which requires identification of remedial measures to deal with it.

During floods, low-lying areas adjoining the Tagoloan River are frequently inundated due to the inadequacy of channel flow capacity. Inundation and damages in the Tagoloan River Basin are concentrated in the lower reaches due to the topographic features.

In 1984, the Municipality of Tagoloan was not spared by catastrophic typhoon “Nitang” which caused inundation from the Tagoloan river bank sweeping away the northern section of the PHIVIDEC Industrial Estate and the town proper of Tagoloan. Properties were damaged and numerous lives were lost. Another devastating typhoon in 1990 ravaged the river bank and left approximately 100 families homeless.

2.4 Related Information

2.4.1 Water Resources Development Plans

The water resources potential of the basin has been assessed generally, but the comprehensive water resources development plan is yet to be completely established. The conceived and studied projects in the past have been realized.

2.4.2 Actual Flood Mitigation Projects in the Past

Flood mitigation projects for Tagoloan River in the past were all undertaken by contract under the supervision of the DPWH Region X Office. The following implementation was based on the yearly allocations under the Regular Infrastructure Program.

Table R 2.6 River Improvement Projects in Tagoloan River Basin

Funding (Yearly)	Length (l.m.)	Appropriation (₱'000)	Location/Date of Completion
1994	528.50	48.000	Upstream of Eastern Side/August 12, 1997
Part of 1995 & Part of 1996	433.90	28.000	Upstream and Downstream of Western Side/February 12,1998
Part of 1997, 1998, 1999, 2000	678.00	68.000	Upstream and Downstream of Eastern and Western Sides/November 30, 1998
1998	300.00	33.273	Upstream of Eastern Side/November 15 1999
1999 & 2001	401.70	73.151	Downstream of Western Side/April, 2001
2000	170.00	19.166	Upstream & Downstream/February 8, 2002
Total	2,510.10	269.59	

CHAPTER 3 SOCIO-ECONOMY

3.1 The Population and Economy

Tagoloan, though still predominantly agricultural at 83% utilization of the total land resources, is envisioned to be the industrial growth corridor of the Growth Center of the Northern Mindanao area. This is farther complemented by the fact that Tagoloan is only around 19 km away from the prime city of Cagayan de Oro and that the spillover effect of the rapid expansion of the city could easily gravitate to Tagoloan Municipality.

Presidential Decree 538 (during the Marcos Regime) was promulgated to allocate a total land area of 800 ha for the use of PHIVIDEC who is assigned to take charge of the industrialization of the area being declared as an Industrial Estate. Lately, however, the local leaders of Tagoloan identified the disadvantages of PD 538. They have formulated an even better structure of accelerating the phase of development in the area up to 2022, which envisions a fully developed Tagoloan Area. At present, Hanjin of South Korea has entered the PHIVIDEC Industrial Estate as one of the Industrial Locators.

The target of an accelerated phase of industrial development in the area has been amplified by the current rate of growth of industry even higher than the prime city center of Cagayan de Oro. While the rate of growth in the industrialization of Tagoloan is already at the 5% level, the Cagayan de Oro city Growth Rate is only 2%.

The present population of Tagoloan is 56,499 with a density of 726 persons per sq km. This population structure has actually oscillated from different growth levels, such as: 5.46% in 1970-75, 8% in 1975-1980, 4.41% during 1980 to 1990 and down to 3.58 beginning 1990-1995. Considering that agricultural land use is still higher at 83% compared to the other sectors, it could be surmised that the population increase due to in- migration is still agricultural by orientation. Shown in **Figure R3.1** is a comparative population chart relative to Misamis Oriental and on a regional level. Numerical values are shown in **Table R3.1**.

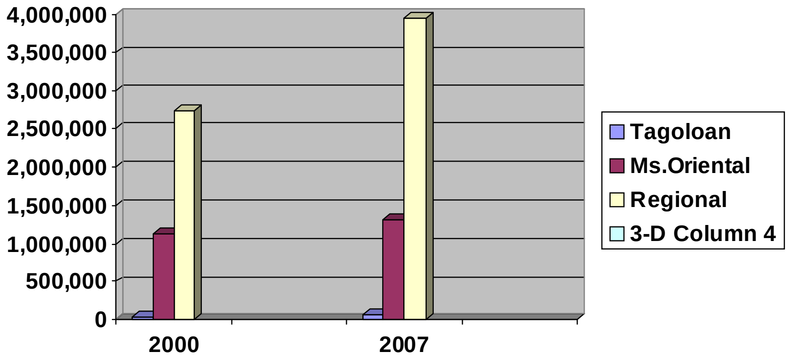


Figure R 3.1 Comparative Population Chart

Table R 3.1 Population Data

Level	Year	
	2000	2007
Tagoloan Municipality	46,187	55,396
Misamis Oriental	1,126,215	1,302,851
Regional Level	2,747,585	3,952,437

The vision to convert Tagoloan into a hub of industrialization in the Iligan-Cagayan Corridor in Northern Mindanao is based on the presence of a strong industry like Hanjin in the Phividec

Industrial Estate. Hanjin has one of the largest shipyard facilities in Asia today. With its total investment of $2B, the targeted employment generation in the area is 40,000 workers.

At present, there are still around 36 industrial establishments in the area covering a total of 176.5 ha. The future trend is very bright and promising due to the accelerated phase of investment allocation in the area.

3.2 Land Use Profile

Though predominantly agricultural, the interesting developments in the area of investment and industrialization had strengthened the insights during the Marcos Regime to establish PHIVIDEC in Tagoloan. This early, the industrial growth rate of Tagoloan at 5% performs considerably higher than that of the prime city of Cagayan de Oro which is only at 2% level. A total of $2B investment was approved for the construction and full business development of a global class Modern Ports and Shipyard Facilities under the aegis of Hanjin.

Shown in **Figure R3.2** is the general distribution of land-use in the Tagoloan River Basin. Numerical values are shown in **Table R3.2**.

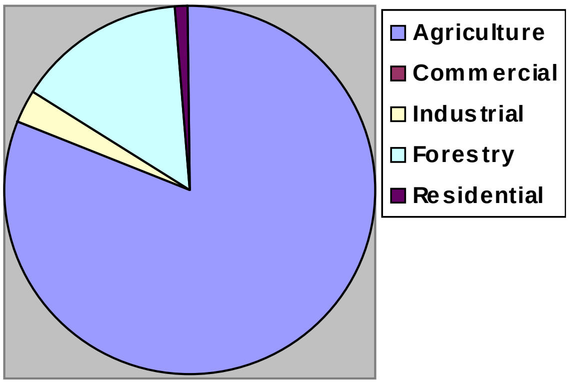


Figure R 3.2 Population Growth Rates (2000-2008)

Table R 3.2 Land Use Distribution

Sector	Land Distribution (%)
Agricultural Sector	81.0
Industrial Sector	3.0
Forestry Sector	15.0
Commercial	0.0
Residential	1.0
Total	**100.0**

In Tagoloan, 53% of agricultural outputs come from corn producers with an annual production of 2,791 MT. Corn plantation covers a total land area of 517 ha. In addition, 350 ha are planted to coconut, 964 ha to varied types of crops and 25 ha of rice lands producing a total of 125 MT.

Another interesting development is in the area of livestock where 914 heads of cattle in 1993 increased to 1,447 heads by 1995. In addition, poultry also had a production of 102.64 MT valued at PhP65,000 per ton and 61.29 MT of beef valued at PhP80,000 per ton.

The fishery sector has also become productive. For instance, there are 1.2T scad caught in fishing barangays, with an additional catch of 5T tuna, 2T skip jack and 7.5MT sardines. The entire Macalajar Bay had produced a total of 268 MT of fishery outputs valued at PhP5.4M.

A GIS Map that features the land use of Tagoloan and its immediate vicinity is shown in **Figure 3.1**.

3.3 General Economic Situation

The local GDP of 5.2% in Tagoloan is relatively much higher than the national GDP. **Table R3.3** shows the GRDP of Tagoloan in recent years to the present. However, this level is negligible when compared to the 18% rate of growth of industries in Vietnam.

With the investment in place as well as the expansion of the commercial sector, this increasing rate of growth in the productive capacity of Tagoloan is still expected to increase in the coming years.

Table R 3.3 Gross Regional Domestic Product/Family Income (Tagoloan, 2009)

Years	Value
GRDP	
2007	67,557,449
2008	71,169.547
Family Income	
2008	14,200
2009	10,000

At present, commerce is also expanding in the area. As early as the year 2001 to 2002, the expansion of commercial activities in the area is already recorded at 5%. There were 97 retailers and 42 business dealers and traders. All in all there are already a total of 360 commercial establishments within Tagoloan area. This growth in commerce and trade is brought about by the spillovers of employment and investment into the sphere of disposable income of the residents, which have contributed to the expansion of commercial activities. Despite its close proximity to a main Economic Corridor like Cagayan de Oro, Tagoloan was able to manage and contain the expansion of local industries within its territory.

This increase of 5.2% in the acceleration of the local economy is brought about by the fact that take off of investments in industry and its employment creation had enhanced the purchasing power in the area, notwithstanding the already increasing levels of disposable income at more than PhP10,000 per month.

It is expected that within a period of 5 years, business, trade and industry would double in volume. By 2020, the economy of Tagoloan is expected to enter the stage of newly industrializing town in the Greater Mindanao Area.

3.4 Water Utilization and Wastewater Disposal

A comprehensive development of water resources in the Tagoloan River basin has yet to be completely established, as implementation has been slow in the past.

Present water use is for municipal and industrial purposes. However, consumptive use is not definitive, as a long-term trend has yet to be established.

Industrial establishments provide their own water treatment facilities. Residential and commercial establishments use septic tanks and concrete lined canals that drain into street canals and natural waterways. Some remote barangays dig open pits to throw their wastewater. The system of sewerage disposal by household is shown in **Table R3.4**.

Table R 3.4 Sewerage System by Household (Municipality of Tagoloan [1/])

Type	Number	% Distribution
Septic tank	5,485	70
Pipe system (PVC or CI)	1,929	24
Anywhere, open canal	461	6
Total	**7,875**	**100**

[1/] *Municipal Engineer's Office, as of 1995*

3.5 Public Hazards

3.5.1 River Overbank Flow

Inundation from uncontrolled river overbank flow is considered a serious public hazard that has to be addressed as the municipality and its immediate surroundings experience this frequent phenomenon due to typhoons that bring in heavy rainfall.

The flood prone areas in Tagoloan are the low-lying areas of Nabulod, Baluarte, parts of Villa Mangga , Villa Victoria, Promised Land Subdivision, Villa Rosario area, Casinglot relocation area, Natumolan, Sta. Cruz, Sta. Ana, Subangcogon relocation area and Mohon (along Tagoloan River).

In addition, the existing drainage in the Poblacion is not adequate to cope with heavy rains. In areas of low elevation where water becomes stagnant, wastewater overflows and causes problems of sanitation and danger of contamination of groundwater resources.

To stem the adverse effects of flooding, initial flood control works in terms of flood dikes have been provided along the Tagoloan River. The list of completed projects is shown in **Table R3.5**.

Table R 3.5 List of Completed Projects

Phase No.	Funding Year	Length, m	Completion Date
I	1994	528.5	Aug. 1997
II	Part of 1995 and Part of 1996	433.9	Feb. 1998
III	Part of 1997, 1998, 1999, 2000	678.0	Nov. 1998
IV	1998	300.0	Nov. 1999
V	1999, 2000	401.7	Apr. 2001
Supplemental Agreement Phase I to V	2000	170.0	Feb. 2000

3.5.2 Solid Waste

Indiscriminate disposal of garbage poses a threat to health as well as adverse flooding when the drainage system is clogged due to debris.

In Tagoloan, garbage collection is done daily in some areas of the Poblacion particularly in the town plaza, municipal compound and public market. The garbage is dumped in designated areas using municipal dump truck for wet garbage and pushcart for combustible wastes. Garbage receptacles are provided at garbage collection areas. In some other barangays, garbage is collected irregularly depending on the volume of garbage.

Methods of household garbage disposal vary. Most households do it by burning or dispose into dug open pits. Only few residents have garbage receptacles.

One of the causes of runoff water to become stagnant especially in the Tagoloan town proper is the system and practice of solid waste disposal of some unconcerned residents (consisting of about 20% of households) where they throw garbage anywhere, even into the open canals thereby causing the drainage system to be clogged.

Shown in **Table R3.6** is the mode of garbage disposal by household:

Table R 3.6 Mode of Garbage Disposal by Household Municipality of Tagoloan[1/]

Type	Number	% Distribution
Garbage can	715	9
Open pit	1,075	14
Burning	4,377	56
Anywhere	1,707	21
Total	**7,875**	**100**

[1/] *Municipal Engineer's Office, as of 1995*

As shown above, almost 80% of the garbage is not properly disposed. The problems and needs have been identified as follows:

- Lack of equipment and personnel
- Indiscriminate disposal of waste/garbage
- Absence of disposal site
- Distant location of existing sanitary landfill

3.5.3 Water Pollution

The possible source of pollution of the groundwater and natural waterways would come from the processing and manufacturing industries in the PHIVIDEC area. However, this is located outside of the Tagoloan core area.

CHAPTER 4 ANALYSIS OF FUTURE LAND USE AND POPULATION

4.1 Future Land Use Conditions

There are available industrial facilities and infrastructures in the area with the Plan to transform Tagoloan into a hub of industrialization in the Growth Corridor. This could be similar to Yokohama Industrial City in relation to Tokyo where only within the total period of (30) years, a new industrial city was created in order to deflate the ballooning of Tokyo Urbanization and Industrialization.

The facilities for industrialization are those of the PHIVIDEC Industrial Estate and the Industrial Zone envisioned for the entire Tagoloan area. In general however, the entire Tagoloan is still predominantly agricultural by land use. **Figure 4.1** shows the future land use of Tagoloan while **Table R4.1** shows the change of built-up area based on the CLUP.

Table R 4.1 Built-up Area

Name	Present (2009)	Future (2020)	Ratio
Tagoloan	8.06 [1/]	16.89 [2/]	2.10

[1/] *Computed by GIS based on satellite image*

[2/] *Computed by GIS based on CLUP of Municipality of Tagoloan*

Based on the CLUP of Tagoloan, the industrial area will increase from 1.77sq.km to 8.83 sq.km. However, this tends to be overestimated. It is more reasonable to assume that 50% of the area is in operation as shown in **Table R4.2**.

Table R 4.2 Projected Industrial Area Occupancy

Present			Future			50%	
Built-up Area (sq.km)	Industrial Area (sq.km)	Percent-age	Built-up Area (sq.km)	Industrial Area (sq.km) [1/]	Ratio	Effec-tive I. A. (sq.km)	Ratio
8.06	1.77	21.96%	16.89	8.83	52.28%	5.30	31.38%

[1/] *Estimated from CLUP by GIS*

4.2 Population Projection (2005-2020)

The population growth of Misamis Oriental as projected by NSO is shown in Table R4.3.

Table R 4.3 Projected Population by NSO [1/]

Year	Population	Ratio	Growth Rate
2000	1,133,500		
2005	1,279,000	1.13	2.44%
2010	1,436,700	1.12	2.35%
2015	1,605,200	1.12	2.24%
2020	1,774,500	1.11	2.03%
2025	1,939,900	1.09	1.80%
2030	2,097,300	1.08	1.57%
2035	2,241,100	1.07	1.34%
2040	2,368,600	1.06	1.11%

1/ *Source: NSO website*

As shown above, there is a decreasing rate of population from 2.44% in year 2005 to 1.11% in year 2040.

However, the result of actual census taken in year 2000 and 2007 has an average of 2.1% for the province and 2.77% for Tagoloan as shown in **Table R4.4**.

Table R 4.4 Population in Actual Census [1/]

Name	unit	2000	2007	Growth Rate
Misamis Oriental	nos.	1,126,215	1,302,851	2.10%
Tagoloan	nos.	46,649	56,499	2.77%

Source: NSO website

In this study, it is assumed that the above rate of population growth from 2000 to 2007 will continue until the target year of 2020. The projected population based on the said assumption is shown in **Table R4.5**.

Table R 4.5 Projected Population under this Study

Place	2009	2010	2015	2020	Ratio (2009/2020)
Misamis Oriental	1,358,229	1,386,794	1,538,889	1,707,665	1.26
Tagoloan	59,678	61,333	70,327	80,640	1.35

As shown above, the ratio of population is only 1.35 even though the ratio of built-up area is 2.10 as mentioned in Sector 4.1.

4.3 Trends of Urban Development and Population Increase

There is a strong possibility that progress in Tagoloan could follow the pathway of an accelerated urbanization with rates of growth high enough to cause congestions, pollutions and urban decay if the safety nets are not provided early enough to project such scenarios of development in the future.

As the targeted hub of industrialization in the Northern Corridor of Mindanao, sufficient safeguards on the sources of water and sanitation must be provided and planned this early. This particularly refers to River Basin Plans and Programs so as to insure stability in the ecological conditions of the Critical Natural Resources of the area. Moreover, the entry of investments must be evenly calibrated to balance economic expansion and ecological preservation.

Another critical risk is flooding due to the onslaught of Climate Change in the entire country with typhoons loaded with rain whose magnitude has increased tremendously beyond normal levels. In this regard, flood control must be fully studied and planned so as to make it very responsive even to the new demands for climate change.

CHAPTER 5 HYDROLOGIC AND HYDRAULIC ANALYSIS

5.1 Approach

This chapter presents the hydrologic assumptions and considerations made to derive probable flood discharges and, consequently, the discussion on the usage of these discharges in determining the effect of inundation under different return periods or flood scales. The effect of inundation in turn affords the determination of the degree of structural flood protection to be provided, which is presented in Chapter 7 (Structural Flood Mitigation Plan).

The general considerations for discussion under this chapter are outlined as follows:

Table R 5.1 Approach for Sector Loan Study

Item	MP / FS	This Study	Remarks
Report	MP in 1982		
Rainfall Data	Unspecified but more than 30 years	1961 – 2008	Data from Cag. de Oro, Kisolon and Malaybalay and updated from 1982 to 2008
Rainfall Analysis	3-day rainfall, Thiessen method for 3 stations	2-day rainfall, Thiessen method for 3 stations	
Runoff Analysis	Unit hydrograph method	Unit hydrograph method	Done
Flood Runoff	Peak value of discharge only	Flood hydrograph	Data for calibration/verification is not adequate.
River Cross-section	Unspecified	200 and 500m interval	Done
Initial Water Level	Unspecified	Converted from Mean high spring tide at Cebu Port	W.L = 0.75m
Flood Analysis	Unspecified	One-dimensional unsteady flow	Done
Grid Size	Unspecified	100m	Done

The hydrologic modeling is done using the HEC-HMS mathematical model with the aid of HEC-GeoHMS, a GIS based application that served as module to prepare the input especially the physical variables to the subsequent routine.

The hydraulic modeling runs are performed using the HEC-RAS mathematical model with the aid of HEC-GeoRAS, also a GIS based application that served as the input program.

Both HEC-HMS and HEC-RAS are public domain software developed and distributed by the U.S. Hydrologic Engineering Center.

In the hydraulic analyses, mathematical model runs are conducted considering a simple single reach of the Tagoloan River from its mouth to about 10km upstream.

5.2 Hydrology

5.2.1 Rainfall Analysis

(1) Data Availability

Rainfall gauging stations are found available from the following locations (Table R5.2):

Table R 5.2 Rainfall Stations and Years of Record

Sta. No./Location	Coordinates		Years of Record	Station Type
	Latitude	Longitude		
748 Cagayan de Oro City	08^{0}29'00.0"N	124^{0}38'00.0"E	1961-2008	Synoptic
1008 Kisolon, Sumilao, Bukidnon	08^{0}52'00.0"N	124^{0}16'00.0"E	1980-2006	Climatic
751 Malaybalay, Bukidnon	08^{0}09'07.3"N	125^{0}07'57.1"E	1961-2008	Synoptic

(2) Basin Mean Rainfall

The basin mean rainfall is estimated by Thiessen Polygon method considering the three rainfall stations mentioned in Table R 5.2 above.

In applying the method, the three stations are used where all their available records are parallel in time from 1980 to 2006. For the other years wherein data at Kisolon are missing, only the Cagayan de Oro and Malaybalay rainfall stations are used.

The Thiessen polygons, using the three and two stations as well as their ratios, are shown in Figure 5.1 and Figure 5.2**.**

(3) Design Storm Hyetograph

The process is undertaken in three stages, namely; (a) probable point rainfall frequency analysis, (b) rainfall intensity duration frequency (RIDF) analysis and (c) derivation of design storm hyetographs.

(a) Probable Point Rainfall Frequency Analysis

Probable rainfall analysis has two sub-parts, namely frequency analysis and selection of the best fit frequency distribution.

Frequency Analysis

This involves the fitting of theoretical frequency distributions to the annual maximum rainfall data. Four types of theoretical distributions are used in this study, namely Extreme Value Distribution (Gumbel), Log Pearson Type III Distribution, Log Normal Distribution, and 2-Parameter Gamma Distribution.

(i) Extreme Value Distribution (Gumbel)

This distribution utilizes the Fisher-Tippet extreme value function, which relates magnitude linearly with the logarithm of the reciprocal of the exceedance probability. Working equations are the following:

$$R_{Tr} = \overline{R} + K_{Tr} \cdot S$$

$$K_{Tr} = \frac{\left(Y_{Tr} - Y_n\right)}{S_n}$$

$$Y_{Tr} = -\left(0.83405 + 2.3025 \cdot \log \log \frac{Tr}{Tr - 1}\right)$$

Where,

R_{Tr} = Probable rainfall at return period Tr

$\overline{R}$ = Mean of the annual maximum rainfall series

K_{Tr} = Frequency factor at return period Tr

S = Standard deviation of annual maximum rainfall series

Y_{Tr} = reduced variate at return period Tr

Y_n, S_n = reduced mean and reduced standard deviation

n = number years of record

Table R 5.3 Reduced Mean and Standard Deviation

n	Yn	Sn	n	Yn	Sn	n	Yn	Sn
0	0.49522	0.94963	21	0.52519	1.06938	31	0.53714	1.11588
10	0.49522	0.94963	22	0.52673	1.07547	32	0.53803	1.11927
11	0.49969	0.96753	23	0.52819	1.08115	33	0.53889	1.12245
12	0.50348	0.98327	24	0.52959	1.08648	34	0.53959	1.12557
13	0.50699	0.99712	25	0.53084	1.09143	35	0.54026	1.12849
14	0.51000	1.00951	26	0.53202	1.09615	36	0.54107	1.13127
15	0.51285	1.02055	27	0.53326	1.10048	37	0.54177	1.13391
16	0.51542	1.03058	28	0.53419	1.10471	38	0.54243	1.13649
17	0.51770	1.03972	29	0.53533	1.10860	39	0.54294	1.13900
18	0.51978	1.04806	30	0.53616	1.11238	40	0.54363	1.14130
19	0.52177	1.05575						
20	0.52352	1.06282						

(ii) Log Pearson Type III Distribution

This distribution belongs to the family of distribution suggested by Pearson with log transformation of rainfall data. The parameters used are the mean, standard deviation and skewness coefficient. The working equations are the following:

$$R_{Tr} = \overline{R} + K_{Tr} \cdot S$$

$$K_{Tr} = \frac{2}{G} \cdot \{[(K_n - \frac{G}{6}) \cdot \frac{G}{6} + 1]^3 - 1\}$$

Where

R_{Tr} = Log of probable rainfall at return period Tr

$\overline{R}$ = Mean of the log of rainfall series

K_{Tr} = Frequency factor at return period Tr

S = Standard deviation of the log of rainfall series

K_n = Normal frequency factor (see table)

G = Skewness coefficient of the series

P = Probability

Table R 5.4 Normal Frequency Factor

Kn	P	Tr	Kn	P	Tr
-3.71902	0.99990	1.000	0.00000	0.50000	2.000
-3.29053	0.99950	1.001	0.17733	0.42960	2.328
-3.09023	0.99900	1.001	0.25335	0.40000	2.500
-2.87816	0.99800	1.002	0.52440	0.30000	3.333
-2.57583	0.99500	1.005	0.84162	0.20000	5
-2.32635	0.99000	1.010	1.28155	0.10000	10
-2.05375	0.98000	1.020	1.64485	0.05000	20
-1.95996	0.97500	1.026	1.75069	0.04000	25
-1.75069	0.96000	1.042	1.95996	0.02500	40
-1.64485	0.95000	1.053	2.05375	0.02000	50
-1.28155	0.90000	1.111	2.32635	0.01000	100
-0.84162	0.80000	1.250	2.57583	0.00500	200
-0.52440	0.70000	1.429	2.87816	0.00200	500
-0.25335	0.60000	1.667	3.09023	0.00100	1000
-0.17733	0.57040	1.753	3.29053	0.00050	2000
0.00000	0.50000	2.000	3.71902	0.00010	10000

(iii) Log Normal Distribution

This method uses a 2-parameter function identical to the Log Pearson III distribution except that the skew coefficient is neither computed nor used. Values of frequency factor K which are related to the probability of exceedance p and return period Tr are computed by the use of transformed normal distribution function available in MS Excel.

(iv) 2-Parameter Gamma Distribution

The method is identical to Gamma 3 except that the location parameter is set to zero, hence only the shape and scale parameters are used in the computation. Values of frequency factor K which are related to the probability of exceedance p and return period Tr are computed by the use of the Gamma Distribution function available in MS Excel. Input parameters to the Gamma function in MS Excel are the alpha α and beta β variables, which are computed using the following working equations:

$$\alpha = 1 + \frac{\sqrt{1 + \frac{4}{3} \cdot \left(\ln \overline{R} - \frac{1}{n} \cdot \sum \ln R\right)}}{4 \cdot \left(\ln \overline{R} - \frac{1}{n} \cdot \sum \ln R\right)} - \Delta\alpha$$

$$\beta = \alpha \cdot \tfrac{1}{n} \sum R$$

Where

R = Annual maximum rainfall

$\overline{R}$ = Mean of the rainfall series

n = number of years of records

The daily rainfall values within the Tagoloan river basin are estimated using the rainfall records of Cagayan de Oro City, Kisolon and Malaybalay together with their respective computed Theissen factors earlier discussed. From the derived daily rainfall values for Tagoloan river basin, annual maximum rainfall of 1-day and 2-day are extracted and tabulated in Table R5.5.

Table R 5.5 Annual Maximum Rainfall for Tagoloan River Basin

Year	Annual Max., mm		Year	Annual Max., mm	
	1-Day	2-Day		1-Day	2-Day
1961	51.6	62.2	1985	60.5	103.0
1962	90.9	139.7	1986	63.2	91.8
1963	80.4	100.3	1987	59.0	95.5
1964	88.4	130.3	1988	103.0	164.5
1965	103.6	147.6	1989	59.1	90.2
1966	62.4	100.7	1990	127.2	164.8
1967	81.8	89.3	1991	143.4	154.9
1968	61.8	63.0	1992	62.5	70.3
1969	73.9	80.1	1993	68.0	102.7
1970	61.1	104.5	1994	71.4	103.6
1971	59.4	87.8	1995	64.5	116.4
1972	130.3	142.2	1996	56.4	86.1
1973	79.5	99.2	1997	55.1	72.0
1974	77.2	80.6	1998	60.7	70.2
1975	98.3	119.9	1999	102.8	165.6
1976	46.9	75.7	2000	59.3	78.5
1977	88.7	106.2	2001	60.9	106.2
1978	83.7	93.4	2002	40.8	72.1
1979	145.5	173.9	2003	71.1	114.5
1980	65.2	78.0	2004	82.1	93.5
1981	73.0	90.5	2005	83.9	103.2
1982	130.9	136.7	2006	56.7	75.8
1983	63.0	86.1	2007	78.8	98.9
1984	73.3	110.6	2008	63.5	92.2

The above values are subjected to frequency analysis by fitting them to the following frequency distribution model (a) Gumbel, (b) Log-Pearson Type III, (c) Log Normal and (d) Gamma 2 distributions.

The plots of the frequency analysis for the selected frequency distribution are shown in Figure 5.3.The results of the analysis listing the probable rainfall for the design return periods of 2-yr, 5-yr, 10-yr, 25,yr, 50-yr and 100-yr are in Table R5.6.

Table R 5.6 Probable Rainfall

Return Period	1-day Rainfall (mm)			
	Gumbel	Log Pearson 3	Log Normal	Gamma 2
2	74.55	71.73	74.32	73.91
5	99.32	93.14	94.74	100.29
10	115.72	109.12	107.55	108.70
25	136.44	131.50	123.13	133.59
50	151.81	149.85	134.37	149.05
100	167.07	169.72	145.36	169.05
Return Period	**2-day Rainfall (mm)**			
	Gumbel	**Log Pearson 3**	**Log Normal**	**Gamma 2**
2	100.27	98.83	100.24	99.66
5	129.36	124.61	125.27	131.93
10	148.61	141.84	140.75	150.50
25	172.95	163.90	159.37	174.36
50	191.00	180.60	172.68	184.36
100	208.91	197.57	185.61	204.36

Selection of the 'best-fit' frequency distribution

The selection of fitted frequency distribution is undertaken by evaluating the summation of the offset of the computed values from the observed values and this is done for each of the abovementioned distribution. The following expressions are used in the evaluation;

$$E = \sum \frac{abs(Ro - Rc)}{Rc}$$

Table R 5.7 shows the result of the evaluation. The result suggests that the best fitted frequency distribution both for the 1-day and 2-day rainfall series is the Log Pearson Type III model since the distribution yields the least error, E.

Table R 5.7 Value of Error, E

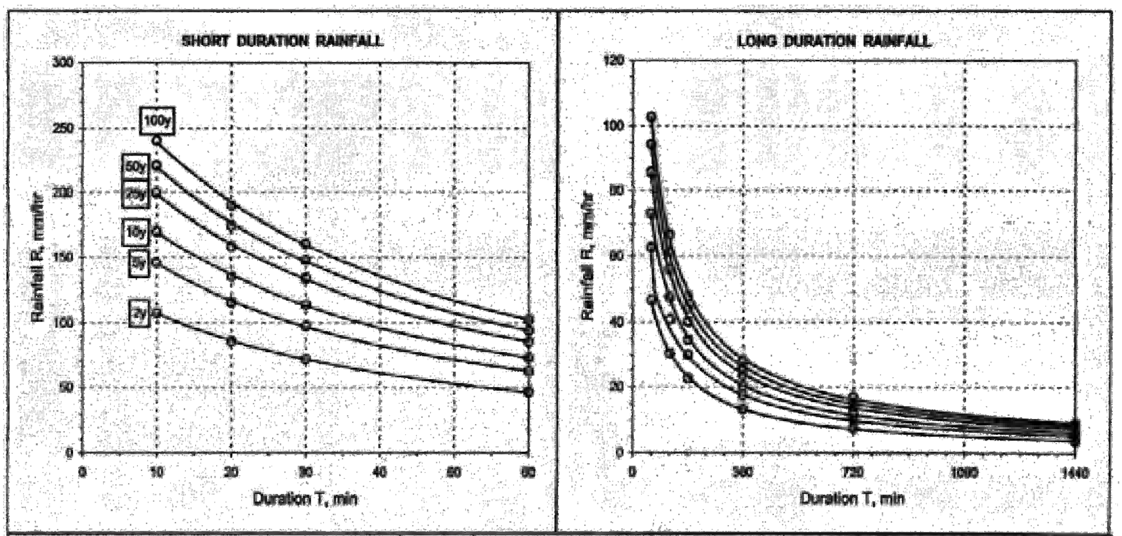
	Gumbel	Log Pearson 3	Log Normal	Gamma 2
1-day Rainfall	1.345	1.318	1.545	1.646
2-day Rainfall	2.100	1.299	2.146	2.354

(b) Rainfall intensity duration frequency (RIDF) analysis

The rainfall intensity is the average rainfall rate in mm/hr with the decided safety level indicated in the form of return period for the considered catchment area whose duration is equal to the concentration time.

Among the rainfall records used for the development of rainfall information within the Tagoloan river basin, the PAGASA synoptic rainfall station located in Cagayan de Oro City includes short duration rainfall. Likewise, the rainfall intensity duration curve of probable 1-day rainfall based on short duration rainfall data of Cagayan de Oro City synoptic station is developed by DPWH which are included in the supplemental volume of the Project Report titled "Manual on Flood Control Planning" under the Project for Enhancement of Capabilities in Flood Control and Sabo Engineering.

The RIDF relationship for Cagayan de Oro City is shown in Figure R 5.1.



Legends:
- O Probable Rainfall
- —— Fitted RIDF Curve

Type	Equation
1	$R = A/(C+T^b)$
2	$R = A/(C+T)^b$

Return Period, Yr	Short Duration RIDF Curves Type	A	C	b	Long Duration RIDF Curves Type	A	C	b
2	1	6103.34	44.55	1.09	2	4307.59	53.53	0.98
5	1	8869.52	48.27	1.11	1	7555.18	84.48	0.99
10	1	10706.45	50.07	1.12	2	4190.60	35.35	0.89
25	1	12972.53	51.93	1.12	2	4709.48	34.53	0.88
50	1	14512.97	52.72	1.13	2	4567.68	29.12	0.86
100	1	16182.66	54.14	1.13	2	4758.22	27.53	0.86

Figure R 5.1 Rainfall Intensity Duration Frequency (RIDF) Cagayan de Oro City

(c) Design Storms

The methodology applied in the development of design hyetograph follows the "One Rainfall Station Method" (Alternating Block Method) which means one design hyetograph for all the sub basins is prepared from the RIDF curve.

Review of the previous analysis contained in the Project Report titled "Nationwide Flood Control Plan and River Dredging Program" prepared by DPWH in 1982 indicated that the storm duration is about 72 hours. The present Study updated the analysis and indicated that the probable storm duration is about 48 hours (2 day) considering the assumption that storm duration can be as short as 2 times of the lag time. Lag time is the time difference from the rainfall peak to the discharge peak. Rainfall duration time is set to one-hour interval since the concentration time is longer than one hour.

The RIDF curve is necessary to prepare the design hyetograph by alternating block method. The RIDF curve prepared for Cagayan de Oro City is used and adjusted for Tagoloan River Basin using the ratio of 1-day probable rainfall of Tagoloan against Cagayan de Oro City. Table 5.1 shows the estimated RIDF for Tagoloan River Basin.

The rainfall intensity is computed from the RIDF curve for each of the durations Δt, 2Δt, 3Δt, nΔt. These increments, or blocks, are recorded into a time sequence with the maximum intensity occurring at the center of the required duration Td and the remaining blocks arranged in descending order alternately to the right and left of the central block to form the design hyetograph. The computation is shown in Table 5.2 and illustrated in Figure 5.4.

5.2.2 Runoff Analysis

The rainfall-runoff analysis is done using HEC-GeoHMS and HEC-HMS (Hydrologic Engineering Center – Hydrological Modeling System). HEC-GeoHMS is an ArcGIS extension designed to prepare the basin model as an input to HEC-HMS. The extension has the ability to delineate sub-basins boundaries, river valleys, length of longest river reaches and length of centroidal flow by geo-processing a digital terrain model. HEC-HMS is a stand-alone computer program designed for rainfall-runoff computation. The software, including its detailed manual, is public domain available from the website of US Army Corps of Engineers. Also, the program is available through the Project for Enhancement of Capabilities of DPWH Engineers in the field of Flood Control and Sabo Engineering (Project ENCA), PMO-Flood Control and Sabo Engineering Center (FCSEC).

(1) River Basin Model

As an initial input to HEC-HMS, the river basin model consists of geo-referenced terrain parameters such as sub-basins boundaries, longest river courses, length of centroidal flows, sub-basin slope, river profile and other are determined by extracting them from the terrain model based on SRTM (Shuttle Radar Topographic Mission) in ArcGIS environment specifically with the aid of HEC-GeoHMS extension. Figure 5.5 shows the delineation of the basin model that includes the schematic flow diagram while Table 5.3 tabulates the physical properties of each of the delineated sub-basin and river reaches. Except for the river confluences, which are indicated in the map with name starting with letter ”J”, sub-basin names and river reach names are consistent with the basin map and the names entered on the respective tables.

(2) Verification of the Basin and Runoff Models

The above basin model is compared with the basin model developed in the 1982 Master Plan Report. The following are the highlights of the comparison;

(a) The basin model in the 1982 Master Plan Report is created from 1:50,000 NAMRIA topographic maps while the present model is based on 2003 SRTM data. Figure R5.2 shows the two superimposed basins.

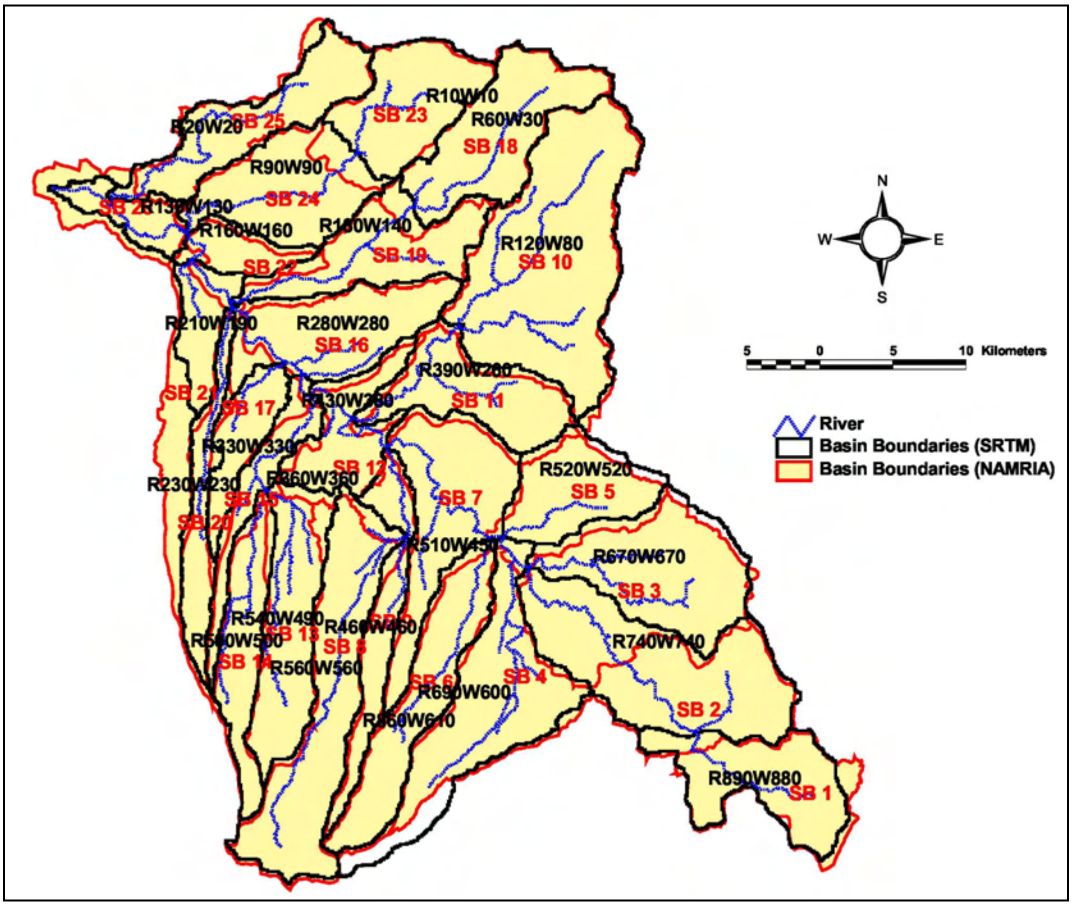


Figure R 5.2 Tagoloan Basin Models

The basins are not perfectly identical and it shows that the size of the catchment of the 1982 Basin Model is larger than the present model. Some of the 50,000 NAMRIA maps especially those covering the lower right corner of the 1982 basin model are extrapolated and the maps are irreconcilable due to lack of terrain information. The outlet of the basin has tremendously changed through the years and it is very much different from the 1959 NAMRIA maps. The catchment area based on the 1982 Master Plan Report is estimated to be 1,778km² while for the present study, the catchment area is computed to be 1,735 km².

(b) With the present basin model, the runoff hydrograph for the design scale of 50-yr is estimated using the design hyetograph of similar scale found in the 1982Master Plan Report. Consequently, the resulting runoff hydrograph is compared with the 1982 Master Plan hydrograph. Figure R 5.3 shows the comparison.

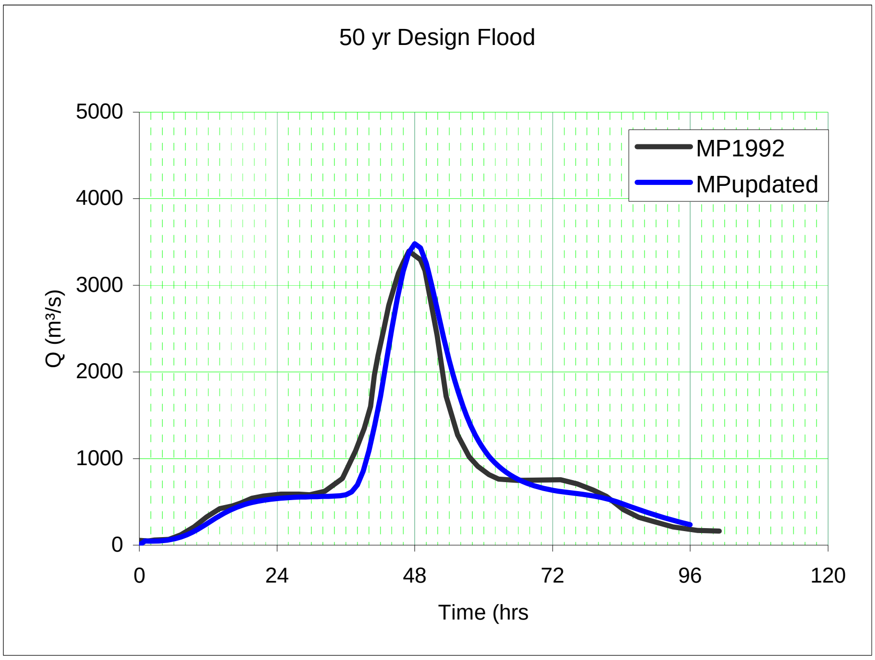


Figure R 5.3 Comparison of Flood Runoff Hydrographs

With the above comparison therefore, it can be concluded that the present model although based on different methodology (HEC-HMS) is still compatible with the earlier model used in the 1982 Master Plan Report.

HEC-HMS is further used to generate an annual flood hydrograph (1.05y return period) and later used to estimate the flood level of Tagoloan River at the Bridge. The flood level estimation is made possible using HEC-RAS flood simulation model. Figure R 5.4 shows the result of simulation at the Bridge site.

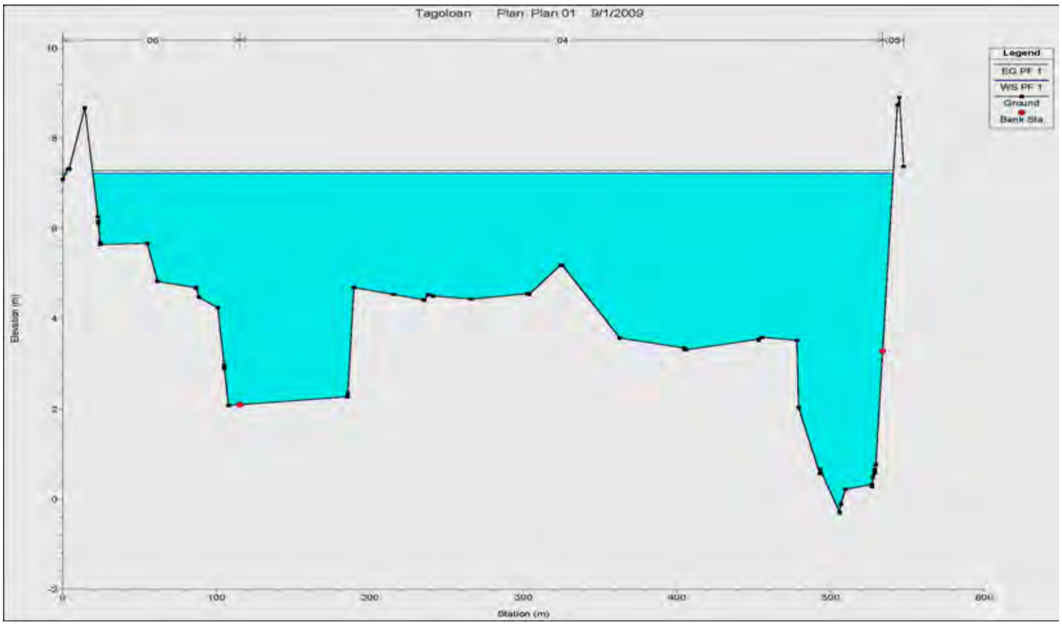


Figure R 5.4 Estimated Flood Level in Tagoloan River at the Bridge

The estimated water surface elevation is 7.22m and it almost coincides with the bottom edge of the bridge girder. During the field investigation, residents living near the bridge confirmed that the annual maximum flood level of Tagoloan River almost touched the lower edge of the bridge girder.

With the above findings, the developed rainfall-runoff model based on HEC-HMS methodology is further used to generate the probable flood discharges of 2-yr, 5-yr, 10-yr, 25-yr, 50-yr and 100-yr as discussed in the succeeding section.

(3) Probable Flood Discharge

Having confirmed the validity and applicability of the above rainfall-runoff model (HEC-HMS) and together with the basin model parameters, the design hyetographs of various return periods are transformed into design flood runoff hydrographs as shown in Figure 5.6.

5.3 Hydraulic Analysis

The objective of hydraulic analysis is to determine the full capacity of the river channel and the extent and depths of flood inundation for flood flow greater than the river channel capacity. With the result of hydraulic analysis, formulation of plan to mitigate the possible flooding can be undertaken.

5.3.1 Target Area

The target area covers the vicinity of the Municipality of Tagoloan particularly those barangays and other built up areas located close to the riverbanks and the immediate left and right flood plains.

5.3.2 River Cross-section Survey

The cross section geometry for the main river channel is obtained from actual field survey using GPS, Total Station, Transit Level and Echo Sounder survey instruments. The cross sections on the flood plains and/or 'dry' ground (similarly located as those taken from the actual field surveys) are derived from a triangular irregular network (TIN) of digital elevation database downloaded from the Shuttle Radar Topography Mission (SRTM).

5.3.3 Initial Boundary Condition

Macabalan Port which is secondary tide station in the Philippines is the nearest tide station. However there is few data to set sea level as an initial water level because the operation of the station just started in 2008.

The latest "Tide and Current Tables, Philippines" published by NAMRIA as of 2009 shows that the high water level at the Port Tagoloan is 0.31m lower than the level at the Cebu Port. Previous study1 conducted by JICA adopted mean spring higher high water level of 1.06 EL.m as a initial water level.

Therefore, the initial water level at Tagoloan river mouth is 0.75 EL.m.

[1] Study on the Flood Control for Rivers in the Selected Urban Cneters, JICA, Feb. 1995

5.3.4 Flow Capacity

The river channel capacity is defined as the maximum discharge at bank capacity. Flood discharges above the channel capacity are considered overbank discharges. Determination of river channel capacity are determined by creating stage-discharge curves (flow rating curves) for each of the available river cross sections along the Tagoloan River. Figure R5.5 shows the location of the cross-section lines.

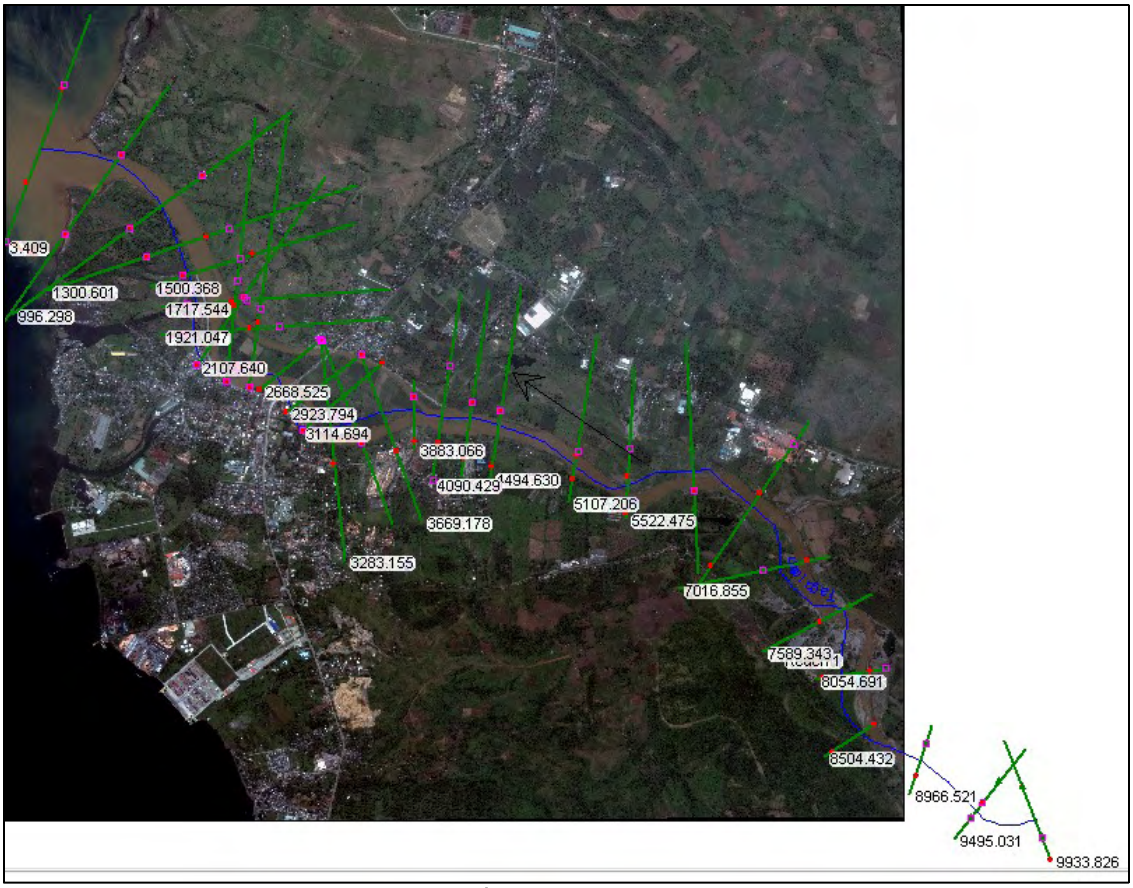


Figure R 5.5 Locations of River Cross-Sections along Tagoloan River

Using the steady flow analysis module of HEC-RAS, several flow discharges are tried, thereby developing the flow rating curves for each river cross-section. The results of the analysis are shown in Table 5.4**.**

5.4 Flood Inundation Analysis

5.4.1 General

(1) Concept and Outline of the Flood Inundation Model

The river shall be modelled taking into consideration the main river channel and its left and right flood plains. Initially, the river channel in its original or existing condition shall be modelled. As for Tagoloan, it might be necessary to make a model including upstream portion in accordance with verifiable observed data for the model. Moreover judging from geographical features in the downstream, the flood inundation is diffusion type, therefore, virtual river channel for the floodplain has to be built in the flood inundation model.

(2) Description of Software

HEC-RAS is an integrated system of software for interactive use in a multi-tasking environment. It is designed to perform one-dimensional hydraulic calculations for a full network of natural and artificial or constructed channels. It is comprised of a graphical user interface, separate analysis components, and data storage and management capabilities. The system contains a) steady flow water surface profile computation intended for steady gradually varied flow b) unsteady flow simulation primarily for subcritical flow and mixed flow regimes b) movable boundary sediment transport computation resulting from scour and deposition over moderate time periods and d) water quality analysis wherein the current version (Ver 4.0) can perform detailed temperature analysis and transport of a limited number of water quality constituents.

5.4.2 Flood Inundation Model

(1) Model Setup

The flood simulation is generally conducted in three steps; namely, calculation of flood runoff from the sub-basins, channel flood routing, and determination of flood inundation on the flood plains. The structure of the HEC-RAS model is shown in Figure R 5.6.

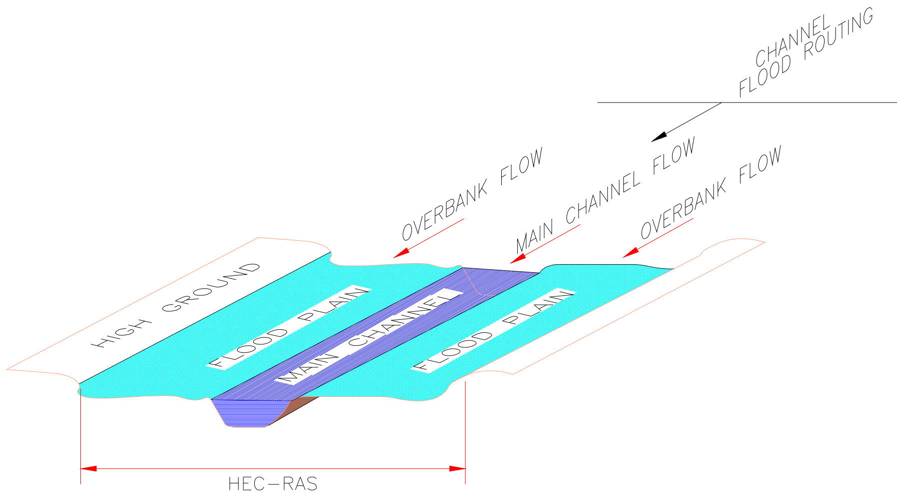


Figure R 5.6 Structure of HEC-RAS Model

(2) Methodology

The basic inputs to the HEC-RAS model are stream discharge, cross sections perpendicular to the flow direction along the river channel and flood plains, geometry of bridge or other cross channel structures, Manning's roughness coefficients (n values) as well as upstream and downstream channel boundary conditions.

Hydraulic calculations of flow in channels and overbank areas require an estimate of flow resistance, which is generally expressed by the Manning's roughness coefficient, n. The effect of channel roughness on water surface profiles is that as the n value is increased, the resistance to flow also increases, which results in higher water surface elevations. The assumed roughness, n, considered for the main channel and overbank areas under this study are 0.035 and 0.045, respectively.

Water surface profile calculations are computed from one cross-section to the next by solving the Energy equation by means of an iterative procedure called the standard step method. The Energy equation is written as follows:

$$Z_2 + Y_2 + \frac{a_2 V_2^2}{2g} = Z_1 + Y_1 + \frac{a_1 V_1^2}{2g} + he$$

Where:

Z1, Z2 = elevation of the main channel inverts at section 1 and 2

Y1, Y2 = depth of water at section 1 and 2

a1, a2 = velocity weighing coefficients at section 1 and 2

g = gravitational acceleration

he = energy head loss

A diagram showing the terms of the Energy equation is shown in Figure R5.7**.**

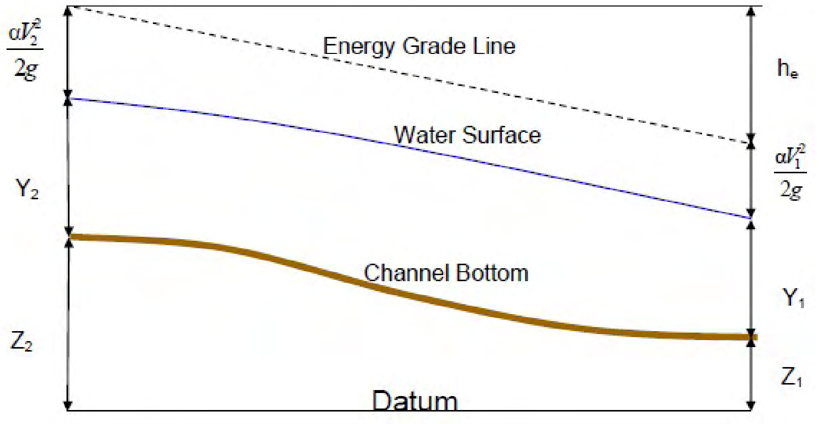


Figure R 5.7 Representations of Terms in the Energy Equation

The energy head loss (he) between the two sections is comprised of friction and contraction/expansion losses and is expressed as follows:

$$he = L\overline{S}_f + C\left|\frac{a_2 V_2^2}{2g} - \frac{a_1 V_1^2}{2g}\right|$$

Where:

L = Weighted reach length

$\overline{S}_f$ = Friction slope between two sections

C = Expansion/contraction loss coefficient

The weighted reach length is calculated as:

$$L = \frac{L_{lob}\overline{Q}_{lob} + L_{ch}\overline{Q}_{ch} + L_{rob}\overline{Q}_{rob}}{\overline{Q}_{lob} + \overline{Q}_{ch} + \overline{Q}_{rob}}$$

L_{lob}, L_{ch}, L_{rob} = Reach lengths for flow in the left overbank, main channel and right overbank, respectively.

$\overline{Q}_{lob}, \overline{Q}_{ch}, \overline{Q}_{rob}$ = Arithmetic average of the flow between sections for the left overbank, main channel and right overbank, respectively

The total conveyance and velocity coefficient for a cross section requires that the flow be subdivided into units for which the velocity is distributed uniformly. The approach is to subdivide the flow in the overbank areas using the cross section n-value breakpoints (i.e., where n values change) as the basis for subdivision as shown in Figure R 5.8**.**

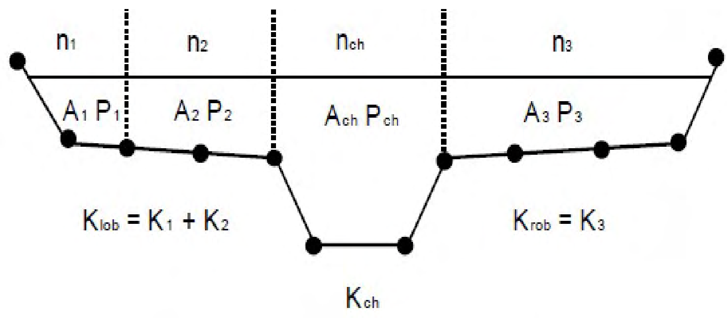


Figure R 5.8 Default Conveyance Method in HEC-RAS

Conveyance is calculated within each subdivision from the Manning's formula:

$$Q = K\sqrt{S_f}$$

$$K = \frac{1}{n} A R^{2/3}$$

Where:

K = conveyance for the subdivision

n = Manning's roughness coefficient for the subdivision

A = flow area for the subdivision

R = hydraulic radius (A/P) for the subdivision

P = wetted perimeter

HEC-RAS sums up all the incremental conveyances in the overbanks to obtain a conveyance for the left and right overbank while the main channel is computed as a single conveyance element. The total conveyance for the cross section is obtained by summing the left, channel and right subdivision conveyances.

(3) Model Network

The model consists of a single line diagram of the Tagoloan River as shown schematically in Figure R5.9.

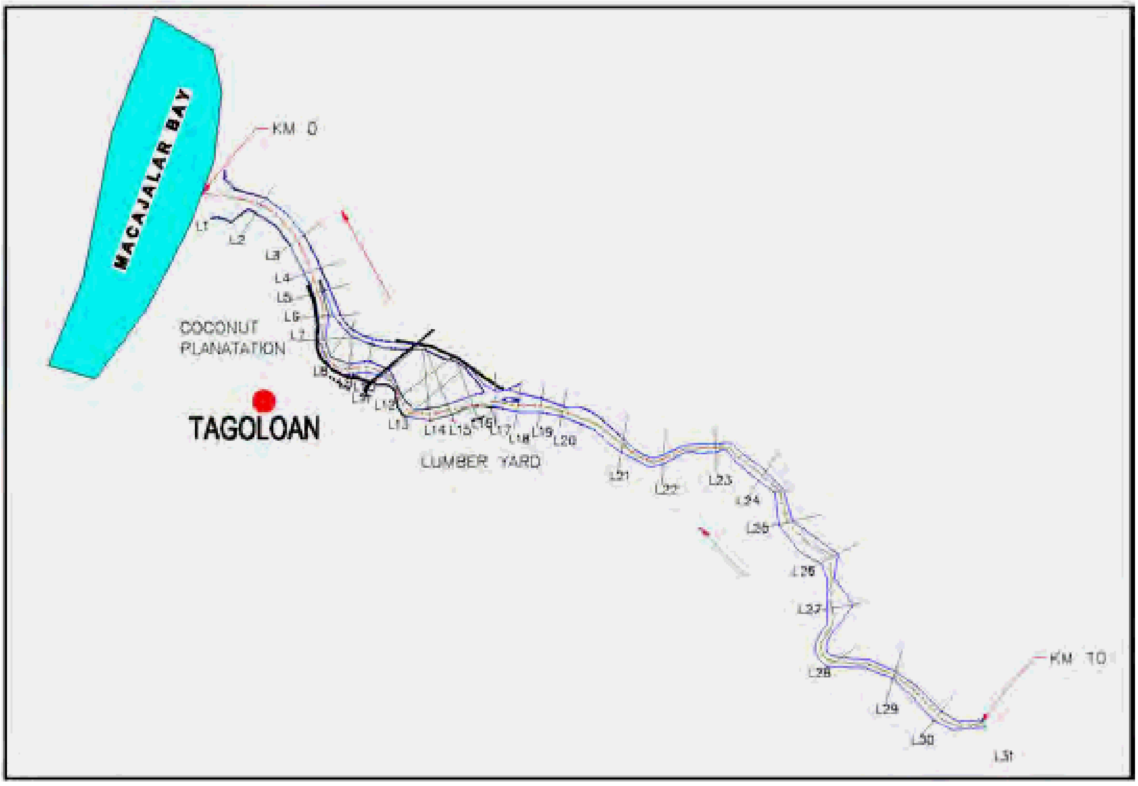


Figure R 5.9 River Model

CHAPTER 6 PLANNING FRAMEWORK

6.1 Basic Concepts on Planning Framework

6.1.1 Summary and Outline of Current M/P

As shown in Part-1 Report, the Master Plan for flood control on the Tagoloan River Basin, which has been selected as a candidate river for the implementation of flood control project in the Sector Loan Project, was formulated as one of the results in River Dredging Project II (Nationwide Flood Control Plan and River Dredging Program in 1982 (1982 M/P) by OECF (former Japan International Cooperation Agency (JICA)). In this 1982 M/P, the plan was classified into two (2) phases, the Basic Plan achieving to protect the area against 50-year return period flood as frame work and the First Phase Plan aiming to control the probable discharge at 25-year return period flood. In view thereof, the First Phase Plan included the construction works of the flood protection dike with slope protection of 11.4km in total on both sides (Refer to Figure 6.1). Total project cost for the First Phase Plan was estimated at 93 million pesos including tributaries treatment (Short-Cut of Pugaan Channel) works in 1982 price level. In this connection, the EIRR of the First Phase Plan Project was also estimated at 12%. As for implementation schedule, the 1982 M/P Report suggested that the schedule of the works would depend on the progress of development works of industry areas by PHIVIDEC located at estuary area of Tagoloan River.

6.1.2 Core Areas to be Protected by Structural Measures in the Sector Loan Project

As shown in Part I Report, Flood Control Projects as sub-projects in the Sector Loan Project on Disaster Risk Management aim to alleviate flood damages in selected “core areas” in the major river basins. Its policy has resulted from the expectations of prompt implementation works without the delay of the works and hastening onset of the flood control project. From that standpoint, core areas refer to the Municipality of Tagolaon, which is playing a role of one of the key industrial areas and built-up areas contributing provincial economic development for Misamis Oriental as shown in the 1982 M/P Report. In fact, the targeted areas are located in the Misamis Oriental Industrial Belt Zone developed and to be developed by PHIVIDEC.

The Sector Loan Project on Disaster Risk Management shall aim to mitigation flood damage in the high-risk flood damage areas (Core Area). The Core areas refer to the following classified land zone in the Comprehensive Land Use Plan 1993-2005 prepared by the Municipality of Tagoloan,

- Residential Areas (Built-up Area),
- Commercial and Industrial Area, and
- Administrative and Educational Area

In this connection, the core areas to be considered along the Tagoloan River are designated as below:

Figure R 6.1 Core Areas to be Protected in the Tagoloan River Improvement Project

6.1.3 Basic Concept for Flood Control

As described above, the Study Area is one of the most significant areas for the provincial economic development in the Misamis Oriental together with adjacent Provincial Capital City (Cagayan De Oro).

However, the Study Area suffers from habitual inundation by storm rainfall and high tide as well as occasional river overflow, which hamper the regional economy and the daily living condition of the residents. Under these circumstances, the DPWH constructed concrete-surfaced flood protection dike on both sides of the Tagoloan River during 1994-2002 as shown in Chapter 2 in this report (Refer to Figure 6.1). However, these dike system stopped halfway since the main objectives of the construction of dike are not only for prevention of inundation but also for protection of lands from scouring and bank erosion in addition to budget limitation. Therefore, the main flood mitigation works in the Sector Loan Project are to complete and improve these diking systems to get rid of the vulnerability to the flood damages in the areas under the incomplete flood protection system. Under the complete structural flood protection system, it is expected that the targeted areas will further be urbanized and industrialized for constraint of the expansion of flood damage.

The flood mitigation plans are conceived based on the results of the 1982 M/P and principally designed with the improvement and extension of diking system to protect the core areas. In addition, the flood mitigation plan consists of the structural and non-structural components with the proposed policy, contents and results by the 1982 M/P. As for structural measures, the main structural measures in this Study Area would be river improvement, such as the extension of dike, excavation of towhead located in the center of river channel and dredging to increase the flood flow capacity of the Tagoloan River. On the other hand, the non-structural measures would be conceived to maintain the function of river facilities for the proper maintenance and to establish early warning and evacuation system for perennial habitual inundation by tidal flood in coastal areas, as listed in Table R6.1.

As described in above, the existing flood dikes, which were constructed in the continuous Regional Office achievements, have been armed by concrete surfacing as shown in Picture below. On the other hand, new bridge on the trunk national road across the Tagoloan River at poblacion of Municipality of Tagoloan is now under construction. In this connection, river control plans with modification of existing river width and re-designing of flood design water level inducing demolition of concrete-surfacing dikes and re-construction of new bridge could not be accepted in terms of economical points of view.

	
Existing Revetment and Dike	New Bridge under Construction

Figure R 6.2 Existing Dike along the River and Bridge under Construction

Table R 6.1 Functions of Conceived Structural and Non-structural Flood Mitigation Measures in the Study Areas

Item	Function	Structural Measures	Non-Structural Measures
Basic Concept	Areas to be Protected	The unprotected areas by the existing dike systems in the upper stretches and lower stretches of the municipality of Tagoloan, in particular for the Phividec Industrial Areas shall be protected by the extension of the diking system to prevent floodwater from the areas to be protected.	Non-structural measures for whole protected area during extraordinary flood and for unprotected areas from tidal flood are considered to alleviate /minimize the flood damage.
	Intention of Stakeholders	Flood mitigation structural and non-structural measures to be selected should be considered and subject to the consents from the stakeholders since their consents are absolutely imperative to construct smoothly and execute effectively for the implementation of river works and O&M Activities.	
Basic Policy	Basic Plan	This Project shall be considered based on the proposed First Phase Plan to prevent flood damage from 25-year return period flood in 1982 M/P.	
Specific Flood Control Measures	Increment of Discharge Capacity in Waterways	• Construction/Extension of Dike and Revetment • Widening of River Channel • Dredging of River Channel (Widening means the excavation of towhead area located in the center of river channel.)	• Harmonization between CLUPs, Flood Control Plan and Solid Waste Management Plan • Prevention of encroachment to river area • Legal arrangement for construction of structural measures
	Flood control / retention capacity in the basins and the application in the project	• Raising of grounds in coastal area should be considered in long-term plan since the excavated materials of towhead land can be utilized.	• Organization Set-up for River basin management since Committee for IWRM in the Tagoloan River basin has not been established yet.
Mitigation measures in the extraordinary flood beyond design discharge		—	• Rainfall gauges with telemeter System have not installed in the Basin by PAGASA. Therefore, FFWS should be set in long-term plan. • Early Flood Forecasting and Evacuation system as community-base measures with easy devices.
Concept of Climate Change Adaptation	Increment of Rainfall intensity and design discharge	• Heightening of Dike • Dredging and widening of low-water channel	• Enhancement of measures proposed for other functions to minimize the damages • Enlightenment Activities to stakeholder for adverse effects of climate change.
	Sea Level Rising	• Heightening of Coastal Dike • Enhancement of Inland Drainage Capacity • Raising of Land Elevation	• Enlightenment Activities to stakeholder for adverse effects of climate change. • Revising of CLUPs • Set-up Legal and Organizational System for Smooth Implementation of Structural Measures

There are several distinct merits and demerits of the above structural and non-structural flood mitigation measures. The merit of structural measures is such that they could almost completely get rid of any damage of the flood, whenever the flood is less than the design scale adapted to them. On the other hand, the structural measures would possess the demerits such that they hardly mitigate the damage of the flood, which exceeds the design scale adapted to them, and they may cause the negative environmental impacts such as a large number of house relocation and felling of the mangrove forest. Moreover, it may take a time and a large cost to complete the construction of the structural measures, and during the time of construction, the effect of the flood mitigation is hardly expected.

As for the non-structural measures, the merits are such that they could bring about the early effect of flood mitigation with less cost of implementation as compared with the structural measures, and at the same time, they could contribute to a certain range of flood mitigation effect for every scales of flood. On the other hand, the demerit of the non-structural measures is such that the quantitative estimation on the flood mitigation by them is hardly made.

The target design level for the structural measures is, in general, determined as precondition according to recommendations in the relevant guideline and/or the design levels applied in the similar flood mitigation projects in the Philippines. Moreover, the common design level is usually applied to the entire target area. These concepts on the design level are useful to avoid the regional gap in the flood safety level. In this connection, the series of this Feasibility Study contain the conducts of feasibility studies for three (3) river basins, namely Tuguegarao & Enrile Area in Cagayan River Basin, Kabankalan & Ilog Area in the Ilog-Hilabanagan River Basin, and this Tagoloan Area simultaneously.

The basic target design scale is determined taking the following items into account:

(1) The design flood levels adopted and/or recommended in the DPWH Design Guidelines or in previous and similar flood mitigation projects in Philippines;

(2) The scale of recorded maximum floods; and

(3) The design flood level, which could be realized with appropriate structural and non-structural measures for the study area in due consideration of financial capacity, allowable extent of land acquisition and other restrictions to project implementation.

The DPWH Guidelines specify a 25-year return period flood as the design level for river channel improvement (refer to “Design Guidelines, Criteria and Standards for Public Works and Highways”). In spite of this specification, most flood mitigation projects for large-scale river basins in the Philippines (hereinafter referred to as “Major River Basin”) have employed the design level of 100-year return period as the long-term or framework plan and 25-year return period as urgent or short-term plan in the proposed M/Ps. In 1982 M/P for this Tagoloan River Basin, the flood control plan had been set as 50-year return period flood as Basic Plan and 25-year return period flood as the First Phase Plan.

The recorded maximum flood in the Study Area was determined to be the flood triggered by Typhoon Ruping in 1990, which had the recurrence probability of almost 10~25-year return period as clarified through the hydrological analysis in the this Study. In addition, the stiff and strong dike system on both sides of river channel has partly been constructed by DPWH. The elevation of these dike systems has been set and designed based on the 1990 Flood.

Accordingly, it is concluded that Items (1) and (2) would require the design scale of more than 25-year return period.

In this F/S Study, however, the above design level as precondition is hardly applied due to the particular physical, social and financial constrains of the Study Area such as: (1) it is hardly acceptable to raise the existing concrete-surfaced dike due to these structural condition, (2) it is impossible to reconstruct the new bridge under construction for heightening of the bridge girder and (3) Causes of flood in the Tagoloan are attributed not only to river flood but also to tidal flood.

In due consideration of the particular conditions of the Study Area, the plan for structural components would be examined with assuming the various different options of design level. It is further noted that the following individual plans for the structural flood mitigation components would be separately formulated for the two locations to be protected due to river flood and tidal flood related to optimum design scale based on the particular physical, social and financial constrains of each target area/scale of the components.

(1) Flood Mitigation Plan from River Flood, in particular for low-lying areas affected by river flow, and

(2) Flood Mitigation Plan from tidal flood along coastal areas

The above concepts on the location to be protected and design level applied in the Study could bring out the minimum negative environmental impact and the most economical and affordable structural flood mitigation plan, while they also cause the regional gap in flood safety level, which lead to the regionally different allowable extents of flood inundation. Moreover, adaptation to climate change, of which the adverse effects are seriously concerned worldwide, shall be taken into consideration.

Hence, the stakeholder meetings are indispensable in order to attain the adequate understandings of the stakeholders on the proposed flood mitigation plan and the unavoidable regional gap in the flood safety level. At the same time, the importance of the non-structural components is highlighted in order to minimize such regional gap inflicted by the structural components.

As described in Main Report (Part-A), the delay of the project implementation resulting in the decrease of the benefit of overall project's objectives might be induced due to the delay of the procedure of ROW acquisition and/or opposition from communities as before, unless the consensus of stakeholders is obtained.

6.2 Planning Framework

Planning frameworks will be set up as the bases for plan formulation taking the results of the previous study, the baseline study and basic analysis into account. The objective planning frameworks will include: (1) the target project completion year; (2) the socio-economic framework; and (3) the design frameworks. The details of these items are as described in the following subsections.

6.2.1 Target Project Completion Year

The flood mitigation project contains both structural and non-structural measures. In accordance with the basic concepts on planning of frame works described in previous section 6.1, the extension of dike system toward upstream end and down stream end will be basic measures to completely protect the core areas (municipal proper of Tagoloan) against 25-year return period river flood as urgent flood control plan in the sector loan project. The urgent project consists of mainly river channel improvement works urgently required as the priority project expected to protect vulnerable and the most densely populated and industrial areas in Tagoloan against flood damage by flood control works for 25-year return period flood.

The target completion years for the urgent projects will be finally determined through discussion with the counterpart agencies in accordance with the Implementation Schedule of Sector Loan Project. The structural flood mitigation measures in particular will involve a large volume of work, which will lead to difficulties in completing any priority components by several years. In addition, the schedule of the progress of the conditionality and status of Sector Loan Project should be considered. Based on the clarification, it is proposed that the target year for the priority structural and non-structural flood mitigation plan should be set in 2020.

6.2.2 Social Framework

Tagoloan City has prepared its own land use plans with 2005 as the target year. In this connection, the municipality has being developed the new CLUP. In addition, PHIVIDEC Industrial Estate (PIE-MO) has developed huge industrial parks in/around estuary areas of the Tagoloan River to complete the development till 2020. As for land use condition, the status of existing land use and future land use conditions have been set based on the present land use condition from the recent satellite image for design of river structures and for economic evaluation as described in Chapter 3 and 4. Other further consideration for incrementing ratio of population and development plan shall be considered based on the present and future land use plan prepared by the Municipality of Tagoloan.

6.2.3 Design Framework

The design framework shall include the target design level and its corresponding standard discharge. Of these items, the target design level is expressed in terms of return period, and the standard discharge means probable peak discharge in natural basin runoff conditions without any control by basin hydrological analysis as shown in Chapter 5. .

In this connection, the Study should adopt 25-year return period for basic design level to protect the targeted areas as explained 6.2.1.

The target design scale to be selected for the Tagoloan River Improvement in the Sector Loan Project is determined taking the following thoughts into account:

(1) Basic Flood Peak Discharge of 25-year flood is considered as basic targeted flood mitigation level;

(2) In case the extension of flood dike system will be attributed to the huge social and environmental issues and/or opposition of stakeholders, far lower viable design scales or far more minimum design scale shall be considered based on the status of regional economic, investment conditions, possible areas to be acquired and other restrictions for the implementation of the project; and

(3) The conditions after climate change shall be considered for design of structural measures.

However, flood damage potential with the occurrence of extraordinary floods beyond targeted design flood discharge (25-year return period) is still high since the catchment area of Tagoloan River Basin is huge defined as one of 18-major river basins in the Philippines.

In the view thereof, the design scale for river flood control of the urgent plan is set at 25-year return period flood level as same as the levels in other selected river basins in the Sector Loan Project. In addition, the basic mitigation measures for far higher protection level will be conceived.

Determined framework of Tagoloan River improvement policy and the relevance with the Sector Loan Project are summarized as follows:

Table R 6.2 Summary of Framework of the Mitigation Measures in the Study Areas

Target	Item	Achievement	Countermeasures	Relativeness to Sector Loan
River Flood	Urgent Plan	25-year return period flood	Structural Measures	For core areas, Sector Loan shall implement the suitable and viable scale flood control works (max. 25-year retrun period).
			Non-structural Measures	In/around core areas, suitable and viable mitigation measures shall be designed and assisted by Sector Loan.
		Together with climate change adaptation		
	Framework Plan	50-year return period flood	Structural Measures	No consideration (formulation of plan / approval of M/P)
			Non-structural Measures	No consideration (formulation of plan / approval of M/P)
Tidal Flood	Urgent Plan	Recorded Max. Highest Tidal Level w/o wave height	Structural Measures	No consideration for coastal protection (formulation of plan / approval of M/P)
			Non-structural Measures	In/around core areas, suitable and viable mitigation measures shall be designed and assisted by Sector Loan.
	Framework Plan	w/ Climate Change Consideration	Structural Measures	Basic plan and measures are proposed or confirmed in M/P.
			Non-structural Measures	In/around core areas, suitable and viable mitigation measures shall be designed and assisted by Sector Loan.

CHAPTER 7 STRUCTURAL FLOOD MITIGATION PLAN

The structural flood mitigation plan would include components against river-overflow and inland floods caused by storm rainfall and high tide. These structural plan components against both types of floods are examined in this Chapter based on the results of the flood simulation analysis described in Section 4 of Chapter 5.

7.1 Structural Flood Mitigation Plan against River-Overflow Flood

7.1.1 Maximum Design Scale Examined in the Study

As indicated in Sub-section 6.2.3, the design scale of 25-year return period is provisionally assumed as the maximum design scale to be examined in the Study. In addition to the consideration of 25-year return period as urgent plan, far higher probable flood scale, such as 50-year or 100-year return period floods shall be considered for long-term or achievement of the Master Plan.

7.1.2 Potential Measures

(1) Structural Measures against River Flood

Basic measure to mitigate river flood damage is to extend the existing dike system upstream and downstream since a part of concrete-surfaced flood protection dikes on both sides have been constructed by DPWH Regional Office.

It is judged that a towhead area between separated flows of Tagoloan River should be excavated (acquired) to confine the design flood to allowable elevation below existing dike level as the most suitable idea.

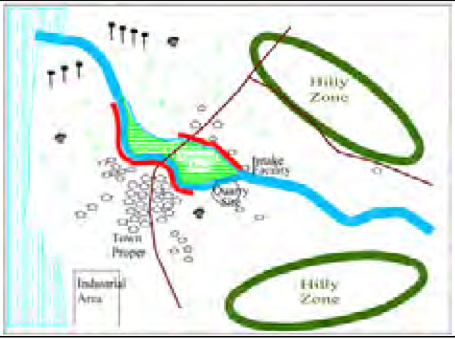


Figure R 7.1 River Flow System and Towhead in the Tagoloan River

According to the field reconnaissance and the interview survey with the residents, the flood overflow of the Tagoloan River has the following particular characteristics:

(a) The biggest flood in the Tagoloan occurred during Typhoon Ruping in 1990. River water level reached on the girder of Old Tagoloan Bridge across the Tagoloan River. The recent flood, in which heavy damages occurred, was experienced in 2001.

(b) On the other hand, inland drainage problems occur in some remaining low-lying areas between diking system and high hinterland, and

(c) Recently, flood issues are not disappeared for low-lying areas along river course and estuary.

Taking the above items into consideration, the following two (2) measures are contemplated as the eligible potential measures against river-overflow flood for the targeted core areas in the Study Area: (1) the Extension of Diking System along Tagoloan River; and (2) the Excavation of Towhead Area. The details of these potential measures are as described below.

(a) Extension of Diking Sytem

The extension of alignment of the flood protection dike is planned to protect low-lying areas in core areas (Municipality of Tagoloan) against 25-year flood. In particular, the areas for PHIVIDEC Industrial Eatate (PIE-MO) being developed are considered for the protection system from river overflow flood.

The raising of the elevation of existing dike crown shall not be considered as explained in Chapter 6 for river improvement plan.

(b) Excavation of Towhead Area

Instead of raising the elevation of dike crown, it is considered to excavate the towhead area located in the river channel for increment of flow capacity of Tagoloan River channel.

In the case far higher protection level is considered in the long-term plan (such as control against 50-year or 100-year flood), the further excavation of towhead will be studied to secure the required river channel dimension.

(2) Mitigation Manner against Tidal Flood

As explained in Sub-section 6.1.3, low-lying areas in Tagoloan are affected not only by river flood but also by tidal flood. In addition, adverse effects due to climate change have largely an impact to the life of the residents who are living in these areas. However, it is very difficult to adopt the structural measures for the tidal flood mitigation in short-term by the following reason:

- Coastal low-lying areas are divided into two (2) areas, one is industrial and others are fishing villages. Under such conditions, there are two manners to construct coastal dike. One is that the coastal dike will be aligned on-shore apart from villages and industrial facilities along shore line. This option will cause the huge construction costs. Another is that the coastal dike will be constructed keeping some distance from the shoreline to reduce the construction cost, but, this option will cause significant environmental and social impacts due to a number of relocation of households and industrial facilities. Neither can be realized in short-term.
- Moreover, coastal dike would hamper current marine navigation system for fisherman and boats of industrial factories.

Therefore, the structural measures coping with tidal flood cannot be applied for the Sector Loan Project but can be adapted in framework plan as follows;

(a) At first, enlightenment activities for publicity of adverse effects on climate change to the residents who are living in the Tagoloan are executed as one of non-structural measures,

(b) Long-term mitigation measures for tidal flood and climate change adaptation are established and reflected to comprehensive land use plan, and

(c) Obligation to raise the land in low-lying areas in development activities and land use control in low-lying areas will be considered.

7.1.3 Alternative Flood Mitigation Plans against River-overflow and Tidal Floods

The current channel improvement, the construction of flood protection dike of the Tagoloan River has protected certain areas, as described in the preceding Subsection 7.1.2. The further channel improvement is considered only as the extension of flood protection dikes. Hence, the alternative of the structural flood mitigation plan against river-overflow is to consider the alignment of flood protection dike and whether it is necessary to excavate towhead area. The combination of alignment of dike and excavation of towhead area is proposed as alternative flood mitigation measures against river-overflow flood.

On the other hand, it is very difficult to deal with tidal flood in short-term due to the following reasons as explained above;

- Coastal area in Tagoloan has already been occupied by industrial firms and fisherman folk residential. Therefore, a number of house relocation activities are required,
- Structural measures will hamper livelihood activities of fisherman folks and cause huge economic loss if industrial firms.

The alternative measures thus proposed are as listed below.

Table R 7.1 Alternative Flood Mitigation Plans against River-Overflow

Alternatives (Flood Scale to be protected)	Extension of Diking System	Widening of River Channel (Excavation of Towhead Area)	Tidal Flood Mitigation
Alt_T-1	●		Consideration in Long Term (Addressing Non-structural Measure in Short-term)
Alt_T-2 25-year return period	●	●	

Note: ● : Adoption in the Alternative

The location and extent of each alternative are shown in Figure 7.1 to 7.2.

7.1.4 Flood Simulation Analysis

(1) Purpose of Analysis

The flood inundation analysis was carried out on several scales of flood, aiming mainly as follows:

(a) To define the probable flood inundation extent, inundation area, inundation depth and inundation duration that could be used as essential information for evaluation of the effect of alternative flood mitigation plans for river overflow.

(b) To estimate flood damage based on the results of hydraulic and land use analyses.

(2) Hydraulic Analysis on Dike Alignment

(a) Alt-T1

DPWH-Region X and PHIVIDEC has planed the extension of diking system to protect right-side bank against river overflow in downstream of exiting dike. The alignment of dike is located along the river to avoid large land acquisition as shown in Figure 7.1. However, as a result of hydraulic analysis, simulated water level has risen higher than present condition due to supercritical flow at just downstream of the delta island as shown in Figure 7.3. The cause of supercritical flow is narrowed water width by river bank in both sides, and it shows that the proposed alignment has to be reexamined.

(b) Alt-T2

Figure 7.2 shows that the proposed alignment is shifted 100 to 200m backward form Alt-T1 to cope with the supercritical flow. The left-side area and upstream area are negatively impacted when the dike is constructed along right-side bank. Therefore, excavation of the delta island is proposed to avert the negative impact.

(3) Simulation Results

As the result of flood inundation analysis, the maximum extent and depth of inundation under the without and with-protection situations are as summarized in the table below. Simulation results are shown in Table 7.1 and Figure 7.4 to 7.5 attached.

Table R 7.2 Flood Inundation Area

	Extent of Inundation Area (km2)					
	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Without Project	4.77	5.31	5.65	6.68	7.17	7.48
Alt-T2 (Dike & Excavation)	3.75	3.94	4.27	5.15	7.17	7.48

7.1.5 Optimum Structural Mitigation Plan (Summary of Simulation Analysis)

The optimum flood mitigation plan was determined through comparison of the alternative schemes not only to control the 25-year return period probable flood in the targeted areas but also not to affect other areas based on the flood simulation analysis described in sub-section 7.1.4. In addition to flood simulation analysis, other considerations have also been evaluated to select the optimum alternative and the summary of comparative study is shown in the table below:

Table R 7.3 Summary of Comparative Study on Alternative Flood Mitigation Plan for the Low-lying Area in Ilog-Hilabangan River Basin

Item	Without Project	Alternative T-1	Alternative T-2
Target Flood	-	25-year	25-year
Concept	No Improvement	Dike alignment follows in line with the existing river bank.	Dike alignment sets so that the flood conditions in unprotected areas do not get worse after the project.
Const. Cost	-	4.0 billion	1.8 billion
Land Acquisition	-	Approx.10ha	Approx. 31ha
House Relocation	-	Approx. 50	Less than 10
Advantage	No. L/A H/R	Industrial area can be utilized at a maximum.	The project will not cause adverse effect to any place except for excavated towhead and alignment on the dike.
Disadvantage	No improve	In river area, water level rises due to confinement of floodwater. Therefore, it is necessary to relocate the peoples who are living in river areas.	Parts of towhead (island) in river should be acquired and excavated to confine the flood water within the present level.
Evaluation	Not recommend	Not recommend	Recommend
	Alternative T-2 is selected as the most suitable Alternative.		

As the results, the following detail description for the facilities and work items to be executed in the Sector Loan was made:

(1) Alignment of Flood Protection Dike and Extent of Excavation of Towhead Area

As shown in Section 7.1.4, the incorrect alignment of dikes confining the flood flow might affect the water stage in upstream stretches. The existing dike system on left bank has sufficiently protected the core areas except for river estuary areas. Therefore, the new flood protection dike on right bank to protect the areas, where the industrialization is expected by Phividec in near future and a number of residents are living in, is proposed. The alignment of dike on right dike is set complying with the results of flood simulation analysis not so as to influence adverse effect on flood water rising in upstream stretches.

In addition, it is necessary to excavate towhead to sustain water level corresponding to existing flood condition.

The alignment of extending dike on right bank and towhead area to be excavated are illustrated in Figure 7.2 and summarized below.

Table R 7.4 Proposed Dike Alignment and Area to be Excavated

Item	Side	Location	Quantity
Construction of Dike			
	Right Bank		
		Downstream from Tagoloan Bridge	L= 2,000 m
		Upstream from Tagoloan Bridge	L= 650 m
Excavation in Towhead			
	Left Side Stream		
		W=50m on average	A=8.8has or V=364,000 m^3

(2) Other Consideration

(a) Drainage Improvement and Set of Drainage Outlet

To improve the drainage condition in built-up area on right bank, drainage channels are set together with drainage sluice passing under the new embankment dike as shown in Figure 7.2 and summarized below.

Table R 7.5 Proposed Drainage Improvement Facilities

Item	Side	Location	Dimension	Quantity
Drainage Channel				
	Right Bank			
		Downstream from Tagoloan Bridge		
			B : 10m	L = 880m
			B : 1.5m	L = 750m
			B : 1.5m	L = 850m
Drainage Sluice				
	Right Bank			
		Downstream from Tagoloan Bridge		
			B x H x n : 3.0 x 3.0m x 2	2 gates
			B x H x n : 1.5 x 1.5m x 1	1 gate
			B x H x n : 1.5 x 1.5m x 1	1 gate

(b) Preservation of Estuary

As explained in flood simulation, vacant area extending over estuary along left bank should be preserved to sustain flood water level. In addition, this area shall be preserved since the several mangroves are flourishing in this area (see Chapter 9 for social and environmental consideration).

Moreover, this estuary area might be excavated and dredged to upgrade the flow capacity for climate change adaptation).

(c) Consideration of Upstream Flood Condition in the Future

Taking into consideration the expansion of development by the Phividec in the right bank along the upstream stretches, it is necessary to secure proper river area to prevent flood from expanding on both banks. In this connection, 250m in width of river area is recommended in terms of the relation between the flow area of river channel and probable flood discharge.

(3) Summary of Project Component

Based on the optimum measures for the structural measures to mitigate flood in the core areas under the Sector Loan Project are summarized in table below.

Table R 7.6 Summary of Proposed Work

Component	Length/area (m/ha)	Height/ Depth (m)	Width (m)	Volume (m3)
Dike(1)_Downstream on Right Bank	2,000 m	2~4m	Crown: 5m	123 thousands
Dike(2)_Upstream on Right Bank	650 m	1~4m	Crown: 5m	71 thousands
Excavation_Towhead Area	8.8 ha	2~4m	50m in width	365 thousands
Total (Embankment)	2,650m	1~4m	Crown: 6m	194 thousands
(Excavation/Dredging)	8.8 ha			365 thousands
Drainage Sluice	1 location	B x H x n = 3.0m x 3.0m x 2		
	2 locations	B x H x n = 1.5m x 1.5m x 1		
Drainage Improvement	880 m	B=10m		
	750 m	B=1.5m		
	850 m	B=1.5m		

7.1.6 Preliminary Design of River Facilities

Based on the results of the study on flood simulation, the optimum consideration and structural measures are proposed in previous sub-section 7.1.5. In this connection, the following structures are preliminarily designed as the proposed structural flood mitigation measures for each alternative in accordance with the design discharge distribution and proposed optimum structural measures as shown in Figure. 7.2. Provisions for the differently-abled and gender-responsive design should preferably be considered for these structures to be designed such as design of railings and steps in Detailed Design Stage.

The basic project flood is against 25-year return period flood and corresponding to 4,000 m^3/s. The elevation and height of the dike to be constructed has been set on envelope line of calculated hydraulic water stage in river channel at design discharge (4,000 m^3/s). The longitudinal profile of the Tagoloan River with design high water level (H.W.L) and other related information is illustrated in Figure 7.6.

The basic design for proposed structures has been made on the basis of the following two standards:

- Design Criteria, Guidelines and Standards by DPWH (DPWH Standards)
- Technical Standard for River and Sabo Facilities (Prepared by the Ministry of Land, Infrastructure, Transport and Tourism)

(1) Flood Protection Dike

(a) Dimension of Dike

The dimension of dike has been set to pass the design discharge safely and the elevation of top of the dike has been obtained by adding a freeboard to the H.W.L. The material of flood protection of dike is basically embankment type to adapt the condition such as climate change and utilization of the crown of the dike as service road except for joint section between existing concrete surfacing dike and new dike section to be constructed.

The standard design section of river dike is shown in Figure 7.7. The dike height is determined by adding 1.5m of a freeboard to the design high water level which is reckoned on the design flood discharge. The freeboard, which is the margin of height to guard against overtopping and wave wash, is given by the design flood discharge.

Top width complying with DPWH Standard should be planned in consideration of dike stabilities and function of road during maintenance operations. Top width is also given by the design flood discharge in accordance with DPWH Standards.

The side slopes on both land side and river side of the dike are designed as 1:2.0 (V:H) from the aspect of dike stability. Berms are provided along the slopes of high dikes surpassing 5~10m in height in terms of the improvement of stability of dikes-self against slope failure as shown in Figure.7.7. .

(b) Slope Protection on Dike

For the protection of dike against slope erosion or scouring, the revetment structure is applied on the slope of river side. In this connection, all slope surfaces on river side shall be protected by the revetment to secure the margin of safety corresponding to the existing dike.

Revetment is designed with the use of wet stone masonry (grouted riprap type) (0.3m of thickness). The standard design section of revetment is shown in Figure 7.8. The base concrete of revetment should be set to prevent sliding failure of wet stone masonry and shall be constructed in the dry condition.

(2) Drainage Sluice and Drainage Channel

As shown in Sub-section 7.1.5, drainage channels are designed in right bank to mitigate inland flood and the drainage sluice passing under the dike shall also be designed to prevent flood of the Tagoloan River water from intruding into protected areas by flood protection dike.

The standard design of sluice gate(s), classified into two types (Type A and Type B) in accordance with the dimension, are shown in Figure 7.9 respectively. Type A, which placed for the outlet of small drainage channels, has one box culvert of 1.5m by 1.5m. Type B, which is placed for natural drainage channel originally flowing into the Tagoloan River on right bank, has two barrels of 3.0m by 3.0m.

Drainage channel, which is provided to drain landside water, is composed of open channel or box culvert type. The dimension of drainage channel to be installed newly is set at 1.5m x 1.5m of box culvert type. On the other hand, natural drainage shall be secure the width of original drainage channel.

These are determined not to change the existing conditions based on the existing drainage channel width and the required dimension shall be modified in the D/D stage subject to the detailed inland drainage hydrological analysis.

(3) Foot Protection of Bridge Pier

The existing towhead area shall be excavated to sustain flood water stage in upstream stretches. In this connection, several bridge piers, in particular bridge piers of old Tagoloan Bridge, are retrofitted by Steel Pipe Sheet Piles (SPSP) as illustrated in Figure 7.10 to secure the stability of piers due to the excavation and dredging around piers.

7.1.7 Construction Plan

(1) Basic Policy of Construction Plan

(a) Scope of Works for Construction of Proposed Structural Plan

Proposed structural component is manly composed of the construction of flood protection dike with appurtenant facilities, such as revetment on embankment dike and drainage sluices. Their works aims to safely flow the design discharge toward sea downstream.

The work items consists of six (6) major facilities; namely excavation work in towhead area, embankment work for construction of flood protection dike, masonry work for revetment, concrete work for revetment, drainage facilities and fabrication/installation of sluice gate and driving work of Steel Pipe Sheet Pile (SPSP) for retrofitting of bridge piers.

These works will ideally be undertaken during 2011-2013 as shown below.

(b) Major Features of Facilities and Construction Procedure/Method

Major requirements for the works are as follows.

- The type of dike proposed is mainly embankment type with masonry protection on river side slope.
- The excavation works in the towhead is one of main works with retrofitting of the piers of the existing bridge to secure flow area.
- Drainage sluice is a box culvert passing under dike with installation of slide gates.

Major part of construction work will be earthwork. Construction procedure/method of earthwork shall be as follows.

- As for embankment works, it is necessary to make sure that the compaction retains the required consistency. Earth fill work should be implemented in accordance with the compaction regulations to maintain such strength against settlement, shearing force and piping.
- In this connection, excavated materials in the towhead area will be used for filling material.
- Earthwork equipments are bulldozers and backhoes for excavation, dump trucks or barges for transport, and tamping rollers for compaction.
- Volume of excavated materials is estimated approximately 370,000m^3. 200,000 m^3 of that is reused for constructing the dam and landscape facilities, etc. The remaining is transported to the dumping site, graded and compacted.

(c) Disposal and Dumping Sites

According to the discussion about disposal/dumping site/method with Phividec, following issues have been developed.

- Land developments for the industrialization projects under the Phividec are actively carried out in the Municipality of Tagoloan. However, shortage of embankment/filling material and high material price are the issues.
- It is expected that surplus soil of construction work of the excavation and embankment would be welcomed by those land development. If excavated

soil is offered to land developers without any charge, they would utilize it as their embankment/filling material, and then disposal cost of surplus soil would not be included in the project cost.

- According to the land use plan established by the Phividec and municipal government, the areas around project sites are mostly categorized into industrial area.

Taking conditions described above into consideration, disposal plan of surplus excavated soil in this project shall be as follows.

- Some amount of excavated soil shall be carried into the construction of embankment dike, since the construction of flood protection dike will be carried out at the same time. Average hailing distance shall be about 2km in this case.
- On condition that surplus excavated soil would be utilized as embankment/filling material for land development, disposal cost consists of loading, hauling (average distance = 5km), unloading and spreading works in this cost estimation.

Location map of disposal and dumping sites is shown in Figure 7.11 attached.

(2) Basic Condition of Construction Schedule

The construction schedules to be prepared are based on the scope of works defined above with the working quantities for the each work item through the feasibility study. Each of the scheduled activities contains labor to be assigned and equipment resources considered with the most appropriate method to the particular site conditions and requirement of the work.

In F/S study, unit construction schedules for each work item has been analyzed and fixed in this section hereinafter.

(a) Work Quantity of Major Construction Work Items

The major construction work items are divided into following five (5) main work items: (1) Earth Works (i.e. Excavation and Embankment), (2) Construction of Drainage Ditch (i.e. concrete work), (3) Construction of drainage sluices (i.e. concrete work and gate installation), (4) Revetment Works (i.e. masonry and concrete works), and (5) Bridge Pier Retrofit Works (i.e. steel pipe sheet pile work). The work items and their work volumes are as listed below:

Table R 7.7 Major Construction Works

Tagoloan Project *Major* Work Description		Quantity	Unit
Earth Work			
	Clearing and Grubbing	222,750	m^2
	Removal and Stripping of Topsoil	80,000	m^2
	Excavation, Open Cut -1	186,000	m^3
	Excavation and Loading -1	178,000	m^3
	Dike Embankment	194,000	m^3
	Grass Sodding	39,000	m^2
Drainage Ditch (BxH=0.3m x 0.3m)			
	Concrete Work for Small Structure-2	477	m^3
	Concrete Work for Leveling Concrete-2	212	m^3
Drainage Sluice			
	Concrete Work for Reinforced Concrete-1	846	m^3
	Concrete Work for Leveling Concrete-2	37	m^3
	Formwork F1 (for Large Sized Structure)	1,843	m^2
	Installation of 1.5x1.5m Slide Gate	2	nos
	Installation of 3.0x3.0m Slide Gate	2	nos
	Steel Sheet Pile Type II	380	m^2
	Reinforcing Bar (Grade 60)	85	ton
Drainage Channel			
	Excavation and Loading by Backhoe (0.63 cu.m.)	38,968	m^3
	Backfill, about Structures and Services (with Excavated Material)	28,749	m^3
	Hauling - 5 km, Loaded by Backhoe (0.63 cu.m.)	10,219	m^3
	Concrete Work for Small Concrete, Class-C, Concrete Pump Placing	5,812	m^3
	Concrete Work for Leveling Concrete, Class-F, Manpower Placing	843	m^3
	Reinforcing Bar (Grade 60)	465	ton
Revetment Works			
	Stone Masonry/Wet Stone Masonry-1	37,000	m^2
	Gravel Bedding and Backfill	5,550	m^3
	Concrete Work for Small Structure-2	1,427	m^3
	Reinforcing Bar (Grade 60)	114	ton
Bridge Retrofit			
	SPSP Fabrication	371	kg
	SPSP Driving	1,272	m^2

(b) Climate Condition

The characteristic of climate at the project area is dominated by the rainy season from May to October and dry season for the rest of the months. The total rainfall from May to October accounts for about 80% of the annual rainfall.

(c) Available Working Time

In determining the number of working days available for construction activities, the following factors are considered:

- Working day per week, Working hours per day
- Public Holiday
- Rainfall
- Type of Construction Activity

(i) Working Day per Week, Working Hours per Day

The normal workweek consisting of six (6) working days is adopted for developing all calendars in the sure track program. All construction schedules are based on an 8-hour per a working day.

(ii) Public Holiday

The following days are excluded from the working calendars as public holidays:

Holiday	Date
New Year’s Day	January 1
Maundy Thursday	On day in March / April
Good Friday	On day in March / April
Labor Day	May 1
Independence Day	June 12
National Heroes Day	August 30
All Souls Day	November 1
Bonifasio Day	November 30
Christmas Day	December 25
Rizal Day	December 30
Special Holiday	December 31
Sub-total of Public Holiday	11 days

In addition, an allowance is made for four (4) extra days that may be declared non-working by government on account of special events. Thus, total number of non-working days accounts for 15 days in this study.

(iii) Daily Rainfall and Annual Working Day

The time lost due to rainfall was based from the rainfall data and the number of rainy days. It is recognized that the effect of rain on different types of construction activities will vary.

Based on the previous construction plans under JICA or JBIC projects, the total number of working days available annually for different activities is established by incorporating all assessed time losses into the eight (8) items shown in the following table:

Table R 7.8 Annual Working Day for Major Work Items

Work Item	Sunday	Public Holiday	Rainy at Weekday	Suspension Day	Annual Working day
Structural Excavation	52	15	51	12	235
Gabion Works	52	15	51	12	235
Embankment /Backfill	52	15	51	12	235
Concrete Work	52	15	51	-	247
Revetment Work	52	15	51	-	247
Grading Works	52	15	51	-	247
Canal Facility Work	52	15	51	12	235
Road Work	52	15	51	12	235

(d) Works Productivity

Major equipment items were selected based on the equipment capacity quoted from the publication of the Association of Construction and Equipment Lessors, Inc. (Equipment Guidebook 2001, edition 22, ACEL). Labor requirement were assessed using a mix of productivity rates provided through the current practice and the rates recorded on similar overseas projects.

(i) Earth Works

The performance of the construction machine is assumed as listed in the flowing table taking the most suitable machine combination and the reuse of the excavation soil.

Based on the performance of the construction machine, the construction period of earthwork was estimated. Due to huge volume of earth work, critical paths are attributed to the construction schedule of earth work for each retarding basin.

Table R 7.9 Performance of Construction Machines in Earth Work

Item of Earth Work	Major Equipment	Performance Capacity	Remarks
Common Excavation	Bulldozer (32t)	146 m^3/hr	
Loading	Backhoe (1.0m^3)	104 m^3/hr	
Hauling	Dump Track (10t)	30.8 m^3/hr	Distance: 0.5 km.
	Dump Track (10t)	8.0 m^3/hr	Distance: 8 km.
	Dump Track (10t)	6.7 m^3/hr	Distance: 12 km.
Grading & Compaction	Bulldozer (21ft)	100 m^3/hr	Disposal site, Road work
Compaction of Embankment	Tamping Roller	55 m^3/hr	Road Work

(ii) Concrete Work and Revetment Work

Concrete works and revetment (masonry) works are also main construction works other than earth work. The construction period of concrete of the small structure and placing work of masonry are estimated on the basis of the following assumptions:

Table R 7.10 Performance of Main Construction Work

Item of Work	Daily Capacity	Remarks
Concrete Work	60 m^3/day/party	Depending on Concrete Pump
Gabion Work	75 m^3/day/party	t=500 mm, Equivalent to 37 m^3/day/party
Revetment Work (1:2.0)	38 m^3/day/party	Wet Stone Masonry
Revetment Work (1:2.0)	13 m^3/day/party	Concrete Block

(3) Construction Schedule

In accordance with the program and strategy mentioned above, the entire construction period for the major work components of the optimum structural plan was assumed as shown in the following table.

Table R 7.11 Entire Construction Schedule for Tagoloan River Improvement Project

Working Item	Unit	Q'ty
Mobilization & Preparatory Work	L.S.	1
Earth Work		
Clearing & Grubbing / Stripping of Top Soil	m^2	222,750
Excavation	m^3	364,000
Embankment	m^3	194,000
Disposal of Soil	m^3	186,000
Drainage Improvement		
Concrete	m^3	5,812
Leveling Concrete	m^3	843
Form Work for Concrete	m^2	10,304
Form Work for Leveling Concrete	m^2	496
Drainage Ditch (BxH=0.3m x 0.3m)		
Concrete (for Small Structure)	m^3	477
Leveling Concrete	m^3	212
Form Work for Concrete	m^2	3,975
Form Work for Leveling Concrete	m^2	530
Drainage Sluice		
Reinforced Concrete, Staging, Supporting	m^3	846
Leveling Concrete	m^3	37
Formwork for Concrete	m^2	1,843
Formwork for Leveling Concrete	m^2	29
Supporting	m^3	1,179
Furnishing and Installation of Slide Gate	pcs	4
SSP	m^2	380
Re-Bar	ton	85
Revetment (1:3.0 – 1:2.0)		
Wet Stone Masonry (t=200mm)	m^2	37,000
Gravel Bedding	m^3	5,550
Concrete (Small Structure)	m^3	1,427
FormWork for Concrete	m^2	6,938
Re-Bar	ton	114
Retrofitting of Bridge Piers		
SPSP	m^2	1,272
Others		
Grass Sodding	m^2	39,000
Other Ancillary Works	L.S.	1
Site Clearance / Cleaning	L.S.	1
Demoblization	L.S.	1
Commpletion		

7.1.8 Cost Estimation

(1) Constitution and Conditions of Project Cost

Project cost has been estimated under the following conditions:

(a) Construction Base Cost

Construction base cost is composed of direct cost estimated based on the work quantities multiplied by unit cost, and indirect cost which is estimated in percentage.

(b) Price Level

Price level is as of August 2009.

(c) Contingencies

Price escalation and physical contingencies are assumed as follows:

Annual Price Escalation: 5.20% for Local Currency Portion; 2.10% for Foreign Currency Portion

Physical Contingency : 10% of the sum of construction base cost, compensation cost and engineering service cost

(d) Currency Conversion Rate

Currency conversion rates are assumed at USD1.00 = JPY93.67 = PHP49.70 as of the end of August 2009.

(e) Compensation Cost

Compensation cost consists of the costs of house evacuation and land acquisition. These costs are estimated on the basis of actual market value obtained from the Interview Survey in Tagoloan of land and properties assessed for taxation purposes in the locality and the actual cost of past or ongoing house evacuation activities, as well as the ongoing projects of similar nature under JBIC and DPWH such as the Iloilo Flood Control Project and the Pasig-Marikina River Channel Improvement Project (River-Overflow Flood Mitigation Projects).

The compensation unit costs are enumerated below.

Table R 7.12 Adopted Compensation Cost for F/S Study

Item of Cost	Site/Condition	Unit Cost Php/m2 for Land , Php/(house/family) for House		
		Zonal Value	Market Price *2	Adopted Price
Land Acquisition	Right Bank (Down)	50~200	350	None *1
	Right Bank (Up)	50~200	350	350
	Estuary	50~200	350	None *1
	Towhead	50~200	350	350
House Relocation	Formal Residents	-	-	350,000
	Informal Dwellers	-	-	50,000
Support Activities	All Concerned Families	-	-	50,000

Note *1 : Land Property Right is under Phividec.
*2 : Results of hearing survey with Officers concerned based on in-real land sale.

(f) Administration Cost

Administration Cost (Project Owner's Expense for management) of the Project is estimated at 5% of the total sum of construction cost and compensation cost.

(g) Engineering Service Cost

Engineering service cost is prepared for the detailed engineering design and construction supervision services at 6% and 10% respectively of construction base cost.

(h) Tax, etc.

12% of the sum of construction base cost and engineering service cost is added to project cost for VAT, etc.

(i) Constitution of Project Cost

Based on conditions described above, the constitution of the project cost is given a below:

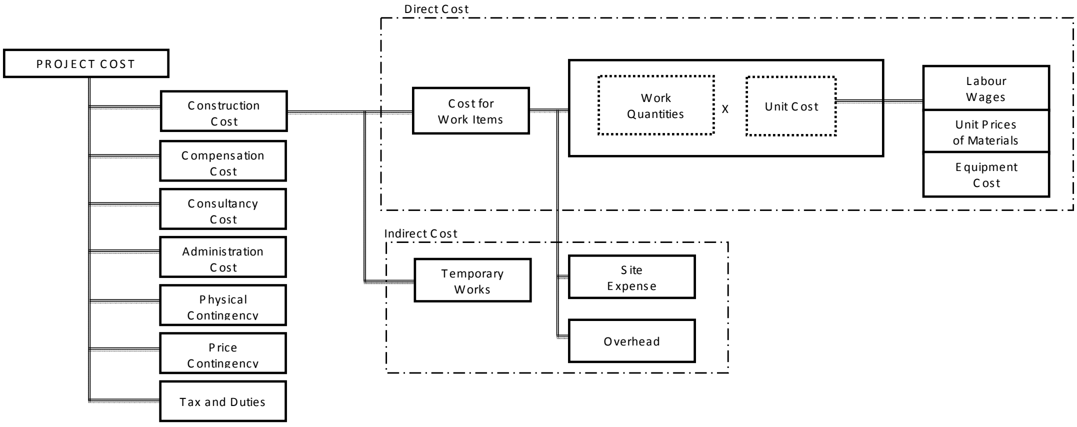


Figure R 7.2 Constitution of Project Cost

(2) Construction Base Cost

The construction base cost is estimated as the sum of the direct cost and the indirect cost.

(a) Direct Cost

The estimate for direct costs is performed based on the quantities of all construction tasks shown on figures and described in the project requirements. The direct cost includes all of countable element due to the type, size, design, construction procedures and quality of the intended structure, which are taken into account when deriving the cost for each work item. The costs are estimated on the unit cost basis as shown below:

Direct Cost = ∑ (Unit Cost for a Payment Item x Work Quantity for a Payment Item). The unit cost can be estimated based on the basic costs such as labor wage, unit prices of materials and equipment cost.

In direct cost, “Overhead & Profit” shall be included. “Overhead” is the expense for the main and branch office support of the Contractor composed of director’s remuneration, retirement allowances, communication fee, advertising, research activities, social expense, profit and insurance. “Profit” is the profit of the contractor. 16 % of the sum of the direct cost, “Overhead & Profit” is adopted.

(b) Indirect Cost

The indirect cost on the project is an integral part of each estimate. “Temporary works”, “Site expense” and “Mobilization & Demobilization” are considered as the indirect cost.

"Temporary works" includes items such as temporary buildings, electrical facilities, water supply system, access road construction and maintenance, and temporary utilities. 10 % of the sum of the direct cost is adopted.

"Site expense" includes the cost items such as salary and allowance of the Contractor's employee, job office expenses, consumables, small tools and insurance at site. 5 % of the cost for the direct cost and "Temporary works" is adopted.

"Mobilization & Demobilization" includes the costs such as the movement of the contractor's equipment, facilities and man powers at the commencement and retreat of the Project. 1 % of the cost for the direct cost and "Temporary works" is adopted.

(3) Project Cost

Based on the above assumptions, the project cost estimated for the optimum structural flood mitigation plan is estimated at Php. 644 million in total, which is divided into (1) Php. 375 million for the construction base cost, (2) Php. 72 million for the compensation cost and (3) Php. 60 million for the consultancy service, (4) Php. 19 million for the administration cost, (5) Php. 116 million for the contingencies and (6) Php. 65 million for the value added tax, etc. The breakdown of the project cost is given in Tables 7.2 to 7.4, and as tabulated below:

Table R 7.13 Project Cost for the Proposed Structural Flood Mitigation Measures

Objective	Item	Description	Cost (mil. P)
Tagoloan River Improvement Project			
	Construction Base Cost	Civil	375
	Compensation Cost	House/Support	2
		Land	70
	Consultancy Services	D/D & S/V	60
	Administration	5% of Civil& Compensation	19
	Subtotal		463
	Contingencies	Physical for Civil, D/D & S/V	43
		Physical for Compensation	1
		Price for Civil, D/D & S/V	67
		Price for Comp. & Admin.	5
	Value Added Tax, etc	12% of Civil & Consultancy	65
Grand Total			644

(4) Operation and Maintenance Cost

The operation and maintenance cost mainly consist of costs for Patrol/Inspection Work, Maintenance Work and Operation Work. These costs include facility maintenance cost, cost for the administrative and logistic support, cost for operation cost in case of flooding, cost for repair of the structures, and other miscellaneous expenses but exclusive for heavy damage due to calamities, such as seismic forces and huge flood.

The annual operation and maintenance cost is estimated at Php 2.60 million upon completion of the three retarding basin as listed in the table below.

Table R 7.14 Project Cost for the Proposed Structural Flood Mitigation Measures

Work Item	Annual Cost (mil. P)	Remarks
Patrol/Inspection	0.05	Inspection & Preventive
Maintenance	2.50	Annual Repair
Operation	0.05	During Flood (Mean Annual Amount)
Total	2.60	

Details of operation and maintenance cost for the structural plan are given in Table 7.5. The necessary annual budget proposed should be assured from both budgets of DPWH, Province and LGU with approval and concurrence of FMC or similar mandatory committee for flood mitigation activities.

7.2 Economic Evaluation of Project

7.2.1 Methodology

Taking NEDA policy into consideration, economic evaluation is made according to the following steps in this kind of project:

1) Identify the most likely damage item.
2) Estimate the basic unit value per unit and/or unit area (amount/unit, or amount/ha) for each damage item.
3) Evaluate the damages of existing floods to be the basis of evaluation.
4) Estimate the annual average flood damages by means of probability analysis for each return period under the "With-" and "Without-Project" concept.
5) Identify the economic benefit as differences of damages in the "With-" and "Without-Project" conditions.
6) Compare the economic benefit with the economic cost of project, and evaluate project feasibility by means of some indices such as the economic internal rate of return (EIRR), the net present value (B – C), and the B/C Ratio.

The Economic Internal Rate of Return (EIRR) is calculated using the cash flow of economic cost and economic benefit during the project life. This EIRR is defined by the following formula:

$$\sum_{t=1}^{t=T} \frac{C_t}{(1+R_e)^t} = \sum_{t=1}^{t=T} \frac{B_t}{(1+R_e)^t}$$

Where, T = the last year of the project life;

Ct = an annual economic cost flow of the project under study in year t;

Bt = annual benefit flow derived from the project in year t; and

Re = the EIRR (a discount rate to be used for costs resulting in the same amount of benefit in terms of present value).

When the resulting EIRR is of the same rate as or higher than the discount rate applied for the calculation of present value of both the benefit and cost, the project has the feasibility for execution.

The NPV is expressed as "B-C" and defined by the following formula:

$$NPV = B - C = \sum_{t=1}^{t=T} \frac{B_t}{(1+R_e)^t} - \sum_{t=1}^{t=T} \frac{C_t}{(1+R_e)^t}$$

If "B-C" (subtract present value of cost from present value of the benefit) would become positive, it means that the project under the Study will have a reliability to execute.

The B/C Ratio is defined by the following formula:

$$B/C = \left. \sum_{t=1}^{t=T} \frac{B_t}{(1+R_e)^t} \middle/ \sum_{t=1}^{t=T} \frac{C_t}{(1+R_e)^t} \right.$$

It means that, if the rate of the present value of the benefit divided by the present value of the cost would become more than "1.00", then the project under study will have a reliability to execute.

Project life is assumed at 50 years after completion of river channel improvement works and 30 years after completion of inland drainage works for the Project. Cash flow of the economic cost and economic benefit should be made from the first year of the construction works to the end of each project life.

In this case, annual operation and maintenance cost (O&M Cost) should be taken into account, and some amount of replacement cost, if any, should also be taken into consideration since some parts of the initial works for the facilities may not be durable during the project life.

7.2.2 Basic Unit for Estimation of Economic Benefit

(1) Damages to Buildings, Household Effects, Durable Assets and Inventory Stocks in Built-Up Area

First of all, the number of buildings is counted by City Profile according to the type of building, i.e., (1) Residential/Housing units; (2) Manufacturing; (3) Wholesale and Retail Trade (Shops); (4) Hotels and Restaurants; (5) Real Estate and Business Activities (Offices); (6) Education Facilities; and (7) Buildings for Health and Social Works, because property values vary according to the type of building. In this case, the share rate of each type of building to the total number of buildings is assumed in the Study.

The following table shows the share rates of each type of building per unit area:

Table R 7.15 Share Rate of Buildings by Type

Kind of Building	Share Rate
Total	100.00%
1. Housing Units	96.53%
2. Manufacturing	0.12%
3. Wholesale & Retail Trade	1.50%
4. Hotels & Restaurants	0.61%
5. Real Estate & Offices	0.27%
6. Education Facilities	0.72%
7. Health/Medical Facilities	0.25%

Source: Tagoloan Municipality

As basic units for the estimation of damages, the figures shown in the following table are to be applied. These figures are based on the said similar projects in the Philippines modified by the magnitude of buildings, the ratio of gross regional domestic product (GRDP), results of site investigation and interview with the officials concerned municipality of Tagoloan.

Table R 7.16 Economic Basic Units for the Estimation of Flood Damage

(Unit: Pesos/unit)

Assets	Building (*1) (Pesos/ unit)	Durable Assets (Pesos/unit)	H. Effects/ Inv. Stock (Pesos/unit)	Value Added (*2) (Pesos/day)	Damageable Value (Pesos/ha)	Daily Amount (*3) (Pesos/day)
1. Residence						
a. Residential Unit	178,893		120,172			1,186
2. Industrial, Educational and Medical Facilities						
a. Manufacturing	2,510,550	8,608,934	4,324,405	20,576		
b. Wholesale & Retail Trade	987,105	2,407,150	12,113,741	7,160		
c. Hotels & Restaurants	1,203,615	729	38,221	5,529		
d. Real Estate & Business Activities	1,026,165	698	225,229	27,335		
e. Education	1,584,600	380,304	19,595	0		
f. Health & Social Work	2,052,330	529,634	127,350	0		
3. Crop Production						
a. Palay					58,864	
b. Corn						
c. Sugarcane						

Note: *1: Per square meter cost is derived using 1st quarter 2009 index of construction cost of NSO, formula used based on NEDA guidelines

*2: VA is calculated based on not actual business days of 250 days but 365 calendar days.

*3: In residence, the daily amount for cleaning damaged house is equivalent to daily income of an average family because they should stop working for cleaning.

Furthermore, the following table shows the damage rates for the estimation of damages according to inundation depth. In this case, inundation duration is already taken into consideration assuming it to be 2 days on average for agricultural crops.

Table R 7.17 Damage Rate by Inundation Depth

Item			Inundation Depth					
			Below Floor/Ground Level	Over Floor/Ground Level				
				Less than 0.5m	0.5-0.9m	1.0-1.9m	2.0-2.9m	More than 3.0m
1	Building							
	a	Building*[1]	0.000	0.092	0.119	0.266	0.380	0.834
2	Residence							
	a.	Household Effects	0.000	0.145	0.326	0.508	0.928	0.991
3	Industrial, Educational and Medical Facilities							
	a.	Depreciable Assets	-	0.232	0.453	0.789	0.966	0.995
	b.	Inventory Stock	-	0.128	0.267	0.586	0.897	0.982
4	Crop Production *[2]							
	a.	Lowland Crop	-	0.210	0.240	0.370	0.370	0.370
	b.	Upland Crop	-	0.200	0.310	0.440	0.440	0.440

Note: *1 In case of all buildings, floor level is 15cm higher than the ground level, because t almost all buildings have the threshold of around 15cm in height in front of their entrances according to the field investigation.
*2 Assuming that inundation duration is 2 days on average.

(2) Income Losses due to Cleaning of Building and/or Houses and Business Suspension

Once flood occurs and houses are inundated, several days will be needed for cleaning the houses. In case of business activities, they should be suspended for several days. During these days, people's income is decreased because they stop working or businesses are suspended.

Average daily income per household (HH) is estimated at 1,186 pesos/day as of 2009 (estimated based on CPI) in Region X (Northern Mindanao Region) according to the "Philippine Yearbook 2008" and as shown in Table R 7.15 above together with the average daily amount of value added tax for business activities. The average number of days needed for cleaning and business suspension are estimated, as shown in the following table.

Table R 7.18 Estimated Days for Cleaning and Business Suspension by Inundation Depth

Item		Inundation Depth					
		Below Floor Level	Above Floor Level				
			Less than 0.5m	0.5-0.99m	1.0-1.99m	2.0-2.99m	More than 3.0m
1.	Residence						
	Cleaning (days)	-	7.5	13.3	26.1	42.4	50.1
2.	Business Facilities						
	Suspension of Business (days)	-	4.4	6.3	10.3	16.8	22.6
	Stagnant Days of Business after Suspension*[1]		2.2	3.2	5.2	8.4	11.3
	Total		6.6	9.5	15.5	25.2	33.9

Note: *1 Businesses shall be suspended during the stagnant days.

(3) Damage to Industrial Estates

There are several large industries besides a small and medium-sized manufacturing. Damages due to floods also extend over these industrial areas. The damages are estimated as the statistical decrease in "value added" corporate income and the amount of value added income which is estimated for small scale and micro scale industries in the built-up areas. The following table gives a summary of the basic unit for estimation of damages. In this case, the industrial area is estimated by means of GIS.

Table R 7.19 Basic Unit for the Estimation of Damages to Industrial Estates

Unit Value Added of All Commercial Sectors in Built-Up Area (Pesos/ha./day)	Unit Value Added in Large-Scale Industries in Industrial Estate (Pesos/ha./day)
1,512 Pesos/ha./day (*1)	278,231 Pesos/ha./day (*2)

Remarks: (*1) [Unit value added of all commercial sectors in built-up area]
= [60,600 Pesos/day/unit (total of "value added" of all commercial sectors, 2.a~d in Table R 7.16)]
x [0.2196 unit/ha (total number of unit of all commercial sectors per area, b~e in Table R 7.15)]
(*2) [Unit value added in large-scale industries in industrial estate]
= [1,512 Pesos/ha./day (Unit value added of all commercial sectors in built-up area)]
x [184 = (value added of industries in industrial estate) / (value added of small/micro scale industries in built-up area)] (*3)

Source: (*3) 2008 Annual Survey of Philippine Business and Industry (by NCSO)

(4) Damage to Agricultural Crops

It is assumed that the damaged agricultural crops in irrigated areas are mainly "palay" based on statistical records and the results of field investigation, while the damaged upland crops are mainly corn.

Farm gate prices of palay are mentioned in Table R 7.14 as 58,864 pesos/ha estimated in the table below, and their damage rates are already indicated according to inundation depth in Table R 7.15.

Table R 7.20 Damageable unit price of Agriculture

	Crop Production	Area Harvested	Crop Yield	Farmgate Prices	
	(metric tons)	(ha)	(kg/ha)	(Pesos/kg)	(Pesos/ha)
Irrigated Palay	26,034	6,154	4,230		
Rainfed Palay	1,408	466	3,021		
Palay Total	27,442	6,620	4,145	14.20	58,864
Corn	95,296	53,877	1,769		
Sugarcane	0	0			
Coconut	512,279	102,618	4,992		
Banana	159,171	16,067	9,907		

Source: Bureau of Agricultural statistics website, (www.bas.gov.ph)
*: Total in Misamis Occidental Province

(5) Damage to Social Infrastructures (Roads, Bridges, Drainage Ditches)

Once flood occurs, social infrastructures such as roads, bridges, drainages sustain heavy damages. This is the other kind of damage to be checked. According to some previous flood control projects in the Philippines, the damage of social infrastructures is approximately 10% of direct damage. Therefore, the damage is assumed to be 10% of total amount of item (1) to (4) above in this Study.

(6) Damage to Fishery

It is assumed that once a flood occurs, the whole fishpond production will be damaged. Fishpond area is located at the downstream and the damage will not change between under without project condition and with project condition. Moreover, the benefit for project evaluation is estimated from the assumption of the damage with project and without project. Therefore, the fishery damage is not estimated in this study.

(7) Other Indirect Damages

Following items can be considered as indirect damage.

- Losses due to interruption of transport service and/or detour losses,
- Saving of expenses for the support of evacuees,
- Losses due to interference of supply from lifeline facility such as water, gas and electricity,
- Medical expenses (medical cost and/or fees for some of waterborne diseases may be people's burden), and
- etc.

However, further basic data such as traffic volume, estimation of evacuees including food, water, medicines, tents, blankets, dishes, etc are required for the estimation of above indirect damage requires.

In a previous flood control project report in the Philippines, indirect damage is approximately 10% to 30% of direct damage. Then, it is assumed to be 20% of the above total amount of item (1) to (4) as indirect damages in this Study.

7.2.3 Identification of Economic Benefit

The economic benefit is given as the difference between annual average damages in cases of "with project" and "without project," i.e., the economic benefit is to be the value of "average expected damage to be mitigated". For this purpose, annual average damages "with project" and "without project" should be estimated and the target year is set at the year 2020. In this connection, therefore, the said annual average damage is estimated in both cases of "2009 Land Use Status" (hereinafter referred to as "Present") and "2020 Land Use Status" (hereinafter referred to as "Future").

(1) Estimation of Flood Damage

The following table shows a summary of the total damage caused by each probable flood on each damage item mentioned above Sector 7.2.2. Detail estimation sheet is tabulated in Table 7.6.

Table R 7.21 Estimated Damage

(Million Pesos)	Without Project		With Project	
Return Period	Present	Future	Present	Future
2-year	515	1,262	413	1,096
5-year	595	1,451	595	1,227
10-year	672	1,603	672	1,307
25-year	763	1,761	763	1,480
50-year	894	1,986	894	1,986
100-year	1,145	2,339	1,145	2,339

(2) Estimation of Annual Average Expected Damage to be mitigated

The annual damage caused by each scale of flood and the annual damage to be mitigated by the river channel improvement at each scale of flood are estimated as shown in Table 7.7. The following table gives a summary of the results of estimation for annual average expected damages to be mitigated due to execution of measures in each flood scale.

Table R 7.22 Annual Average Expected Damage to be mitigated

(Million Pesos)

Return Period	Present	Future
2-year	32	41
5-year	76	100
10-year	95	126
25-year	109	143
50-year	111	146
100-year	111	146

If the project is executed, these figures will be the economic benefit in each project scale corresponding to flood return period.

In the future, namely in 2020, the land use status will have changed as projected by the CLUP, and urbanization will have increased. In case none of the measures for the mitigation of flood damage as indicated in the above table has been executed, flood damage will greatly exceed the damage under the present land use status. In this connection, the flood control measures should be executed to keep with the changes under the future land use status.

7.2.4 Estimation of Economic Cost

(1) Standard Conversion Factor (SCF)

The Standard Conversion Factor (SCF) has been estimated as 0.97166 based on the international trade statistics, as shown in the table below.

Here, SCF is calculated by the following formula.

$$SCF = \frac{\sum I + \sum E}{(\sum I + \sum I_{customs}) + (\sum E - \sum E_{tax} + \sum E_{subsidy})}$$

Where,

SCF	=	Standard Conversion Factor
I	=	Import Amount
E	=	Export Amount
Icustoms	=	Import Duties (Custom Duties)
Etax	=	Export Tax
Esubsidy	=	Export Subsidy

The following table shows the calculation of the Standard Conversion Factor (SCF).

Table R 7.23 Calculation of Standard Conversion Factor

(million Pesos)

Year	Export in Mil Pesos	Import in Mil Pesos	Import Duties (Customs Duties)	Export Tax	Export Subsidies
2002	1,803,362	2,045,007	96,835	0	0
2003	1,948,514	2,214,951	100,694	0	0
2004	2,215,363	2,501,868	122,715	0	0
2005	2,255,393	2,637,873	151,474	0	0
2006	2,414,597	2,680,841	190,797	0	0
Total	10,637,231	12,080,540	662,515	0	0
				SCF =	0.97166

Source: Philippine Year Book 2008 and NSO website

(2) Personal Income Tax

Usually, project cost consists of cost for equipment and materials, and cost for manpower as personnel expenses and labor cost. For the cost of manpower, personal income tax is one of the transfer items. Therefore, the amount of personal income tax should be deducted from the project cost. Of course, personal income tax may consist of several levels in percentage. In this Project, the rate of 5% is applied for labor and 12% for consulting (engineering) services as the minimum rates according to the Tax Code of the Philippines.

(3) Shadow Wage Rate

Based on similar projects in the Philippines, the shadow wage rate of 0.60 is applied to unskilled labor employed for the Project.

(4) Shadow Price of Land

Also based on the said similar project in the Philippines, the rate of 0.50 is applied as the conversion factor for making clear the shadow price of land needed to be acquired for the Project.

(5) Taxes

All kinds of taxes are transfer items. Therefore, the taxes, if any, should be deducted from the financial cost for the conversion into economic cost. In the Project, the value added tax (VAT) of 12% is applied according to the said Tax Code of the Philippines.

(6) Corporate Profit Tax

In the Philippines, the net profit of corporations as contractors is estimated as 10% to 20% or more of the contract price. In this Project, the net profit is assumed at 15% as the reasonable level.

Corporate income tax is levied against the said net profit, and this corporate income tax is also one of the transfer items. Therefore, this tax should be deducted from the financial cost of the Project. There should be several levels of rates of the corporate income tax, but for the Project, 32% is applied based on the said Tax Code of the Philippines.

(7) Economic Cost

Under the conditions and assumptions, the economic cost is converted from the financial cost, as shown in Table R7.22 below. Details of the Financial Cost are as described in the preceding subsection.

Table R 7.24 Economic Cost for the Proposed Structural Measures

Item	Financial Cost (million Pesos)	Economic Cost (million Pesos)
Construction Base Cost with Physical Contingency	483	422
Compensation Cost with Physical Contingency	34	31
Administration Cost	24	22
Engineering Service Cost with Physical Contingency	77	70
Price Contingencies for All	87	-
Value Added Tax, etc	77	-
Total	781	546
O&M Cost	3	2

7.2.5 Results of Economic Evaluation for the Project and Conclusion

(1) Estimation of NPV, EIRR and B/S

The economic evaluation for the Project has been made by using a cash stream as indicated in Table 7.8 taking certain conditions and assumption into account. In this case, project life is set at 50 years after completion of the works for river channel improvement. The evaluation process is shown in the attached Table 7.9. The following table shows the results of the economic evaluation.

Table R 7.25 Economic Evaluation Results

Indices	
NPV (million Pesos)	129
EIRR	19.48%
B/C	1.36

As indicated in the above-said table, the Tagoloan River Flood Control Project is viable for execution without any problem based on the Economic Internal Rate of Return (EIRR).

(2) Sensitivity Analysis

According to NEDA guidelines, sensitivity analysis shall be carried out using the following scenarios:

Case I : Increase in projected costs by 10% or 20%
Case II : Decrease in revenues by 10% and 20%
Case III : Combination of Cases I and II

From the point of views, the sensitivity analysis was made. The results of the analysis are as summarized below:

Table R 7.26 Result of Sensitivity Aalysis

	Case I		Case II		Case III			
Cost	+10%	+20%			+10%		+20%	
Benefit			-10%	-20%	-10%	-20%	-10%	-20%
NPV	93	56	80	31	43	-6	7	-42
EIRR	17.97%	16.68%	17.82%	16.10%	16.41%	14.81%	15.21%	13.71%
B/C	1.23	1.13	1.22	1.08	1.11	0.99	1.02	0.90

As listed above, EIRR fell below 15% under the condition of Benefit -20% and Cost +10% or +20%. In another words, the economic viability of the project could not be verified under these pessimistic cases.

CHAPTER 8 NON-STRUCTURAL FLOOD MITIGATION PLAN

8.1 Overview of Eligible Measures

In 1976, PD 1566 was enforced to pursue pre-disaster planning, community disaster preparedness and positive, precise disaster control action for rescue evacuation, relief and rehabilitation against natural disaster including floods. In 1988, National Disaster and Calamity Preparedness Plan (NDCPP) was prepared to ensure effective and efficient implementation of civil protection program thru an integrated, multi-sectoral and community based approach and strategies for the protection and preservation of life, property and environment. Based on PD 1566, Disaster Coordination Councils (DCCs) have been organized from the national level to LGU level. In the core areas of three (3) target river basins for the Feasibility Study, namely, Cagayan, Ilog-Hilabangan and Tagoloan river basins, CDCC (city) or MDCC (municipality) is undertaking several flood preparedness activities such as designation of evacuation centers, implementation of evacuation and rescue and relief.

In the Philippines, PAGASA is an agency in charge of flood forecasting and warning activities. In 1973, PAGASA commenced operation of the first Flood Forecasting and Warning System (FFWS) in the Pampanga River and at present operates four (4) FFWS in Luzon including the Cagayan River Basin. At present, the PAGASA plans, designs and assists the operation of the Community-based Flood Early Warning Systems (CBFEWSs). By the end of 2011, CBFEWSs assisted by the PAGASA will commence operation in 27 provinces. However, the Core Areas in the Ilog-Hilabangan and the Tagoloan river basins are not covered by the CBFEWSs.

In the Feasibility Study, inundation conditions analyzed for floods with several probabilities in Core Areas. Flood preparedness activities in these Core Areas are conducted based on experienced floods and thus, they will encounter surely floods with much wider in area and much deeper in depth, exceeding their preparedness. Therefore, it is necessary to make Flood Preparedness Plan in consideration of the probable floods analyzed in the Study. The flood warning under FFWSs by the PAGASA at present aims to disseminate occurrence of flooding and information does not cover magnitude and/or degree of flooding. CBFEWSs operated by cities/municipalities intend to disseminate simpler information to inhabitants.

Under these circumstances, a project using the results of the Feasibility Study for the Core Areas is proposed; composing of 1) preparation of flood preparedness plan for the Core Areas against estimated probable floods, and 2) establishment of CBFEWSs for the Core Areas to provide necessary information for the flood preparedness plan to be implemented.

8.2 Practice of Non-structural Measures in The Philippines

8.2.1 Preparedness Plan

In the Philippines, flood preparedness plans are prepared by Disaster Coordinating Councils (DCCs) organized from the national level to LGUs. Hereunder, DCCs and National Disaster and Calamities Preparedness Plan (NDCPP) is first explained. Then, two (2) projects to assist preparedness planning are explained so as to understand/evaluate the existing organization and activities in the Core Areas of the Feasibility Study.

(1) DCCs and National Disaster and Calamities Preparedness Plan (NDCPP)

On October 19, 1970, after the wrath of Typhoon “Sening” which affected most specially the Bicol Region and caused flooding for almost three (3) months in Metro Manila, President Ferdinand E. Marcos approved the Disaster and Calamities Plan prepared by an Inter-Departmental Planning Group on Disasters and Calamities. This plan includes among others, the creation of the National Disaster Control Center.

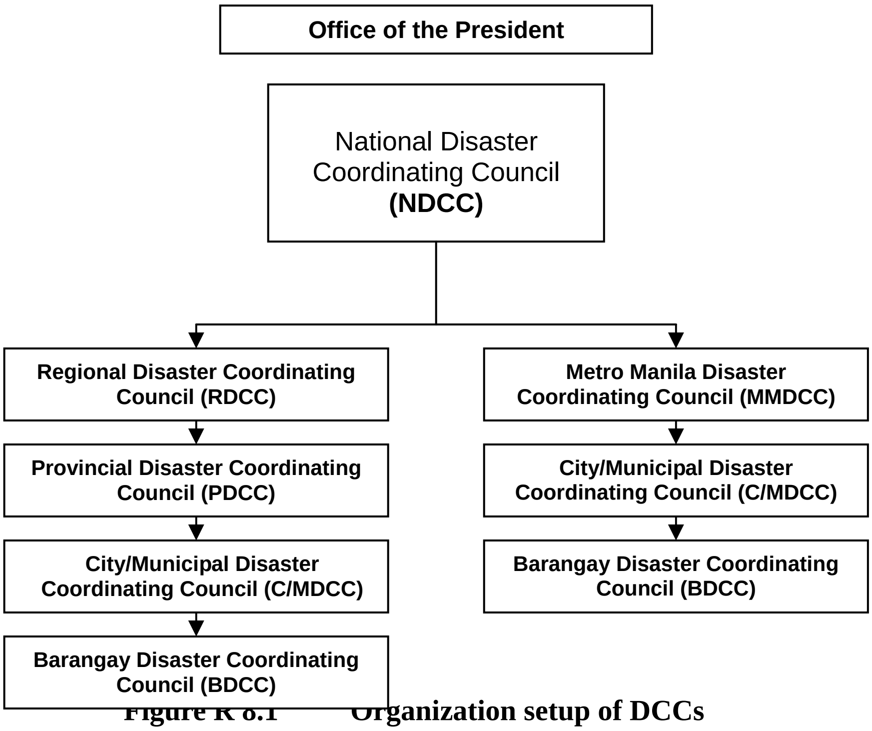


Figure R 8.1 Organization setup of DCCs

On June 11, 1978 through Presidential Decree (P.D. 1566), the National Disaster Coordinating Council (NDCC) replaced the National Disaster Control Center. In accordance with P.D. 1566, the Office of Civil Defense (OCD) prepared a National Disaster and Calamities Preparedness Plan (NDCPP) in 1988 and implementing plans by NDCC member-agencies. The primary objective of NDCPP is to ensure effective and efficient implementation of civil protection program thru an integrated, multi-sectoral and community based approach and strategies for the protection and preservation of life, property and environment.

To ensure the activities, organizations of national level, regional level and local government level (Figure R8.1) was established. The establishment of the National Disaster Coordinating Council (NDCC) embodies PD 1566. The Secretary of National Defense heads the NDCC with the heads of 18 departments/ agencies as members including Executive Secretary and the Administrator, Office of Civil Defense (OCD) who is the Executive Officer of the Council. The OCD functions as the operating arm or secretariat of the NDCC. The Members of DCCs of Regional and LGU levels are as follows.

(a) Regional Disaster Coordinating Council (RDCC)

- Regional PNP Director - Chairman;
- Heads of Regional Offices and Field Stations – Member;
- National Agencies and Selected Non-Government Organizations (NGOs) – Member

(b) Provincial Disaster Coordinating Council (PDCC)

- Provincial Governor – Chairman;
- Provincial Director of the PNP – Vice Chairman;
- All Organic Provincial Officials – Member; and
- National Officials – Member

(c) City/Municipal Coordinating Council (C/MDCC)

- City/Municipal Mayor – Chairman;
- City/Municipal Director of PNP – Vice Chairman;
- All Organic City Officials – Member; and
- National Officials – Members

(d) Barangay Disaster Coordinating Council (BDCC)

- Barangay Captain – Chairman; and
- Leading Persons in the community - Members

Each Council shall have the following staff elements:

- Damage Assessment and Needs Analysis Unit;
- Emergency Management Information Service Unit;
- Vulnerability Risk Reduction Management Unit;
- Plans and Operations Unit;
- Resource Unit
- Communication Transportation Service and Early Warning Service; and
- Relief and Rehabilitation Service;

(2) Hazard Mapping and Assessment for Effective Community-Based Disaster Risk Management (READY Project)

(a) Outline

The project, supported by the UNDP, AusAID and ADB, aims to address the problems of Disaster Risk Management (DRM) at the local level. At the national level, it aims to institutionalize and standardize DRM measures and processes. At the community level, the project aims to empower the most vulnerable municipalities and cities in the country and enable them to prepare disaster risk management plans. Target areas of the Project are 27 provinces vulnerable to national hazards. The project will be implemented from 2006 to 2011. Responsible agencies are; PHIVOLCS (DOST), PAGASA (DOST), MGB (DENR) and NAMRIA (DENR).

(b) Main Project Components

(i) Multihazard Identification and Disaster Risk Management

MGB made floods and flashfloods hazard maps with 1: 50,000 scale based on geomorphologic analysis. Figure 8.2 shows those for Negros Island. PAGASA will make past flood inundation maps for the flood prone areas covered by the existing 10,000 maps made by the NAMRIA.

(ii) Community-based Disaster Preparedness

- Development of Community-based early warning system for floods/flashfloods by the PAGASA and for Tsunami by PHIVOLCS
- Conduct of Information and Education Campaign (IEC) and distribution of related pamphlets, flyers and posters

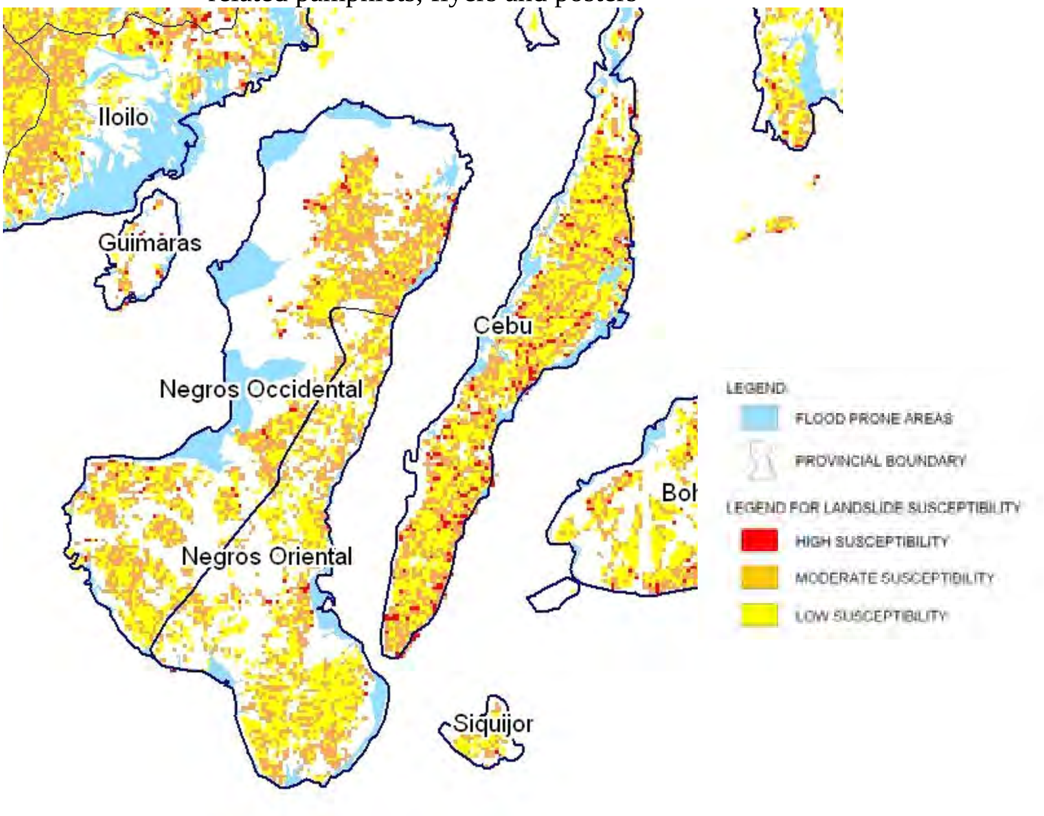


Figure R 8.2 Floods and Landslide Hazard Map for Negros Island

(3) GTZ – Dipecho Disaster Preparedness Project

(a) Outline

Target river basin is the Pagsangaan River Basin, which is located in Ormoc City, Kanamanga Municipality and Matag-ob Municipality of Leyte Province. Catchment area of this river basin is 551.84 km^2. Flooding occurs 2-3 times a year and lasts between 1-3 days. Population affected by flooding totals 17,400, equivalent to 62 % of the total population in the basin. In two (2) barangays, barangay hall could be used as evacuation sites/centers, but in most cases inhabitants stayed in their houses or moved to elevated areas, if there are.

As part of the engagement of the project, Participatory Disaster Risk Assessments (PRDA) was done in eleven (11) barangays within the Ormoc part of the Pagsangaan River Basin. Five (5) of these (11) barangays were PAGASA-identified monitoring area for the Flood Early Warning System that the Project will install in 2007 in partnership with the City Government and PAGASA.

(b) Barangay Disaster Preparedness Plan

In addition to the EFW, Barangay Disaster Preparedness Plan (BDPP) was formulated as the results of the PRDA for the Barangay Lao of Ormoc City, which was identified as Resettlement Area for those affected by 1991 flash flood in Ormoc City. The total population is 3,746. Estimated land area is 750.3 ha. with rice fields comprised of 61.2 ha. as its major land use. Major source of income of its residents is farming.

Following is contents of the BDPP for the Barangay Lao for CY 2008 - 2012. Chapter 1 describes the Barangay Profile and members of the Barangay Disaster Coordinating Council (BDCC) as shown below

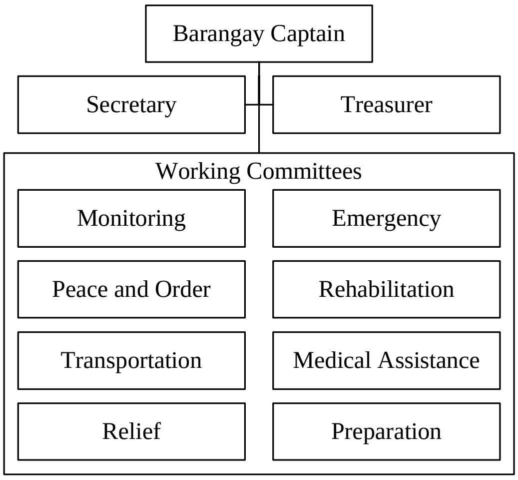


Figure R 8.3 Organization of BDCC

Chapter 2 of the BDPP contains the Profile of hazard flooding. This includes the historical background of the barangay on major/worst flooding that had happened in the barangay over the years. Hazard Profile includes the following information:

(i) A table containing the year, the catastrophe, disasters, and casualties affected;

(ii) Historical Transect provides and recalls information on records and occurrences of flooding that had happened years ago. Including reasons and suggestions;

(iii) Quantitative Description of Flooding Hazards; describes the path or direction and height of floodwater in the event of flooding; and

(iv) Worst Case Scenario illustrates what will happen in worst case including natural and social impacts, if flooding problems do not be resolved

Chapter 3 contains the Profile of Vulnerable Sectors. This chapter comprises the list and number of disabled persons, infants/children who are prone to sickness/illness, farmers whose major income is from crops and households who have continuously experienced flooding. Statistics on the types of materials used for housing, sources of drinking water and types of comfort rooms in the community, details and summary of coping mechanisms are also included.

The last Chapter (Chapter 4) contains the Disaster Preparedness Programs, Projects and Annual Investment Programs for flood mitigation in the Barangay. The Community Disaster Preparedness Action Plan contains the following information:

(i) A five-year Disaster Preparedness Plan involving the following sectors:

Social Sector

This includes purchase of medicines to insure good health and prevent sickness of the barangay people particularly the children.

Economic Sector

This provides other sources of income such as livelihood programs, training/seminars on farming technologies, marketing support and tree planting.

Infrastructure Sector

Development of a safe infrastructure in the barangay to provide evacuation and security to the community against flooding including dike construction (3 kms) and desilting of drainage channel (more or less 3 kms).

In addition, the technical materials for construction and other support needed for the project such as agencies or organizations will be included.

(ii) Five-year Annual Investment Programs (AIP)

This comprises the annual budget and sources of fund for flood mitigation projects.

8.2.2 Flood Early Warning System

Flood early warning is conducted by the PAGASA as the mandate. The System can be classified into three (3) systems, namely, PABC FFWS, FFWSDO and Community-based FEW System.

(1) PABC FFW System

(a) Outline of System and Warning

The PAGASA is conducting the flood forecasting and warning operation in the four (4) major rivers in the Luzon, Pampanga, the Agno, the Bicol and the Cagayan rivers. These are called as PABC Flood Forecasting and Warning (FFW) Systems. Pampanga FFWS commenced in 1973, while the other three (3) FFWSs started in 1982. Field Flood Forecasting and Warning Center (FFWC) is located at San Fernando City for Pampanga FFWS, at Rosales City for Agno FFWS, at Naga City for Bicol FFWS and at Tuguegarao City for Cagayan FFWS.

PAGASA analyzes the runoff characteristic of the respective rivers using the storage function model. FFWCs forecast WLs after 24 hours using present WLs and rainfall with forecasted rainfall. When the forecasted WL exceeds the warning WL, the warning are issued and transmitted as the Flood Bulletin.

Table R 8.1 Flood Warning Level and Definition

Flood Warning Level	Discharge Criteria	Definitions	Suggested Actions
Flood Outlook	40 % of flow capacity	There is possibility of flooding within the next 24 hours	Awareness
Flood Alert	60 % of flow capacity	There is threat of flooding with the next 12 hours	Preparedness
Flood Warning	100 % of flow capacity	Flooding is expected within the next 12 hours, or flooding has occurred	Response

The PAGASA issues Flood Bulletin two (2) times a day at 4:00 am and 4:00 pm. Intermediate flood bulletin is issued at 11:00 am and 11:00 pm, if necessary. Furthermore, auxiliary bulletin is issued when sudden flood is expected. Draft Bulletin made by the FFWC is sent to the Hydro-Meteorological Division (HMD) of Data Information Center (DIC) at Manila through the facsimile. The chief of HMD signs the Bulletin and sends back to FFWC. The HMD sends the Bulletin to the OCD. FFWC also sends the Bulletin to the RDCC and the PDCC. The flow of the Flood Bulletin dissemination is shown in Figure 8.4. Figure 8.5 shows the Flood Bulletin for Cagayan River Basin (At present, Flood Forecasting Branch, FFB is reorganized to Hydro-Meteorology Division, HMD).

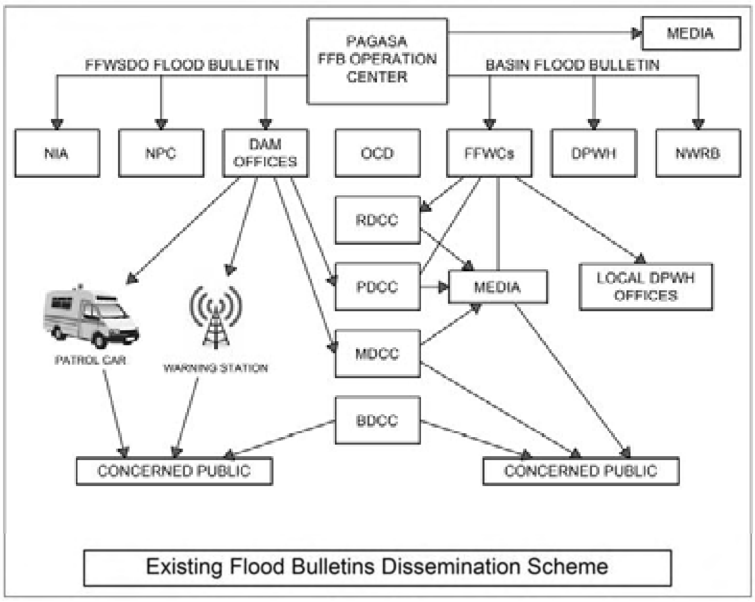


Figure R 8.4 Flood Bulletins Dissemination Scheme

(b) Upgrading of Pampanga and Agno FFWS

Since it took 25 to 30 years after completion, the PABC FFWSs encountered difficulties to keep their functions due to deterioration and shortage of spare parts, particularly for the Pampanga and Agno FFWSs, which were seriously damaged by volcanic mudflows caused by the eruption of Mount Pinatubo and Baguio Earthquake.

Under these circumstances, the Project for Upgrading of Flood Forecasting and Warning System in The Pampanga and Agno River Basins commenced on January 2008 through the JICA grant aid scheme. The items to be upgraded are as follows:

(i) Installation of Additional Gauging Stations

Existing stations are removed due to the present river conditions and new stations are added in consideration of the social and technical needs as well as the development situation in the cities in the basins. Table 8.2 shows number of stations before and after the upgrading.

REPUBLIC OF THE PHILIPPINES
Department of Science and Technology
Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)
Tuguegarao PAGASA Complex, Tuguegarao City

FLOOD BULLETIN NO.5
ISSUED AT 4:00 AM, 19 AUGUST 2000
(VALID UNITL THE NEXT ISSUEANCE AT 4:00 PM TODAY)

AVERAGE BASIN RAINFALL(mm):
PAST 48 HOURS ENDING AT 2:00 AM TODAY = 200 mm
FORECAST FOR THE NEXT 24 HOURS = LESS THAN 60 mm

EXPECTED HYDROLOGICAL RESPONSE:

1. FURTHER RISE OF THE FLOODWATERS FROM UPPER CAGAYAN RIVER AND TRIBUTARIES DIADI AND ILUT RIVERS.
   FLOODING IS EXPECTED TO PERSIST: IN THE LOW LYING AREAS OF CAUAYAN, BANQUERO, ECHAGUE AND ALICIA UNTIL TOMORROW MORNING.

2. RAPID RISE AND OVERFLOWING OF MIDDLE CAGAYAN RIVER AND TRIBUTARY MAGAT RIVER.
   FLOODING IS EXPECTED TO OCCUR: IN THE LOW LYING AREAS OF AURORA, LUNA, NAGUILIAN, GAMU, ILAGAN, SARAGAN, SAN PABLO AND TUMAUINI BEGINNING THIS AFTERNOON.

3. GRADUAL RISE OF LOWER CAGAYAN RIVER AND TRIBUTARIES PARET, PINACANAUAN, AND CHICI RIVERS.
   FLOODING IS THREATENING: IN THE LOW LYING AREAS OF SOLANA, IGUIG, AMULUNG, ALCALA, MINANGA NORTE, TUGUEGARAO, GATTARAN, LAL-LO AND APARRI BEGINNING LATE THIS MORNING.

THE RESIDENTS IN THE LOW LYING AREAS AND THE DISASTER COORDINATING COUNCILS CONCERNED ARE STILL ADVISED TO TAKE APPROPRIATE ACTION.

PREPARED BY:
LLB/ ACP/AEB

NOTED BY:
A LAN L. PINEDA
Chief , FFB

Figure R 8.5 Flood Bulletin for Cagayan River Basin

Table R 8.2 Number of Stations

Type	River basin	No. of station	
Rainfall gauging station	Pampanga	6 (4)	8 (4)
	Agno	2 (0)	
WL and rainfall gauging station	Pampanga	10 (8)	18 (15)
	Agno	8 (7)	
Repeater station with rainfall gauge	Pampanga	1 (1)	2 (2)
	Agno	1 (1)	

Figures in parentheses is those before upgrading

(ii) Improvement of Multiplex Radio Network

Existing multiplex radio network with 2 GHz, which is developed for the communication between Science Garden with FFWCs and also with the relevant agencies, has fatal interference due to the mobile phones. New multiplex radio network will be established with 7.5 GHz and 18 GHz. 7.5 GHz is used between Science Garden to Pampanga FFWCs and Agno FFWCs, while 18 GHz is applied to NIA and ODC, which are near to the Science Garden.

(iii) Upgrading of Equipment for Flood Forecasting and Warning Operation

- Equipment at DIC, Pampanga FFWC, Agno FFWC and monitoring stations such as OCD, NPC, NIA and DPWH are upgraded or newly installed.
- Present runoff model used by DIC is improved and inundation model will be applied to accurately estimate areas to be flooded.

(2) FFWSDO

Flood Forecasting and Warning System for Dam Operation (FFWSDO) aims to: 1) effectively utilize the six (6) dams located in the Luzon Island by the NPC or the NIA which operates the dam; 2) issue dam discharge warning by the NPC or the NIA to the related agencies and inhabitants along the river reaches which has sudden water rise due to dam water release; and 3) undertake flood warning by the PAGASA obtaining the released discharge data from the NPC or the NIA.

Originally, dams included in the FFWSDO System are Angat Dam and Pantabangan Dam in Pampanga River, Binga/Ambuklao Dam in Agno River and Magat Dam in Cagayan River. In August 2002, San Roque Dam was completed in the Agno River and included in the FFWSDO System.

Through the FFWSDO Project, Data Information Center (DIC), Dam Offices and Multiplex Network connecting DIC and Dam Offices have been completed. Following table summarizes number of stations under the FFWSDO.

The NPC has responsibility for the operation and maintenance of the FFWSDO system and gate operation for the Angat, Binga, Ambuklao and San Roque Dams, while the NIA has responsibility for the Pantabangan and the Magat Dams.

Dam offices forecast inflow discharge to the reservoir using the installed rainfall gauges and decide the operation of the gates and issue dam discharge warning, when gates are opened. PAGASA disseminates flood warning to the downstream areas using the discharge data released from the dam with the storage function runoff model. Table 8.3 tabulates number of stations and facilities under the FFWSDO.

Table R 8.3 Number of Stations and Facilities under FFWSDO

Nos.	Angat	Pantabangan	Binga/Ambuklao	San Roque	Magat
Dam Office	1	1	1	1	1
Rainfall Sta.	4	4	4	8	5
WL Sta.	2	1	1	4	1
Combined Rain/WL Sta.			1	1	1
Warning Sta. (A)	7	6	7	7	9
Warning Sta.(B)	10	13	11	11	6
Patrol Car	6	6	6	6	6
Walkie-talkie	21	18	21	21	27

(3) Community-based Flood Early Warning System (CBFEWS)

In READY Project, PAGASA will install CBFEWS in total 27 Provinces. Based on the experience of the PABC FFWS and FFWSDO, PAGASA designs and install observation and communication network while the LGUs operate the network and disseminate flood warning with assistance of PAGASA. Following explains to establish a CBFEWS.

(a) Consultation with LGUs

The consultation meeting aims to bring together the stakeholders to discuss the feasibility of implementing a CBFEWS and to assess the existing facilities for the CBFEWS. The consultation meeting shall be conducted in coordination with the Governor or City/Municipal Mayor and invite the key persons in the target area.

(b) Design of Rain Gauges, WL Gauges and Communication

Type of gauges is selected in consideration of: 1) technical capability of the community to operate and maintain the installed equipment; 2) economic capability of the community to purchase or acquire the equipment and spare parts to ensure the continuous operation of the system; and 3) availability of volunteer or LGUs from the community to operate the instrument. The communication system to transmit observed data to the operation center is selected among ; 1) existing communication system (SMS), 2) radio; or 3) walkie-talkie. For warning purposes, bells can be used in addition to the warning equipment being utilized by the community.

(c) Ocular Survey of Proposed Sites

After establishing the network density, the proposed sites are verified through actual survey in coordination with LGUs. There are criteria that are considered in choosing the sites of the proposed monitoring stations such as the presence or availability of an observer, access to the site and the availability of communication facilities.

(d) Installation and Hydrologic Survey

(i) Installation of Observation Instruments

The rain gauges and WL (staff) gauges are installed by PAGASA personnel and the LGUs based on the Installation guidelines made by the PAGASA.

(ii) Hydrologic Survey

The hydrologic survey consists of discharge measurement and cross sectioning of the river channel by PAGASA to determine the carrying capacity of rivers and to derive the assessment levels at the particular cross-section.

The assessment levels are divided into Level 1, Level 2 and Level 3. These levels are the basis in issuing flood advisories/warnings as shown in Table below.

Table R 8.4 Meaning of Flood Advisory

Assessment Level	Discharge at WL Observation Point	Flood Advisory/ Warning	Meaning of Message
Level 1	40 % of flow capacity	READY	**"Awareness** " that flooding is possible within the next 24 hours
Level 2	60 % of flow capacity	GET SET	**"Preparedness**" that flooding is threatening with 12 hours
Level 3	100 % full	GO	**"Response"** that flooding is expected to occur/or will persist within the next 12 hours

For rainfall gauges, initial threshold values for "Ready", "Get Set" and "Go" are set.

(e) Training of Observers

The LGUs are requested to identify two (2) observers for each installed station to be trained in the observation, recording and transmission of data to the DOC. Formal lectures and on-the-job training are conducted by PAGASA and the necessary forms and operation manuals will be provided to the observers.

The deputized Civil Defense Coordinator (DCDC) in the municipality and his staff will also be trained on the protocols on data interpretation and issuance of flood warning/advisory

(f) Pilot Testing/Dry Run on the Operation of the CBFEWS

A dry run is conducted to test the observation and transmission of data by observers, analysis of data and formulation of flood warning/advisories and the dissemination of warnings to the threatened communities. A sample flow chart of the communication flow for the CBFEWS is shown in Figure 8.6.

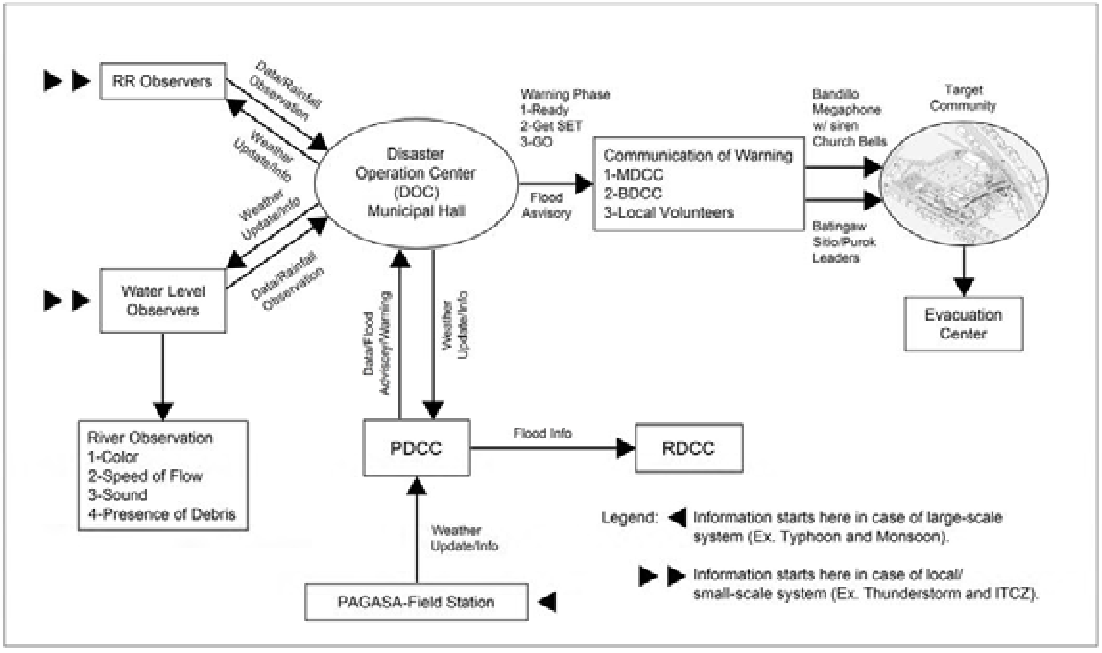


Figure R 8.6 Communication Scheme of a CBFEWS

(g) Other Activities

(i) Signing of a Memorandum of Agreement

Activities to be undertaken, the cost sharing scheme and roles of the community and institutions shall be stipulated in a Memorandum of Agreement (MOA).

(ii) Enactment of a Local Ordinance for the Operation and Maintenance of the CBFEWS

Local ordinance shall be enacted by the Provincial Council and City/Municipal Council to allocate continuously a reasonable amount of money for the operation and maintenance of the CBFEWS.

8.3 Present Activities related to Non-structural Measures in the Tagoloan River Basin

8.3.1 Flood Preparedness Plan

(1) Tagoloan MDCC

Organization chart of Tagoloan MDCC is shown in Figure R8.7.

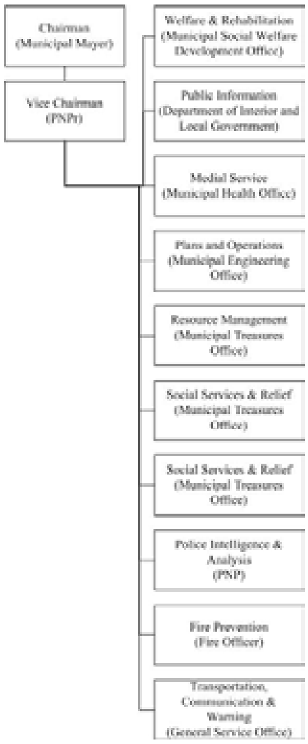


Figure R 8.7 Organization of Tagoloan MDCC

(2) Hazard map

Flood prone area of Tagoloan municipality is Brgy. Santa Cruz, which is located just along the existing river dike. Flood water enters end of the existing dike, which is not connected to higher land/structures. Location of this flood prone area is shown in their flood simulation results for without-project as attached in Chapter 7.

8.3.2 Early-flood Warning Information

Flood warning is given by the MDCC and inhabitants in Brgy. Santa Cruz evacuates to nearby evacuation center (elementary school).

8.4 Non-Structural Measures and Implementation Plans

8.4.1 Hydrological Hazard Mapping and Flood Preparedness Plan

(1) Objectives

The CDCC or MDCC in the core areas is conducting the evacuation operation based on the experience of the past floods. The magnitude of these past floods is normally not so large and thus there are high possibility that unexpected flood exceeding the preparedness might occur even in the areas, which are normally not flooded.

Criteria of PAGASA's flood warning, both for the PABC FFWSs and for CBFEWS, is flow capacity of the existing river channels, which is normally small. Therefore, the flood warning informs the discharge will exceed the flow capacity of the river channel but does not explain the magnitude of flooding.

For the Tagoloan River, a runoff model is newly established to estimate probable discharge and inundation analysis is conducted with the same objectives.

The results of runoff and inundation analysis can be used for establishment of more effective flood preparedness plan and early flood warning system covering floods exceeding the normal flood, though it is necessary to review for the models to use these objectives. Under these circumstances, this project aims to assist that; 1) inundation maps for the probable floods containing description of hazard impacts are prepared by the related agencies, 2) flood preparedness plan including the hazard maps is prepared by the LGUs in the Core Areas, 3) early warning system necessary for the flood preparedness plan, and 4) leading land development to suitable one in the flood-prone areas will be established.

(2) Related Agencies

(a) OCD: Executive Agency

(b) NAMRIA: Provision of base maps

(c) FCSEC: Runoff model/analysis and Inundation modeling/analysis

(d) PAGASA: Runoff model/analysis, Inundation modeling/analysis and establishment of community based early warning system

(e) LGUs (CDCCs, MDCCs, BDCCs): Preparation of flood preparedness plan

(f) LGUs (CPDOs, MPDOs): Land use and development planning

(3) Activities

Activities will be done with the JICA experts to be dispatched for the Project.

(a) Identification of Necessary Preparedness Plan and FEWS

Consulting meeting will be held in coordination with Regional Director, Governor(s), mayors of City/municipalities located in the river basin and invite key staffs of the related RDCC, PDCC and CDCC/MDCC.

(i) Disaster profile in target core area;

(ii) Necessity of preparedness plan and FEWS; and

(iii) Identification of preparedness plan and FEWS

For the Tagoloan River basins, community–based flood early warning system will be installed.

The most crucial for CBFEW is the Project could install robust information network from hydrologic warning transmission stations up to the end communities at an impending flood disaster, in terms of institutional capacity for data transmission and receiving as well as technical aspects.

(b) Establishment of CBFEWS

Design and installation of CBFEWS will be done for the Tagoloan River basins in the following manner.

Considering the extent of its basin, location of villages and easy accessibility, it could be recommended to install four rain gauges and two water level gauges in the upper reaches, and two rain gauges and one water level gauge in the lower reaches.

Type of gauges and data transmission system to the Disaster Operation Center (DOC) shall be determined as a unit. The following combinations shall be compared in the succeeding study/design stage.

- manual type of gauge and VHF radio communication system,
- automatic recorder with data logger and GSM telecommunication system, and
- automatic recorder with data logger and telecommunication system using communication satellites, for instance Iridium.

After installation of the observation network, training activities shall be made to observers for proper observation, recording and data transmission and to operators in the DOC for proper data management and dissemination of disaster information to the communities concerned.

Overall flood early warning system, including information from PAGASA, is illustrated below.

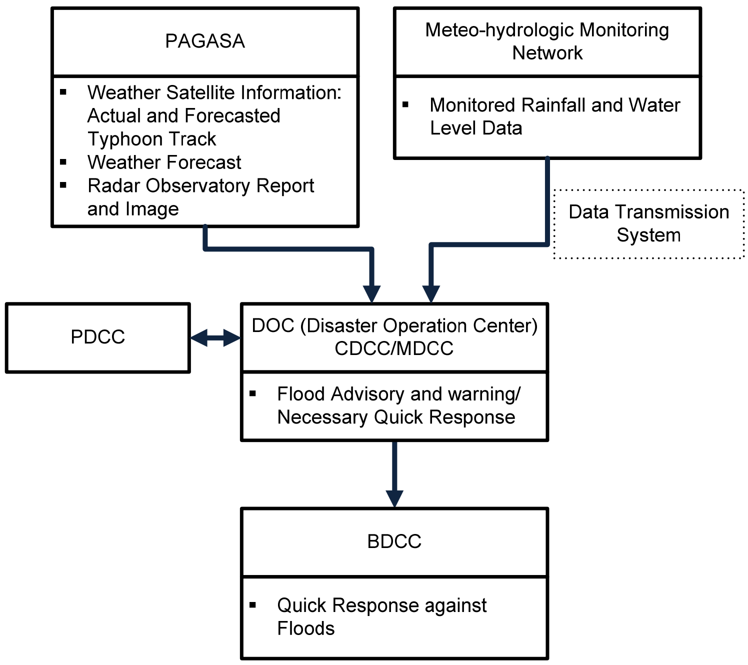


Figure R 8.8 Overall Flood Early Warning System in the Tagoloan River Basin

(c) Establishment of Hazard Map and Preparedness Plan

(i) Detailed Inundation Maps

Probable runoff discharge and inundation conditions used during the Feasibility Study are reviewed and revised. Using the NAMRIA data (land use, land elevation, etc), runoff model and inundation model will be established.

- Data collection
- Establishment of runoff and inundation model
- Detailed flood inundation analysis for the core area corresponding to the probable discharge

(ii) Establishment of Warning WLs and Threshold Rainfalls

- Grouping of barangays in core areas in consideration of inundation characteristics
- Establishment of warning WLs and threshold rainfalls (if appropriate) corresponding to the grouped barangays

(iii) Establishment of Flood Preparedness Plan

- Flood Preparedness Plan is formulated in respective barangays to be affected by flood including evacuation centers, route and method
- Flood Preparedness Plan is formulated for the City or Municipality

(iv) Implementation of Dry Run

- Field Reconnaissance
- Preparation of seminar and dry run
- Implementation of dry run
- Modification of Flood Preparedness Plan

(v) Revision of Flood Preparedness Plan

- Review of flood preparedness plan after major flood events using the runoff model and the inundation model
- Revision of flood preparedness plan and flood warning WL and threshold rainfall

(d) Revision/Modification of Land Use/Development Plan

Urban/industrial developments in the flood-prone areas always increase the flood damages. Thus future land development should be led to distribute suitable land use in future in the flood prone areas. Evaluation on the land use and development plan should be made overlaying the City/Municipality development plan onto the flood hazard map. If such land use modification/control could be successfully pursued, it might be advantageous for future river improvement to acquire a necessary land, upgrading the design level or adopting the adaptive measures against effects of global warming.

Reference

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Office of Civil Defense, Project Management Office: Hazards Mapping and Assessment for Effective Community-Based Disaster Risk Management (READY Project)

Homepage of the following Philippine Government Agencies:

- National Disaster and Coordinating Council (NDCC)
- Office of Civil Defense (OCD)
- Philippine Atmospheric, Geophysical & Astronomical Services Administration (PAGASA)

CHAPTER 9 ENVIRONMENTAL SOCIAL CONSIDERATIONS

9.1 Introduction

9.1.1 Necessity of environmental and social considerations

In accordance with DENR (Department of Environment and Natural Resources) Administrative Order NO.37 in 1996 (DAO 37-1996), any projects in Philippines are required to obtain Environmental Compliance Certificate (ECC). If a project has no significant impact and has no necessity of ECC, the project proponent shall obtain the Certificate of Non-Coverage (CNC).

The Environmental Management Bureau (EMB) of the DENR published the Revised Procedural Manual (August 2008) (hereinafter referred to as RPM). The relation between the project cycle and EIA process is described in Chapter 1.0 of the RPM. In accordance with the RPM, the EIA study for preparation of ECC application would be carried out during the F/S study. Meanwhile, this study can be termed as a preparatory study for the detail EIA/RAP study in the next stage as shown as Figure R 9.1

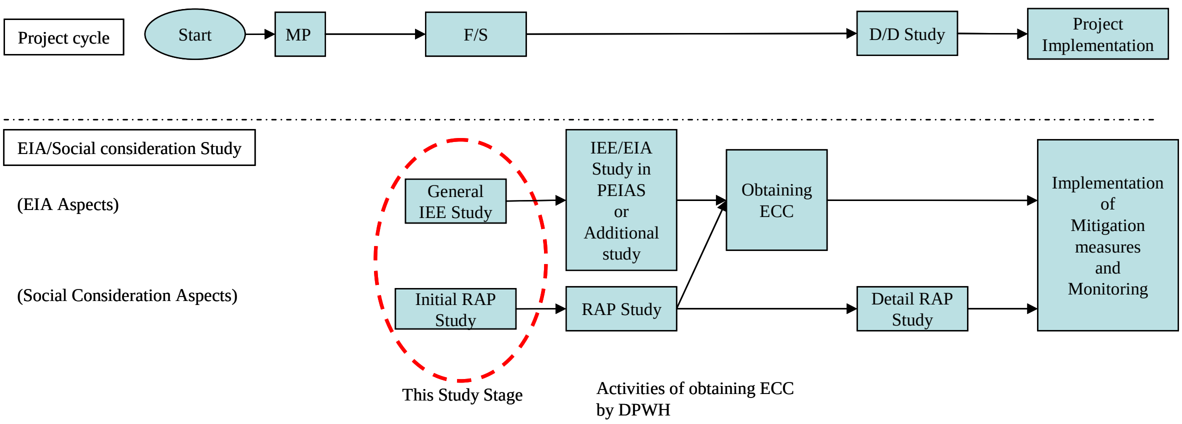


Figure R 9.1 Project cycle and EIA/Social Consideration Study of the Project

9.1.2 Scope of IEE study

The scope of this IEE study is described as below:

Study Area: The areas directly and indirectly affected by the Project. The Project Area is shown in Chapter 1 and 2.

Baseline data collection: The baseline data of natural and social environments on the project threshold.

IEE study: The study follows the requirements of the RPM. The outline of IEE report is described in the RPM.

Recommendation of the necessary mitigation measures: The mitigation measures for the results of scoping on the project threshold will be considered.

Recommendation of the monitoring plan: The monitoring plan will be recommended.

9.1.3 Baseline data of natural condition

(1) Data of natural condition

The RPM describes four specific modules as below:

(a) The land (Land Use/classification, associated Terrestrial Biology (flora and fauna), Relevant aspects of Geology (i.e. land forms/topography/slope/ terrain), and Pedology (main soil type and quality). In this report, the land use/classification was described in Sub-section 9.1.4. (2) as a part of social environment conditions.

(b) The water (Hydrology and Hydrogeology, Water quality, and Freshwater Biology.

(c) The air (Meteorology and Air Quality)

(2) Biological Environment

The existing vegetation and wildlife survey in the Project site was not conducted. Assessment of the vegetation and wildlife in the Project site were conducted from July to August 2009. Three survey routes were selected along the river banks within a 500m wide strip on both sides of the river. The survey routes are shown as Annex PIIC_9-1. The survey routes were established and all plants and animals encountered were noted and recorded. Some animal species not observed were yielded by interviewing local farmers and residents in the area.

The site was noted to consist predominantly of residential, and commercial built up areas. Areas along the river banks were found to have secondary growth of plant cover composed of grasses, shrubs, trees, with some areas being planted out with backyard vegetables. In accordance with the results of field surveys, rare species listed on the Philippines Red Data Book were not found in the Project area.

(3) Topography/Geology

(Geographical features): The Tagoloan River Basin is one of the eight (8) major basins in Mindanao. The Tagaloan River Basin has a basin area of 1,778 km^2, is situated in the northern part of Mindanao Island. The downstream reaches of the Tagoloan River consist of a series of plateaus, hilly terrain, river deltas and valleys. Most of the low-lying areas have developed into residential, crop production, commercial and industrial zones in the Municipality of Tagoloan.

(Topography): In the municipal territory of Tagoloan whose the boundaries consist mostly of a part of the lower catchments of the Tagoloan River, more than half (58%) has the slope of 0% to 3%. A combined 15.4% are within the 3-8% and 8-18% slope categories, while the remaining 26.2% of the whole jurisdictional area of Tagoloan Municipality have slopes of over 18%.

(Geological condition): The northern part of the watershed belongs to the volcanic Lanao-Bukidnon highland composed of Pliocene-Quarternary Plateau, basalts and pyroclastic deposits. Beneath it is a sequence of Miocene sedimentary layers and basement rocks. The volcanic flows overly the pyroclatic deposition ally contact with the older formations, sequences of volcanic flows and pyroclastics mainly of volcanic beccia and series of conglomerate sandstone and shales are found in the same areas.

The details of topographical/geological condition were described in Chapter 2.1 in this report.

(4) Soil/Sediments

The soil types in the watershed are classified as six (6) soil series and two (2) miscellaneous land types. The soil series comprise the Adtuyon clay, Alimodian clay, Faraon clay, Jassan clay, Kidapawan clay and Umingan sandy clay, while the miscellaneous land types include the Undifferentiated Mountain Soil and Rough Broken Land. (The details of soil type were described in Chapter 2.1.1 in this report.)

Sediments were also collected from the sampling sites to test for heavy metals in case these areas were dredged and the dredged materials sent elsewhere. The results were as follows:

Table R 9.1 Results of Sedimentation Quality Measurement

(Unit: ppm)

Analysis	Sample 1	Sample 2	Standard Value in Dutch
Total mercury	Not Detected	Not Detected	0.3
Arsenic	1.8	1.6	29.0
Cadmium	Not detected	Not Detected	0.8
Chromium	69	62	100.0
Lead	Not detected	Not detected	85.0
Cyanide	Not detected	Not detected	5.0

The Philippines does not have any standards for soil or sediment quality. The Dutch standard for sediments is generally used. The standard values are shown in the Table R 9.1. The survey results show that the sediments in the project site are not contaminated by heavy metals.

(5) Hydrology (River System)

The Tagaloan River is the main drainage-way of the basin. It originates in the slopes of Mount Kibuwa, and flows in a northwesterly direction before draining into the Macajalar Bay. It has eight major tributaries. Tagoloan River is the 13th largest river system in the Philippines in terms of basin size, as classified by the NWRB.

The river system is rather simple running almost straightly from the upper mountainous reaches to the sea. The Tagoloan River splits into two channels, each 30 to 40 meters wide, at about 800 meters upstream of the Tagoloan-Villanueva Highway. The two channels join again after 840 meters, creating a river enclosed piece of land of 42.8 hectares. The estimated annual runoff of the Tagoloan River is about 2,560 x 10^6 m^3.

The details of river system were described in Chapter 2.2.2 in this report.

(6) Surface Water

(a) General

Surface water is used primarily for irrigation and subsistence fishing in the Ilog Hilabangan basin.

According to DENR Administrative Order (DAO) No. 34 (Revised Water Usage and Classification 1990), water bodies are classified into five (5) classes (i.e AA, A, B, C and D) for fresh surface waters, and four (4) for marine and estuarine waters (i.e SA, SB, SC and SD). The criteria of classification of the water quality are shown below:

Class	Definition
Class AA	Public Water Sully Class I. This class is tended primarily for waters having watershed which are inhabited and otherwise protected and which require only approved disinfection order to meet the National Standards for Drinking Water (NSDW) of the Philippines.
Class A	Public Water Supply Class II – Intended as sources of water supply requiring conventional treatment to meet the PNSDW
Class B	Recreational Water Class I – Intended for primary contact recreation (e.g., bathing, swimming, skin diving, etc.)
Class C	Fishery Water, Recreational Water Class II, or Water Supply Class I – Intended for propagation and growth of fish & other aquatic resources, boating, manufacturing processes after treatment
Class D	Industrial Water Supply Class I – Intended for agriculture, irrigation, livestock watering, etc.

(Source: DAO NO.34, 1990)

DAO 34-1990 establishes the water quality standard (water quality criteria for conventional and other pollutants contributing to aesthetics and oxygen demand for fresh waters). The table below shows some parameters of the standard.

Table R 9.2 Water Quality Criteria for Conventional and Other Pollutants Contributing to Aesthetics and Oxygen Demand for Fresh Waters (abridgment)

Parameter	Unit	Class AA	Class A	Class B	Class C	Class D
BOD (Max)	mg/L	1.0	5.0	5.0	7.0 (10.0)	10.0 (15.0)
DO (Min)	mg/L	5.0	5.0	5.0	5.0	3.0
TDS (Max)	mg/L	500.0	1,000.0	--	--	1,000.0
TSS (Max)	mg/L	25.0	50.0	(b)	(c)	(d)

Notes: BOD: Biochemical Oxygen Demand, DO: Dissolved Oxygen, TDS: Total Dissolved Solids, TSS: Total Suspended Solid
(a) -The numerical limits are yearly average values. Values enclosed in parentheses are maximum values., (b) -Not more than 30% increase, (c) -Not more than 30 mg/L increase, (d) -Not more than 60 mg/L increase
Source: DENR Administrative Order 34-1990

The DAO establishes water quality standards for toxic and other deleterious substances for fresh waters as Table R 9.3.

Table R 9.3 Water Quality Criteria for Toxic and Other Deleterious Substances for Fresh Waters (For the Protection of Public Health)

Parameters	Class AA	Class A	Class B	Class C	Class D
Arsenic	0.05	0.05	0.05	0.05	0.01
Cadmium	0.01	0.01	0.01	0.01	0.05
Chromium (hexavalent)	0.05	0.05	0.05	0.05	-----
Cyanide	0.05	0.05	0.05	0.05	-----
Lead	0.05	0.05	0.05	0.05	-----
Total Mercury	0.002	0.002	0.002	0.002	0.002
Organophosphate	nil				
Aldrin	0.001	0.001	-----	-----	-----
DDT	0.05	0.05	-----	-----	-----
Dieldrin	0.001	0.001	-----	-----	-----
Heptachlor	nil		-----	-----	-----
Lindane	0.004	0.004	-----	-----	-----
Toxaphane	0.005	0.005	-----	-----	-----
Methoxychlor	0.10	0.10	-----	-----	-----
Chlordane	0.003	0.003	-----	-----	-----
Endrin	nil		-----	-----	-----
PCB	0.001	0.01	-----	-----	-----

nil: Extremely low concentration and not detectable by existing equipments
(Source: DENR Administrative Order 34-1990)

(b) Water quality of river in the Project site

Tagoloan was classified as Class A for the entire river in the 1990s. However, based on the latest water sampling done in 2008 by the Philippine Veterans Investment Development Corporation (PHVIDEC), many parameters, including Dissolved Oxygen, Coliform Bacteria, and Suspended Solids, were already below Class C standards.

Water quality sampling (heavy metals) was conducted on July 28, 2009. Annex PIIC_9-2 shows the details of the sampling survey. Table R 9.4 shows the results of the laboratory analyses for each station.

Table R 9.4 Water Quality Sampling Results

(Unit: ppm)

Analysis	Sample 1 (ST.1)	Sample 2 (ST.2)	Class C waters	Method detection Limit
Total Mercury	<0.0001	<0.0001	0.002	0.0001
Total Arsenic	<0.02	<0.02	0.05	0.02
Total Cadmium	<0.002	<0.002	0.01	0.01
Total Chromium	<0.005	<0.005	0.05 (hexavalent)	0.005
Total Lead	<0.01	<0.01	0.05	0.01
Total Cyanide	<0.01	<0.01	0.05	0.01

Source: JICA Study Team

(7) Climatologic Features

The downstream of basin falls under Type III or Intermediate A climate of which season is not very pronounced consisting of relatively dry season from November to April and wet during the rest of the year. Normal annual precipitation varies from about 1,500mm in the northern part to 2,000mm in the southern part.

The 2003-2007 five years rainfall data from the two stations, namely Cagayan De Oro and Bukindon, shows that data gathered in DMPI appears to have an annual average rainfall of 1,848mm while PAGASA Cagayan de Oro City shows an annual average rainfall 1,523mm for the five consecutive years (2003-2007).

The relative humidity observation of the two stations from 2003-2007 shows a decreasing trend from January to March and an increasing trend from April to June, while July to December values show similarity of figures with minimal variability.

The details of climatologic features were described in Chapter 2.2.1 in this report.

(8) Air quality

(a) Air quality standard

The air quality standard in Philippines is shown in Table R 9.5.

Table R 9.5 National Ambient Air Quality Guideline Values

Pollutions	Short Term[a]			Long Term[b]		
	μg/NCM[d]	ppm	Averaging Time	μg/NCM	ppm	Averaging Time
Suspended Particulate Matter[c] TSP	230[d]		24 hours	90		1 year [e]
PM-10	150[f]		24 hours	60		1 year [e]
Sulfur Dioxide [c]	180	0.07	24 hours	80	0.03	1 year
Nitrogen Dioxide	150	0.08	24 hours			
Photochemical Oxidants as Ozone	140 60	0.07 0.03	1 hour 8 hours			
Carbon Monoxide	35mg/NCM 10mg/NCM	30 9	1 hour 8 hours			
Lead [g]	1.5		3 months [g]	1.0		1 year

[a] Maximum limits represented by ninety-eight percentile (98%) values not to exceed more than once a year.
[b] Arithmetic mean.
[c] SO2 and Suspended Particulate matter are sampled once every six days when using the manual methods. A minimum of twelve sampling days per quarter or forty-eight sampling days each year is required for these methods. Daily sampling may be done in the future once continuous analyzers are procured and become available.
[d] Limits for Total Suspended Particulate Matter with mass median diameter less than 25-50 μm.
[e] Annual Geometric Mean.
[f] Provisional limits for Suspended Particulate Matter with mass median diameter less than 10 μm and below until sufficient monitoring data are gathered to base a proper guideline.
[g] Evaluation of this guideline is carried out for 24-hour averaging time and averaged over three moving calendar months. The monitored average value for any three months shall not exceed the guideline value.
(Source: DENR DAO NO.2000-81 (2000))

(b) Air condition in the Project site

DENR took monitoring of TSP in the whole Philippines. The results enable to be seen on the web site[1] and Table R 9.6 shows extracted Regional data.

Table R 9.6 The Regional Monitoring Data of TSP

(Unit: μg/NCM)

Place	2001	2002	2003
NCR	151	147	156
CAR	238	145	-
Region I	64	93	130
Region II	213	339	198
Region III	-	113	120
Region IV-A	-	110	103
Region IV-B	-	246	-
Region V	76	109	109
Region VI	201	168	134
Region VII	66	89	94
Region VIII	98	98	100

[1] http://www.emb.gov.ph/air/AQMN2.html

Place	2001	2002	2003
Region IX	438	360	154
Region X	142	128	156
Region XI	74	92	96
Region XII	175	99	96
Region XIII	184	100	-

(Source: Extracting from web site of EMB-DENR
: The results of monitoring of Regional sampling of TSP)

Table R 9.2 shows the average value of a year. The value of Region X is 142 in 2001, 128 in 2002, and 156 in 2003; it seems to be almost same and lower than the standard.

(9) Noise

The environmental standards for noise in the Philippines are stipulated based on Presidential Decree (P.D.) No. 984 (1978) as Table R 9.7.

Table R 9.7 Environmental Quality Standards for Noise in General Areas

Category of Area	Daytime	Morning & Evening	Nighttime
AA	50 dB	45 dB	40 dB
A	55 dB	50 dB	45 dB
B	65 dB	60 dB	55 dB
C	70 dB	65 dB	60 dB
D	75 dB	70 dB	65 dB

Source: Official Gazette, 1978 Implementing Rules and Regulations of P.D. 984.

(Legend)

Category of Area is as follows:

AA: a section or contiguous area which require quietness such as area within 100 meters from school sites, nursery schools, hospitals, and special home for the aged

A: a section or contiguous area primarily used for residential purposes

B: a section or contiguous area primarily used as commercial area

C: a section primarily reserved as a light industrial area.

D: a section primarily reserved as a heavy industrial area

Division of 24-hour period is as follows:

Morning	5:00 AM to 9:00 AM	Evening	6:00 PM to 10:00 PM
Daytime	9:00 AM to 6:00 PM	Nighttime	10:00 PM to 5:00 AM

Noise level measurement was conducted at the three noise sampling locations from July 24 - 26, 2009. The noise sampling stations were positioned at the nearest residential community to determine the possible impact of noise during the construction period. The measurement was conducted using a precision type, digital sound level meter using the method prescribed in the implementation rules and regulations of PD 984.

The minimum and maximum values based on continuous readings were recorded in each station. The median values were then taken and compared with the DENR noise standards based on the 1978 Rules and Regulations of PD 984. The noise standards may be considered as Class A since the area is primarily used for residential purposes. Thus, the results of the sound level measurement are compared to the daytime standard for Class A areas.

Table R 9.8 shows the summary of the noise measurement around the planed dike areas. The results of sampling at the bridge show that the noise level exceeded the standard of DENR. It seems that this is due to the traffic on the bridge. However, at the other places (near the residential areas or the fields) noise levels are fall well below the standard. The details are shown in Annex PIIC_9-3.

Table R 9.8 Summary of Noise Measurement

(1) At the dike (near Bridge)		
Distance	Time	Difference from the noise standard (dBA)
10 m	Morning	+ 14.15
	Noon	+ 21.25
	Evening	+ 15.50
15 m	Morning	+ 6.50
	Noon	+13.00
	Evening	+4.50
(2) At the dike (Pumping Station)		
Distance	Time	Difference from the noise standard (dBA)
10 m	Morning	- 3.40
	Noon	- 4.10
	Evening	- 2.90
20 m	Morning	- 1.90
	Noon	- 2.25
	Evening	-4.60
(3) At the dike (West end)		
Distance	Time	Difference from the noise standard (dBA)
10 m	Morning	- 15.40
	Noon	- 10.60
	Evening	- 4.10
15 m	Morning	- 13.50
	Noon	- 13.10
	Evening	- 5.70

Source: JICA Study Team

(10) Sensitive areas

(a) Areas declared by law as protected areas: There are no nearest protected area to the Project site, all declared areas by law are too far for it to be affected.

(b) Areas set aside as aesthetic potential tourist spots: There are no potential tourist spots in the Project site as provided in the comprehensive land use plans

(c) Areas which constitute habitat for any endangered or threatened species of Philippine wildlife: The habitats for endangered or threatened species are located in the protected areas. Tagoloan is cities; there are no endangered or threatened specie habitats in the area since whatever habitats were available have been taken over by urban and agricultural activities

(d) Areas of unique historic, archeological, geological, or scientific interests: There are no unique historical, archaeological, geological, or scientific interests in the project site.

(e) Mangrove Areas: There are mangrove areas in the Project area. The Mangrove areas are along the banks of the mouth of the main channel of the Tagoloan River. But, they are not designated as protected mangrove forest area in Philippines.

(f) Coral Reefs: The coral reefs can be seen near the river mouth of Tagoloan River, but they are not covered as protected area in Philippines.

9.1.4 Baseline data of social condition

(1) Data collection methodology

The RPM describes necessary social baseline data as a) demography data, b) displacement of settlers and c) presence of Indigenous people. The land use condition is also required. In this study, demography data was described in Chapter 3 and 4, b) data of displacement of settlers were collected by the interview survey in the field. And there are no indigenous people in the Project site in accordance with the sourced data from the National Commission on Indigenous Peoples.

(2) Land-use

The Existing and Proposed Land Use in Tagoloan City is as per Annex PIIC_9-4. About 1,455 ha (about 18% of 7,940 ha) are zoned industrial. This is because of the presence of a large industrial estate owned by a government controlled corporation, the Philippine Veterans Investment Development Corporation (PHIVIDEC).

Agricultural land amounts to about 3,300 ha (about 41% of total area) followed by industrial areas and the forestry areas which comprise about 1,500 ha (about 17% of total City area). Land use according to choice of crops is shown as Annex PIIC_9-4.

(3) Indigenous People

There are no Indigenous groups in/around the Project site. All Indigenous people's groups were listed and reported in the Accomplishment Report (National Commission on Indigenous Peoples). The relevant section of Region X is shown in Table R 9.9. It shows that the 4 claimants are located outside the Project site.

Table R 9.9 Relevant section of Status Report of Accomplishment Report (CY 2004)

REGION	PROVINCE	AD Location	Claimants Tribe	Area (Has)	Remarks
REG. X	Bukidnon	Upper Pulangi, Malaybalay	BukdinonHigaonon	27,025.00	survey completed; for map projection
	Misamis Occidental	Toliyok, Oroquieta City	Subanen	6,230.00	Social preparation stage
	Misamis Oriental	Samay, Balingasag	Higaonon	14,872.73	for deliberation (2nd reading)
	Lanao del Norte	Rogongon, Iligan City	Higaonon/Kalambugan	28,500.00	Social preparation stage
	Subtotal			76,627.73	

Source: ACCOMPLISHMENT REPORT, CY 2004, NATIONAL COMMISSION ON INDIGENOUS PEOPLES (http://www.ncip.gov.ph/downloads/Annual%20Report%202004.pdf)

(4) Profile of people in/around the Project site

Census data covering demography on the Municipality level is available in the Philippines. However, data on education, employment, income, etc are compiled on a Region level only and therefore Municipality level data is not available. The JICA Study Team therefore carried out an interview survey of about 10 households who were going to be Project-Affected Persons (PAPs) at each planed facility. In total 53 households were interviewed. The interview survey was conducted in order to collect and collate - in brief – the residents' socio-economic conditions and opinions on the Project. The results of the survey were described in (a) to (d). The distribution of the interviewees and the details of the survey results are shown in Annex PIIC_9-5.

Table R 9.10 Number of Respondents in Tagoloan

(Class-wise)			
Residents	Farmers	Fish Cultivators	Total
30	24	0	54

Source : JICA Study Team

(a) Household (HH) heads and family

Gender and age of HH heads:

8 of interviewed respondents' household heads are female and most of HH heads are male. The ratio of males is 85% of 46 HH heads. The ages of heads vary from 30 to 60 years old.

Education of HH heads

A clear majority of the respondents did not reach college level. 54% of HH heads are below elementary school level and 98% of them are below high-school level. Only 2% of 54 respondents have a college education.

Family composition

50 HHs (93% of total respondents) were composed of single families and 4 HHs (7% of total respondents) have extended families in their households.

Family sizes also tend to be smaller, with major family sizes from 3 to 6 persons (69% of 54 HHs). The average of the total number of family members is 4.1 (persons/house) which is calculated by weighted average method.

(b) Economic condition

Income source of HH heads

45 % of 54 respondents are farmers, followed by casual workers at 22 %. Others are variety of income sources: employments (13 %), fishermen (11 %), and construction workers (7 %).

Family income

The combined family income in the Project area is generally low with about 63% of the respondents having family incomes of 8,000 Pesos and below. The average family income (calculated by the weighted average method) is about 8,000 Pesos per month.

(c) Life condition of HHs

House size and material, Electricity, Water supply and Toilet location

(House materials): The major responses as to house materials were natural material (wood, bamboo, etc.) at 83 % (out of 30 respondents), cement and natural materials at17 %, and concrete at 0% (not used at all).

(Electricity): About half of the 29 respondents in Tagoloan Municipality are connected to an electric power supply service. 15 respondents (52% of 29 respondents) have electricity connection.

(Drinking water): About 45 % of 29 respondents use piped water. The river water is used for agricultural purposes / field irrigation.

(Toilet): Sanitation coverage within the respondents is almost complete with no respondents using the river as a toilet facility.

(d) Property

House ownership and size

17 HH heads own the house (54% of 31 respondents) and 46% of 31 HHs are renting the houses w/o payments. Their house sizes do not vary much, 8 HH heads provided no response.

Land ownership and size

Only 1 HH head of 21 respondents owns the land. 12 respondents (about 40 % of 30 HH heads) rent from relatives, and 13 respondents rent from a private owner without payments. 4 HH heads did not provide an answer.

In regard to the size of the homestead land (hereinafter referred to as “lot”), 7 HH heads nominated sizes ranging from $50m^2$ to $200m^2$. 23 HH Heads did not answer the question.

(e) Opinion on the Project

Opinion on relocation

There is general agreement that flood control measures need to be placed in the area. In accordance with the interview results, there are no respondents who disagree on relocation if the Project will require them to do so. 50% of respondents agreed unconditionally and 13% of them agreed conditionally to be relocated or transferred, and 11% agree and follow the LGU’s decision. Others needed more information before deciding. Meanwhile, most would agree to the project, but they needed more concrete information about the extent to which they will be affected, including the relocation site and the lawful payments for their land and crops.

Relocation site

The residents who agreed to be relocated were asked about their preferred relocation site and about 49% of them answered that, if possible, they wanted to be relocated within their neighborhood.

9.1.5 The Project

(1) Project Site

The Sector-Loan Project aims to protect the core area which is the Municipality of Tagoloan. The locations of core areas are shown in Figure R 6.1. in Chapter 6. Project Components

The components of the Project are i) dike construction, ii) excavation of the river channel to expand the river area, iii) drainage sluice, and iv) drainage improvement. The distributions of the physical construction components are shown in attached Figure 7.8 in Chapter 7. A summary of project components is shown below:

Table R 9.11 Summary of the Project Components

Component	Length (m)	Height/ Depth (m)	Width (m)	Volume (m3)
Dike(1)_Downstream on Right Bank	2,000 m	2~4m	Crown: 5m	123 thousands
Dike(2)_Upstream on Right Bank	650 m	1~4m	Crown: 5m	71 thousands
Excavation_Towhead Area	8.8 ha	2~4m	50m in width	365 thousands
Total (Embankment)	2,650m	1~4m	Crown: 6m	194 thousands
(Excavation/Dredging)	8.8 ha			365 thousands
Drainage Sluice	1 location	B x H x n = 3.0m x 3.0m x 2		
	2 locations	B x H x n = 1.5m x 1.5m x 1		
Drainage Improvement	880 m	B=10m		
	750 m	B=1.5m		
	850 m	B=1.5m		

Source : JICA Study Team

(2) Alternatives and Evaluation from Environmental & Social Aspects.

Alternatives were considered as to several aspects such as risk management, economic criteria, construction, natural environment, and social environment. With regard to environmental and social consideration aspects, the scale of impact on people’s lives can be shown as the scale of land acquisition and resettlement.

(a) Consideration of without project

The damage done to the natural and social environments of the core area and the lower downstream area where is planned to be developed through flooding would not be mitigated in the case of the project not proceeding. Other impacts which would be caused by the project such as land acquisition, resettlement, etc., will not eventuate if the Project does not proceed. However, the risk of a flooding disaster would never be mitigated without the Project, and it would certainly have a negative impact on both natural and social environments. The negative impact without the project proceeding is considered much greater than the potential impacts by the project itself. Taking into consideration the entire evaluation of alternatives in Chapter 7- including the option of the project not proceeding- it is concluded that the Project is required and necessary for the Project site.

(b) Comparison of alternatives

There are 2 alternatives (T1 and T2). T1 shows the dike alignment following the river. T2 is a different alignment from the river. T2's land acquisition area is bigger than T1. But, the area for the dike (1) is under control of PHVIDEC. Land acquisition is not required as there are no residents. The total evaluation of 2 alternatives is shown in Table R7.3 in Chapter 7. The consideration/evaluation/decision of alternatives are carried out not only according to environmental & social aspects but also on economical and efficiency/effectiveness aspects and demands of the municipality/general populace. The evaluation criteria for environmental and social consideration aspect are the scale of i) land acquisition, ii) resettlement, iii) scale of flood areas after construction, and iv) amount of disposal soil. The results of comparisons are shown in Table R 9.8. In accordance with the Table, both alternatives can be evaluated as almost identical in outcome. T2 can prevent the effect of flooding both upstream and downstream. Thus, T2 can be evaluated as having a smaller impact than T1.

Table R 9.12 Comparison of Impact on Environmental and Social Condition on Tagoloan

	T1	T2
Concept	Dike alignment follows in line with the existing river bank.	Dike alignment sets so that the flood conditions in unprotected areas do not get worse after the project.
L.A	(-C)	(-B)
R.	(-C)	(-C)
F.A.E	(-B)	(x)
D.S	(-C)	(-C)
C.E.	(-C)	(-C)

L.A.: Land acquisition, R: Relocation, F.A.E.: Flood area expanding
D.S.: Disposal Soil amount, C.E.: Comparative Evaluation
(-A): much significant, (-B): significant, (-C): small impact, (x): no impact
Source: JICA Study Team

9.2 EIA system in Philippines and ECC for the Project

9.2.1 Out line of Philippine EIA System (PEIAS)

(1) Regal Framework of Environmental and Social Considerations in Philippines

The powers and functions of executive agencies other than the Local Government Units (LGUs) are provided in the Administrative Code. Under this law, the Department of Environment and Natural Resources (DENR) is the primary agency responsible for environmental management as well as the use and management of all natural resources.6 The EMB is the unit within DENR that is primarily responsible for pollution issues and environmental impact assessment. A quasi-judicial body, the Pollution Adjudication Board (PAB), is composed of top DENR officials and representatives from the private sector. The PAB is authorized to decide pollution cases and impose fines.

Presidential Decree 1586 required certain projects to submit an environmental impact statement (EIS: detailing the environmental consequences of construction and operation) prior to the development activity. The DAO 37-1996 lists the types of "Environmentally-Critical Projects (ECP)" covered by the requirement (usually heavy industries). All ECPs are required to conduct an environmental study even if the scale of the project impacts would be small. The DAO 30-2003 has added a list of "Environmentally-Critical Areas (ECA)" where even minor projects are required to conduct some impact assessment. It requires detailed EIA for ECPs and relatively simpler studies (called Initial Environmental Examinations (IEEs) or checklists for minor projects or activities in ECAs) based on the level or degree of potential environmental impacts. For projects without any significant impacts, the project proponent shall obtain a Certificate of Non-Coverage (CNC). The EMB-DENR is the primary implementer of the law. The ECC of major projects needs to be approved by the Secretary of the DENR. For minor projects, the Regional Director of the DENR in the region where the project is situated approves the ECC.

PEIAS is a set of laws, regulations, administrative orders and guidelines concerned Environmental Impact Assessment (EIA). Among them some of the most important laws and guidelines are bellows:

(Environment)

- Environmental Impact Statement System, Presidential Decree No. 1586 (1978)

  An act establishing and centralizing the Environmental Impact Statement (EIS) System under the National Environmental Protection Council (NEPC), which merged with the National Pollution Control Commission (NPCC) in June 1987 to become the Environmental Management Bureau(EMB).

- Presidential Proclamation No. 2146 (1981) and No. 803(1996)

  It proclaims Environmentally Critical Projects (ECPs) to have significant impacts on the quality of the environment and Environmentally Critical Areas (ECAs) as environmentally fragile areas within the scope of the EIS System.

- DENR Administrative Order No. 30 Series of 2003 (DAO 03-30), Revised Procedural Manual (2007)

  It provides implementing rules and regulations of Presidential Decree No. 1586, establishing the Philippine Environmental Impact Statement System (PEISS).

Also, detailed information in definitions of technical terms, procedures, related laws and regulations are described.

(Social Consideration)

- Guidelines for the Acquisition of Certain Parcels of Private Land Intended for Public Use Including the Right-of-Way Easement of Several Public Infrastructure Projects, Administrative Order No. 50 (1999)

The order is an amendment of the procedures for acquisition of property, declared by Presidential Decree No. 1533 mentioned in the latter section.

With respect to the conditions to be complied with during the negotiated sale, the order states that all the government agencies which are engaged in public infrastructure projects shall first negotiate with the owner for the acquisition of parcels of private land intended for public use including the right-of-way easement of such projects, by offering in writing a purchase price of an amount equivalent to 10% higher than the zonal value of the said property. During the negotiation, the landowner shall be given 15 days within which to accept the amount offered by the concerned government agency as payment for the land.

After the abovementioned period and no acceptance is made by the landowner, the concerned agency, in coordination with the Solicitor General, shall initiate expropriation proceedings in the proper court, depositing 10% of the offered amount.

Besides, the order prescribes the standards for the assessment of the value of the land subject of expropriation proceeding.

- An Act to Facilitate the Acquisition of Right-of-Way, Site or Location for National Government Infrastructure Projects and for other Purposes, Republic Act 8974 (2000)

It declares that private property shall not be taken for public use without just compensation. Towards this end, the State shall ensure that owners of real property acquired for national government infrastructure projects are promptly paid just compensation. The Act also provides Guidelines for Expropriation Proceedings including compensation of the property which shall be appraised by determining the market values of lands and improvements. The Sec. 8 states that the implementing agency shall take into account the ecological and environmental impact of the project.

- The Agricultural Land Reform Code, Republic Act 6389 (1971)

The Act amended the agricultural land reform code. The agricultural lessee shall be entitled to disturbance compensation equivalent to five times the average of the gross harvests on his landholding during the last five preceding calendar years.

- Executive Order 1035 (1985)

The order provides the procedures and guidelines for the acquisition of private properties or rights for development projects by the government, including government-owned or controlled corporations and state colleges and universities.

Acquisition shall be done either through negotiated sale or expropriation. The order gives authority to the government implementing agency/instrumentality concerned to immediately institute expropriation proceedings if the parties fail to agree in negotiation of the sale. The just compensation to be paid for the property acquired through expropriation shall be in accordance with the provisions of P.D. No. 1533 under-mentioned.

- Presidential Decree No. 1533 (1978)

It establishes a uniform basis for determining just compensation and the amount of deposit for immediate possession of the property involved in eminent domain proceedings.

- Urban Development and Housing Act, Republic Act 7279 (1992)

This Act provides policy to undertake, in cooperation with the private sector, a comprehensive and continuing Urban Development and Housing Program. The program is aimed to uplift the conditions of the underprivileged and homeless citizens in urban areas and in resettlement areas by making available to them decent housing at affordable cost, basic services, and employment opportunities. The Program covers lands in urban and urbanizable areas, including existing areas for priority development, zonal improvement sites, slum improvement and resettlement sites. Under this Act, eviction and demolition are allowed in danger areas such as railroad tracks, garbage dumps, riverbanks, shorelines, waterways, and other public places such as sidewalks, roads, parks, and playgrounds.

- Instituting the National Drive to Suppress and eradicate Professional Squatters and Squatting Syndicates, Executive Order No.153 (1999)

The Act states that the Housing and Urban Development Coordinating Council (HUDCC) and the Department of Justice (DOJ) shall have authority to call on the relevant government agencies to give their assistance and cooperation to intensify the national drive against the professional squatters and squatting syndicates.

Also, the Act prescribes that the National Police Task Force shall be strengthened as the operational arm of the HUDCC in the implementation of the provisions of the order.

- Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples' Policy (LARRIPP) (2007)

This is the guideline of DPWH for land acquisition and resettlement. This policy was established based on Philippines national laws, regulations and it includes the guidelines of WB, ADB, and JBIC. This policy is applicable for the projects under DPWH.

- Relevant Guidelines

Some of the guidelines prepared to put the above-mentioned laws into effect are listed below.

  - Implementing Rules and Regulations Governing the Registration of Socialized housing Beneficiaries (1993)

- Implementing Guidelines for the Acquisition, Validation, Disposition and Utilization of Lands for Social Housing (1993)
- Implementing Rules and Regulations to Ensure the Observance of Proper and Hmane Relocation and Resettlement Procedures Mandated by the Urban Development and Housing Act (1992)
- Guidelines for Land Validation for Socialized Housing, Local Financial Circular 3-92 (1992)
- Guidelines of Executive Order No.153

(Laws and Regulations Concerning the Environmental Standards)

- Environment Code, Presidential Decree No. 1152

  Known as the Philippine Environment Code, it launches a comprehensive program on environmental protection and management. It also provides for air, water quality, land use, natural resources and waste management for fisheries and aquatic resources; wildlife; forestry and soil conservation; flood control and natural calamities; energy development; conservation and utilization of surface and ground water and mineral resources.

- Water Code, Presidential Decree No. 1067

  A decree instituting a water code which revises and consolidates the laws governing the ownership, appropriation, utilization, exploitation, development, conservation and protection of water resources.

- Clean Water Act, Republic Act 9275

  An Act which aims to protect the country’s water bodies from pollution of all possible sources (industrial, commercial, agriculture and household activities). It provides for a comprehensive and integrated strategy to prevent and minimize pollution through a multi-sectoral and participatory approach involving all the stakeholders.

- Clean Air Act of 1999, Republic Act No. 8749

  An Act which lays down policies to prevent and control air pollution. The act sets standards of exhaust gas from vehicles, manufacturing plants and so on to follow. All potential sources of air pollution must comply with the provisions of the Act. As such, all emissions must be with in the air quality standards set under the law. It also imposes the appropriate punishments for violators of the law.

- Ecological Solid Waste Management Act, Republic Act No. 9003 (2000)

  An Act providing for an ecological solid waste management program, creating the necessary institutional mechanisms and incentives, declaring certain acts prohibited and providing penalties, appropriating funds therefore, and for other purposes.

- Pollution Control Law, Presidential Decree No. 984

  An Act that serves as the foundation for managing industrial activities impacting air and water quality. It empowers the DENR to impose ex-parte cease and desist orders (CDO) on the grounds of immediate threat to life, public health, safety or welfare, or to animal or plant life when wastes or discharges exceed the normal.

- Forestry Reform Code, Presidential Decree No. 705

The Forestry Reform Code of the Philippines recognizes that there is an urgent need for proper classification; management and utilization of the lands of the public domain to maximize their productivity to meet the demands of the increasing population of the Philippines. It surmises that to achieve the above purpose, it is necessary to reassess the multiple uses of forest lands and resources before allowing any utilization to optimize the benefits that can be derived. It also emphasizes not only the utilization but more so on the protection, rehabilitation and development of forest lands to ensure the continuity of their productive condition.

- National Integrated Protected Areas System (NIPAS), Republic Act No. 7586

An Act that aims to protect and maintain the natural biological and physical diversities of the environment notably on areas with biologically unique features to sustain human life and development as well as plant and animal life. It establishes a comprehensive system of integrated protected areas within the classification of national park as provided for in the Constitution to secure for the Filipino people of present and future generations the perpetual existence of all native plants and animals. It encompasses outstandingly remarkable areas and biologically important public lands that are habitants of rare and endangered species of plants and animals, bio-geographic zones and related ecosystems, whether terrestrial, wetland or marine.

(2) Category of project

In accordance with DENR Administrative Order No.37, series of 1996 (DAO 37), any projects in Philippines are required to obtain ECC or CNC. The projects which are required CNC are defined in Section 2.0 of DAO 37. The other projects are categorized as EIA-covered projects which are classified into Group I to V as below.

Table R 9.13 Project type in PEIAS

Group	Description
I	Single ECP (Environmentally Critical Project) in ECA (Environmentally Critical Area) or NECA (non-ECA)
II	Single NECP (non-ECP) in ECA
III	Single NECP in NECA
IV	Co-located Projects in either ECA or NECA
V	Unclassified Projects

Source: Table 1-3 of RPM

There are 4 EPCs and 12 ECAs, they are described as Table R 9.14.

Table R 9.14 ECPs and ECAs in PEIAS

A. List of ECPs	
1	Heavy Industries – Non-ferrous Metal Industries, Iron and Steel Mills, Petroleum and Petro-chemical Industries including Oil and Gas, Smelting Plants
2	Resource Extractive Industries – Major Mining and Quarrying Projects, Forestry Projects (logging, major wood processing projects, introduction of fauna (exotic animals) in public and private forests, forest occupancy, extraction of mangrove products, grazing), Fishery Projects (dikes for/ and fishpond development projects)
3	Infrastructure Projects – Major Dams, Major Power Plants (fossil-fueled, nuclear fueled, hydroelectric or geothermal), Major Reclamation Projects, Major Roads and Bridges
4	All golf course projects
B. List of ECA Categories	
1	All areas declared by law as national parks, watershed reserves, wildlife preserves, sanctuaries
2	Areas set aside as aesthetic potential tourist spots
3	Areas which constitute the habitat of any endangered or threatened species of Philippine wildlife (flora and fauna)
4	Areas of unique historic, archaeological, or scientific interests
5	Areas which are traditionally occupied by cultural communities or tribes
6	Areas frequently visited and/or hard-hit by natural calamities (geologic hazards, floods, typhoons, volcanic activity, etc.)
7	Areas with critical slopes
8	Areas classified as prime agricultural lands
9	Recharged areas of aquifers
10	Water bodies characterized by one or any combination of the following conditions: tapped for domestic purposes; within the controlled and/or protected areas declared by appropriate authorities; which support wildlife and fishery activities
11	Mangrove areas characterized by one or any combination of the following conditions: with primary pristine and dense young growth; adjoining mouth of major river systems; near or adjacent to traditional productive fry or fishing grounds; areas which act as natural buffers against shore erosion, strong winds and storm floods; areas on which people are dependent for their livelihood.
12	Coral reefs characterized by one or any combination of the following conditions: With 50% and above live coralline cover; Spawning and nursery grounds for fish; Act as natural breakwater of coastlines

The groups mentioned in Table R 9.13 are classified into several project types, and project types are classified into sub-types. Table R 9.15 shows number of project type and sub-type. The details are described in the Annex 2-1b of the RPM.

Table R 9.15 Number of project types in PEIAS

Group	Number. of types	Number. of sub-types
Group I	4 types	37 sub-types
Group II	20 types	121 sub-types
Group III:	no type	no sub-type
Group IV	1 type	1 sub-type
Group V: ,	1 type	2 sub-types
Total	26 types	161 sub-types

Source: Annex 1-2b of RPM

(3) Required report

There are seven (7) major EIA Report types as: (1)Environmental Impact Statement (EIS), (2) Programmatic EIS (PEIS), (3) Initial Environmental Examination Report (IEER), (4) IEE Checklist (IEEC), (5) Project Description Report (PDR) (6) Environmental Performance Report and Management Plan (EPRMP), (7) Programmatic EPRMP (PEPRMP) for co-located project applications. (1) to (4) are prepared for Group I and II, (5) is for non-covered project (to obtain CNC), (6) and (7) are for the revised projects or co-related projects. The necessary type of EIA report is decided by EMB-DENR.

Table R 9.16 Summary of Project Groups, EIA Report Types, Decision Documents, Deciding Authorities and Processing Duration

Project Groups	Documents Required For ECC/CNC Application	Decision Document	Deciding Authority	Max Processing Duration
I: Environmentally Critical Projects (ECPs) in either Environmentally Critical Area (ECA) or Non-Environmentally Critical Area (NECA)	Environmental Impact Statement (EIS)	ECC	EMB Director / DENR Secretary	120 days (Working Days)
II: Non-Environmentally Critical Projects NECPs) in Environmentally Critical Area (ECA)	Environmental Impact Statement (EIS) / Initial Environmental Examination Report (IEER) / Initial Environmental Examination Checklist (IEEC) /Project Description Report (PDR)	ECC/CNC	EMB RO Director	15-60 days (Working Days)
III: Non-Environmentally Critical Projects (NECPs) in Non-Environmentally Critical Area (NECA)	Project Description Report (PDR)	CNC	EMB Director / EMB RO Director	15 days (Working Days)
IV: Co-located Projects	Programmatic Environmental Impact Statement (PEIS)	ECC	DENR Secretary	180 days (Working Days)
V: Unclassified Projects	Project Description Report (PDR)	CNC or Recommendation on Final Grouping and EIA Report Type	EMB Director / DENR Secretary / EMB RO Director	15 days (Working Days)

Source: Revised Procedural Manual for DENR Administrative Order No. 30 Series of 2003 (DAO 03-30) (2007)

After decision of type of required report, the EIA system in Philippines is going on as follows.

(4) Procedure of ECC obtaining

The following comprise the major steps of the environmental compliance certificate application process for projects requiring an environmental impact study:

1. Project Screening - The first step in the EIS process is determining which projects are covered or not by which requirements. The law pre-categorizes projects based on the level or degree of potential environmental impacts and each category has a prescribed environmental assessment instrument of commensurate scale or level of complexity. Projects that fall under environmentally critical projects in both environmentally critical areas and non-environmentally critical areas are classified as Group I projects. Those that are non-environmentally critical but located within environmentally critical areas are classified as Group II projects. Projects that are neither environmentally critical nor located in environmentally critical areas fall under Group III projects. Co-located projects fall under Type IV while unclassified projects are under Group V. Environmental enhancement projects are included under Group II projects and are required only a simple Project Description except for those with environmentally critical components which will be required IEEs or EIAs. The initial screening is usually done by the proponent with the help and concurrence of DENR staff.

(While the projects in the three rivers are meant to help alleviate the flooding impacts in the core development areas, the projects have been screened as environmental enhancement projects under Group II but since they do have some critical components such as dredging and land excavation they have been required to have an IEE report. This was done with the help of EMB staff and the DPWH-ESSO)

2. Scoping – Scoping is where the key issues and concerns are identified and the scope of the study is agreed upon by the proponent, the EIA consultants, DENR-EMB, EIA Review Committee (EIARC), local residents and other project stakeholders. Here the proponent is required to submit a Project Description for Scoping (PD-S) which will be the basis for the determination by the EIARC of the pertinent technical issues. It is during scoping that the EIARC for the project is formed and project stakeholders are identified. The review committee is a body of independent technical experts and professionals of various fields organized by the DENR-EMB to evaluate the EIS Report and to make appropriate recommendations regarding the issuance or non-issuance of an environmental compliance certificate. It is also during scoping when requirements for specific studies such as environmental risk assessment and environmental health impact assessment are determined. The major activities include presentation of project to the EIA Review Committee, on-site scoping with project stakeholders, and a technical scoping session with the review committee. These activities result in the production of the scoping report and the scoping checklist.

A new memorandum issued only last October 1, 2009 has made such a scoping session optional although the necessary scoping guidelines have not yet been issued. This means that scoping may be done wholly by the project proponent without intervention by the EMB or the EIARC. The hiring of outside consultants for the EIARC has also been discouraged. This means that the EMB has to review the submitted report with its in-house personnel.

3. Environmental Impact Assessment Study - The conduct of the EIA study commences after the scoping checklist is finalized. The assessment for Category B projects typically includes characterization and analysis of the biophysical, chemical, social, economic and cultural environment although on a much smaller and specific

scale than that of a full-blown EIA. However, the new memorandum issued on October 1, 2009 has focused the EIA study to include only the environmental impacts of the proposed project. The socio-economic impacts and impact mitigation have been transferred to other agencies such as the LGUs. Public participation has also been removed from the EIA process with public scoping, socio-economic and perception surveys, and public hearings and consultations not required anymore . Since the memorandum is rather new, the impact of this on the EIA guidelines is rather obscure and a new set of guidelines will be expected from the DENR. Other important parts of the EIA study include the following

a. baseline data gathering, where the environmental conditions within the main impact areas before the project commences are gathered. This includes air quality, water quality, soil quality, flora and fauna studies, and other environmental data that is identified during scoping. Primary data may be collected but for IEE reports, data may be sourced from secondary sources

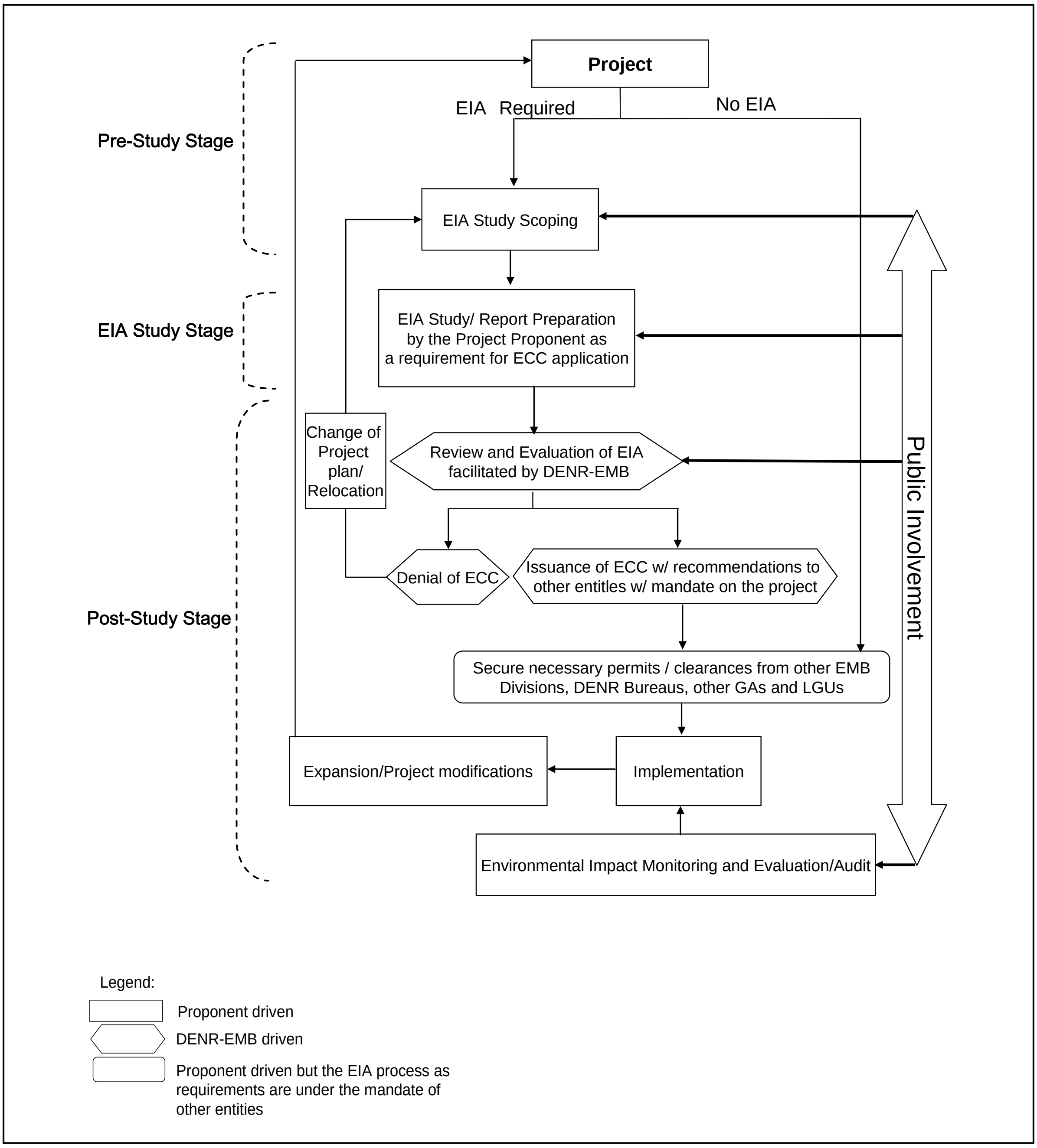
b. impact identification, prediction and evaluation, which involves a description of the project to be developed and its activities and the characterization of the possible impacts of project activities

c. environmental planning, which involves the creation of an environmental management plan and an environmental monitoring plan. The environmental management plan focuses on the key impacts and the manner by which these impacts are mitigated. This will also include a maintenance plan and an abandonment plan if the project is abandoned.

4. Environmental Impact Assessment Review - The results of the EIA study together with other required documents are packaged into an EIS or an IEE Report, which is submitted to DENR-EMB office for review. If a full-blown EIA is required, the document is submitted to the EMB central office. If an IEE or a CNC document is provided, the document is submitted to the EMB regional office where the project is located The review process consists of two stages. The first stage is a “procedural review” to be conducted by a DENR-EMB staff whose primary job is to check for completeness and ensure that submitted documents are clear and legible. Once the document is complete, the IEE or EIA shall be deemed accepted by the EMB. The second stage is the “substantive review” by the EIA Review Committee, which is now supposed to be chiefly composed of EMB and DENR personnel. At this stage, the review committee may conduct field visits or site inspections. The EIARC may not require any additional information anymore according to the new memorandum. ECC process application is now 20 working days.

5. Post-ECC requirements – After the environmental compliance certificate is issued, the proponent is expected to implement the environmental management plan and meet the conditions stipulated in the environmental compliance certificate. Post-environmental compliance certificate requirements may include the conduct of additional specialized studies such as biodiversity. With the shorter processing times and the optional attendance of the EMB and the EIARC during scoping, it is expected that the ECC conditions may become longer and more stringent. Since there is no limit on the number and types of conditions that can be included in the environmental compliance certificate, the DENR has used the environmental compliance certificate to include conditions or requirements that were not yet mandated by law but which the DENR felt necessary.

The summarize EIA process in Philippines is shown in Figure R 9.2.



Source: Revised Procedural Manual for DENR Administrative Order No. 30 Series of 2003 (DAO 03-30)(2007)

Figure R 9.2 Summary Flowchart of EIA Process

9.2.2 ECC obtaining process for the Sector-Loan Project

(1) Category of the Project in PEIAS

The JICA Study Team prepared the checklist as self-screening and discussed the category of the Project, the procedure for ECC with EMB-DENR on 28th of September. Also, The JICA Study Team discussed this matter with R.O. of EMB in each region.

EMB-DENR evaluated the Project through project description and concerning the condition surrounding the Project site as below:

a. The Project is not EPC stipulated by DAO 37-1996.

b. The Project targets a river. However, the Project does not include a reservoir, and there is not much possibility that the river flow will be changed in any way.

c. The Project aims to mitigate the impact of potential natural disasters and would enhance the social environment.

d. The Project includes large amounts of excavated soil. Therefore, the handling of the soil disposal issue should be considered and necessary measures prepared and taken.

Based on these considerations, EMB-DENR explained that the Project was categorized as the Environmental Enhancement Project of Type II. The required report for ECC application for the Project is IEE report. The prepared self-screening checklist was attached as Annex PIIC_9-7.

(2) Necessary items of application for ECC in PEIAS

In accordance with explanations by EMB-DENR, for projects required to submit an Initial Environmental Examination, the requirements would almost be the same as an Environmental Impact Statement, although scaled down. There would be the same modules required, i.e. land, water, air, people but the EMB is usually not stringent in requiring actual water sampling or primary data collection in this case. Presumably, the IEE report can be accomplished in a faster span of time.

(3) Outputs of IEE report of this study

The outline of this study is listed below: 1) Project description, 2) Baseline data of natural/social conditions, 3) Scoping and necessary mitigation measures, 4) Recommendations of the monitoring plan

(4) Comparison of former JBIC guideline and requirements for ECC in Philippines

The comparisons between JBIC Guidelines for Confirmation of Environmental and Social Considerations[2] (hereinafter referred to as JBIC guidelines) and requirements for IEE report in PEIAS are described in Annex PIIC_9-8. There is no major difference between them.

(5) Necessary studies for the next step by DPWH

After this preparatory study, DPWH would need to carry out the IEE study and the simple RAP study to obtain ECC.

[2] It was established in 2004 April.

9.3 General IEE study result (not specified IEE in Philippine)

The Project description and the baseline data collection have been described in previous chapters. In this chapter, the results of scoping, mitigation measures and recommendation of the monitoring plan are described.

9.3.1 Scoping results

(1) Resettlement, land acquisition

The estimated number of houses which will be relocated is about 1 or 2. The confirmed number of resettlers is 2 to 8 (in maximum). The number shows no large scale resettlement.

The land acquisition area for construction is estimated as 30.9 ha in total. 20ha of the necessary land acquisition area for dikes (1) is under the control of PHIVIDEC. 8.8 ha of excavation on towhead is basically Government-owned land. Farmers rent the lands and cultivate them. One of the farmers is insisting on his land ownership which needs to be confirmed and verified. The lands for dikes (2) are almost all in private hands. The land is either agricultural or bare land present.

(2) Affection for traffic, living facilities, and the living of residents

(Impact on traffic): It is expected that the dike constructions would not cause much disruption to traffic, because the dike construction sites are located along the river and far from the residential area. The excavation area is located on towhead. The people living on the towhead (under the Tagoloan Bridge) go down from Tagoloan Bridge using a wood ladder. The residents living in the town areas use the bridge across Tagoloan River and there is no water traffic in the Project site. Therefore, it is not expected much impact on the disruption to traffic.

(Impact on living conditions of residents): The impact on the life of residents is expected to include i) temporary noise/vibration, air pollution, water pollution during construction, ii) life style changes due to resettlement. The impacts during construction are described (6) in this chapter.

(Benefit impact on living conditions of residents)

i) Mitigation of flood disaster: The dike (1) would be prepared by a developer of the area if the Project does not proceed. If the dike alignment is set along the river, it should introduce an expansion of the flood areas at upper/lower areas. The dike (2) aims to mitigation the flood into the core area. Therefore the adverse impact of the Project would be large. ii) Opportunity for employment: The construction would need many laborers during construction, thus it would introduce the opportunities for employment to the local residents.

(3) Solid waste

Short-term deterioration of sanitary conditions could occur in and around the construction site during construction activities, including worker’s camps. Disposal of the construction residue of the project would be expected to occur during construction. Waste from worker’s camps is also expected to increase during construction in the short-term.

Excavation will generate about 365 100 m^3 of excavated soil in total, with about 194 000 m^3 of it being used for the construction materials for the dikes. About 171 000 m^3

surplus soil will need to be treated. The sedimentation soil was sampled and analyzed for this study to test for heavy metals. There are no indications of the presence of hazardous heavy metals. In case the surplus soil will be disposed in inappropriate places, the impact should be significant on the environment. Therefore, serious consideration must be given to appropriate treatment methods.

(4) Safety during construction

Due to the dike constructions involving the use of heavy equipment, there is a possibility for the Project to cause a construction-related accident.

The excavation area is located near the residential areas (not only the residents on the towhead but also the residential area along the river). There is a possibility of traffic accidents involving the residents due to the increase in the volume of construction equipment and transportation vehicles.

(5) Biological Environment

The major direct impacts on the natural vegetation cover and wildlife would not be expected to be significant. The Project will build dikes near the agricultural areas where the natural conditions have already been changed to the extent that the area no longer contains much original natural vegetation which could be potentially negatively and directly affected.

There is the possibility for the Project causing an impact on sediment-based living creatures due to the excavation works which will dredge parts of the river sediment. However, the scale of work to be carried out is small compared to the scale of the Tagoloan River (about 1,778 km^2, and only 8.8ha in the excavation areas). The change of conditions of the sediments in the river through excavation would be expected to return to normal levels again in a comparatively short period of time. Therefore a significant impact on the sediments in the river would not be expected

(6) Impacts during construction

The dikes are designed in the area far from the residential areas, while the excavation work is located near to the residential areas. The impacts during the excavation work period may include i) air pollution, ii) noise/vibration, iii) traffic problems, and iv) water pollution. These impacts are expected only during the construction stage but their magnitude would be large.

(Air quality): Locally significant impacts of dust emission are expected in the short term during the construction period caused by the movement of haulers and the operation of construction equipment, earthworks, and other related activities. A degradation of air quality due to gas emissions from those vehicles would be expected in the short term.

(Noise/vibration): Short-term noise created by the operation of the construction equipment and transport vehicles could be expected.

(Traffic): The number of vehicles would increase in the short term during construction. There is not a lot of traffic except around the bridge at present and a significant impact - such as heavy traffic - is not expected.

(Water pollution); There is a possibility in the short term for the Project to cause water pollution due to the dike construction and excavation of the river.

In the case of water pollution occurring, fisheries downstream and residents who use river water for drinking purposes, are expected to be affected. There are no fisheries in the river, and most residents do not use the river water for domestic consumption.

The total area of Tagoloan basin is approximately 1,778km^2. The area of excavation is about 8.8ha. Therefore, water pollution resulting from excavating the river could be expected to return to normal levels again in a comparatively short time.

SS (suspended solids) in the river are not measured and the river water looks murky with a charcoal color. It can be estimated that the water includes a lot of silt which have been carried down from upstream.

There is, therefore, the possibility for the Project to cause water pollution in the short term but there would not be significant impacts in accordance with the overall scale of construction, size and condition of the river, as well as current usage of the river water.

(7) Scoping table

The scoping results are shown in Table R 9.15.

Table R 9.17 Recommended Monitoring Plan

Item	Rating	Rating ground
Social consideration		
Resettlement	-B	- Only a few houses would be relocated along the designed excavation work in the Project area. - The necessary land acquisition area is about 30.9 ha in total. Most of the areas of land acquisition are owned by PHIVIDEC. The landowner of the towhead is Philippine Government while the lands for dike (2) are someone's private properties but it is unclear in detail. - The farmers who are currently renting the land for farming on the towhead would lose some of their income sources from the land.
Affection for traffic, living facilities, and the living of residents	-B/+A	- (negative point) The construction works would introduce air pollution, noise/vibration and water pollution temporarily. Some negative impacts on the people's lives due to the lifestyle changes by the resettlements are expected. - The people use Tagoloan Bridge to across the river and there is no water traffic. - (positive point) The core area has received flood damages in the past. The protection of the area as the fundamental base of people's lives would be very beneficial for the local people. The dike (1) would protect the planned development areas and with appropriate design, it would prevent expansion of flood on the upper/lower sides. - (positive point) During construction, employment opportunities for local residents would be created.
Decupling the areas	D	- The areas designated for dike constructions are agriculture lands or bear lands (no houses) at present. - The area between the dike and the river shall not be used for any purpose because of the anticipated/experienced risks of floods.
The local archeological, historical, cultural, and religious	D	- There are no local archeological, historical, cultural, and religious heritage sites in and surrounding the

Item	Rating	Rating ground
heritage sites		Project area.
Right of water, right of common	D	- There are no fisheries in the river in the Project site.
Ethnic Minorities and Indigenous Peoples	D	- There are no Ethnic Minorities and Indigenous Peoples in and close to the Project area.
Waste/sanitation	-A	- Deterioration of sanitary conditions would occur in and around the construction sites & worker's camps in the short-term. - Disposal of the construction residues and wastes from worker's camps would be expected during construction works in a short-term. - Excavation will generate about 171 000 m^3 of disposal soil in total. - The sedimentations were sampled and analyzed. There are no indications of the presence of hazardous heavy metals. - If the surplus soil will be disposed at inappropriate places, the negative impacts should be significant.
Safety during the constructions, waste control	-A	- Heavy equipment would be used for the construction. Therefore, there is some chance of accidents occurring. - The excavation site is located near residential areas. There is the potential for traffic accidents. - The work camp sites would generate waste
Natural condition		
Sensitive areas	D	- There are no national parks, protected areas, endangered or threatened species, protected mangrove areas, protected coral reefs in or near the Project site.
Topography and Geology	D	- The Project components are dike construction and excavation of the river. These constructions are not expected to introduce significant changes of topography and geology.
Lake, river flow condition	D	- The dike construction would not cause a significant change of river flow.
Sea shore, marine area	D	- The Project does not include any changing of the drift sands
Flora and fauna	D	- The Project area is a developed area. - There are no endangered species. - The dikes will be constructed on the agricultural areas which do not include much natural vegetation directly affected. - Total area of Tagoloan basin is 1,778km^2, the scale of excavation is not big. The change in sediment condition would be expected to recover comparatively quickly.
Landscape	D	- The height of dike is 1 to 4 m. It is not expected to cause topographic change, change of landscape.
Environmental Pollution		
Air quality	A	- Significant impacts of dust emission are expected in the short term during the construction period at excavation site - A degradation of air quality due to gas emissions from those vehicles would be expected in the short term
Noise/vibration	-A	- The excavation site will be located near the residential areas. Therefore, the impact of noise/vibration would be expected to be significant in the short term.
Traffic	D	- The number of vehicles would increase in the short term during construction.

Item	Rating	Rating ground
		- There is not a lot of traffic at present and a significant impact - such as heavy traffic - is not expected except for the areas adjacent to Tagoloan Bridge.
Water pollution	B	- There is a possibility for the Project to cause water pollution caused by dike constructions and excavation of the river in the short term. - The river water is not used domestically by the majority of residents. - There are no fisheries in the river. - The entire Tagoloan River Basin is 1,778 km^2 and the excavation is 8.8 ha - The river water looks murky with a charcoal color, it could be estimated that the water includes a lot of silt which would have been carried from upstream.

A: Significant impact will be expected
B: Some impact will be expected
C: The impact is not clear this time.
D: No impacts will be expected. No consideration is required for the EIA study
(Source: JICA Study Team)

9.3.2 Recommendations of the mitigation measures

The outlines of the mitigation measures are suggested below, with these representing the minimum requirements. These are expected to be verified and finalized by the results of IEE and simple RAP study which would be carried out by DPWH

(1) Mitigation measures for Resettlement, land acquisition

It is expected that a relocation of about 1 to 2 households and an area of approximately 39 ha of the total land acquisition. The impact from the resettlement and land acquisition is estimated as not to be significant. However, on the towhead, there is a farmer who is insisting his land ownership and it is expected that some tenant farmers would lose their sources of livelihood from the land. Therefore, it is required for DPWH to carry out a simple RAP study aiming at i) confirmation of the land ownership, ii) identification of the people who would be resettled and iii) preparation of rehabilitation programs for the farmers who would lose their sources of livelihood on the towhead. The simple RAP also would be required to be prepared through implementation of the study referring to the international donors' guidelines such as the World Bank and JICA.

(2) Mitigation measures for waste/sanitation

(Sanitation): To provide appropriate waste water treatment facility, toilet and waste collection at the workers' camps and project site.

(Waste): Rubbish, waste surplus and debris be cleared from the site and regularly disposed of in n approved landfill sites in line with and following governing rules and regulations.

(Surplus soil): It is required to confirm the points to prevent any significant impact on the environment from surplus soil as follows; i) verification of the soil which is not contaminated by heavy metals, ii) preparation of a appropriate disposal site, and iii) ascertaining a sufficient capacity for the disposal site, The construction plan for the Project was considered in this Study. The JICA Study Team discussed the plan with the local governments; Municipality Tagoloan and PHIVIDEC. As a result of the discussion, the following points were agreed

- It is expected that surplus soil of construction work of the excavation and embankment would be welcomed by those land development.
- It was agreed to use the planned industrial areas as disposal area and the surplus soil would be used as filling material for the creation of the land.

The soil has already been confirmed as containing no heavy metals and the disposal sites have sufficient capacity. In the case of the construction being carried out in accordance with the plan, the surplus soil will be used for the creation of the land as filling material and it will be treated without significant impact on the environment. The construction plan will be therefore a function of an effective mitigation measure. It is expected to mitigate the environmental impact if the construction would be carried out as planned.

It is recommended that the mitigation measures are identical as described in the construction plan in this report as follows; i) the soil will be used as filling material for dike constructions, ii) the surplus soil shall be carried to the planned sites for industrial development land areas in the PHIVIDEC owned lands and will be used as filling materials for land reclamation. It also is recommended that when the detailed construction plan is prepared, it should be discussed with the Local Government of Tagoloan and PHIVIDEC again and confirm the receiving sites.

(3) Mitigation measures for safety during construction

The recommendations for safety during the construction are: i) keep safety in mind at all times, ii) provide safety helmets to each laborer. It is highly recommended to pay attention to accident prevention especially during heavy equipment operation, iii) emphasis on accident prevention involving residents when transport vehicles access through residential areas, iv) disclosure of information relating to construction to the residents from the construction planning stage onwards and asking them for their understanding and cooperation regarding the impacts of construction.

(4) Mitigation measures for biological conditions

The excavation work would excavate a part of the sediment, which would have an impact on the sediment biology. However, it could be expected to be insignificant and to recover comparatively quickly. In the case of a long span of excavation being carried out in the short term, it is expected to become significant. Therefore, it is recommended to set a sufficient and adequate construction time period. Also, it is recommended to conduct interviews with the residents regarding the river conditions and confirm that significant changes – such as the degradation of fish stocks - would not occur.

(5) Mitigation measures for impacts by construction

The impacts during construction of excavation of towhead are expected to be i) air pollution (dust, exhaust emissions), ii) noise/vibration, iii) traffic, and iv)water pollution, while an impact expected by the dike constructions is water pollution only, because the construction sites are far from the residential areas. The recommendable mitigation measures for these works are as follows:

(Air pollution): It is recommended to mitigate the impact of air pollution as follows: i) launder mud and dust from vehicles, ii) keep the excavated soil or other soil materials wet by watering. The mitigation measures of exhaust emissions are; i) prohibit needless idling of engines, ii) prevent the concentrated operation of heavy equipment in one place, iii) adhere to the construction time schedule.

(Noise/vibration): it is recommended to mitigate impacts of noise/vibration as follows; i) use low noise equipment, ii) prohibit construction work during night time hours, iii) employ low noise construction methods. It is also recommended to disclose the information regarding construction procedures to the residents from the construction planning stage onwards and ask them to understand the resulting impacts of the construction activity.

(Water pollution): The impact from water pollution caused by the dike construction and excavation. However, it can be expected to be insignificant on the basis of considering the entire scale of construction as well as the river and the current usage of river water. It is recommended to conduct interviews with the residents and local governments' officials during construction and operation to confirm the impacts on river conditions.

9.3.3 Recommendation of monitoring plan

The environmental monitoring plan is recommended as below. The necessary items are i) air quality, ii) water quality, iii) noise/ vibration, v) resettlement/compensation and land acquisition.

The monitoring of air quality and noise/vibration is required during construction. Water quality needs to be monitored during both the construction and operation stage. The monitoring plan is recommended based on this study as below:

Table R 9.18 Recommended Monitoring Plan

Item	Location	Parameter	Frequency	Supervision
Preconstruction stage				
Payment of compensation according to the compensation policy described in the simple RAP				RIC
Public information (campaign) procedures				RIC
Grievance procedures				RIC
Resettlement site location/ design/ construction and plot allocation				RIC
Houses and its construction technical assistance, payment of subsistence and shifting allowances as described in the simple RAP				RIC
Provision of livelihood restoration programs (job training, etc.)				RIC
Construction stage				
Air quality	Left bank of Tagoloan River near excavation/dredging work.	PM10, TSP, CO, NOx, and SOx	Once per 4 months	Contractor
Water quality (General)	At upper & lower stream of excavation/dredging work area.	BOD, (5-Day 20ºC), DO, TDS, TSS ,Temperature, Oil/Grease, pH	Once per 4 months	Contractor
Noise/vibration	Left bank of Tagoloan River near excavation/dredging work.	Leq, sound speed and acceleration	Once per 4 months	Contractor
Operation Stage				
Livelihood conditions of PAPs (Whether the income of PAPs would not decrease caused by the resettlement)				RIC/ LUGs
Live conditions of PAPs (Whether the life conditions of PAPs would not be changed by the resettlement)				RIC/ LUGs

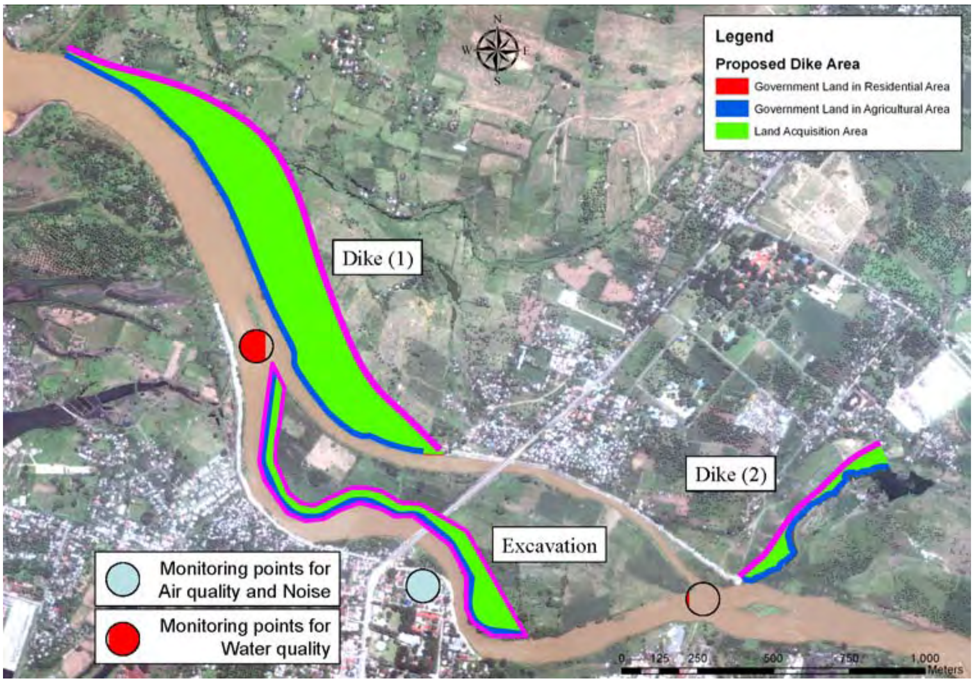


Figure R 9.3 Recommended Monitoring Locations

9.4 TOR for additional study in next stage for ECC obtaining

Initial Environment Evaluation Study: This study provides an IEE study report. DPWH would prepare the application to obtain ECC using this report and the IEE report.

9.5 Social consideration

9.5.1 Institution of resettlement and land acquisition in Philippines

(1) Policy of DPWH for resettlement and land acquisition

In the case of DPWH implementing a project, a revised policy was established in March 2007 (the contents show as guidelines). It is named as Land Acquisition, Resettlement, Rehabilitation and Indigenous People's Policy, 3rd edition (2007) (hereinafter refer as LARRIPP). It was revised and is now in its third edition. It was established in 1999 as Land Acquisition, Resettlement and Rehabilitation (LARR). The World Bank (WB) assisted in developing it with other financing institutions such as the Asian Development Bank (ADB), JBIC. A second edition of the LARR was formulated in 2004, assisted by ADB with JBIC guidelines. It was revised in 2006 when the DPWH policy of indigenous people was added, based on the Indigenous Peoples' Right Act (IPRA) and NCIP Administrative Order No. 1, series of 2006 or the Free and Prior Informed Consent Guidelines of 2006. Some minor points were revised in 2007 and it is now used as 3rd edition.

This policy includes the principles and objectives of the involuntary resettlement policy, the legal framework, eligibility, compensation and entitlements, the indigenous peoples' policy framework, implementation procedures that ensure complaints are processed, public support and participation, and the provision of internal and external monitoring of the implementation of the RAP with other financing institutions' policies such as WB, ADB and JBIC. It is composed of 8 chapters which are described below:

Chapter 1: INTRODUCTION (the general meaning of this policy, the sequence of revises)

Chapter 2: LEGAL FRAMEWORK

Chapter 3: POLICY ON ELIGIBILITY, COMPENSATION AND OTHER ENTITLEMENTS (1. landowners, 2. PAPs, 3. indicators of severity of impacts, 4. compensation per category of assets affected, 5. entitlement matrix)

Chapter 4: ON INDIGENOUS PEOPLE WHO WILL BE AFFECTED BY THE PROJECT

Chapter 5: PUBLIC PARTICIPATION AND CONSULTATION

Chapter 6: GRIEVANCE PROCEDURES

Chapter 7: INSTITUTIONAL ARRANGEMENTS

Chapter 8: MONITORING AND EVALUATION

The Process of land acquisition was described in 2 cases; i) including the indigenous people in the project site, and ii) not including the indigenous people in the project area. In accordance with LARRIPP, the process of land acquisition in the case of no indigenous people in the project site is summarized below:

DPWH, the project proponent, informs all PAPs of the following 3 points: i) the project would introduce involuntary resettlement, ii) Each PAP is entitled to receive just compensation for his/her affected plot at a rate to be negotiated between the Bureau of Internal Revenue (BIR) zonal valuation and the fair market value as provided by RA 8974, iii) 3. The BIR zonal valuation and the fair market value may differ substantially. The negotiation process is described as follows:

a. The DPWH will explainthe necessity of land acquisition as well as the compensation to PAPs,

b. In the case of PAPs not agreeing with the above, the DPWH will offer compensation at the BIR zonal valuation rates,

c. In case PAPs not agreeing with the above, the DPWH will promptly seek an independent valuation agent / estimator to appraise and determine the fair market value based on the following parameters: i. land use classification, ii. development costs for land improvement, iii. value declared by PAPs, iv. current selling price of similar properties in the vicinity, based on deeds of sale, v. disturbance / inconvenience, vi. tax declaration and BIR zonal valuation, vii. replacement cost,

d. The DPWH will communicate to the PAPs the current market value as determined by an independent land valuation agent,

e. The DPWH then begins negotiations with the PAPs to determine the final compensation,

f. If the PAPs do not accept the terms of this negotiation and the land valuation possible under RA 8974, their affected properties will be expropriated,

g. The DPWH will pay those PAPs whose property is under expropriation the amount equivalent to the sum of one hundred percent (100%) of the BIR zonal valuation and the court shall determine the just compensation to be paid to the PAP within sixty (60) days from the date of filing of the expropriation case. When the decision of the court becomes final and executable, DPWH shall pay the PAP the difference between the amounts already paid and the just compensation as determined by the court. In the interim, DPWH will deposit 100% of the BIR valuation into an escrow account.

The PAPs will be advised and notified of the available channels for complaints and grievances and related procedures. The PAPs will be informed that grievances related to the LARRIPP implementation or any aspect of the project will be handled through negotiations and are aimed at achieving consensus according to the following procedures:

1. The PAPs will lodge their grievances in writing with the Resettlement Implementation Committee (RIC) for immediate resolution.

2. If the complaint is not satisfactorily resolved within 15 days or the PAP does not receive any response from the RIC, the PAP can forward the complaint to or file an appeal with the DPWH Regional Office (RO).

3. If the complaint is not satisfactorily resolved within 15 days or the PAP does not receive any response from the DPWH RO, the PAP can file a legal complaint in any appropriate Court of Law.

The process of information disseminationwill be carried out by the Project Management Office (PMO) with the support of the Environmental and Social Services Office (ESSO, internal organization of DENR), the Regional Offices and District Engineering Offices and will be implemented through community meetings and leaflets. In accordance with Chapter V in the LARRIPP, it is noted that women and the elderly among the PAPs shall be consulted and mobilized to participate in the consultation meeting, and the Resettlement Action Plan discussed with them.

(2) Comparison of JBIC guideline and LARRIPP

The comparisons between JBIC Guidelines and LARRIPP are described in Annex PIIC_9-8. There are some differences between them, as outlined below. However, there is no major difference as to other items.

- Promotion of appropriate participation by the PAPs and their communities in the planning, implementation and monitoring of involuntary resettlement plans: The LARRIPP mentions the promotion of participation in the consultation meeting, but not any implementation and monitoring stages.

- Assistance for the informal settlers: The LARRIPP does not mention informal resettlers.

9.5.2 Stake holders meeting (SHM) and public consultation meeting (PCM)

(1) Plan of SHMs and PCMs

(a) Purpose of the meetings

Purpose of SHMs and PCMs are listed as below:

- To explain the project concept/design to LGUs and general people.

- To answer their questions.
- To collect their opinions and revise the design taking into consideration their opinions.
- To confirm basic agreement of the proposed Project and the design.

(b) Participants

The target participants for SHM are the members of LGUs such as, City/municipality/Barangay government officials, the Mayor and the politicians. The target participants for PCMs are the general public and NGOs. Basically, it is not easy for the public at large to express their opinions/questions in front of high positioned and senior persons such as the mayor. Therefore, the JICA Study team decided to divide the meetings into 2 types.

(c) Achievements

The SHMs in Tagooan were held on three occasions. The dates and venues of SHMs are shown in Table R 9.19.

Table R 9.19 SHMs in Tagoloan

SHM	Date/time	Host organization	Venue	Major participants	Major Agenda
1st	July 26	R.O. of DPWH in region 2	Tagoloan Conference Hall	From City/Municipality: CPDC/MPDC, Engineer, Sanggunian members, etc. From central Agencies: NEDA, DPWH, OCD, etc.	Project concept
2nd	Aug. 21	-ditto-	-ditto-	-ditto-	Design alternative
3rd	Sep. 24	-ditto-	-ditto-	-ditto-	Revised design
CPDC: City Planning and Development Coordinator, MPDC: Municipality Planning and Development Coordinator,OCD: Office of Civil Diffence, Sanggunian: Council of City/Municipality					
Source: JICA Study Team					

DPWH held SHMs as a host organization. The R.O. of DPWH arranged the SHMs with cooperation of government of City/Municipality. The officer of City/Municipality facilitated the meetings at the request of DPWH. The JICA Study Team took presentations of the design and answered the questions from participants.

The JICA Study Team held PCMs with the cooperation of the LGUs (City/Municipality) as shown in Table R 9.20.

Table R 9.20 PCMs in Tagoloan

SHM	Date/time	Host organization	Venue	Major participants	Major Agenda
1st	July 27	JICA Study Team	Tagoloan F.C.	Stakeholders (basically general people including PAPs)	Project concept
2nd	Aug. 22	-ditto-	-ditto-	-ditto-	Design alternative
3rd	Sep. 25	-ditto-	-ditto-	-ditto-	Revised design
F.C.: Formation Center					
Source: JICA Study Team					

9.5.3 Necessity of land acquisition and resettlement

(a) Land acquisition

Principle of land acquisition

(Necessary Areas): The necessary land acquisition areas are for dikes and for the land excavation. The land outsidethe dike is necessary for maintenance of the river flow. Therefore, this area outside the dike shall not be used for any purpose and the land shall be acquired. However, the planned areas for the dikes have been purchased by the Government of Philippines, and the PHIVIDEC manages these areas. Therefore, these lands allocated for the dikes need not be acquired. DPWH will arrange an Agreement between PHIVIDEC to use the land for dikes.

The towhead lands to be excavated are basically owned by the Government. There is one person, however, who insists on his personal ownership of the land. JICA Study Team confirmed his title, but the documents he produced seemed to be tax payment certificates. The ownership status will be verified and confirmed during the simple RAP study, and also consider his eligibility. Previously in the Philippines, the Government gave permission to use the government land for agriculture and the farmers were required to pay tax. But the law says that when the land is assigned and allocated for public purposes, it shall revert back to the Government, with compensation being paid for structures (crops, trees, constructions, etc) only.

The necessary areas for land acquisition are described in Figure R 9.4.

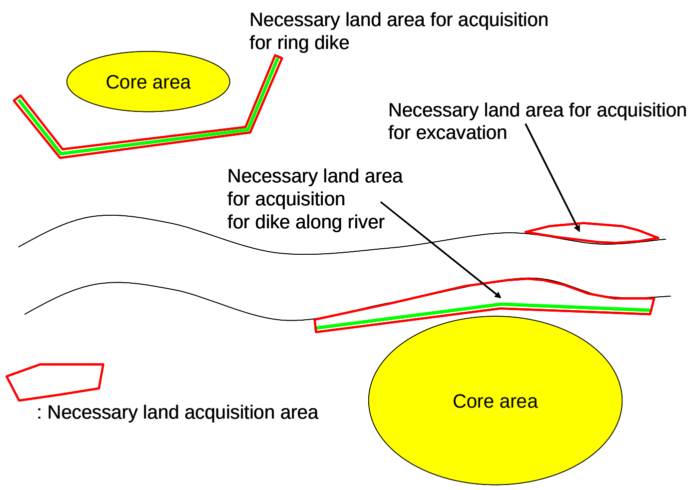


Figure R 9.4 Necessary areas for land acquisition

(Government land next to the river): In accordance with the Philippine civil code article 464, the area with a width or distance of 3m from the edge of the river in the residential area shall be deemed as Philippines Government land, meaning the land belongs to DPWH. The width (or distance) in agricultural use is 20m and 40m in forested areas. The determination of areas for residential, agricultural and forest use is governed by the land-use plan in each City/Municipality. (Figure R 9.5).

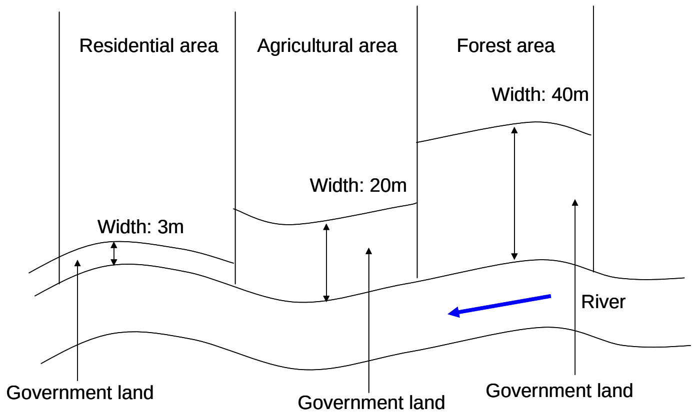


Figure R 9.5 Land ownership next to the river

<u>Necessary areas for land acquisition</u>

The total land acquisition area in the Project site is approx 31 ha. The details of land acquisition areas are shown in Table R 9.21.

Table R 9.21 Land Acquisition Area

Construction	Place	L.A. area (ha)	Initial land use
Flood protection dike	Downstream	20	Present: vacant, grassland Future: Industrial Area The are is under control by PHIVIDEC
Flood protection dike	Upstream	2.1	Flood plain, agricultural land The area is under control by PHIVIDEC
Excavation	Towhead area	8.8	Vacant, agricultural land
Total		30.9	
L.A.: Land acquisition Source: JICA Study Team, Refer to Table R.9.			

The location of the land acquisition area is shown in Figure R 9.5.

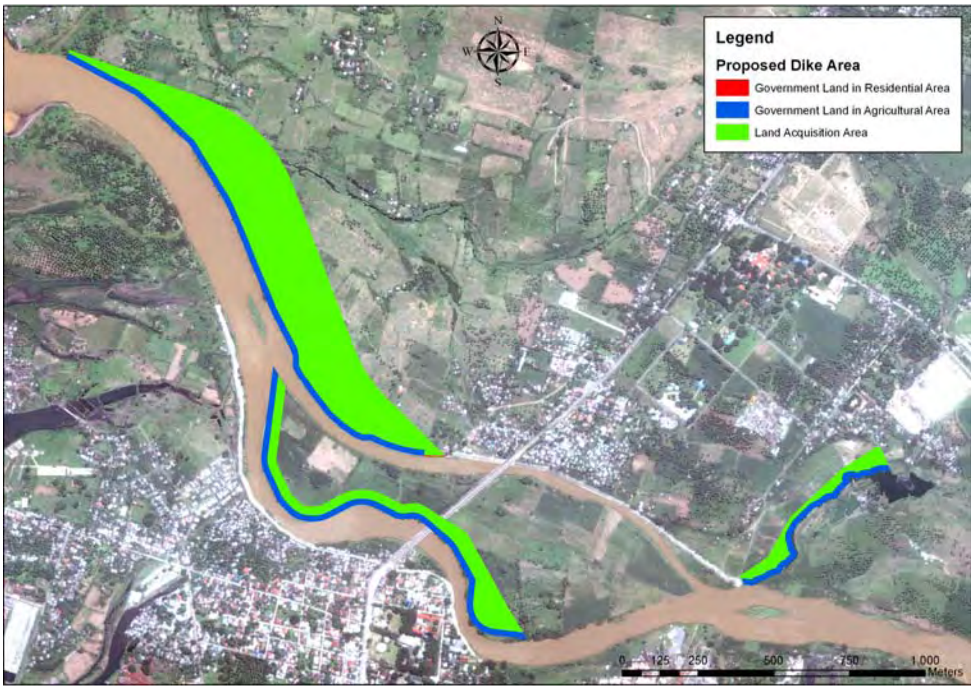


Figure R 9.6 Location of Land Acquisition

(b) Resettlement

Determination of housing which will be relocated

The towhead lands for excavation are mainly used for agricultural purposes. But there are some people living in an area under the bridge without any land tenure or title. The width of excavation is 50m and it was confirmed that only one house would be relocated due to the excavation work. The house owner is living with her husband. The summary of their profiles is shown below:

Number of family members in the house	2 (wife and husband)
Age	Wife: 44, husband: 38
House size	About $40m^2$, 2 levels Lot size : about $100m^2$
Occupation	Wife: food vendor Husband: employment in farming
Family income	22,000 Pesos/ month
Land title	No title (informal settlers)
Opinion on resettlement	She would like to move to her family's residence with compensation

She realizes that she is no formal resident and if the Project will be implemented she would like to move to her family's place.

In this study no PAPs to be relocated were found except for the people mentioned above. If any PAPs are found in the next simple RAP study, it is required following issues i) determine land ownership, ii) prepare the appropriate resettlement site, and iii) consider rehabilitation of livelihood of PAPs.

The dike along the river is required to keep a necessary distance from he river, with 3 to 5 m wide strip is required for a transport road along the dike shape . Therefore, in case that any persons are living inside of the land acquisition area, they would be required to relocate. The relation of dike and land acquisition and resettlement are shown in Figure R 9.6. The houses of Case I are located outside (riverside direction) of the construction road along the dike. Some parts of houses in Case II are outside of the land acquisition area. However, the houses are intended for relocation. The house located inside of the dike will not be relocated.

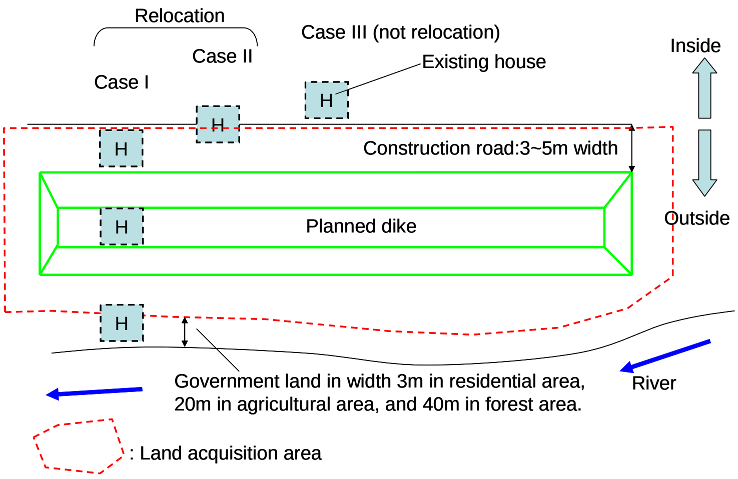


Figure R 9.7 Principle of Land Acquisition and Resettlement

9.5.4 Preparation of RAP study in the next study stage

The following study items are recommended for the land acquisition and resettlement action plan (simple RAP).

- Number and distribution of relocated houses, socio-economic conditions of PAPs, resettlement site candidates
- Determination of PAPs, eligible, entitles, -> entitle matrix, necessary study items for RAP (especially JICA requirements shall be considered)
- Recommendation of a restoration program
- Recommendation of a monitoring plan

CHAPTER 10 ADAPTATION TO CLIMATE CHANGE

10.1 Consideration of the Impact of Climate Change in the Study Area

10.1.1 General

The Philippine climate is influenced by large-scale atmospheric phenomena that bring in substantial amounts of rains almost all year round. However, due to the uneven distribution of rain with respect to time and space and the occurrences of extreme events such as floods and droughts, the country's water resources have in the past experienced Imbalances. The Intergovernmental Panel on Climate Change (IPCC) has warned the climate changes associated with global warning. The climate changes include the rises of temperature, storm rainfall intensity and sea level, which could further aggravate the flood conditions of the Study Area.

The IPCC estimated the change of global temperature based on the Fourth Special Report on Emission Scenarios (SRES), which describes several scenarios on the future global emission volume of greenhouse gas (such as carbon dioxide and nitrogen monoxide and methane gas) and sulphate. The IPCC estimated based on the SRES that the present global average temperature would most likely rise by 1.8 to 4.0°C at the end of the 21st Century. Significant changes in the earth's climatic system, particularly an alteration of rainfall and temperature in both time and space, are expected.

The present endeavor is focus on the impacts of climate change in the development of flood control measures for Tagoloan River. Expected output from the analysis would be a proposed component adoptive in future flood control plan of the current Sectoral Loan overall flood control project

10.1.2 Assessment Methodology

Assessment of climate variability and change impacts on the performance of a flood protection system is manifested through the following: (a) climate change scenarios; (b) hydrologic processes; and (c) impacts to the development of flood control measures (structural and non structural).

Climate Change Scenario

The Fourth Special Report on Emission Scenarios (SRES) for IPCC describes several scenarios on the future global emission volume of greenhouse gas and sulphate. Three (3) scenarios taken from the SRES are adapted to the present endeavor namely;

a) ***Status quo scenario***. No climate change

b) ***B1 scenario***. The temperature rise is predicted at the smallest which projects a convergent world with the same global growth of population but with rapid change in economic structures toward a service and information economy, with reductions in material intensity and the introduction of clean and resource efficient technologies

c) ***A1FI scenario***. The temperature rise is predicted at the largest due to a very intensive use of fossil fuel for energy system which is consequent to a very rapid growth of the global economy.

Global Temperature Rise

The IPCC estimated that the present global average temperature would most likely rise by 1.8 to 4.0°C at the end of the 21st Century as shown in Table R10.1 and delineated in Figure R10.1.

Table R 10.1 Global Average Temperature Rise at the End of 21st Century

Scenario	Temperature Rise from the Average of 1980-1999 to the Average of 2090-2099 (ºC)	
	Best Estimate	Likely Range
B1	1.8	1.1-2.9
A1F1	4	2.4-6.4

Source:
IPCC 2007, Summary for Policymakers.

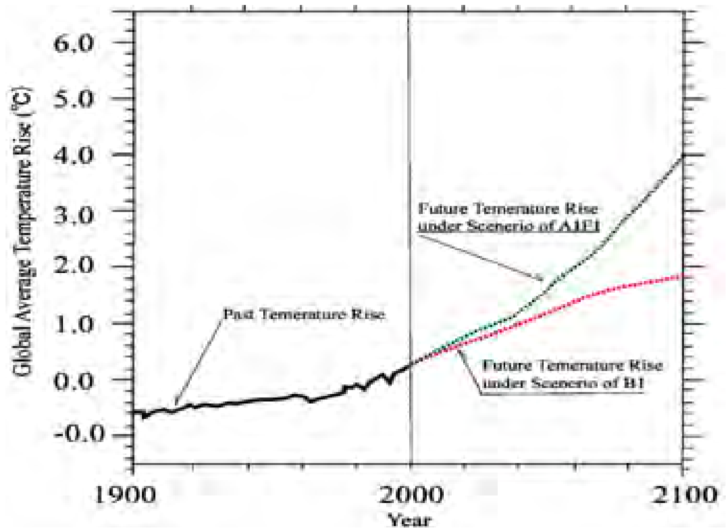


Figure R 10.1 Global Average Temperature Rise

(Consecutive Average Temperature Rise as the Base of Value in 1980-1999)
Source: IPCC 2007, Summary for Policymakers

The 2005 Study Report on Mapping Philippine Vulnerability on Environmental Disasters undertaken by the Department of Environment and Natural Resources (DENR) whose objective is to identify areas in the country that are at high vulnerability and risk to environmental disasters includes analysis on the temperature increases nationwide. Hazards and disasters are mapped and analyzed via geographic information systems (GIS), environmental modeling tools and resulting spatial databases.

One of the results of the analysis relevant to climate change is shown in Figure R10.2 and it tends to support the global trend on temperature increases. The figure suggest that the present temperature increases for the Project Area (Cagayan, Ilog-Hilabangan and Tagoloan River basins) are found to be more than 0.5 ºC.

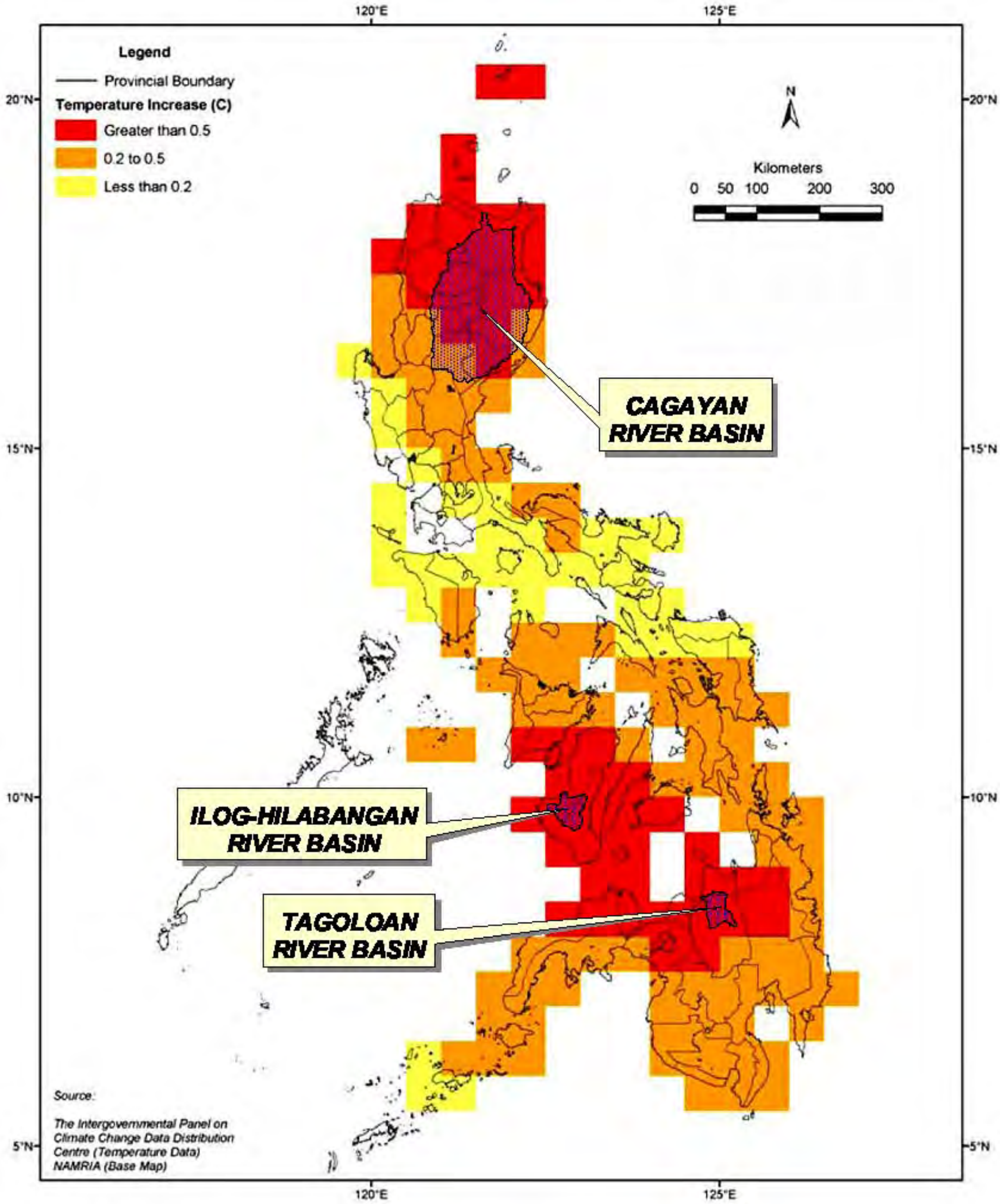


Figure R 10.2 Temperature Increase in the Philippines

Future Temperature Rise in the Project Area

In the recent Project Study titled "The Study on Comprehensive Flood Mitigation for Cavite Lowland Area in the Republic of the Philippines" undertaken in February 2009 undertaken by JICA, the relationship of the future global temperature rises and the local spatial temperature rises in the Philippines is analyzed by the TIGS/CCSR of the University of Tokyo.

The result of the mathematical modeling concerning the relationship between the aforesaid global average temperature rises and the local spatial average temperature rises in the Philippines is shown in Figure R10.3. The simulation which covers the area of long. 116.0 to 126.0°E and lat. 9.0 to 19.0°N (the area of about 1,000km x 1,000km) is made through a subset of models (twelve models) applied in the Forth Assessment Report of IPCC. The above temperature rises are expressed as the averages of those at each mesh of 100km x 100km, and at the same time as the differences between the late 20th century (1981-2000) and the late 21st century (2081-2100) with assuming SRES A1FI and B1 scenarios.

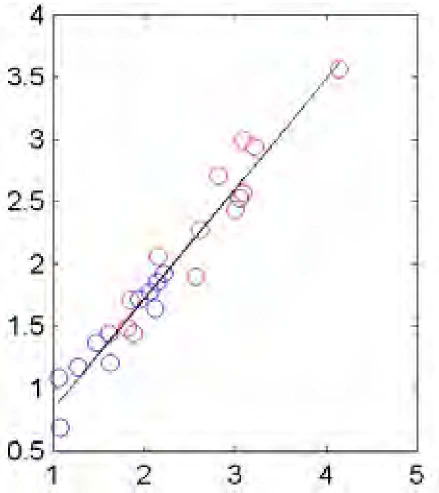


Figure R 10.3 Relation between Global Average Temperature Rise and Local Temperature Rise in the Philippines

According to the results of the above simulation, the local average temperature in the Philippines would rise by 1.1 to 2.3℃ in 2050 and further 1.5 to 3.5℃ in 2010 as shown in the following Table R10.2

Table R 10.2 Relation between Global Average Temperature Rise and Local Temperature Rise in the Philippines

Scenario	Year	Global Average Temperature Rise (ºC)	Local Average Temperature Rise in the Philippines (ºC)
B1	2050	1.2	1.1
	2100	1.8	1.5
A1FI	2050	2.6	2.3
	2100	4	3.5

Since the area of Mindanao where Tagoloan River Basin is situated is practically not covered by the above simulations, verifications of global temperature rises with respect to local temperature rises nationwide, thus further analysis is undertaken. Future temperature rises covering nationwide using the web-based model (SRES/CSSR) provided by IPCC Data Distribution Center, produces the following results as shown in Figures R10.4 to R10.9.

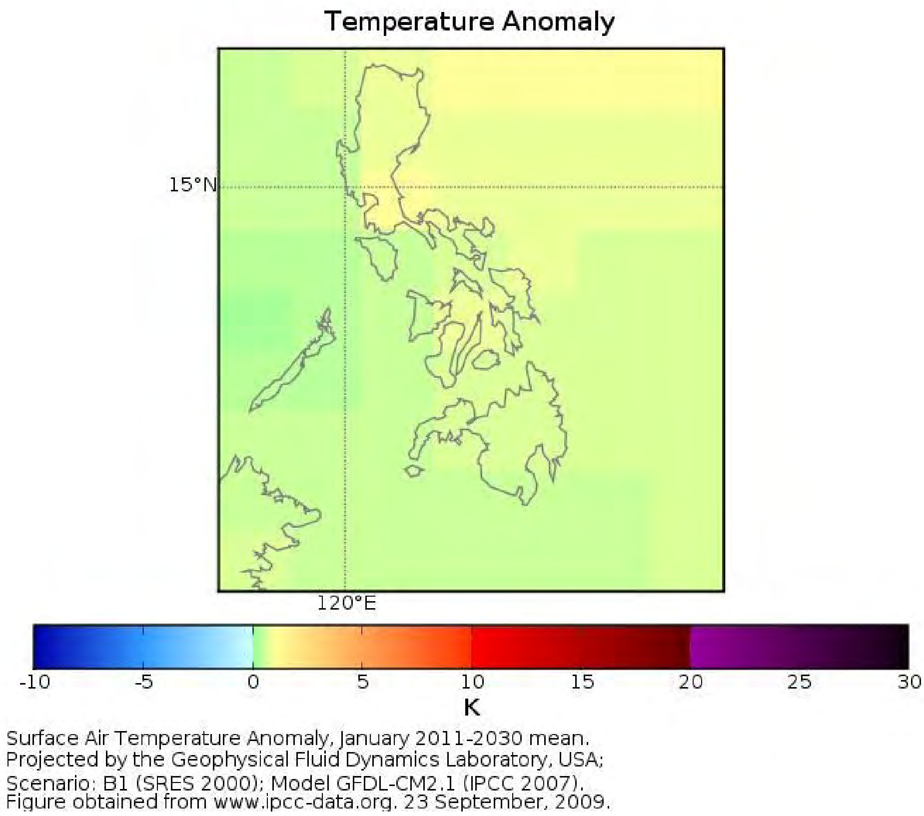


Figure R 10.4 Future Temperature Anomalies (B1 Scenario, 2011-2030)

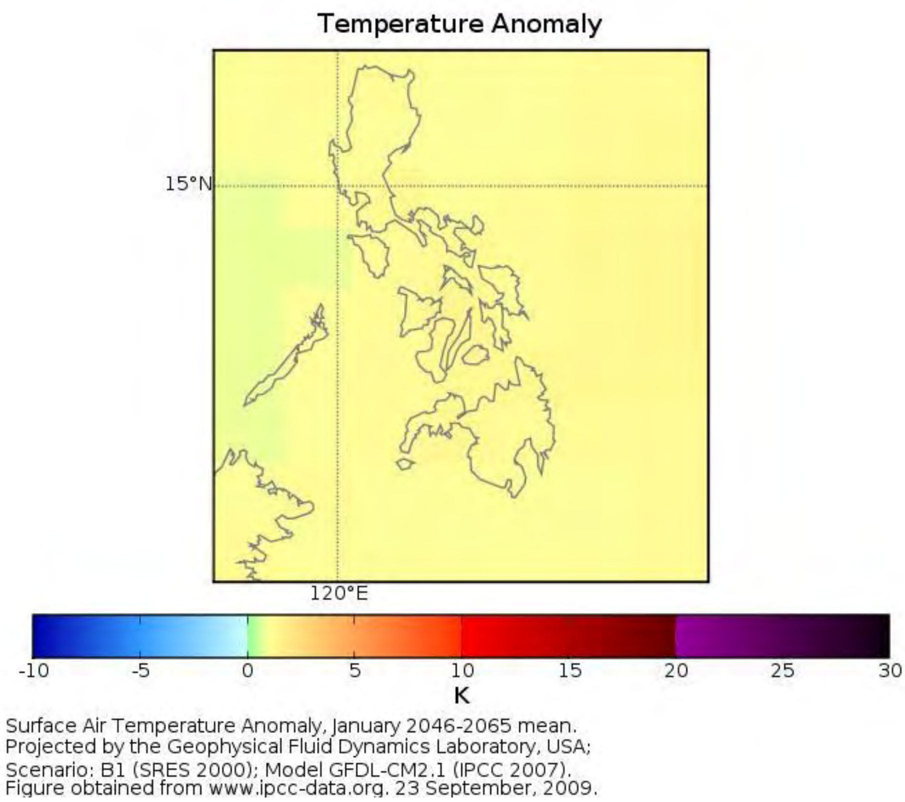
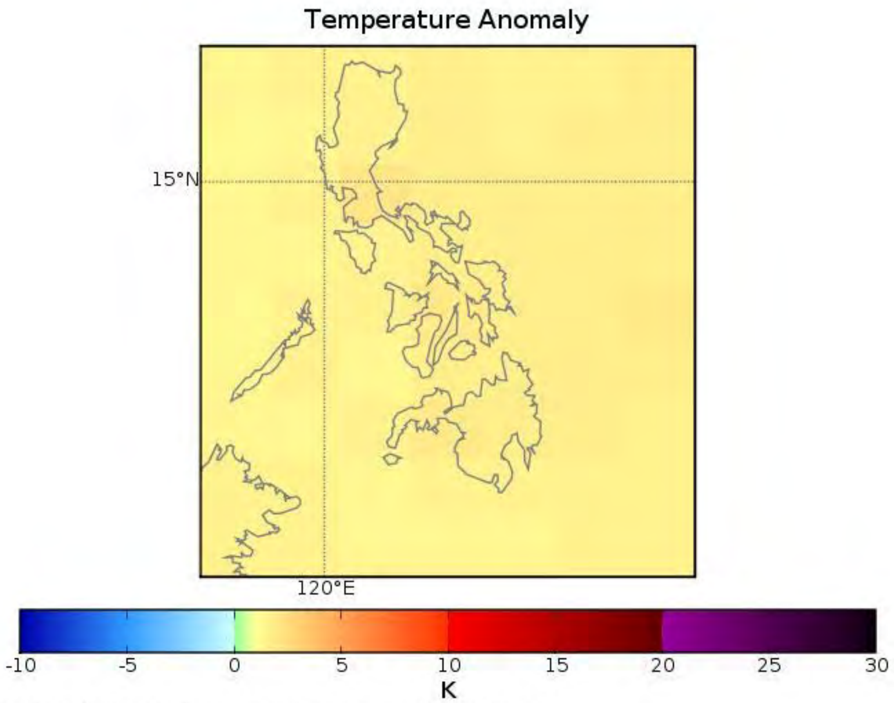
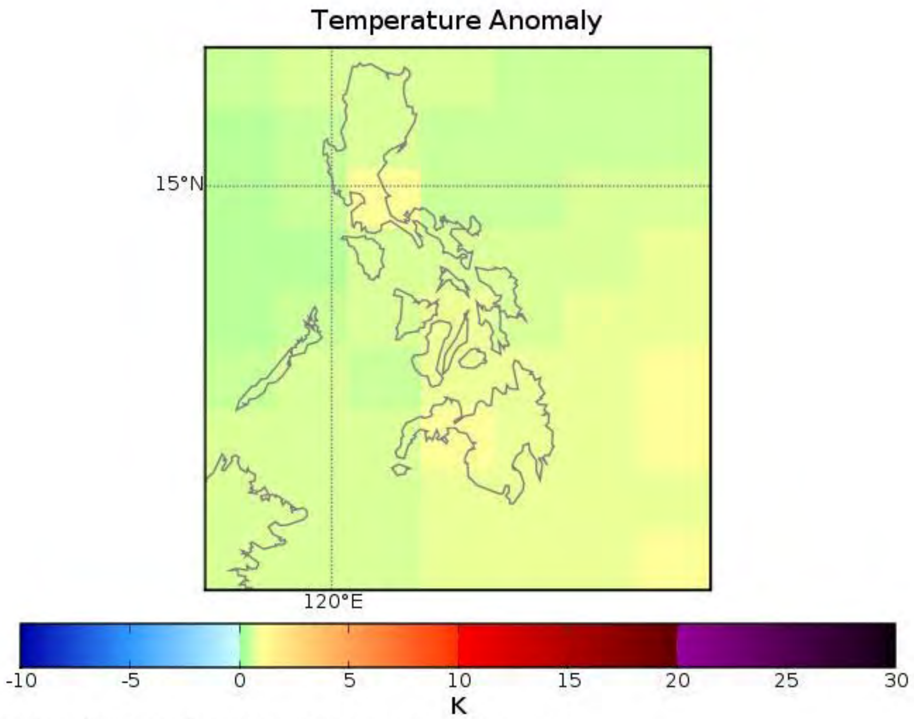


Figure R 10.5 Future Temperature Anomalies (B1 Scenario, 2046-2065)



Surface Air Temperature Anomaly, January 2080-2099 mean.
Projected by the Geophysical Fluid Dynamics Laboratory, USA;
Scenario: B1 (SRES 2000); Model GFDL-CM2.1 (IPCC 2007).
Figure obtained from www.ipcc-data.org. 23 September, 2009.

Figure R 10.6 Future Temperature Anomalies (B1 Scenario, 2080-2099)



Surface Air Temperature Anomaly, January 2011-2030 mean.
Projected by the Geophysical Fluid Dynamics Laboratory, USA;
Scenario: A1B (SRES 2000); Model GFDL-CM2.1 (IPCC 2007).
Figure obtained from www.ipcc-data.org. 23 September, 2009.

Figure R 10.7 Future Temperature Anomalies (A1FI Scenario, 2011-2030)

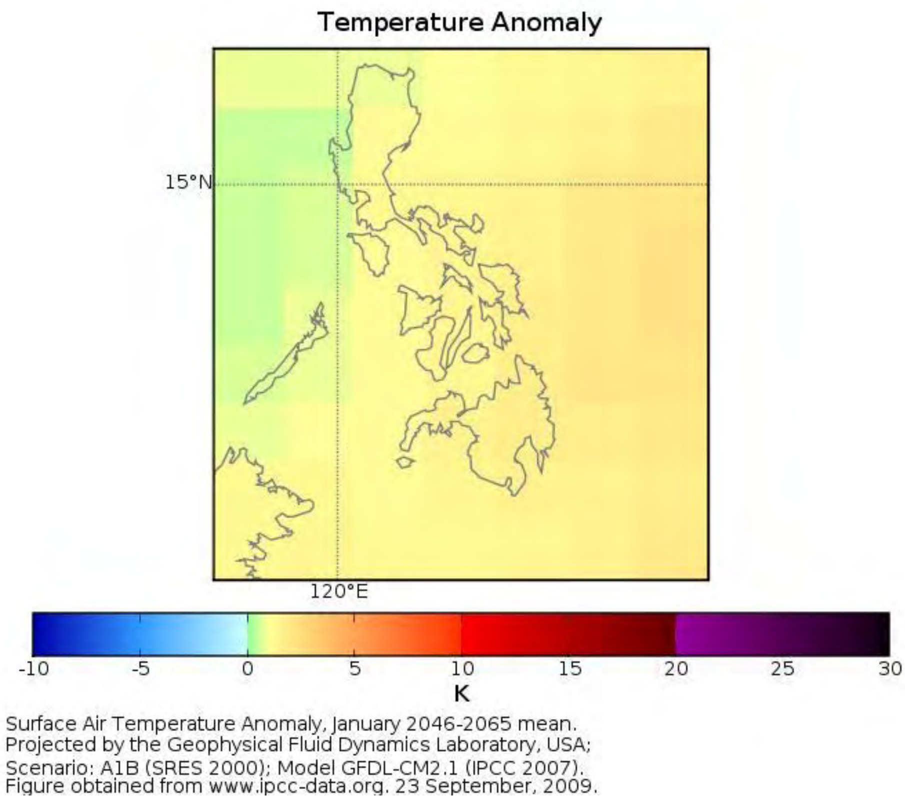


Figure R 10.8 Future Temperature Anomalies (A1FI Scenario, 2046-2065)

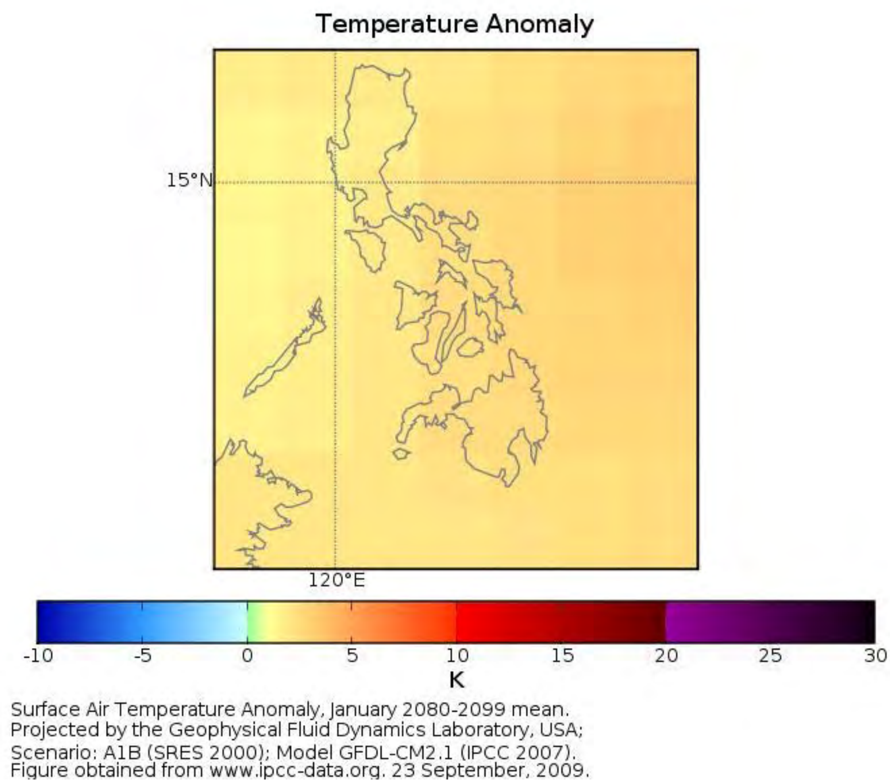


Figure R 10.9 Future Temperature Anomalies (A1FI Scenario, 2080-2099)

The result of the analysis concluded that the earlier simulation undertaken by TIGS/CSSR is still applicable to the Mindanao Area.

Increase in Future Rainfall Intensity due to Temperature Rise

The IPCC projected that the global warning would possibly induce increment of the storm rainfall intensity causing more sever flood. In this connection, the aforesaid TIGS/CCSR simulated between the spatial-average changes of precipitable water and local temperature rises over the Philippines. This simulation is made in the same manner as that for the above relation between the global temperature rises and the local average temperature rises in the Philippines The results of the simulation are as shown in Figure R10.10.

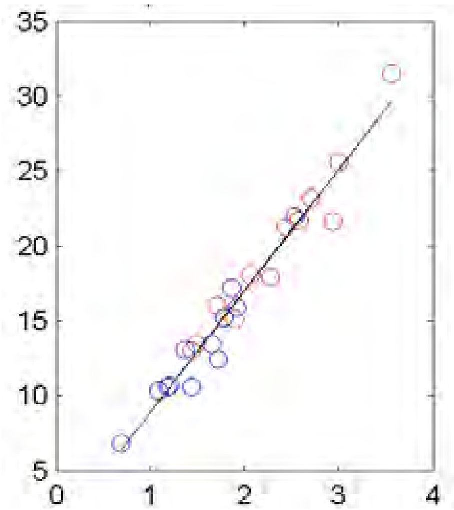


Figure R 10.10 Relationship between Local Average Temperature Rise and Incremental Rate of Precipitable Water in Philippines

The results of the simulations indicated that the storm rainfall intensity in the Philippines would increase by 11 to 20% in 2050 and 14 to 29% in 2100 as shown in Table R10.3

Table R 10.3 Relationship between Local Average Temperature Rise and Incremental Rate of Precipitable Water in Philippines g

Scenario	Year	Temperature Rise (ºC)	Increase Rate of Rainfall Intensity (%)
B1	2050	1.1	11
	2100	1.5	14
A1FI	2050	2.3	20
	2100	3.5	29

Application of the above results as an increment of storm rainfall intensity for the Study Area will mean increasing the present design probable hyetograph or shortening the return period and consequently, the probable design flood runoff discharges would be increased as a design parameter in the future.

Upon the application of the above factor, the adjusted probable hyetographs for the subject project area of the Tagoloan River basin are listed in Table R10.4. The probable hyetographs for Tagoloan River basin are based on maximum 2-day storm.

Table R 10.4 Future Increment of Probable 2-day Storm Rainfall for Tagoloan River Basin

Tagoloan Design Rainfall (mm)			Return Period (y)					
			2	**5**	**10**	**25**	**50**	**100**
Status Quo			99	125	142	164	181	198
A1FI	2050		119	150	170	197	217	237
	2100		127	161	183	211	233	255
B1	2050		110	138	157	182	200	219
	2100		113	142	162	187	206	225

Based on the above figures, design probable hyetographs for future design consideration are developed for each of the subject river basins considering the adopted climatic change scenarios and these are presented in Figures 10.11 to 10.14.

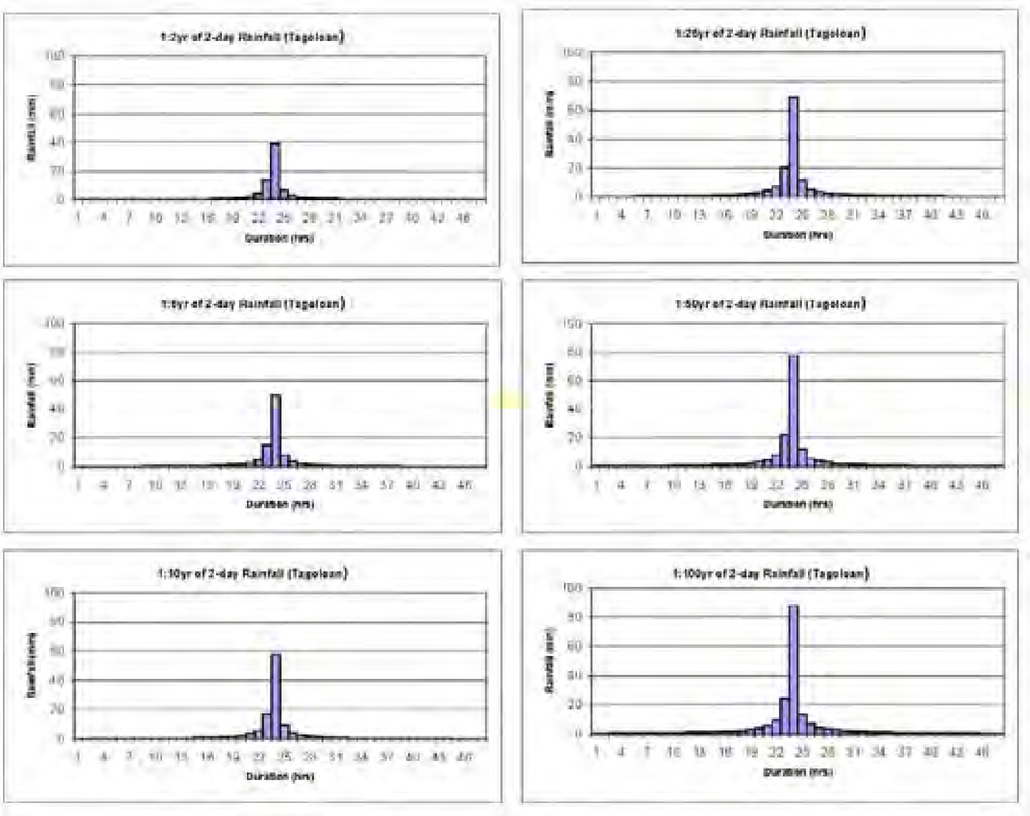


Figure R 10.11 Future Design Probable Hyetograph (B1-2050 Scenario)
Tagoloan River Basin

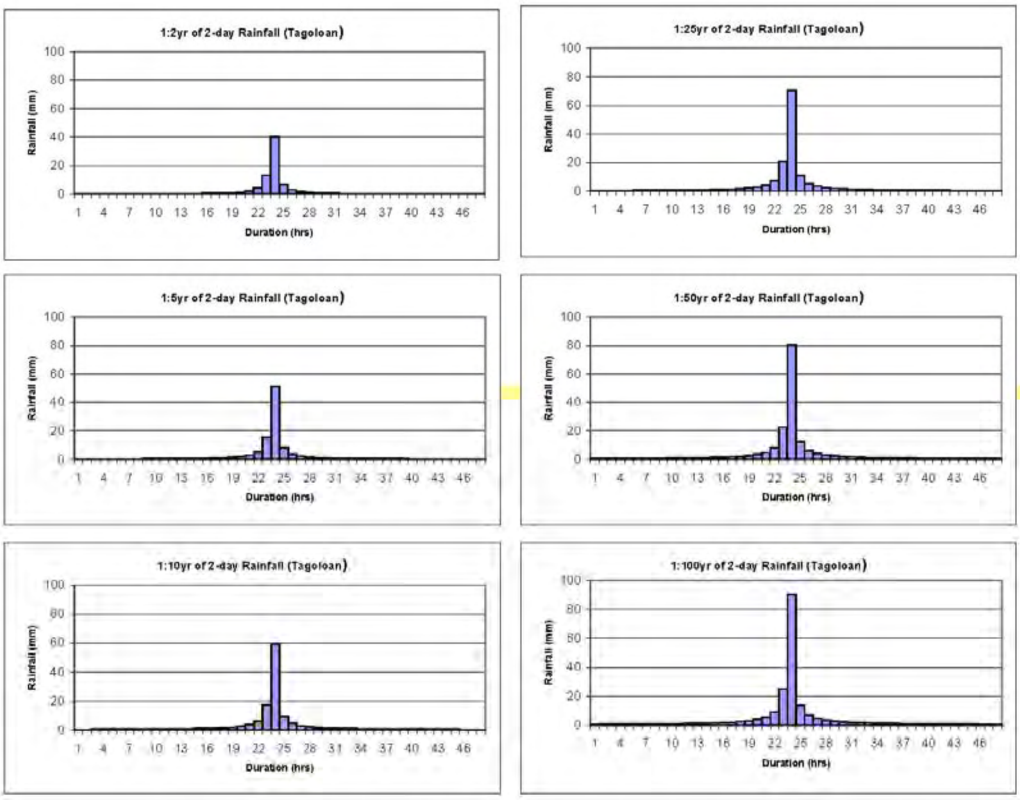


Figure R 10.12 Future Design Probable Hyetograph (B1-2100 Scenario)
Tagoloan River Basin

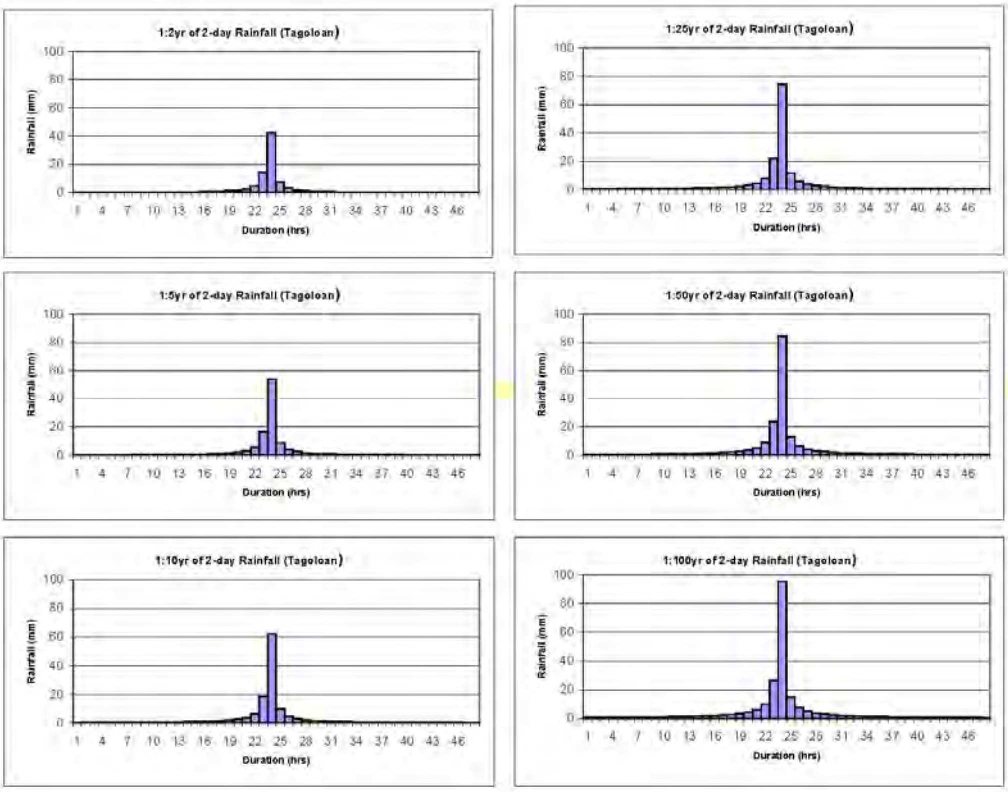


Figure R 10.13 Future Design Probable Hyetograph (A1FI-2050 Scenario) Tagoloan River Basin

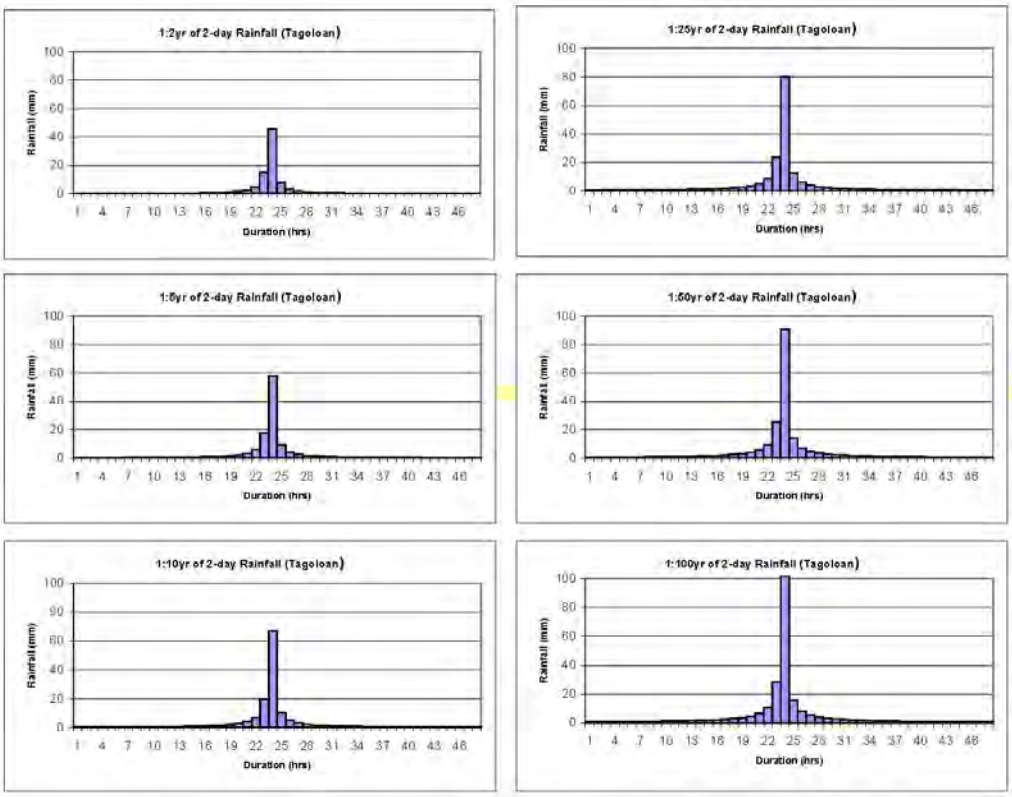


Figure R 10.14 Future Design Probable Hyetograph (A1FI-2100 Scenario) Tagoloan River Basin

Increase in Future Sea Level due to Temperature Rise

The IPCC confirmed the global tendency in rise of sea level from the 19th to 20th century and estimated that the global average rate of sea level rises over 1961 to 2003 was about 1.8mm per year, while the rate was faster over 1993 to 2003: about 3.1 mm per year.

The IPCC further projected that the average sea level over 2090-2099 would rise by about 0.38cm at the maximum as compared with the average over 1980-2000 under the B1 Scenario and/or about 0.59cm under the A1FI Scenario as shown in Figure R10.15 and Table R10.5.

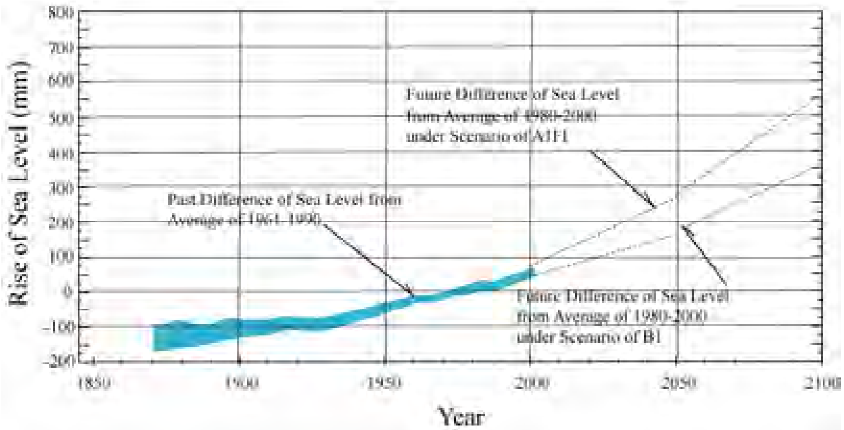


Figure R 10.15 Future Global Sea Level Rise

Table R 10.5   Future Global Sea Level Rise

Sea Rise (m)			Min	Max
A1FI	2050		0.13	0.29
	2100		0.26	0.59
B1	2050		0.09	0.19
	2100		0.18	0.38

The trends in monthly sea levels at Manila South Harbor where the long-term sea level records are available for the Philippines show that sea level has kept rising since 1996 up to the present. However, there is no constant increasing or decreasing trend in long term and the astronomical tide with a period of 19 years is deemed to be more predominant. In addition, datum planes had been adjusted at Manila South Harbor due to relocation of tidal gauge and land subsidence effect according to NAMRIA as of 2006.

Therefore, it is difficult to conclude that sea level at Manila Bay has been rising due to global warming based on the available historical records. Nevertheless, there is a high confidence that the sea level would rise in a long-term rage due primarily to thermal expansion of the oceans and melting of glaciers and ice caps as projected by IPCC.

For the Project Areas inTagoloan River, hydraulic regimes are directly affected by the sea levels. Applying the above discussion for future design consideration, the recommended sea levels for the Project Area are listed in the succeeding Table R10.6.

Table R 10.6 Future Sea Level Rise for the Project Area

Sea Rise (m)		Status Quo	A1FI		B1	
			2050	2100	2050	2100
Tagoloan		0.75	1.04	1.34	0.94	1.13
Ilog Hilabangan		1.50	1.79	2.09	1.69	1.88
Cagayan		-	-	-	-	-

Hydrologic Process

Determination of the future probable design flood runoff discharges for each of the Project Areas with the consideration of the adopted climatic change scenarios are made by superimposing and routing the respective future probable design hyetograph earlier presented through the respective Project Areas' catchment. The resulting hydrographs for each of the catchment for return period of 25-yr and 50-yr are shown in Figures R10.16 to R10.17.

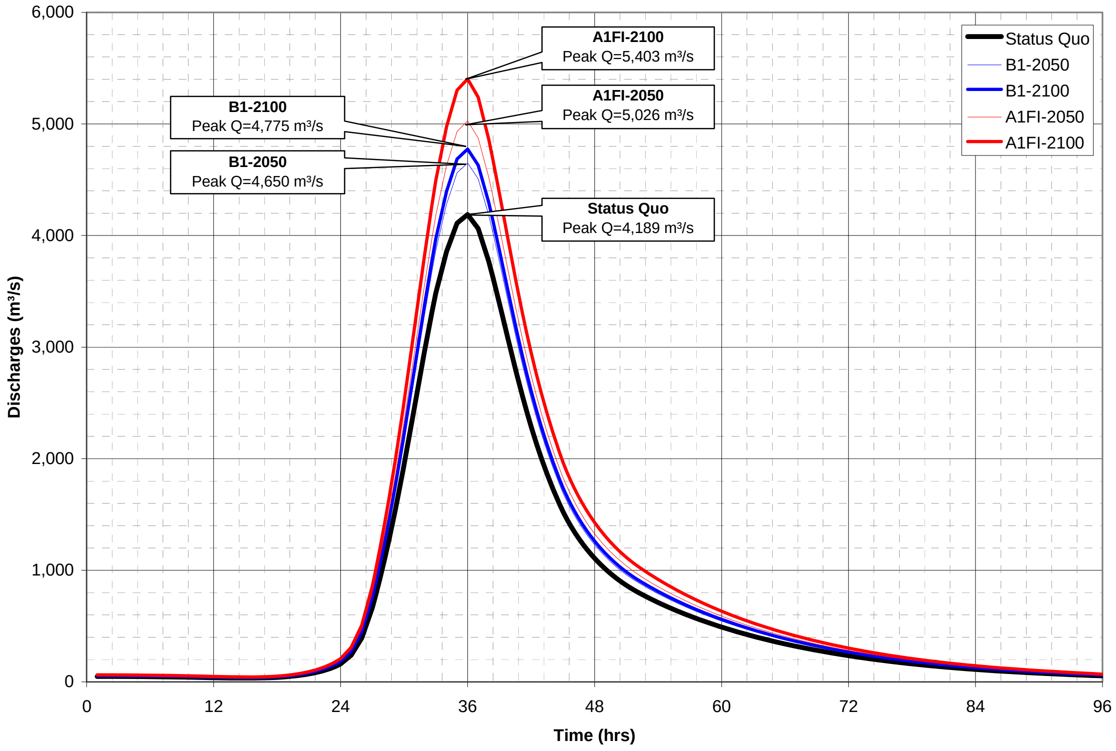


Figure R 10.16 Future 25-yr Probable Design Hydrographs Tagoloan River Basin

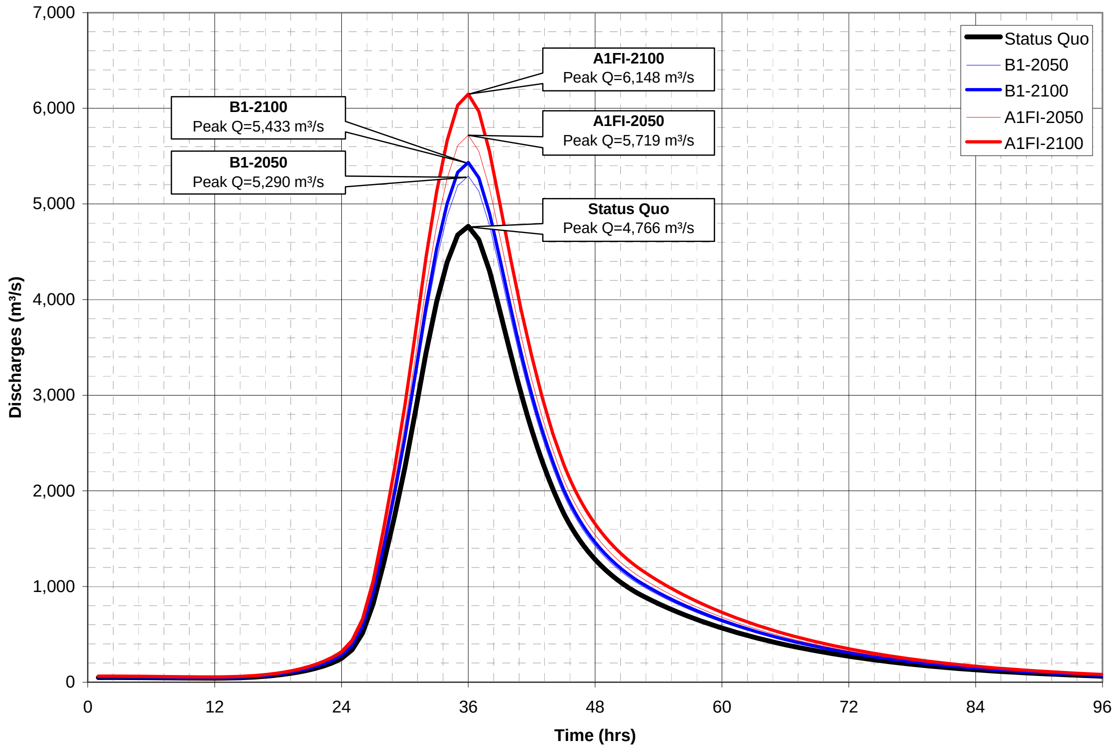


Figure R 10.17 Future 50-yr Probable Design Hydrographs Tagoloan River Basin

10.2 Impact on Flood Mitigation Plan

Based on the flood runoff computation as presented in the preceding section, the computed probable peak discharges and safety levels in return period would be changed in line with global warming. The following table summarizes the changes of probable discharge in 25-year and 50-year. Flood discharge would increase by 11 to 20 % in 2050 and by 14 to 29 % in 2100. Those increases of probable flood discharges are illustrated in Figure R10.18.

As a result of the above increscent effects of flood discharge, the safety level of flood control structures would decrease in line with the progress of global warming. Those effects are presented in Figure R10.19. The safety level of 25-year is likely to decrease to 11- to 17-year in 2050 and to 8- to 15-year in 2100.

Table R 10.7 Computed Probable Flood Discharges in Line with Global Warming

Return Period (Status Quo)	Year	Global Warming Scenario	
		B1	A1FI
25-year (4,190)	2050	4,650	4,780
	2100	5,030	5,400
50-year (4,770)	2050	5,290	5,720
	2100	5,430	6,150

unit: m^3/s

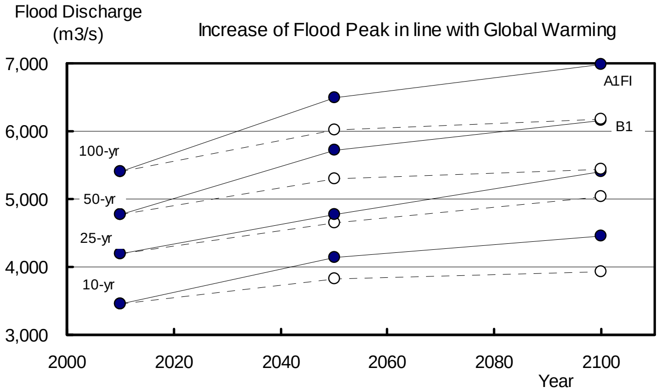


Figure R 10.18 Increase of Probable Flood Peak Discharge in Line with Global Warming

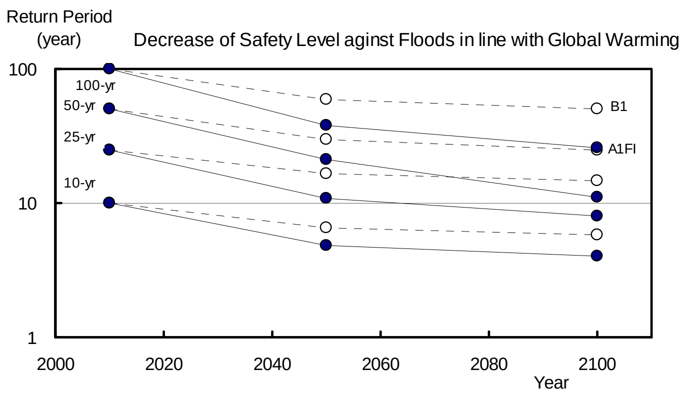


Figure R 10.19 Decrease of Safety Levels in Return Period in Line with Global Warming

10.3 Conceived Mitigation Measures against Climate Change

The global warming in climate change would have intensive impacts on flood control measures to be taken in the future. The process of global warming still contains considerable uncertainty in scientific fields. However, the mitigation measures shall be formulated with careful deliberation on decrease of secured safety level due to the increment of probable flood discharge in climate change as described in Section 10.2 above. The basic concept of mitigation measures against hydrological effects in climate change for the Tagoloan could be summarized below and depicted in Figure 10.1.

(1) After implementation of urgent flood control measures

After implementation of the urgent flood control measures in the Sector Loan Project, the secured safety level (against 25-year Flood) would decrease gradually in line with global warming. In this period, the following measures shall be taken hereafter.

(a) Land Use Control and Regulation

The development and land use in the following areas shall be regulated in terms of climate change adaptation:

- Low-lying Area on Left Bank of Estuary

  The low-lying area extending across the estuary on the left bank where floodwater always overflows shall be regulated so as not to be developed so that the deterioration of flood condition of Tagoloan River due to sea level rise and flood level rise by global warming will be alleviated.

- Probable Flood Area in Upstream Stretch

  The development activities in probable flood area in upstream stretch as delineated in Figure 10.1 should be controlled as land use control zone.

- Low-lying Coastal Area

  The low-lying coastal areas in Tagoloan are affected by tidal flood. In addition, adverse effects due to climate change have largely an impact to the life of the residents who are living in these areas as well as economic activities in coastal industrial zones. However, it is very difficult to adopt the structural measures for the tidal flood mitigation in short-term. In this regard, coastal area with 50 m in width from shoreline shall be designated as “Coastal Zone” for the restriction of economic and human activities and securement of structural measures against future sea level rise by global warming immediately by concerned LGUs. (See Figure 10.1)

(b) Countermeasure by Structural Measures

In case it is necessary to sustain the floodwater level for mitigation of the flood damage in the municipality due to the development of riparian areas in the upstream stretch, further excavation of towhead area (a small island in the river channel) would contribute to minimizing the floodwater rise in the upstream stretches provided that the low-lying area is sustained and controlled to maintain the extent of rivermouth even though the global warming in the climate change progresses. It is necessary to excavate whole towhead area to keep the floodwater levels at 25-year return period flood in 2100 of the A1FI scenario compared to the floodwater level in the present condition (Status Quo).

These excavation works would cost PHP 610 million.

(2) Recommendation of Formulation of future master plan for flood mitigation and management

The future flood mitigation and management plan shall be formulated on the basis of predicted effects of future climate change. In this Study, the outline of the comprehensive flood mitigation methods has been introduced. In this connection, the integrated amd comprehensive flood mitigation master plan shall basin-widely be revised/formulated through incorporating the effects of climate change including the following items.

- Establishment and strengthening of meteo-hydrological monitoring system,
- Establishment and Strengthening of early warning dissemination system through newly installation of flood forecasting system,
- Establishment and improvement of flood preparedness and emergency response plan in each local level, municipality and barangay, and
- Strengthening of land use plan or control in due consideration of flooding situation and future flood mitigation measures.

CHAPTER 11 CONCLUSION AND RECOMMENDATIONS

11.1 Selection of Optimum Flood Mitigation Plan

The alternative structural flood mitigation plans and the potential non-structural flood mitigation measures have been examined in Chapters 7 and 8. Socio-economic considerations on the structural flood mitigation plans were further made in Chapter 9. In addition, Chapter 10 delineates the measures for climate change adaptation in progress. Based on the results of those examinations, the optimum flood mitigation plan in the Sector Loan Project is as summarized below.

11.1.1 Proposed Structural Flood Mitigation Plan

(1) Summary of Structural Scheme to be Implemented under the Sector Loan

The M/P of Tagoloan River Basin was formulated as one of the results in the River Dredging Project II [Nationwide Flood Control Plan and River Dredging Program in 1982 (1982 M/P) by OECF (former Japan International Cooperation Agency (JICA)]. In this 1982 M/P, the plan was divided into two (2) phases: the Basic Plan to protect the area against a 50-year return period flood as the framework plan, and the First Phase Plan aiming to control the probable discharge of 25-year return period.

Based on the above recommendation of the 1982 M/P, the first phase plan proposed against a 25-year return period flood is adopted for the Sector Loan Project in this Study to mitigate the flood damage in core areas where the industrialization and housing built-up areas are presently located. In this regard, the Municipality of Tagoloan along the Tagoloan River is also selected as the core area for the Sector Loan in the Tagoloan River Basin.

Due to the industrialization and urbanization in the Municipality of Tagoloan, the DPWH constructed concrete-surfaced flood protection dikes on both sides of the Tagoloan River during 1994-2002. However, the dike system was stopped halfway due to financial constraint, although the main objective of dike construction was not only to prevent inundation but also to protect the adjoining land from scouring and bank erosion.

Therefore, the main flood mitigation work in the Sector Loan Project is to complete and improve the discontinued dike system and minimize the vulnerability to flood damage. With a complete structural flood protection system, it is expected that the core area will further be urbanized and industrialized. Based on the result of the flood simulation analysis, the extension of the dike on the right bank to the downstream will mitigate flood damage in the expected industrial zone in the near future. In addition, it is proposed together with the construction of dike on the right bank to prevent floodwater from intruding to the built-up area in the upstream stretch.

Moreover, dredging and excavation works in the towhead area located in the river course are proposed to sustain the design flood water level below the existing flood protection dike and the bottom of girder of the Tagoloan Bridge with sufficient freeboard.

The main features and estimated costs of the Tagolaon River Improvement Works are as summarized below:

Table R 11.1 Summary of Sector Loan Project Components Proposed for the Tagoloan River Improvement Works

Contents of Project	Quantity	Purpose of Project
Extension of Dike along Right Bank at Downstream Section	L=2,000m	To protect area against 25-year return period flood
Construction of Dike along Right Bank at Upstream Section	L= 650m	To protect area against 25-year return period flood
Dredging Work in Towhead Area	A=8.8 has	To sustain water level below existing dike system

Table R 11.2 Summary of Sector Loan Project Cost Proposed for the Tagoloan River Improvement Works

Major Items	Cost Items	Estimated Cost (Million Pesos)	Remarks
Cost Applicable for Loan	Construction Base	439	Construction Term: 2012-2014
	D/D & S/V	70	
	Contingencies	129	
Sub-Total (1)		638	
Cost Not Applicable for Loan	Compensation	31	Houses and Lots
	Administration	24	DPWH and LGUs
	Contingencies	11	
	VAT & Tax	77	
Sub-Total (2)		143	
Total		781	
O&M		2.60	
EIRR		19.48%	

(2) Concerns in Project Implementation

The concerns in project implementation are as follows:

(a) Natural and Social Environmental Impact Evaluation

Most of the houses located in the project site have already been relocated by PHIVIDEC. Therefore, the flood mitigation structural measure (dike and excavation) proposed in the Study will require house relocation of only a few families.

However, DENR had recommended the preparation of a relocation action plan (RAP) even though number of resettlement is quite small. In view thereof, the RAP is to be formulated and implemented in accordance with “The Land Acquisition, Resettlement and Indigenous Peoples Policy of the Department of Public Works and Highways (DPWH).”

To execute the RAP, “Census Survey-cum-Structure Tagging (C/T)” shall be performed to identify the PAPs and to prevent illegal settlers from encroaching to the project site. Preparation of the RAP for Tagoloan together with the other two candidate river basins (Cagayan and Ilog-Hilabangan) will require six (6) months, at least, prior to project implementation.

(b) Land Acquisition

The alignment of the proposed flood prevention dike has been shifted to the land side to secure the river flow area for smooth flow and sustain the design floodwater level below the existing dike crown with sufficient freeboard. Therefore, the river area proposed in the Study has widened compared to the river area presumed by PHIVIDEC.

This difference between the PHIVIDEC presumed area and the area proposed by the Study accounts for 20 hectares. Originally, this area has been designated as government land. Therefore, the ownership of the land shall be dealt with prior to project implementation, including MOA.

(c) Low-lying Area on Left Bank of Estuary

The low-lying area extending across the estuary on the left bank will be maintained as it is from the following reasons:

- Floodwater does not expand widely even without the construction of dike in the low-lying area.
- Since mangrove coasts have expanded in this low-lying area, it is desirable to preserve this area without modification.
- Taking into consideration climate change adaptation, this low-lying area should be secured for climate change adaptation to increase the flood discharge capacity of Tagoloan River.

Under the circumstances mentioned above, the low-lying area shall be preserved by Tagoloan Municipality in association with PHIVIDEC.

11.1.2 Proposed Non-Structural Measures

Based on the current status and activities in the Tagoloan River Basin described in Chapter 8, the following community-based non-structural measures are proposed in parallel with the structural measures:

- Establishment of an Early Flood Warning System utilizing the Basin Flood Forecasting System.
- Preparation of Flood Hazard Map with the participation of Residents, including dry run and map exercises in flood vulnerable areas.

In connection with the execution of the proposed measures mentioned above, proposed is a Technical Assistant Activity to support and enhance the capacity of related agencies, such as DPWH, OCD and PAGASA, in parallel with and as one sphere of implementation of the Sector Loan.

In addition, it is essential to maintain a proper river area in the estuary area including upstream stretches and coastal area for future widening/excavation of river channel, extension of the flood dike and control of rising of tidal level respectively. To achieve such a full-scale river improvement works, the LGUs shall first of all secure the proper river course to implement the widening of river channel. In this connection, the CLUP (comprehensive land use plan) shall delineate the river area with designed dike alignment and low-lying area located in the estuary and shoreline in the future land use map as the river or control areas.

11.1.3 Climate Change Adaptation

The Tagoloan River in the target area has a wide river width between the existing dikes on both sides. Therefore, the excavation works in such a broad river area, such as towhead area and low-lying area to be preserved, can be applied to climate change adaptation.

In addition to the structural measures explained above, the following non-structural measures shall be applied to climate change adaptation:

- Enlightenment Activities to Stakeholders regarding the Impact of Climate Change
- Strengthening of Flood Forecasting and Warning System

11.1.4 Support and Capacity Enhancement of Related Agency Activities

As proposed in the Main Report (Part I), the Sector Loan Project aims at not only flood damage mitigation in the target core areas but also at strengthening and enhancing the capacity of the related agencies such as DPWH, LGU, OCD and PAGASA. In this regard, it is proposed that the following T/As regarding support for non-structural activities and contribution to the betterment of O&M activities shall be executed in parallel with the implementation of the project.

(1) Assistance on Setup of Non-Structural Measures

(2) Advice on Collection System Arrangement for the O&M Budget and Capacity Development for Drainage Improvement

The T/As mentioned above would contribute to the strengthening of the capacity for DRM of the Planning Service and FCSEC of DPWH, as well as OCD and PAGASA, and the enhancement of LGUs' activities regarding the DRM (Tagoloan)

11.2 Implementation Plan of the Project under Sector Loan

It is proposed that the construction flood protection dike and the dredging works in the lower channel proposed by this Study will be implemented as the First Batch in the Sector Loan Project. The estimated construction term is two (2) years during 2014-2015, as shown below:

Table R 11.3 Implementation Program of Tagoloan River Improvement Works in the Sector Loan Project

Item	2010				2011				2012				2013				2014				2015				2016				2017			
	J-M	A-J	J-S	O-D	J-M	A-J	J-S	O-D	J-M	A-J	J-S	O-D	J-M	A-J	J-S	O-D	J-M	A-J	J-S	O-D	J-M	A-J	J-S	O-D	J-M	A-J	J-S	O-D	J-M	A-J	J-S	O-D
F/S	△																															
RAP	◄	—	►	: 6months for 2 Slected River Basins (First Batch)																												
MOA	◄	—	►																													
Resettlement & Land Acquisition													◄	—	—	—	—	—	—	►	◄	Monitoring & Livilihood Support	—	—	—	—	—	—	►			
ICC (TB, CC)	◄	—	►	: as Umbrella ICC																												
L/A					☆																											
Selection of Consultant					◄	—	—	►																								
D/D and Bidding									◄	—	► / ◄	—	—	—	—	►																
Structural Measure																																
Construction																	◄	—	—	—	—	—	—	—	—	—	—	►	◄ Liability (1 Year)	- -	- -	►
Non-Structural Measures																																
Assistance on Setup of Non-Structural Measures																		◄	—	►												
Advice on Collection System Arrangement for O&M Budget and Capacity Development on Drainage Improvement																												◄	—	►		

TABLES

Duration in hrs	Rainfall Intensity (mm/hr)					
	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
1	35.33	45.05	51.88	61.87	70.30	79.33
2	23.52	29.38	33.62	40.10	45.06	50.70
3	17.70	21.99	25.15	30.02	33.65	37.84
4	14.21	17.66	20.21	24.15	27.06	30.44
5	11.89	14.80	16.97	20.28	22.74	25.59
6	10.23	12.76	14.66	17.54	19.68	22.15
7	8.99	11.24	12.93	15.48	17.38	19.58
8	8.02	10.05	11.58	13.87	15.60	17.58
9	7.24	9.10	10.50	12.59	14.17	15.97
10	6.60	8.32	9.61	11.53	12.99	14.65
11	6.07	7.67	8.87	10.65	12.01	13.55
12	5.61	7.12	8.24	9.90	11.17	12.61
13	5.23	6.64	7.70	9.25	10.45	11.80
14	4.89	6.23	7.23	8.69	9.83	11.10
15	4.59	5.87	6.82	8.19	9.28	10.48
16	4.33	5.54	6.45	7.76	8.79	9.93
17	4.10	5.26	6.12	7.37	8.35	9.44
18	3.89	5.00	5.83	7.01	7.96	9.00
19	3.71	4.77	5.56	6.70	7.61	8.60
20	3.54	4.56	5.32	6.41	7.28	8.24
21	3.38	4.37	5.10	6.15	6.99	7.91
22	3.24	4.19	4.90	5.91	6.72	7.61
23	3.11	4.03	4.72	5.68	6.47	7.33
24	2.99	3.88	4.55	5.48	6.24	7.07
25	2.88	3.74	4.39	5.29	6.03	6.83
26	2.78	3.61	4.24	5.11	5.83	6.61
27	2.68	3.50	4.10	4.95	5.65	6.40
28	2.59	3.38	3.98	4.80	5.48	6.21
29	2.51	3.28	3.86	4.65	5.32	6.03
30	2.43	3.18	3.74	4.52	5.17	5.86
31	2.36	3.09	3.64	4.39	5.02	5.70
32	2.29	3.01	3.54	4.27	4.89	5.55
33	2.22	2.92	3.45	4.16	4.76	5.41
34	2.16	2.85	3.36	4.05	4.64	5.27
35	2.10	2.77	3.27	3.95	4.53	5.14
36	2.05	2.71	3.19	3.86	4.42	5.02
37	2.00	2.64	3.12	3.77	4.32	4.91
38	1.95	2.58	3.05	3.68	4.22	4.80
39	1.90	2.52	2.98	3.60	4.13	4.69
40	1.86	2.46	2.91	3.52	4.04	4.59
41	1.81	2.41	2.85	3.45	3.96	4.50
42	1.77	2.36	2.79	3.37	3.88	4.41
43	1.74	2.31	2.73	3.31	3.80	4.32
44	1.70	2.26	2.68	3.24	3.73	4.24
45	1.66	2.22	2.63	3.18	3.66	4.16
46	1.63	2.17	2.58	3.12	3.59	4.08
47	1.60	2.13	2.53	3.06	3.52	4.01
48	1.56	2.09	2.48	3.00	3.46	3.93

Table 5.1

Rainfall Intensity Duration Curve for Tagoloan River Basin

Hrs	Accumulated Rainfall (mm)						Incremental Rainfall (mm)						Design Rainfall (mm)					
	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
1	35.33	45.05	51.88	61.87	70.30	79.33	35.33	45.05	51.88	61.87	70.30	79.33	0.10	0.22	0.31	0.40	0.52	0.61
2	47.05	58.76	67.24	80.20	90.12	101.41	11.72	13.70	15.36	18.33	19.82	22.07	0.10	0.23	0.33	0.41	0.54	0.63
3	53.09	65.97	75.45	90.06	100.94	113.52	6.04	7.21	8.21	9.86	10.81	12.11	0.11	0.24	0.34	0.43	0.56	0.66
4	56.85	70.63	80.86	96.60	108.23	121.74	3.76	4.66	5.41	6.54	7.29	8.22	0.11	0.26	0.36	0.45	0.59	0.69
5	59.46	73.99	84.83	101.42	113.69	127.94	2.61	3.36	3.97	4.82	5.46	6.19	0.12	0.27	0.38	0.48	0.61	0.72
6	61.40	76.58	87.94	105.22	118.05	132.90	1.94	2.59	3.11	3.80	4.36	4.97	0.13	0.28	0.40	0.50	0.64	0.76
7	62.91	78.67	90.49	108.34	121.68	137.05	1.51	2.09	2.55	3.12	3.63	4.15	0.14	0.30	0.42	0.53	0.68	0.80
8	64.13	80.42	92.64	110.99	124.78	140.61	1.22	1.75	2.15	2.65	3.10	3.56	0.15	0.32	0.44	0.56	0.72	0.85
9	65.14	81.91	94.50	113.28	127.50	143.73	1.01	1.49	1.86	2.29	2.72	3.12	0.16	0.34	0.47	0.60	0.76	0.90
10	66.00	83.22	96.14	115.30	129.91	146.52	0.86	1.30	1.64	2.02	2.41	2.78	0.18	0.37	0.51	0.64	0.81	0.96
11	66.73	84.37	97.60	117.12	132.09	149.03	0.74	1.15	1.46	1.81	2.18	2.51	0.20	0.40	0.54	0.69	0.87	1.02
12	67.38	85.40	98.92	118.75	134.07	151.32	0.65	1.03	1.32	1.64	1.98	2.29	0.22	0.43	0.59	0.74	0.94	1.10
13	67.95	86.34	100.13	120.25	135.89	153.43	0.57	0.94	1.20	1.50	1.82	2.11	0.25	0.48	0.64	0.81	1.02	1.19
14	68.46	87.20	101.23	121.63	137.57	155.38	0.51	0.85	1.11	1.38	1.68	1.95	0.28	0.53	0.71	0.89	1.11	1.30
15	68.92	87.98	102.26	122.90	139.14	157.20	0.46	0.79	1.02	1.28	1.57	1.82	0.33	0.59	0.79	0.99	1.23	1.44
16	69.34	88.71	103.21	124.09	140.60	158.91	0.42	0.73	0.95	1.19	1.46	1.71	0.38	0.68	0.89	1.11	1.38	1.60
17	69.72	89.39	104.10	125.21	141.98	160.51	0.38	0.68	0.89	1.11	1.38	1.60	0.46	0.79	1.02	1.28	1.57	1.82
18	70.07	90.02	104.94	126.25	143.28	162.03	0.35	0.63	0.84	1.05	1.30	1.52	0.57	0.94	1.20	1.50	1.82	2.11
19	70.40	90.61	105.73	127.24	144.51	163.47	0.33	0.59	0.79	0.99	1.23	1.44	0.74	1.15	1.46	1.81	2.18	2.51
20	70.70	91.17	106.48	128.18	145.68	164.83	0.30	0.56	0.75	0.94	1.17	1.37	1.01	1.49	1.86	2.29	2.72	3.12
21	70.98	91.70	107.19	129.07	146.79	166.14	0.28	0.53	0.71	0.89	1.11	1.30	1.51	2.09	2.55	3.12	3.63	4.15
22	71.25	92.20	107.86	129.92	147.85	167.38	0.26	0.50	0.67	0.85	1.06	1.24	2.61	3.36	3.97	4.82	5.46	6.19
23	71.49	92.68	108.50	130.72	148.87	168.57	0.25	0.48	0.64	0.81	1.02	1.19	6.04	7.21	8.21	9.86	10.81	12.11
24	71.73	93.14	109.12	131.50	149.85	169.72	0.23	0.46	0.62	0.77	0.98	1.14	35.33	45.05	51.88	61.87	70.30	79.33
25	71.95	93.57	109.71	132.24	150.78	170.82	0.22	0.43	0.59	0.74	0.94	1.10	11.72	13.70	15.36	18.33	19.82	22.07
26	72.16	93.99	110.28	132.95	151.69	171.88	0.21	0.42	0.57	0.71	0.90	1.06	3.76	4.66	5.41	6.54	7.29	8.22
27	72.36	94.39	110.82	133.64	152.56	172.90	0.20	0.40	0.54	0.69	0.87	1.02	1.94	2.59	3.11	3.80	4.36	4.97
28	72.54	94.77	111.35	134.30	153.40	173.88	0.19	0.38	0.52	0.66	0.84	0.99	1.22	1.75	2.15	2.65	3.10	3.56
29	72.72	95.14	111.85	134.94	154.21	174.84	0.18	0.37	0.51	0.64	0.81	0.96	0.86	1.30	1.64	2.02	2.41	2.78
30	72.90	95.50	112.34	135.55	155.00	175.77	0.17	0.36	0.49	0.62	0.79	0.92	0.65	1.03	1.32	1.64	1.98	2.29
31	73.06	95.84	112.81	136.15	155.76	176.66	0.16	0.34	0.47	0.60	0.76	0.90	0.51	0.85	1.11	1.38	1.68	1.95
32	73.22	96.17	113.27	136.73	156.50	177.53	0.16	0.33	0.46	0.58	0.74	0.87	0.42	0.73	0.95	1.19	1.46	1.71
33	73.37	96.49	113.71	137.29	157.21	178.38	0.15	0.32	0.44	0.56	0.72	0.85	0.35	0.63	0.84	1.05	1.30	1.52
34	73.52	96.80	114.14	137.83	157.91	179.20	0.15	0.31	0.43	0.54	0.70	0.82	0.30	0.56	0.75	0.94	1.17	1.37
35	73.66	97.11	114.56	138.36	158.59	180.00	0.14	0.30	0.42	0.53	0.68	0.80	0.26	0.50	0.67	0.85	1.06	1.24
36	73.79	97.40	114.97	138.88	159.25	180.78	0.14	0.29	0.41	0.51	0.66	0.78	0.23	0.46	0.62	0.77	0.98	1.14
37	73.92	97.68	115.36	139.38	159.90	181.54	0.13	0.28	0.40	0.50	0.64	0.76	0.21	0.42	0.57	0.71	0.90	1.06
38	74.05	97.96	115.75	139.86	160.52	182.28	0.13	0.28	0.38	0.49	0.63	0.74	0.19	0.38	0.52	0.66	0.84	0.99
39	74.17	98.23	116.12	140.34	161.14	183.01	0.12	0.27	0.38	0.48	0.61	0.72	0.17	0.36	0.49	0.62	0.79	0.92
40	74.29	98.49	116.49	140.80	161.74	183.71	0.12	0.26	0.37	0.46	0.60	0.71	0.16	0.33	0.46	0.58	0.74	0.87
41	74.40	98.74	116.85	141.26	162.32	184.41	0.11	0.26	0.36	0.45	0.59	0.69	0.15	0.31	0.43	0.54	0.70	0.82
42	74.51	98.99	117.20	141.70	162.89	185.08	0.11	0.25	0.35	0.44	0.57	0.68	0.14	0.29	0.41	0.51	0.66	0.78
43	74.62	99.24	117.54	142.13	163.45	185.74	0.11	0.24	0.34	0.43	0.56	0.66	0.13	0.28	0.38	0.49	0.63	0.74
44	74.72	99.47	117.87	142.55	164.00	186.39	0.10	0.24	0.33	0.42	0.55	0.65	0.12	0.26	0.37	0.46	0.60	0.71
45	74.82	99.70	118.19	142.97	164.54	187.03	0.10	0.23	0.33	0.41	0.54	0.63	0.11	0.25	0.35	0.44	0.57	0.68
46	74.92	99.93	118.51	143.37	165.06	187.65	0.10	0.23	0.32	0.40	0.53	0.62	0.10	0.24	0.33	0.42	0.55	0.65
47	75.02	100.15	118.83	143.77	165.58	188.26	0.10	0.22	0.31	0.40	0.52	0.61	0.10	0.23	0.32	0.40	0.53	0.62
48	75.11	100.37	119.13	144.16	166.09	188.86	0.09	0.22	0.31	0.39	0.51	0.60	0.09	0.22	0.31	0.39	0.51	0.60

Table 5.2

Design Hyetographs Computation

Sub Basin ID	Longest Flowpath L (m)	Distance from the Center Lca (m)	Upstream Elevation (m)	Downstream Elevation (m)	Area (km²)	Llca/√S	Lag (hrs)
R10W10	15,384.22	5,145.26	775.00	333.00	63.16	466.99	1.72
R60W30	20,034.37	10,360.69	912.00	391.00	78.00	1,287.16	2.54
R20W20	30,097.31	17,273.12	478.00	8.00	65.27	4,160.19	3.98
R130W130	12,945.93	5,782.65	19.00	3.00	22.56	2,129.45	3.08
R90W90	20,522.89	10,561.92	228.00	34.00	72.95	2,229.46	3.14
R180W140	25,645.66	11,966.39	295.00	72.00	66.12	3,291.03	3.64
R160W160	11,203.97	5,856.12	369.00	32.00	22.49	378.31	1.59
R120W80	23,914.15	8,446.58	848.00	518.00	166.55	1,719.52	2.84
R330W330	17,122.32	9,127.01	489.00	113.00	30.95	1,054.58	2.36
R390W260	23,053.84	12,352.93	828.00	178.00	62.34	1,696.01	2.83
R280W280	24,115.37	13,246.40	556.00	73.00	74.73	2,257.17	3.15
R210W190	13,766.72	7,215.63	342.00	50.00	27.76	682.07	1.99
R430W380	13,022.69	4,034.67	167.00	124.00	44.18	914.38	2.23
R360W360	28,093.27	15,785.30	607.00	112.00	33.19	3,340.82	3.66
R460W460	31,973.05	16,688.08	857.00	254.00	45.01	3,885.29	3.88
R540W490	25,223.46	11,597.10	855.00	406.00	70.73	2,192.47	3.12
R520W520	14,572.74	6,765.49	1,155.00	402.00	55.39	433.72	1.68
R510W450	25,444.44	12,358.16	618.00	238.00	84.02	2,573.07	3.31
R690W600	33,562.61	17,495.86	917.00	403.00	103.21	4,745.01	4.19
R670W670	23,415.18	9,056.83	1,099.00	427.00	92.25	1,251.81	2.52
R560W560	32,257.62	13,287.51	1,018.00	439.00	108.09	3,199.28	3.60
R500W500	27,115.09	13,188.26	932.00	410.00	49.13	2,577.32	3.32
R230W230	29,639.46	15,016.30	574.00	85.00	35.99	3,465.08	3.71
R740W740	32,555.36	16,113.48	1,056.00	427.00	121.65	3,773.96	3.84
R860W610	27,701.26	14,137.53	1,004.00	410.00	72.76	2,674.42	3.36
R890W880	17,420.06	10,998.09	734.00	643.00	66.35	2,650.76	3.35

Reach	Length (m)	Slope (m/m)	Manning's n	Invert (m)	Bottom Width (m)	Side Slope (H:V)	Tc (min)
R130	7,705.87	0.007181	0.04	11	150	0.333	36.69
R140	16,640.38	0.026108	0.04	69	100	0.333	79.24
R160	3,186.18	0.042533	0.04	36	120	0.333	15.17
R210	4,566.80	0.010076	0.04	54	120	0.333	21.75
R220	444.48	0.075912	0.04	69	110	0.333	2.12
R260	14,019.49	0.073824	0.04	169	80	0.333	66.76
R280	7,359.84	0.011417	0.04	75	100	0.333	35.05
R320	769.32	0.014533	0.04	103	100	0.333	3.66
R340	880.19	0.017935	0.04	105	90	0.333	4.19
R360	2,144.41	0.030021	0.04	111	90	0.333	10.21
R380	6,181.67	0.044973	0.04	169	80	0.333	29.44
R450	14,787.13	0.037901	0.04	245	70	0.333	70.41
R480	9,668.97	0.066037	0.04	125	80	0.333	46.04
R580	872.34	0.047215	0.04	393	60	0.333	4.15
R690	3,339.70	0.066982	0.04	402	60	0.333	15.90
R740	21,792.22	0.046525	0.04	427	50	0.333	103.77
R760	15,280.31	0.060495	0.04	245	50	0.333	72.76
R780	4,432.76	0.025181	0.04	125	90	0.333	21.11
R80	4,549.83	0.005013	0.04	2	160	0.333	21.67
R90	17,512.73	0.024985	0.04	36	100	0.333	116.75

Table 5.3

Sub-basin Parameters and
River reach Parameters

Xs No.	Station	Distance (m)	Whole Channel Section					Oxbow Section				
			Elevation (m)			Flow Capacity (m³/s)		Elevation (m)			Flow Capacity (m³/s)	
			Left Bank	Right Ban	River Bottom	Left Bank	Right Ban	Left Bank	Right Ban	River Bottom	Left Bank	Right Ban
1	0+000.000	0.00	0.97	1.00	-3.57	2,114.53	2,066.40					
2	0+538.053	538.05	1.62	1.75	-1.54	1,425.12	1,468.31					
3	0+980.427	980.43	2.34	2.34	-1.23	1,074.85	1,074.85					
4	1+293.624	1293.62	2.95	3.51	-1.06	1,112.55	1,368.38					
5	1+492.939	1492.94	8.30	3.63	-0.46	7,092.29	1,354.78					
6	1+709.431	1709.43	8.32	4.53	-0.21	5,119.90	1,522.54					
7	1+911.832	*Not used*										
8	2+100.642	2100.64	8.86	2.18	-2.89	4,606.72	759.00	3.55	2.18	0.43	625.26	232.39
9	2+316.745	2316.75	8.50	2.18	-1.06	4,163.83	657.32	3.03	2.18	0.36	211.02	151.34
10	2+488.915	2488.92	9.01	5.21	-0.36	4,657.93	1,409.15	3.49	5.21	-0.36	323.26	1,066.91
11	2+660.650	2660.65	6.15	8.67	-0.50	2,016.01	4,234.31	3.56	8.67	-0.50	280.71	4,351.91
12	2+913.256	2913.26	9.14	8.94	-2.65	4,597.74	4,397.94	5.04	8.94	0.62	664.02	2,543.28
13	3+085.275	3085.28	9.74	9.75	0.24	5,139.48	5,150.04	5.88	9.75	0.25	571.07	2,247.28
14	3+258.380	3258.39	5.31	8.67	-0.54	1,063.65	3,981.90	5.37	8.67	-0.54	407.29	1,663.66
15	3+438.097	3438.10	10.44	8.64	-1.00	5,783.04	3,869.52	4.69	8.64	-1.00	245.69	1,658.13
16	3+646.538	3646.54	3.96	8.94	0.31	747.25	4,154.59	4.32	8.94	0.37	188.09	1,822.53
17	3+859.307	3859.31	8.41	9.80	1.31	3,611.55	5,147.82					
18	4+061.656	4061.66	7.63	5.37	2.56	2,630.63	893.73					
19	4+264.511	4264.51	6.92	9.43	2.26	1,410.71	4,105.04					
20	4+466.098	4466.10	8.65	9.62	2.50	3,007.68	3,870.77					
21	5+079.300	5079.30	13.93	10.87	2.79	8,379.67	3,918.10					
22	5+494.201	5494.20	14.87	11.21	3.67	7,518.91	3,227.32					
23	5+978.103	5978.10	11.75	12.62	3.51	2,833.95	3,766.26					
24	6+492.152	6492.15	12.19	14.52	4.37	2,568.60	5,147.24					
25	6+981.892	6981.89	13.50	14.73	5.61	3,686.49	5,120.37					
26	7+492.254	7492.25	14.84	16.40	4.52	4,751.09	6,759.74					
27	7+950.606	7950.61	20.57	19.70	9.52	12,467.47	11,214.26					
28	8+527.694	8527.69	18.86	19.66	10.98	7,685.70	9,111.40					
29	9+075.272	9075.27	18.94	20.94	13.27	2,899.18	5,813.69					
30	9+603.007	9603.01	23.95	22.01	16.07	6,003.46	2,861.42					
31	10+043.951	10043.95	24.50	22.65	17.56	3,542.57	1,923.74					

DRAFT FINAL REPORT FOR SECTORAL LOAN FOR DISASTER RISK MANAGEMENT	Table 5.4 River Channel Capacity
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	

Table 7.1 Result of Flood Inundation Analysis

(1) Without Project

Inundation Depth (m)			Extent of Inundation Area (km2)					
			2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
0.01	-	0.24	0.27	0.35	0.21	0.32	0.31	0.32
0.25	-	0.49	0.34	0.25	0.33	0.40	0.38	0.31
0.50	-	0.99	0.70	0.50	0.57	1.06	0.96	0.86
1.00	-	1.99	1.09	1.31	1.30	1.37	1.64	1.85
2.00	-	2.99	1.06	1.12	1.00	1.06	1.23	1.22
	>=	3.00	1.32	1.79	2.25	2.47	2.66	2.93
Total			4.77	5.31	5.65	6.68	7.17	7.48

(2) With Suitable Plan

Inundation Depth (m)			Extent of Inundation Area (km2)					
			2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
0.01	-	0.24	0.18	0.14	0.30	0.35	0.31	0.32
0.25	-	0.49	0.23	0.17	0.23	0.33	0.38	0.31
0.50	-	0.99	0.55	0.37	0.27	0.68	0.96	0.86
1.00	-	1.99	0.97	1.11	0.99	0.93	1.64	1.85
2.00	-	2.99	0.74	0.73	0.82	0.89	1.23	1.22
	>=	3.00	1.09	1.42	1.66	1.98	2.66	2.93
Total			3.75	3.94	4.27	5.15	7.17	7.48

Table 7.2 Construction Base Cost for Tagoloan River Improvement Project

Tagoloan Project / *Major* Work Description	Quantity	Unit	Unit Cost L/C	Unit Cost F/C	Total Cost L/C	Total Cost F/C	Total
Earth Work							
Clearing and Grubbing	222,750	m^2	8.9	15.2	1,973,092	3,379,741	5,352,833
Removal and Stripping of Tops	80,000	m^2	198.9	367.0	15,913,742	29,359,065	45,272,806
Excavation, Open Cut -1	186,000	m^3	13.7	25.9	2,546,420	4,811,341	7,357,761
Excavation and Loading -1	178,000	m^3	23.5	47.6	4,179,409	8,479,445	12,658,854
Hauling - 2 km -1	231,200	m^3	31.9	60.5	7,366,641	13,997,477	21,364,118
Hauling - 5 km -1	148,800	m^3	59.4	113.0	8,845,447	16,807,382	25,652,829
Spreading	186,000	m^3	9.4	16.3	1,741,859	3,038,339	4,780,198
Dike Embankment	194,000	m^3	51.3	103.7	9,944,107	20,113,175	30,057,282
Grass Sodding	39,000	m^2	70.2	5.1	2,738,057	199,056	2,937,113
Subtotal					*55,248,773*	*100,185,021*	*155,433,794*
Drainage Ditch (BxH=0.3m x 0.3m)							
Concrete Work for Small Structure-	477	m^3	1529.5	2098.4	729,586	1,000,954	1,730,540
Concrete Work for Leveling	212	m^3	1109.2	1754.0	235,159	371,845	607,004
Formwork F2 (for Small Sized Structure)	3,975	m^2	432.5	59.1	1,719,109	234,938	1,954,048
Formwork for Leveling Concrete	530	m^2	321.7	39.0	170,496	20,675	191,171
Subtotal					*2,854,350*	*1,628,411*	*4,482,762*
Drainage Sluice							
Concrete Work for Reinforced Concrete-1	846	m^3	1096.3	2164.2	927,749	1,831,521	2,759,269
Concrete Work for Leveling	37	m^3	1109.2396	1753.985	41,197	65,143	106,340
Formwork F1 (for Large Sized Structure)	1,843	m^2	425.5	48.8	784,210	89,946	874,156
Formwork for Leveling Concrete	29	m^2	321.7	39.0	9,371	1,136	10,507
Supporting/Scaffolding Work	1,179	m^3	299.5	81.8	353,013	96,384	449,396
Installation of 1.5x1.5m Slide	2	nos	1000000.0	2000000.0	2,000,000	4,000,000	6,000,000
Installation of 3.0x3.0m Slide	2	nos	3000000.0	9000000.0	6,000,000	18,000,000	24,000,000
Steel Sheet Pile Type II	380	m^2	1237.9	9169.4	470,613	3,485,926	3,956,539
Reinforcing Bar (Grade 60)	85	ton	25005.5	40182.7	2,116,143	3,400,543	5,516,685
Subtotal					*12,702,295*	*30,970,598*	*43,672,893*
Drainage Channel							
Excavation and Loading by Backhoe (0.63 cu.m.)	38,968	m^3	32.0	59.6	1,245,432	2,321,258	3,566,691
Backfill, about Structures and Services (with Excavated Material)	28,749	m^3	108.7	134.2	3,125,179	3,857,367	6,982,545
Hauling - 5 km, Loaded by Backhoe (	10,219	m^3	63.7	128.3	650,786	1,310,801	1,961,587
Spreading	10,219	m^3	9.4	16.3	95,701	166,932	262,633
Concrete Work for Small Concrete, Class-C, Concrete Pump Placing	5,812	m^3	1,107.0	2,224.4	6,433,761	12,927,999	19,361,760
Concrete Work for Leveling Concrete, Class-F, Manpower	843	m^3	1,000.5	1,754.0	843,592	1,478,960	2,322,553
Formwork F2 (for Small Sized Structu	10,304	m^2	351.2	59.1	3,618,627	609,007	4,227,635
Formwork for Leveling Concrete	496	m^2	250.1	39.0	124,054	19,348	143,403
Reinforcing Bar (Grade 60)	465	ton	25,005.5	40,182.7	11,626,565	18,683,347	30,309,912
Subtotal					*27,763,698*	*41,375,020*	*69,138,718*
Revetment Works							
Stone Masonry/Wet Stone Masonry-1	37,000	m^2	853.3	497.3	31,570,623	18,400,895	49,971,518
Gravel Bedding and Backfill	5,550	m^3	872.7	223.0	4,843,606	1,237,663	6,081,268
Concrete Work for Small Structure-	1,427	m^3	1529.5	2098.4	2,182,679	2,994,520	5,177,198
Formwork F2 (for Small Sized Structure)	6,938	m^2	432.5	59.1	3,000,419	410,046	3,410,464
Reinforcing Bar (Grade 60)	114	ton	25005.5	40182.7	2,850,629	4,580,827	7,431,456
Subtotal					*44,447,955*	*27,623,950*	*72,071,906*
Bridge Retrofit							
SPSP Fabrication	371	kg	7632.2	68690.0	2,834,790	25,513,107	28,347,897
SPSP Driving	1,272	m^2	1751.8	2638.1	2,228,239	3,355,626	5,583,866
Subtotal					*5,063,029*	*28,868,734*	*33,931,762*
Grand Total					*148,080,101*	*230,651,734*	*378,731,835*

Table 7.3 Compensation Cost

Project / Item / Description	Quantity	Unit	Unit Cost (Php)	Total Cost (Php)	Remarks
Tagoloan Project					
House Relocation					
Informal Dwellers	18	house	0	0	Estuary (Not Required for the Project)
Informal Dwellers	1	house	100,000	100,000	inclusive of Livelihood Support
Tenant Farmer-1	0	house	350,000	0	Compensation House
Tenant Farmer-2	0	family	50,000	0	Livilihood Support
Land Acquisition	200,000	m^2	0	0	Downstream, Phividec property
	21,000	m^2	0	0	Upstream, Phividec property
	88,000	m^2	350	30,800,000	Towhead
	Total			30,900,000	
Summary					
House Relocation				100,000	
Land Acquisition				30,800,000	
Grand Total				30,900,000	

Table 7.4 Project Cost Excluding Contingencies

Objective	Cost			Remarks	
Imus Retarding Basin	L/C	F.C	Total		
Construction Cost (Construction Base Cost)	*171,772,000*	*267,554,000*	*439,326,000*		- (A)
Estimated Direct Cost + OPC	148,080,000	230,651,000	378,731,000		
Mobilization & Demobilization	1,480,000	2,306,000	3,786,000	1.0%	of Estimated Direct Cost
Site Expenses	7,404,000	11,532,000	18,936,000	5.0%	of Estimated Direct Cost
Temporary Work	14,808,000	23,065,000	37,873,000	10.0%	of Estimated Direct Cost
Compensation Cost (Base Cost)	*30,900,000*	*0*	*30,900,000*		- (B)
House Relocation & Livelihood Support	100,000		100,000		
Land Acquisition	30,800,000		30,800,000		
Administration Cost (Base Cost)	*23,511,000*		*23,511,000*	5.0%	of (A) + (B)
Engineering Service Cost (Base Cost)	*28,116,000*	*42,174,000*	*70,290,000*		- (C)
Detailed Design Engineering	10,543,000	15,815,000	26,358,000	6.0%	of (A)
Supervision	17,573,000	26,359,000	43,932,000	10.0%	of (A)
Tax and Duties	*61,154,000*		*61,154,000*	12.0%	of (A) + (C)
Total	***315,453,000***	***309,728,000***	***625,181,000***		

Table 7.5 Assumed O&M Cost for Tagoloan River Improvement Project

Item of O & M					Annual		Unit Cost		Cost			Remarks
General	Item	Description	Frequency	Unit Item	Q'ty	Unit	L/C	F/C	L/C	F/C	Total	
Inspection												
	Inspection	Conducted by Municipal Government	Monthly	Inspector	24		Salary				0	2 person x 12months
				Gasoline	120	litre	10	40	*1,200*	*4,800*	*6,000*	10litre x 12months
Maintenance												
	Preventive	Conducted by Municipal Government	Semiannually	Labor (Residential P.)	10	persons	200		2,000	0	2,000	Based on Bayanihan
				Small Truck	16	hours	195	455	3,120	7,280	10,400	2cargo truck x 8hours x 2
				Leaders	4		Salary				0	
				Plastic Garbage Bag etc	1	L.S.	30000		30,000	0	30,000	for Garbage Collection
				Subtotal							*42,400*	
	Corrective (Repair of Structure)	Conducted by Provincial Government or DPWH	As Required	2% for New Revetment and Sluice (1% for New, 1% for Old Dike)	1	L.S.	1,143,005	1,171,891	*1,143,005*	*1,171,891*	*2,314,896*	
Operation												
				Electrical Charge	1	L.S.	200,000	0	200,000	0	200,000	
	In Flood	Personnel committed	6month contract	Personnel committed	12	months	3000	0	*36,000*	*0*	*36,000*	2 persons x 6 months
Grand Total									*1,380,205*	*1,176,691*	*2,599,296*	

Table 7.6 Estimated Flood Damage

Without Project

(under Plesent Land Status) unit: million pesos

Return Period	(1) Buildings	(2) Value Added	(3) Industry	(4) Agriculture	(5) Infrastructure	(6) Other Indirect	TOTAL
2-year	283	36	76	2	40	79	515
5-year	322	41	93	2	46	92	595
10-year	365	47	103	2	52	103	672
25-year	409	52	123	2	59	117	763
50-year	483	62	140	3	69	138	894
100-year	632	79	167	3	88	176	1,145

(under Future Land Status) unit: million pesos

Return Period	(1) Buildings	(2) Value Added	(3) Industry	(4) Agriculture	(5) Infrastructure	(6) Other Indirect	TOTAL
2-year	382	49	538	2	97	194	1,262
5-year	441	56	618	2	112	223	1,451
10-year	495	63	673	2	123	247	1,603
25-year	559	71	722	2	135	271	1,761
50-year	658	84	784	2	153	306	1,986
100-year	867	109	821	2	180	360	2,339

With Project

(under Plesent Land Status) unit: million pesos

Return Period	(1) Buildings	(2) Value Added	(3) Industry	(4) Agriculture	(5) Infrastructure	(6) Other Indirect	TOTAL
2-year	213	27	76	2	32	63	413
5-year	322	41	93	2	46	92	595
10-year	365	47	103	2	52	103	672
25-year	409	52	123	2	59	117	763
50-year	483	62	140	3	69	138	894
100-year	632	79	167	3	88	176	1,145

(under Future Land Status) unit: million pesos

Return Period	(1) Buildings	(2) Value Added	(3) Industry	(4) Agriculture	(5) Infrastructure	(6) Other Indirect	TOTAL
2-year	288	36	518	1	84	169	1,096
5-year	315	40	587	2	94	189	1,227
10-year	328	42	634	2	101	201	1,307
25-year	386	49	701	2	114	228	1,480
50-year	658	84	784	2	153	306	1,986
100-year	867	109	821	2	180	360	2,339

Table 7.7(1) Estimation of Annual Average Flood Damages to Be Mitigated

Under Present Land Use

In Case of Without-Project (million Pesos)

Return Period	Annual Average Probability of Exceedance	Probability of Occurrence	Flood Damages by Return Period	Average Amount of Assumed Damages	Average Annual Amount of Probable Damages	Accumu-lated Amount of Probable Damages
2-year	0.5000	0.5000	515	258	129	129
5-year	0.2000	0.3000	595	555	167	295
10-year	0.1000	0.1000	672	634	63	359
25-year	0.0400	0.0600	763	717	43	402
50-year	0.0200	0.0200	894	828	17	418
100-year	0.0100	0.0100	1,145	1,019	10	429

In Case of With-Project (million Pesos)

Return Period	Annual Average Probability of Exceedance	Probability of Occurrence	Flood Damages by Return Period	Average Amount of Assumed Damages	Average Annual Amount of Probable Damages	Accumu-lated Amount of Probable Damages	Annual Average Mitigated Damages to Be Expected (may be converted into E. Benefit)
2-year	0.5000	0.5000	388	194	97	97	32
5-year	0.2000	0.3000	429	408	123	219	76
10-year	0.1000	0.1000	450	439	44	263	95
25-year	0.0400	0.0600	537	494	30	293	109
50-year	0.0200	0.0200	894	716	14	307	111
100-year	0.0100	0.0100	1,145	1,019	10	317	111
							(= A - B)

Table 7.7(2) Estimation of Annual Average Flood Damages to Be Mitigated under Future Land Use Status

In Case of Without-Project (million Pesos)

Return Period	Annual Average Probability of Exceedance	Probability of Occurrence	Flood Damages by Return Period	Average Amount of Assumed Damages	Average Annual Amount of Probable Damages	Accumu-lated Amount of Probable Damages
2-year	0.5000	0.5000	1,262	631	316	316
5-year	0.2000	0.3000	1,451	1,356	407	722
10-year	0.1000	0.1000	1,602	1,526	153	875
25-year	0.0400	0.0600	1,761	1,681	101	976
50-year	0.0200	0.0200	1,986	1,874	37	1,013
100-year	0.0100	0.0100	2,339	2,163	22	1,035

In Case of With-Project (million Pesos)

Return Period	Annual Average Probability of Exceedance	Probability of Occurrence	Flood Damages by Return Period	Average Amount of Assumed Damages	Average Annual Amount of Probable Damages	Accumu-lated Amount of Probable Damages	Annual Average Mitigated Damages to Be Expected (may be converted into E. Benefit)
2-year	0.5000	0.5000	1,096	548	274	274	41
5-year	0.2000	0.3000	1,227	1,162	349	623	100
10-year	0.1000	0.1000	1,307	1,267	127	749	126
25-year	0.0400	0.0600	1,480	1,393	84	833	143
50-year	0.0200	0.0200	1,986	1,733	35	868	146
100-year	0.0100	0.0100	2,339	2,163	22	889	146
							(= A - B)

Table 7.8 Cash Stream of Tagoloan River Improvement Project (Economic Cost)

Withtout Price Contingency (without Tax, etc (VAT)) million P.

No.	Year	Construction				Compe-nsation	Admin.	Engineering Service Cost				O&M				Grand Total
		L/C		F/C	Total			L/C		F/C	Total	L/C		F/C	Total	
		Labor	M&E			L/C	L/C	Labor	M&E			Labor	M&E			
0	2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	2010	0	0	0	0	15	1	0	0	0	0	0	0	0	0	16
2	2011	0	0	0	0	15	1	9	1	17	26	0	0	0	0	42
3	2012	4	29	52	84	0	4	4	1	8	13	0	0	0	0	102
4	2013	9	65	116	190	0	9	5	1	10	15	0	0	0	0	215
5	2014	7	50	91	148	0	7	4	1	8	13	0	0	0	1	169
6	2015	0	0	0	0	0	0	1	0	1	2	0	1	1	2	5
7	2016	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
8	2017	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
9	2018	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
10	2019	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
11	2020	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
12	2021	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
13	2022	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
14	2023	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
15	2024	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
16	2025	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
17	2026	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
18	2027	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
19	2028	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
20	2029	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
21	2030	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
22	2031	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
23	2032	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
24	2033	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
25	2034	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
26	2035	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
27	2036	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
28	2037	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
29	2038	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
30	2039	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
31	2040	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
32	2041	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
33	2042	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
34	2043	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
35	2044	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
36	2045	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
37	2046	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
38	2047	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
39	2048	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
40	2049	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
41	2050	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
42	2051	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
43	2052	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
44	2053	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
45	2054	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
46	2055	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
47	2056	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
48	2057	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
49	2058	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
50	2059	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2

Table 7.9 Economic Evaluation for Tagoloan River

(million Pesos)

Calendar Year	Year in Order	Economic Cost			Base of Benefit from Economic Product	Benefit to Be Derived			Cash Balance
		Project Cost	OM Cost	Total				Economic Benefit in Total	
2005	-4			0				0	0
2006	-3			0				0	0
2007	-2			0				0	0
2008	-1			0				0	0
2009	Base Year	0	0	0				0	0
2010	1	37	0	37			0	0	-37
2011	2	64	0	64			0	0	-64
2012	3	102	0	102			0	0	-102
2013	4	215	0	215	37		12	12	-202
2014	5	168	1	169	76		38	38	-131
2015	6	2	2	5	130		130	130	126
2016	7	0	2	2	133		133	133	131
2017	8	0	2	2	136		136	136	134
2018	9	0	2	2	140		140	140	137
2019	10	0	2	2	143		143	143	140
2020	11	0	2	2	146		146	146	143
2021	12	0	2	2	146		146	146	143
2022	13	0	2	2	146		146	146	143
2023	14	0	2	2	146		146	146	143
2024	15	0	2	2	146		146	146	143
2025	16	0	2	2	146		146	146	143
2026	17	0	2	2	146		146	146	143
2027	18	0	2	2	146		146	146	143
2028	19	0	2	2	146		146	146	143
2029	20	0	2	2	146		146	146	143
2030	21	0	2	2	146		146	146	143
2031	22	0	2	2	146		146	146	143
2032	23	0	2	2	146		146	146	143
2033	24	0	2	2	146		146	146	143
2034	25	0	2	2	146		146	146	143
2035	26	0	2	2	146		146	146	143
2036	27	0	2	2	146		146	146	143
2037	28	0	2	2	146		146	146	143
2038	29	0	2	2	146		146	146	143
2039	30	0	2	2	146		146	146	143
2040	31	0	2	2	146		146	146	143
2041	32	0	2	2	146		146	146	143
2042	33	0	2	2	146		146	146	143
2043	34	0	2	2	146		146	146	143
2044	35	0	2	2	146		146	146	143
2045	36	0	2	2	146		146	146	143
2046	37	0	2	2	146		146	146	143
2047	38	0	2	2	146		146	146	143
2048	39	0	2	2	146		146	146	143
2049	40	0	2	2	146		146	146	143
2050	41	0	2	2	146		146	146	143
2051	42	0	2	2	146		146	146	143
2052	43	0	2	2	146		146	146	143
2053	44	0	2	2	146		146	146	143
2054	45	0	2	2	146		146	146	143
2055	46	0	2	2	146		146	146	143
2056	47	0	2	2	146		146	146	143
2057	48	0	2	2	146		146	146	143
2058	49	0	2	2	146		146	146	143
2059	50	0	2	2	146		146	146	143
2060	51	0	0	0	146		146	146	146
2061	52	0	0	0	146		146	146	146
2062	53	0	0	0	146		146	146	146
2063	54	0	0	0	146		146	146	146
2064	55	0	0	0	146		146	146	146
2065	56	0	0	0	146		146	146	146
2066	57	0	0	0	146		146	146	146
2067	58	0	0	0	146		146	146	146
2068	59	0	0	0	146		146	146	146
2069	60	0	0	0	146		146	146	146
2070	61	0	0	0	146		146	146	146
2071	62	0	0	0	146		146	146	146
Total		588	107	695		0	8,317	8,317	7,622
Applied Discount Rate: 15 % according to a regulation of the nation.									
NPV				363				492	129
EIRR									19.48%
B/C									1.36