PREPARATORY SURVEY FOR FLOOD RISK MANAGEMENT PROJECT

for

CAGAYAN DE ORO RIVER (FRIMP-CDOR)

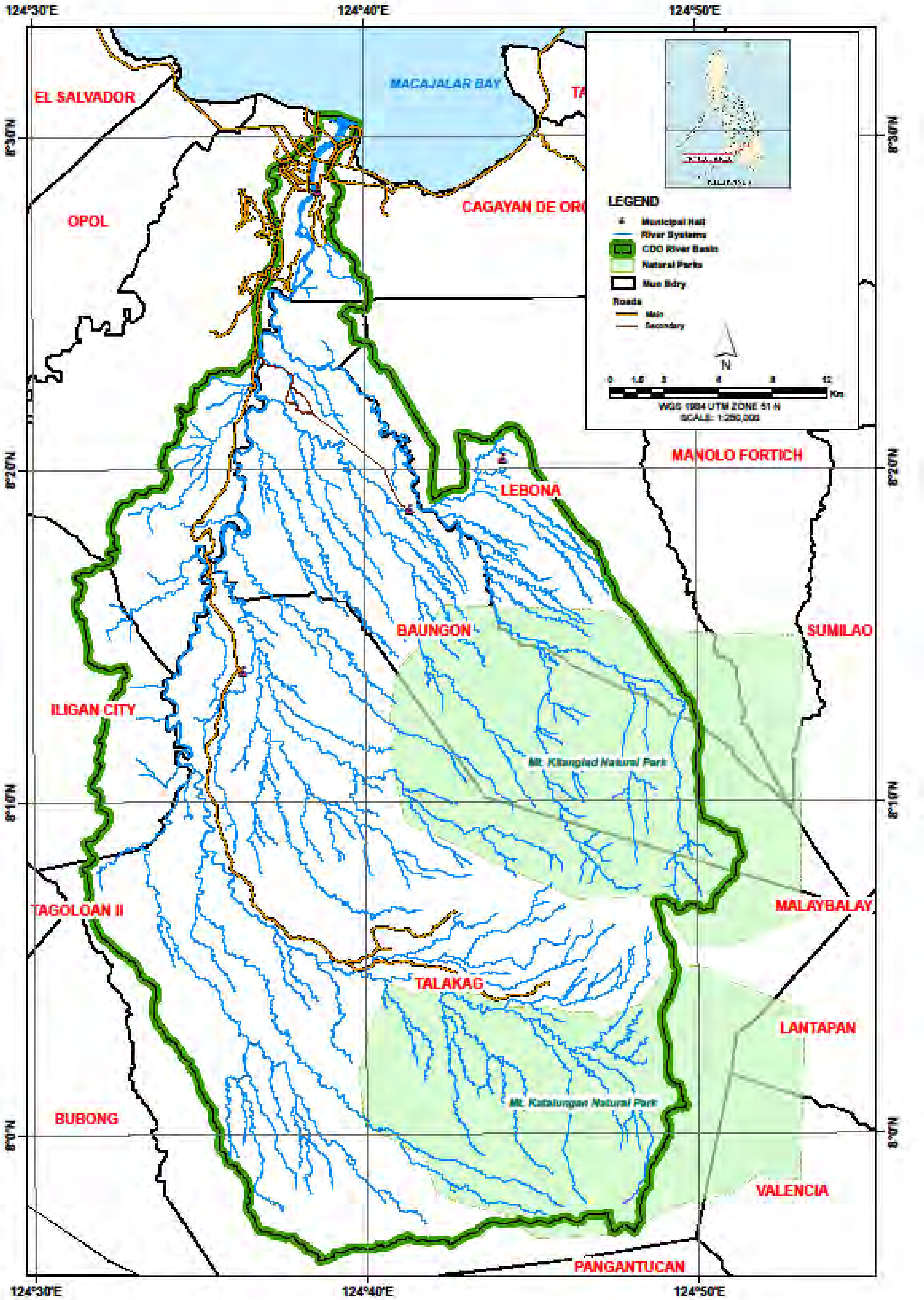
in

THE REPUBLIC OF THE PHILIPPINES

ENVIRONMENTAL IMPACT STATEMENT

NOVEMBER 2013

Department of Public Works and Highways



Location Map of Cagayan de Oro River Basin

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ENVIRONMENTAL IMPACT STATEMENT (DRAFT)

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ABBREVIATIONS

ABAMIN	Abante Mindanao
ADB	Asian Development Bank
ALAGAD	Alliance Against Aids
AO	Administrative Order
APHA	American Public Health Association
ARMM	Autonomous Region in Muslim Mindanao
AWWA	American Water Works Association
BBHP	Bulanog-Batang Hydropower Development Project
BDRRMC	Barangay Disaster Risk Reduction and Management Council
BFAR	Bureau of Fisheries and Aquatic Resources
BOD	Biochemical Oxygen Demand
BSWM	Bureau of Soils and Water Management, DA
CCA	Climate Change Adaptation
CDI	Cities Development Initiative for Asia
CDF	Controlled Dumpsite Facility
CDO	Cagayan de Oro
CDOR	Cagayan de Oro River
CDORBMC	Cagayan de Oro River Basin Management Council
CENRO	Community Environment and Natural Resources Office
CEPALCO	Cagayan Electric Power and Light Company, Inc.
CGIAR-CSI	Consortium for Spatial Information of the Consultative Group on International Agricultural Research
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLENRO	City Local Environment and Natural Resource Office, LGU
COD	Chemical Oxygen Demand
COWD	Cagayan de Oro Water District
D	Berger Parker Dominance Index
DAO	DENR Administrative Order
D/D	Detailed Design
DEM	Digital Elevation Model
DENR	Department of Environment and Natural Resources
DENR 10	DENR Region 10
DepED	Department of Education
DO	Dissolved Oxygen
DOH	Department of Health
DOLE	Department of Labor and Employment
DPWH	Department of Public Works and Highways
DRR	Disaster Risk Reduction
DRRMC	Disaster Risk Reduction and Management Committee
DSWD	Department of Social Welfare and Development
DTI	Department of Trade and Industry
E	Equitability Index
ECA	Environmentally Critical Areas
ECC	Environmental Compliance Certificate
ECP	Environmentally Critical Project

EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EISS	Environmental Impact Statement System
EMB	Environmental Management Bureau
EMB 10	EMB Region 10
EMoP	Environmental Monitoring Plan
EMP	Environmental Management Plan
EPRMP	Environmental Performance Report and Management Plan
ESSO	Environmental and Social Services Office
ESSD	Environmental and Social Safeguard Division
FADs	Fish aggregating devices
FCSEC	Flood Mitigation and Sabo Engineering Center, DPWH
FFWS	Flood Forecasting and Warning System
FRIMP-CDOR	The Preparatory Survey for Flood Risk Management Project for Cagayan de Oro River
F/S	Feasibility Study
GIS	Geographic Information System
GOP	Government of the Philippines
GPS	Global Positioning System
GRDP	Gross Regional Domestic Products
H’	Shannon-Wiener Index of Diversity
HAB	Harmful Algal Blooms
HIV/AIDS	Human Immunodeficiency Virus / Acquired Immune Deficiency Syndrome
IEC	Information, Education and Communication
IEE	Initial Environmental Examination
IEEC	Initial Environmental Examination Checklist
IEER	Initial Environmental Examination Report
IP	Indigenous People
IUCN	International Union for Conservation of Nature and Natural Resources
JICA	Japan International Cooperation Agency
JST	JICA Survey Team
LGU	Local Government Unit
LHC	Live Hard Coral
LIT	Line Intercept Transect
LMS	Lands Management Service
MBDA	Macajalar Bay Development Alliance
MCL	Maximum Contamination Level
MENRO	Municipal Environment and Natural Resource Office, LGU
MGB	Mines and Geosciences Bureau
MGB 10	MGB Region 10
MMC	McKeough Marine Center
MOA	Memorandum of Agreement
MOCAN	Misamis Oriental-CDO AIDS Network
M/P	Master Plan
MRF	Materials Recovery Facility
NAAQS	National Ambient Air Quality Standard
NCR	National Capital Region
NEDA	National Economic Development Agency
NHA	National Housing Authority
NIPAS	National Integrated Protected Areas System

NO_2	Nitrogen dioxide
NPAA	Network of Protected Areas for Agriculture
NSCB	National Statistical Coordinating Board
NSO	National Statistics Office
NSSM	National Sewerage and Septage Management
OCD	Office of Civil Defense
OSHS	Occupational Safety and Health Standards
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PAPs	Project Affected Persons
PAWB	Protected Areas and Wildlife Bureau
PCG	Philippine Coast Guard
PD	Presidential Decree
PDO	Planning and Development Office
PDR	Project Description Report
PEIS	Programmatic EIS
PEISS	Philippine Environmental Impact Statement System
PENRO	Provincial Environment and Natural Resources Office
PEPRMP	Programmatic Environmental Performance Report and Management Plan
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PM	Particular Matter
PM-10	Particulate Matter with size of 10 μm
PMO	Project Management Office
PVC	Polyvinylchloride
RA	Republic Act
R-10	Region 10
RAP	Resettlement Action Plan
RED	Regional Executive Director
ROW	Right of Way
ROWA	Right of Way Acquisition
SEA	Strategic Environmental Assessment
SLF	Sanitary Land Fill
SO_2	Sulfur dioxide
SRTM	Shuttle Radar Topography Mission
ST	Super Typhoon
STI	Sexually Transmitted Infection
SWM	Solid Waste Management
SWMP	Solid Waste Management Plan
TESDA	Technical Education and Skills Development Authority
TDS	Total Dissolved Solid
TOR	Terms of Reference
TS	Tropical Storm
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
TY	Typhoon
WB	World Bank
WEF	Water Environment Federation

CHAPTER 1 INTRODUCTION

1.1 Background

Baseline surveys of environmental and social conditions for Initial Environmental Evaluation (IEE) had been conducted to implement the Flood Risk Management Project for Cagayan de Oro River (FRIMP-CDOR) in the Philippines, consulting DENR-EMB Region X, the competent authority for the Philippines Environmental Impact Statement System (PEISS). The Project is categorized as A under JICA Guidelines for Environmental and Social Considerations (April 2010) (the JICA Environmental Guidelines), and the EIA survey has been implemented as part of Preparatory Survey for this Project. To comply with the JICA Environmental Guidelines, this EIA report (EIS in the Philippines) has been prepared, integrating survey results of IEE and EIA.

1.2 Objective

The objectives of the EIA Study are the following:

- To implement the necessary survey, examination and assessment for anticipated impacts of the FRIMP CDOR to attain the requirements stipulated in the JICA's Environmental and Social Considerations Guidelines as well as in the Philippines Environmental Impact Statement System (PEISS).
- To incorporate all the results of EIA study into the project design and to formulate the Environmental Management and Monitoring Plans (EMP / EMoP) by ensuring the mitigation measures for the anticipated negative impacts.

CHAPTER 2 PROJECT DESCRIPTION

2.1 Project Area

The project area is located in the Cagayan de Oro (CDO) River Basin, which is situated in the Northern Mindanao Region. The CDO river basin administratively belongs to Region 10, and specifically located in five local government units: Cagayan de Oro City (highly urbanized city) and three municipalities of Talakag, Baungon and Libona in Bukidnon and Illigan City in Misamis Oriental.

Location map of the CDO river basin is presented in **Figure 2.1.1.** The project area is located in the most downstream area of the CDO river where suffered from the serious damages due to recent floods. The targeted river stretch of the project is the one from the river mouth, flowing out to the Macajalar Bay, to the Pelaez Bridge with approx. 12 km long as shown in **Figure 2.1.2.**

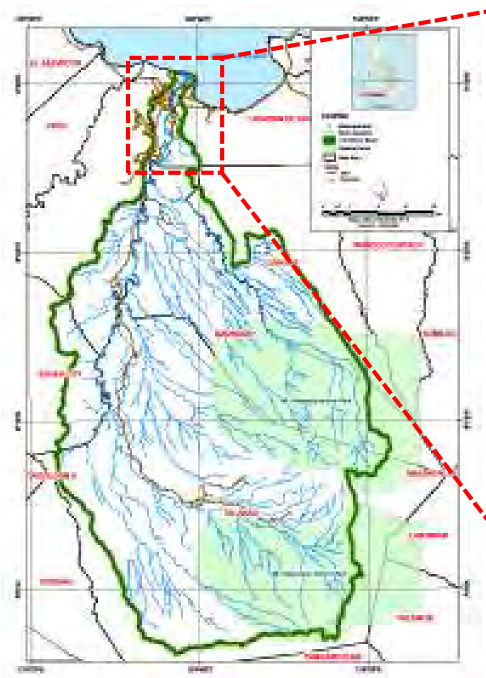


Figure 2.1.1 Cagayan de Oro River Basin

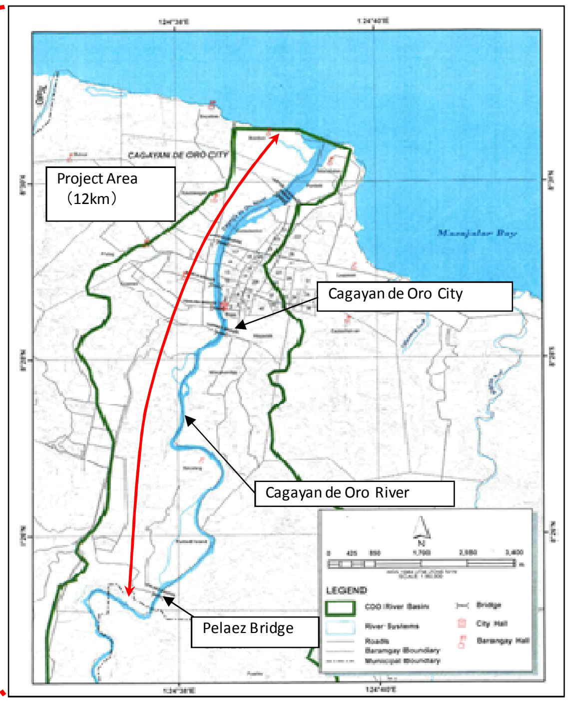


Figure 2.1.2 The Project Area Downstream of Cagayan de Oro River

2.2 Project Rationale

The Government of the Philippines (GOP) has set measures for flood mitigation such as watershed management, and efficient and appropriate infrastructure development, as one of the important policies in the Philippine Development Plan (2011-2016), with the following strategies:

- To give priority to construction of flood mitigation structures for high flood risk area,
- To consider climate change adaptation in planning and design for flood mitigation structures, and
- To execute flood mitigation and management by structural and non-structural measures.

The Cagayan de Oro River Basin was selected from the fifty six (56) priority river basins in "Nationwide Flood Risk Evaluation and Flood Damage Mitigation Plan in Selected River Basin, 2006-2008" by Department of Public Works and Highway (DPWH) under technical assistance of Japan International Cooperation Agency (JICA). Then, due to urgent need, DPWH has conducted a Master Plan (M/P) and Feasibility Study (F/S) in the Cagayan de Oro River Basin in June 2011, by their national budget. In the M/P, target year was set at Year 2035 with a flood protection level in 25 year probability.

Tropical Storm Sendong in December 2011, after the conduct of the said M/P and F/S, had brought about serious damages in the north Mindanao area. About 1,170 thousand people were affected and about 1,250 persons were lost. One of the serious damaged cities was Cagayan de Oro City, which is located at the downstream of the Cagayan de Oro River Basin, where about 600,000 people live. Due to tremendous changes in natural and social conditions by the Sendong, review and update of M/P and F/S are urgently necessary.

Under aforementioned circumstance, a project regarding urgent flood risk management measures for the Basin is requested in order to strengthen the disaster resilience of communities around the Basin. In March 2012, DPWH and JICA have agreed to conduct the technical assistance of JICA on the Preparatory Survey for Flood Risk Management Project for Cagayan de Oro River(the Survey) intending to formulate a Yen loan project for the Cagayan de Oro River Basin.

In the course of the Survey, the revised Master Plan was formulated and the Priority Project was selected and recommended to implement to mitigate the flood risk in the Cagayan de Oro River. This implementation program was prepared to promote the implementation of the proposed project works.

The primary objective of the Project is to mitigate flood risk in Cagayan de Oro River Basin through the construction of flood protection measures and implementation of non-structural measures.

2.3 Project Components

2.3.1 Basic Measures of Flood Risk Management Plan

Among the proposed measures in the Master Plan, the following measures were selected as the priority project (the Project), which should be implemented in short-mid term to effectively mitigate the flood risks in the Cagayan de Oro river basin. The Project is composed of both structural and non-structural measures as listed below:

Table 2.3.1 Flood Risk Management Measures of the Project

Structural measures	Short-Mid Term	**River improvement in downstream** (for floods of 25- year probability) (1) Construction of New Dike/ Retaining Wall (2) Installation of Gate and Drainage Outlets (3) Construction of New Road/Raising of Existing Road for Evacuation (4) Improvement of Kagayan Bridge (5) Construction of Retarding Basin (6) Removal of Sedimentation and Sandbar
Non-structural measures	Short-Mid Term	(1) Preparation/Update of Flood Hazard Map, Evacuation Planning (2) FFWS

		(3) Community Based Flood Early Warning System (CBFEWS) (4) Information Campaign and Publicity for the Project (Structural Measures) (5) Technical Assistance for Land Use Regulation for Habitual Inundation Area (6) Technical Assistance for Riparian Forest Establishment in the Agricultural Lands (7) Technical Assistance for Mangrove Forest Establishment along the Coastal Areas

2.3.2 Objective Area of Flood Risk Management Works

The objective area of the flood risk management works is approx.12 km long stretching from the river mouth to Pelaez Bridge considering the topographic, social and development conditions in the area as well as the flood damage in TS Sendong.

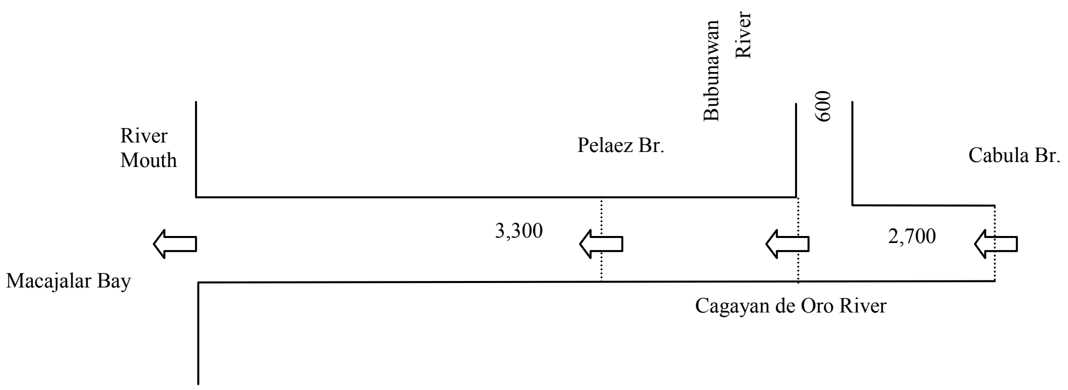
2.3.3 Design Discharge

The design scale adopted for the flood risk management plan is 25-year probable flood as presented in the figure below taking into account of the existing flow capacity of the objective stretch of the Cagayan de Oro River, etc.

Flood hydrograph was prepared based on the results of rainfall and run-off analysis which was calibrated with the observed rainfalls in the basin and discharge at the Cabula Bridge.

Table 2.3.2 Design Discharge at Pelaez and Cabula Bridges and Bubunawan River

Return Period	At Pelaez Bridge	At Cabula Bridge (upstream of Bubunawan Conf.)	Bubunawan River
25-year	3,300 m^3/s	2,700 m^3/s	600 m^3/s



Source: JICA Survey Team

Figure 2.3.1 Design Discharge Distribution (25-year flood)

2.3.4 River Boundary

The river boundary along the CDO River was established in consideration of existence of wider flood prone area than the Non Build Zone declared after TS Sendong, and based on the results of studies on river morphology, inundation analysis and flood risk level assessment.

The flood risk was assessed referring to an evaluation criteria adapted in the World Bank Study[1] as presented in **Figure 2.3.2.**

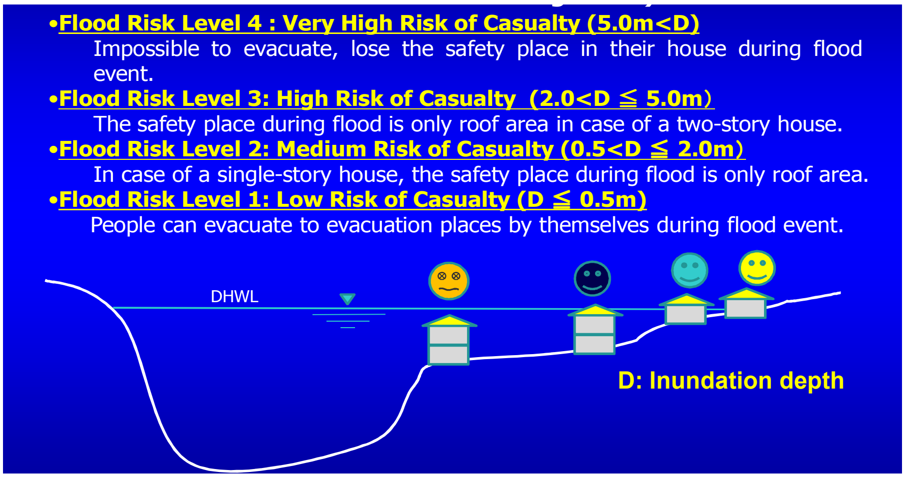


Figure 2.3.2 Criteria for Assessment of Flood Risk Level

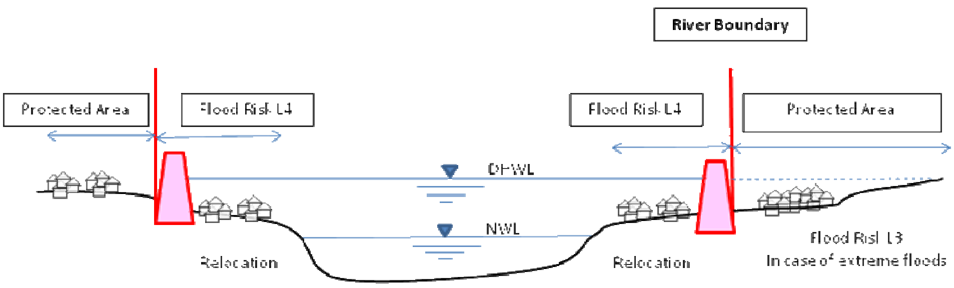
Note: Criteria for assessment of flood risk level is referring to the World Bank Study "Flood Management Master Plan for Metro Manila and Surrounding Areas" (2012)

The concept of the river boundary along the Cagayan de Oro River is presented below and the conceptual illustration of cross section is shown in **Figure 2.3.3.**

(1) Concept of River Boundary:

The alignment of river boundary is set along the outer line of Flood Risk Level 4 (refer to **Figure 2.3.2**). The area of Level 4 was seriously damaged by recent floods repeatedly. This area is not the safety place where people can live. That is why it should be defined as River Area.

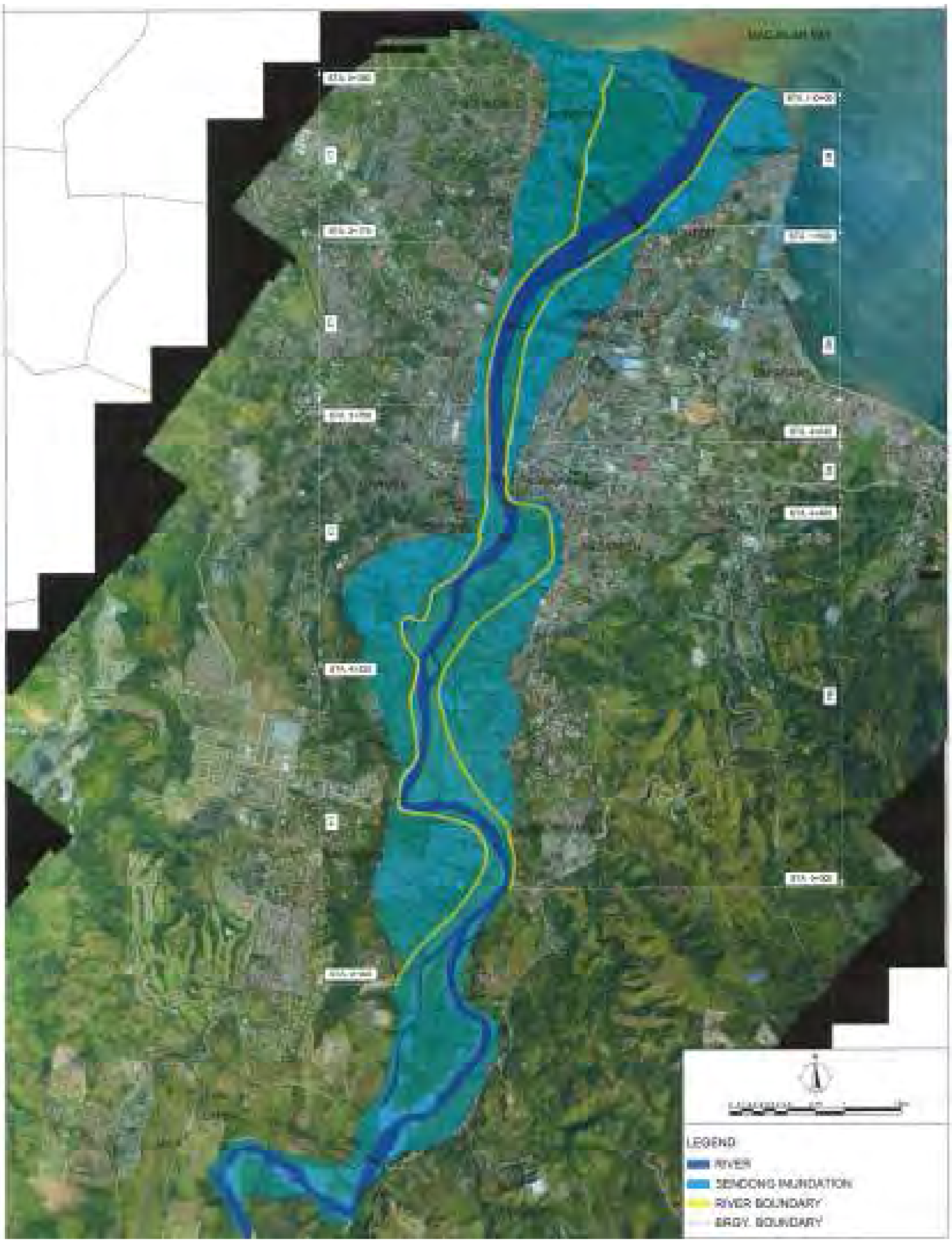
Under this concept, people living in Flood Risk Level 4 are to be relocated, and people living in the Flood Risk Levels 1 to 3 are to be protected. In case of breaching of the dike by extreme floods like TS Sendong, this concept will protect human lives in Flood Risk Levels 1 to 3 from serious flooding with combination with flood forecasting, and early warning systems and evacuation system. In this case, proposed river width is to be designed wider than the present condition to mitigate flood risk in the area (refer to **Figure 2.3.3**). The number of affected houses is estimated at around 1,260 based on the preliminary survey.



Source: JICA Survey Team

Figure 2.3.3 Illustration of Concept of Cross Section of River Boundary

[1] The World Bank Study "Flood Management Master Plan for Metro Manila and Surrounding Areas" (2012)



Source: JICA Survey Team

Figure 2.3.4 Base Map for Study of River Boundary in Cagayan de Oro River

2.3.5 Location of Proposed Structural Measures

Figure 2.3.5 shows the proposed structural measures in the Project. The figure also shows the existing structural measures including planned / on-going construction works to be conducted by DPWH as the Flood Mitigation Measures after TS Sendong and TY Pablo.

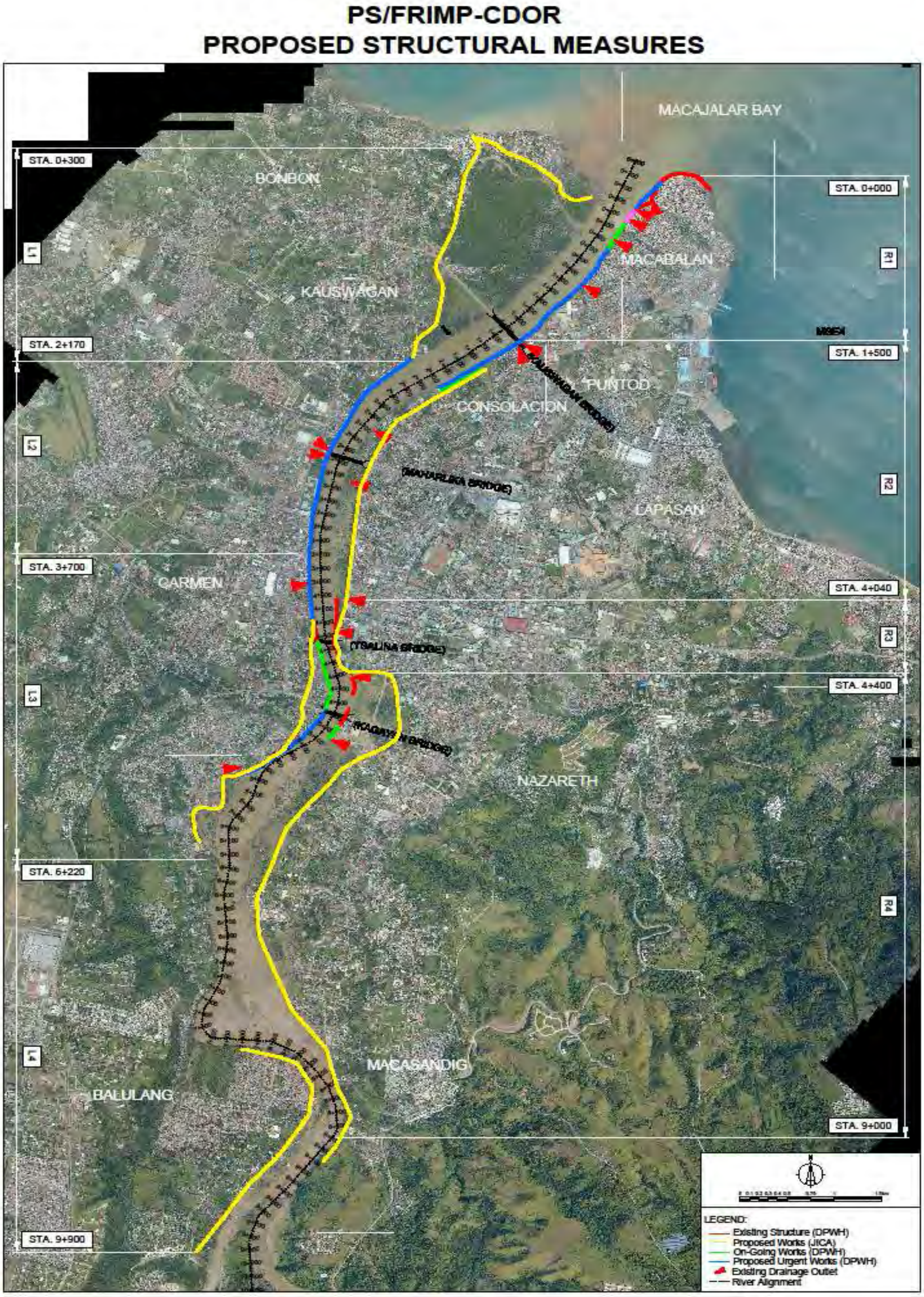


Figure 2.3.5 Location Map of Existing and Proposed Structural Measures

2.3.6 Structural Measures

The typical sections of proposed structural designs are shown as follows:

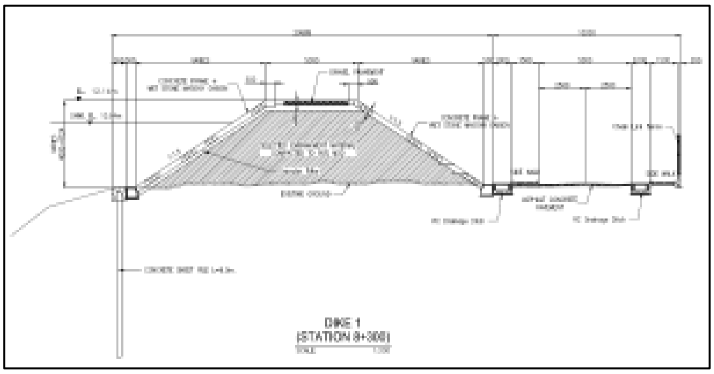
(1) Earth Dike

Construction of dike (Earth-fill dike) is required for areas with large space/land, which are designed with its slope of 1:2.0 to 1:1.5 on assumption that sandy-soil would be stable with angle of repose under the designed slop. Riverbed materials (sandy soil) of the Cagayan de Oro River will be used as earth fill materials. Sandy soil is characteristic of low cohesiveness so that designed slope of the earth dike of 1:2.0 to 1:1.5 can be stable.

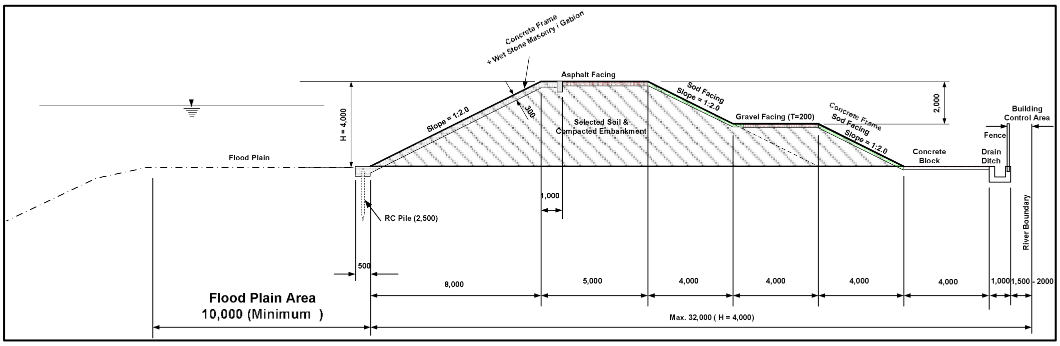
Two types design of the dike are applied due to Right of Way Acquisition (ROWA).

Dike-1: Designed slope of 1:1.5 with concrete slope protection and sheet pile foundation for limited construction space. Required length of sheet pile should be applied to avoid seepage failure and lateral flow of soil at high water channel.

Dike-2: Designed slope of 1:2.0 without sheet pile foundation at sufficient construction space. Required seepage length (width of dike) and sufficient width of high water channel should be designed to avoid seepage failure and lateral flow of soil at high water channel.



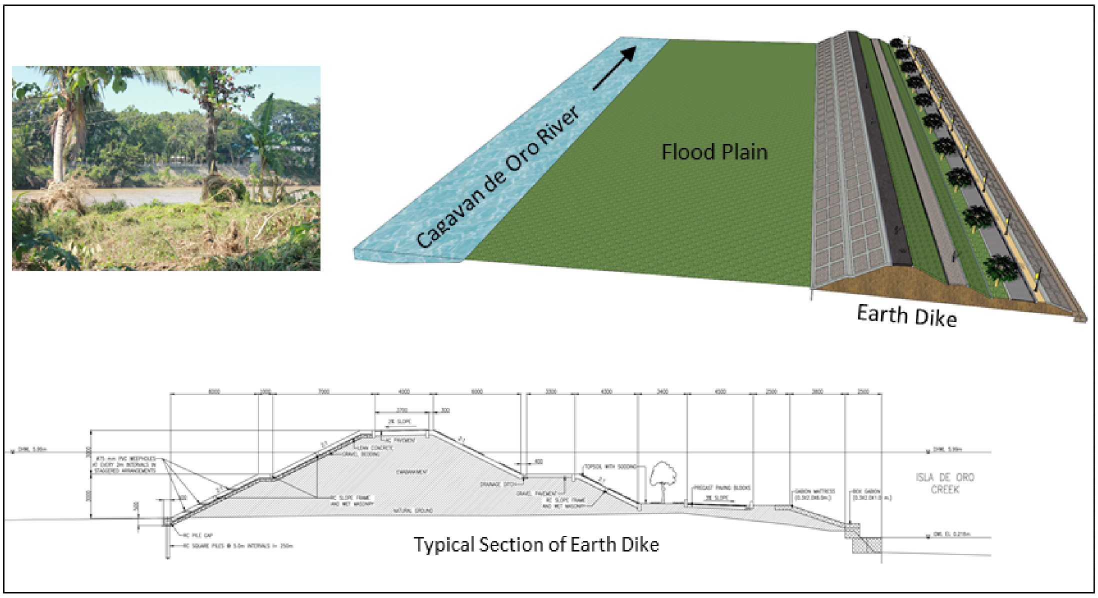
<u>Dike-1 (Case of Flood Plain Area Width: less than 10m)</u>



<u>Dike-2 (Case of Flood Plain Area Width: more than 10m)</u>

Source: JICA Survey Team (2013)

Figure 2.3.6 Typical Section of Earth-Fill Dike (Types of Dike-1 and Dike-2)

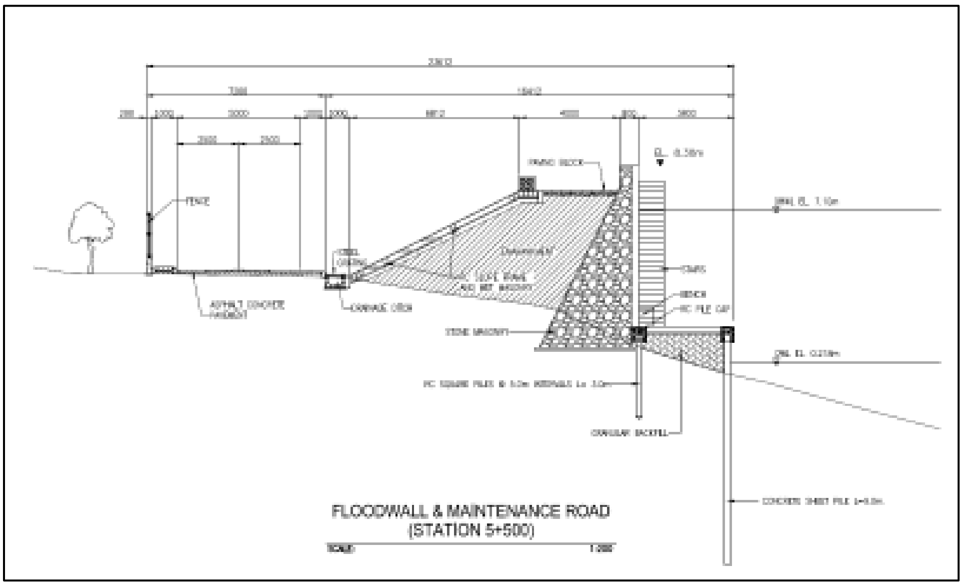


Source: JICA Survey Team

Figure 2.3.7 Three Dimensional (3D) Image of Earth-Fill Dike (Type of Dike-2)

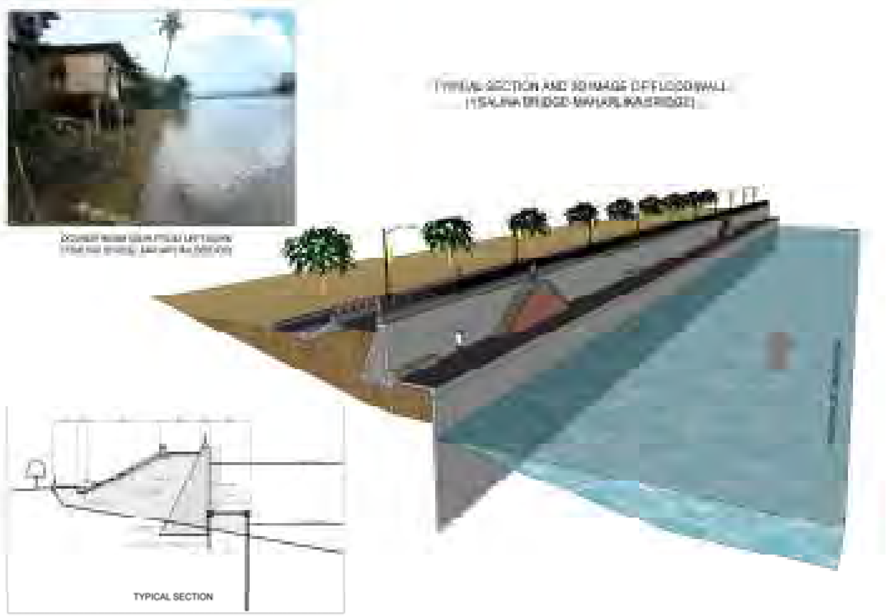
(2) Concrete Floodwall

Concrete Flood Wall will be designed in area with limited space/land in order to minimize land acquisition and social impact.



Source: JICA Survey Team

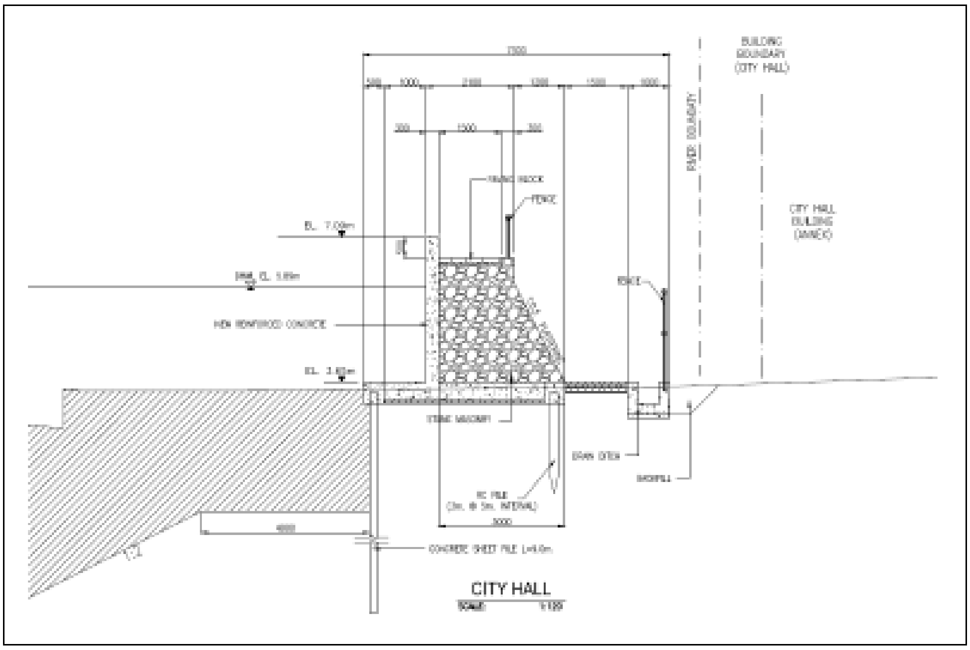
Figure 2.3.8 Typical Section of Concrete Wall (Floodwall and O/M Road)



Source: JICA Survey Team

Figure 2.3.9 Three Dimensional (3D) Image of Concrete Wall

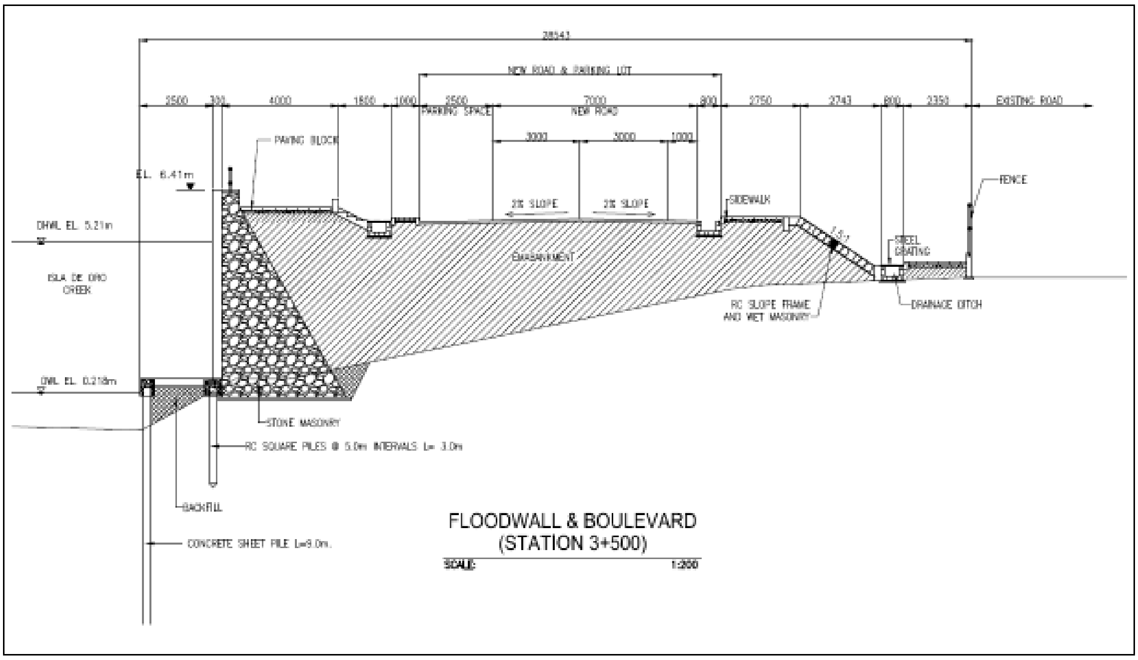
In the river narrow area or limited space of river bank, the following design is applied to maintain the river width or minimize the ROWA.



Source: JICA Survey Team

Figure 2.3.10 Typical Section of Concrete Wall (River Narrow Area)

The following design (typical section and 3-D image) is applied as floodwall & two (2) lanes road (Boulevard) at right bank between the Kauswagan Bridge and the Kagayan Bridge (distance about 2.9km), by which floodwall can be combined with Boulevard and Promenade to contribute improvement of social environment conditions, urban development and evacuation from disaster.



Source: JICA Survey Team

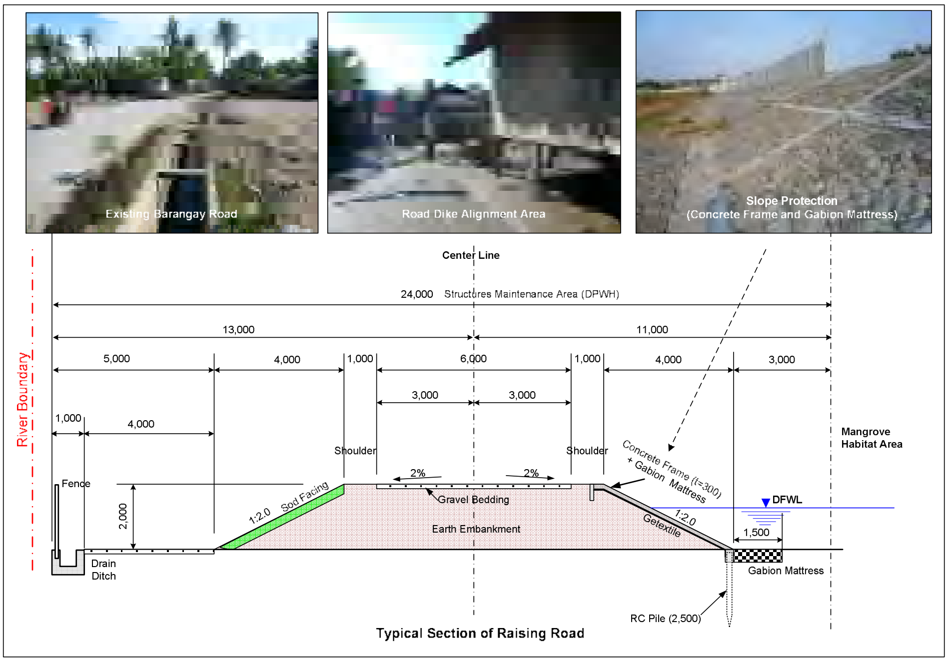
Figure 2.3.11 Typical Section of Concrete Wall & Boulevard (2 Lanes Road)

Source: JICA Survey Team

Figure 2.3.12 Three Dimensional (3D) Image of Concrete Wall & Boulevard (2 Lanes Road)

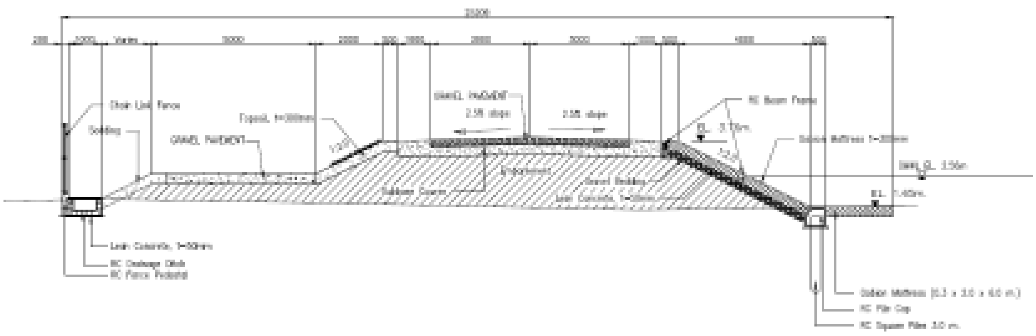
(3) Raising Road / Evacuation Road

Evacuation road will be provided by the following design at left bank of river mouth along the outer line of the Mangrove Protection Area (distance about 2.6 km) between Sta. 0+000 and Sta. 2+200. Slope of embankment dike are designed to be protected by Concrete Frame with Gabion Mattress at river side and Sod facing at land side as shown in the following figure.



Source: JICA Survey Team

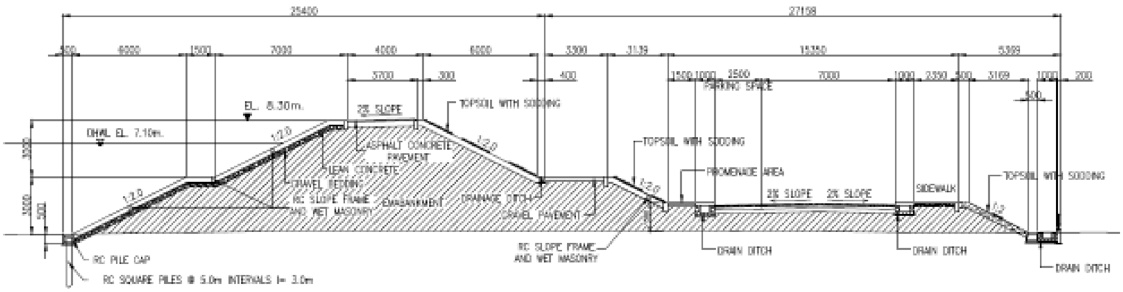
Figure 2.3.13 Typical Section of Raising Road



Source: JICA Survey Team (2013)

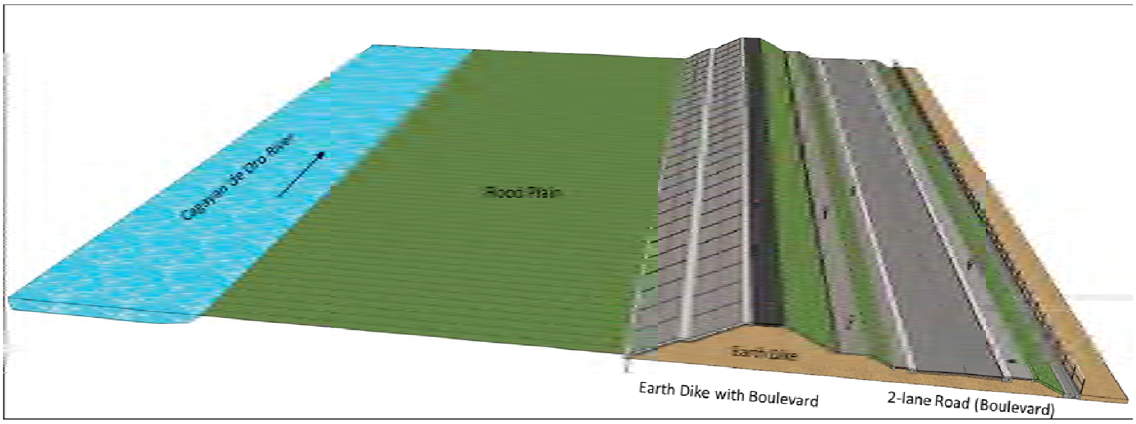
Figure 2.3.14 Typical Section of Road Raising

The following design (typical section) is applied as earth dike & two (2) lanes road (Boulevard) at right bank between the Kagayan Bridge and the Calacala Area, Macasandig (distance about 2.7km), by which earth dike can be combined with Boulevard and Promenade to contribute improvement of social environment conditions, urban development and evacuation from disaster.



Source: JICA Survey Team

Figure 2.3.15 Typical Section of Earth Dike (Dike-2) and Boulevard (2-Lanes Road)



Source: JICA Survey Team

Figure 2.3.16 Three Dimensional (3D) Image of Earth Dike & Boulevard (2 Lanes Road)

(4) Improvement of the Kagayan Bridge and Raising Approach

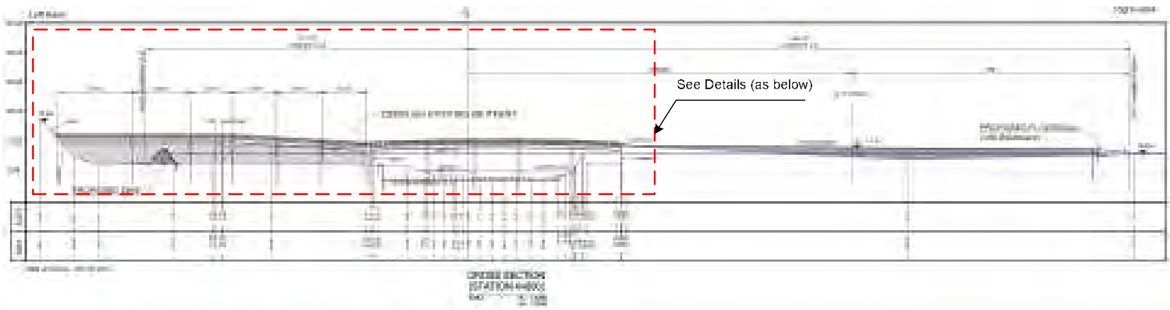
The Kagayan Bridge is located at the river narrow area (Sta. 4+000 to Sta.5+000), so it should be improved at the following parts:

a) Left Abutment and Approach: The existing abutment and approach will be demolished and be replaced by bridge structures such as piers to increase river flow area and construction of new dike

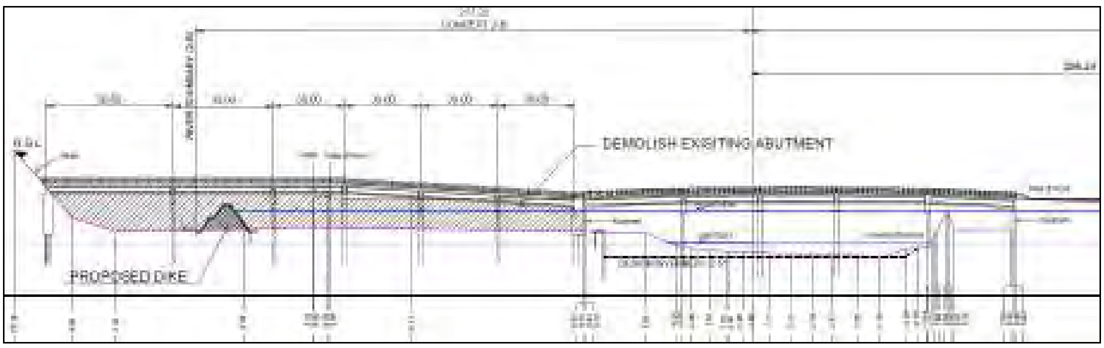
b) Right Approach Road: The approach will be raised up to design bank level to maintain public transportation, access and evacuation during flood.

Source: JICA Survey Team

Figure 2.3.17 Plan of the Kagayan Bridge and Approach Roads



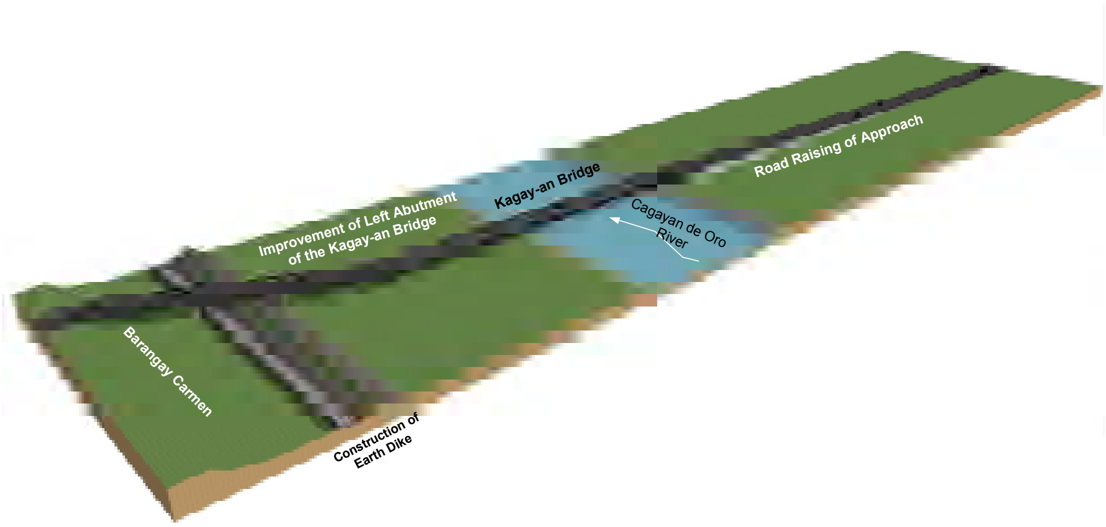
Whole Section of the Kagayan Bridge



Section of Improvement on Left Abutment of the Kagayan Bridge

Source: JICA Survey Team (2013)

Figure 2.3.18 Typical Section of Improvement of the Kagayan Bridge



Source: JICA Survey Team

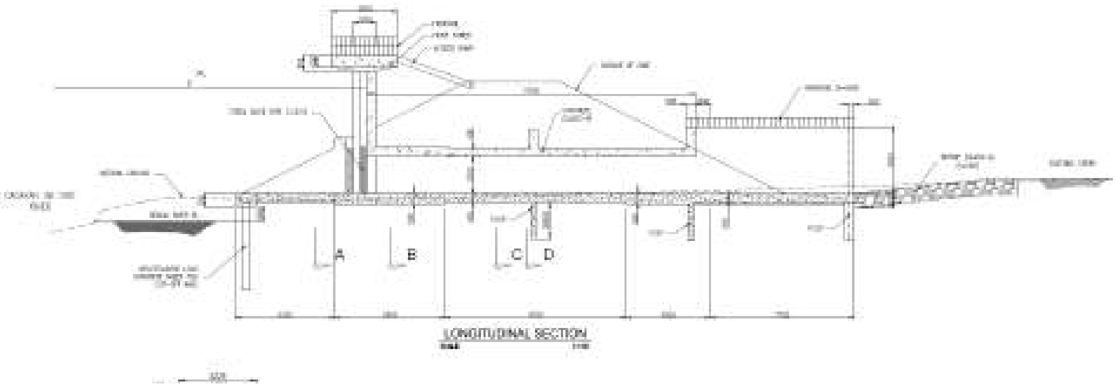
Figure 2.3.19 Three Dimensional (3D) Image of Improvement of Left Abutment of the Kagayan Bridge

(5) Installation of Gate and Drainage Outlets

Drainage outlet structures will be constructed to be connected to the existing drainage channel including the following gate facilities:

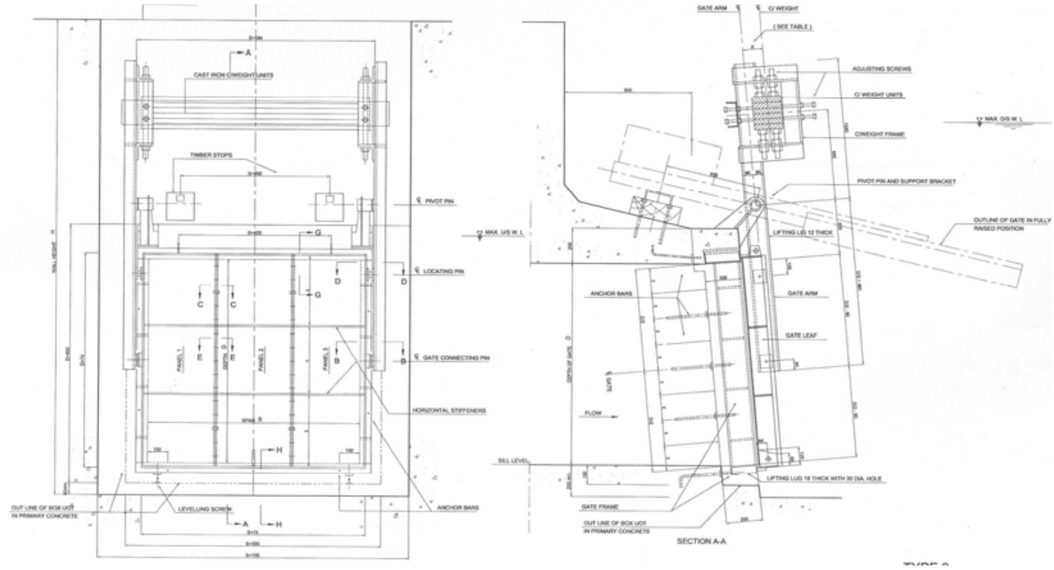
Flap Gate - Fiber Grass Plastic Flap Gate
- Steel Flap Gate

Slide Gate - Single / Double Spindle Types



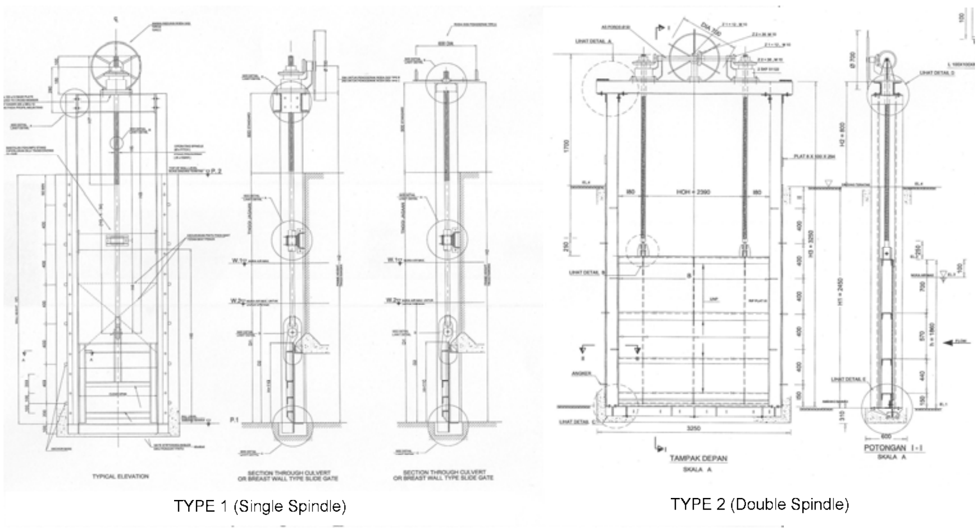
Source: JICA Survey Team

Figure 2.3.20 Typical Designs of Drainage Outlet with Steel Slide Gate



Source: JICA Survey Team

Figure 2.3.21 Typical Designs of Steel Flap Gate



Source: JICA Survey Team

Figure 2.3.22 Typical Designs of Steel Slide Gate

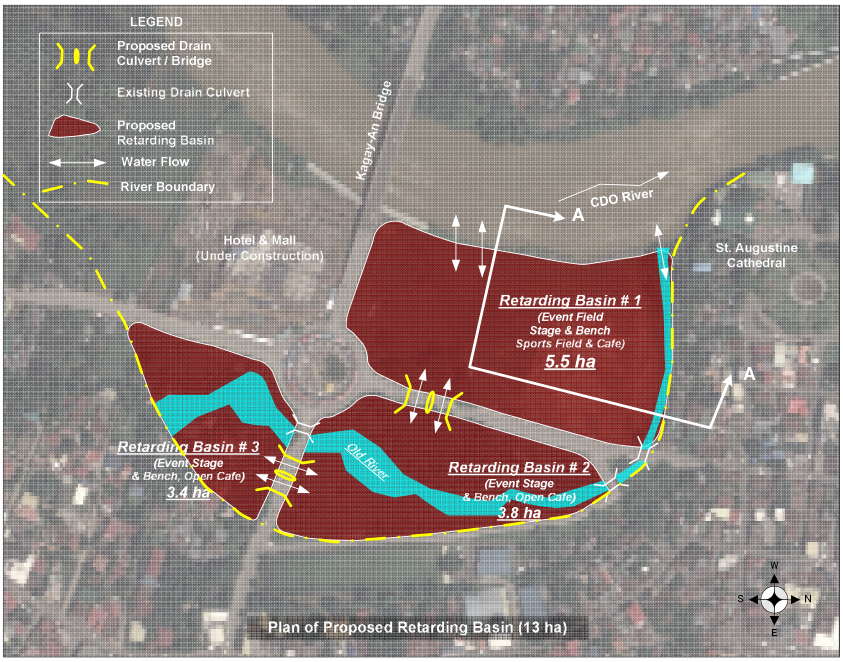
(6) Construction of Retarding Basin

Three location of retarding basins (total = around 13 ha) were proposed by JICA survey team at right bank upstream of the St. Augustine's Cathedral, which would be designed to be connected each other through culvert or drainage pipe within the river boundary.

Source: JICA Survey Team

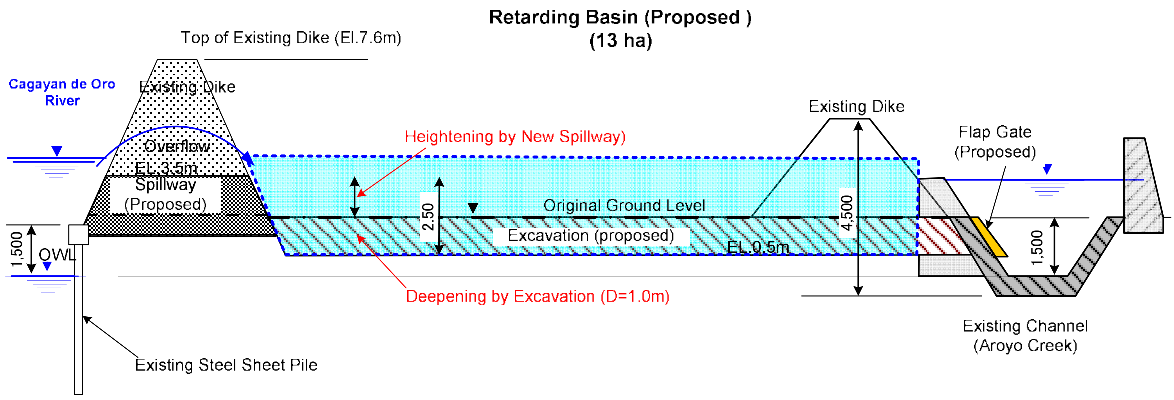
Figure 2.3.23 Aerial Photo around the Kagayan Bridge (Proposed Retarding Basin)

Capacity of the retarding basin (about 300,000 m^3) can be produced with 2m height and around 13ha of area: design of 1m deepening and 1m height of spillway from original ground line as shown in the following concept, in which flap gate should be installed along existing channel to drain water from the retarding basin after flood water level drop down.



Source: JICA Survey Team

Figure 2.3.24 Plan of Retarding Basin



Source: JICA Survey Team

Figure 2.3.25 Conceptual Section of Retarding Basin (Section A-A)

2.3.7 Non-structural Measures

The following were selected as non-structural measures proposed for the Project.

(1) Preparation/Update of Flood Hazard Map, Evacuation Planning

Following measures are proposed:

- Preparation/Update of Flood Hazard Map
- Evacuation Planning (Number, Location, Capacity of Facilities (Area, Water Supply, Toilet, etc.) of Evacuation Center, Route & Transportation of Evacuation, Role of DRRMC for Evacuation, etc.)

(2) FFWS

PAGASA is planning to introduce FFWS for the CDO River Basin with an open-ended type as an initial development stage with a limited number of monitoring stations (rain gauges and water level gauges), which is to be connected to "River Center" to be constructed in PAGASA compound in El Salvador, however, details of the type of the system are not known. Following measures are proposed:

- Review of FFWS model
- Technical assistance for establishment of FFWS for the CDO River Basin with an open-ended type, which includes study on additional rainfall and water level stations and revision of model due to the addition
- Preliminary study on future System to be connected between PAGASA Central Office- Hydro Meteorological Division and PAGASA River Center in El Salvador

(3) Community Based Flood Early Warning System (CBFEWS)

It will aim at one of the non-structural measures for selected barangays in the CDO River Basin. Following measures are proposed:

- Selection of Conventional Rainfall and River Water Level Stations
- Technical Assistance for Warning by Rainfall, River Water Level, etc.
- Capacity Development for LGUs

(4) Information Campaign and Publicity for the Project (Structural Measures)

As one of the IEC program, Information Campaign and Publicity for the Project (Structural Measures) are proposed.

- Information Campaign and Publicity for Proposed Structural Measures (by Web site, leaflet, etc.)
- Capacity Development by Seminar, Workshop, etc.
- Disaster Education w/ DepED/PAGASA, OCD, etc. (Understanding of Disaster, Evacuation, Illegal Disposal of Garbage to River, etc.)

(5) Technical Assistance for Land Use Regulation for Habitual Inundation Areas

It will aim to inform of the areas that are risky for floods to residents in the vicinity and to minimize flood damages. Following measures are proposed:

- Database for Land Use Regulation of Habitual Inundation Areas
- Study on Land Use Regulation based on Flood Hazard Map

(6) Technical Assistance for Riparian Forest Establishment in the Agricultural Lands

Following measures are proposed.

- Institutional arrangement and technical assistances on reinforcement in cooperation with LGUs both in the upper and lower watersheds and DPWH as the executing agency of the Project
- Technical advices on selection of the target rivers and creeks to establish the riparian forests
- Institutional arrangement and technical assistances on establishment and maintenances of the riparian forests in coordination with LGUs both in upper and lower watersheds and DPWH

(7) Technical Assistance for Mangrove Forest Establishment along the Coastal Areas

Following measures are proposed.

- Technical advices on selection of the target areas to establish the mangrove forests
- Institutional arrangement and technical assistances on establishment and maintenances of the mangrove forests in coordination with barangays, LGUs, DENR and DPWH

Target DRRMCs and related agencies for the above measures are shown below.

Table 2.3.3 Non-Structural Measures Proposed for the Project

No.	CDO City	Talakag	Baungon	Libona	PAGASA
(1) Technical Assistance for Flood Hazard Mapping and Evacuation Planning	✓	✓	✓	✓	
(2) Technical Assistance for FFWS Step 1					✓
(3) Technical Assistance for Community Based Flood Early Warning System (CBFEWS)	✓	✓	✓	✓	
(4) Technical Assistance for Information Campaign and Publicity for the Project (Structural Measures)	✓	✓	✓	✓	
(5) Technical Assistance for Land Use Regulation for Flood Plain	✓				
(6) Technical Assistance for Riparian Forest Establishment in the Agricultural Lands	✓	✓	✓	✓	
(7) Technical Assistance for Mangrove Forest Establishment along the Coastal Areas	✓				

Source: JICA Survey Team

2.4 Construction Plan and Schedule

2.4.1 Basic Conditions of Construction Plan

(1) Main work items of construction works

The Priority Project along downstream reaches of the Cagayan de Oro River consists of the following structures and works:

- Construction of river structures (earth dike, flood wall, raising wall)
- Construction of new road/Raising of existing road
- Removal of sedimentation
- Construction of retarding basin
- Kagayan Bridge Improvement

(2) Quantity of major work

The principal dimensions of major works are summarized in **Table 2.4.1.**

Table 2.4.1 Principal Features of Structural Measures

Earth Dike

Structure Location (Station to Station)		Structure Description	Length (m)	Remarks
LEFT BANK				
L1	BONBON - KAUSWAGAN			
(1)	Along Existing Barangay Road	Raising of Existing Road (Evacuation Road)	1,050	
(2)	Sta. 0+400 to Sta. 2+060	New Road Embankment Dike	1,706	
L3				
(3)	Sta. 4+200 to Sta. 5+280	New Earth Dike (Dike-3)	908	
(4)	Sta. 5+600 to Sta. 6+100	New Earth Dike (Dike-3)	850	
L4	BALULANG			
(5)	Sta. 7+656 to Sta. 9+900	New Earth Dike (Dike-2)	2,181	
RIGHT BANK				
R2	CONSOLACION - POBLACION			
(6)	Sta. 2+050 to Sta. 4+030	Road Embankment (Boulevard)	1,736	Isla de Oro Section
R4	POBLACION - NAZARETH			
(7)	Sta. 4+650 to Sta. 5+140	New Earth Dike (Dike-2)	955	Retarding Basin
R4	MACASANDIG			
(8)	Sta. 5+140 to Sta. 8+380	New Earth Dike (Dike-2)	2,422	
(9)	Sta. 8+380 to Sta. 8+500	New Earth Dike (Dike-1)	120	

Floodwall

Structure Location (Station to Station)		Structure Description	Length (m)	Remarks
LEFT BANK				
L3	CARMEN			
(1)	Sta. 5+280 to Sta. 5+600	RC/Masonry Floodwall (Floodwall-2)	391	
RIGHT BANK				
R2	CONSOLACION - POBLACION			
(2)	Sta. 2+050 to Sta. 4+030	RC/Masonry Floodwall (Floodwall-2) with Boulevard	1,736	Isla de Oro Section
R3	POBLACION			
(3)	Sta. 4+040 to Sta. 4+370	RC/Masonry Floodwall (Floodwall-1)	325	City Hall area
R4	POBLACION - NAZARETH			
(4)	Sta. 4+520 to Sta. 4+650	RC/Masonry Floodwall (Floodwall-2)	346	Cathedral area
(5)	Sta. 4+520 to Sta. 4+660	RC/Masonry Floodwall (Floodwall-2)	217	along Arroyo Creek
(6)	Sta. 4+640 to Sta. 4+830	Masonry Dike with Steel Sheet Piles	244	along CDOR right bank at Retarding Basin
(7)	Sta. 4+660 to Sta. 5+040	RC/Masonry Slope Protection	1,449	along existing road (both sides) at Retarding Basin

Drainage Outlets and Regulating Gates

No.	Station	Name of Outlet	Type	Size	Location		Proposed			REMARKS
					Bank	Barangay	Control Type	Outlet Structure	Size	
1	0+520	Creek	Lined Canal	W = 2.00 m	Left	Bonbon	Steel Slide Gate	RCBC	2-1.5x1.5m	
2	3+160	DO-1	not existing		Right	Poblacion	Flap Gate	RCPC	0.9 m. dia	Isla De Oro Area
3	3+240	DO-2			Right	Poblacion	Flap Gate	RCPC	0.9 m. dia	
4	3+320	DO-3			Right	Poblacion	Flap Gate	RCPC	0.9 m. dia	
5	3+400	DO-4			Right	Poblacion	Flap Gate	RCPC	0.9 m. dia	
6	3+480	DO-5			Right	Poblacion	Flap Gate	RCPC	0.9 m. dia	
7	3+560	DO-6			Right	Poblacion	Flap Gate	RCPC	0.9 m. dia	
8	3+640	DO-7			Right	Poblacion	Flap Gate	RCPC	0.9 m. dia	
9	3+720	DO-8			Right	Poblacion	Flap Gate	RCPC	0.9 m. dia	
10	3+800	DO-9			Right	Poblacion	Flap Gate	RCPC	0.9 m. dia	
11	3+880	DO-10			Right	Poblacion	Flap Gate	RCPC	0.9 m. dia	
12	4+060	DO-11	RCPC	0.6 m. dia	Right	Poblacion	Flap Gate	RC Headwall	0.6 m. dia	City Hall
13	4+360	DO-12	RCPC	0.6 m. dia	Left	Carmen	Flap Gate	RCPC	0.9 m. dia	
14	4+460	DO-13	RCPC	0.6 m. dia	Left	Carmen	Flap Gate	RCPC	0.9 m. dia	
15	4+640	DO-14 (1)	not existing		Right	Poblacion	Flap Gate	RCPC	1.50 m	For Retarding Basin Drainage (Arroyo Creek)
16		DO-14 (2)					Flap Gate	RCPC	1.50 m	
17		DO-14 (3)					Flap Gate	RCPC	1.50 m	
18		DO-14 (4)					Flap Gate	RCPC	1.50 m	
19		DO-14 (5)					Flap Gate	RCPC	1.50 m	
20	4+760	DO-15	RC Ditch	0.5 x 0.5 m	Left	Carmen	Flap Gate	RCPC	0.6 m. dia	
21	5+040	DO-16	Lined Canal	6 x 2 m	Right	Nazareth	Steel Slide Gate	RCBC	2-3.0x3.0m	Paseo del Rio
22	5+580	DO-17	Lined Canal	3 x 3 m	Left	Carmen	Steel Slide Gate	RCBC	1-3.0x3.0m	Trapezoidal Section

Source: JICA Survey Team

(3) Workable days and hours

The number of the workable days for construction is estimated as 246 days / year for the works of structural excavation, embankment, backfill, drainage works and road works, and 258 days for the works of dredging, concrete works and revetment works, considering the climate condition, national holidays, working days (6 days / week).

(4) Access road

Since the most of the construction area do not have roads along Cagayan de Oro River, the access roads along the river and from the major road to the site are required. The width of the access road is estimated at 10 m.

(5) Borrow area and quarry

Candidates of the borrow area and quarry sites (2 sites) for the project are tentatively selected. Regarding the borrow areas, there are two candidates: one is located along the Tagoloan River in the eastward, and the other is at the hilly area in the westward. The distances of the two are about 20 km and 6 km, respectively. As for the quarry sites, there are two candidates as well: one is located at the immediately upstream of Pelaez Bridge, and the other is located at Calacala, Macasandig.

(6) Disposal area

Disposal area shall be defined before the commencement of the construction. Several candidate locations of the disposal area, consisting of temporary and the permanent ones, are tentatively examined. Temporary disposal area will be required for the dredging work with pump, and permanent disposal area will be needed for dumping the excavated and dredged materials.

(7) Labor, Equipment and Material for Construction

1) Labor

All necessary labors can be found in Cagayan de Oro city and surrounding areas.

2) Equipment

Major heavy equipment required in this project can be found in Cagayan de Oro City, surrounding areas.

3) Material

Most of the material can be procured in Cagayan de Oro City and surrounding areas including concrete sheet piles and concrete square piles. However, a flap gate made of fiber reinforced plastic is not produced in Philippines. Hence, such materials and related tools will be procured and transported from Japan or the third countries.

2.4.2 Construction Method

(1) General

Most of the construction includes earth work and concrete works. As the condition of construction, it is assumed that the average hauling distance of embankment material is at 4 km and the one to disposal area is at 7.5 km. Considering the general market in Cagayan de Oro city and surrounding areas, ready mix concrete is applied in the construction method and cost estimation described later. It is also considered that concrete works require at least ten days to start after the placement of the concrete in order to assure the strength of the concrete.

Although the effect of the rainfall is already counted in the workable day calculation, it is ruled that embankment work can be performed only in dry season in order to prevent embankment under construction from being flushed away.

(2) Dike

There are two types of dikes. The one is with concrete sheet piles at the toe of slope protection and the other has concrete square piles there. Dike consists of pile foundation, embankment, slope protection with concrete frame and stone masonry, road pavement, sodding and pedestrian. Flow of construction of the dike is shown in the figure below.

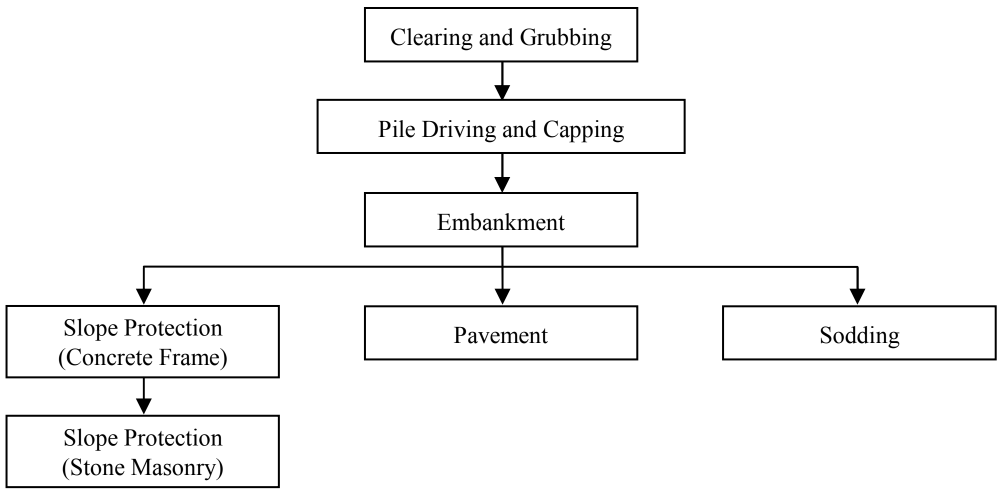


Figure 2.4.1 Construction Flow of Dike-1 and Dike-2

(3) Flood Wall

Flood wall consists of pile foundation, concrete retaining wall, stone masonry, embankment road pavement, sodding and pedestrian. Flow of construction is shown in the figure below**.**

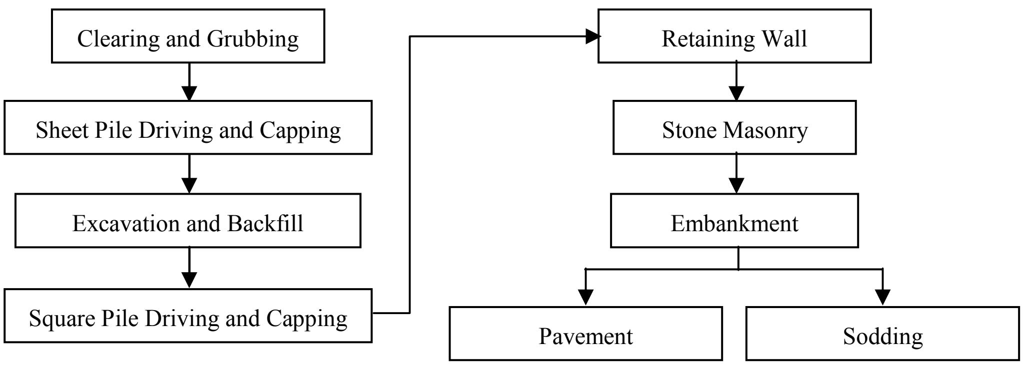


Figure 2.4.2 Construction Flow of Flood Wall

(4) Raising Road

Raising Road, similar to a dike, consists of embankment, slope protection with concrete frame and gabion and road pavement. Flow of construction is shown in **Figure 2.4.3**.

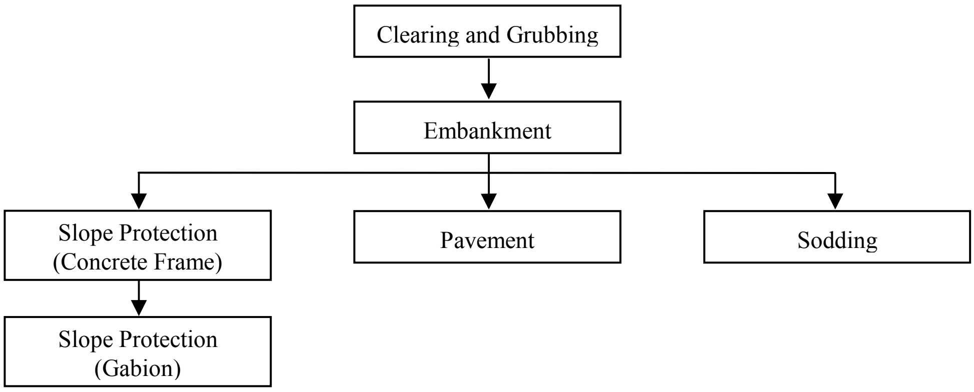


Figure 2.4.3 Construction Flow of Raising Road

The lower one thousand meters (1000m) out of total length of three thousand meters (3,000m) of the raising road is sometimes submerged by the high tide. Hence, the coffer dam with sand bags is designed for the construction of the area. The height of the coffer dam was set at one meter (1.0m) and length of the closed area by the sand bag was set at fifty meters (50m).

(5) Dredging

In this project, two kind of dredging is proposed. One is with dredging pump and the other is with a backhoe dredger. Flow of work of pump dredging, and backhoe dredging is shown in **Figure 2.4.4** and **Figure 2.4.5**, respectively.

Preparation work for the temporary disposal area is composed of clearing, grubbing, excavation of the temporary disposal area, construction of drainage and construction of small dikes. The average length of hauling through pipes was assumed to be at one point five kilometers (1.5km) for each three (3) temporary disposal area. In the construction plan, excavation of the dredged soil at temporary disposal area would be started after ten (10) days of spreading in order to have soil dry enough to haul.

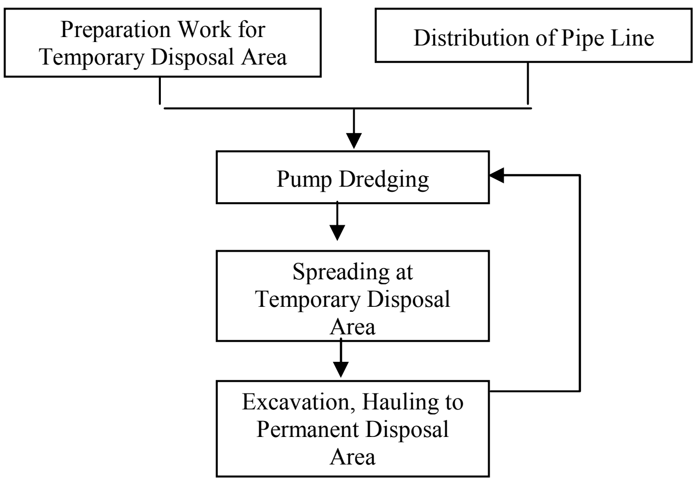


Figure 2.4.4 Dredging Flow with Pump

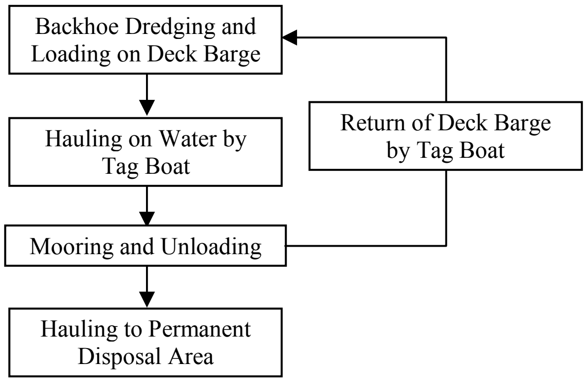


Figure 2.4.5 Dredging Flow of with Backhoe Barge

(6) Retarding Basin

Retarding basin is proposed at the east side of Kagayan Bridge. This work consists of excavation of the basin at one meter (1m) to two meters (2m), construction of slope protection, dike, flood wall, spillway and several drainages. Basically, the construction method for retarding basin follows the ones explained in the precious clause. The two culverts are to be constructed under the existing roads so that those roads can be passable during the flood. Although the embankment work can be done only in dry season, it is ruled that excavation of the basin can be performed throughout the year since there is less damage from flush flood.

(7) Drainage and Hydro Mechanic Work

Drainage and hydro mechanic work consists of excavation, diversion of the channel, construction of drainage structures that are either a pipe culvert or a box culvert, backfill, concrete work, procurement and installation of flap gates and slice gates. Construction flow of the drainage and hydro mechanic work is described in the figure below. Structures such as dikes and floodwalls can be constructed in the middle or after the following flow.

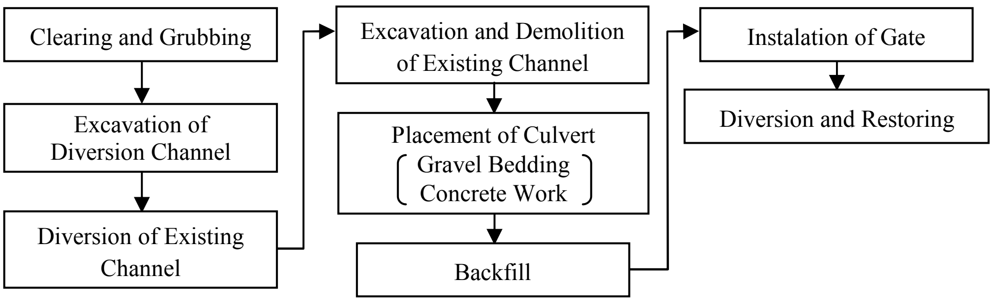


Figure 2.4.6 Construction Flow of Drainage and Hydro Mechanic Work

(8) Improvement of Kagayan Bridge

For the purpose of acquiring the enough large cross section in Cagayan de Oro River, Kagayan Bridge needs to be improved. The improvement works includes, the demolition of the existing abatement and the existing ramp in the west side of Cagayan de Oro River, installation of bored piles, reconstruction of a new abatement, piers, superstructure with girder, embankment and pavement on them. The flow of improvement of the bridge is as shown in **Figure 2.4.7**. The existing abatement is composed of the bored piles, inverse t-shaped retaining wall, and soil filled in the retaining wall. Demolition of abatement targets to remove the side retaining wall and filled soil and to preserve the existing retaining wall with bored piles supporting the existing girder directly. Supporting work of the abatement and the girder which may be required during the improvement shall be studied in the detailed design stage. During the construction, the both sides of the road that has four (4) lines will be closed for a little less than two (2) years. However, since Borja Bridge, which is under construction presently at approximately 200m in the downstream side of Kagayan Bridge will be completed, it is considered that the necessity of temporary bridge is less.

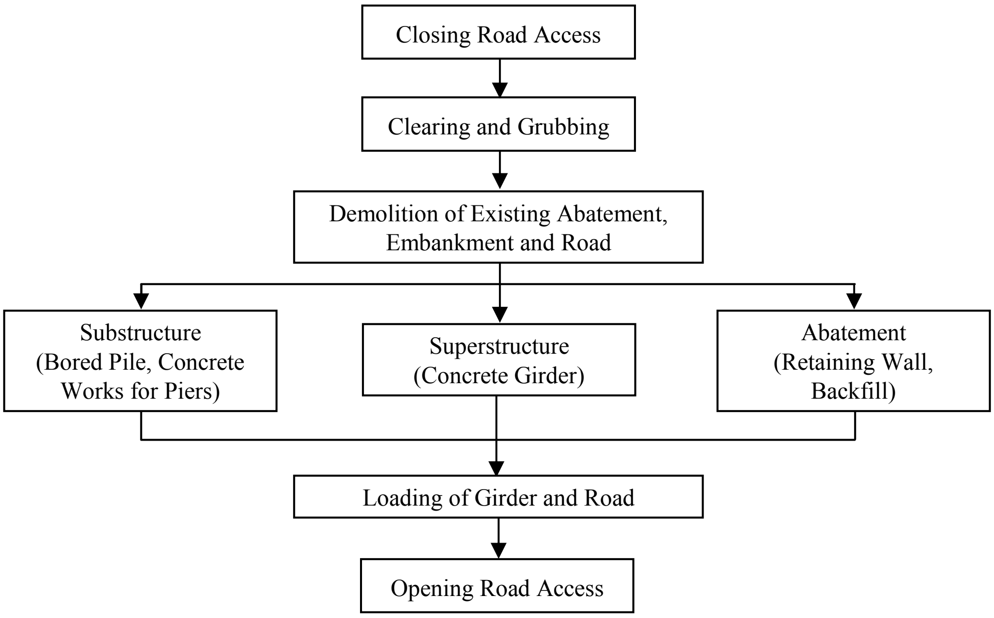


Figure 2.4.7 Improvement Flow of Kagayan Bridge

(9) Construction equipment

Major construction equipment to be used for the construction works in the Project are listed below:

Table 2.4.2 Major Construction Equipment to be Used in the Project

Work Item	Equipment
Excavation	- Dump Truck (10 m^3) - Backhoe (0.8 m^3)
Embankment, Road Work	- Motorized Road Grader - Vibratory Roller (10 MT) - (Dump Truck (10 m^3))*
Dredging (Pump)	- Bulldozer (140 HT) - Backhoe (1.1 m^3) - Vibratory Roller (12 MT) - Pump Dredger (16" dia.) - Anchor Boat, - House Boat - Motorized Road Grader
Dredging (Backhoe)	- Backhoe Barge (3.6 m^3.) - Backhoe (3.3 m^3) - Deck Barge (600 MT)

	- Tugboat
Concrete Sheet Pile(Driving)	- Crawler Crane (40 MT) - Pile Vibratory Hammer
Concrete Square Pile (Driving)	- Crawler Crane (40 MT) - Pile Drop Hammer

Source: JICA Study Team

2.4.3 Packaging of Contract

The project will be implemented through an international/local tendering in accordance with the guideline of JICA. The contract packages are broken down into four (4) taking account of amount of direct construction cost, geographic layout of each segment for construction, trafficability of construction equipment/material, etc. as follows:

Package 1: Construction of Dike and Floodwalls
in Carmen-Balulang Stretch:(L3: L=2,149 m), Consolation-Poblacion Stretch(R2: L=1,736 m) and Removal of Sedimentation

Package 2: Construction of Dike and Floodwalls
in Balulang Stretch (L4: L=2,181 m), Poblacion Stretch (R3: L=325 m), Poblacion-Nazareth-Macasandig Stretch (R4:L=3,105m) and Construction of Retarding basin

Package 3: Construction of New Road and Raising Existing Road for Evacuation
in Bonbon-Kauswagan stretch (L1:L = 2,756 m)

Package 4: Improvement of Kagayan Bridge

2.4.4 Implementation Schedule

Implementation Schedule is presented in Figure 2.4.8.

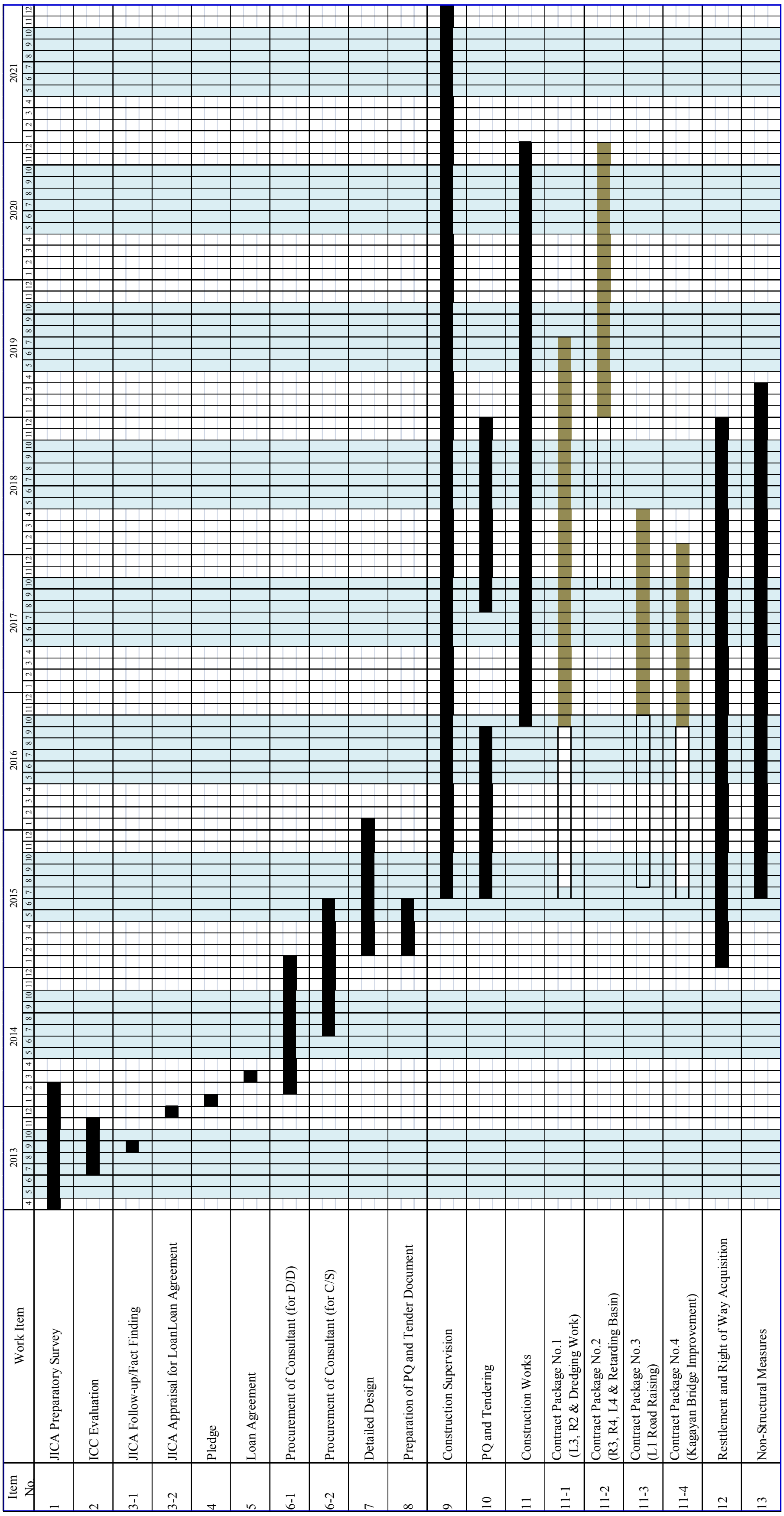


Figure 2.4.8 Implementation Schedule

CHAPTER 3 OUTLINE OF CURRENT ENVIRONMENT

3.1 Physical-Chemical Environment

3.1.1 Air Quality

Data monitored by DENR Region 10 includes only TSP before 2003, and SO_2, NO_2, O_3 and PM_{10} from 2006 to 2011. Although there were many missing data due to the malfunction of monitoring instrument, monitored data indicates that most of TSP and some of PM10 values show relatively high concentration exceeding quality standard (ref. Table 3.1.1 – 3.1.2). Regarding O_3 and PM_{10}, however, there are other data, indicating that the parameters are fair level according to a research paper (Short-Term Cycles of Ozone (O_3) and Particulate Matter (PM_{10}) in Cagayan de Oro City (July - November 2002)) from the Xavier University.

Air quality data monitored at Acacia Street, Brgy. Carmen during the F/S for the Flood Control and Drainage Project in 2011 shows that only TSP indicated high concentration beyond the quality standard but SO_2 or NO_2 did not (ref. Table 3.1.3).

These data can be interpreted as Cagayan de Oro City is suffering from high TSP (dust) but harmful substances such as SO_2 or NO_2 are not at a significant level.

Table 3.1.1 TSP data monitored by DENR

Unit: µg/NCM

No.	Station	Year	Monitored value (average)	Quality standard*
1	Region 10 (Not specified)	2001	142	90
		2002	128	
		2003	156	
2	RER Subdivision	1998	147	90
		1999	127	
		2000	91	
		2001	64	
		2002	65	
3	Lapasan Shell Station	1998	259	90
		1999	272	
		2000	206	
		2001	220	
		2002	191	

Note) *: Quality standard for Long Term, DENR DAO No. 2000-81

Source: DENR-EMB

Table 3.1.2 SO_2, NO_2, O_3 and PM_{10} data monitored by DENR

No.	Parameter	Unit	Year	Monitored value		Quality standard*	
				Range (Min. – Max.)	Average	Short term	Long term
1	SO_2	µg/NCM	2006	4.61 – 5.32	4.98	180	80
			2007	3.60 – 9.46	5.06		
			2008	4.44 – 9.15	5.50		
			2009	3.56 – 7.37	5.05		
			2010	2.08 – 31.64	5.23		

No.	Parameter	Unit	Year	Monitored value		Quality standard*	
				Range (Min. – Max.)	Average	Short term	Long term
			2011	0.96 – 12.09	7.96		
2	NO_2	μg/NCM	2006	16.03 – 19.10	17.56	150	-
			2007	9.10 – 29.97	17.83		
			2008	12.06 – 28.53	18.21		
			2009	9.28 – 27.15	16.22		
			2010	0.65 – 28.29	14.98		
			2011	0.88 – 20.16	10.91		
3	O_3	μg/NCM	2006	28.75 – 55.72	39.85	140	-
			2007	1.94 – 55.40	20.45		
			2008	0.66 – 60.14	28.00		
			2009	6.10 – 86.77	38.00		
			2010	20.87 – 57.56	29.96		
			2011	61.00 – 105.59	83.49		
4	PM_{10}	μg/NCM	2006	20.11 – 49.26	38.43	150	60
			2007	1.33 – 66.75	27.30		
			2008	na**	na		
			2009	na	na		
			2010	na	na		
			2011	na	na	-	

Note) *: DENR DAO No. 2000-81,

**: Missing data due to malfunction of monitoring equipment.

Source: DENR-EMB Region 10

Table 3.1.3 SO2, NO2, TSP data monitored by DPWH in F/S

Station	Parameter	Unit	Monitored value	Quality standard*
Acasia St., Brgy. Carmen	SO_2	μg/NCM	46	180
	NO_2	μg/NCM	31	150
	TSP	μg/NCM	258	230

Note) Sampling date: Dec. 4 to 7, 2010.

Source: E/S Report for Flood Control and Drainage Projects of Selected River Basins – Cagayan de Oro River (2011)

3.1.2 Noise and Vibration

Data on ambient noise is limited to F/S Report of the Flood Control and Drainage Projects of Selected River Basins – Cagayan de Oro River (2011) based on the data collected so far. Data on ambient vibration is not available.

Ambient noise was measured in the F/S at 4 locations: NL1) Acacia Street, Brgy. Carmen; NL2) Burgos Street, Brgy. Consolacion; NL3) JR Borja-Burgos Street; and NL4) Liceo de Cagayan University Compound. The measurement results showed that noise levels exceeded the quality standard (allowable noise level) at most of the time regime (ref. Table 2.5.4). The F/S report pointed out that source of noise includes traffic related sounds, household appliances etc., and that measured noise level is typical ambient noise in the urban and road side areas.

Table 3.1.4 Noise level data monitored DPWH in F/S

Unit: dB(A)

Station	Evening Period (6:00 pm - 10:00 pm)	Nighttime Period (10:00 pm - 5:00 am)	Morning Period (5:00 am - 9:00 am)	Daytime Period (9:00 am - 6:00 pm)
NL1(a)	51.3	46.6	48.6	53.8
NL2(a)	56.2	51.2	53.5	63.8
NL3(a)	51.8	46.2	50.0	52.6
NL4(b)	51.8	47.1	51.3	61.3
DENR Maximum Allowable Noise Level				
(a) Residential	50	45	50	55
(b) School/ Hospital	45	40	45	50
(c) Commercial	60	55	60	65
(b) Light Industrial	65	60	65	70
(e) Heavy Industrial	70	65	70	75

Source: F/S Report of the Flood Control and Drainage Projects of Selected River Basins – Cagayan de Oro River (2011)

3.1.3 River Water Quality

Data on water quality of the Cagayan de Oro River are available in the regularly monitored ones obtained by DENR-EMB Region 10 and F/S Report of the Flood Control and Drainage Projects as shown in Table 3.1.5 and 3.1.6, respectively.

According to the data monitored by DENR-EMB R-10, the following characteristics are identified:

- Almost all of coliform numbers (Fecal and Total) exceed the quality standard (Class A) stipulated by DENR DAO No. 90-34 for CDO River and tributaries,
- Recent data (2011 and 2012) of TSS exceed the quality standard.
- BOD and pH is usually consistent with the quality standard, but occasionally exceeds the standard,
- Temperature and DO are always consistent with the quality standard.

Table 3.1.5 Water quality data monitored by DENR-EMB Region 10

No.	Parameter	Unit	Station*	Monitored value					Quality standard** (Class A)
				2008	2009	2010 (min.-max.)	2011 (min.-max.)	2012 (min.-max.)	
1	Temp.	^{o}C	Station 1	-	27.7	27.6-29.3	25.72-26.4	25.63-28.57	<3.0 ^{o}C Rise
			Station 2	26.3	27.3	26.7-27.2	24.77-26.1	25.9-26.7	
			Station 3	26.9	27.1	25.4-27.0	25.49-26.5	25.12-25.96	
			Station 4	24.9	26.9	25.8-26.9	24.72-26.0	25.49-27.4	
			Station 5	-	25.9	25.1-26.1	23.5-25.7	24.98-27.47	
			Station 6	-	-	-	24.3-25.8	-	
2	DO	mg/l	Station 1	-	8.5	7.3 -7.7	7.3-8.7	7.06-9.25	5.0
			Station 2	8.1	9.1	8.0 -8.3	8.1-8.4	7.57-9.27	
			Station 3	8.3	8.9	8.3 -8.4	7.9-8.5	8.32-9.56	
			Station 4	8.6	8.7	8.3 -8.8	8.0-8.6	7.25-9.22	
			Station 5	-	8.9	8.2 -8.3	7.9-8.4	7.46-9.24	
			Station 6	-	-	-	7.8-9.2	-	
3	BOD	mg/l	Station 1	-	-	1.0	1-4	<1 - 3	5.0
			Station 2	1.4	-	1.0	1-5	<1 - 4	
			Station 3	1.3	-	1.0	2-5	<1 - 4	
			Station 4	1.3	-	1.0	3-6	<1 - 7	

No.	Parameter	Unit	Station*	Monitored value					Quality standard** (Class A)
				2008	2009	2010 (min.-max.)	2011 (min.-max.)	2012 (min.-max.)	
			Station 5	-	-	1.0	2-4	<1 - 3	
			Station 6	-	-	-	3-5	-	
4	pH	mg/l	Station 1	-	8.1	7.82-8.83	7.47-8.40	6.79-8.63	6.5-8.5
			Station 2	7.16	7.9	8.01-8.6	7.25-8.79	6.21-8.73	
			Station 3	7.36	8.1	7.91-8.38	7.55-8.75	6.20-8.35	
			Station 4	7.48	7.9	8.13	7.20-8.69	6.43-8.41	
			Station 5	-	8.0	7.78-8.07	6.68-8.65	6.50-8.47	
			Station 6	-	-	-	7.64-8.71	-	
5	TSS	mg/l	Station 1	23	14	8-29	11-206	4-73	50.0
			Station 2	37	15	19-39	4-175	4-92	
			Station 3	30	16	16-39	8-176	<1-114	
			Station 4	-	8	2-35	5-125	2-142	
			Station 5	-	3	2-89	4-206	3-28	
			Station 6	-	-	-	3-104	-	
6	Fecal coliform	MPN/ 100ml	Station 1	-	$10x10^4$	$84x10^2$-$17x10^3$	$11x10^3$-$35x10^4$	-	100
			Station 2	$13x10^3$	$81x10^3$	$11x10^3$-$54x10^5$	$11x10^3$-$17x10^3$	$16x10^3$-$35x10^4$	
			Station 3	$42x10^3$	$12x10^3$	$46x10^3$-$49x10^3$	$79x10^3$-$94x10^3$	$16x10^3$-$34x10^4$	
			Station 4	$40x10^3$	$26x10^3$	780-$17x10^3$	$54x10^2$-$22x10^3$	680-$11x10^4$	
			Station 5	-	$56x10^2$	680-$17x10^2$	$49x10^2$-$92x10^3$	170-$14x10^4$	
			Station 6	-	-	-	$16x10^3$-$22x10^3$	680-$35x10^3$	
7	Total coliform	MPN/ 100ml	Station 1	-	$10x10^4$	$22x10^3$-$22x10^4$	$16x10^3$-$54x10^4$	-	1,000
			Station 2	$42x10^3$	$81x10^3$	$11x10^3$-$92x10^5$	$11x10^3$-$17x10^3$	$16x10^3$-$43x10^3$	
			Station 3	$90x10^2$	$12x10^3$	$11x10^3$-$49x10^3$	$54x10^3$	$16x10^3$	
			Station 4	$52x10^3$	$29x10^3$	$13x10^3$-$35x10^3$	$16x10^5$	$11x10^2$	
			Station 5	-	$80x10^2$	680-$24x10^2$	$54x10^2$-$35x10^3$	170-$12x10^2$	
			Station 6	-	-	-	$16x10^3$-$35x10^3$	$17x10^2$-$22x10^2$	

Note) *Station 1: Kauswagan, Station 2: Carmen bridge / Kagayan bridge, Station 3: Pelaez Bridge, Station 4: Kabula Bridge, Station 5: Pualas, Bubunawan Rirver, Station 6: Tumalaong Rirver, Spillway
**: DENR DAO No. 90-34.
Source: DENR-EMB Region 10

According to the data monitored by the F/S Report, on the other hand, the following characteristics are identified:

- All of coliform numbers (Fecal and Total), BOD and TSS exceed the quality standard,
- DO, pH and Temperature are always consistent with the quality standard.

Table 3.1.6 Water quality data monitored DPWH in F/S

Water Quality Parameters	Unit	Stations			Quality standards* (Class A)
		1	2	3	
		Ysalina Bridge	In front of Isla de Oro	Maharlika Bridge	
Dissolved Oxygen (DO)	mg/l	7.34	7.04	6.97	5.0
Biochemical Oxygen Demand (BOD)	mg/l	9	13	15	5.0
Total Suspended Solids (TSS)	mg/l	136	150	169	50
pH	range	6.59	6.67	6.99	6.5 – 8.5
Total Coliform	MPN/100ml	16,000	92,000	160,000	1,000
Fecal Coliform	MPN/100ml	470	3,900	35,000	100

Temperature	°C	25.7	26.3	25.2	<3.0°C Rise

Note) **: DENR DAO No. 90-34.
Source: F/S Report of the Flood Control and Drainage Projects of Selected River Basins – Cagayan de Oro River (2011)

In conclusion, the river water quality of Cagayan de Oro River is suffering from biological pollutants and coliform number that exceeds quality standard and most of BOD, and TSS exceed the standard.

In the available data, only the data monitored by DENR-EMB R-10 in 2012 was obtained after Typhoon Sendong occurred in December 2011. Comparing with the data before and after the typhoon, it can be pointed out that Fecal and Total Coliform numbers have decreased.

3.1.4 Riverbed Sediment Quality

(1) Riverbed sediment quality

Data of riverbed sediment of CDO River is limited to one data monitored at the river stretch between Maharlika Bridge and Ysalina Bridge by F/S for the Flood Control and Drainage Projects as shown in Table 3.1.7.

All the monitored heavy metal substances showed below detection limit, meaning below the Maximum Contamination Level (MCL) stipulated in DENR revised DAO 04-36. However, this data was obtained before Typhoon Sendong occurred. There is a possibility that the riverbed sediment condition has been changed by the said typhoon.

Table 3.1.7 Heavy Metal Concentration of Riverbed Sediment of CDO River

Parameters	Units	Monitored value*	MCL**
Arsenic (As)	mg/L	ND	1.0
Barium (Ba)	mg/L	ND	70
Cadmium (Cd)	mg/L	ND	5.0
Lead (Pb)	mg/L	ND	1.0
Mercury (Hg)	mg/L	ND	0.1
Chromium (Cr)	mg/L	ND	5.0
Cyanide (CN)	mg/kg	ND	70

Note) *: ND = Not detected, **: Maximum Contaminant Level (mg/L), DENR Revised DAO 04-36,
Source: F/S Report of the Flood Control and Drainage Projects of Selected River Basins – Cagayan de Oro River (2011)

(2) Pollution source for contamination of riverbed sediment

1) Pollution source by mining

According to a map of mining permits issued by the Mine Management Division, MGB Region10, March 2012, legal mining activities within the Cagayan de Oro River watershed has been limited to small scale mining operations for Copper and Iron Ore and non-metals such as Limestone, within Barangay Dansolihon, Cagayan de Oro City.

As for exploration, only three exploration permits have been issued since 2007 for Iron Ore, which have all expired in 2011 as shown in Table 3.1.8. No renewal or application for exploration or mining has been approved then. The MGB Region 10 is awaiting the expiration of all existing permits in the region issued under PD 1899 prior to issuing permits under the RA 7076 of 1991 which aims to improve mining standards and regulation. Given such situation, the Mines Management Division of MGB Region 10 deems contamination of the riverbed by heavy metals brought about by mining-related activities as minimal or nil. It can also be noted, however, that most of the legal, as well as illegal mining activities reported, are within the Iponan River watershed, which is the most adjacent (westward) of the Cagayan de Oro River Basin.

Table 3.1.8 Approved Exploration Permits (EP) (2 Years) Affecting Cagayan de Oro River Watershed

As of December 2011

TENEMENT ID	TENEMENT HOLDER	DATE APPROVED	DATE OF EXPIRY	LOCATION		AREA (has.)	COMMODITY
				Mun./City	Province		
EP-000003-X	Eagle Crest Mining & Development Corporation	8/3/2007 11/11/2009 First Renewal	11/10/2011 Expired but with 2nd Renewal application under process at CO	Dansolihon Cagayan de Oro City	Misamis Oriental	1,961,2546	Iron and other minerals
EP-000004-X	Cypress Mining & Development Corporation	8/3/2007 11/11/2009 First Renewal	11/10/2011 Expired but with 2nd Renweal application under process at CO	Dansolihon Cagayan de Oro City	Misamis Oriental	3,341.7473	Iron and other minerals
EP-000005-X	Glendale Mining & Development Corporation	8/3/2007 11/11/2009 First Renewal	11/10/2011 Expired but with 2nd Renewal application under process at CO	Dansolihon Cagayan de Oro City	Misamis Oriental	1,561.4608	Iron and other minerals

Source: Mine Management Division, MGB Region 10

2) Pollution source by industrial activities

Industrial activities (e.g., manufacturing, processing, bottling, fabrication, and assembling) in Cagayan de Oro City are concentrated along the National Highway, especially at the northeastern portion, along Macajalar Bay but not along Cagayan de Oro River. Bacteriologic contamination has been cited as the greater problem because of the domestic waste from the heavy concentration and continuing development of residential and commercial areas along the river.

3.1.5 Topography and Geology

(1) Topography

The lowland area is relatively flat with development in the City of Cagayan de Oro (CDO). Most of the developed area in the lowland is bounded by the contour lines with an elevation of 20 meters. Mount Kitanglad is the highest spot in the area with an elevation of 2,927 meters.

From the top of the mountains in the south, rivers run through from southern parts of the river basin towards Macajalar Bay. The major rivers are: Cagayan de Oro River, Iponan River, Bigaan River, Cugman River, Umalag River, Agusan River, and Alae River. The more notable creeks are Binono-an, Bitan-ag, Indulong, Kolambog, Sapong, and Umalag.

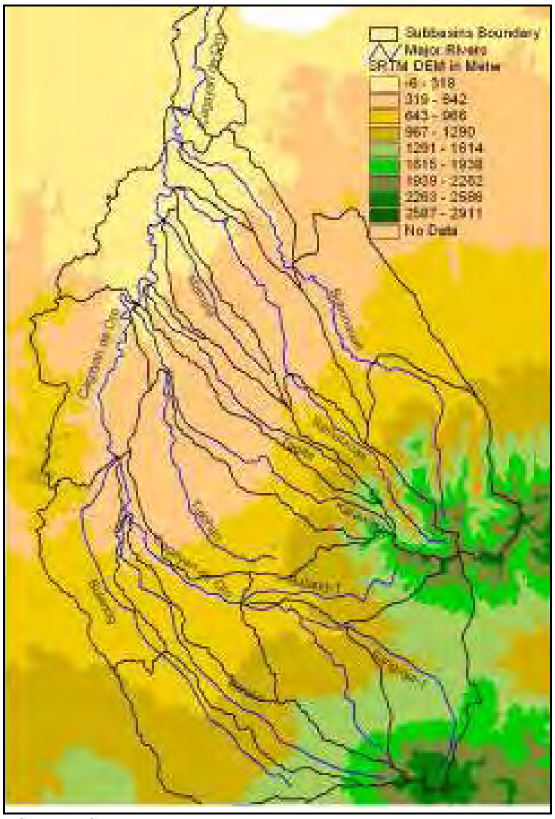
There are relatively flat areas in the inland areas at the foot of the mountains in Lingating, Baungon, Danao and Mantalahak at elevations ranging from 280 to 320 meters. Other than those areas, the area is characterized by steep slope with narrow flood plains along the rivers and creeks.

As for the Cagayan de Oro River, total river length of the main river is 97 km from its origin to the river mouth with steep riverbed slope of 1/1-1/40 in the upstream of

76 km, mild slope of 1/40-1/190 between 19 and 76 km and gentle slope of 1/190-1/4000 in the downstream of 19 km.

Two major tributaries join to the Cagayan de Oro River at the confluence of 22.3 km from the Tumalaong River and at 18.5km from the Bubunawan River, both run-offs come from the east slope of the mountainous area in the basin.

The CDO River basin over the 90 m grid SRTM DEM data of version 4 collected from CGIAR-CSI GeoPortal web sites shown in figure below.



Source: SRTM DEM

Figure 3.1.1 Land Elevation in CDOR Basin using SRTM DEM

(2) Geology

1) Regional Geology and Stratigraphic Sequence

General Geology of Cagayan de Oro Watershed is as follows.

Sedimentary rock of Tertiary period is distributed on the old bedrocks, and is covered by volcanic rocks and pyroclastic deposit. And these volcanic deposits are covered by gravel layer, terrace deposits and shallow water deposits (See **Table 3.1.9** and **Figure 3.1.2**).

Table 3.1.9 Stratigraphic Sequence

Geologic Map	Stratigraphic Sequence	Geological Contents
Quaternary Alluvium	Alluvium	Quaternary Alluvium
	Cagayan Terrace Gravel	Cagayan Terrace Gravel
Bukidnon Formation	Bukidnon Formation	Bukidnon Formation
Quaternary Volcanics		
Tertiary Sediments	Indahag Limestone	Indahag Limestone

	Opol Formation	
Diorite	Andesite Porphyry	
	Diorite	
Metamorphosed Shales and Pyroclastics	Tood Formation	
	Himalayan Formation	
Ultrafamics	Ultrafamics	Ultrafamics Complex
Basement Rocks (Shist)	Tago Shist	

Consultancy Servicesfor the Conduct of Master Plan and Feasibility Study of Flood Control and Drainage Projects of Selected River Basins Nationwide package 3: June 2011 (JICA)P2-3 Retouch

A) Bed rock

Metamorphic rock (Crystalline schist; Tago schist in previous table) of Pre-Cretaceous, and ultrabasic rock of Cretaceous, and pelitic schist and granodiorite after Cretaceous are distributed as bedrock.

Crystalline schist, which is mainly basic schist, is observed in the range from the middle reach to downstream of Bubunawan River.

Pelitic schist, which is accompanied with dike of granodiorite, is observed at the Cepalco hydraulic power plant.

Metamorphic rock (near 17km)
Fold Axis of the East-West Direction

Pelitic schist
Cepalco hydraulic power plant

Figure 3.1.2 Metamorphic rock and Pelitic schist near CEPALCO Power Plant

B) Tertiary period sedimentary rock

Sedimentary rocks, which consist of conglomerate and mudstone, mainly of limestone, form hilly area over bed rock.

Sedimentary rocks are observed in the range from the Uguiaban Bridge to the Kabura Bridge of Cagayan de Oro River.

Sedimentary rocks, which are partially formed by the development of bedding stratification, form the steep cliff or the limestone cave.

Tumalaong Cave
Limestone
(Confluence of Tumalaong : near 22.5km)

Sedimentary rocks (near 13km)
Alternation(Tertiary)
(Conglomerate/Sandstone/Siltstone)
The steep cliff is about 120m high.

Siliseous Sandstone (near airport)
(Altemate of Limestone and Sandstone)
Slope failures are observed in several places;
Weak resistance to erosion

C) Volcano and Pyroclastic deposit

”Bukidonon Formation” is consisted of volcanic product. This formation is distributed around Katangrad volcanic group and Kratungan volcano.

Volcano is presumed to have been a submarine volcano which was formed on the bedrocks.

Katangrad volcanic group, which are eroded considerably, are considered to be volcanoes formed in Pliocene of Tertiary or Quaternary. Sediment which was produced by slope failure, volcanic mud flow and debris flow formed the vast alluvial fan on the foot of mountain. "Cagayan Terrace Gravel” is considered to be a part of this alluvial fan.

Tuff (near 39km)
(Weak Welding: Columnar Join partially)

Welded Tuff (near 38km)
Developed Columnar Joint

River condition (near 24km)
Bounding Stone of Welded tuff
(Shark Deep)

Basaltic Andesite (near 14km)
Bedthickness: about 40m high
Radial Joint by rapid cooling

D) Gravel Layer

Gravel layer is considered to be covered vastly the Bukidnon formation and distribution area of tertiary period sedimentary rock.

High terrace is observed along the Cagayan de Oro River which flows in the western side of Katangrad volcanic group. Brackish -water deposit which consists of sand and gravel covered with Gravel layer. Therefore, the sediment discharge to the downstream is presumed to have been continuously occurred for a long period. The highest slope of outcrop confirmed is about 20m high.

Dissection of Gravel Layer progressed in association with upheaval of the earth's crust and fall of sea level. Gravel and boulder of lower terrace and towhead are its remnants. At present, dissection reached a depth of bedrock, therefore a small amount of the sediment is considered to be transported by the river.

Gravel Layer near the Higher Terrace
Diameter : 5-35cm
Matrix : Little

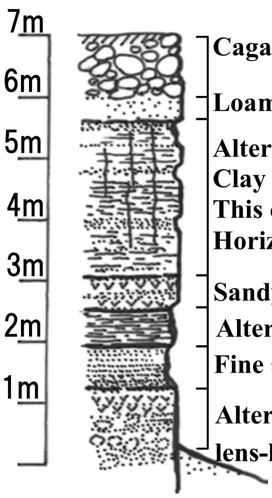
Gravel Layer of the middle terrace
Diameter : 5-15cm
Matrix : Volcanic Ash and Sandy Soil Locally Cross Lamina

E) Shallow water Deposit

Shallow water deposit is observed the left bank of along Cagayan de Oro River.

This shallow water deposit which consists of volcanic silt and cohesive soil with sand and gravel is formed horizontal layer. This layer is covered with Cagayan Gravel Layer.

The Higher Terrace located at the northern part of CDO Airport
Upper Layer: Cagayan Gravel layer
Lower layer: Shallow water Deposit



Cagayan Gravel Layer:φ5-20cm : Poor Sorting

Loam soil: Relatively firm soil, Volcanic ash after the land's emergence

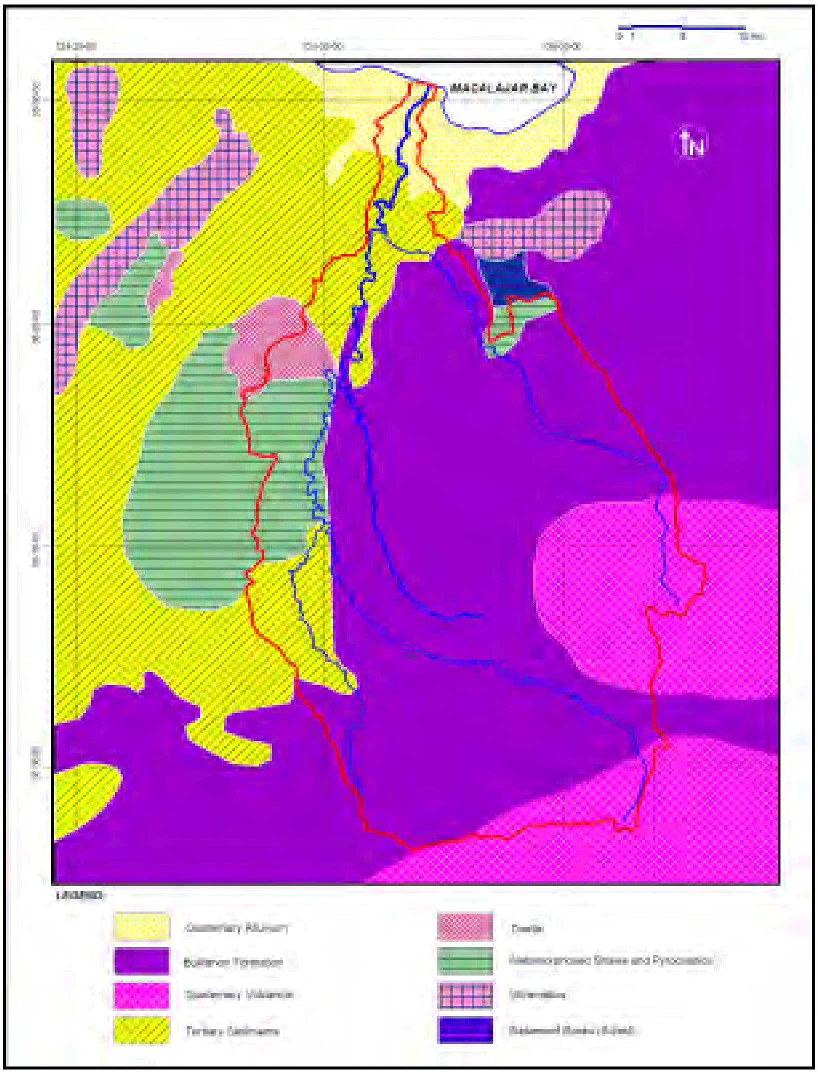
Alternate of volcanic silt and volcanic sand, upper layer contains many sands
Clay arranged vertically, which is 3-5mm width, is observed.
This clay has a possibility of trace fossil.
Horizontal layer is developed remarkably.

Sandy volcanic ash layer, Inverse Grading is observed

Alternate of volcanic silt and volcanic sand

Fine sand layer, Grading is good

Alternate of volcanic silt and volcanic sand, upper layer contains pumice layer lens-like, and contains strong weathered tuffaceous gravel.



Consultancy Services for the Conduct of Master Plan And Feasibility Study of Flood Control and Drainage Projects of Selected River Basin Nationwide Package 3:June 2011 (JICA):P2-3

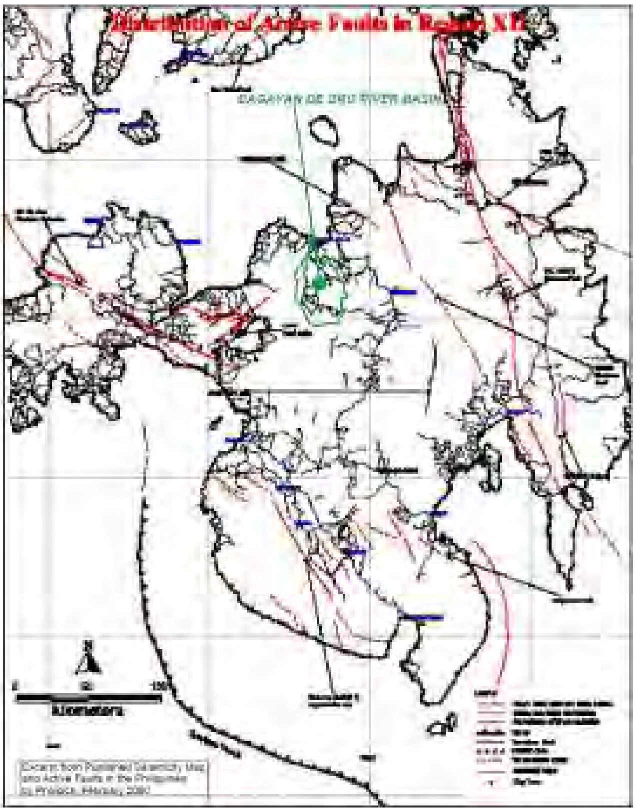
Figure 3.1.3 Geological Map

2) Geologic Structures

The nearest regional faults or large-scale geologic structures identified by PHIVOLCS in the region are the Western Mindanao Extension Fault and Lanao Fault System. The geologic structure of the former trends NW-SE and is approximately about 200 km south of Cagayan de Oro City. Lanao Fault System is about 70 km southwest of Cagayan de Oro City (see **Figure 3.1.4** to **Figure 3.1.5).**

The soil mantle in the region comes mainly from the weathering of the sedimentary rock units. The relatively thick covering of these material deposits has probably obscured the apparent presence of other significant geologic structures e.g. faults and fractures in the region and immediate environment.

Elsewhere, the schist in the area is almost in contact with the ultramafic rocks which are distributed along the fault. These two rock formations were trusted into the other rock formations. Joints, beddings and other short discontinuous breaks have already been filled up and healed with volcanic ash and air materials from the recent volcanic deposition and sedimentation. The observed beds of the sedimentary rocks appear gently dipping and generally follow the slope of the land. In most instances, the beds dip in the west, northwest and north directions.



Source: Master Plan ; June 2011 (JICA):P2-6

Figure 3.1.4 Active Faults in Cagayan de Oro Watershed and Vicinity

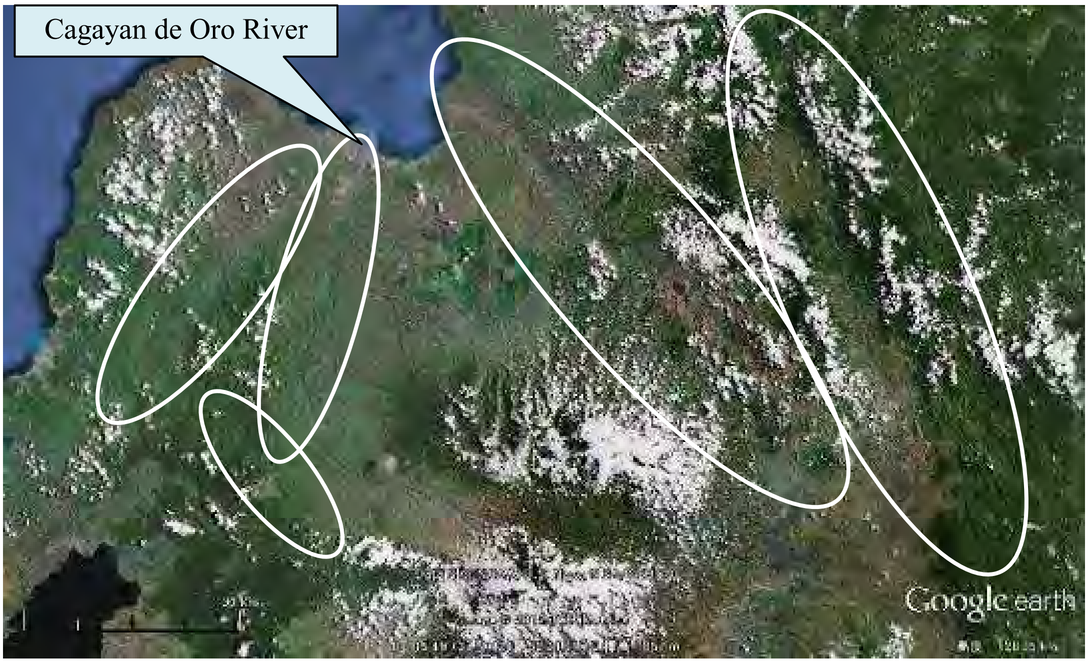


Figure 3.1.5 Recognized Tectonic Lines (inside circle)

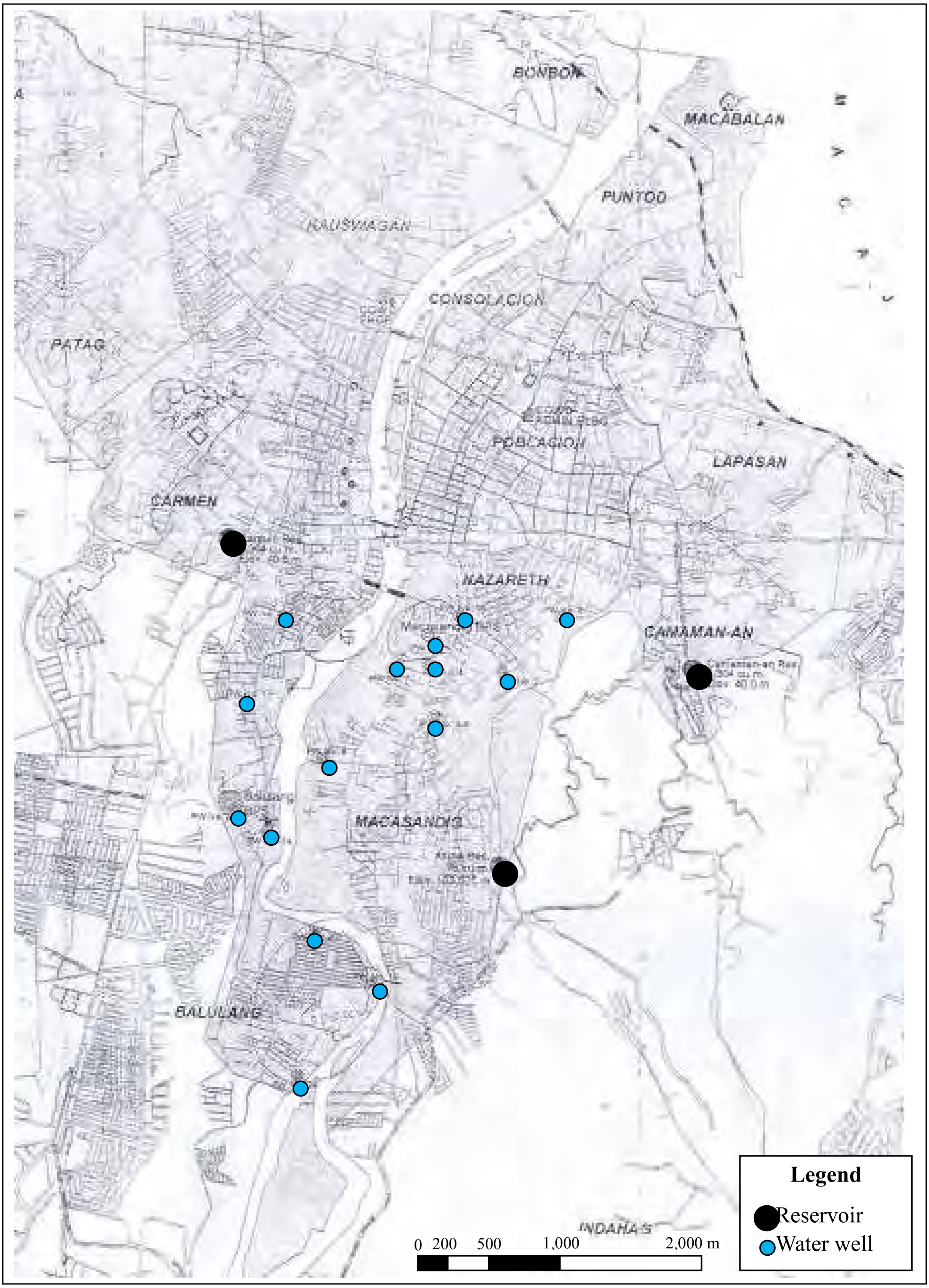
3.1.6 Groundwater

Groundwater is one of the main water sources of Cagayan de Oro City. Groundwater for water supply is taken from the water wells of Cagayan de Oro Water District (COWD). Private companies also have water wells for their own groundwater use.

There are 27 water wells at present targeted for deep aquifer with the depth of more or less 150 to 250 according to the Engr. Batar, COWD. Water wells located along the CDO River are located within the low land area of the Cagayan de Oro River, distributed in three areas: 1) Brgy. Macasandig; 2) Brgy. Balulang; and 3) Brgy. Camaman-an, Other wells of COWD are located in east side coastal zone of the city. Several wells are located in the vicinity of the Cagayan de Oro River. Distribution of water wells along the river is shown on Figure 3.1.6.

Regarding the water level and yield of the groundwater from the wells, they are almost stable or havea tendency of gradually decreasing although its gradient is little, according to Engr. Batar. There is no critical issue on groundwater use and its distribution to Cagayan de Oro City.

Groundwater quality of water wells are monitored regularly by COWD. The monitored results indicate that color, TDS and pH partly exceeds the quality standards.



Source: Cagayan de Oro Water District (COED)

Figure 3.1.6. Location of groundwater wells and reservoirs of Cagayan de Oro Water District

3.2 Natural Environment

3.2.1 Vegetation

(1) Vegetation along Cagayan de Oro River

Vegetation along the river was surveyed in F/S for the Flood Control and Drainage Projects of Selected River Basins – Cagayan de Oro River (2011). The survey was conducted along the downstream river stretch with a total length of 4.7 km by setting 5 transects. The survey identified the following three vegetation types:

- Mangrove ecosystem located in the mouth of Cagayan de Oro River in Barangay Bonbon,
- Mixed Secondary vegetation-Agricultural orchards in between Kauswagan Bridge and Kagayan Bridge where the residential and commercial buildings are concentrated, and
- Mixed Agricultural Plantation – Secondary Vegetation upstream of Kagayan Bridge.

(2) Mangrove forest

There is a mangrove forest along the left bank and the seacoast west of river mouth of Cagayan de Oro River. According to the F/S report, the mangrove ecosystem is the riverine type and located from the mouth to upstream of Kauswagan Bridge. It is dominated by mangrove tree, *Sonneratia caseolaris* and mangrove palm, *Nypa fruticans* in association with mangrove associate trees, *Terminalia catappa* and *Hibiscus tiliaceus* (ref. Figure 3.2.1).

Photo 1: Mangrove forest along seacoast, Brgy. Bonbon

Photo 2: Nypa mangrove, Sitio Paradise, Brgy. Bonbon

Figure 3.2.1 Mangrove forest located at the west of Cagayan de Oro River, Brgy. Bonbon

Macajalar Bay Development Alliance (MBDA), an alliance of 14 coastal local government units (LGUs) within the bay including the province of Misamis Oriental, surveyed the mangrove cover in Macajalar Bay and developed a mangrove coverage map. According to the map (Sep. 2012), the area of the mangrove forest located at the river mouth (left bank side and westward seacoast) is 13.05 ha, consisting of old (existing) mangroves (10.39 ha) and newly planted ones (2.66 ha). More than 10 species mangrove trees are observed including *Rhizophora apiculata, Sonneratia alba, Nypa fruticans* according to a German consultant of MBDA.

In order to clarify the distribution and area of mangrove forest near the river mouth of the CDOR, the JICA Survey Team carried out a field survey for confirming the distribution of the mangrove forest by GPS. The survey was done on Feb. 6, 2013, through plotting the coordinates data from river side using boat and by land.

Figure 3.2.3 shows the survey results. The mangrove forest distributes along the seashore, at the west side of the river mouth along seashore and over the marshy area, and along both river banks of the CDO River.

Mangrove forest along the seashore of Barangay Bonbon (area A on the figure) are planted mangrove forest according to the government official of Agricultural Office, CDO City. The species planted here are mainly *Rhizophora apiculata* (local name: Bakhaw lalaki), *Rhizophora mucronata* (Local name: bakhaw babae). Few of *Sonneratia Alba* (local name: Pagatpat) trees are also growing around the planted area.

Mangrove forest located over the marshy area in Barangay Bonbon (area B on the figure) is natural mangrove forest. It mainly consists of *Nypa fruticans* (local name: Nipa) which glows along the Nabuslutan creek main channel and its tributaries which creates a channel network and its surrounding areas. Many of *Sonneratia Alba* and few of *Rhizophora apiculata and Rhizophora mucronata,* which are planted, are mixed in the forest. The mangrove forest become more in patches to westward and southward where the growing condition is drier and *Nypa fruticans* grows in between residential areas.

Along the river banks, mixture of *Sonneratia Alba* and *Nypa fruticans* are seen every here and there from river month up to immediately upstream point of Puntod Bridge along the left bank (area C on the figure). Along the right bank, on the other hand, they are seen between barangay Puntod and MaharlikaBridge (area C on the figure) although the density of mangrove trees are less than that on left bank side.

Photo 1: Planted seedlings of mangrove trees *(Rhizophora apiculata)*

Photo 2: *Nypa fruticans* along Nabuslutan creek in Brgy. Bonbon

Photo 3: Mangrove forest (mixture of *Sonneratia Alba* and *Nypa fruticans)* along left bank of CDO River

Photo 4: Mangrove trees (*Sonneratia Alba)* distribute in patches along right bank of CDO River

Figure 3.2.2 Features of mangrove forest located in the downstream area of CDO River

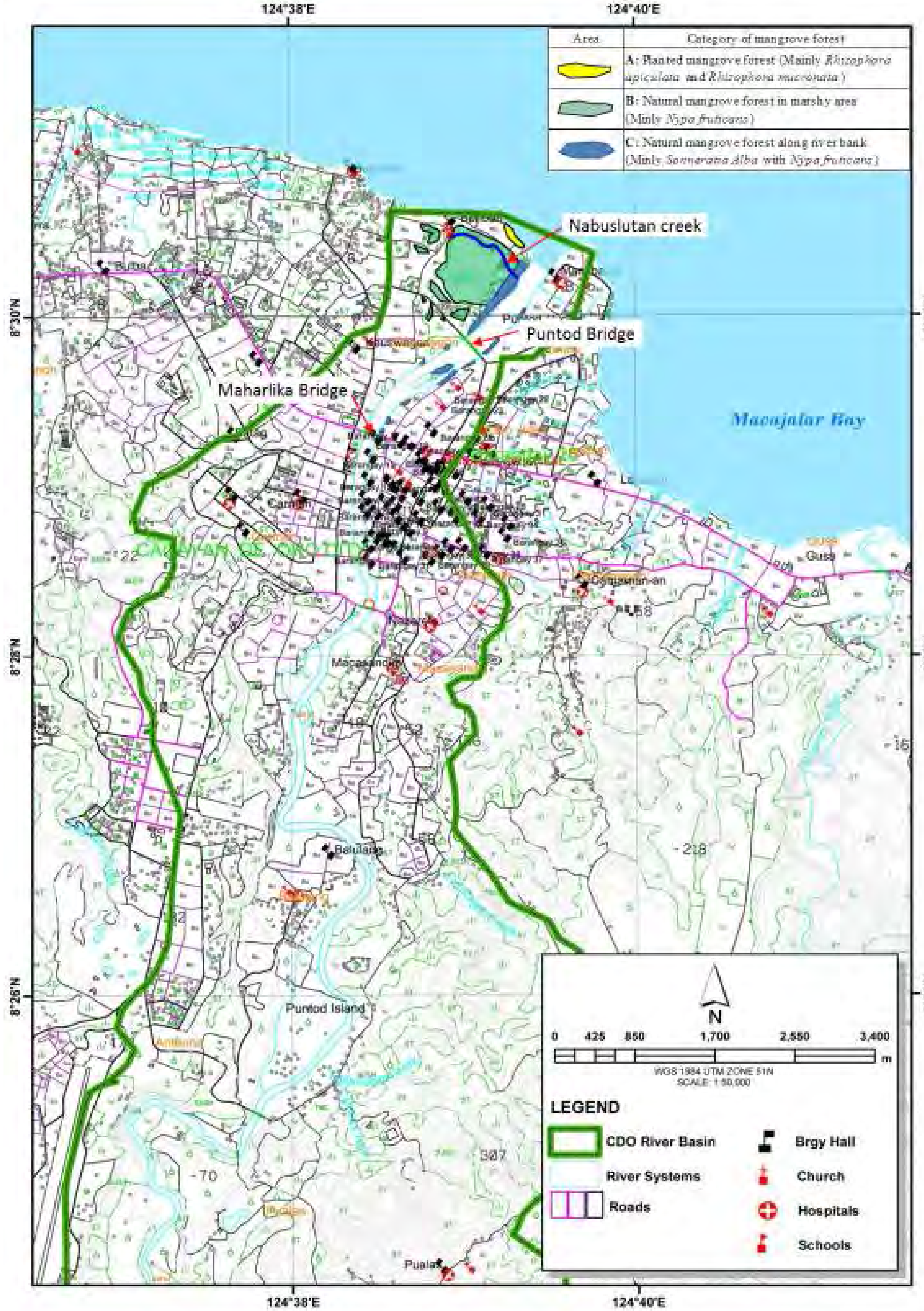


Figure 3.2.3 Location of mangrove forest located in the downstream area of CDO River

3.2.2 Terrestrial Flora

(1) Summary of Secondary Data

Based on the secondary data collected so far, terrestrial flora is summarized as below.

Table 3.2.1 shows the summary of inventory survey conducted in Mt. Kitanglad Range Natural Park in 1996 (Pipoly, et al, 1996 and Palis, 1996). The survey identified that there are at least 185 species of trees and other woody vegetations, and 345 fern species that exist in the park. Thus, it was indicated in the Mt. Kitanglad Range Natural Park Management Plan (2001) that Mt. Kitanglad Range is one of the most important parks in the Philippines and considered a priority site for protection because of the presence of habitats of many endangered, endemic, rare and economically important floral species.

Table 3.2.1 Summary of inventory survey conducted in Mt. Kitanglad Range Natural Park in 1996

Category	Number of family recorded	Number of species recorded
Trees, shrubs and other woody vegetations	58	185
Ferns	29	345

Source: Management Plan, Mt. Kitanglad Range Natural Park, Feb. 2001.

In the meantime, an inventory survey for terrestrial flora was conducted in F/S for the Flood Control and Drainage Projects of Selected River Basins – Cagayan de Oro River (2011). The survey was done along the downstream stretches of CDO River by setting 5 transects as mentioned in previous section: 1) river mouth to Kauswagan Bridge, 2) Kauswagan Bridge to Maharlika Bridge, 3) Maharlika Bridge to Ysalina Bridge, 4) Ysalina Bridge to Kagayan Bridge, and 5) Upstream (about 500 m) of Kagayan Bridge. Inventory of flora was carried out using a boat along the main stream of the CDO River. Table 3.2.2 shows the survey results.

According to the survey, a total of 51 species under 29 families belonging to 7 life forms were recorded at the proposed project area (i.e. Phase I: the stretch between Maharlika and Ysalina bridges). Trees, shrubs, herbs and vine consist of 30, 6, 8 and 1 species, respectively. Three bamboo species and 2 palm species were also recorded including 1 fern species. Of the total number of species, 17 are non-native (introduced) and the rest are native plants (indigenous). In addition, a high of 15 species are domesticated forms either as ornamental garden plant or farm crop.

Table 3.2.2 List of Flora Species Recorded in Downstream Stretch of CDO River

No.	Species	Common Name	Family	Life form	Bank present*
1	*Acrosticum aureum l.*	Lagolo	Pteridaceae	Fern	Right
2	*Aglaonema sp.*	Aglaonema	Araceae	Herb	Left
3	*Artocarpus altilis*	Rimas	Moraceae	Tree	Right
4	*Artocarpus heterophyllus lam.*	Nangka	Moraceae	Tree	Right
5	*Arundo donax*	Giant reed	Poaceae	Herb	Left
6	*Bambusa spinosa roxb.*	Kawayan tinik	Poaceae	Bamboo	Right
7	*Bambusa vulgaris schrad.*	Kawayan kiling	Poaceae	Bamboo	Right
8	*Bambusa vulgaris var. Striata*	Kawayan dilaw	Poaceae	Bamboo	Right
9	*Cassia alata*	Akapulko	Fabaceae	Shrub	Right
10	*Ceiba pentandra*	American kapok	Bombacaceae	Tree	Right
11	*Chrysophyllum caimito l.*	Caimito	Sapotaceae	Left	Right, Left
12	*Citrus grandis (l.) Osb.*	Lukban	Rutaceae	Tree	Left
13	*Cocos nucifera*	Coconut	Arecaceae	Palm	Right, Left

No.	Species	Common Name	Family	Life form	Bank present*
14	*Colocasia esculentum*	Gabi	Araceae	Herb	Right
15	*Colona serratifolia cav.*	Anilaw	Malvaceae	Tree	Left
16	*Cyperus alternifolius*	Cyperus	Cyperaceae	Herb	Right, Left
17	*Dracontamelon dao*	Dao	Anacardiaceae	Tree	Right
18	*Dysoxylum glaudichaudianum*	Igyo	Meliaceae	Tree	Right
19	*Ficus elastica*	India rubber	Moraceae	Tree	Right
20	*Ficus septica*	Hauili	Moraceae	Tree	Right
21	*Ficus sp.*	Ficus	Moraceae	Tree	Right, Left
22	*Gliricidia sepium*	Kakawate	Fabaceae	Tree	Right
23	*Gmelina arborea*	Gmelina	Verbenaceae	Tree	Right
24	*Hibiscus tiliaceus l.*	Malubago	Malvaceae	Tree	Right, Left
25	*Imperata cylindrica*	Cogon	Poaceae	Herb	Right
26	*Lantana camara*	Lantana	Verbenaceae	Shrub	Left
27	*Leucosyke capitellata*	Alagasi	Urticaceae	Shrub	Left
28	*Mangifera indica l.*	Mangga	Anacardiaceae	Tree	Right
29	*Melanolepis multiglandulosa*	Alim	Euphorbiaceae	Tree	Right
30	*Mikania cordata*	Uoko	Asteraceae	Vine	Right
31	*Moringa oleifera lam.*	Malunggay	Moringaceae	Tree	Right
32	*Muntingia calabura l*	Aratiles	Malvaceae	Tree	Right
33	*Musa sapientum*	Banana	Musaceae	Tree	Right
34	*Nauclea orientalis (l.) L.*	Bangkal	Rubiaceae	Tree	Right
35	*Nypa fruticans wurmb.*	Nipa	Arecaceae	Palm	Right
36	*Pennisetum polystachyon*	Pennisetum	Poaceae	Herb	Right
37	*Pterocarpus indicus*	Narra	Fabaceae	Tree	Right
38	*Ravenala madagascariensis*	Traveller's tree	Strelitziaceae	Tree	Right
39	*Ricinus communis*	Ricinus	Euphorbiaceae	Shrub	Right
40	*Saccharum spontaneum l.*	Talahib	Poaceae	Herb	Right
41	*Sandoricum koetjape*	Santol	Meliaceae	Tree	Right
42	*Solanum torvum sw.*	Talong-talonga	Solanaceae	Shrub	Right
43	*Sonneratia caseolaris*	Pedada	Sonneratiaceae	Tree	Left
44	*Sterculia foetida l.*	Kalumpang	Sterculiaceae	Tree	Left
45	*Swietenia macrophylla*	Mahogany	Meliaceae	Tree	Left
46	*Syzygium sp.*	Syzygium	Myrtaceae	Tree	Right
47	*Terminalia catappa l.*	Talisay	Combretaceae	Tree	Right, Left
48	*Theobroma cacao l.*	Cacao	Malvaceae	Tree	Right, Left
49	*Trema orientalis (l.) Blume*	Anabiong	Celtidaceae	Tree	Right
50	*Vitex negundo l.*	Lagundi	Lamiaceae	Shrub	Right
51	*Zea mays*	Mais	Poaceae	Herb	Right

Source: F/S Report for Flood Control and Drainage Projects of Selected River Basins – Cagayan de Oro River (2011)

(2) Threatened Species

Out of the recorded species in F/S Report, three(3) are considered threatened species based on National List of Threatened Species (DAO 2007-01) and Threatened Species in 2006 IUCN Red List, as presented in Table 3.2.3. All of them are trees and sought for their high-quality wood.

Narra (*Pterocarpus indicus),* the Philippine national tree, is a critically endangered species (i.e. facing extremely high risk of extinction in the wild in the immediate future), Molave (*Vitex parviflora*) is an Endangered species (i.e. not critically endangered but whose survival in the wild is unlikely if the causal factors continue operating) and Dao (*Dracontamelon dao)* is a Vulnerable species (i.e. under threat from adverse factors throughout its range and is likely to move to the endangered category in the future).

These species, although threatened in the wild, are common reforestation plants used in river bank stabilization and landscape enhancement that is why they are present even in highly urbanized area like the downstream reaches of the CDO River according to the description in the F/S Report.

Table 3.2.3 List of Threatened Species Recorded in the Inventory Survey

Species	Common Name	Conservation Status	Economic Use
Dracontamelon dao	Dao	Vulnerable	Wood
Pterocarpus indicus	Narra	Critically endangered	Wood
Vitex parviflora	Molave	Endangered	Wood

Source: F/S for the Flood Control and Drainage Projects of Selected River Basins – Cagayan de Oro River (2011)

3.2.3 Terrestrial Fauna

(1) Summary of Secondary Data

Based on the secondary data collected so far, terrestrial fauna is summarized below.

Table 3.2.4 shows the summary of inventory survey conducted in Mt. Kitanglad Range Natural Park. It was indicated in the Management Plan, Mt. Kitanglad Range Natural Park (Feb. 2001) that Mt. Kitanglad harbors rich array of fauna among the protected areas in the Philippines, many of which are considered rare and endemic. However, there is a sign that the diversity of Mt. Kitanglad's birds and mammals have been decreasing according to description in the Management Plan.

Table 3.2.4 Summary of inventory survey conducted in Mt. Kitanglad Range Natural Park

Category	Number of species recorded	Number of endemic species
Mammals	63	27 (43 %)
Birds	168	62 (37 %)
Reptiles	25	13 (52 %)
Amphibians	25	12 (48 %)

Source: Management Plan, Mt. Kitanglad Range Natural Park, Feb. 2001.

In the meantime, a census survey for terrestrial fauna was conducted in F/S for the Flood Control and Drainage Projects of Selected River Basins – Cagayan de Oro River (2011). The survey was conducted along the downstream stretches of the river with a total length of 5.4 km by setting 4 transect lines: 1) river mouth to Kauswagan Bridge, 2) Kauswagan Bridge to Maharlika Bridge, 3) Maharlika Bridge to Ysalina Bridge, and 4) Ysalina Bridge to Kagayan Bridge. The census was carried out using a boat along the main stream of the Cagayan de Oro River for recording mammals, birds, reptiles and amphibians. Census time was conducted during early morning (0600h-1000h) and late afternoon (1400h-1800h). Table 3.2.5 shows the survey results.

Table 3.2.5 List of Fauna Species Recorded in Downstream Stretch of CDO River

No.	Species	Common Name	Residency status
I.	**Mammals**		
1	*Suncus murinus*	Asian house shrew	Alien, pest
2	*Cynopterus brachyotis*	Common short-nosed fruit bat	Native
3	*Ptenochirus jagori*	Musky fruit bat	Endemic
4	*Rousettus amplexicaudatus*	Common rousette	Native
5	*Scotophilus kuhlii*	Lesser Asian house bat	Native
6	*Rattus norvegicus*	Norway rat	Alien, Pest
II.	**Birds**		
1	*Egretta garzetta*	Little Egret	Migrant

No.	Species	Common Name	Residency status
2	*Butorides striatus*	Little Heron	Migrant and resident
3	*Haliastur indus*	Brahminy Kite	Resident
4	*Geopelia striata*	Zebra Dove	Resident
5	*Centropus bengalensis*	Lesser Coucal	Resident
6	*Collocalia esculenta*	Glossy Swiftlet	Resident
7	*Collocalia troglodytes*	Pygmy Swiftlet	Endemic
8	*Halcyon chloris*	White-collared Kingfisher	Resident
9	*Hirundo rustica*	Barn Swallow	Migrant
10	*Hirundo tahitica*	Pacific Swallow	Resident
11	*Pycnonotus goiavier*	Yeloow-vented Bulbul	Resident
12	*Gerygone sulphurea*	Golden-bellied Flyeater	Resident
13	*Phylloscopus borealis*	Arctic Warbler	Migrant
14	*Rhipidura javanica*	Pied Fantail	Resident
15	*Artamus leucorhynchus*	White-breasted Wood-Swallow	Resident
16	*Aplonis panayensis*	Asian Glossy Starling	Resident
17	*Nectarinia jugularis*	Olive-backed Sunbird	Resident
18	*Dicaeum australe*	Red-keeled Flowerpecker	Endemic
19	*Passer montanus*	Eurasian Sparrow	Resident
III.	**Amphibians & Reptiles**		
1	*Bufo marinus*	Marine Toad	Alien, Pest
2	*Mabuya multicarinata*	Mabuya multicarinata	Native
3	*Mabuya multifasciata*	Common Mabouya	Native
4	*Cosymbotus platyrus*	Flat-bodied House Gecko	Native
5	*Gehyra mutilata*	Tender-skinned House Gecko	Native
6	*Hemidactylus frenatus*	Common House Gecko	Native
7	*Python reticulatus*	Retoculated Python	Native

Source: F/S Report for Flood Control and Drainage Projects of Selected River Basins – Cagayan de Oro River (2011)

The survey results are summarized below:

<u>Mammals:</u>

Six (6) species of mammals were recorded, composed of one shrew, four bats, and one rodent. Four of the recorded species are native ones, including one endemic species (Musky fruit bat: *Ptenochirus jagon*). There are two species that are considered as invasive and regarded as pests: the Asian House Shrew (*Suncus murinus*) and Norway Rat (*Rattus norvegicus*).

<u>Birds:</u>

A total of 377 individuals representing 19 species were observed. At least 16 species (84%) are resident breeders, of which two species are listed as Philippine endemics. In addition, three migratory species were also observed. With a few exceptions, majority of the birds observed are strongly associated with disturbed habitats (e.g. Agricultural and residential areas). Exceptions are those that can also be found in either forests (at least second growth) or wetland habitats (e.g. mangroves).

<u>Amphibians and reptiles:</u>

One species of amphibian and six species of reptiles were observed. The amphibian, Marine Toad (*Bufo marinus*), is listed as an invasive species (from South America) and a permanent fixture in every residential areas all over the country. The six reptile species are resident species although virtually all of these are strongly associated with residential, and agricultural areas; and occasionally on scrub-type vegetation.

(2) Threatened species

No species listed as endangered, threatened, or vulnerable species in DENR Administrative Order 07-01 regarding protected species or IUCN Red List was observed.

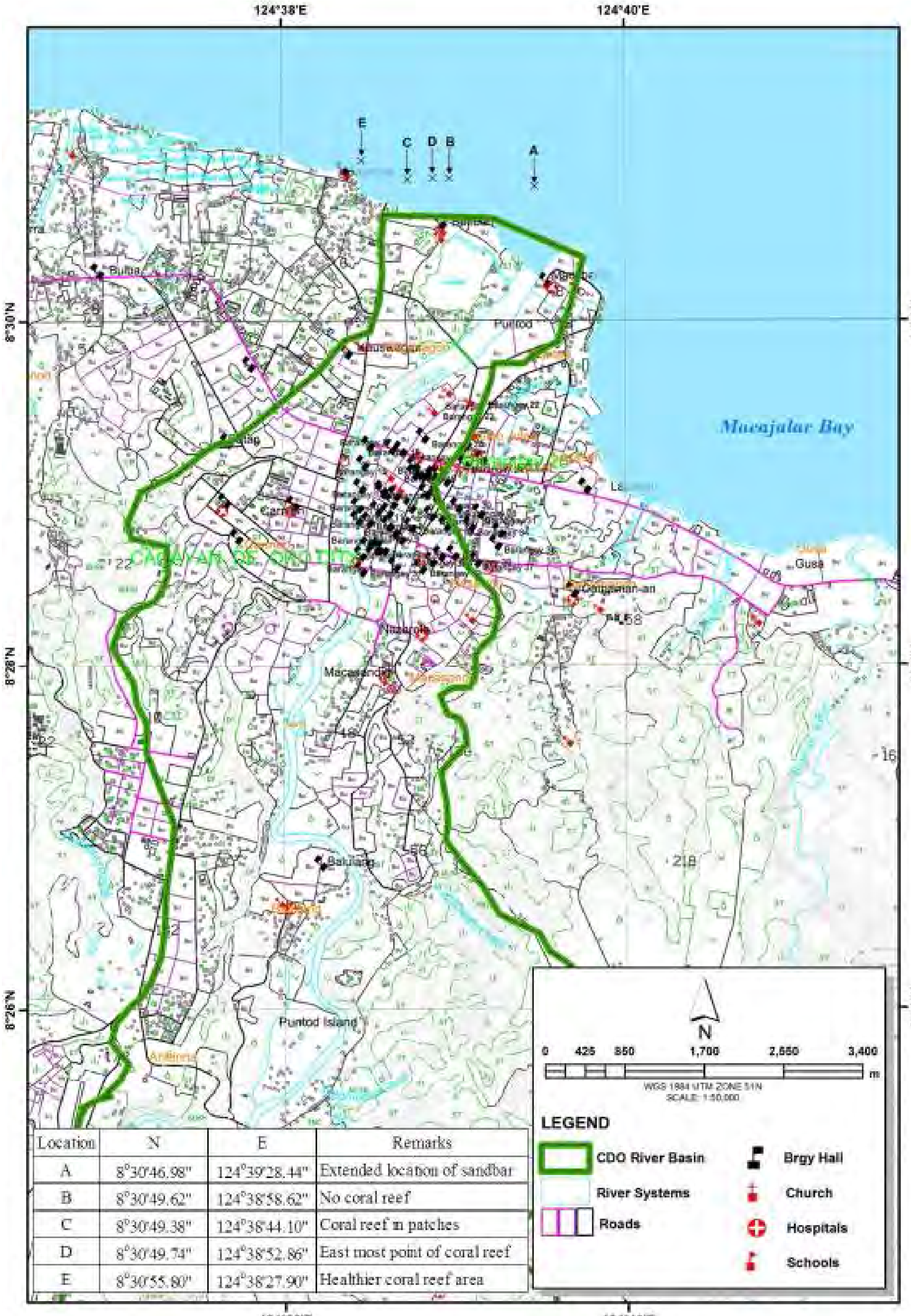
3.2.4 Aquatic Biota and Coastal Environment

Data on aquatic biota in the CDO River including phytoplankton, zooplankton, macro-benthos, and nekton (fish) are not available in the collected data so far.

According to the Ecological and Fisheries Profile of Macajalar Bay (2008), it is pointed out that the bay, a major hub in Northern Mindanao, is under serious threat brought about by industrialization, rapid development and coastal migration. There are coastal resources management (CRM) efforts in Macajalar Bay in some of its 14 government units (LGUs). In the document, coral reef of the seacoast of Cagayan de Oro City is observed at two locations: Bayabas Reef and Gusa Reef. The former is located in front of the sea at Brgy. Bayabas, west of Brgy. Bonbon, and the latter at that of Brgy. Gusa, east of Cagayan de Oro River mouth. Coral reefs are flat and shallow and are very silty, probably because of the influence of rivers and creeks that drain into the nearby sea. Bayabas Reef is located near the Cagayan de Oro River plume.

In the meantime, according to McKeough Marine Center (MMC), Xavier University, there is a coral reef at a distance of 400 – 500 meters from the seacoast of Brgy. Bonbon located left bank of Cagayan de Oro River mouth. The area of the coral reef has a length of approximately 200-300 meters in the east-west direction and 100 meters in the north-south direction. This information was obtained during the interview with Director Marin Tan only. According to him, the details of the coral reef have not been surveyed by MMC yet. The relationship with Bayabas Reef mentioned above is not clear, either.

In order to clarify the information on the coral reef above, the Survey Team carried out a preliminary field survey for confirming the presence and distribution of the coral reef. The survey was done on Feb. 5, 2013, through diving (snorkeling) by fisherfolk hired by the Survey Team, accompanied by an expert of McKeough Marine Center (MMC), Xavier University. Figure 3.2.4 shows the survey results.



Location	N	E	Remarks
A	8°30'46.98"	124°39'28.44"	Extended location of sandbar
B	8°30'49.62"	124°38'58.62"	No coral reef
C	8°30'49.38"	124°38'44.10"	Coral reef in patches
D	8°30'49.74"	124°38'52.86"	East most point of coral reef
E	8°30'55.80"	124°38'27.90"	Healthier coral reef area

Figure 3.2.4 Result of preliminary coral reef survey

The nearest location of coral reef (Point D on the figure) is located at about 1.5 km from the river mouth of the CDO River and about 400m from the seashore of Barangay Bonbon. But around this site, most of the coral reef is dead, or even alive, the coral reef does not develop continuously but only develop in patches. No coral reef is seen eastward from this site. As going westward, on the other hand, healthier coral can be seen at nearer point from the seashore according to the fisherfolk, but the distance from the river mouth becomes further.

3.2.5 Protected Area

Republic Act No. 7586, otherwise known as the National Integrated Protected Areas System Act of 1992 provides system of managing and establishing protected areas in the Philippines. Protected areas are classified into the following:

a. Strict nature reserve
b. Natural park
c. Natural monument
d. Wildlife sanctuary,
e. Protected landscapes and seascapes,
f. Resources reserve,
g. Natural biotic areas, and
h. Other categories established by law, conventions or international agreements which the Philippine Government is a signatory.

Table 3.2.6 presents the proclaimed protected areas in Region-10. There is no protected area along the downstream reaches of the Cagayan de Oro River. In the headwater areas of the Cagayan de Oro River Basin are two protected areas: Mt. Kitanglad Range Natural Park and Mt. Kalatungan Range Natural Park.

Table 3.2.6 Protected Areas in Region-10

Name of Protected Area	Area (hectares)		
	Protected area	Buffer zone	Total
A. Misamis Occidental	34,989	18,334	53,323
1) Mt. Malindang Range Natural Park	34,694	18,334	53,028
2) Baliangao Protected Landscape/Seascape	295		295
B. Misamis Oriental	1,367	800	2,167
1) Initao-Libertad Protected Landscape / Seascape	1,301	800	2,101
2) Mimbilisan Protected Landscape / Seascape	66		66
C. Bukidnon	52,483	29,926	82,409
1) Mt. Kitanglad Range Natural Park	**31,235**	**16,035**	**47,270**
2) Mt. Kalatungan Range Natural Park	**21,248**	**13,892**	**35,139**
D. Camiguin	2,227	1,422	3,649
1) Timpoong-Hibok hibok Natural Monument	2,227	1,422	3,649
TOTAL	**91,066**	**50,483**	**141,548**

Source: DENR-PAWB, Region-10

Mt. Kitanglad Range Natural Park was initially classified as National Park through Presidential Proclamation 677 in 1990 and then classified as Natural Park through Presidential Proclamation No. 896 in 1996. Finally, it was proclaimed as a Protected Area through Republic Act 8978 in 2000. Mt. Kalatungan Range Natural Park is classified as Natural Park, through Presidential Proclamation No. 305 of May 5, 2000.

Location of the two natural parks is shown on Figure 3.2.5. Of the area of Mt. Kitanglad Range Natural Park, western side, one half of it is included in the CDO River basin, while out of Mt. Kalatungan Range Natural Park, northwestern side, one third is included in the CDO River basin.

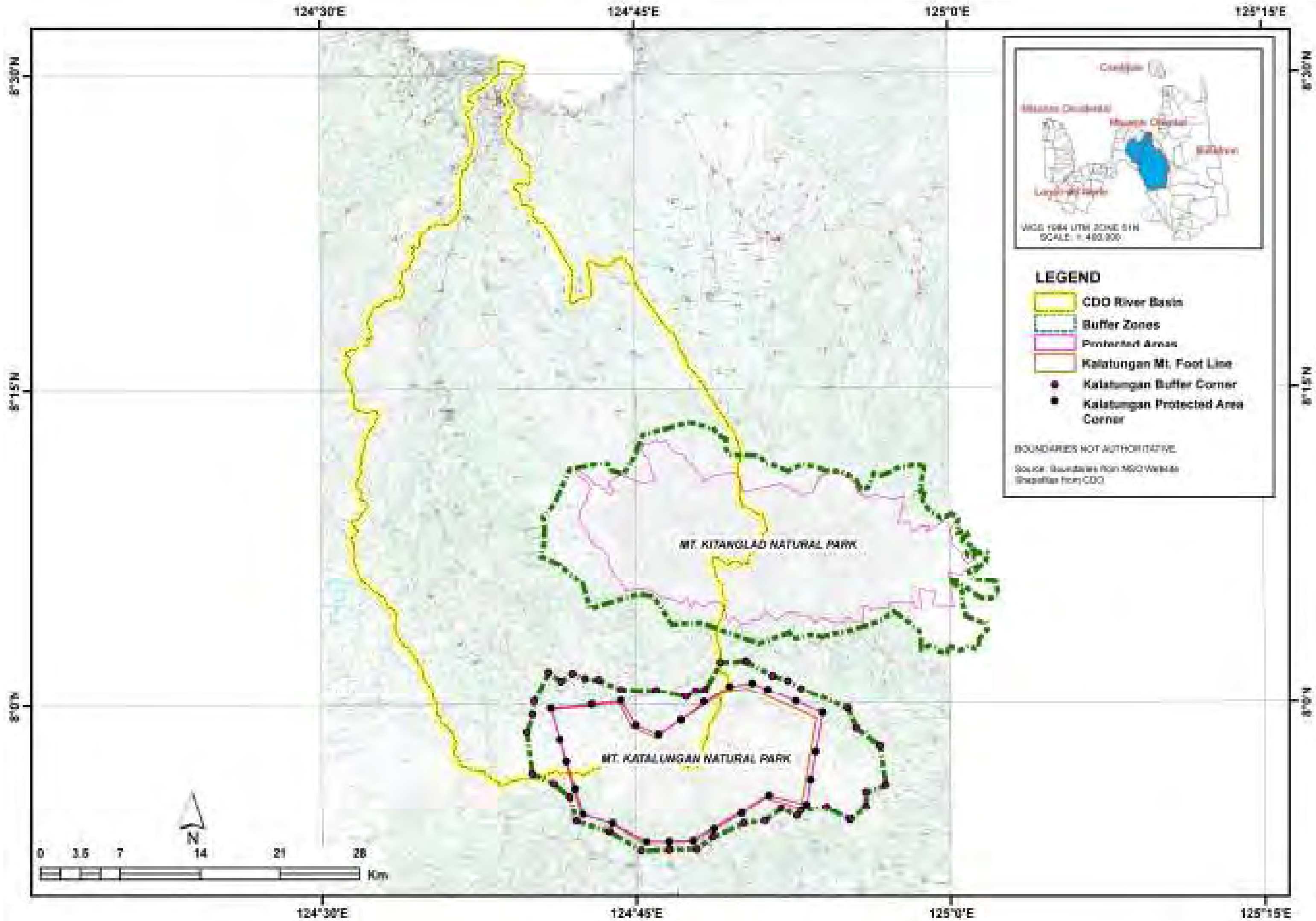


Figure 3.2.5 Location of Protected Areas (Mt. Kitanglad and Mt. Kalatungan) in CDO River Basin

3.3 Social Environment

3.3.1 Local Administration

The Cagayan de Oro River Basin is situated in the Northern Mindanao Region, which is administratively called Region X. The Region is composed of five provinces in the Mindanao Island, namely Bukidnon, Misamis Oriental, Misamis Occidental, Lanao del Norte and Camiguin. Of the five provinces, the Cagayan de Oro River Basin is located in two provinces of Misamis Oriental and Bukidnon and specifically under four local government units, the city of Cagayan de Oro in Misamis Oriental and municipalities of Talakag, Baungon and Libona in Bukidnon.

In the Region, there are a total of nine cities, two of which are classified as a highly urbanized city. The two cities are Cagayan de Oro City in the Misamis Oriental Province and Iligan City in the Lanao del Norte Province. Aside from the cities, there are 84 municipalities and 2,022 barangays in the Region.

3.3.2 Socioeconomic Status of the Northern Mindanao Region

In this section, the socioeconomic status of the region of Northern Mindanao is briefly summarized in the following tables shown below.

(1) Overall Socioeconomic Status

Table 3.3.1 Overall Socioeconomic Status of the Northern Mindanao Region

	Description of Status
Land Area (ha) *2	2,018,618
Regional Population (2007 *1/ 2010 *2)	4,297,323 (2010)
	3,952,437 (2007)
	The total population of the Region as of 2010 reached 4.297 million. It increased by 344 thousand over the figure in the 2007 Census, at an average annual population growth rate of 2.83%.
No. of Households (2007) *2	805,530 (2007)
Average Household Size (2007) *2	4.90
Population Density	1.96 / ha
Annual Population Growth Rate (2007-2010)	2.83
No. of Provinces (2007) *3	5
No. of Cities (2007) *3	9
No. of Municipalities (2007) *3	84
No. of Barangays (2007) *3	2,022
Gross Regional Domestic Products or GRDP (2004-2009) *4	73.2 Billion Peso (2009)
	56.0 Billion Peso (2004)
	GRDP of the Region as of 2009 is 73 billion peso, which increased by 17 billion peso over the 2004 figure, at an average annual growth rate of 5.40%.
	Comparing the annual growth rate with other regions, the GRDP of the Region in 2009 (5.5%) is higher than the GDP of the country (4.45%) and the highest in Mindanao. The GRDP in the other regions are: Region IX, 5.02%; Region XI, 4.84%; Region XII, 4.31%; Caraga, 4.82%; and in ARMM, 3.44%. Furthermore, the GRDP of the Region is higher than rest of the country as well (4.35%).
Agriculture Sector (including Forestry and Fishery) *4	4.2% (Growth Rate 2008-2009)
	4.4% (Growth Rate 2004-2005)
	Agriculture has been the leading sector, contributing to the regional economy growth in the Region with a GDRP growth rate of 4.2% (2008-2009) and 4.4% (2004-2005) compared to

Table 3.3.1 Overall Socioeconomic Status of the Northern Mindanao Region

	Description of Status
	the industry sector (3.1%//2.0%) and service sector (1.7%/6.3%).
Industry and Service Sector *[4]	3.1% (Industry Sector Growth Rate 2008-2009)
	1.7% (Service Growth Rate 2008-2009)
	While agriculture remains to be the leading sector in contributing to the regional economy, the Region is in the process of transforming into an industry-based economy with improvements in productivity competitiveness in all sectors.
Major Infrastructure *[4]	Transportation – The total road network is 22 million kilometers as of 2009, composed of national roads (8%) 31% of which is unpaved and local roads (92%), 88% of which is unpaved. Majority of the unpaved roads are in provinces of Misamis Oriental and Bukidnon.
	Power and Electrification – The power generation efficiency of the Region has decreased by 16.3% from 92% in 2004 to only 75.7% in 2009, due to deteriorated plants and climate change. With the increasing economic activities in the Region, improvement of efficiency with more investments is a concern.
	Communication – While cellular phone lines have been made more available and expanded its coverage area with an annual increase of 15% from 2005-2009, the connectivity in rural areas is still low and needs to be improved.
Social Conditions *[4]	Health – Health situation of the Region in the past five years (2004-2005) shows that most of health indicators have a downward trend based on the 2010 plan target. Actual figures in 2009 and the target of 2010 for key indicators are: (a) crude birth rate per 1,000 population (22.03 in 2009 / 21.17 in 2010), (b) maternal mortality rate per 100,000 live births (94.00 / 57.00) and (c) infant mortality rate per live births (7.20 / 7.17).
	Education – Basic literacy rate of the Region has been low and at 93.9% in 2009, it is lower than the national rate (95.9%). The efficiency indicators (repetition rate, dropout rate, completion rate and cohort survival rate) of the Region, all came short of the targets.
Poverty Incidence Among Families (2006 / 2009) *[4]	32.8% (2009)
	32.7% (2006)
	The poverty incidence among families in the Region in 2009 (32.8%) is higher than that of the country (20.9%). Among the provinces in the Region, except for Misamis Oriental (26.3%), incidences are higher than that of the Region, Bukidnon (33.0%), Camiguin (36.4%), Lanao del Norte (39.0%) and Misamis Occidental (36.9%).

Sources:
* [1] Census of Population and Housing 2010 (NSO)
* [2] Northern Mindanao Regional Social and Economic Trend 2011 (NSCB)
* [3] Philippine Standard Geographic Code (NSCB)
* [4] Northern Mindanao Regional Development Plan 2011-2016 (NEDA)

(2) Socioeconomic Indicators by Province

Table 3.3.2 Socioeconomic Indicators of the Northern Mindanao Region by Province

	Bukidnon	Misamis Oriental	Misamis Occidental	Lanao del Norte	Camiguin
Land Area (ha) *[2]	1,049,859	351,570	205,522	382,478	29,187
Population (2010) *[1]	1,299,192	1,415,944	567,642	930,738	83,807
Population (2007) *[2]	1,190,284	1,302,851	531,680	846,329	81,293
No. of Households (2007) *[2]	238,899	269,113	112,650	167,840	17,028
Average Household Size (2007) *[2]	4.98	4.84	4.72	5.04	4.77
Population Density (2007)	1.13/ha	3.71/ha	2.59/ha	2.21/ha	2.78/ha
Annual Population Growth Rate (2007-2010)	2.96	2.81	2.21	3.22	1.02
Income Classification (2007) *[3]	1st	1st	2nd	2nd	5th
No. of Cities (2007) *[3]	2	3	3	1	0
No. of Municipalities (2007) *[3]	20	23	14	22	5
No. of Barangays (2007) *[3]	464	504	490	506	58

Sources:
* [1] Census of Population and Housing 2010 (NSO)
* [2] Northern Mindanao Regional Social and Economic Trend 2011 (NSCB)
* [3] Philippine Standard Geographic Code (NSCB)

(3) Summarized Socioeconomic Characteristics of the Region

- In the Mindanao, the Northern Mindanao Region has the largest regional economy in 2009, indicated by a higher annual growth rate of the Gross Domestic Regional Products (GDRP) than that of other regions in the Island.
- In the Region, while the agricultural sector is a dominant and contributing sector to the regional economy, the Region is experiencing an economic transformation from a traditional agriculture-led economy to an industry-based economy.
- While the economy of the Region is growing, infrastructure conditions such as paving of roads, improvement of power supply efficiency, and access to telecommunication still need to be improved to support growth of the regional economy.
- Aside from infrastructure, social conditions such as health and education conditions also need to be improved to meet targets of the Region.

3.3.3 Socioeconomic Status of the River Basin

In this section, the socioeconomic status of the River Basin is briefly summarized in the following tables shown below.

(1) Socioeconomic Status by City and Municipality

Table 3.3.3 Socioeconomic Indicators of the River Basin by City/Municipality

	Cagayan de Oro * [1]	Talakag * [2]	Baungon * [3]	Libona * [4]
General Land Use:				
- Built-Up Area	12.7%	1.5%	0.9%	0.7%
- Agricultural Area	35.8%	33.0%	41.1%	28.0%
- Forest Area	29.6%	54.9%	54.3%	47.0%
Local Economy:				
- Primary Industry	Trade / Industry	Agriculture	Agriculture	Agriculture
- Primary Products / Service	Wholesale / Retail	Crops	Crops	Crops / Fruits
- Kind of Primary Products		Corn / Rubber	Corn / Cassava	Corn / Pina
Transportation:				
- Unpaved Roads	62.5%	96.8%	98.5%	94.1%
Power Supply:				
- Electrified Households	N/A * [5]	16.1%	40.2%	63.0%
Communication:				
- Cellular Phone	Operated	Operated	Operated	Operated
- Telephone Landline	Operated	Not Operated	Only Town Hall	Not Operated

Table 3.3.3 Socioeconomic Indicators of the River Basin by City/Municipality

	Cagayan de Oro * 1	Talakag * 2	Baungon * 3	Libona * 4
Water Supply:				
- Supplied Households	N/A* 6	43.7%	100%	N/A * 7

Sources:
* 1 Socioeconomic Profile of Cagayan de Oro City (2010)
* 2 Municipal Comprehensive Land Use Plan, Talakag Municipality (2000-2010)
* 3 Comprehensive Land Use Plan, Baungon Municipality (2010-2019)
* 4 Municipal Comprehensive Land Use Plan, Libona Municipality (2010-2019)

Notes:
* 5 All barangays in Cagayan de Oro are electrified. However, data on ratio of electrified households is not confirmed.
* 7 Data on ratio of supplied households in Cagayan de Oro is not yet confirmed.
* 7 All barangays in Libona are supplied water. However, data on ratio of supplied households is not confirmed.

(2) Socioeconomic Indicators by City and Municipality

Table 3.3.4 Socioeconomic Indicators of the River Basin by City/Municipality

	Cagayan de Oro	Talakag	Baungon	Libona
Land Area (has) *2	41,280	78,640	32,834	37,437
Population (2010) *1	602,088	67,123	32,868	39,393
Population (2007) *2	553,966	53,316	29,757	35,670
No. of Households (2007) *2	116,224	10,216	5,995	7,379
Average Household Size (2007)*2	4.7	5.2	5.0	4.8
Population Density (2007)	13.41/ha	0.68/ha	0.91/ha	0.95/ha
Annual Population Growth Rate (2007-2010)	2.82	7.98	3.37	3.36
Income Classification (2007) *3	1st	1st	2nd	1st
No. of Barangays (2007) *3	80	29	16	14
- No. of Urban Barangays *3	80	2	2	2
- No. of Rural Barangays *3	0	27	14	12

Sources:
* 1 Census of Population and Housing 2010 (NSO)
* 2 2011 Northern Mindanao Regional Social and Economic Trend (NSCB)
* 3 Philippine Standard Geographic Code (NSCB)

(3) Summary of the Socioeconomic Characteristics of the River Basin

- In the River Basin, agricultural area is one of the dominant land uses. This land use characteristic is reflected in the primary local industry in the River Basin which is agriculture, except in Cagayan de Oro City where the primary industry is wholesale and retail trade.
- The River Basin is largely covered by mountainous terrains, indicating a low ratio of paved roads, electrified households, households with water supply and landline telephone access, except in the City of Cagayan de Oro, capital of Misamis Oriental and functions as the regional center of Northern Mindanao and where infrastructure and services are well provided.

CHAPTER 4 ENVIRONMENTAL IMPACT STATEMENT SYSTEM IN THE PHILIPPINES

4.1 Legal Framework for PEISS

4.1.1 Overall Legal Framework of PEISS

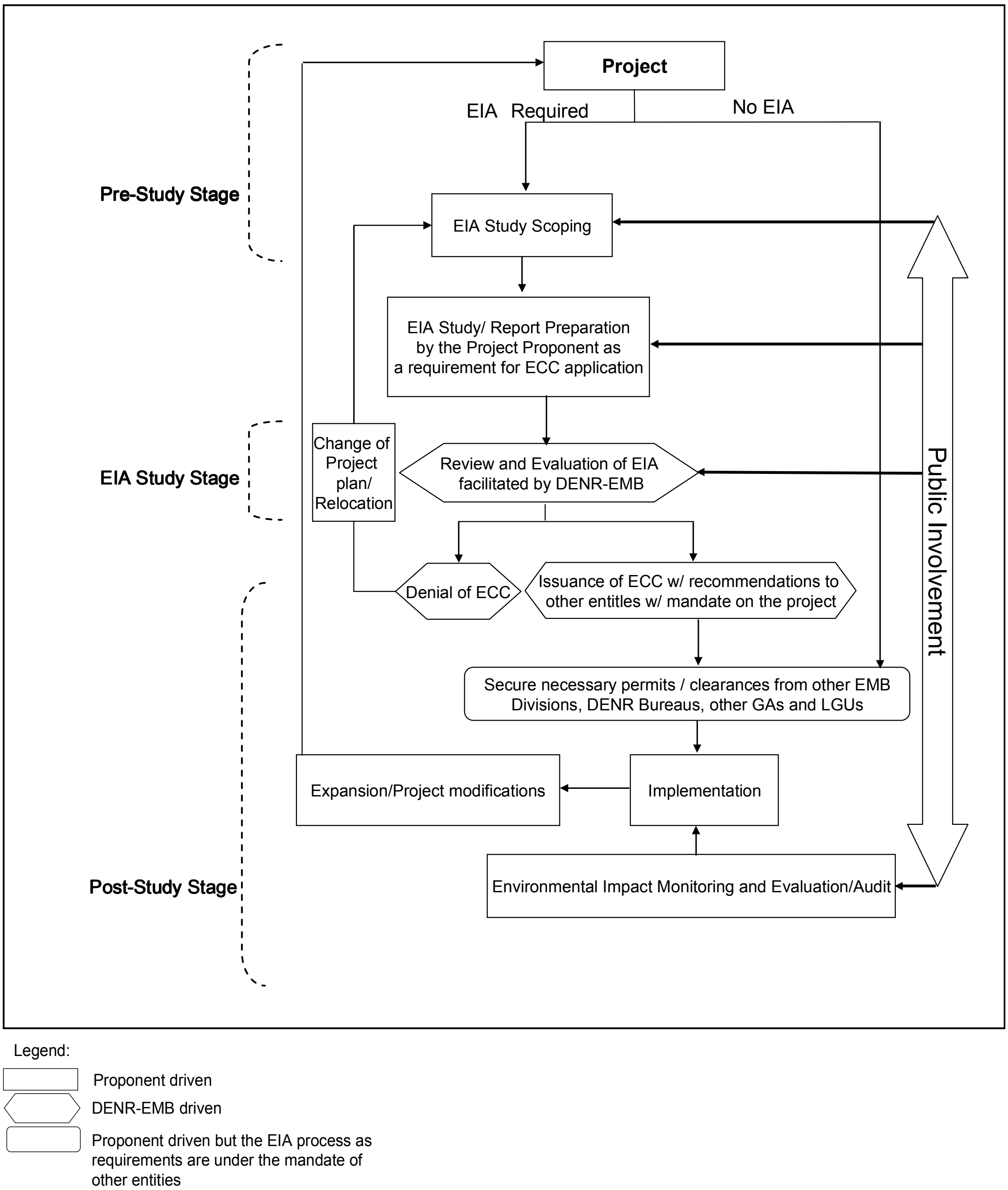
In the Philippines, any project or activity that may potentially have a negative impact on the environment is subject to an Environmental Impact Assessment (EIA) under the Philippine Environmental Impact Statement System (PEISS). The PEISS was initially set up by Presidential Decree (PD) No. 1151 in 1977, known as the Philippine Environmental Policy. It stipulates the necessity of the preparation of EIS for the proposed project and/or undertakings which might cause significant environmental impacts. In the following year, PD No. 1586 was promulgated to formalize the EIS System.

The EIS process applies to proposed projects that are identified as Environmentally Critical Projects (ECPs) and proposed projects to be located in Environmentally Critical Areas (ECAs) that are presumed to have significant impacts on the environment. The ECPs and ECAs have been defined and identified in the Presidential Proclamation (PP) No. 2148 (1981) and PP No. 803 (1996). The implementation rules of the EIS System was stipulated in the DENR Administrative Order No. 37 in 1996 (DAO No. 96-37), which was revised to partly simplify the procedures by AO No. 42 and DAO No.03-30. In November 2011, Memorandum Circular 005 was issued by DENR-EMB to streamline EIA requirements and include climate change adaptation and disaster risk reduction into the EIA. Table 4.1.1 summarizes the legal framework of the PEISS.

Table 4.1.1 List of Laws and Regulations/Guidelines for PEISS

Subject/Coverage		No./Title of laws, regulations or administrative order	Contents / Points related to FRIMP-CDOR
1)	PEISS (Philippine Environmental Impact Statement System)	Environmental Impact Statement System (EISS), Presidential Decree No. 1586 (1978)	An act establishing and centralizing the Environmental Impact Statement (EIS) System
2)	Screening Process of PEISS	Presidential Proclamation No. 2146 (1981) and No. 803 (1996)	Environmentally Critical Projects (ECPs) to have significant impact on the quality of environment and Environmentally Critical Areas (ECAs)
3)	Further strengthening of PEISS	DENR Administrative Order No. 37 Series of 1996 (DAO 96-37)	Emphasis on promoting maximum public participation in EIA process for social acceptability of the project.
4)	Implementation Rules and Procedures of PEISS	DENR Administrative Order No. 30 Series of 2003 (DAO 03-30), Revised Procedural Manual (2007)	Implementation rules and regulations of Presidential Decree No. 1586 (above). Also, provided detailed definitions of technical terms and detailed information regarding procedures, related laws and regulations
5)	Climate change adaption and disaster risk reduction	DENR-EMB Memorandum Circular 005 (2011)	Promotion of Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR), and streamlining EIA Requirements.

As shown in Figure 4.1.1, the procedures of EIA can be grouped into three major stages, including the pre-study stage (screening and scoping), the EIA study stage and post-study stage (review, decision-making and monitoring).



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

Figure 4.1.1 Summary Flowchart of EIA Process

4.1.2 Projects Covered by PEISS

The four (4) ECP project types and twelve (12) ECA categories declared under Proclamation No. 2146 (1981) and Proclamation No. 803 (1996) are summarized in Table 4.1.2 and Table 4.1.3, respectively.

Table 4.1.2 Summary of Environmentally Critical Projects (ECPs)

Main Categories	Sub Category
- A. Golf Course Project	- Golf course projects/complex
- B. Heavy Industries	- Iron and Steel Metals - Non-ferrous Metal Industries - Petroleum and Petrochemical Industries - Smelting Plants
- C. Resource Extractive Industries	- Fishery Projects (fishery-related dikes and fishpond development projects) - Forestry Projects - Major mining and quarrying projects
- D. Infrastructure Projects	- Major Dams - Major Reclamation Projects - Major Power Plants (Proc No. 2146 declared types: fossil-fuelled, nuclear-fuelled, hydroelectric or geothermal)

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

Table 4.1.3 Summary of Environmentally Critical Areas (ECAs)

ECA Categories	Examples
1. Areas declared by law to be national parks, watershed reserves, wildlife preserves, and sanctuaries	- Areas of the National Integrated Protected Areas System (NIPAS)
2. Areas set aside as aesthetic, potential tourist spots	- Areas declared and reserved by the Department of Tourism or other authorities for tourism development
3. Areas which constitute the habitat for any endangered or threatened species of indigenous Philippine wildlife (flora and fauna)	- Areas inhabited by indeterminate species, threatened species, rare species, endangered species, such species categorized as Appendix I or II of CITES as well as those listed in the National List of Threatened Fauna
4. Areas of unique historic, archeological, geological, or scientific interests	- National historical landmarks, geological monuments, paleontological and anthropological reservations as designated or determined by the National Historical Institute, National Museum, National Commission for Culture and the Arts, National Commission on Geological Sciences, and other authorities
5. Areas which are traditionally occupied by cultural communities or tribes	- Areas that are occupied or claimed as Certificated Ancestral Domains/Lands by indigenous communities
6. Areas frequently visited and or hard-hit by natural calamities (geologic hazards, floods, typhoons, volcanic activity, etc.	- Areas frequently visited or hard-hit by typhoons - Areas frequently visited or hard-hit by tsunamis - Areas frequently visited or hard-hit by earthquakes - Storm surge-prone areas - Flood-prone areas - Areas prone to volcanic activities - Areas located along fault lines or within fault zones - Drought-prone areas
7. Areas with critical slope	- Lands with slope of 50% or more - Alienable and disposable forest lands and unclassified forests

8. Areas classified as prime agricultural lands	- Irrigated and irrigable areas and other areas mapped under the Network of Protected Areas for Agriculture (NPAA) of the Bureau of Soils and Water Management (BSWM)
9. Recharged areas of aquifers	- Areas of sources of water replenishment
10. Water bodies	- Areas that are tapped for domestic purposes - Areas which support wildlife and fishery activities
11. Mangrove Areas	- Tidal areas covered by salt-tolerant, intertidal tree species - Areas declared as mangrove swamp forest reserves
12. L. Coral Reefs	- Areas characterized by the assemblage of different types of marine plants and organisms - Areas identified by local sources such as PAWB-DENR to be rich in corals.

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

The FRIMP-CDOR can be considered under the category of infrastructure, as indicated in Table 4.1.2 (ECPs). However, the Project is not included in the sub-category of the table. On Table 4.1.3 for ECAs, this Project is included in Category 6.

4.1.3 Required Document under PEISS

Projects are classified into five major groups depending on the type and location of the project as shown in table below:

Table 4.1.4 Project Groups for EIA under PEISS

Group	Definition
13. I	14. Environmentally Critical Projects (ECPs) in both Environmentally Critical Areas (ECAs) and Non-Environmentally Critical Areas (Non-ECAs)
15. II	16. Non-Environmentally Critical Projects in Environmentally Critical Areas
17. III	18. Non-Environmentally Critical Projects in Non-Environmentally Critical Areas.
19. IV	20. Co-located projects in either Environmentally Critical Areas (ECAs) or Non-Environmentally Critical Areas (Non-ECAs); A group of single projects, under one (1) or more Proponents/Locators, which are located in a contiguous area and managed by one (1) Administrator, who is also the ECC Applicant (e.g., Economic Zones)
21. V	22. Unclassified projects which are not listed in any of the groups above, e.g., projects using new processes/ technologies with uncertain impacts (interim category)

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

There are seven different types of reports required under the PEISS, including:

1) Environmental Impact Statement (EIS),
2) Programmatic EIS (PEIS),
3) Initial Environmental Examination Report (IEER),
4) Initial Environmental Examination Checklist (IEEC),
5) Project Description Report (PDR),
6) Environmental Performance Report and Management Plan (EPRMP), and
7) Programmatic EPRMP (PEPRMP).

For new projects, EIA-covered projects in Group I, II and IV in Table 4.1.4 are required either of EIS, PEIS, IEER or IEEC. For non-covered projects in Group II and III, PDR is the appropriate document to secure a Certificate of Non-Coverage (CNC) from

DENR-EMB.

For operating projects with an existing Environmental Compliance Certificate (ECC) but planning to modify/expand or re-start operations, the requirement is EPRMP for a single project and PEPRMP for co-located project is applied.

According to Memorandum Circular 005 issued by DENR-EMB in Nov. 2011 (listed in Table 4.1.1), an IEEC may be required for Irrigation and Flood Control Projects. The FRIMP-CDOR may require an IEEC for an ECC application, if it will be considered as a new project. However, if it will be considered part of an expansion effort as part of the on-going construction of revetment by DPWH R-10 (refer to section 4.1.2), an EPRMP shall be required for the ECC application.

(4) Public Participation in EIA Process

1) Information, Education and Communication (IEC) and Public Scoping

DENR Administrative Order No. 30 Series of 2003 (DAO 03-30) states that an IEC of Local Government Unit (LGU) is required at the minimum of EIS-based applications as part of the social preparation process at Pre-Scoping. IEC serves as a basis for preliminary identification of stakeholders and related issues in preparation for the Public Scoping. For EIS-based applications, Public Scoping is one of the processes to obtain community inputs prior to the technical scoping of EIA Review Team with the proponent, conducted before signing-off of the Scoping Checklist mentioned, which comprises the final TOR of the EIA Study.

2) Public Hearing/Consultation

For the disclosure of the EIA findings, Public Hearings shall be required for all new ECPs for which Public Scoping was undertaken. A waiver of the Public Hearing requested by the Proponent may be granted by the DENR-EMB if there is no mounting opposition or written request for one with valid basis. In such cases, a Public Consultation might be conducted instead.

4.2 Difference of Requirements between JICA Guidelines and PEISS

4.2.1 Coverage of Environmental and Social Considerations

It is necessary to clarify the consistency and difference between PEISS and JICA Guidelines of Environmental and Social Considerations so that this study shall cover all the necessary components/issues required under both system and guidelines. The table below compares the environmental and social components/issues required to be studied the baseline condition, potential impacts and evaluation as well as mitigation measures, etc.

Table 4.2.1 Comparison of Required Environmental Components between JICA Guidelines and PEISS

No.	Environmental Components	JICA Guidelines*	PEISS**			
			Land	Water	Air/Noise	People
1.	**Pollution**					
1)	Air Pollution	○			○	
2)	Water Pollution	○		○		
3)	Soil Contamination	○	○			
4)	Waste	○	○			
5)	Noise and Vibration	○			○	
6)	Ground Subsidence	○				

7)	Offensive Odor	○				
8)	Sediment Contamination	○		○		
2.	**Natural Environment**					
1)	Topography and Geology	○	○			
2)	Soil Erosion	○	○			
3)	Groundwater	○		○		
4)	Hydrological Situation	○		○		
5)	Coral Reef	○	○			
6)	Mangrove	○	○			
7)	Flora, Fauna and Ecology	○	○			
8)	Aquatic Biota	○	○			
9)	Protected Area	○	○			
10)	Threatened Species	○	○			
11)	Meteorology	○			○	
12)	Global Warming	○				
3.	**Social Environment**					
1)	Involuntary Resettlement	○				○
2)	Poverty Group	○				○
3)	Indigenous Peoples	○				○
4)	Local Economy such as Employment and Livelihood	○				○
5)	Land Use and Utilization of Local Resources	○	○			
6)	Water Use	○		○		
7)	Existing Social Infrastructures and Services (Sensitive Facilities)	○				○
8)	Social Institutions such as Social Infrastructure and Local Decision - making Institutions	○				
9)	Misdistribution of Benefits and Damage	○				
10)	Local Conflicts of Interest	○				
11)	Cultural Heritage, Historical and Religious Sites (Sensitive Facilities)	○				
12)	Landscape	○				
13)	Gender / Socially Vulnerable Groups	○				
14)	Rights of Children	○				
15)	Infectious Diseases such as HIV/AIDS	○				○
16)	Labor Environment (Including Occupational Safety)	○				○
4.	**Others**					
1)	Traffic					○
2)	Accidents	○				○
3)	Transcontinental impacts	○				
4)	Community Health and Safety					○

*Note) * : JICA Guidelines for Environmental and Social Considerations (April, 2010), and Reporting Guideline for the Case of Environmental Category B Projects (June, 2011)*

*** : Components to be examined for general case based on DENR DAO No.03-30 (2007)*

4.2.2 Information Disclosure and Public Participation

JICA Guidelines require the disclosure of information and stakeholder participation on the environmental and social aspects of projects in a timely manner throughout the EIA process during the following occasions:

- Scoping and Examination of Alternatives in M/P and F/S.
- Preparation of draft EIA Report so that the results of stakeholder meeting can be incorporated in the EIA Final Report.

The PEISS also requires information disclosure throughout the EIA, including:

- Initial stages of the EIA process where an IEC and Public Scoping needs to be done.
- Conduct of Public Hearings as a requirement for all new ECPs. Public Consultations may be conducted as requested by its stakeholders.
- A press release two weeks before the conduct of Public Scoping and Public Hearing to inform the public of the scheduled stakeholder meeting.
- Conduct of Public Scoping or Public Hearing is not always required for projects requiring an IEE, but the competent EMB may request the proponent to conduct these meetings as the need arises.

4.2.3 Adjustment of the Difference between PEISS and JICA Guidelines

There are some differences in coverage of environmental and social considerations as well as the timing and manner of information disclosure and public participation in the process of EIA as described above. It is, therefore, necessary to adjust the scope of study and activities in this Survey to meet the requirements of both JICA Guidelines and PEISS.

4.3 Responsibility of Relevant Organizations

4.3.1 DENR-EMB

The Department of Environment and Natural Resources (DENR) is responsible for the conservation, management, and development of the environment and natural resources in the Philippines. As the main government agency tasked to promote sustainable development, its core function is to formulate and implement environmental policies or guidelines for environmental management, as well as pollution prevention and control. The DENR also regulates the exploration, development, extraction and disposition of natural resources in the Philippines, which includes water bodies, forests, lands, minerals and wildlife.

Pollution prevention and control, environmental protection and environmental impact assessments are carried out by DENR through its line bureau, the DENR Environmental Management Bureau (DENR-EMB). The DENR-EMB is mandated to implement national environmental laws, namely, the Environmental Impact Statement (EIS) System (PD 1586), Toxic Substances and Hazardous and Nuclear Waste Control Act of 1990 (RA 6969), Clean Air Act of 1999 (RA 8749), Ecological Solid Waste Management Act of 2000 (RA 9003), Philippine Clean Water Act of 2004 (RA 9275), and the Environmental Awareness and Education Act of 2008 (RA 9512). Technical and regulatory assistance is provided by DENR-EMB, which includes the issuance of environmental permits, clearances and environmental compliance monitoring. Various environmental parameters, including air quality, water quality and noise, are monitored and assessed using environmental standards set by the DENR-EMB. In line with its mandate of implementing the EIS System, the issuance of an ECC for proposed projects that will pose significant risks or impacts on the environment, such as mining, agricultural or infrastructure projects, including flood risk management projects.

The DENR-EMB operates at the central, regional, provincial and community level. It is headed by the DENR-EMB Director at the national level and supported by seven divisions. The secretariats for the National Solid Waste Management Commission and the Pollution Adjudication Board are under the DENR-EMB. Regional DENR-EMB offices have five supporting divisions that allow each region to function independently.

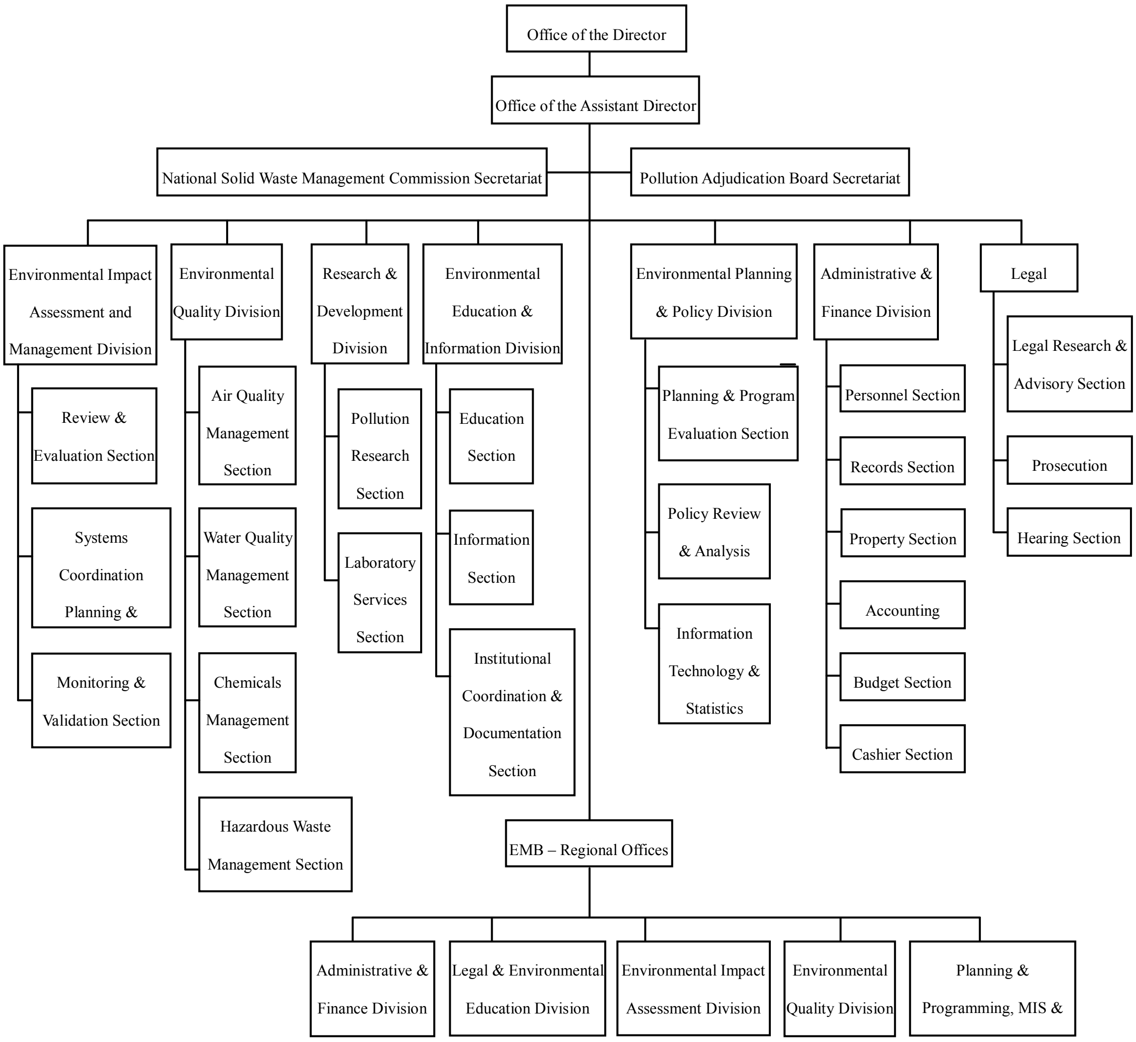


Figure 4.3.1 Organizational Chart of DENR-EMB

4.3.2 DENR Region 10

(1) DENR Region 10

The Department of Environment and Natural Resources Regional Office 10 (DENR 10) is headed by the Regional Executive Director (RED) and has six organic/mandatory administrative divisions and offices (refer to Figure 4.3.2). There are four (4) technical service sectors, each of which is headed by a Technical Regional Director who is under the direct supervision of the RED. The technical service sectors support the regulatory, research, management and conservation mandates of the DENR related to region's forest, aquatic/marine and land resources and wildlife.

There are two agencies attached to the DENR Regional Executive Director; namely, the Region 10 branches of the Environmental Management Bureau (EMB 10) and the Mines and Geosciences Bureau (MGB 10). They are more independent organizations which coordinate and collaborate with the DENR 10 through the Office of the Regional Executive Director.

Provincial level operations are undertaken through the Provincial Environment and Natural Resources offices (PENROs) of Lanao del Norte, Bukidnon, Camiguin, Misamis Oriental and Misamis Occidental. The PENROs are also under the direct supervision also of the DENR 10 Regional Executive Director. Scope of operations, especially relating to coordination with local government units, are further divided among various Community Environment and Natural Resources offices (CENROs) under each PENRO.

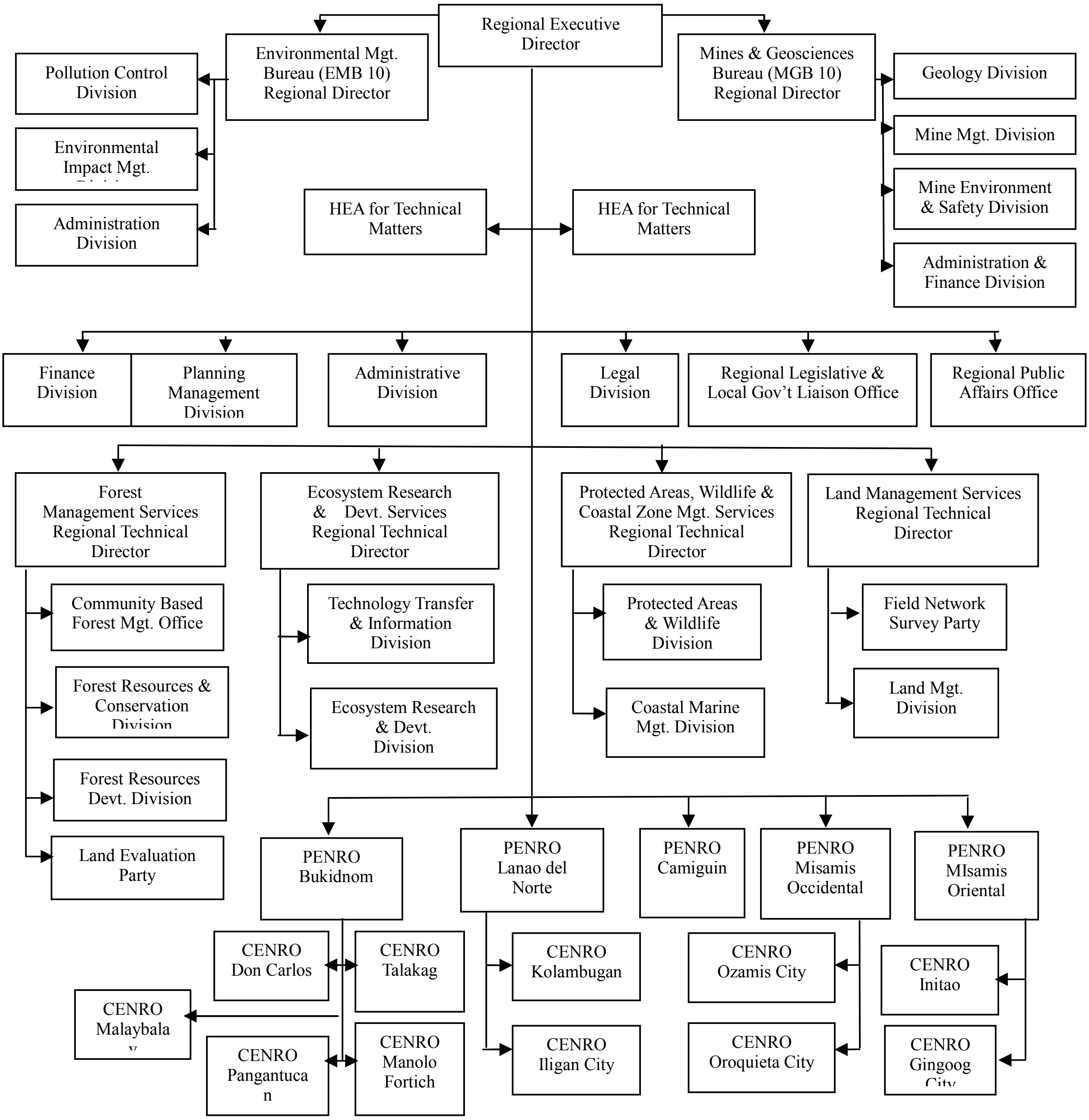


Figure 4.3.2 Organizational Chart of DENR, Region 10

4.3.3 DENR-EMB Region 10

The Environmental Management Bureau Regional Office in Region 10 (DENR-EMB 10) is an attached agency of the DENR 10, headed by the Regional Director, as mentioned above (refer to Figure 4.3.3). In consonance with the EMB's legal mandates, its major role is to promote environmental quality and implement the Philippine EIS System. There are four major divisions for Administration and Finance, Pollution Control, Environmental Impact and Monitoring, and Planning and Programming and Statistics; with support from the legal, laboratory and management information system sections. The DENR Region's Provincial Environment Natural Resources Officers (PENROs) and

Community Environment Natural Resources Officers (CENROs) serve as EMB Focal Persons at provincial level and at key city and municipality level.

The Environment Impact and Monitoring Division is the main office responsible for receiving and processes applications for ECCs for various proposed projects, including FRIMP-CDOR, and enterprises in the locality, especially those categorized as critical or are proposed to be established in areas deemed to be environmentally significant. Furthermore, the office facilitates the creation of mandatory monitoring teams and leads in monitoring environmental compliance and performance made by project proponents, industries, among others.

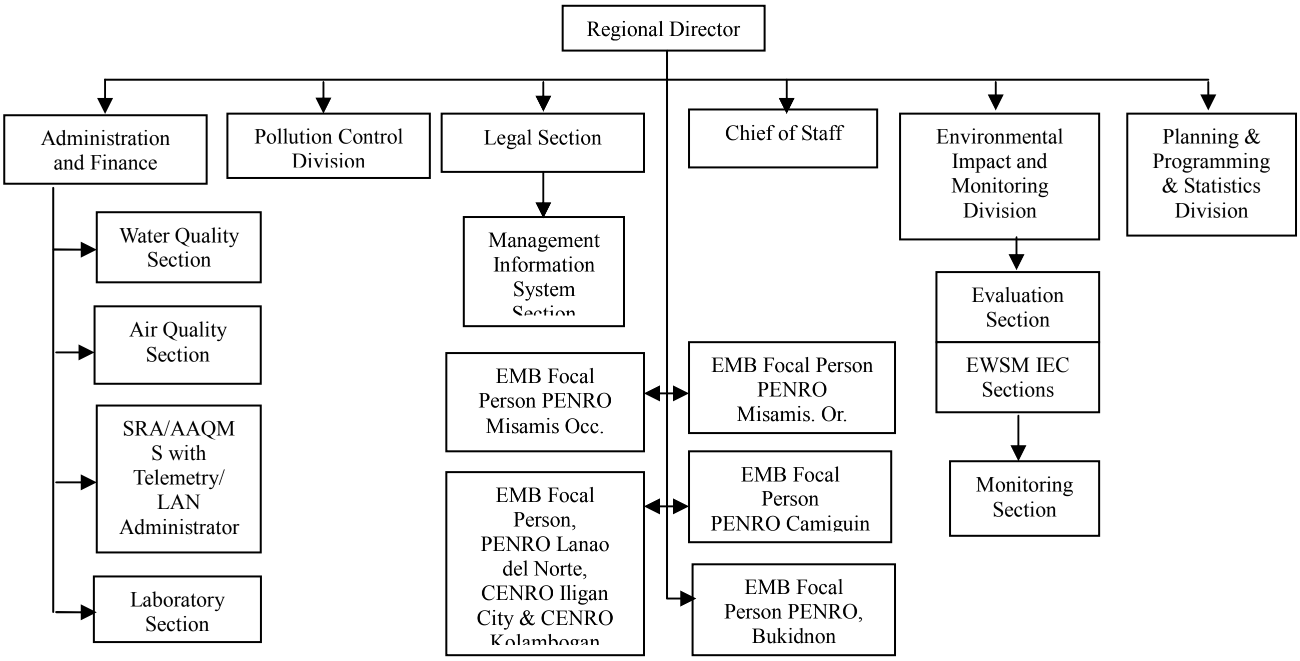


Figure 4.3.3 Organizational Chart of DENR-EMB, Region 10

4.3.4 DPWH-ESSD

Formerly known as the Environmental and Social Service Office of the Department of Public Works and Highways (DWPH-ESSO), the Environmental and Social Safeguard Division (DPWH-ESSD) is under the Planning Service of the DPWH Assistant Secretary. The DWPH-ESSD oversees environmental and social considerations for proposed DPWH projects and has worked with international donors like JICA, ADB and WB, for various development projects. Aside from fulfilling requirements from international aid donors, DPWH-ESSD uses the Philippine EIS as a guide to understand environmental and social conditions at proposed project sites. More specifically, DPHW-ESSD performs the following:

- Assessments for environmental and social impacts, as well as land acquisition.
- Preparation of various documents required by the PEISS for proposed projects, including reports for IEE, EIA, Environmental Management Plans (EMP) and Resettlement Action Plans (RAP).
- Monitoring for environmental parameters, RAP implementation and post-project implementation.
- Guidance for DPWH-PMO regional and district offices for the preparation of the abovementioned PEISS documents, project monitoring and implementation

- Facilitation of consultations and information dissemination to project stakeholders.
- Maintenance and update of Geographical Information System (GIS) and data bank.
- Training at the regional, district and local level for environmental and social consultation, RAP implementation, environmental management planning, monitoring, and other EIA tools.
- Coordination with other DPWH Offices, government agencies, LGUs, NGOs and other stakeholders with regard to environmental concerns on DPWH projects.

The organizational structure of DPWH-ESSD is found under Figure 4.3.4. There are three offices supporting DPHW-ESSD, including the National Sewerage and Septage Management (NSSM) Office, the Environmental Section and Social and Gender Section.

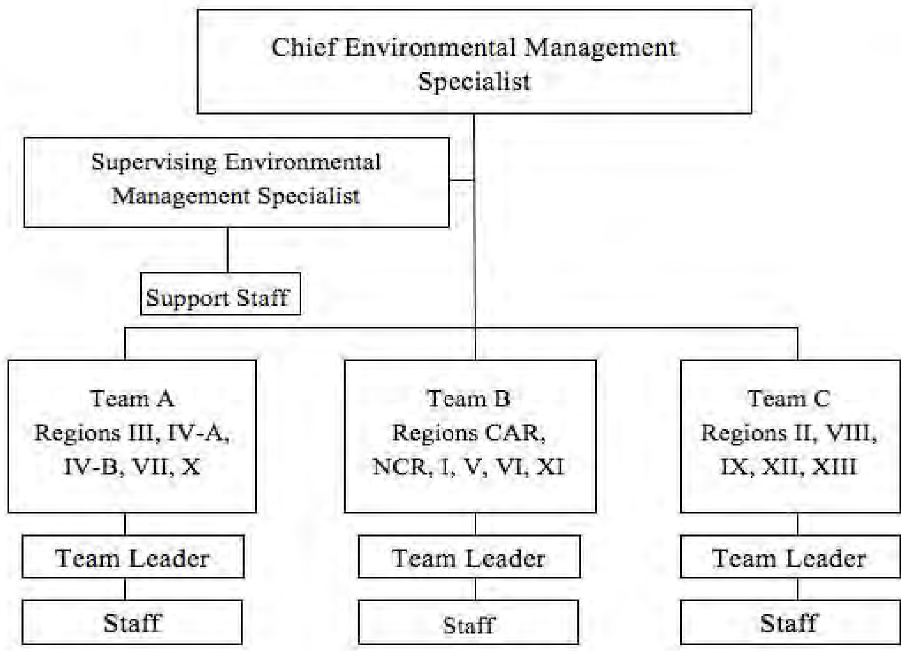


Figure 4.3.4 Organizational Chart of DPWH-ESSD

CHAPTER 5 SCOPING AND TOR OF ENVIRONMENT AND SOCIAL CONSIDERATIONS

5.1 Scoping of EIA Study for FRIMP-CDOR

Considering project components and activities described in Chapter 2, and the current environmental status described in Chapter 3, scoping of EIA Study is summarized in Table 5.1.1. This table of scoping has incorporated the discussion results and recommendations of the first JICA Advisory Committee.

Table 5.1.1 Scoping (Possible Negative Impacts without Mitigations)

Environmental components			Evaluation of impacts without mitigation		Explanation for the evaluation
			Pre-construction, Construction	Operation	
Physical-Chemical Environment (Pollution)	1	Air Pollution	B-	D	[Construction] Air pollution due to dust and emission gas by construction equipment and vehicles as well as earth works will occur. [Operation] No air pollution which is attributed to the project components will occur because the project facilities are not pollution source.
	2	Water Pollution	B-	C-	[Construction] Suspension of sediments and release of sediment pollutants will occur as a result of excavation/dredging, if conducted, in the river. Waste water from contractor base camp and/or office would also cause water pollution in the river. [Operation] There will be no pollution source of water quality, but flood mitigation structures of the Project would affect to existing creek inflowing to the CDO River, which might cause water pollution.
	3	Soil Contamination	C-	D	[Construction] Disposal of dredged materials, if dredging operation is conducted, would cause soil contamination if the riverbed sediment is contaminated. Spilled oil from construction equipment or during piling works would also cause soil contamination by oil. [Operation] There will be no pollution source of soil contamination.
	4	Wastes (including Dredged Material)	B-	C-	[Construction] Wastes from contractor office and base camp, demolished structures, dredged material, if dredging is conducted, etc. would be generated. [Operation] There is a possibility that wastes would increase in the Project site.
	5	Noise and Vibration	B-	D	[Construction] Noise and vibration caused by construction activities and transportation will occur, but the additional noise and vibration would be limited in the vicinity of construction activities. [Operation] There will be no source of noise or vibration from the project facilities.
	6	Ground Subsidence	D	D	No ground subsidence is anticipated during both construction and operation stage because pumping of groundwater, deep excavation work, or tunneling work is not included in the project activities.

	7	Offensive Odor	C-	C-	[Construction] Offensive odor might occasionally occur in case the dredging work is conducted at the sludge area of the river. [Operation] There is a possibility to increase of waste dumping and odor from it.
	8	Riverbed Sediment Contamination	C-	C-	[Construction] In case that excavation and dredging operation is conducted, there is a possibility to dig-out the contaminants from the riverbed sediment, if any, and for them to spread out. [Operation] In case that maintenance dredging is conducted, the same situation would occur.
	9	Accidents	C-	D	[Construction] Construction related accidents by heavy equipment and transportation vehicles might occur. [Operation] Project components will not become a source of accidents.
Natural Environment	1	Topography and Geographical Features	B-	D	[Construction] Construction of dike system would cause the change of topographical features along the CDO River. [Operation] There is no topographical or geological change.
	2	Soil Erosion	B-	D	[Construction] Vegetation clearance would temporarily cause soil erosion over the cleared land. Embankment of earth for construction of dike would cause soil erosion. [Operation] There would be no soil erosion because the vegetation-cleared land will be recovered by greening, and the constructed dike will be protected by masonry or vegetation.
	3	Groundwater	C-	C-	[Construction/ Operation] No pumping of groundwater, deep excavation work, or tunneling work is included in the Project. Sheet pile works, however, is included, which would cause impacts on the groundwater flow in a shallow aquifer.
	4	Hydrological Situation	D	A+	Construction of dike and flood walls, which are the main project components of the Project, will increase the discharge capacity of the CDO River, and thus, which will mitigate the flood risks in the residential areas along the river.
	5	Coral Reef	C-	C-	[Construction] There is coral reef at about 400 m offshore of Barangay Bonbon, which is 1.5 km-distant from the river mouth of CDO River. The growing condition of the coral reef is not healthy but most of them are already dead. There would be some impacts on the coral due to dredging operation, if operated, near the river mouth. [Operation] Possibility of the impact is unknown.
	6	Mangrove Forest	B-	C-	[Construction] There is mangrove forests along the downstream reaches of the CDO River. In order to dike construction, mangrove trees would be partly cleared although the area of clearance is limited. [Operation] There would be a possibility of the impact on the mangrove forests.
	7	Terrestrial Flora, Fauna and Biodiversity	B-	C-	[Construction] Vegetation along the CDO River will be partially cleared for the construction of project facilities or temporary facilities such as contractor base camp or office. The impact on terrestrial fauna would be minor because the vegetation clearance would be limited within the whole vegetated areas along the river. [Operation] Possibility of the impact is unknown.

	8	Aquatic Biota	B-	C-	[Construction] Dredging operation, if operated, and/or river improvement works along the river channel would cause disturbance to habitat of aquatic biota in the vicinity of dredging operation. [Operation] Possibility of the impact is unknown.
	9	Protected Area	D	D	There is no protected area in and around the presumed project area from river mouth of the CDO River until the Pelaez Bridge.
	10	Threatened species	C-	C-	[Construction] Vegetation clearance for construction of project facilities might cause adverse impact on threatened species, if any. [Operation] Possibility of the impact is unknown.
	11	Meteorology	D	D	Not affected or least likely affected by the construction works or project components.
	12	Global Warming	–	D	Not affected or least likely affected by the construction works or project components.
Social Environment:	1	Involuntary Resettlement	A-	C-	[Pre-Construction/Construction] There will be a total of approx. 660 nos. of involuntary resettlement, consisting of approx. 340 (in ROW) and approx. 320 (in River Area). [Operation] It is necessary to monitor the livelihood recovery after resettlement.
	2	Poverty Group	C-	C-	[Pre-Construction/Construction/Operation] Affected persons will include a certain number of low-income families such as informal settlers.
	3	Indigenous Peoples	D	D	No indigenous peoples are observed along the river stretch of the downstream areas of CDO River.
	4	Local Economy such as Employment and Livelihood	C-	C-	[Pre-Construction] Depending on selection of alternative designs, a certain number of small-scale local business establishments could be affected, which is concerned with local employment and livelihood. [Operation] In case maintenance dredging is done in operation stage, fishery and sand mining activities might be affected.
	5	Land Use and Utilization of Local Resources	C-	C-	[Pre-Construction] Persons making living by sand mining in the river could be affected if dredging is included in project components. [Operation] In case maintenance dredging is done in operation stage, fishery and sand mining activities might be affected.
	6	Water Usage	B-	B-	[Pre-Construction]Local residents living along the river could have difficulty getting access to the river for use of water such as washing clothes due to construction of dike system and/or flood walls, etc. Operation] Depending on design of flood control structures, local residents living along the river could have difficulty getting access to the river for use of river water and/or groundwater.
	7	Existing Social Infrastructures and Services (Sensitive Facilities)	B	D	[Construction] Depending on selection of alternative designs, sensitive facilities located along the river such as schools, hospitals, barangay facilities, medium to large scale commercial establishments and so on could be affected by flood control structures.

	8	Social Institutions such as Social Infrastructure and Local Decision - making Institutions	D	D	This Project aims at flood risk mitigation and alleviation, and the resolution to support the Project is raised by Regional Development Council 10: RDC-10 which is the competent agency to approve development projects. Thus, it is expected that this Project is supported by the Local Decision-making Institutions.
	9	Misdistribution of Benefits and Damage	C-	D	[Pre-Construction] Misdistribution of benefits and damage could be observed among the people who need resettlement and those who do not need along the river when land acquisition is required for the project facilities.
	10	Local Conflicts of Interest	C-	D	[Pre-Construction] Local conflict of interests could be observed among the people who need resettlement and those who do not need along the river when land acquisition is required for the project facilities.
	11	Cultural Heritage, Historical and Religious Sites (Sensitive Facilities)	C-	D	[Construction] Depending on selection of alternative designs, sensitive facilities located along the river such as cultural heritage, school, and historical and religious sites could be affected by flood control structures.
	12	Landscape	D	B-	[Operation] Construction of dike system and revetments would cause obstruction to landscape views especially at the vicinity where the dike/revetment is relatively high.
	13	Gender / Socially Vulnerable Groups	C-	C-	[Pre-Construction/ Construction / Operation] Affected persons could include a certain number of socially vulnerable groups, such as the elderly, the handicapped, the poor, single-parent households, child-headed households and so on.
	14	Rights of Children	C-	D	[Pre-Construction] Affected persons could include a certain number of children.
	15	Infectious Diseases such as HIV/AIDS	C-	D	[Construction] Influx of construction workers would have a possibility of infectious disease.
	16	Labor Environment (Including Occupational Safety)	C-	D	[Pre-Construction/ Construction] Labor environment of construction works is considered, since the construction works of the Project is in a certain scale.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Possibility of impact and its magnitude are unknown. (A further examination is needed, and the impact could be clarified as the study progresses.)
D: No impact is expected.

5.2 TOR for EIA Study

Based on the Scoping listed in Table 5.1.1, TOR for the EIA Study pursuant to the JICA Guidelines for Environmental and Social Considerations were examined and prepared targeted for the priority project components described in Chapter 2, Table 5.2.1 shows the details of the TOR, which covers all the environmental components of which the potential negative impacts are evaluated as A-, B- or C- in the scoping (Table 5.1.1). This table of TOR has reflected the discussion results and recommendations of the first JICA Advisory Committee.

Table 5.2.1 TOR for Environmental and Social Considerations Study

No.	Components	Elements to be clarified	Survey method	Impact prediction, Formulation of EMP and EMoP
I.	**Project components**			
1)	Alternatives	a. Proposed options of flood risk management measures, b. Details (location, area and dimensions, etc.) of the measures and activities involved, c. Construction method and the method/manner to demolish the existing households / other structures and area, d. Mobilization of laborer, construction materials, heavy equipment, etc., and transportation routes.	a. Examination of management measures aiming to maximize project benefit and minimize resettlement and land acquisition. b. Examination of construction/ demolishing method to minimize the environmental impacts such as pollution, accidents and traffic jam, etc.	a. These are the basis for SEA and impact prediction and assessment.
II	**Physical, Chemical Environment**			
1)	Air quality	a. Clarification of environmental standards in the Philippines, b. Survey on baseline condition of ambient air quality, c. Survey on road network, physical condition and traffic condition, d. Survey on location of sensitive facilities such as school, hospital, residential area, etc.	a. Data collection on legal basis, b. Collection on secondary data and baseline survey (2 times of survey consisting of dry and rainy seasons) by Sub-contracting, c. Parameters to be analyzed (NO2, SO2 and TSP)	a. Impact prediction focusing on dust and emission gas, b. Formulation of EMP regarding mitigation measures to minimize dust and emission gas during construction stage, c. Formulation of EMoP showing monitoring location, frequency and parameters to be analyzed.
2)	Noise and vibration	a. Clarification of environmental standards in the Philippines b. Survey on baseline condition of ambient noise and vibration, c. Survey on road network, physical condition and traffic condition, d. Survey on location of sensitive facilities such as school, hospital, residential area, etc.	a. Data collection on legal basis, b. Collection on secondary data and baseline survey (1 time each for noise and vibration) by Sub-contracting	a. Impact prediction focusing on noise and vibration levels due to construction works, b. Formulation of EMP regarding mitigation measures to minimize noise and vibration during construction stage, c. Formulation of EMoP showing monitoring location and frequency of monitoring.
3)	Water quality	a. Clarification of environmental standards in the Philippines,	a. Data collection on legal basis, b. Collection on secondary data and	a. Impact prediction focusing on possibility of water pollution in the CDO River during construction stage,

No.	Components	Elements to be clarified	Survey method	Impact prediction, Formulation of EMP and EMoP
		b. Survey on baseline condition of river water quality, c. Survey on potential pollution sources.	baseline survey (2 times of survey consisting of dry and rainy seasons) by Sub-contracting, c. Parameters to be analyzed (Temp. pH, DO, BOD, COD, TSS, TDS, Oil and grease, Nitrate, Phosphate, Total Coliform, Fecal Coliform, 7 parameters of heavy metals (Cupper (Cu), Chromium (Cr), Mercury (Hg), Lead (Pb), Cadmium (Cd), Cyanide (CN) and Arsenic (As)).	and possibility of water pollution during operation stage, b. Formulation of EMP regarding mitigation measures to minimize water pollution during construction stage, c. Formulation of EMoP showing monitoring location, frequency and parameters to be analyzed.
4)	Riverbed sediment quality	a. Clarification of environmental standards for hazardous waste in the Philippines, b. Survey on baseline condition of riverbed sediment quality, c. Survey on potential pollution sources.	a. Data collection on legal basis, b. Collection on secondary data and baseline survey (2 times of survey consisting of dry and rainy seasons) by Sub-contracting, c. Parameters to be analyzed (7 parameters of heavy metals (Cupper (Cu), Chromium (Cr), Mercury (Hg), Lead (Pb), Cadmium (Cd), Cyanide (CN) and Arsenic (As)) d. Collection on secondary data on pollution source, interview survey with competent authority and site survey.	a. Impact prediction focusing on possibility of soil contamination in and around the dumping site of dredged materials, b. Formulation of EMP regarding mitigation measures to minimize soil contamination, if necessary, c. Formulation of EMoP showing monitoring location, frequency and parameters to be analyzed.
5)	Waste	a. Clarification of current system of waste collection and dumping in the CDO City, b. Confirmation on problems in existing system, c. Volume of wastes to be generated due to the project activity, including general waste, demolished structures and dredged materials.	a. Collection on secondary data, interview survey with competent authority and confirmation in site, b. Estimation of the volume of wastes to be generated based on project design and activity plan.	a. Impact prediction by examination of waste disposal method of the project during construction stage with clarifying the disposal site, volume, necessity of ECC of the disposal site, and possibility of impacts during operation stage, etc. b. Formulation of EMP to accomplish adequate waste disposal from the project site during construction stage, c. Formulation of EMoP showing monitoring item (kind of wastes to be generated, disposal method, etc.) and frequency.

No.	Components	Elements to be clarified	Survey method	Impact prediction, Formulation of EMP and EMoP
6)	Traffic condition (Land and River)	a. Road network and traffic situation near the Project site, b. Traffic volume at the transportation route of construction materials, etc. c. Current situation of river transportation.	a. Collection of secondary data, interview survey with competent authority, b. Baseline survey of traffic volume of land and river (one time each) by Sub-contracting.	a. Impact prediction focusing on additional traffic of project related vehicles/vessels, level of road service, possibility of traffic jam, safety in both land and river traffic, etc. b. Formulation of EMP regarding mitigation measures to minimize traffic jam and traffic accident, selection of transportation route, c. Formulation of EMoP showing monitoring location and frequency of monitoring.
7)	Topography, Geology and Soil Erosion	a. Data on elevation, topographic features, geological situation, and soil conditions, b. Location and area of vegetation clearance, removal/ demolition of existing structures, etc.	a. Collection on secondary data, aero-photograph, and confirmation in site when necessary, b. Examination based on construction plan of the project, etc.	a. Impact prediction by examination on topographic modification due to earth work and possibility of soil erosion, etc. b. Formulation of EMP regarding mitigation measures to minimize earth-related disaster and soil erosion. c. Formulation of EMoP showing monitoring location and frequency to analyzed.
8)	Groundwater	a. Groundwater regime (water level, flow direction, etc.) b. Groundwater quality of shallow aquifer	a. Collection on secondary data, confirmation on site when necessary b. Baseline survey of groundwater quality (4 locations in total along the CDO River) by Sub-contracting.	a. Impact prediction focusing on possibility of adverse impacts due to sheet pile works on shallow groundwater, b. Formulation of EMP regarding mitigation measures to minimize earth-related disaster and soil erosion, c. Formulation of EMoP regarding monitoring method, location, frequency, parameters to be analyzed.
9)	Odor	a. Presence of muck and/or accumulation of wastes at the dredging operation	a. Confirmation on site	a. Impact prediction focusing on possibility of odor during dredging operation, odor due to the accumulation of wastes, and possibility of impact during operation stage, b. Formulation of EMP regarding mitigation measures to minimize the impacts due to generation of odor, c. Formulation of EMoP regarding monitoring method, location, frequency of monitoring
III	**Biological Environment**			
1)	Terrestrial Flora	a. Clarification of vegetation along the CDO River, b. Identification of flora (trees, shrubs and	a. Collection of secondary data, analysis of aero-photograph, and confirmation in site,	a. Impact prediction focusing on the area of vegetation clearance and examination of negative impact on terrestrial ecology, and possibility of residual impacts

No.	Components	Elements to be clarified	Survey method	Impact prediction, Formulation of EMP and EMoP
		herbs) and biodiversity, c. Clarification of threatened species listed in Red List of the Philippines and IUCN.	b. Baseline survey (2 times of survey consisting of dry and rainy seasons) by Sub-contracting c. The survey shall cover the area from river mouth to Pelaez Bridge	during operation stage, b. Formulation of EMP regarding mitigation measures to minimize loss of vegetation and recovery of cleared vegetation. c. Formulation of EMoP showing monitoring location, monitoring item and frequency of monitoring.
2)	Mangrove forest	a. Identification of distribution and area of mangrove forest in the Project area, b. Identification of existing species of mangrove trees and biodiversity, c. Evaluation of ecology and value of the existing mangrove forest.	a. Collection of secondary data, analysis of aero-photograph, and confirmation in site, b. Baseline survey (2 times of survey consisting of dry and rainy seasons) by Sub-contracting c. The survey shall cover the west of river mouth and the both right and left bank of the river.	a. Impact prediction focusing on the area of mangrove trees to be cleared due to the project implementation, and examination of negative impact on ecology of the existing mangrove forest, and possibility of residual impacts during operation stage, b. Formulation of EMP regarding mitigation measures to minimize loss of mangrove forest and recovery/ compensation of cleared mangrove forest. c. Formulation of EMoP showing monitoring location, monitoring item and frequency of monitoring.
3)	Terrestrial fauna	a. Identification of existing species of mammals, birds, reptiles and amphibians, b. Evaluation of biodiversity and ecology c. Clarification of threatened species listed in Red List of the Philippines and IUCN.	a. Collection of secondary data, b. Baseline survey (2 times of survey consisting of dry and rainy seasons) by Sub-contracting c. The survey shall cover the area from river mouth to Pelaez Bridge	a. Impact prediction focusing on negative impact on terrestrial fauna of the vegetation clearance, and possibility of residual impacts during operation stage, b. Formulation of EMP regarding mitigation measures to minimize negative impacts on terrestrial fauna, c. Formulation of EMoP showing monitoring location, monitoring item and frequency of monitoring.
4)	Aquatic biota (including coral reef)	a. Identification of existing species (phytoplankton, zoo plankton, macro-benthos (including crustacea) and fish), b. Evaluation of biodiversity and current habitat of CDO River for aquatic biota.	a. Collection of secondary data, b. Baseline survey (coral reef: 1 time of survey, other elements: 2 times of survey consisting of dry and rainy seasons) by Sub-contracting	a. Impact prediction focusing on the disturbance to the habitat of aquatic biota in the CDO River due to dredging operation and other activities to be done in and around the river, and possibility of residual impacts during operation stage, b. Formulation of EMP regarding mitigation measures to minimize the disturbance of the aquatic habitat in the CDO River, c. Formulation of EMoP showing monitoring location, monitoring item and frequency of monitoring.
5)	Threatened species	a. Identification of threatened and/or endangered species among those	a. Examination of threatened and/or endangered species based on inventory	a. Impact prediction focusing on possibility of negative impacts on the threatened and endangered species, if

No.	Components	Elements to be clarified	Survey method	Impact prediction, Formulation of EMP and EMoP
		recorded in the inventory survey.	of terrestrial and aquatic biota comparing with Red Lists of IUCN and the Philippines (DAO 2007-01), etc.	any, including possibility of residual impacts during operation stage, b. Formulation of EMP regarding mitigation measures to avoid / minimize loss of threatened/endangered species, c. Formulation of EMoP showing monitoring location, monitoring item and frequency of monitoring.
IV	**Social Environment**			
1)	Involuntary Resettlement	a. Confirmation of legal basis, institutions, etc. on resettlement, b. Confirmation of scale and extent of land acquisition and resettlement, c. Preparation of resettlement plan (including livelihood recovery measures).	a. Review of guidelines, plans、surveys, institutions and laws related to resettlement, b. Identification of affected houses and buildings on aerial photographs, c. Conduct of resettlement related surveys (socioeconomic, resettlement assistance and replacement cost surveys), d. Conduct of consultation for affected persons on proposed design, survey results, resettlement assistance measures and compensation policy.	a. Impact prediction on effects of living level of resettled persons and its related matters made through resettlement, and the possibility of residual impacts during operation stage, b. Formulation of EMP regarding mitigation measure to minimize negative effects of living level of resettled persons and its related matters made through resettlement, c. Formulation of EMoP showing monitoring items (process, procedures and schedule of resettlement plan implementation, and status of job, income and physical and mental health of resettled persons, for example), parameters and frequency of monitoring.
2)	Poverty Group	a. Confirmation of low-income persons, families or groups among persons to be resettled and its current situations (income, livelihood, sanitary, and problems, etc.)	a. Conduct of socioeconomic survey and resettlement assistant survey to identify poverty groups among persons to be resettled and obtain its current situations, in order to come up with mitigation measures.	a. Impact prediction on effects of living level of poverty groups among persons to be resettled, b. Formulation of EMP regarding mitigation measure to minimize negative effects of living level of poverty group among persons to be resettled, c. Formulation of EMoP showing monitoring items (status of job, status of income, status of physical and mental health and pending issues, for example), parameters and frequency of monitoring.
3)	Local Economy such as Employment and Livelihood	a. Confirmation of local business establishments among persons to be resettled and its related issuers. (as to sand mining and fishery, and other river usage as economic activities, TOR	a. Conduct of socioeconomic survey to identify local business establishments among persons to be resettled and obtain its related issues, in order to come up with mitigation measures.	a. Impact prediction on effects of local business establishments among persons to be resettled and its related issues, b. Formulation of EMP regarding mitigation measure to minimize negative effects of local business

No.	Components	Elements to be clarified	Survey method	Impact prediction, Formulation of EMP and EMoP
		for survey and analysis are described in "5) Land Use and Utilization of River as Local Resources (economic aspect)."		establishments among persons to be resettled and its related issues, c. Formulation of EMoP showing monitoring items (status of business and livelihood of business owners after resettlement, status of local employees, particularly livelihood, for example), parameters and frequency of monitoring.
4)	Water Usage (Ordinary lives aspect)	a. Confirmation on use of water by local residents living along the river such as washing, bathing and other daily activities of living. (as to groundwater usage, TOR for survey and analysis are described in "8) Groundwater, II. Physical and Chemical Element."	a. Hearing survey made to key informants (representatives of local residents and concerned government officers) to confirm current situations on water usage by local residents, with collection of related secondary data if any. (by Sub-contract)	a. Impact prediction on effects of usability and accessibility of river water by local residents for daily living, b. Formulation of EMP regarding mitigation measure to minimize negative effects of usability and accessibility of local residents to river water, c. Formulation of EMoP showing monitoring items (status of use of and of access to water from the river by local residents for daily living such as bathing, washing, drinking, irrigation, for example), parameters and frequency of monitoring.
5)	Land Use and Utilization of River as Local Resources (economic aspect)	a. Confirmation on utilization of the river as local resources, which is related to local economy such as sand mining, inland water fisheries, and irrigation and so on. b.	a. Hearing survey made to key informants (representatives of local residents and concerned government officers) to confirm current situations on resources utilization of the river by local residents, with collection of related secondary data if any. (by Sub-contract)	a. Impact prediction on effects of utilization of river and/or river water by local people for livelihood, b. Formulation of EMP regarding mitigation measure to minimize negative effects of utilization of river renounces and/or river water by local residents for livelihood, c. Formulation of EMoP showing monitoring items (status of utilization of river resources for livelihood activities of local residents such as sand mining and fishing, for example), parameters and frequency of monitoring.
6)	Sensitive Facilities (social infrastructure, historical and cultural heritage, school, hospital,	a. Confirmation on sensitive facilities located along the river, such as schools, hospitals, barangay facilities, cultural, historical and religious facilities, medium to large scale commercial establishments and so on.	a. Collection and analysis of secondary data. (by Sub-contract) b. Hearing survey made to experts and site survey (by Sub-contract)	a. Impact prediction on effects of accessibility and usability of sensitive facilities by local residents, b. Formulation of EMP regarding mitigation measure to minimize negative effects of accessibility and usability of local residents to sensitive facilities, c. Formulation of EMoP showing monitoring items

No.	Components	Elements to be clarified	Survey method	Impact prediction, Formulation of EMP and EMoP
	religious site, etc.)	b. Historical and cultural heritage including San Augustin Metropolitan Cathedral and Huluga cave, and others, if any.		(accessibility and usability of sensitive facilities by local residents if partially affected or relocated by the project), parameters and frequency of monitoring.
7)	Misdistribution of benefits and damage / Local conflicts of interest	a. Survey and identification of such case as there are people who need resettlement and those who do not need in a community due to the Project, b. Survey and identification of such case as there is conflict between the communities that need resettlement and that does not need.	a. Conduct of socioeconomic survey and resettlement assistant survey to identify misdistribution of benefits and damage and local conflicts of interest, b. Interview survey on perspective of local people	a. Impact prediction on possibility and magnitude of misdistribution of benefits and damage, and local conflicts of interest, b. Formulation of EMP regarding mitigation measure to minimize such negative effects, c. Formulation of EMoP showing monitoring area, targeted community, and its magnitude of impact.
8)	Gender / Socially Vulnerable Groups	c. Confirmation of socially vulnerable groups (such as the elderly, the handicapped, the poor, single-parent households, child-headed households and so on) among persons to be resettled and its current situations,	c. Conduct of socioeconomic survey and resettlement assistant survey to identify socially vulnerable groups among persons to be resettled and obtain its current situations, in order to come up with mitigation measures.	a. Impact prediction on effects of living level of resettled socially vulnerable groups and its related matters made through resettlement, and possibility of residual impacts during operation stage, b. Formulation of EMP regarding mitigation measure to minimize negative effects of living level of resettled socially vulnerable groups and its related matters made through resettlement, c. Formulation of EMoP showing monitoring items (status of job, status of income, status of physical and mental health and pending issues, for example, parameters and frequency of monitoring.
9)	Rights of Children	a. Confirmation of children, particularly needy children, among persons to be resettled and its current situations,	a. Conduct of socioeconomic survey and resettlement assistant survey to identify children, particularly needy children, among persons to be resettled and obtain its current situations, in order to come up with mitigation measures.	a. Impact prediction on effects of living level of resettled children and its related matters made through resettlement, and possibility of residual impacts during operation stage, b. Formulation of EMP regarding mitigation measure to minimize negative effects of living level of resettled children and its related matters made through resettlement, c. Formulation of EMoP showing monitoring items (status of job and income of parents, status of education, status of physical and mental health and pending issues, for example, parameters and

No.	Components	Elements to be clarified	Survey method	Impact prediction, Formulation of EMP and EMoP
				frequency of monitoring.
10)	Infectious Diseases such as HIV/AIDS	a. Confirmation of current status of HIV/AIDS situations in and around Cagayan de Oro City.	(ア) Conduct of secondary data collection of situations of HIV/AIDS in and around Cagayan de Oro City from local authorities. (イ) Conduct of interview to local authorities based on the collected secondary data.	a. Impact prediction on effects of infectious disease, particularly HIV/AIDS, through construction workers locally employed, b. Formulation of EMP regarding mitigation measure to minimize negative effects of infectious disease, particularly HIV/AIDS, through construction workers locally employed c. Formulation of EMoP showing monitoring items (status of HIV/AIDS infection of construction workers and its countermeasures), parameters and frequency of monitoring.
11)	Landscape	b. General situation of landscape, and river scape along the CDO river, c. The waterfront amenity areas along the CDO river	(ウ) Collection and analysis of secondary data and site survey	a. Impact prediction on effects of flood mitigation structures on river front landscape and/or waterfront amenity, and its magnitude, b. Formulation of EMP regarding mitigation measure to minimize negative effects on landscape and waterfront amenity through designing of the structures, and the measure to minimize the graffiti on them during operation stage , c. Formulation of EMoP showing monitoring area, items, and frequency of monitoring.
12)	Accidents and Labor Environment	d. General information on accidents and labor environment in the Philippines	(ア) Collection and analysis of secondary data	a. Formulation of EMP regarding mitigation measure to minimize the accidents during construction works

CHAPTER 6 SURVEY RESULTS ON ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

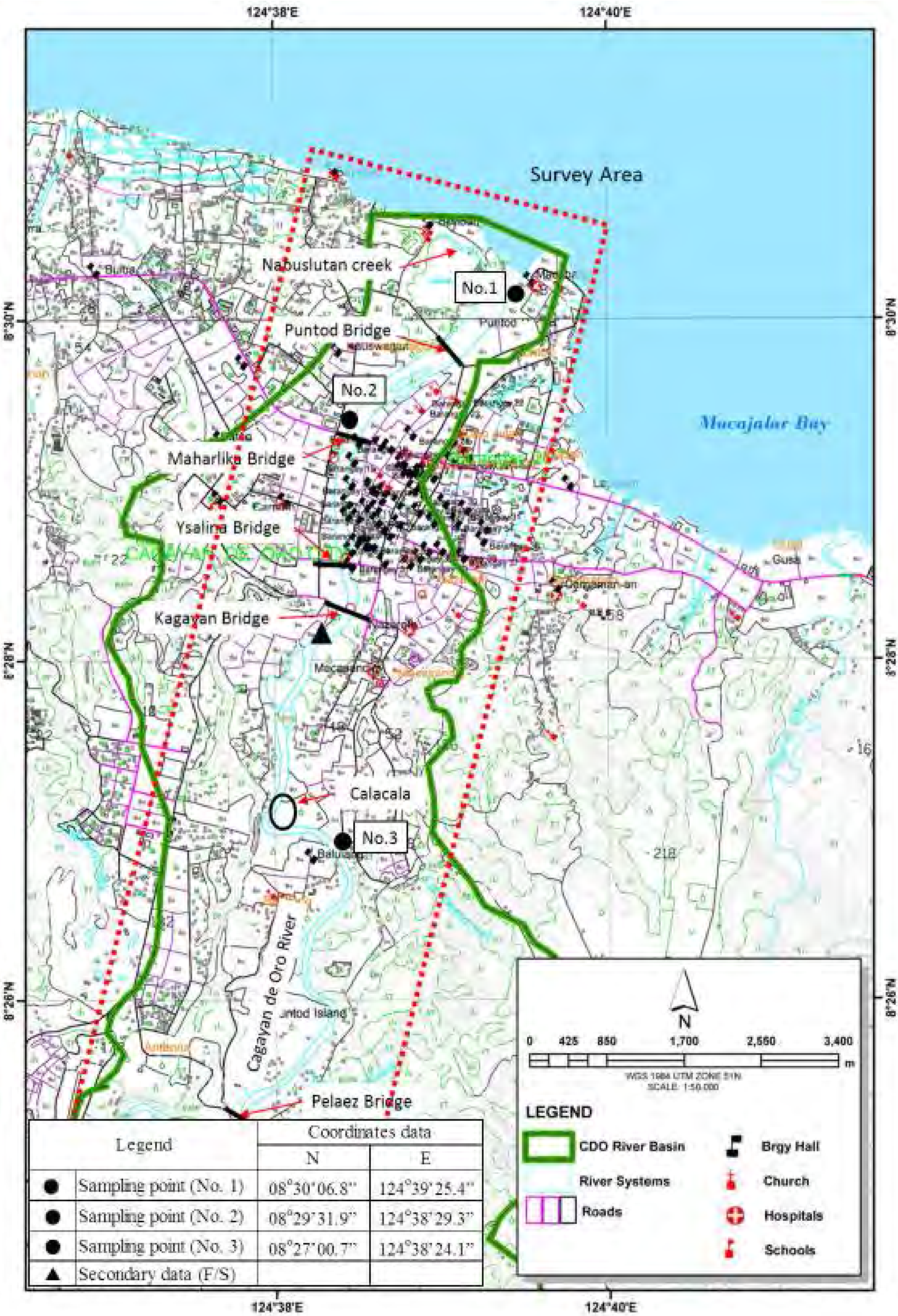
6.1 Physical-Chemical Environment

6.1.1 Air quality

(1) Baseline Environment

1) Survey Method.

The baseline air quality within and around the project site was measured on April 4-8, 2013 at the first set and Aug. 3-6, 2013 at the second set, Three sampling stations for air quality were established at 24-hour duration. The sampling locations for air are as follows: Station 1 in Barangay Puntod, Station 2 in Barangay Kauswagan and Station 3 in Barangay Macasandig (Refer to **Figure 6.1.1**).



Legend		Coordinates data	
		N	E
●	Sampling point (No. 1)	08°30'06.8"	124°39'25.4"
●	Sampling point (No. 2)	08°29'31.9"	124°38'29.3"
●	Sampling point (No. 3)	08°27'00.7"	124°38'24.1"
▲	Secondary data (F/S)		

Figure 6.1.1 Sampling Stations for Air Quality

The air samples were collected using Imoto air check gas sampler for sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) and Staples high volume sampler for Total Suspended Particulates (TSP).

The sample collections were done in conformity with the National Ambient Air Quality Standard (NAAQS) as specified by Department of Environment and Natural Resources (DENR) Administrative Order No. 14. The designated DENR accredited laboratory for the air quality analysis is ELARSI, Incorporated. The methods of analysis for air are presented in **Table 6.1.1**.

Table 6.1.1 Test Methods for the Air Quality Parameters

Parameter	Method of Analysis
SO_2	Pararosaline method
NO_2	Griess Saltzman method
TSP	Gravimetric method

The results obtained were compared using the National Ambient Air Quality Guidelines for Criteria Pollutants as specified by DAO No. 14 series of 1993 as shown in **Table 6.1.2**.

Table 6.1.2 DENR National Ambient Air Quality Guideline for Criteria Pollutants

Pollutant	Short	Term	(a)	Long	Term	(b)
	µg/Ncm	ppm	Ave. Time	µg/Ncm	ppm	Ave. Time
Suspended Particulate Matter (e) -TSP PM -10	230 (f) 150 (g)		24 hours 24 hours	90 60	-- --	1 year (c) 1 year (c)
Sulfur Dioxide ($S0_2$) (e)	180	0.07	24 hours	80	0.03	1 year
Nitrogen Dioxide ($N0_2$)	150	0.08	24 hours	--	--	--
Photochemical Oxidants As Ozone	140 60	0.07 0.03	1 hour 8 hours	-- --	-- --	-- --
Carbon Monoxide	35 mg/Ncm 10 mg/Ncm	30 9	1 hour 8 hours	-- --	-- --	-- --
Lead (d)	1.5	--	3 mo. (d)	1.0	--	1 year

Notes:
(a) Maximum limits represented by (98%) values not to be exceeded more than once a year.
(b) Arithmetic Mean
(c) Annual Geometric Mean
(d) Evaluation of this guideline is carried out for 24- hours averaging time and averaged over three moving calendar months.
(e) $S0_2$ and Suspended Particulates are sampled once every 6-days when using the manual method
(f) With mass median diameter less than 25-50 µm.
(g) With mass median less than 10 µm.

2) Survey Results

A) Air Quality in Dry Season

The obtained result for the air quality in dry season is presented in **Table 6.1.3** while the Certificate of Analysis issued by the laboratory is attached as **Annex**.

Table 6.1.3 Survey Results of Baseline Air Quality, Dry Season

Location	Parameters		
	***SO$_2$ (μg/Ncm)**	***NO$_2$ (μg/Ncm)**	***TSP (μg/Ncm)**
Station 1 – Puntod	1.230	1.599	392.08
Station 2 – Kausawagan	1.353	1.846	351.20
Station 3 – Tibasak, Macasandig	1.967	0.623	275.81
DENR NAAQS**	**180**	**150**	**230**

*Note): * Results of 24-hour continuous monitoring*
*** Standards used are representative of the short-term 24-hours average time in μg/Ncm*
Source : JICA Survey Team

Results of the air quality survey indicate that the concentration levels of SO_2 and NO_2 along all sampling stations are very low and well within acceptable limits of the DENR standards. But these data shows too little values and suggests some errors in sampling or laboratory analysis.

On the other hand, all the observed ambient ground level concentration for TSP exceeded the minimum standard of 230 μg/Ncm. This may be attributed to the re-suspension of fine particulate matter which is a common scenario due to the highly urbanized conditions. The present air quality condition is highly influenced by the activities surrounding the monitoring stations.

B) Air Quality in Rainy Season

The obtained result for the air quality in rainy season is presented in **Table 6.1.4** while the Certificate of Analysis issued by the laboratory is attached as **Annex**.

Table 6.1.4 Survey Results of Baseline Air Quality, Wet Season

Location	Parameters		
	***SO$_2$ (μg/Ncm)**	***NO$_2$ (μg/Ncm)**	***TSP (μg/Ncm)**
Station 1 – Puntod	40	31	75
Station 2 – Kausawagan	46	39	111
Station 3 – Tibasak, Macasandig	29	20	49
DENR NAAQS**	**180**	**150**	**230**

*Note): * Results of 24-hour continuous monitoring*
*** Standards used are representative of the short-term 24-hours average time in μg/Ncm*
Source : JICA Survey Team

Results of the air quality survey indicate that the concentration levels of the three parameters are within acceptable limits of the DENR standards. The concentration for TSP, which exceeded the minimum standard of 230 μg/Ncm in dry season, was also consistent with the standards. This may be attributed to the little re-suspension of fine particulate matter during the rainy season.

Summarizing the two survey results in dry season and rainy season, it is suggested that the ambient air quality in the project site and its environment is generally good in terms of gaseous pollutant and moderately high for total suspended particulate. This high amount of TSP in turn may pose risks to human health and to the operation of certain mechanical equipment.

(2) Potential Impacts

The potential impacts on the air quality due to the implementation of the Project are as follows:

- Air pollution to be caused by dust (TSP) during the construction works,
- Air pollution to be caused by emission gas from the construction equipment.

These impacts are inevitable as long as the construction works are implemented. The impacts are described in more detail as follows:

1) Air pollution to be caused by dust (TSP) during the construction works

Due to the construction work of structural measures such as dikes and flood walls, earth works for embankment, excavation and leveling, etc. will be conducted.

The area for construction of dike and floodwalls within the Right-of-Way (ROW) is calculated as 31.6 ha. All the structures and vegetation in the area will basically be cleared before the construction works. In addition, all the area within the river area, amounting up to 43.1 ha, will also be cleared before the construction works. Thus, the total area of 74.7 ha will be cleared where the dust (TSP) may be raised in the dry season during the construction phase.

2) Air pollution to be caused by emission gas from the construction equipment and vehicles

During the construction, heavy equipment including the mainly operated ones as well as dump truck as listed below will be used for construction works and transportation of construction materials, and spoil materials.

- Backhoe
- Bulldozer
- Crawler Crane
- Motorized Road Grader
- Vibratory Roller
- Payloader
- Pile Vibratory Hammer
- Drop Hammer
- Tandem Steel Roller
- Transit Mixer
- Dump Truck
- Backhoe Barge
- Pump Dredger
- Deck Barge
- Tag Boat

Construction works will be mainly carried out along the river boundary, it is therefore, predicted that the area along the river area will be relatively large magnitude of impacts with more frequently on air quality. However, the impacts will not occur simultaneously at every construction site but intermittently along with the progress of the construction works.

(3) Mitigation measures

As for the mitigating these potential impacts during the construction works, the Construction Contractor is to cope with the adequate mitigation measures and proper implementation and can be manageable during the construction stage, including the following:

- Excavation materials must be properly stockpiled and properly disposed of immediately from the construction site when not needed,

- Provision of covers to stockpiles that will be left idle for a long time,
- Dust generation will be mitigated with watering at dusty place during dry season and covering the load of trucks by tarpaulin,
- Periodical and timely cleaning of the spilled materials on road or other public space along the transportation route of construction materials and spoil materials,
- The emission gas can be mitigated with the regular maintenance of heavy equipment,
- Consideration of operation manner of the equipment due to the regular education to the operators.

6.1.2 Noise and vibration

(1) Baseline Environment

1) Noise

A) Survey Method

Three stations for the survey of noise levels were set: 1) the location on the right bank near the river mouth in Barangay Puntod, 2) the location on the right bank in Barangay Macasandig, and 3) the location on the left bank in Barangay Balulang **(Figure 6.1.2).**

The survey was conducted on April 4-8, 2013. The noise level was measured for 24 hours by digital sound level meter. The results for noise level measurement were compared to the Environmental Quality Standards for Noise in General Areas specified in Presidential Decree (PD) 984 as presented in **Table 6.1.5.**

Table 6.1.5 DENR Standards for Noise in General Areas (PD No. 984)

Unit: dBA

Time Period	Class				
	AA	A	B	C	D
0500H (05 AM) to 0900H (09 AM) : morning	50	60	65	70	75
0900H (09 AM) to 1800H (06 PM) : daytime	45	50	60	65	70
1800H (06 PM) to 1000H (10 PM) : evening	40	45	55	60	60
1000H (10 PM) to 0500H (05 AM) : night time	45	50	60	65	70

Notes:

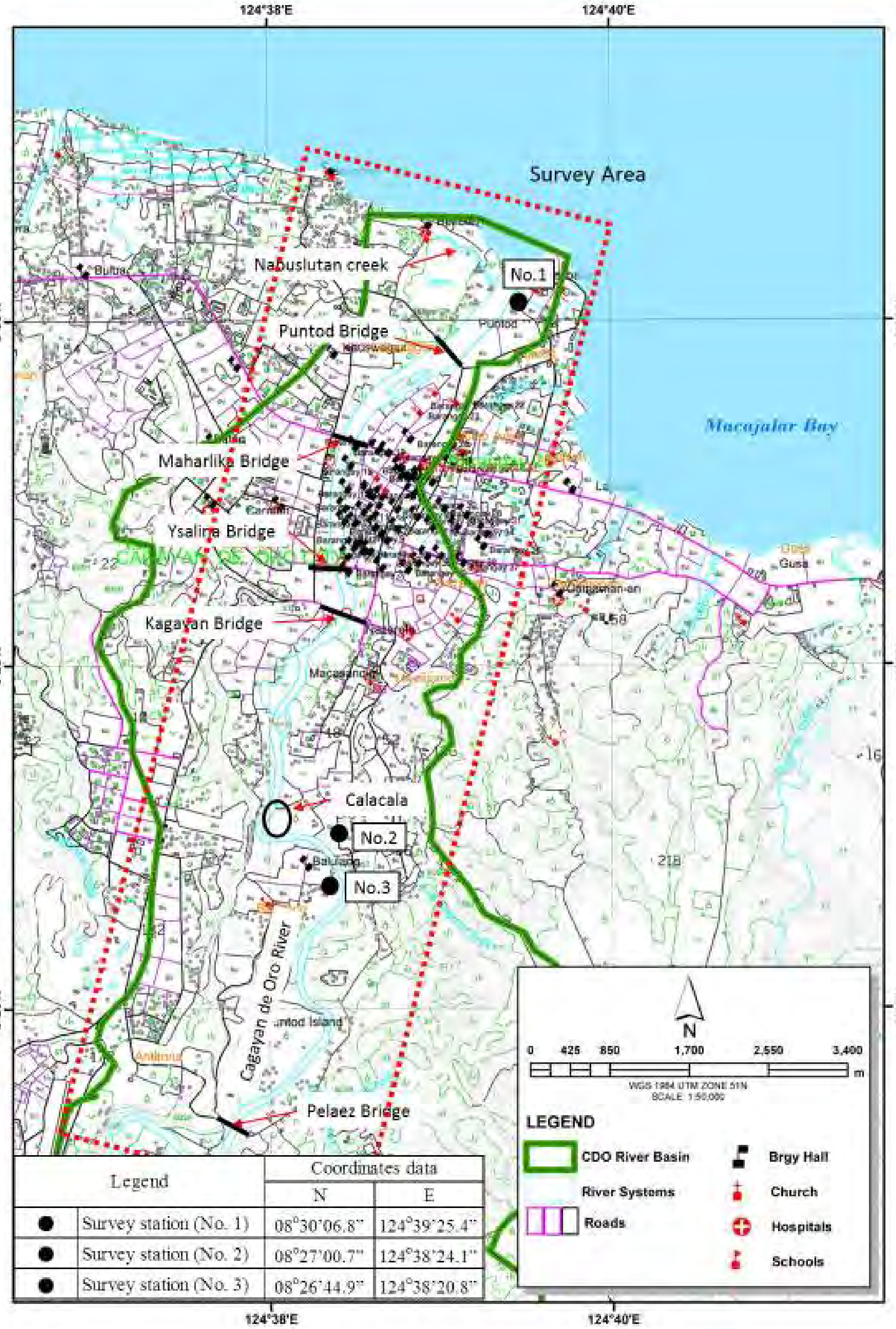
Class AA: a section of contiguous area which requires quietness, such as areas within 100 meters from school sites, nursery schools, hospitals and special homes for the aged

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

Class B: a section or contiguous area which is primarily a commercial area

Class C: a section primarily zoned or used as light industrial area

Class D: a section which is primarily reserved, zoned or used as a heavy industrial area



Legend		Coordinates data N	Coordinates data E
●	Survey station (No. 1)	08°30'06.8"	124°39'25.4"
●	Survey station (No. 2)	08°27'00.7"	124°38'24.1"
●	Survey station (No. 3)	08°26'44.9"	124°38'20.8"

Figure 6.1.2 Survey Stations of Baseline Noise Level

B) Survey Results

The results of noise level measurement are presented in **Table 6.1.6.** The noise levels around the proposed project sites are typical for an urban area and also in the area near a road network.

Table 6.1.6 Survey Results of Baseline Noise Level

Station		24-Hour Period [a]	Unit	Environmental Standard* (Class A**)	Baseline Condition
No.	Name				
1	Brgy. Puntod	Daytime	dBA	60	54.3
		Evening	dBA	50	55.9
		Nighttime	dBA	45	49.4
		Morning	dBA	50	52.0
		AVERAGE			52.9
2	Brgy. Macasandig	Daytime	dBA	60	62.1
		Evening	dBA	50	61.8
		Nighttime	dBA	45	47.5
		Morning	dBA	50	56.4
		AVERAGE			57.0
3	Brgy. Bulalang	Daytime	dBA	60	55.3
		Evening	dBA	50	55.4
		Nighttime	dBA	45	51.3
		Morning	dBA	50	54.0
		AVERAGE			54.0

*Notes: * Presidential Decree (PD) No. 984*
*** Class A: a section or contiguous area which is primary used for residential purposes.*
[a] The division of the 24-hour period shall be as follows:

Morning… 5:00 A.M. to 9:00 A.M.
Daytime…. 9:00 A.M. to 6:00 P.M.
Evening…..6:00 P.M. to 10:00 P.M.
Night time..10:00 P.M. to 5:00 A.M.

Source : JICA Survey Team

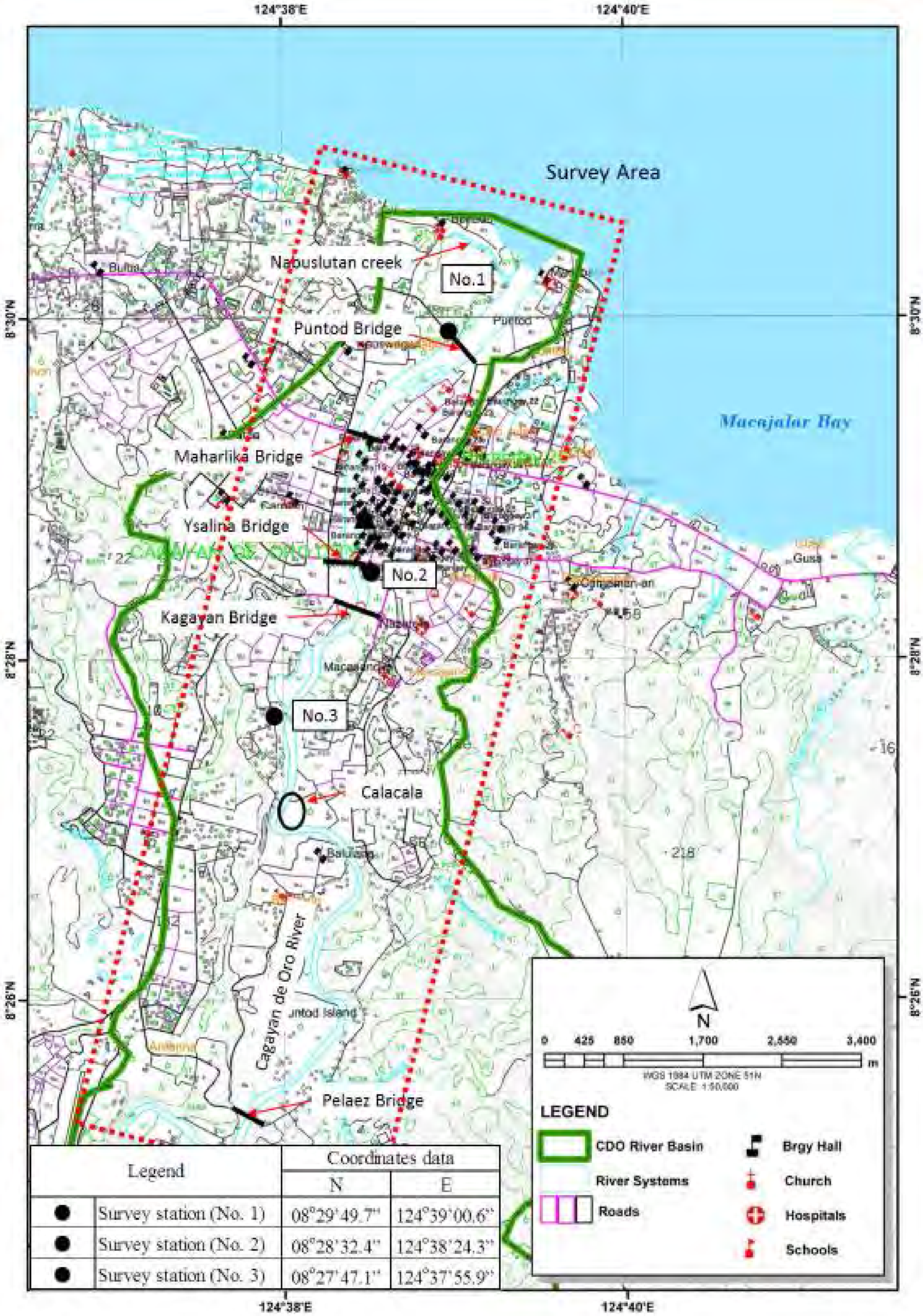
The records of noise level exhibit values higher than the DENR Standards for Noise in General Areas especially on Station 2 wherein all values of all time periods exceeded the DENR standards. For Station 1 and 3, the average noise levels exceeded the maximum allowable noise level for residential areas except for daytime.

The results of noise level measurements imply to reflect the impacts of the urban activities in the surrounding environment. The observed activities close to the monitoring stations include the passage of motorized boats on Cagayan de Oro River, domestic sound such as use of household appliances, use of generator set, and regular movement of vehicles.

2) Vibration

A) Survey Method

Three stations for vibration survey were set: 1) the location near the Puntod Kauswagan bridge on the left bank of the CDO River, 2) the location neat the St. Augustin Cathedral and 3) the location along local road along Barangay Balulang **(Figure 6.1.3).**



Legend		Coordinates data	
		N	E
●	Survey station (No. 1)	08°29'49.7"	124°39'00.6"
●	Survey station (No. 2)	08°28'32.4"	124°38'24.3"
●	Survey station (No. 3)	08°27'47.1"	124°37'55.9"

Figure 6.1.3 Survey Station of Baseline Vibration Level

The vibration survey was conducted on August 29 - 30, 2013. To obtain a representative vibration level for each station, three trials were conducted for each time regime specifically for morning, daytime and evening. These time regimes are same as those designated in the DENR Standards for Noise in General Areas.

As for the vibration, there is no environmental standard provided in the Philippines. Therefore, the survey results of vibration level at each station was evaluated based on the Vibration Regulation Law of Japan (1976), wherein the standard threshold level in the residential area is 65 dB from the industrial activities and 75 dB from the construction works.

B) Survey Results

The survey results of vibration are presented in **Table 6.1.7.**

Table 6.1.7 Survey Results of Vibration Level

Time Regime	Vibration Level (dB)		
	Station 1	Station 2	Station 3
Morning	43	<40	72
Daytime	72	43	55
Evening	57	53	53
Standard*	65 / 75		

Note) * Threshold level at the boundary of the periphery given by the Vibration Regulation Law of Japan (1976)), 65 dB: Vibration from industrial activity, 75 dB: Vibration from construction works,

Source: JICA Survey Team

Survey results indicate that the vibration levels were less than 60 dB except for two cases: the first one is 72 dB at Station 1 in daytime and the second one is 72 dB at Station 3 in morning time. According to the observation at site during the survey, the first one at Station 1 was caused by the traffic at the nearby road, and the second one at Station was estimated to be caused by the passage of a lot of domesticated animals during the survey period.

The survey results suggests that the ambient vibration level is such that being not perceived level by people under the natural conditions expect for the case there is specified vibration source such as traffic or special activities.

(2) Potential Impacts

Potential impacts of the implementation of the Project is the generation of noise and vibration associated with the construction works of structures (dike and floodwall) and dredging work if it is included as maintenance operation, which will cause nuisance to the local people living near the construction works sites. The noise and vibration to be generated by the construction works are predicted as follows:

1) Noise

A) Method of noise level prediction

Prediction of noise level was done based on the power level data of heavy equipment and vehicles to be used for the construction works of the Project. The noise level prediction was firstly done for those from a single source (individual equipment) and then done for noise level from the plural operation of the equipment taking into consideration of the type of civil works in the Project.

Noise level from the equipment was calculated using the mathematical model, theoretical propagation equation from point noise source:

$$\mathbf{Ln = PWL - 20 \log_{10} X - 8 - \alpha_d}$$

Where Ln: Noise level at the distance of X meter (dBA)

PWL: Power Level of the noise source (dBA)

X: Distance between noise source and receiver (m), and

$-\alpha_d$: Noise level decrease due to diffraction (dBA)

In this regard, α_d was not considered because of safety side prediction.

During civil works, there will be the case in which plural equipment will be operating depending on the type of civil works. The compound noise level in such case was calculated using the following equation:

$$\mathbf{L=10 \log_{10} (10^{L1/10} + 10^{L2/10} + 10^{L3/10} + \ldots + 10^{Ln/10})}$$

Where L: Compound noise level (dBA),

n: The number of noise sources,

Ln: Noise level from individual noise source.

B) List of heavy equipment by type of civil work

Table below shows the list of heavy equipment and vehicles to be used for the construction works by civil work in the Project, which is to be the target of noise level prediction. It is assumed based on the construction plan (refer to Chap. 2).

Table 6.1.8 Major Construction Equipment to be Used in the Project

No.	Work Item	Equipment
1	Excavation	- Dump Truck (10 m^3) - Backhoe (0.8 m^3)
2	Embankment & Road Work	- Motorized Road Grader - Vibratory Roller (10 MT) - (Dump Truck (10 m^3))*
3	Dredging (Pump)	- Bulldozer (140 HT) - Backhoe (1.1 m^3) - Vibratory Roller (12 MT) - Pump Dredger (16" dia.) - Anchor Boat, - House Boat - Motorized Road Grader
4	Dredging (Backhoe)	- Backhoe Barge (3.6 m^3.) - Backhoe (3.3 m^3) - Deck Barge (600 MT) - Tugboat
5	Concrete Sheet Pile(Driving)	- Crawler Crane (40 MT) - Pile Vibratory Hammer

6	Concrete Square Pile (Driving)	- Crawler Crane (40 MT) - Pile Drop Hammer

Source: JICA Survey Team

C) Results of noise level prediction

a) Noise level from the general construction works

Table below shows the predicted noise level from the individual equipment and vehicles to be used for construction works.

Table 6.1.9 Prediction results of noise level from individual equipment and vehicles

Unit: dBA

No.	Construction equipment / vehicles	Power level* (dBA)	Distance (m)									
			5	10	15	20	30	40	50	60	80	100
1	Backhoe (0.8 m3)	104	82.0	76.0	72.5	70.0	66.5	64.0	62.0	60.4	57.9	56.0
2	Backhoe (1.1 m3)	106	84.0	78.0	74.5	72.0	68.5	66.0	64.0	62.4	59.9	58.0
3	Backhoe (3.3 m3)	112	90.0	84.0	80.5	78.0	74.5	72.0	70.0	68.4	65.9	64.0
4	Bulldozer (140HP)	111	89.0	83.0	79.5	77.0	73.5	71.0	69.0	67.4	64.9	63.0
5	Bulldozer (155 HP)	113	91.0	85.0	81.5	79.0	75.5	73.0	71.0	69.4	66.9	65.0
6	Crawler Crane (40 MT)	110	88.0	82.0	78.5	76.0	72.5	70.0	68.0	66.4	63.9	62.0
7	Motorized Road Grader	117	95.0	89.0	85.5	83.0	79.5	77.0	75.0	73.4	70.9	69.0
8	Vibratory Roller (10 MT)	101	79.0	73.0	69.5	67.0	63.5	61.0	59.0	57.4	54.9	53.0
9	Vibratory Roller (12MT)	104	82.0	76.0	72.5	70.0	66.5	64.0	62.0	60.4	57.9	56.0
10	Payloader (1.5 m3)	109	87.0	81.0	77.5	75.0	71.5	69.0	67.0	65.4	62.9	61.0
11	Pile Vibratory Hammer	115	93.0	87.0	83.5	81.0	77.5	75.0	73.0	71.4	68.9	67.0
12	Drop Hammer	125	103.0	97.0	93.5	91.0	87.5	85.0	83.0	81.4	78.9	77.0
13	Pile Drop Hammer	125	103.0	97.0	93.5	91.0	87.5	85.0	83.0	81.4	78.9	77.0
14	Tandem Steel Roller (10 MT)	104	82.0	76.0	72.5	70.0	66.5	64.0	62.0	60.4	57.9	56.0
15	Transit Mixer (5 m3)	107	85.0	79.0	75.5	73.0	69.5	67.0	65.0	63.4	60.9	59.0
16	Dump Truck (10 MT)	102	80.0	74.0	70.5	68.0	64.5	62.0	60.0	58.4	55.9	54.0
17	Backhoe Barge (3.6 m3)	120	98.0	92.0	88.5	86.0	82.5	80.0	78.0	76.4	73.9	72.0
18	Pump Dredger (16" dia.)	119	97.0	91.0	87.5	85.0	81.5	79.0	77.0	75.4	72.9	71.0
19	Tug Boat	111	89.0	83.0	79.5	77.0	73.5	71.0	69.0	67.4	64.9	63.0

Note) *: Data Source: Handbook of mitigation measures for noise and vibration from construction works, 3rd edition, 2001.

Source: JICA Survey Team

Among those listed in the Table 6.1.8, there will are three types of civil works in which plural operation of heavy equipment and vehicles are to be operating in the Project, including 1) dredging (by pumping), concrete sheet pile (driving) and concrete square pile (driving). As for other civil works, such as excavation, embankment & toad work, and dredging (by using backhoe), the period when plural equipment/vehicles are being operated will be none or limited. Thus, the noise level from plural operation of equipment was predicted for these three cases above. The prediction results are shown in Table 6.1.10.

Table 6.1.10 Prediction results of compound noise level from construction works

Unit: dBA

Type of work	Equipment	Power level* (dBA)	Compound power level (dBA)	Distance (m)									
				5	10	15	20	30	40	50	60	80	100
Dredging (Pump)	Bulldozer (140 HT)	111	112.2	90.2	84.2	80.7	78.2	74.7	72.2	70.2	68.6	66.1	64.2
	Backhoe (1.1 m3)	106											
Concrete Sheet Pile(Driving)	Crawler Crane (40 MT)	110	116.2	94.2	88.2	84.7	82.2	78.7	76.2	74.2	72.6	70.1	68.2
	Pile Vibratory Hammer	115											
Concrete Square Pile (Driving)	Crawler Crane (40 MT)	110	125.1	103.2	97.1	93.6	91.1	87.6	85.1	83.2	81.6	79.1	77.1
	Pile Drop Hammer	125											

Note) *: Data Source: Handbook of mitigation measures for noise and vibration from construction works, 3rd edition, 2001
Source: JICA Survey Team

In case of several types of construction works, the noise from the heavy equipment will be significant, including the following:

- Motorized road grader for leveling work of dredged materials in the temporary disposal area (staging area),
- Pile drop hummer for piling work of concrete square pile.
- Backhoe barge and pump dredger for dredging works by pumping.

Since the noise from a point source can be exponentially decremented as the distance increases from the source. If the distance between the operating heavy equipment and the impact recipient is more than 30 m, the impacts can be tolerable in general. But the distance is less than 10 m, the noise pollution would become intolerable as the period of exposure continues.

Consequently, it is predicted that the noise pollution from the heavy equipment during the construction works may cause significant nuisance in the vicinity of the construction works above when the same construction works continues.

b) Noise level from the foundation improvement construction works

Since the soil conditions along the right bank side of the CDO River near the Maharlika Bridge and Isla de Oro are not solid, the foundation improvement work will be done. The method to be adopted for the improvement work is “sand compaction pile method.” This work will cause significant noise pollution to the environment. According to the past data on noise generation, it is estimated that the noise level is approx. 85 dBA at the distance of 30 m from the heavy equipment (sand compaction pile machine) unless any mitigation measures are not adopted.

Consequently, it is predicted that the noise pollution from the sand compaction piling machine will cause significant nuisance in the vicinity of the work site when it continues without any mitigation measure.

2) Vibration

A) Method of vibration level prediction

Same as the noise level, prediction of vibration level was done based on the vibration level data of heavy equipment and vehicles to be used for the construction works of the Project. The vibration level prediction was firstly done for vibration level from a single source (individual equipment) and then done for vibration level from the plural operation of the equipment taking consideration of the types of civil works in the Project.

Vibration level from the equipment was calculated using mathematical model, theoretical propagation equation from point vibration source:

$$\mathbf{L_x = L_o - 8.7\,\lambda\,(r - r_o) - 20\log_{10}(r/r_o)^n}$$

Where L_x: Vibration at the distance of r meter (dB)

L_o: Vibration level at the distance of r_o meter (dB),

λ: Internal vibration constant of the ground (m), λ = 0.037 (for unconsolidated ground), and 0.003 (for consolidated ground),

n: A constant depending on vibration wave (in case of wave, n= 0.5)

In case of this Project, the prediction site is unconsolidated ground, and therefore, 0.037 was applied for internal vibration constant of the ground (λ).

During civil works, there will be the case in which plural equipment will be operating depending on the type of civil works. The compound of vibration level from plural vibration sources was calculated using the following equation:

$$\mathbf{L=10\log_{10}(10^{L1/10} + 10^{L2/10} + 10^{L3/10} + \ldots + 10^{Ln/10})}$$

Where L: Compound vibration level (dB),

n: The number of vibration source,

Ln: Vibration level from each vibration source (dB).

B) List of heavy equipment by type of civil work

Same as the case of noise level, prediction of vibration level was done for heavy equipment and vehicles listed in Table 6.1.9.

C) Results of vibration level prediction

Table below shows the predicted vibration level from the individual equipment and vehicles to be used for construction works.

Table 6.1.11 Prediction results of vibration level from individual equipment and vehicles

Unit: dB

No.	Construction equipment / vehicles	Vibration level (dB)	Reference point (m)	Distance (m)									
				5	10	15	20	30	40	50	60	80	100
1	Backhoe (0.8 m3)	70	5	70.0	65.4	62.0	59.2	54.2	49.7	45.5	41.5	33.8	26.4
2	Backhoe (1.1 m3)	72	5	72.0	67.4	64.0	61.2	56.2	51.7	47.5	43.5	35.8	28.4
3	Backhoe (3.3 m3)	78	5	78.0	73.4	70.0	67.2	62.2	57.7	53.5	49.5	41.8	34.4
4	Bulldozer (140HP)	65	5	65.0	60.4	57.0	54.2	49.2	44.7	40.5	36.5	28.8	21.4
5	Bulldozer (155 HP)	67	5	67.0	62.4	59.0	56.2	51.2	46.7	42.5	38.5	30.8	23.4
6	Crawler Crane (40 MT)	45	7	47.1	42.5	39.1	36.3	31.3	26.8	22.6	18.6	10.9	3.5
7	Motorized Road Grader	60	5	60.0	55.4	52.0	49.2	44.2	39.7	35.5	31.5	23.8	16.4

8	Vibratory Roller (10 MT)	85	7	87.1	82.5	79.1	76.3	71.3	66.8	62.6	58.6	50.9	43.5
9	Vibratory Roller (12MT)	90	7	92.1	87.5	84.1	81.3	76.3	71.8	67.6	63.6	55.9	48.5
10	Payloader (1.5 m3)	56	7	58.1	53.5	50.1	47.3	42.3	37.8	33.6	29.6	21.9	14.5
11	Pile Vibratory Hammer	85	7	87.1	82.5	79.1	76.3	71.3	66.8	62.6	58.6	50.9	43.5
12	Drop Hammer	85	7	87.1	82.5	79.1	76.3	71.3	66.8	62.6	58.6	50.9	43.5
13	Pile Drop Hammer	85	7	87.1	82.5	79.1	76.3	71.3	66.8	62.6	58.6	50.9	43.5
14	Tandem Steel Roller (10 MT)	70	7	72.1	67.5	64.1	61.3	56.3	51.8	47.6	43.6	35.9	28.5
15	Transit Mixer (5 m3)	47	5	47.0	42.4	39.0	36.2	31.2	26.7	22.5	18.5	10.8	3.4
16	Dump Truck (10 MT)	56	7	58.1	53.5	50.1	47.3	42.3	37.8	33.6	29.6	21.9	14.5

Note) *: Data Source: Handbook of mitigation measures for noise and vibration from construction works, 3rd edition, 2001.
Source: JICA Survey Team

Same as the case of noise level prediction, the vibration level from plural operation of equipment was predicted for these three cases: 1) dredging (by pumping), concrete sheet pile (driving) and concrete square pile (driving). The prediction results are shown in Table 6.1.12.

Table 6.1.12 Prediction results of compound vibration level from construction works

Work Item	Equipment	Vibration level (dB)	Reference point (m)	Distance (m)									
				5	10	15	20	30	40	50	60	80	100
Dredging (Pump)	Bulldozer (140 HT)	65	5	72.8	68.2	64.8	61.9	57.0	52.5	48.3	44.3	36.6	29.2
	Backhoe (1.1 m3)	72	5										
Concrete Sheet Pile(Driving)	Crawler Crane (40 MT)	45	7	87.1	82.5	79.1	76.3	71.3	66.8	62.6	58.6	50.9	43.5
	Pile Vibratory Hammer	85	7										
Concrete Square Pile (Driving)	Crawler Crane (40 MT)	45	7	87.1	82.5	79.1	76.3	71.3	66.8	62.6	58.6	50.9	43.5
	Pile Drop Hammer	85	7										

Note) *: Data Source: Handbook of mitigation measures for noise and vibration from construction works, 3rd edition, 2001
Source: JICA Survey Team

In case of several types of construction works, the vibration from the heavy equipment will be significant, including the following:

- Vibration roller for consolidation work of dredged materials,
- Pile vibration hummer for piling work of concrete sheet pile.
- Pile drop hummer for piling work of concrete square pile.

Since the vibration from a point source can be exponentially decremented as the distance increases from the source. If the distance between the operating heavy equipment and the impact recipient is more than 30 m, the impacts can be tolerable in general. But the distance is less than 10 m, the vibration would become intolerable as the period of exposure continues.

Consequently, it is predicted that the vibration from the heavy equipment during the construction works may cause significant nuisance in the vicinity of the construction works above when the same construction works continues.

b) Vibration level from the foundation improvement construction works

As described in the section of noise level from the foundation improvement construction works above, the foundation improvement work will be done along the right bank side of the CDO River near the Maharlika Bridge and Isla de Oro. The method to be adopted for the improvement work is "sand compaction pile method." This work will cause significant vibration to the environment. According to the past data on vibration generation, it is estimated that the vibration level is approx. 80 dB at the distance of 30m from the heavy equipment (sand compaction pile machine) unless any mitigation measures are not adopted.

Consequently, it is predicted that the noise pollution from the sand compaction piling machine will cause significant nuisance in the vicinity of the work site when it continues without any mitigation measure.

(3) Mitigation Measures

In the previous section, it was predicted that noise and vibration from the construction works will be significant unless any mitigation measures are provided. The mitigation measures include the following:

Mitigation measures during the detailed design stage are as follows:

- To study further for adopting the construction method with less noise and vibration generation.
- Detailed impact prediction is to be carried out based on the detailed design study by setting the location of heavy equipment and vehicles.
- Based on the prediction results of noise and vibration above, examination of mitigation measures to be adopted during the actual construction works

Mitigation measures to reduce the generation level of noise and vibration from the heavy equipment and vehicles are as follows:

- Good maintenance of dump trucks, other vehicles and heavy equipment,
- Education of drivers and operators to observe and respect driving and operation manners,
- Use of type of equipment with less noise and less vibration generation,

Mitigation measures to obtain understanding from the local community are as follows:

- Regular communication with local residents about the methodology and implementation schedule of construction works,
- Special dissemination about the works and schedule which may cause significant noise and vibration by holding the consultation meetings.
- Adjustments in the operation time of heavy equipment and dump trucks, transportation route, transportation method (by land or river), etc.

Special mitigation measures in case that significant noise and vibration are anticipated are as follows:

- Installation of sound abatement wall during construction work in the vicinity of residents and sensitive facilities such as schools or settlement areas, if necessary.

- Installation of temporary trench between the vibration source (civil work) and residential area and sensitive facilities, if necessary.
- Request of temporary relocation during the anticipated period of critical noise and vibration, if necessary.
- Survey of structures and existing cracks of residents in the vicinity of civil works which are anticipated to cause critical vibration prior to the civil works, which is the basis for the compensation when necessary.

6.1.3 River water quality

(1) Baseline Environment

1) Survey Method

Water sampling was conducted on April 4, 2013 at the first set in dray season and September 4, 2013 at the second set in rainy season. The three sampling stations were set: 1) near the river mouth (downstream), 2) near Kagayan Bridge (midstream) and 3) Pelaez Bridge (upstream) as shown on **Figure 6.1.4** Sampling was done by directly scooping water from the river with a clean container or by manual grab sampling.

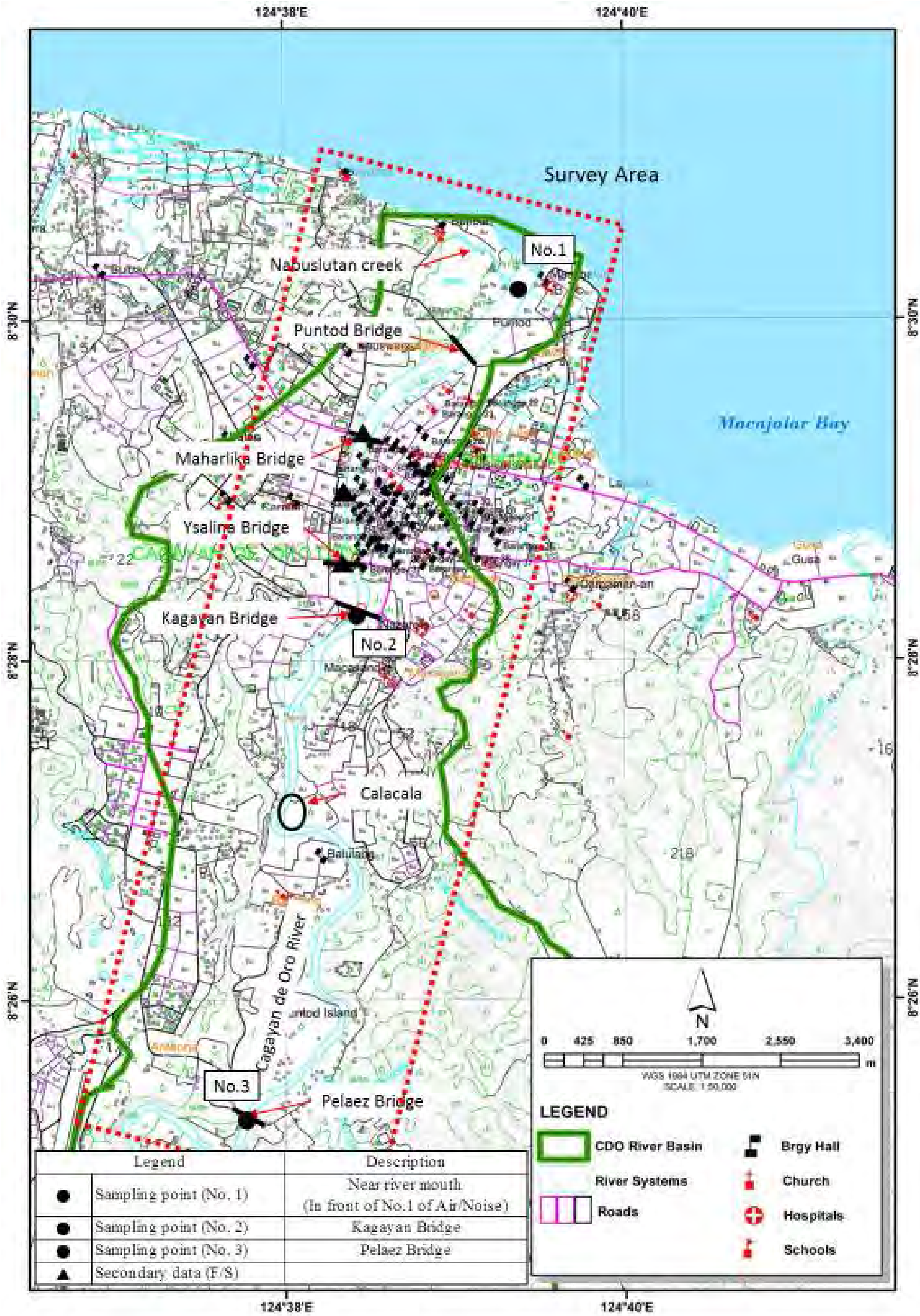


Figure 6.1.4 Sampling Stations for Water Quality

The analyzed parameters are listed in **Table 6.1.13**. The analysis was conducted at CRL Environmental Laboratory, a DENR accredited laboratory, in accordance with the standard methods for examining Water and Wastewater (AWWA), APHA, WEF, 21st Edition (DENR-EMB Modified) while in-situ sampling was conducted using Hach portable equipment such as pH meter, DO meter and conductivity meter.

Table 6.1.13 Physico-Chemical Parameters for Water Quality Sampling

For Laboratory Analysis	In-Situ/ On Site Sampling
1. Biochemical Oxygen Demand (BOD)	1. Temperature
2. Chemical Oxygen Demand (COD)	2. pH
3. Total Suspended Solids (TSS)	3. Dissolved Oxygen (DO)
4. Oil and grease	4. Total Dissolved Solids (TDS)
5. Nitrate	5. Conductivity
6. Phosphate	6. Salinity
7. Total coliform	
8. Fecal coliform	
9. Heavy metals such as copper (Cu), chromium (Cr), mercury (Hg), lead (Pb), cadmium (Cd), cyanide (CN) and arsenic (As)	

The results of the water quality analyses were compared to standards set by DENR specified in DAO No. 34 series of 1990**.** The survey results are to be evaluated comparing with the standard values of Class A of DAO No. 34 as the water use and classification of CDO River is Class A. The objective of comparing the concentration level with standard values is for the Project to establish the potential impacts of its activities with the beneficial use of the water body.

Test methods performed by the laboratory for these parameters are presented in **Table 6.1.14**.

Table 6.1.14 Laboratory Test Methods for Water Quality Parameters

Parameter	Method of Analysis
BOD	Azide Modification Winkler
COD	Open reflux Method
TSS	Gravimetry
Oil and grease	Pet. Ether Extraction (DENR-EMB Modified)
Nitrate	Colorimetry - Brucine
Phosphate	Colorimetry - Stannous chloride
Total coliform	Multiple tube fermentation technique
Fecal coliform	Multiple tube fermentation technique
Copper (Cu)	Flame AAS
Arsenic (As)	Colorimetry - SDDC
Chromium (Cr)	Flame AAS
Cyanide (CN)	Ion Selective Electrode (ISE)
Lead (Pb)	Flame AAS
Cadmium	Flame AAS
Mercury (Hg)	AAS-Cold vapor

Source: CRL Environmental Laboratory

The results of the water quality analyses was compared to standards set by DENR specified in DAO No. 34 series of 1990 as shown in **Table 6.1.15** and **Table 6.1.16**.

Table 6.1.15 Water Quality Criteria for Conventional and Other Pollutants Contributing to Aesthetics and Oxygen Demand for Fresh Waters (a)

Parameter	Unit	Class AA	Class A	Class B	Class C	Class D(b)
Temperature (d) (max. rise in ^oC)	^oC rise		3	3	3	3
pH (range)	--	6.5 - 8.5	6.5 – 8.5	6.5 - 8.5	6.5 – 8.5	6.5 – 8.5
Dissolved Oxygen (e) (minimum)	% Satn.	70	70	70	60	40
	mg/L	5.0	5.0	5.0	5.0	3.0
5-Day 20^oC BOD	mg/L	1	5	5	7(10)	10(15)
Total Suspended Solids	mg/L	25	50	(f)	(g)	(h)
Total Dissolved Solids	mg/L	500 (i)	1,000 (i)	--	--	1,000(i)
Oil and Grease (Petroleum Ether Extracts)	mg/L	Nil	1	1	2	5
Nitrate as Nitrogen	mg/L	1.0	10	nr	10(j)	--
Phosphate as Phosphorus	mg/L	Nil	0.1(k)	0.2(k)	0.4(k)	--
Total Coliforms	MPN/100mL	50(m)	1,000(m)	1,000(m)	5,000(m)	--
Fecal Coliforms	MPN/100mL	20(m)	100(m)	200(m)	--	--
Copper	mg/L	1.0	1.0	--	0.05(o)	--

Footnotes for **Table 6.1.15** and **Table 6.1.16.**
(a) - Except as otherwise indicated, the numerical limits in Tables 1 and 3 are yearly average values. Values enclosed in parentheses are maximum values.
(b) - For irrigation purposes, SAR should have a minimum value of 8 and a maximum value not to exceed 18. Boron should not exceed 0.75 mg/L.
(c) - No abnormal discoloration from unnatural causes
(d) - The allowable temperature increase over the average ambient temperature for each month. This rise shall be based on the average of the maximum daily temperature readings recorded at the site but upstream of the mixing zone over a period of one (1) month.
(e) - Sampling taken between 9:00 AM and 4:00 PM
(f) - Not more than 30% increase
(g) - Not more than 30 mg/L increase
(h) - Not more than 60 mg/L increase
(i) - Do not apply if natural background is higher in concentration. The latter will prevail and will be used as baseline
(j) - Applicable only to lakes or reservoirs, and similarly impounded water
(k) - When applied to lakes or reservoirs, the Phosphate as P concentration should not exceed an average of 0.05 mg/L nor a maximum of 0.1 mg/L
(l) - Not present in concentrations to affect fish flavor/taste
(m) - These values refer to the geometric mean of the most probable number of coliform organism during a 3-month period and that the limit indicated shall not be exceeded in 20 percent of the samples taken during the same period
(n) - For spawning areas for Chanos chanos and other similar species
(o) - Limit is in terms of dissolved copper
nil - Extremely low concentration and not detectable by existing equipment
--- - Means the standard of these substances are not considered necessary for the present time, considering the stage of the country's development and DENR capabilities, equipment and resources
nr - Means No Recommendation made

Table 6.1.16 Water Quality Criteria for Toxic and Other Deleterious Substances for Fresh Waters (For the Protection of Public Health)

Parameter	Unit	Class AA	Class A	Class B	Class C	Class D
Arsenic (i)	mg/L	0.05	0.05	0.05	0.05	0.01
Cadmium (i)	mg/L	0.01	0.01	0.01	0.01	0.05
Chromium (i) (hexavalent)	mg/L	0.05	0.05	0.05	0.05	--

Cyanide	mg/L	0.05	0.05	0.05	0.05	--
Lead (i)	mg/L	0.05	0.05	0.05	0.05	--
Total Mercury (i)	mg/L	0.002	0.002	0.002	0.002	0.002

Note:
1. Limiting values of organophosphates and organochlorines may in the meantime serve as guidelines in the interim period pending the procurement and availability of necessary laboratory equipment. For Barium, Cobalt, Fluoride, Iron, Lithium, Manganese, Nickel, Selenium, Silver and Vanadium, the 1978 NPCC Rules and Regulations, Section 69 may be considered.
2. For footnotes please refer to **Table 6.1.15.**

2) Survey Results

A) River Water Quality in Dry Season

The result of the water quality analysis is presented in **Table 6.1.17** while the current test results and the Certificate of Analysis issued by the laboratory are attached as **Annex**.

Table 6.1.17 Analysis Results of River Water Quality

Parameters	Units	DENR Standards* Class A	Sampling Stations		
			WQ 1 River mouth	WQ 2 Kagayan Br.	WQ 3 Pelaez Br.
			8°30'21.95"N 124°39'29.38"E	8°28'17.86"N 124°38'26.84"E	8°25'19.27"N 124°37'47.80"E
Temperature	ºC	3ºC max. rise	28.9	29.8	29.2
pH	--	6.5-8.5	7.4	7.8	7.7
Dissolved Oxygen (DO)	mg/L	5	9.2	6.0	5.3
BOD	mg/L	5	4	1	1
COD	mg/L	--	29	5	5
TSS	mg/L	50	9.0	16	6
TDS	mg/L	1000(i)	5.9	61.8	60.9
Conductivity	μs/cm	--	11.7	123.5	121.8
Salinity	‰	--	6.7	0.1	0.1
Oil and grease	mg/L	1	0.56	0.51	0.43
Nitrate	mg/L	10	<0.02	<0.02	<0.02
Phosphate	mg/L	0.1	<0.006	<0.006	<0.006
Total coliform	MPN/100mL	1,000	24,000	3,500	7,900
Fecal coliform	MPN/100mL	100	13,000	1,100	4,900
Copper	mg/L	1	ND	ND	ND
Arsenic	mg/L	0.05	ND	ND	ND
Cadmium	mg/L	0.01	ND	ND	ND
Hexavalent chromium	mg/L	0.05	ND	ND	ND
Cyanide	mg/L	0.05	0.03	ND	ND
Lead	mg/L	0.05	ND	ND	ND
Mercury	mg/L	0.002	ND	ND	ND

Notes:
(*) DAO 1990-34
(i) Do not apply if natural background is higher in concentration. The latter will prevail and will be used as baseline.
(--) No standards in DAO 1990-34
ND Not detected (below MDL)
G Not more than 30mg/L increase
NA Not Applicable
Source: JICA Survey Team

a) Station 1 – River mouth

Temperature of the water sample for Station 1 is 28.9ºC which shows the normal ambient ones. The obtained values of pH, DO, BOD, TSS, TDS, oil and grease nitrate and phosphate are all within the DENR standard for Class A water.

Conductivity values for this station are observed to be low while the salinity content of 6.7‰ is relatively high for freshwater. Salinity levels are generally higher near the river mouth since this is where the water from the sea and river meets but the actual salinity values varies throughout the tidal cycle.

The total coliform value of 24,000 MPN/100mL and fecal coliform value of 13,000 MPN/100mL are notably high. Both failed to meet the DENR standard for Class A water of 1,000 MPN/100mL and 100 MPN/100mL for total and fecal coliform respectively. The values obtained are the highest among the sampling stations. The high concentrations of coliform values on this station might be attributed to the occurrence of human settlement located along the riverbanks that directly discharge their sewerage on the river water. This might also be a result of overflow of nonpoint sources of human and animal waste.

Copper and all the toxic substances such as arsenic, cadmium, hexavalent chromium, copper, cyanide, lead and total mercury are not detected and well below the DENR standards.

b) Station 2 – Kagayan Bridge

Temperature of the water sample for Station 1 is 29.8ºC which shows the normal ambient ones. The obtained values of pH, DO, BOD, TSS, TDS, oil and grease nitrate and phosphate are all within the DENR standard for Class A water.

Conductivity values for this station are observed to be the highest values among the three sampling stations while the salinity value of the water is 0.1‰.

The fecal and total coliform values of the river did not pass the standard. These values might have been brought about by the settlement and business establishments observed near the riverbanks.

Copper and all the toxic substances such as arsenic, cadmium, hexavalent chromium, copper, cyanide, lead and total mercury are not detected and well below the DENR standards.

c) Station 3 – Pelaez Bridge

The obtained values are similar to those of station 2 as a whole. Temperature of the water sample for Station 1 is 29.2ºC which shows the normal ambient ones. The obtained values of pH, DO, BOD, TSS, TDS, oil and grease nitrate and phosphate are all within the DENR standard for Class A water.

Conductivity values for this station are observed to be the similar values with station 2 while the salinity value of the water is 0.1‰ which is also the same level as station 2.

The total coliform and fecal coliform values both failed to meet the DENR standard, which suggesting the same reason of station 1 and 2. This indicates that the water is not suitable for drinking. High total and fecal coliform also indicates that the water is contaminated with pathogens or disease producing bacteria or viruses that are sources of potential health risk for individuals exposed on the water.

As the same as stations 1 and 2, copper and all the toxic substances such as arsenic, cadmium, hexavalent chromium, copper, cyanide, lead and total mercury are not detected and well below the DENR standards, suggesting there no contamination with toxic substances in the CDO River.

B) River Water Quality in Rainy Season

Table 6.1.18 Physical, Chemical and Bacteriological Characteristics of the Water Samples

Parameters	Units	DENR Standards* Class A	Sampling Stations		
			WQ 1 River mouth	WQ 2 Kagayan Br.	WQ 3 Pelaez Br.
			8°30'21.95"N 124°39'29.38"E	8°28'17.86"N 124°38'26.84"E	8°25'19.27"N 124°37'47.80"E
Temperature	ºC	3ºC max. rise	26.6	27.5	28.1
pH	--	6.5-8.5	7.8	7.8	7.9
Dissolved oxygen	mg/L	5	7.0	7.6	7.5
BOD	mg/L	5	5	11	8
COD	mg/L	--	9.7	19	14
TSS	mg/L	50	32	81	80
TDS	mg/L	1000(i)	169.8	65.2	65.5
Conductivity	µs/cm	--	265.3	101.9	102.4
Salinity	‰	--	0.1	0.1	0.1
Oil and grease	mg/L	1	0.6	0.7	0.6
Nitrate	mg/L	10	0.2	0.2	0.1
Phosphate	mg/L	0.1	0.05	0.08	0.05
Total coliform	MPN/100mL	1,000	16,000	35,000	24,000
Fecal coliform	MPN/100mL	100	1,700	210	2,200
Copper	mg/L	1	ND	ND	ND
Arsenic	mg/L	0.05	ND	ND	ND
Cadmium	mg/L	0.01	ND	ND	ND
Hexavalent chromium	mg/L	0.05	ND	ND	ND
Cyanide	mg/L	0.05	ND	ND	ND
Lead	mg/L	0.05	ND	ND	ND
Mercury	mg/L	0.002	ND	ND	ND

Notes:
(*) DAO 1990-34
(i) Do not apply if natural background is higher in concentration. The latter will prevail and will be used as baseline.
(--) No standards in DAO 1990-34
ND Not detected (below MDL)
G Not more than 30mg/L increase
NA Not Applicable
Source: JICA Survey Team

a) Station 1 – River mouth

Temperature of the water sample for Station 1 is 26.6ºC which shows the normal ambient ones. The obtained pH, DO, TDS, oil and grease, nitrate and phosphate are all within the DENR standard for Class A water.

Regarding BOD and TSS, the obtained data is the same values as standard (5 mg/l). River water seems to be affected by organic pollutants.

Conductivity value for this station is observed to be the highest among the station while the salinity content is 0.1‰, which is the same value as others.

The total coliform and fecal coliform values both failed to meet the DENR standard. Human settlements within the riverbanks and near the river mouth that directly discharge their sewerage on the river might have contributed to the increase of the concentrations of coliform values.

Copper and all the toxic substances such as arsenic, cadmium, hexavalent chromium, copper, cyanide, lead and total mercury are not detected and well below the DENR standards.

b) Station 2 – Kagayan Bridge

Temperature of the water sample for Station 2 is 27.5ºC which shows the normal ambient ones. The obtained pH, DO, TDS, oil and grease, nitrate and phosphate are all within the DENR standard for Class A water.

Regarding BOD and TSS, the obtained data exceeded the standard values. The increase in BOD for this station might be related to the rate of microbial decomposition as observed for the high coliform values of the water during the time of the sampling. The observed color of the river water during the sampling is brown of which is brought by the consistent raining on the area. During the rainy season, soil particles and other minerals are being carried by the rainwater from the agricultural lands to the river. This is also supported by the minimal detected values of nitrate and phosphate and the high TSS concentration of the river water from the agricultural runoffs during the rainy season.

Conductivity value for this station is observed to be the lowest among the station while the salinity content is $0.1‰_0$, which is the same value as others.

The total coliform and fecal coliform values both failed to meet the DENR standard. Human settlements within the riverbanks and near the river mouth that directly discharge their sewerage on the river might have contributed to the increase of the concentrations of coliform values.

Copper and all the toxic substances such as arsenic, cadmium, hexavalent chromium, copper, cyanide, lead and total mercury are not detected and well below the DENR standards.

c) Station 3 – Pelaez Bridge

The obtained values are similar to those of station 2 as a whole. Temperature of the water sample for Station 3 is 28.1ºC which shows the normal ambient ones as the same as other stations. The obtained pH, DO, TDS, oil and grease, nitrate and phosphate are all within the DENR standard for Class A water.

Regarding BOD and TSS, the obtained data exceeded the standard values as the same as that of station 2, suggesting the same reason of the station 2.

Conductivity value for this station is observed to be the lowest among the station while the salinity content is $0.1‰_0$, which is the same value as others.

The total coliform and fecal coliform values both failed to meet the DENR standard, which suggesting the same reason of station 1 and 2. This indicates that the water is not suitable for drinking. High total and fecal coliform also indicates that the water is contaminated with pathogens or disease producing bacteria or viruses that are sources of potential health risk for individuals exposed on the water.

As the same as stations 1 and 2, copper and all the toxic substances such as arsenic, cadmium, hexavalent chromium, copper, cyanide, lead and total mercury are not detected and well below the DENR standards, suggesting there no contamination with toxic substances in the CDO River.

C) Summary of the Survey Results

The baseline condition of the river water quality in both dry season and rainy season based on the survey results can be summarized as follows:

Water temperature shows the normal ambient conditions reflecting the surrounding conditions.

The values of pH, DO, oil and grease, nitrate and phosphate are well consistent with the standard values of DENR for Class A water.

As for BOD, COD, TSS shows high concentration in rainy season; values of BOD and TSS exceeded the standard values of DENR for Class A water, which suggests that soil particles and other minerals are carried by the rainwater from the agricultural lands to the river during the rainy season.

The total coliform and fecal coliform values both failed to meet the DENR standard, which indicates that the water is not suitable for drinking and that the water is contaminated with pathogens or disease producing bacteria or viruses that are sources of potential health risk for individuals exposed on the water.

Copper and all the toxic substances such as arsenic, cadmium, hexavalent chromium, copper, cyanide, lead and total mercury are not detected and well below the DENR standards, suggesting there no contamination with toxic substances in the CDO River.

(2) Potential Impacts

The potential impacts on the water pollution due to the implementation of the Project are as follows:

- River water pollution in the CDO River during the construction works.
- Impacts on water quality due to the alteration of river hydrology during operation phase.

1) River water pollution during the construction works

Potential impact sources of water pollution of the CDO River during the construction phase are surface runoff laden with soil particles; waste water (effluent) generated by construction yards and offices. In the potential sources of water pollution, oil and other chemicals might be included in case of accidental spillage or during the piing works.

Regarding the hazardous liquid wastes including oil or some chemicals, in case of used and generated, these wastes are temporarily stocked under strictly managed.

2) Impacts on water quality due to the alteration of river hydrology

The change of river hydrology includes the following:

- Increase of water volume during the flooding,
- Increase of flow distance of flooding water into the sea from the river mouth.

In short, the flooding water will be confined in the dike and floodwall (within the river area) during the flooding with the 25 years probability of flood without overtopping of the dike or floodwall. Accordingly, when comparing with the same scale of flooding, the water volume during the flooding and the flow distance of flooding water into the sea from the river mouth would increase, which means the impact area of floodwater with high turbidity would theoretically reach further in the Makajalar bay. This may be increase the siltation in the Makajalar bay in further points from the seashore. But the possibility and the magnitude of impacts are always clarified.

(3) Mitigation Measures

As for the mitigating these potential impacts during the construction works, the Construction Contractor is to cope with the adequate mitigation measures and proper implementation and can be manageable during the construction stage, including the following:

- To avoid the construction works during rainy season or rainy day as much as possible,
- Installation of temporary embankment and drainage at the boundary of periphery of project site,
- Installation of sedimentation pond at appropriate location to avoid the turbid water discharge for settlement the laden with soil particles.
- Waste water from construction yards or offices is to be properly treated and disposed using septic tank or other appropriate treatment method,
- Provision of portable toilet (portalet) for the workers at the construction work sites.
- Selection of less agitation method of dredging and its proper implementation, etc.

As for the chemical wastes, in case of used and generated, these wastes are temporarily stocked under strictly managed according to RA 6969 regarding the Act to Control Toxic Substances and hazardous and Nuclear Wastes.

- The used oil and chemical wastes are to be treated based on the accredited waste contractor and appropriately re-used or disposed.

As for the impacts due to the river hydrology during the operation phase, there is no practical mitigation measure as long as this project is implemented. The monitoring of water quality of sea water and the aquatic biota by DPWH in collaboration with concerned agency such as DENR, Xavier Univ. and NGOs, etc. is needed instead.

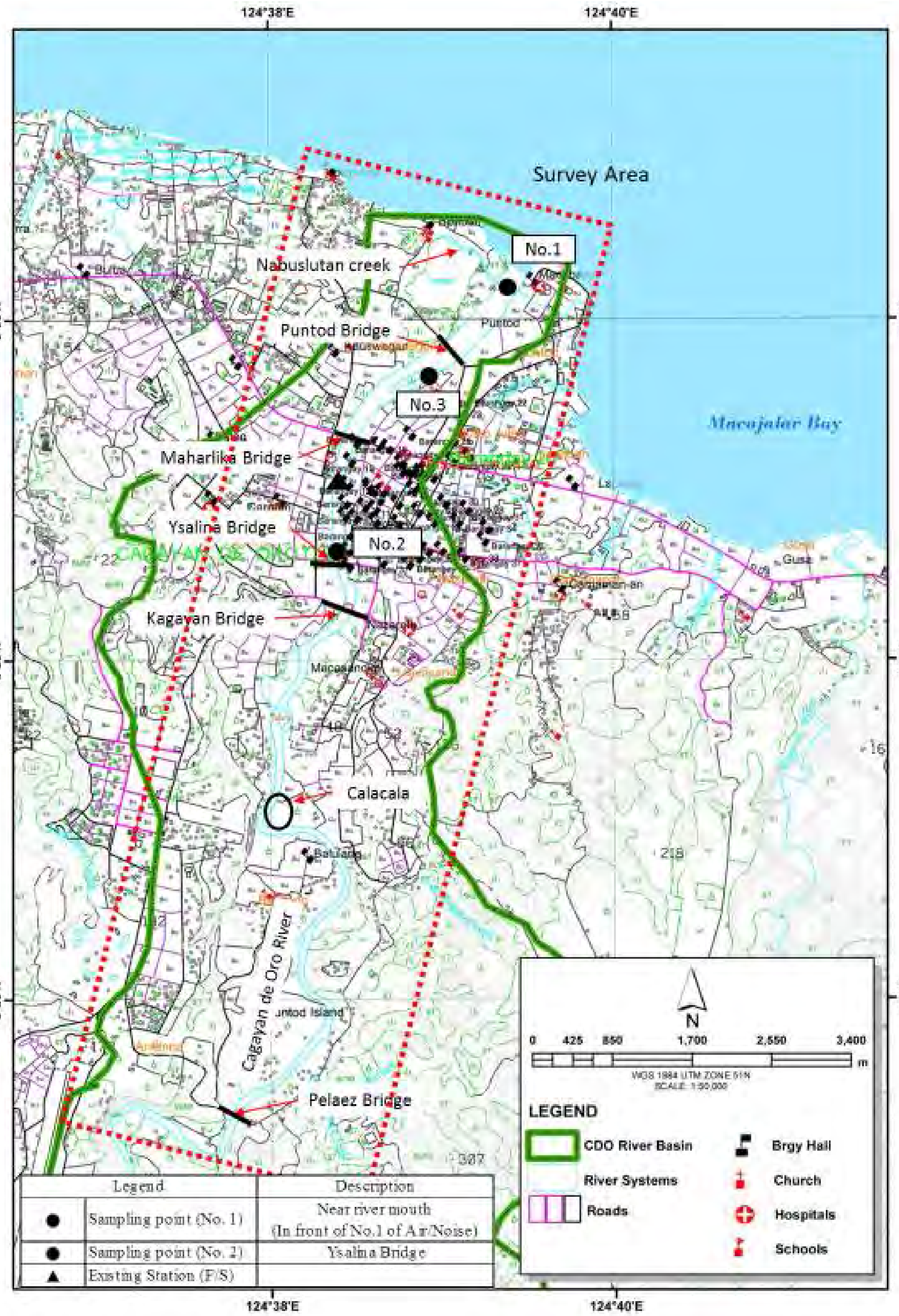
6.1.4 Riverbed sediment quality

(1) Baseline Environment

1) Survey Method

Riverbed sediment quality was conducted by the sampling of riverbed sediment and laboratory analysis.

The sediment sampling was conducted two times: first sampling was on April 4, 2013 and the second one was on August 31, in the same year within the stretch of Cagayan de Oro River. Sediment sampling was conducted at two locations for the first sampling was: 1) near the river mouth (downstream) and 2) immediately downstream of Ysalina Bridge. Sediment sampling for the second sampling were conducted for confirmation of the set of survey results at three locations: 1) near the river mouth (downstream) and 2) at the Isla Bakusan, and 3) immediately downstream of Ysalina Bridge. The location of sampling stations is shown in **Figure 6.1.5.**



Legend		Description
●	Sampling point (No. 1)	Near river mouth (In front of No.1 of Air/Noise)
●	Sampling point (No. 2)	Ysalina Bridge
▲	Existing Station (F/S)	

Figure 6.1.5 Sampling Stations for Sediment Quality

Sediment samples were obtained using an improvised grab sampling bucket. The samples were shipped to Manila and brought on the same day to CRL Environmental Laboratory for testing on heavy metal content such as copper (Cu), chromium (Cr), mercury (Hg), Lead (Pb), cadmium (Cd), cyanide (CN) and arsenic (As). The parameters were analyzed on the laboratory by Toxicity Characteristic Leaching Procedure (TCLP) and Elutriate Test.

The TCLP Test is as shown in the USEPA Method for Evaluating Solid Waste (SW-846) - Method 1311. It is an extraction method for chemical analysis that simulates leaching in a landfill. It aims to determine if the waste to be disposed of is characteristically hazardous or not, or whether these wastes need further treatment before disposal.

The Elutriate Test, on the other hand, was originally developed by the Engineers of U.S. Army Corps to simulate a situation that occurs during the dredging work by testing if the target parameters will be leached out in the process. It is, therefore, often used as an extraction method used to predict the potential release of contaminants from sediment at the point of dredging the riverbed sediments; and at confined disposal area, when the dredged material touches with water or rain.

The features of these tests are summarized in the table below:

Table 6.1.19 Details of TCLP and Elutriate Tests for Riverbed Sediment Quality

Items	TCLP Test	Elutriate Test
Description of test	Method 1311, in the US EPA Method for Evaluating Solid Waste (SW-846).	Originally developed by the Engineers of U.S. Army Corps.
Purpose / Usage of data	To determine whether the waste hazardous or not.	To predict the potential release of contaminants from sediment at dredging and at disposal area due to touching with water including rain.
Parameters analysed in this survey	Copper (Cu), Chromium (Cr^{6+}), Mercury (T-Hg), Lead (Pb), Cadmium (Cd), Cyanide (CN), Arsenic (As)	ditto
Evaluation criteria	Administrative Order (AO) No. 36 series of The Detailed Design of 2004, Procedural Manual Title III of DAO 92-29 (Annex D)	No specific Criteria is provided in the Philippines, DAO 90-35 for Effluent Standards are often applied as reference.

Table 6.1.20 Laboratory Test Methods for Heavy Metals in the Leaching Water from Riverbed Sediment

Parameter	Method of Analysis
Copper (Cu)	Flame AAS
Chromium (Cr^{6+})	Flame AAS
Mercury (Hg)	AAS-Cold Vapor
Lead (Pb)	Flame AAS
Cadmium (Cd)	Flame AAS
Cyanide (CN)	Ion Selective Electrode (ISE)
	AAS-Hydride Generation

Source: CRL Environmental Laboratory

The results of the TCLP and Elutriate Test are evaluated comparing with **Table 6.1.21 and 6.1.22**, respectively.

Table 6.1.21 Heavy Metal Concentration of Riverbed Standards

Parameters	Units	*MCL
Copper (Cu)	mg/L	-
Chromium (Cr)	mg/L	5
Mercury (Hg)	mg/L	0.2
Lead (Pb)	mg/L	5
Cadmium (Cd)	mg/L	5
Cyanide (CN)	mg/L	200
Arsenic (As)	mg/L	5

Note:
**Maximum Contaminant Level (mg/L), DENR Revised DAO 04-36*
No standard value stated

Table 6.1.22 Effluent Standards for Toxic and Other Deleterious Substance (Revised Effluent Regulation DAO 90-35)

Parameters	Units	DENR Standards
Hexavalent chromium	mg/L	0.05
Cyanide	mg/L	0.1
Arsenic	mg/L	0.1
Cadmium	mg/L	0.02
Copper	mg/L	-
Lead	mg/L	0.1
Mercury	mg/L	0.005

Note:
Standards for Class A of New/Proposed Industry/ wastewater
- No standard value stated

2) Survey Results

A) Analysis Results based on TCLP Test

The result of the TCLP is compared with the revised Procedural Manual on Hazardous Waste or the Revised DAO 04-36 to determine whether the wastes generated are hazardous or not. The Revised DAO 04-36 is used as thresholds for protecting public health and the environment by classifying hazardous wastes based on maximum contaminant levels (MCL). The result of the sediment quality analysis is presented in **Table 6.1.23 and 6.1.24** while the Certificate of Analysis issued by the laboratory is attached as **Annex.**

Table 6.1.23 Results of TCLP Test of first sampling

Parameters	Units	DENR Standards* Maximum Contaminant Levels	Method Detection Limits (MDL)	Sampling Stations	
				SQ 1 River mouth	SQ 2 Ysalina Bridge
				8°30'21.95"N 124°39'29.38"E	8°28'32.14"N 124°38'24.09"E
Chromium	mg/L	5	0.003	ND	ND
Cyanide	mg/L	200	1.0	1.8	ND
Arsenic	mg/L	5	0.001	0.004	0.002
Cadmium	mg/L	5	0.006	ND	ND
Copper	mg/L	--	0.02	ND	ND
Lead	mg/L	5	0.04	ND	ND
Mercury	mg/L	0.2	0.0001	ND	ND

Notes: (*) DAO 2004-36
(--) No standards in DAO 2004-36
ND Not detected (below MDL)
Source: JICA Survey Team

Table 6.1.24 Results of TCLP Test of second sampling

Parameters	Units	DENR Standards* Maximum Contaminant Levels	Method Detection Limits (MDL)	Sampling Stations		
				SQ1 River mouth	SQ2 Ysalina Bridge	SQ3 Isla Bakusan
				8°30'21.95"N 124°39'29.3	8°28'32.14"N 124°38'24.09"E	8°29'45.08"N 124°38'59.7"E
Chromium	mg/L	5	0.02	ND	ND	ND
Cyanide	mg/L	200	0.5	0.8	ND	ND
Arsenic	mg/L	5	0.001	0.005	ND	0.007
Cadmium	mg/L	5	0.006	ND	ND	ND
Copper	mg/L	--	0.02	ND	ND	ND
Lead	mg/L	5	0.04	ND	ND	ND
Mercury	mg/L	0.2	0.0001	ND	ND	ND

Notes: (*) DAO 2004-36
(--) No standards in DAO 2004-36
ND Not detected (below MDL)
Source: JICA Survey Team

a) Station 1 - River mouth

Toxic substances such as chromium, cadmium, copper, lead and mercury are not detected and below the DENR standards. The values of cyanide and arsenic, although they are detected, were below the standard values. The tendency of the detection of toxic substances was similar between the first and the second monitoring.

It should be noted that this station is prone to wave and current action that might disturb the bottom sediments. The activities observed on the area to be noted are the small scale of quarrying of river sediments by the resident, on-going dredging near the river mouth and construction of walls along the riverbanks. These activities might as well cause sediment disturbance on the area.

b) Station 2 – Ysalina Bridge

Similar with the station 1, toxic substances except for arsenic are not detected and consistent with the DENR standards. The obtained value of arsenic was detected but is within the standard. At the second monitoring, all the parameters were not detected and below the DENR standards.

c) Station 3 – Isla Bakusan

This location was tested at only the second sampling. All the toxic substances were not detected except for arsenic. The value of arsenic, although detected, was within the standard value.

In summary, the results of the TCLP analyses revealed that the tested toxic substances are below their maximum contaminant levels. Thus, the riverbed sediments are evaluated as non-hazardous and therefore, are not needed to be stored under strict management in a container or treated appropriately for disposal.

B) Analysis Results based on Elutriate Test

Since the Philippines have no standard for elutriate test, the result is compared with the revised effluent regulation of DAO 90-35 to know the possible release of contaminants to the water column during the dredging activity as mentioned above. The result of the elutriate test for the riverbed sediments presented in **Table 6.1.25 and 6.1.26.**

Table 6.1.25 Results of Elutriate Test of first sampling

Parameters	**Units**	**DENR Standards* Class A (for Reference)**	**Method Detection Limits (MDL)**	**Sampling Stations**	
				SQ 1 River mouth	**SQ 2 Ysalina Br.**
				8°30'21.95"N 124°39'29.38"E	8°28'32.14"N 124°38'24.09"E
Hexavalent chromium	mg/L	0.05	0.003	ND	ND
Cyanide**	mg/L	0.1	0.02	0.12	ND
Arsenic	mg/L	0.1	0.001	0.004	0.004
Cadmium	mg/L	0.02	0.006	ND	ND
Copper	mg/L	-	0.02	ND	ND
Lead	mg/L	0.1	0.04	ND	ND
Mercury	mg/L	0.005	0.0001	ND	ND

Notes: (*) DAO 1990-35
ND Not Detected (below MDL)
(--) No standards in DAO 1990-35

Source: JICA Survey Team

Table 6.1.26 Results of Elutriate Test of second sampling

Parameters	**Units**	**DENR Standards*** Class A (for Reference)	**Method Detection Limits (MDL)**	**Sampling Stations**		
				SQ1 River mouth	**SQ2 Ysalina Bridge**	**SQ3 Isla Bakusan**
				8°30'21.95"N 124°39'29.3	8°28'32.14"N 124°38'24.09"E	8°29'45.08"N 124°38'59.7"E
Hexavalent chromium	mg/L	0.05	0.02	ND	ND	ND
Cyanide**	mg/L	0.1	0.02	ND	ND	ND
Arsenic	mg/L	0.1	0.001	0.003	0.007	0.002

Cadmium	mg/L	0.02	0.006	ND	ND	ND
Copper	mg/L	-	0.02	ND	ND	ND
Lead	mg/L	0.1	0.04	ND	ND	ND
Mercury	mg/L	0.005	0.0001	ND	ND	ND

Notes: (*) DAO 1990-35
ND Not Detected (below MDL)
(--) No standards in DAO 1990-35

Source: JICA Survey Team

a) Station 1 - River mouth

Toxic substances were not detected or below the reference values except for cyanide at the first monitoring. The amount of cyanide value detected exceeds the reference values of DAO 1990-35. The cause of the relatively high concentration of cyanide is not clear at this moment. At the second monitoring, cyanide was not detected while arsenic was detected but the values were well within the reference value.

b) Station 2 – Ysalina Bridge

Toxic substances were not detected except for arsenic at both the first and second monitoring. The value of arsenic, although detected, was below the reference value.

c) Station 3 – Isla Bakusan

This location was tested at only the second sampling. Test results was similar to that of Ysalina Bridge; only arsenic was detected but well below the reference value.

In summary, the results of the elutriate test shows that most of the toxic substances are not detected or below the method detection limits of the laboratory. Of the two heavy metals detected, i.e., cyanide and arsenic, only cyanide exceeded the reference value provided in DAO 90-35 for effluent standards although the detected value (0.12 mg/L) was almost the same level as the reference value (0.1 mg/L). Regarding arsenic, the detected value is still within the reference value of DAO 90-35.

(2) Potential Impacts

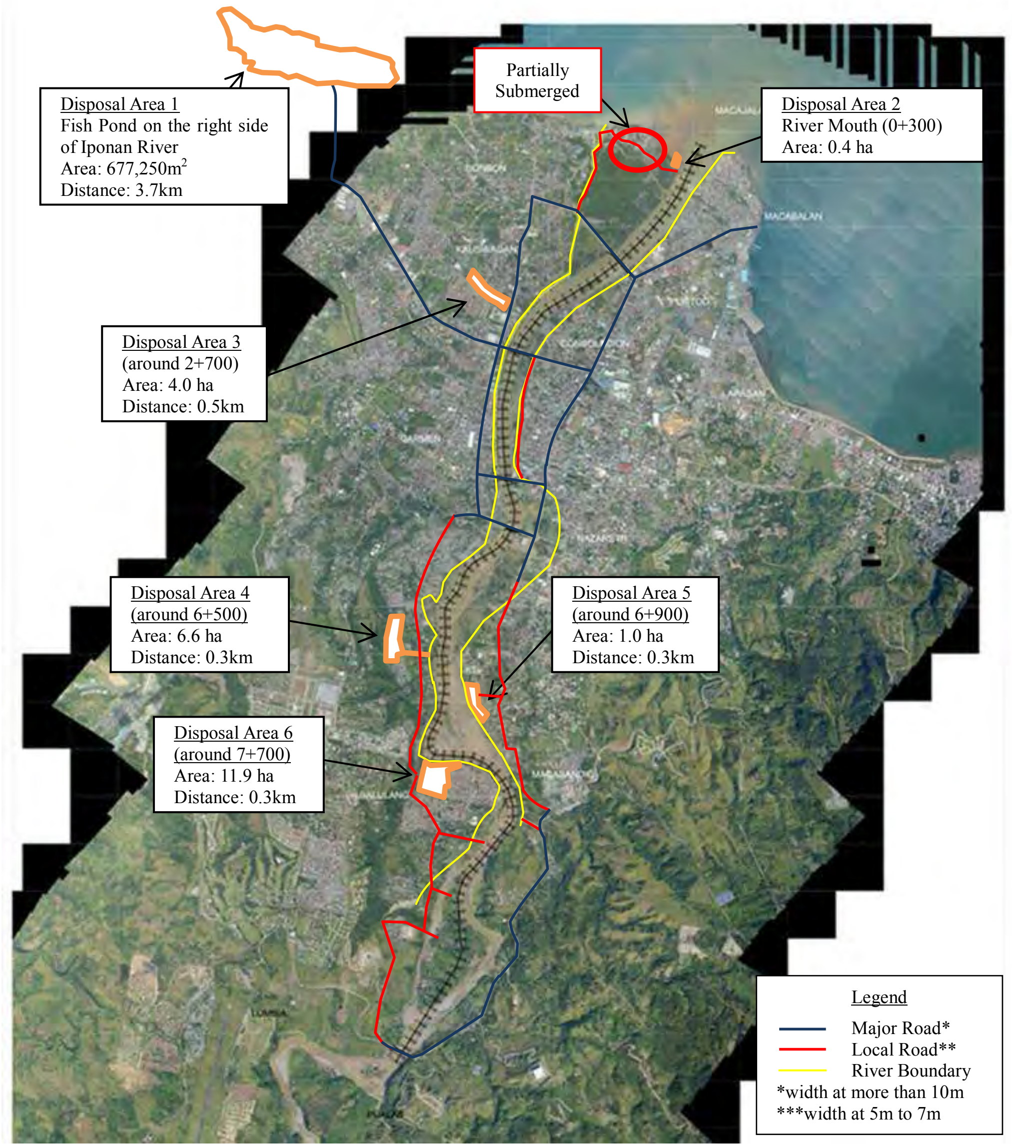
Impact source related to the riverbed sediment due to the implementation of the Project are as follows:

Excavation and dredging of riverbed sediment:

- Location: from the river mouth to the points up to approx. 4 km.
- Volume: approx. 130,000 m3 based on the topographic survey results of river cross section.

Disposal of excavated/dredged materials:

Candidate location of disposal areas and the characteristics of them are shown on **Figure 6.1.6 and Table 6.1.27.**



Source: DPWH

Figure 6.1.6 Location of Candidate Disposal Area

Table 6.1.27 Comparison and Examination of Environment and Social Impacts in Disposal Area

No.	Evaluation Axis	Disposal Area 1	Disposal Area 2	Disposal Area 3	Disposal Area 4	Disposal Area 5	Disposal Area 6
1	Land Use (target area)	Fish Pond	Vacant Ground	Mixture of Farmland (plantation) Forest and Grassland	Mixture of Farmland and Grassland	Grassland (Meadow)	Coconut Farm and Dry Field
2	Land Use (surrounding area)	Scattered Farmland and Residential Area	Residential Area, Mangrove Forest (natural area and plantation)	New Residential Area, School	Mountain Forest, Residential Area	River (CDO River), Residential Area	Scattered Mountain Forest, River (CDO River) and Residential Area
3	Area	67.73 ha	0.4 ha	4.0 ha	6.6 ha	1.0 ha	11.9 ha
4	Terrain Condition	For land use as Fish Pond, it is a depression and acceptance capacity of dredged material and drilled soil is large.	Plain Land, used for a dump site of dredged material still now	Plain Land	Plain Land	Plain Land, but motor-shaped terrain with a slightly lower center	Plain Land
5	Distance from CDO River	3.7 km	0 km (Adjacent to the river)	0.5 km	0.3 km	0.3 km	0.3 km
6	Condition of Access Road	Wide, good	Adjacent to the river, land access through narrow road inside of village	Adjacent to paved local road, good	Good, need to pass through inside of village	Relatively narrow, need to pass through inside of village	Close to local road, exits are slope and curved
7	Impacts on Social Environment	Need to compensate for fishermen and take measures for their relief	Used for a dump site of dredged material at present, need coordination	More than 10 units of housings in the area, stores etc. at center of the area, need to compensate for farmland	Need to compensate for farmland	Need to compensate for meadow	Residential area in part, need to compensate for farmland
8	Impacts on Natural Environment	Natural area (grassland, forest, etc.) will not be changed.	Natural area will not be changed.	Although a part of trees need to be logged, they are not growing by natural vegetation.	Although a part of trees need to be logged, they are not growing by natural vegetation.	Trees will not be logged very much.	Need to log coconut trees in the farm
9	Impacts on Living Environment (pollution)	Low impact for a small number of housings around the area	Low impact on living environment as long as soil is directly thrown from the river	Impacts are predicted because a school is relatively close and a new residential area is located at the opposite side across the road.	Impacts on housings are predicted because of the access passing through the residential area.	Impacts are possible predicted because of the relatively narrow road and need to pass through inside of the village.	Traffic jam in access pass (gateway) from the local road is concerned.

Source: JICA Survey Team

Potential impacts related to the riverbed sediment due to the implementation of the Project are as follows:

- Soil contamination at around the disposal site of the excavated /dredged materials,
- Groundwater contamination at around the disposal site of the excavated /dredged materials, and
- Contamination of river water quality during the dredging work, if included as maintenance operation.

1) Soil contamination at around the disposal site of the excavated /dredged materials

According to the TCLP Test results, the riverbed sediment is categorized as non-hazardous materials which can be utilized as the reclamation and/or backfill materials for the civil works. Thus, it is predicted that no soil contamination would occur at around the disposal site due to the disposal of excavated / dredged materials from the CDO River.

2) Groundwater contamination at around the disposal site of the excavated /dredged materials.

Based on the results of Elutriate Test, cyanide was detected and the value exceeded the reference value of DAO 90-35 for Effluent Standards, although the detected value (0.1 mg/L) was the same level of the reference value (0.12 mg/L) of DAO 90-35, which can be applied as reference to be used to predict the potential release of contaminants from sediment at the point of dredging the riverbed sediments; and at confined disposal area, when the dredged material touches with water or rain. Taking into consideration this point, it cannot be totally denied the possibility of groundwater contamination at around the disposal site.

3) Contamination of river water quality during the dredging work

Similar to the previous prediction on groundwater contamination, it cannot be totally denied the possibility of the river water pollution during the dredging work in the CDO River although the exceeding parameters are only cyanide and its level are almost the same level of reference value of DAO 90-35 for Effluent Standards.

(3) Mitigation measures

As for the potential impacts described above, the following measures can be adopted for mitigation:

- Adoption of less agitating type of dredging, such as pumping dredger, to minimize the re-suspension of sediments during dredging works.
- Installation of silt curtain for enhance the entrapment mechanism during the dredging work,

Confirmation of riverbed sediment quality by increasing the sampling points during the Detail Design stage, because the riverbed sediment analysis was limited to three (3) stations during this EIA study. Additional information on riverbed sediment is important for further prediction and evaluation of potential impacts, and formulation of necessary mitigation measures. As for the environmental monitoring, it is described in detail in Chap. 9.

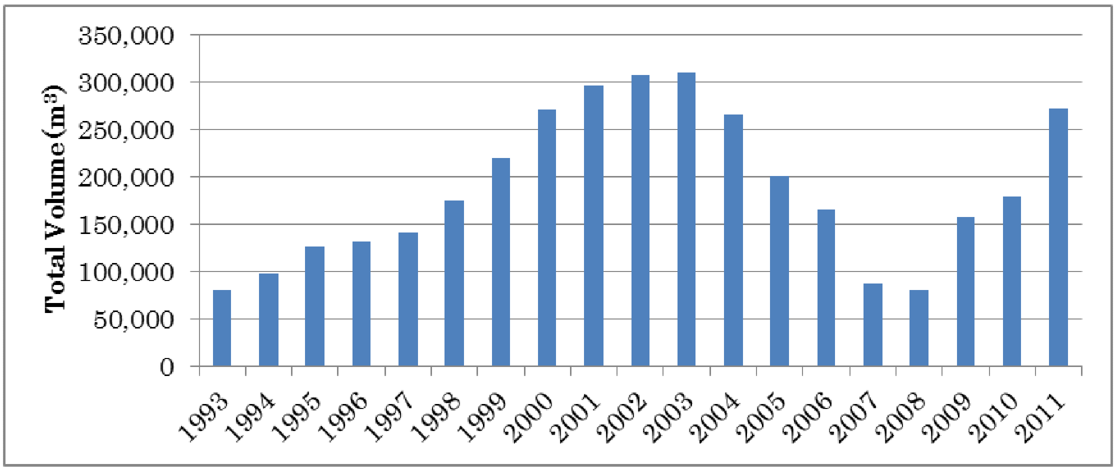
6.1.5 Waste

(1) Baseline Environment

1) Current status of solid waste generation

As population growth is experienced in Cagayan de Oro City, solid waste generation is also expected to increase. Between the year 2000 to 2010, the average annual population growth rate was pegged at 2.69% as population increased from 461,877 in 2000 to 641,877 in 2010 (NSO, 2010). The total number of households in Cagayan de Oro City is 120,418 as of December 2011 (Machado 2012).

An ADB and CDI-funded pre-feasibility study conducted by Idom (2012), a private professional consultancy firm, showed that solid waste collection in the city varied throughout 1993 to 2011. A gradual increase was observed from 1993 to 2003 followed by a decline until 2008 and then increasing significantly until 2011 (Figure 6.1.5).



Source: Idom, 2012, 'Total volume of waste collected between 1993-2011 in Cagayan de Oro City and Sources of solid waste generation as recorded from the waste disposed in the dumpsite', graph, in Draft Pre-Feasibility Study on Wastewater, Watershed and Solid Waste Management. Phlippines: Asian Development Bank and Cities Development Initiative for Asia, p. 5.

Figure 6.1.7 Total volume of waste collected between 1993 to 2011 in Cagayan de Oro City

A 17-ha controlled dumpsite facility (CDF) located in Upper Dagong, Barangay Carmen, about 3.5 km from the city proper, services Cagayan de Oro City (Idom 2012; Machada 2012). Although nearby municipalities of Villanueva and Opol are also serviced by the CDF in Barangay Carmen (**Figure 6.1.8**), the amount of solid waste coming from these municipalities are significantly less and deemed negligible in volume compared to the amount of waste generated by Cagayan de Oro City. The land fill bed has about 8 ha and has an estimated capacity of 1.9 MCM (Machada 2012). The dumpsite in Barangay Carmen has been operational for more than 25 years and is almost nearing its maximum capacity (Idom 2012; Machada 2012).

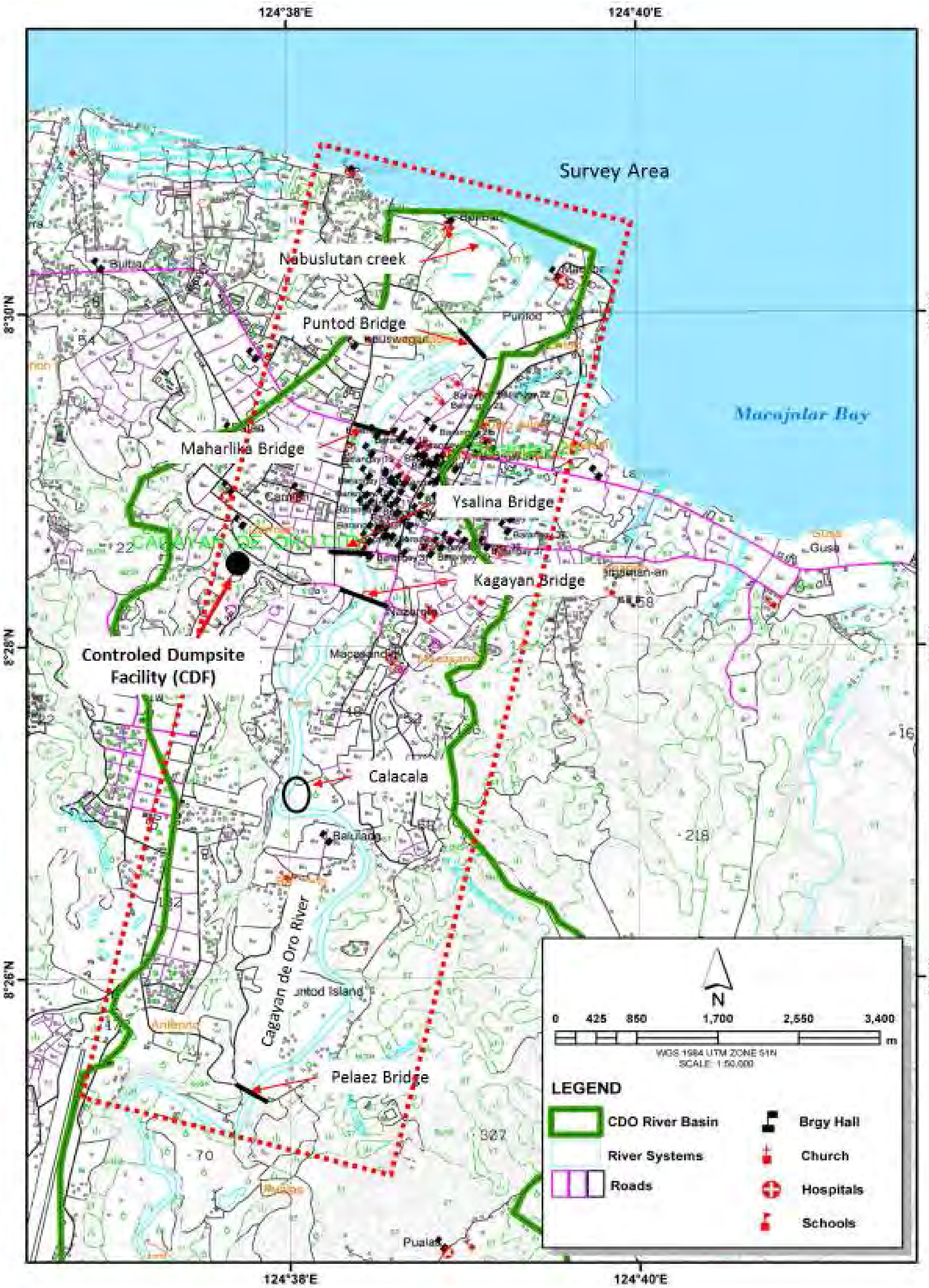
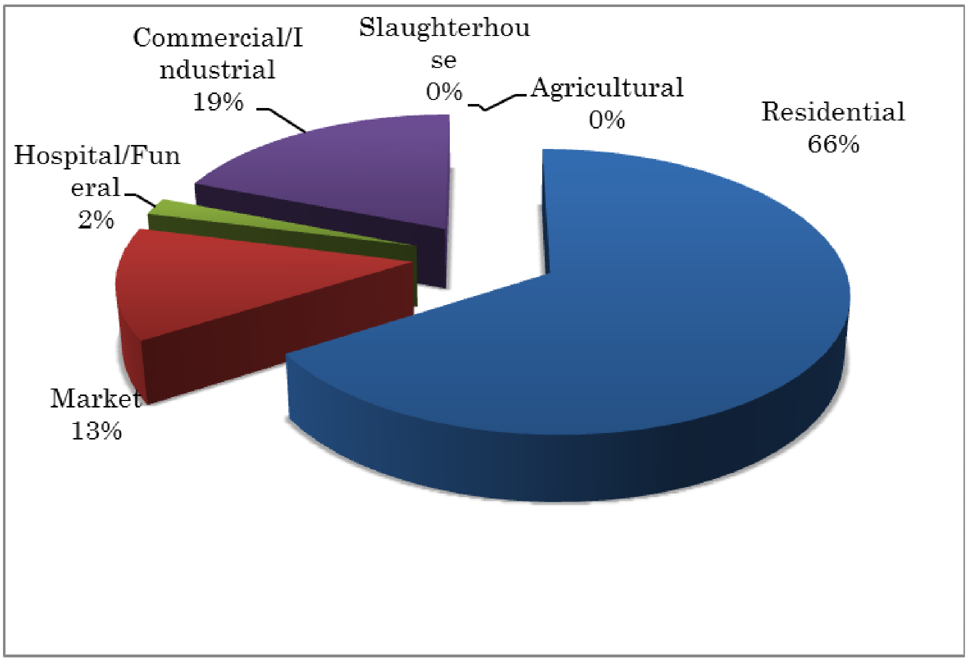


Figure 6.1.8 Location of Controlled Dumpsite Facility in Barangay Carmen

Only 80% of the barangays in Cagayan de Oro City composed of 40 urban barangays and 40 other coastal and hinterland barangays, are serviced by through collection facilities in barangays, private establishments and contractors for garbage collection and hauling (Machada 2012). Majority of the waste comes from residential homes (66%), followed by the combined commercial and industrial entities (16%), markets (13%), and a very small percentage comes from hospitals, funeral homes and slaughter houses (Figure 6.1.9).



Source: Idom, 2012, 'Total volume of waste collected between 1993-2011 in Cagayan de Oro City and Sources of solid waste generation as recorded from the waste disposed in the dumpsite', graph, in Draft Pre-Feasibility Study on Wastewater, Watershed and Solid Waste Management. Phlippines: Asian Development Bank and Cities Development Initiative for Asia, p. 5.

Figure 6.1.9 Percentage of solid waste from various sources disposed in Carmen dumpsite

Findings by Idom (2012) indicate that assuming the generation of 0.5 kg of garbage/per capita/day, which is common in Mindanao, it is predicted that a total of 1,180 m^3 of solid waste would have been generated daily in 2011. However, only 272,836 m^3 or an average of 758 m^3/day (~65%) were collected and brought to the dumpsite in Barangay Carmen. This suggests that a large portion of the solid waste potentially ends up elsewhere. Of the approximately 700 m^3 of garbage collected, 30% are deemed recyclable, 45% are biodegradable and 35% are residual (Machada 2012).

According to Machada (2012), the plan of Cagayan de Oro City for SWM includes:

- Establishing a new Sanitary Land Fill (SLF) in Pagatpat, Cagayan de Oro City for residual waste.
- Conducting Information Education Campaigns on waste segregation in each barangay.

- Establishing a Materials Recovery Facility (MRF) in each baranga (at the moment there are only 3 existing MRFs).
- Reducing waste collection by 25% every year.
- Having minimized or close to zero emissions of methane.

2) Legal basis for Solid Waste Management (SWM)

Relevant laws and city ordinances for the Solid Waste Management (SWM) in Cagayan de Oro City are summarized under **Table 6.1.28**

Table 6.1.28 Laws and City Ordinances relating to Solid Waste Management in Cagayan de Oro City

No.	Law / Regulation	Description
1	The Ecological Solid Waste Management Act of 2000/Republic Act 9003 (RA 9003) and its Implementing Rules and Regulations (IRR), Department of Environment and Natural Resources Administrative Order (DAO) no. 34, series of 2001 or DAO 2001-34	An Act Providing for an Ecological Solid Waste Management Program, Creating Necessary Institutional Mechanisms, Incentives, Declaring Certain Acts Prohibited, Providing Penalties, Appropriating Funds Thereof, and Other Purposes
2	Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990/Republic Act 6969 (RA 6969) and its IRR, DAO 92-29	An Act to Control Toxic Substances and Hazardous and Nuclear Wastes, Providing Penalties for Violations Thereof, and for Other Purposes
3	Cagayan de Oro City Ordinance 8975	An Ordinance Requiring the Mandatory Segregation of Waste at Source and Providing Penalty for Violation Thereof and for Other Purposes
4	Cagayan de Oro City Ordinance No. 11556-2009	An Ordinance Further Amending the Section 202 (1) (C) and (D) Under Article UU: Service Charge for Garbage Collection, of Ordinance No. 88-2003, Otherwise, Known as The Cagayan de Oro City Revenue Code of 2003, As Amended, So As To Exempt Commercial, Industrial Establishments, Companies, Institutions and Building Contractors with Cagayan de Oro City from Payment of Disposal/Dumping/Tipping Fees for Disposing Garbage in Bulk at the City's Controlled Dumpsite Using Their Own Trucks or Other Vehicles and Personnel, and for Other Purposes

By virtue of RA 9003, the SWM system of Cagayan de Oro City should include the following:

- Segregation at source
- Segregated collection
- Establishment of a Materials Recovery Facility (MRF) in all Barangays or Barangay Clusters

- Recycling
- Composting
- Establishment of appropriate disposal sites
- Prohibition of burning of waste (also mentioned in Clean Air Act of 1999 or RA 8749)

The transport, handling, storage and disposal of hazardous waste (hazwaste) are regulated by the DENR under RA 6969. This law requires hazwaste generators to obtain a Hazwaste Generators ID, transport/handle hazwaste through DENR-licensed hazwaste transporters/handlers and treat/dispose hazwaste at appropriate DENR-licensed treatment/disposal facilities.

Both City Ordinances 8975 and 11556-2009 are enacted as compliance to rules under RA 9003 devolving the task of solid waste management to LGUs and including waste segregation at source.

3) Waste Collection System in Cagayan de Oro City

The City Local Environment and Natural Resources Office (CLENRO), which is under the Solid Waste Management Division, oversees the implementation of Cagayan de Oro's SWM Plan (SWMP). Since 2012, collection of solid waste was privatized and handled by a hauling contractor Basura Atbp., Inc. (BAI). Only 64 out of 80 barangays are serviced by BAI because the remaining 16 barangays are in remote locations and mostly have agricultural waste that can easily be managed by the respective barangays. Collection and transport of solid waste is done daily and the cost for transport from the barangay to the CDF in Carmen costs 348.40 PHP/m^3.

Mr Julian of the Cagayan de Oro City Hall mentioned that industrial waste is dealt with by respective industries in Cagayan de Oro City and often brought to Cebu for treatment and disposal since there is very little industrial waste generation in Cagayan de Oro City (personal communication, 18 September 2013)

4) Issues on Solid Waste Disposal in Cagayan de Oro City

An SWMP and several SWM programs have been drafted in 2006 for Cagayan de Oro City. The following are issues noted on solid waste disposal in Cagayan de Oro City, based on the findings of Idom (2012) and Machada (2012):

- The 2006 SWMP has not yet been implemented fully and the current SWM system of Cagayan de Oro City fails to comply with all the requirements of RA 9003, mostly due to lack of awareness, lack of resources and other political and administrative hindrances.
- Some efforts geared towards promoting SWM in Cagayan de Oro City were negatively affected following the occurrence of Typhoon Sendong in 2011.
- With the continuing increase in population and Carmen CDF nearing its capacity, the SWMP must be updated and investments for infrastructure and funding operations are needed.

(2) Potential Impacts

The potential impacts of the implementation of the Project regarding the waste are the following:

- Impacts associated with the waste generation due to the demolition of existing buildings and infrastructures within the river area and ROW for the construction of structures (dike and floodwall),
- Impacts associated with the wastes generation from the cut trees including trunks, leaves and roots necessary within the ROW for the construction of structures (dike and floodwall),
- Impacts associated with the wastes to be generated from the construction works and contractor's offices.

Possibility of the increase of illegal waste dumping during the operation phase can be avoided by maintenance activity by the Proponent in collaboration with concerned LGUs and police.

1) Impacts of the wastes due to the demolition of existing structures

Types of the wastes to be generated from the demolished structures (individual houses, offices and infrastructures, etc.) in the affected areas include the following:

- Galvanized iron (G.I.) Sheet,
- Deformed Bar,
- Plastics,
- Poly Vinyl Chloride,
- Wood / Timber,
- Concrete / Asphalt
- Miscellaneous (paper, tarpaulin, used clothes, etc.)
- Electric appliances.

Among the items above, regarding G.I. sheet, Deformed bar and Plastics, almost all of the waste materials can be re-used or recycled and therefore the wastes generation from these items are minimal. As for Poly Vinyl Chloride and Wood/Timber, On the other hand, all the materials cannot be re-used or recycled, but approx. one third (1/3), at least, of the existing materials is estimated to be generated as waste. As to the concrete /asphalt, almost all of the used materials are to be disposed as waste. But they can be used as backfill material or reclamation under the permission of the land owner and the Project Proponent as long as the materials have appropriate characteristics as backfill materials. Regarding the miscellaneous materials, such as paper, tarpaulin, used clothes, etc. high percentage of them can be reused or recycled by the owner of the house / offices to be demolished. Only the totally unusable materials will be thrown out.

Consequently, even though most of the materials to be generated from the affected buildings can be reused and/or recycled, it is estimated that residual wastes will become a substantial amount, considering the number of buildings to be demolished, namely approx. 1,200 units.

As for the electric appliances, they are considered valuable items and not discarded by owners unless totally unusable in the Philippines,. Most non-functional appliances are being reconditioned and sold as second-hand items or broken down into reusable parts and used to refurbish other salvageable units. Electrical appliances, whether functional or non-functional may be auctioned, sold out to recyclers or junkshops or given out free to takers. Thus, it is estimated that the residual wastes of electrical appliances will be limited only to the totally unusable ones.

2) Impacts of the waste from the cut trees

First of all, tree cutting needs permission from DENR and concerned LGUs. Cutting tree can be done when it is inevitable and after obtaining DENR and concerned LGUs.

The bulk of wastes from tree cutting activities, mostly in the form of logs and branches are valuable and mostly usable. Especially if mangrove trees, even the branches will have takers as these may be used as fuel for cooking or else converted to charcoal.

As for the logs and other valuable trees, therefore, the owner may want to have the right to use the logs and tree branches. If owned by the government, e.g., the LGU, the DPWH or the DENR, the owner may want to get the logs (and branches) as well. If to be paid for by the project, the DPWH has custody. Whoever is the legal land owner should be consulted on what they plan to do with the cut trees at the land procurement process or at least before the construction work.

The residual wastes, in the form of twigs, leaves and roots are biodegradable. These are essential for composting. They are to be brought to the nearby composting site around the project area.

3) Impacts of the wastes to be generated from the construction works

Types of the wastes to be generated during the construction works including the Contractor office and accommodation if any include the following:

- Iron / other metals,
- Plastics,
- Wood / timber,
- Concrete debris,
- Soil, sand and gravel,
- Excavated / dredged materials from the CDO River,
- General waste (paper, garb age, etc.)
- Liquid waste (human waste)
- Oil and grease /other chemical waste, if any.

Among the items above, regarding Iron/other metals, Plastics, and Wood/timber, the volume of generation as waste will be minimal because all the necessary volume or products can be procured by the project. The residual volume can be recycles as materials.

Concrete debris, soil and sand as the surplus of being used in the construction work sites will be generated. These materials, if they cannot be back materials, shall be disposed as construction waste.

The excavated / dredged materials from the riverbed will be transported and disposed to the designated disposal site. The candidate locations of the disposal area are shown in Sec. 6.1.4 above.

As for the general wastes including paper, garbage, etc. to be generated from the offices and accommodation will be collected and disposed by the accredited waste contractor based on the CDO City's waste disposal system.

Liquid waste (human waste) will be treated in the septic tank installed in the base camp / construction yard and accommodation facility.

Regarding the oil and grease to be generated during the process of maintenance activity of vehicles and heavy equipment, can be re-used and/or recycled and therefore the residual volume to be generated as waste oil will be minimal.

The other chemical waste including paint and solvent containers, in case of used and generated, are temporarily stocked under strictly managed, and delegated to be accredited waste contractor.

(2) Mitigation Measures

The potential impacts of the implementation of the Project regarding the waste are the following:

1) Mitigation measures for potential impacts of the wastes to be generated due to the demolition of structures in the affected areas

- Reduction of wastes generation by segregation, re-use and recycling the existing materials used in the demolished buildings and infrastructures in the affected areas. In this connection, the collected metals, deformed bars and plastics can be sold in the Junkshop in the CDO City.
- Reduction of wastes can be facilitated through the auction, selling to recycler and/or junkshop. The following materials are usually included as tradable items: scrap paper, cardboard, empty ink and toner cartridge, plastics, used batteries, including electrical appliances.
- Appropriate treatment and disposal of the wastes from demolished structures by delegating to the accredited waste contractor. In this regard, collection, transportation and disposal shall be based on the MOA among the Proponent, CDO City and the Construction Contractor because the wastes from the demolished structures shall not be treated and disposed based on the City's existing waste disposal system.

2) Mitigation measures for potential impacts of the wastes of the cut trees

Reduction of wastes of cut trees by reducing t by the following measures:

- To minimize the area of vegetation clearance by consideration of construction methodology such as:
  - providing a temporary fencing to vegetation that will be retained for limiting land clearing as much as possible,
  - Using markers and fences to direct heavy equipment in the construction site and minimize damage to trees/ vegetation,
  - Affected trees should be transferred to other sites or nearby areas as much as possible

- Burning or incineration of wastes is strictly prohibited by RA 9003. Instead, to reduce the wastes from the cut trees, in the form of twigs, leaves and roots, etc. composting is to be utilized.

3) Mitigation measures for impacts of wastes to be generated from the construction works

Construction wastes to be generated during the construction works shall be managed by the Construction Contractor through appointing a Pollution Control Officer (as general expression of the person in charge), who is in charge of the following measures:

- Reduction of wastes generation by continuous efforts of segregation, re-use and recycling the residual construction materials.
- Prevention of waste scattering by installation of temporary deposit area in the construction yard with an appropriate sheet coverage.
- Construction wastes cannot be collected and transported through City's waste disposal system done by CLENRO, CDO City and accordingly the collection, collection, transportation and disposal shall be based on the MOA among the Proponent, CDO City and the Construction Contractor.
- Appropriate treatment and disposal of the wastes from demolished structures by delegating to the accredited waste contractor.
- Excavated / dredged materials from the CDO River shall be disposed in the disposal area, which is to be developed for this Project or existing one.
- In case to develop a new disposal area, it is necessary to acquire a permission including ECC before the construction works in timely manner based on the requirement of PEISS and instruction of the authority (DENR EMB 10).
- Oil or some chemicals including paint and solvent containers, in case of used and generated, are to be temporarily stocked under strictly managed.
- The used oil and chemical wastes are to be treated based on the accredited waste contractor and appropriately re-used or disposed pursuant to Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990/Republic Act 6969 (RA 6969) and its IRR, DAO 92-29

6.1.6 Traffic

(1) Baseline Environment

1) Survey Method

A) Road Traffic Survey

The traffic survey was conducted for two (2) days over 24-hour period and in all four (4) selected survey locations; Puntod Road (RD01), Kauswagan Road (RD02), Macanhan Road (RD03), and Calacala-Macasandig Road (RD04) as shown on **Figure 6.1.10.**

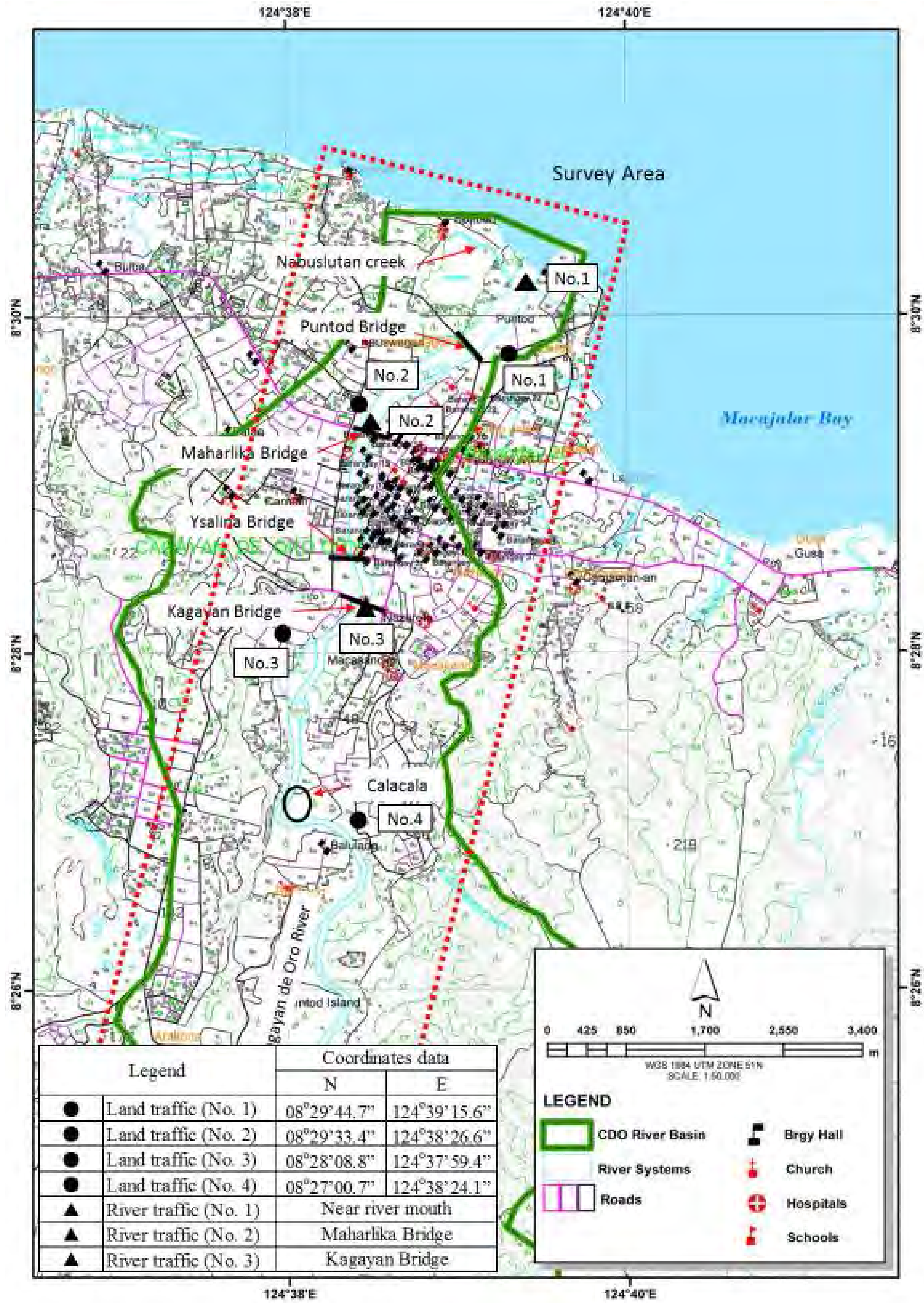
The survey was conducted by visual observation for two days over a 48-hour period from 06:00 on April 3 to 06:00 on April 5, 2013.

The traffic survey form used for the land transport surveys in this Project was adopted from NRTSP. The form classifies 13 different types of vehicles depending on the size and category of passenger or cargo, etc.

Based on the survey results, Average Annual Daily Traffic (AADT) for each of the roads was estimated. The AADTs were computed using the method used by the Department of Public Works and Highways (DPWH). The AADT by vehicle type was converted into equivalent Passenger Car Unit (PCU) using the DPWH PCU values as follows:

- Motorcycle = 0.5 PCU;
- Motorized tricycle = 2.5 PCU;
- Passenger car = 1.0 PCU;
- Passenger utility = 1.5 PCU;
- Goods utility = 1.5 PCU;
- Small bus = 1.5 PCU;
- Large bus = 2.0 PCU;
- Rigid truck = 2.0 PCU;
- Rigid truck (3+ axles) = 2.5 PCU;
- Truck Semi-trailer (all classes) = 3.0 PCU;
- Truck Trailers (all classes) = 3.0 PCU;
- SUV (Sport Utility Vehicle)= 1.5 PCU; and
- Non- motorized tricycle = 0.5 PCU.

After estimating the actual volume of the road in terms of PCUs and the analysis of the capacity, the Level-of-Service (LOS) analysis was conducted by dividing the volume in PCUs with the capacity of a two-lane or multi-lane road under study. Three roads sections in this project were considered two-lane roads and one as four-lane undivided road. However, during the traffic survey, the actual number of lanes were counted and measured in order to collect the right data needed in the LOS analysis.



Legend		Coordinates data	
		N	E
●	Land traffic (No. 1)	08°29'44.7"	124°39'15.6"
●	Land traffic (No. 2)	08°29'33.4"	124°38'26.6"
●	Land traffic (No. 3)	08°28'08.8"	124°37'59.4"
●	Land traffic (No. 4)	08°27'00.7"	124°38'24.1"
▲	River traffic (No. 1)	Near river mouth	
▲	River traffic (No. 2)	Maharlika Bridge	
▲	River traffic (No. 3)	Kagayan Bridge	

Figure 6.1.10 Survey Location of Road Traffic and River Traffic

In this Project, the LOS of the four road sections was defined through the results of the volume/capacity (V/C) ratio evaluation results as follows (Ref. DPWH DO No. 22, series of 2013):

Table 6.1.29 Level of Service Rating Scale

Level of Service Rating	Volume-Capacity Ratio	Indicative Traffic Condition
A	0 – 0.19	Very Light
B	0.20 – 0.44	Light
C	0.45 – 0.69	Moderate
D	0.70 – 0.84	Moderately Heavy
E	0.85 – 1.00	Heavy
F	> 1.00	Very Heavy

B) River Traffic Survey

River traffic along Cagayan de Oro River was conducted to count all vessels passing the three survey locations. The river survey considered the traffic by kind of boat (purpose of boat), by direction (upstream/downstream), and by time regime. The survey (river traffic count) was made at river bank by visual observation.

The survey was conducted at river bank by visual observation for two days over a 24-hour period on April 3 & 4, 2013. The survey locations are the Barra, Macabalan (RS01), near the mouth of the river, in Consolacion (RS02), below Maharlika Bridge, and near City Hall (RS03), below Kagayan Bridge (Refer to Figure 6.1.10).

(2) Traffic Survey Results

1) Road Traffic Survey Results

The computed AADT for each of the four (4) roads are shown in **Table 6.1.30**. The traffic survey results for each of the survey stations, on the other hand, are shown in **Annex**.

2) River Traffic Survey Results

The results of the river traffic survey results were likewise encoded using Microsoft Excel. However, the Consultant provided a format that is easy to understand. Summary of the river traffic survey on three (3) locations are shown in **Table 6.1.8**, while the details are shown in **Annex.**

(3) Traffic Analysis

1) The AADT converted to Passenger Car Units (PCU)

The DPWH measures road capacity in Passenger Car Units (PCU[1]) per hour. Hence, in order to be able to analyze the level of service along each of the roads, it is necessary to convert their respective AADTs (as presented in **Table 6.1.30**) to PCU. Passenger Car Equivalent Factors (PCEF) per vehicle type are used for the conversion. The PCEFs used are based on lengthy studies made by DPWH

[1] *Passenger Car Unit or PCU is a unit of measure which is used to normalize vehicle volumes relative to the size and operational characteristics of a typical four-door sedan (car).*

throughout the country on the effects of the road capacity due to slow moving two-wheeled and three-wheeled motorized and non-motorized transport, the peak hour traffic volume, the effects of heavy vehicles like trucks, the effects of roadside friction/parking, pedestrians, lane width, number of lanes, etc. The same values were also used in this study. The AADT and equivalent PCU's in all four (4) survey locations are shown in **Table 6.1.32**.

2) Road Capacities of Four Road Survey Locations

After estimating the AADTs in PCU for each of the roads, their effective capacities were also analyzed. As per DPWH manual, the capacity of Philippine national roads ranges from 1600 PCU to 2400 PCU per hour. The estimated effective capacities of each of the roads are shown in **Table 6.1.33**.

Table 6.1.30 Survey Results of Road Traffic for the Four Survey Locations

Vehicle Types	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	Non-motorized Tricycle	Total
Puntod Survey Location (R01)														
AADT, veh/day	1,840	2,761	2,110	2,233	354	5	0	433	225	74	76	1,080	0	11,192
Kauswagan Survey Location (R02)														
AADT, veh/day	1,984	2,976	2733	2,364	365	0	2	317	72	37	1	2,053	0	12,903
Macanhan Survey Location (R03)														
AADT, veh/day	3,080	4,621	2,504	2,653	135	1	0	198	46	2	0	886	449	14,126
Calacala, Macasandig Survey Location (R04)														
AADT, veh/day	1,390	154	269	47	18	0	0	44	43	0	0	81	3	2,046

Table 6.1.31 Survey Results of River Traffic for the Three Locations

Location	River Location	Bangka	Fishing Pumpboat		Barges	Passenger Pump Boat		Total
		Non-motorized	Small	Big	Non-Motorized	Small	Big	
Barra, Macabalan	RS01	124	58	11	-	41	-	234
Consolacion (below Maharlika Bridge)	RS02	3	2	4	12	-	-	21
Near City Hall (below Kagayan Bridge)	Rs03	6	3	1	-	-	-	10

Table 6.1.32 AADT and Equivalent PCU's per Road Survey Location

Vehicle Types	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	Non-motorized Tricycle	Total
Puntod Survey Location (R01)														
AADT in vehicles/day	1,840	2,761	2,110	2,233	354	5	0	433	225	74	76	1,080	0	11,192
pcu values	0.5	2.5	1.0	1.5	1.5	1.5	2.0	2.0	2.5	3.0	3.0	1.5	0.5	-
AADT in pcu's	920	6,902	2,110	3,349	532	7	1	867	563	223	227	1,620	0	17,320
Kauswagan Survey Location (R02)														
AADT in vehicles/day	1,984	2,976	2733	2,364	365	0	2	317	72	37	1	2,053	0	12,903
pcu values	0.5	2.5	1.0	1.5	1.5	1.5	2.0	2.0	2.5	3.0	3.0	1.5	0.5	-
AADT in pcu's	992	7,440	2,733	3,547	548	0	4	633	179	111	3	3,080	0	19,268
Macanhan Survey Location (R03)														
AADT in vehicles/day	3,080	4,621	2,504	2,653	135	1	0	198	46	2	0	886	449	14,126
pcu values	0.5	2.5	1.0	1.5	1.5	1.5	2.0	2.0	2.5	3.0	3.0	1.5	0.5	-
AADT in pcu's	1,540	11,551	2,504	3,980	203	1	0	396	114	6	0	1,329	225	21,625
Calacala, Macasandig Survey Location (R04)														
AADT in vehicles/day	1,390	154	269	47	18	0	0	44	43	0	0	81	3	2,046
pcu values	0.5	2.5	1.0	1.5	1.5	1.5	2.0	2.0	2.5	3.0	3.0	1.5	0.5	-
AADT in pcu's	695	386	269	70	28	0	0	88	107	0	0	121	2	1,764

Table 6.1.33 General Characteristics and Estimated Effective Capacity

Road Name	No of Lanes	No of Direction (Traffic Flow)	Total Carriageway Width (in Meters)	Remarks	Estimated Effective Capacity (in PCU/Hour)
Puntod (R01)	2	2	7.0	• This is a well-paved asphalt road. It serves as one of the main access roads leading to the Port of Cagayan de Oro. • Apart from the main carriageway, it has 1.80 meter shoulders on both sides which are also paved with asphalt. • Congestion is observed along this road especially when there is loading and unloading operation at the Port of Cagayan de Oro. During this time, there is a relatively high volume of heavy vehicles.	2,000
Kauswagan (R02)*	2 / 4	2	6.0 / 11.60	• This road is paved with concrete. However, deterioration of the carriageway, i.e. cracks along the pavement, is highly observable. • There are sections of the roads with four (4) lanes. However, majority of the road has only two (2) lanes. Hence, effectively its capacity is equal to the capacity at its narrowest section.	1,800
Macanhan (R03)	2	2	5.0	• This road is paved with concrete. It serves as a local road going to some of the residential barangays of Cagayan De Oro. • It has unpaved shoulders. Also, there is relatively heavy motorized tricycle volume along this road.	1,600
Calacala (R04)	2	2	6.0	• This road is paved with concrete. However, deterioration of the carriageway, i.e. cracks along the pavement, is observable in some sections. • There is relatively heavy motorized tricycle volume since this road caters some of the residential barangays of Cagayan De Oro. • Also, there is no defined shoulder for most section of the road. There are even sections where fences of residential developments are very close, i.e. less than 0.2 meters from the carriageway. Hence, these result in very high roadside friction which limits the road’s effective capacity.	1,600

Note) *: There are some sections of Kauswagan road with four (4) lanes. However, majority of the road has only 2 lanes. Hence, its effective capacity is equal to the capacity of its narrowest section

3) Level of Service (LOS)

The LOS Rating is based on the standards set by the DPWH as shown in **Table 6.1.29.** **U**sing the data in the table, the average hourly and peak hour LOS ratings were determined in **Table 6.1.34**.

Table 6.1.34 Volume – Capacity Ratios and Level of Service Ratings

Road	Average Hourly		Peak Hour	
	VC	LOS	VC	LOS
Puntod (R01)	0.348	B	0.651	C
Kauswagan (R02)	0.430	B	0.806	D
Macanhan (R03)	0.544	C	1.003	F
Calacala (R04)	0.043	A	0.109	A

Source: JICA Survey Team

As shown in **Table 6.1.34**, on the average, all four (4) roads have capacity to accommodate additional demand. However, saturation of capacity is observed during the peak hours along Macanhan Road. Along Kauswagan Road, on the other hand, its effective capacity is near saturated during the peak hours. For the two (2) other roads, i.e Puntod and Calacala, there is still excess capacity even during the peak hours.

4) Analysis result of River Traffic

The analysis of the river traffic shows that Cagayan de Oro City River has minimal boat traffic. Majority of the boats are non-motorized and motorized fishing boat including about 40 passenger pump boats that cater passengers on both sides of the river, namely: Macabalan and Kauswagan.

(2) Potential Impacts

Potential impact on the traffic associated with the implementation of the Project is the following:

- Increase of land traffic by generation of project-related vehicles during the construction phase.
- Potential impact on river traffic including the economic activities such as sand mining and fishing due to the construction activities inside the river including excavation and dredging works.

1) Increase of land traffic by generation of project-related vehicles

According the construction plan, the following projections are given for the estimation of project-related vehicles.

Table 6.1.35 Projection on project-related vehicles during Construction Phase

No.	Project-related vehicles	Nos. to be generated.	Time regime for generation
1	Dump truck for hauling construction materials	28 nos. / day/ package	Time regime for generation: from 08:00 – 17:00 (net 8 hours)
2	Dump truck for hauling excavated/ dredged materials	31 nos./day for package 1	ditto

3	Passenger cars/ passenger utility for laborer	20 nos. / day / package	20 nos. (07:00 – 08:00 and 18:00 -20:00)

Source: JICA Survey Team

As for the prediction of the project-related vehicles, the following assumption was incorporated.

- Regarding the dump truck for hauling construction materials, 28 nos. of trucks will be added to the traffic survey location (refer to **Figure 6.1.10**). Considering one truck needs a round trip between the borrow area and construction site, 56 nos. of trucks will be passing at each survey location. The 56 nos. of dump trucks are to be generated during 8 hours (working hours a day), meaning 7 nos. of trucks is to be generated hourly except for 12:00 – 13:00.
- As for the dump trucks for hauling of excavated/dredged materials, 31 nos. of trucks will be added to the traffic survey location of Puntod and Kauswagan evenly because the location of dredging work is limited to lower river reaches. With this regard, considering one truck needs a round trip between the dredged area and disposal area, 31 nos. of trucks will be passing at the two locations. Accordingly, 4 nos. of trucks is to be added during the working hours in a day as the same as that of dump trucks for hauling construction materials.
- As for the passenger cars/utilities, 20 nos. will be added to commute from accommodation to workplace. In this regards, the time regime of generation will be limited to one hour (07:00 – 08:00) in the morning and two hours in the evening (18:00 -20:00).

These assumptions are summarized in the table below:

Table 6.1.36 Assumption on the consideration of project-related vehicles

Location No. / Barangay	Baseline volume	Dump truck for hauling construction materials.	Passenger cars/ passenger utility for laborer
No. 1 /Puntod	Survey result	Added	Added
No. 2 / Kauswagan	Survey result	Added	Added
No. 3 / Macanhan	Survey result	Added	Added
No. 4 / Calacala	Survey result	Added	Added

Source: JICA Survey Team

Based on this assumption, the future volume of the traffic (future base + project-related one) will be calculated in the form of AADT. Based on the future traffic volume, then, future LOS at the survey location is to be calculated as impact prediction. The results of the future LOS with comparing with the baseline condition are summarized in the table below.

Table 6.1.37 Results of Impact Prediction on Traffic Volume

Road	Baseline / Construction stage	Average Hourly		Peak Hour	
		V/C	LOS	V/C	LOS
Puntod (R01)	Baseline	0.348	B	0.651	C
	Construction stage	0.353	B	0.662	C
Kauswagan (R02)	Baseline	0.430	B	0.806	D
	Construction stage	0.436	B	0.817	D
Macanhan (R03)	Baseline	0.544	C	1.003	F

	Construction stage	0.549	C	1.011	F
Calacala (R04)	Baseline	0.043	A	0.109	A
	Construction stage	0.048	A	0.121	A

Source: JICA Survey Team

It is obvious that the additional traffic volume is not significant at all the locations, and LOS will not be significantly changed accordingly. However, the impacts on land traffic cannot always be evaluated by only the increase of traffic volume. The possibility of the increase of traffic accidents, the inconvenience of daily activities of local people along the transportation route will also be predicted because there are a lot of one way with narrow width along the CDO river.

2) Potential impact on river traffic including the economic activities

Construction works of the project include the construction activities in the river and along the river bank, which might affect to the river traffic such as vessels for fishing, quarrying of sand and gravel from the river bed, and passenger vessels according to the survey results of river traffic. The impact on river traffic would not be minor near the river month, where a total of 234 vessels are observed a day along the stretch of Barangay Macabalan unless appropriate measures are provide.

(3) Mitigation Measures

1) Land Traffic

The impacts on land traffic can be mitigated by the following measures:

- The Project Proponent and the Construction Contractor may coordinate with the concerned LGU for assistance in land and traffic management,
- Appropriate route selection for transportation including establishment of temporary road for construction works,
- Education of drivers and operators to observe and respect driving and operation manners,
- Adjustments in transportation time of heavy equipment, construction materials, transportation method (by land or in the river), etc.
- Placement of traffic control persons depending on the situation,
- Provide appropriate warning signs, lighting and barricades, whenever practicable,
- Regular communication with local residents about the transportation route, time and frequency of traffic through Information, Education and Communication (IEC) activity.
- Provide on-site medical services and supplies for any emergency, through institutional and administrative arrangements with the barangay health unit.

2) River Traffic

The mitigation measures to avoid the adverse impacts, especially accidents of river traffic such as vessel collision are the following:

- Consultation with concerned LGUs, fisherfolk association, individual fisherman, and sand miners in the CDO River, etc. prior to dredging work and hauling activity of the FRIMP-CDOR.

- Establishment of appropriate procedural manual for river transportation by consulting with the Philippine Coast Guard (PCG), LGUs, and/or other concerned agencies.
- Education of construction workers / verge operators to be used for construction works on proper operation.

6.1.7 Topography, geology and soil erosion

(1) Baseline Environment

1) Survey Method

The survey on topography, geology and soil erosion was done through the following method:

- Analysis of (National Mapping and Resource Information Authority (NAMRIA) topography map.
- Analysis of aero-photos image developed in this JICA Survey,
- Geological survey by borehole drilling conducted in this JICA Survey,
- General collection of the information on occurrence of soil erosion along the CDO River.

2) Survey Results

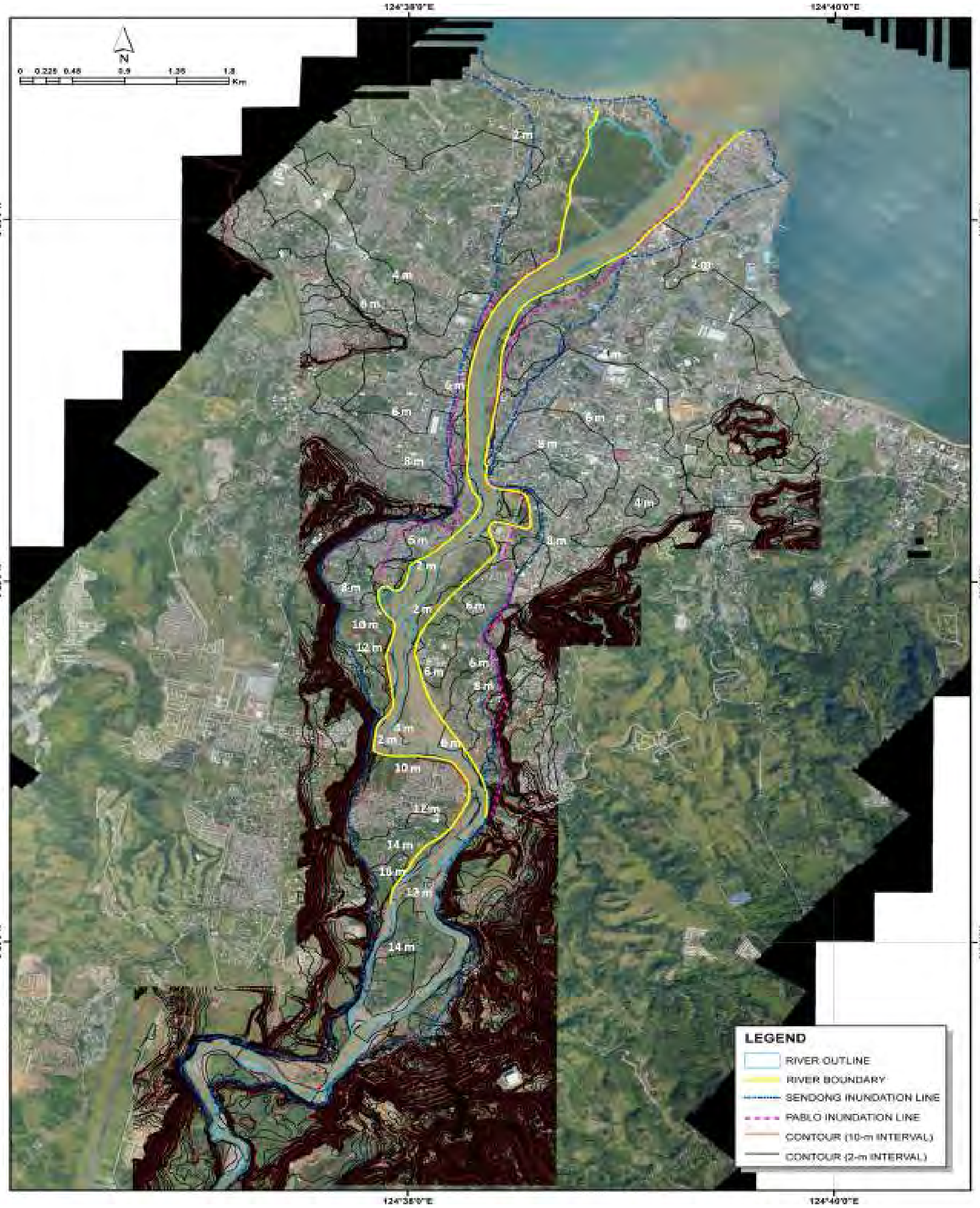
1) Topography

A) Elevation and Slope

Figure 6.1.11 shows the topographic elevation map along the CDO River. The altitude along the CDO River from the river mouth to the Pelaez Bridge is about 2 to 4 m at the Kagayan Bridge and more or less 12 to 14 m at the Pelaez Bridge as shown on the figure.

The topography of the downstream area of the Kagayan Bridge is more like delta where the altitude of the ground level is gradually lowering from more or less 8 m, to 0 m, or the sea level along the sea shore. At the upstream of the Kagayan Bridge up to Pelaez Bridge, the topography along the river is more like valley with the wide flood plain with the width of approx. 500 m to 1,500 m. The flood plain is bounded by steep slope along the outside of the flood plain. The height of the hill is higher than 100 m at around SM super market located west of the CDO River.

As for the Cagayan de Oro River, total river length of the main river is 97 km from its origin to the river mouth with steep riverbed slope of 1/1-1/40 in the upstream of 76 km, mild slope of 1/40-1/190 between 19 and 76 km and gentle slope of 1/190-1/4000 in the downstream of 19 km.



Source: JICA Survey Team

Figure 6.1.11 Topographic Elevation Map along the CDO River in the Project Area

2) Geology

JICA Survey Team conducted the geological survey along the CDO River in Oct. to Nov. 2012 and Jul. to Aug. 2013. The geological survey was conducted by borehole drilling consisting as shown on **Figure 6.1.12**.

Based on the analysis results of the geological survey, geological features along the CDO river is summarized as follows (refer to **Table 6.1.38**):

The entire stretch of the downstream of CDO River is covered with varying thicknesses of loose sediments, mainly composed of sand and silt in the downstream area from the river mouth until the Pelaez Bridge.

The results of Standard Penetration Test shows that the lower river stretches, especially the downstream of Kagayan Bridge, N values are less than 10 in the depth until 10m, and most of which are less than 5 at shallower depth (more or less 5 m from the ground level).

The loose non-plastic granular deposits and high water table at the downstream area would tend to indicate that the liquefaction phenomenon could be concern with regards to foundation stability.

3) Soil Erosion

There is no information of the occurrence of soil erosion with a certain magnitude along the CDO River from the river mouth until Pelaez Bridge obtained in the course of the Survey.

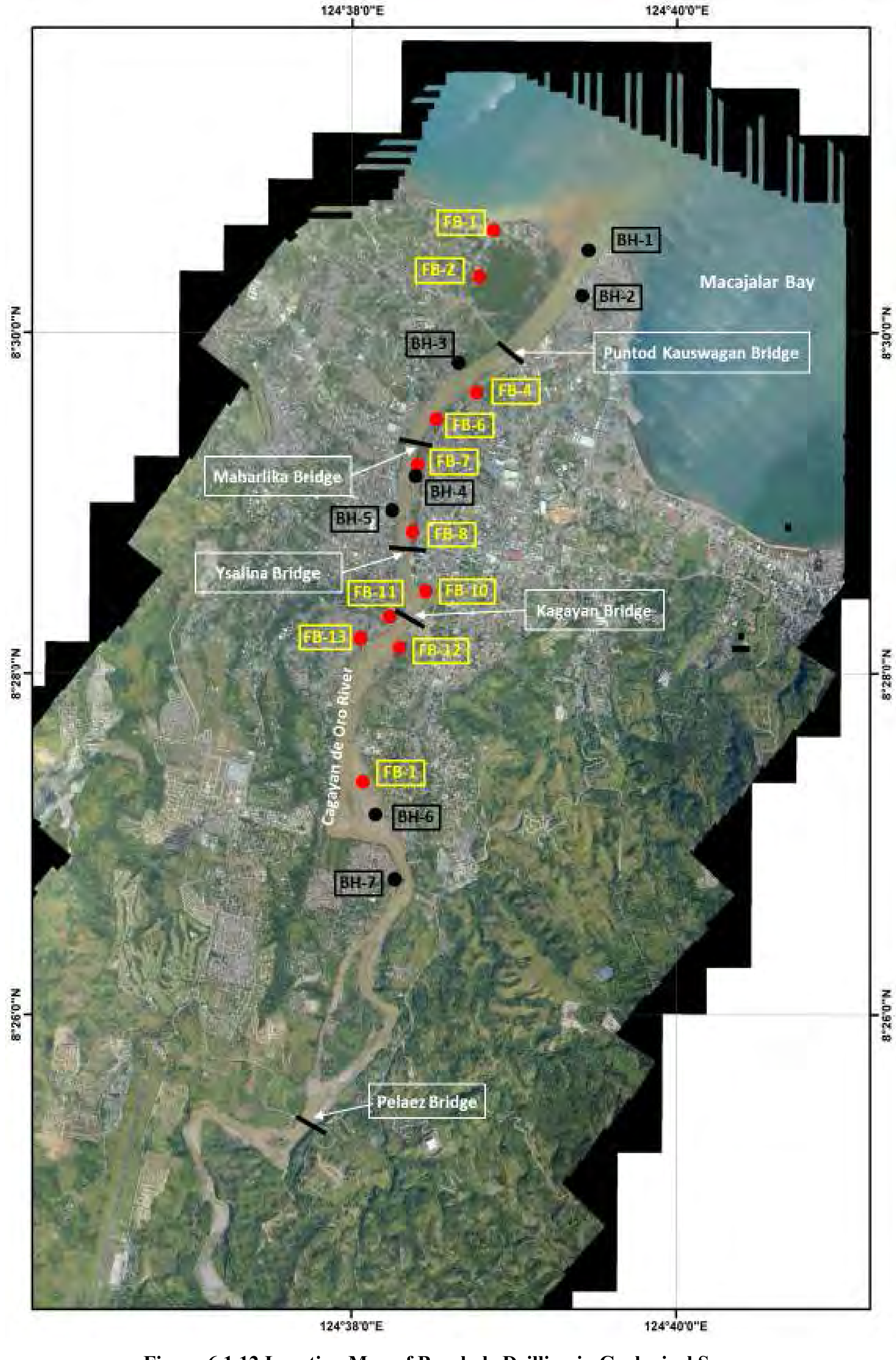


Figure 6.1.12 Location Map of Borehole Drilling in Geological Survey

Table 6.1.38 Result of Geology Investigation (Geology and Standard Penetration Test)

	BH-1	BH-2	BH-3	BH-4
Depth (m)	30	10	10	10
5.0	Fine-medium sand with fine gravel Gray N : 10 (4.55-5.0)	Silty Sand Gray N : 4 (5.0-5.45)	Sand and Gravel Gray N : 5 (4.55-5.0)	Silty Sand Dark gray N : 4 (5.0-5.45)
10.0	Sandy Silt Dark brown N : 8 (10.0-10.45)	Clayey Silt with sand Gray N : 4 (9.55-10.0)	Gravel with sand Gray N : 7 (9.55-10.0)	Sandy Gravel Dark gray N : 13 (9.55-10.0)
12.5	Silty Sand Dark gray N : 9 (12.0-12.45)			
15.0	Sand and Silt Gray N : 9 (14.55-15.0)			
17.5	Sandy Silt Gray N : 11 (17.05-17.5)			
20.0	Silt with Sand Glayish brown N : 12 (20.0-20.45)			
22.5	Clayey Silt Gray N : 6 (22.05-22.5)			
25.0	Clayey Silt Gray N : 11 (25.0-25.45)			
27.5	Clayey Silt Gray N : 9 (27.05-27.5)			
30.0	Clayey Silt Gray N : 11 (29.55-30.0)			

	BH-5	BH-6	BH-7	BH-8
Depth (m)	10	10	2.61	10
5.0	Fine-medium Sand with silt Gray N : 7 (5.0-5.45)	Clayey Silt Gray N : 8 (4.55-5.0)	Gravel Gray N > 50 (2.5-2.61)	Boulder (basaltic andesite) Gray
10.0	Gravel with sand Gray N : 20 (9.55-10.0)			Boulder (basaltic andesite) Gray

Legend

Clayey Silt	Sandy Silt Silt with Sand	Silty Sand Sand with silt Sand and Silt	with fine gravel Sand and Gravel	Gravel Sandy Gravel Gravel with sand	Boulder

(mm)

Clay	0.005	Silt	0.075	Sand: Fine	0.25	Sand: Middle	0.85	Sand: Coarse	2	Gravel: Fine	4.75	Gravel: Middle	19	Gravel: Coarse	75	Cobble

Source: the Survey Team

(2) Potential Impacts

Impact sources of the potential impacts on topography, geology and soil erosion due to the implementation of the Project include the following:

- Vegetation clearance with the total estimated area of approx.7.1 ha in the ROW for the construction of structures for river improvement,
- Excavation and embankment for construction of dike and floodwall,
- Backfilling at along the project facilities especially floodwall.
- Temporary stock of construction / backfilling materials in the construction yard,
- Temporal stock of excavated / dredged materials in the temporal disposal area / staging area,
- Construction of dike system along the CDO River with the total length of approx. 1.9 km with the average height of about 3.5 m at maximum based on the typical cross section,
- Construction of floodwall along the CDO River with the total length of approx. 4.7 km with the average height of about 3.0 m at maximum based on typical cross section,

Due to these activities and impact sources above, the following potential impacts are predicted to occur unless appropriate mitigation measures are provided during the contraction stage:

- Topographic modification along the CDO River with the total length of approx. 16.6 km with the average height of about 3.0 - 3.5 m,
- Geologic modification along the dike and floodwall construction site, especially along the shallow ground surface by excavation and soil removal for improvement of soft ground or construction itself of the structures during construction phase,
- Potential soil erosion over the area of vegetation clearance, embankment and excavation for the construction of dike and floodwall, especially during the rainy season and rainfalls with high intensity is anticipated although it is temporary one during the construction phase owing to the river bank protection works are incorporated in the dike and floodwall.
- The location of the potential impacts of soil erosion would generate over the structures (dike and floodwall) along the river banks shown on **Figure 6.1.13.**

(3) Mitigation Measures

Mitigation measures for the potential impacts on topography, geology and soil erosion include the following:

- Due consideration of soil condition of the construction materials for detailed design of dikes and floodwall, taking into account the dimension (slope) of dike and floodwall
- To minimize the area of vegetation clearance by consideration of construction methodology,
- Providing a temporary fencing to vegetation that will be retained for limiting land clearing as much as possible,
- Using markers and fences to direct heavy equipment in the construction site and minimize damage to trees/ vegetation,
- To enhance the general environment of the Project Site, greening of its vicinity may be implemented,
- To avoid the construction works during rainy season or rainy day as much as possible,
- To conduct careful grading and clearing of the site for minimizing slope, and greening after grading/ clearing of the site,
- Installation of temporary dike and drainage at the boundary of periphery of project site,
- Use of silt fences on all disturbed areas to minimize erosion and siltation into adjacent streams, rivers, or bodies of water.

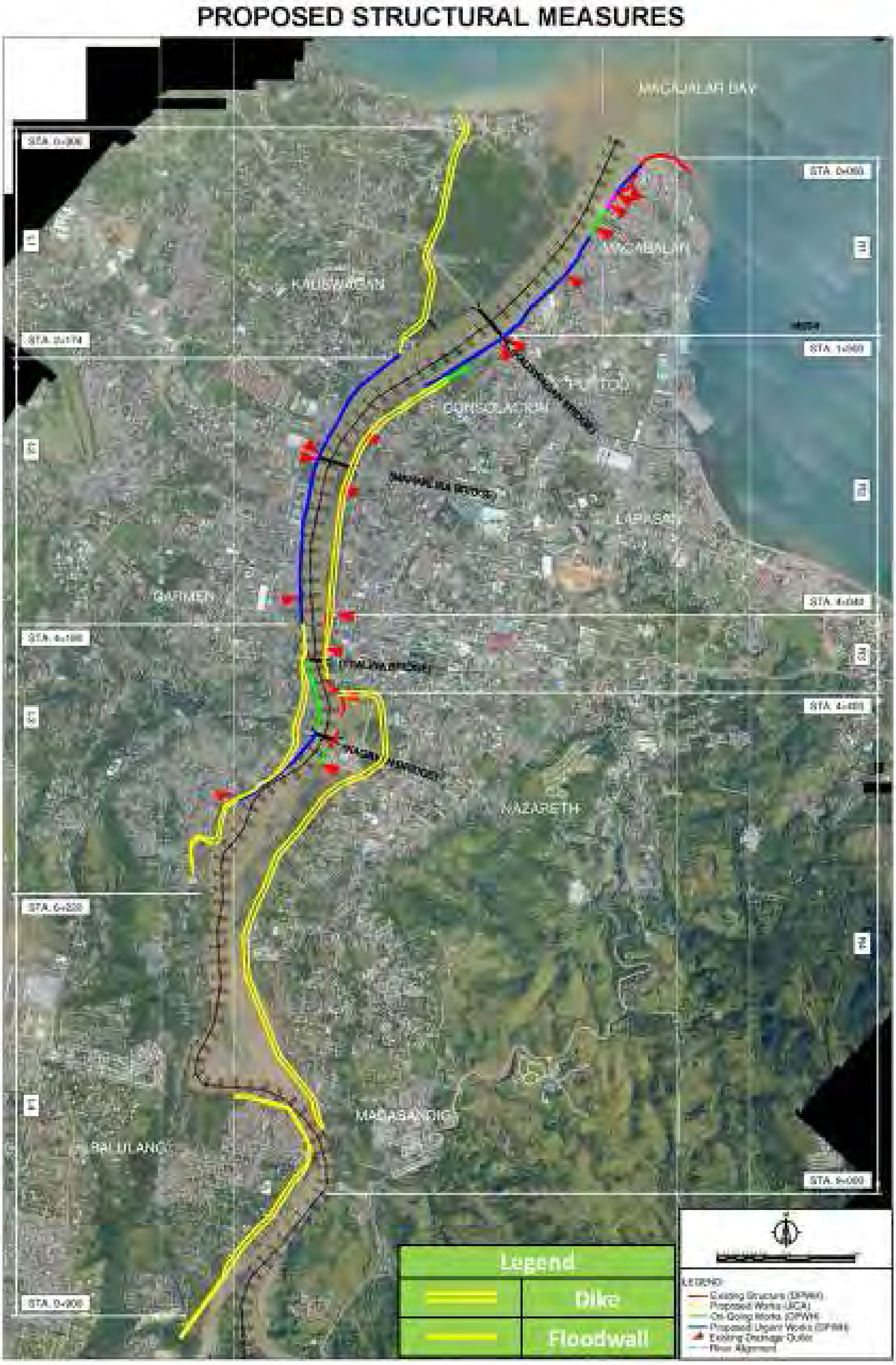


Figure 6.1.13 Planned Location of Dike and Floodwall of the Project

6.1.8 Groundwater

(1) Baseline Environment

1) Aquifers of Groundwater

A) Survey Method

There are two groundwater aquifers in the survey area as the same as in general case: one is shallow (unconfined) groundwater aquifer and the other is deep groundwater aquifer. JICA Survey Team surveyed the groundwater level of the shallow groundwater along the river associated with geological survey. The geological survey was conducted by borehole drilling in Oct. to Nov. 2012 and Jul. to Aug. 2013. Details of the survey are described in the previous section "6.1.7 Topography, geology and soil erosion."

B) Survey Results

Table below summarizes the groundwater level surveyed at the boreholes of the geological survey in Jul. to Aug. 2013. (The groundwater level during the geological survey in Oct. to Nov. 2012, the groundwater level was not surveyed in detail.)

Based on the data, groundwater level of shallow groundwater are more or less than 1.0 m at the area downstream of Maharlika Bridge (FB-1 to FB-6), and between 1.0 m to 2.0 m in the area between Maharlika Bridge and Kagayan Bridge (FB-7 to FB-12), and it deeper than 3.0 m in the upstream of Kagayan Bridge (FB-13 to FB-14). With this regard, it should be noted that the locations of boreholes are apart from the river channel.

Table 6.1.39 Groundwater level in the boreholes based on geological survey (Jul. to Aug. 2013)

Location	Ground elevation (m)	Groundwater level (Ground Level - m)	Groundwater elevation (m)	Remarks
FB-1	1.934	1.01	0.924	
FB-2	1.139	0.38	0.759	
FB-4	1.064	0.70	0.364	
FB-6	1.168	0.69	0.478	
FB-7	2.825	2.15	0.675	
FB-8	2.482	-	-	No available data
FB-10	1.673	1.38	0.293	
FB-11	8.857	2.03	6.827	Location at abutment of Kagayan Bridge
FB-12	3.986	1.72	2.266	Location near the Chinese Temple
FB-13	3.155	3.05	0.105	
FB-14	5.110	4.51	0.600	

Source: JICA Survey Team

As for the deep aquifer of groundwater, on the other hand, the current groundwater situation are as follows according to the data of Cagayan de Oro Water District (COWD) who possesses deep wells for water supply of the CDO City (refer to Sec. 3.1.6 for the details):

- The depth of groundwater well ranges from 150 to 250 m from the ground level in general.
- Groundwater level and yield of the groundwater from the wells are almost stable or have a tendency of gradually decreasing although its gradient is little.
- There is no critical issue on groundwater use and its distribution to Cagayan de Oro City.

2) Groundwater Quality

A) Survey Method

Water sampling and laboratory analysis for shallow groundwater was carried out in order to survey the baseline condition of groundwater quality. Sampling was conducted on August 29, 2013 for four (4) sampling stations at existing wells being used by the community within the area near the Project area. Sampling stations are located in the following barangays: 1) Brgy. Macasandig, 2) Brgy. Carmen, 3) Brgy. Consolacion and 4) Brgy. Kauswagan. The location map is shown in **Figure 6.1.14.**

Sampling was done by using a container to take the water in the shallow wells. The water taken from the wells were sent to CRL Environmental Laboratory, a DENR accredited laboratory, for laboratory analyses in accordance with the standard methods for examining Water and Wastewater (AWWA), APHA, WEF, 21st Edition (DENR-EMB Modified) while in-situ measurement was conducted using Hach portable equipment for the parameters of Temperature, pH, DO, Conductivity and Total Dissolved Solids (TDS). The parameters analyzed/tested are presented in the table below:

Table 6.1.40 Physico-Chemical Parameters for Groundwater Quality

For Laboratory Analysis	In-Situ Measurement
1. Biochemical Oxygen Demand (BOD)	1. Temperature
2. Chemical Oxygen Demand (COD)	2. pH
3. Total Suspended Solids (TSS)	3. Dissolved Oxygen (DO)
4. Oil and grease	4. Conductivity
5. Nitrate	5. Total Dissolved Solids (TDS)
6. Phosphate	
7. Total coliform	
8. Fecal coliform	
9. Heavy metals such as copper (Cu), chromium (Cr), mercury (Hg), lead (Pb), cadmium (Cd), cyanide (CN) and arsenic (As)	

The results of the water quality analyses were compared to the Philippine National Standards for Drinking Standards (PNSDW), 2007, to verify the suit along the Project areas as portable water.

In addition, the interview with the well owner / users was carried out to obtain the data / information on the usage of wells and the groundwater level if available.

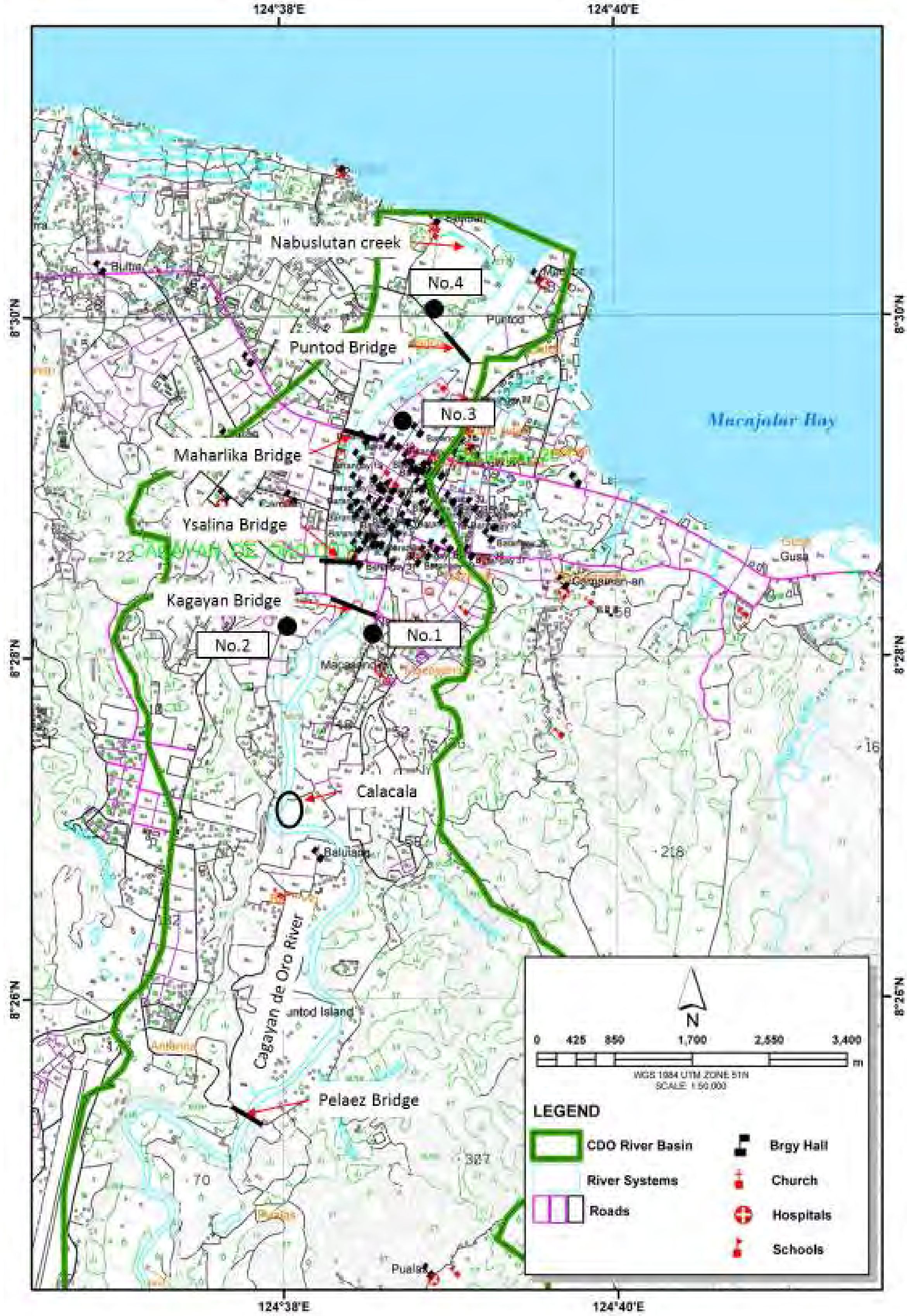


Figure 6.1.14 Sampling Location of Groundwater Quality Survey

B) Survey Results

The result of the water quality analysis is presented in the table below. The Certificate of Analysis issued by the laboratory is attached in **Annex.**

Table 6.1.41 Summary of Survey Results of Groundwater Quality

Parameters	Units	PNSDW*	Sampling Stations			
			GW 1 - Brgy. Macasandig	GW 2 - Brgy. Carmen	GW 3 - Brgy. Consolacion	GW 4 - Brgy. Kauswagan
			8°28'2.1"N 124°38'29.9"E	08°28'08.1"N 124°37'59.2"E	8°29'27.6 N 124°38'40.7" E	08°30'02.6"N 124°38'58.6"E
Temperature	ºC	-	28.5	29.0	27.7	29.5
pH	--	6.5-8.5	7.28	6.57	7.00	6.81
Dissolved oxygen	mg/L	-	3.04	5.90	1.95	7.89
Biochemical Oxygen Demand	mg/L	-	1	2	8	5
Chemical Oxygen Demand	mg/L	-	4.9	4.9	29	68
TSS	mg/L	-	3.0	<2.5	27	10
TDS	mg/L	500	465	301	622	2,117
Oil and grease	mg/L	-	<0.3	<0.3	0.6	0.5
Nitrate	mg/L	50	17	17	32	2.2
Phosphate	mg/L	-	0.4	0.06	0.8	0.2
Total coliform	MPN/100ml	<1.1	>23	>23	>23	>23
Fecal coliform	MPN/100ml	<1.1	>23	>23	>23	1.1
Copper	mg/L	1.0	<0.02	<0.02	<0.02	<0.02
Arsenic	mg/L	0.01	<0.001	<0.001	0.002	0.001
Cadmium	mg/L	0.003	<0.003	<0.003	<0.003	<0.003
Chromium	mg/L	0.05	<0.02	<0.02	<0.02	<0.02
Cyanide	mg/L	0.07	<0.02	<0.02	<0.02	<0.02
Lead	mg/L	0.01	<0.0001	<0.0001	0.001	0.002
Mercury	mg/L	0.001	<0.0001	<0.0001	<0.0001	<0.0001

Note) * Philippine National Standards for Drinking Water, 2007
- No specified standards

Source: JICA Survey Team

The data of groundwater quality were summarized as below:

a) GW 1 – Brgy. Macasandig

Toxic substances including cyanide, arsenic, cadmium, chromium, copper, lead and mercury are below the maximum limit prescribed in the standards. Moreover, the values obtained for TDS and nitrate pass the allowable levels for drinking water. However, this station is contaminated with bacteria as exhibited by high total coliform and fecal coliform counts. The values obtained for both parameters are above the set standards of <1.1 MPN/100ml.

b) GW 2 – Brgy. Carmen

Results show that the level of nitrate, TDS and toxic substances are within the standard limits for drinking water. The pH level exhibits slightly acidic water but still passes the standard range. The total and fecal coliform contents, the levels exceeded the standard value indicating bacterial contamination into the water.

c) GW 3 – Brgy. Consolacion

The values of pH, nitrate and toxic substances are well within the permissible limit of the PNSDW. Unlike Station 1 and Station 2, the acquired TDS level exceeds the 500mg/L requirement for drinking water. The results also show bacterial contamination on the water exhibited by high total coliform and fecal coliform counts. The values exceeded the standard requirement of <1.1 MPN/100ml.

d) GW 4 – Brgy. Kauswagan

Concentration of toxic substances are below as compared with the standard values. However, the TDS level obtained for this station is above the standards having a value of 2,117mg/L. The high TDS value can be attributed to the manner the well was constructed. Unlike the other shallow wells which are made of concrete, this is made of rubber and situated in a soil making it susceptible to contamination of solids.

Consistently, the total coliform count is high and does not meet the standard requirement value. Fecal coliform, on the other hand, is relatively low compared with the other stations but still do not fall within the drinking standards.

e) Summary of groundwater quality

In summary, most of the parameters tested on the selected shallow wells within the Project affected barangays passed the Philippine National Standards for Drinking Water, 2007. However, concentration of total and fecal coliform exceeded the standard values. The presence of fecal coliform indicates that there might be contamination in the groundwater by human sewage or animal wastes containing bacteria, viruses or disease causing organisms. This indicates that the groundwater is not suitable for drinking purposes.

f) Information on groundwater level and usage

According to the interview with the user of the wells, the usage of the groundwater is for domestic activities such as bathing, washing of dishes, washing of clothes and other equipment. The depth of the groundwater is 4.8 m at No.2 (Barangay Macasandig) and 1.3 m at No.1 (Barangay Kauswagan).

(2) Potential Impacts

Construction works of the structural measures of the Project do not include groundwater pumping, deep excavation or tunneling work. It is, therefore, not considered the groundwater depletion or lowering of groundwater level due to the construction works.

Instead, during the construction works of dike and floodwall for river improvement, concrete sheet pile is to be used as the foundation work. The depth of the sheet pile is to be more or less 9 – 12 m and the depth of piling will be more or less 7 – 10 m from the ground level according to the construction plan.

The potential impact on the groundwater in this project, therefore, is:

- Obstruction of groundwater flow of the shallow groundwater,

because the depth of groundwater is shallower than the depth of piling along the river channel as shown in **Table 6.1.39.**

As to the deep groundwater, it is predicted that there will be no impact considering the depth of piling work.

During the piling work or other construction works, no chemical grouting or no other chemical works will be adopted. The impacts on the groundwater quality will not be brought about.

Thus, the potential impact of obstruction of the groundwater flow on the shallow groundwater is examined below:

The location of piling works in the Project is planned along the dike and floodwall as shown on **Figure 6.1.15** according to the construction plan of this Project. Groundwater flow of shallow groundwater is directed from higher to lower elevation in general following the topographic slope direction. In the project area including the vicinity of CDO River, therefore, it is estimated that shallow groundwater flows from south to north direction as a whole in parallel with the flow direction of the river. This means that the direction of the sheet piling and the groundwater flow have basically the same/similar direction, which suggests that the possibility of hindrance of groundwater is minor considering the depth of sheet piling of approx. less than 10 m which was estimated depth of sheet piles as described on the precious page.

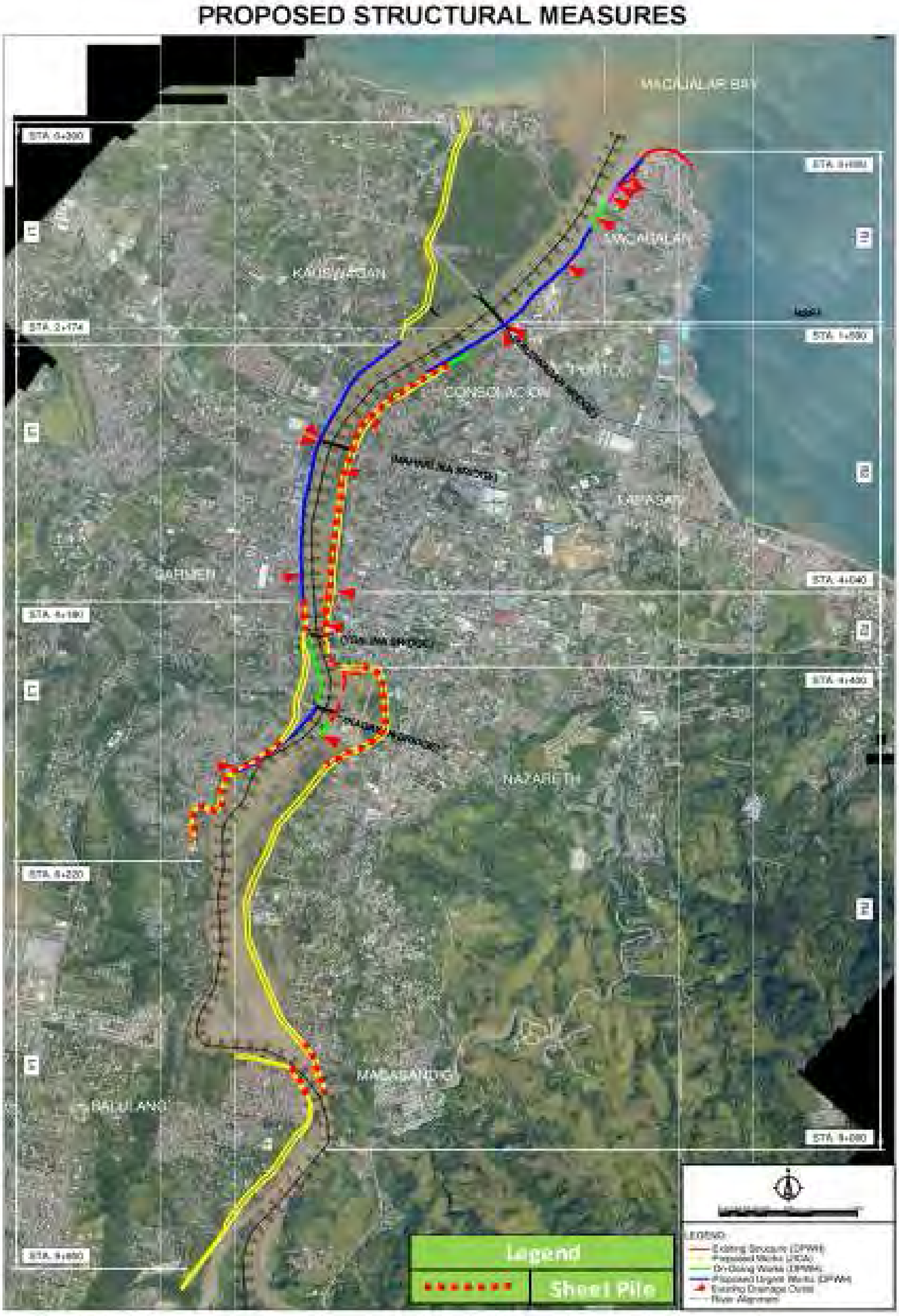


Figure 6.1.15 Location of Sheet Piling in the Project

(3) Mitigation Measures

Although the impacts on groundwater flow or groundwater quality is predicted to be minor or no impact, the possibility of the impacts cannot be always denied completely because the phenomenon of the impacts on the groundwater occur underground, which often unpredictable phenomenon happen. Thus, continuous monitoring of groundwater flow is important and effective as a mitigation measure. The details of the monitoring plan of groundwater are described in Chap. 9.

6.1.9 Odor

(1) Baseline Environment

1) Survey Method

The baseline condition of the odor generation along the CDO River was surveyed through the data collection on current status of sludge accumulation, which is perceived to generate odor to the environment. In addition, gathering of relevant information on actual odor generation was performed, including the following:

- Identification of the evidences on sludge accumulation in the CDO River based on a geological survey,
- Information gathering on existing odor generating sources along the CDO River,
- Observing actual odor generation perceived during the river water sampling and riverbed sediment sampling of the EIA Survey,
- Gathering information from the officials of CDO City and DPWH on the issues of odor generation from the CDO River.

2) Survey Results

According to the results of the geological survey conducted for the Project, geology in the shallow strata is silt, sand or gravel. There is no recognition of a sludge stratum which often generates odor, on the riverbed sediment.

With regard to existing potential odor sources along the riverbank, there were no identified factories that drain industrial waste water. Individual houses and offices, on the other hand, use septic tanks as waste water treatment facility in each lot. However, the percentage of the septic tank usage is low, according to the local community. This implies that the percentage of direct inflow of human waste into the CDO River is potentially large. The high value of coliform counts obtained during the water quality analysis in the EIA Study (refer to Sec. 6.1.3) supports the assertion that wastewater drains into the CDO River without treatment.

Since the CDO River is a tidal river, it is observed that water flows down into the sea (Makajalar Bay) with relatively high velocity especially during ebb tide, which may prevent the sludge from accumulating on the riverbed located on the downstream stretches.

Odor was not perceived during the water sampling or riverbed sampling conducted for the EIA Study. Complaints relating to harmful/bad odor along the CDO River have not been received and have not been a social issue to-date.

(2) Potential Impacts

The potential impacts of the Project on odor include:

- Generation of odor during dredging work from the CDO River.
- Generation of odor from accumulated garbage/wastes during operation phase.

Given the current baseline condition where there are no identified major odor generating sources, like accumulated sludge, along the CDO River, the generation of the offensive odor is not anticipated due to dredging works during construction phase or operation phase even if the operation work is included as maintenance operation of the project.

Regarding the second potential impact, there is a possibility of illegal dumping of garbage along the structures (dikes and floodwalls) to be constructed in the Project during operation phase. However, this can be avoided through waste management and proper maintenance activities in collaboration with concerned LGUs and police.

(3) Mitigation Measures

Mitigation measures for minimizing the odor generation associated with illegal dumping of garbage along the river include the following:

- Appropriate maintenance of construction structures (dike and floodwall) by DPWH in collaboration with LGUs,
- Continuous activity of IEC (Information, Education and Communication) for proper maintenance of the constructed structures by DPWH in collaboration with concerned LGUs,
- Continuous activity of IEC by CDO City and concerned LGUs and police for prohibition of illegal dumping of waste on the public space, especially into the river.

6.1.10 Accidents and Labor Environment

(1) General Information on Occupational Accidents

The Bureau of Working Conditions (BWC) has ranked the construction industry as having recorded the highest number of accidents among the various industry groups. In 1996 alone, construction-related incidents reached 49 cases involving 65 fatalities and 18 worker injuries. In comparison, the manufacturing industry had 22 accidents while the service sector had 10 cases during the same year[a].

BWC records for the period 2007-2012 revealed a steadily increasing number of accidents related to construction, except in 2009 and 2010[b].

Construction accidents are being attributed to (a) construction firms not following DOLE initiatives on construction safety; (b) absence of appropriate and/or incorrect use of personal protective equipment (PPEs); (c) use of substandard construction materials; (d) poor structural design; (e) absence of adequate number of DOLE-accredited safety officers on-site; (f) absence of DOLE-approved Construction Safety and Health Program (CSHP); (g) lack of formal skills training and TESDA certification of heavy equipment workers and workers of critical construction occupations; and (h) use of sub-contractors, whether licensed by PCAB or not that utilizes workers who do not have basic training on Occupational Safety and Health (OSH) and construction safety.

The foregoing emphasizes the need for the implementing agencies of construction projects to strictly implement the occupational safety and health standards, particularly the rules governing safety in the construction industry.

(2) Legal Basis

The Constitution of the Republic of the Philippines mandates the safeguarding of a worker’s social and economic well-being as well as his physical safety and health. To comply with this mandate, the Occupational Safety and Health Standards (OSHS) were passed in 1978. The OSHS was revised in 2006 to respond to worker’s needs in the light of continuing technological innovations that lead to increasing number and types of occupational hazards that Philippine workers are exposed to.

In 2006, the Guidelines Governing Occupational Safety and Health in the Construction Industry better known as DOLE Department Order No. 13 was passed. D.O 13 specifically aims at ensuring the protection and welfare of construction workers, the protection and welfare of the public within and around the immediate vicinity of construction sites, and at promoting harmonious employer-employee relationships.

(3) Management Measures

During the construction stage of the project, there is high probably of incidents or accidents happening at the worksites, particularly at night and during the rainy season. Some common construction site- related accidents and incidents are toppling down of heavy equipment, falls, slips, struck by, electrocution, tripping, and cuts or wounds due to construction machinery. In this project, flash flood, bank erosion and fall into excavation areas are also potential hazards.

To prevent the occurrence of worksite incidents and accidents, the contractor/s to be engaged should be required to strictly adhere to the applicable rules of the OSHS and with DO No. 13. Among others, the contractor/s must be required to:

- Prepare a Construction Health and Safety Plan (CHASP) appropriate to the project. The CHASP shall be executed and verified by the Construction Project Manager and should be submitted to the Bureau of Working Conditions (BWC) of the DOLE for approval. The CHASP should specify:
  - the composition of the contractor's Construction Safety and Health Committee (CSHC) which should be constituted before the start of construction;
  - the safety policies to be implemented in the construction sites for the duration of project construction;
  - the schedule for tool box and gang meetings and the persons responsible for conducting such meetings;
  - the penalties and sanctions for violation of the CHASP;
  - the frequency, content and persons responsible for orienting, instructing and training all workers regarding the CHASP; and
  - the manner of disposing construction wastes.

It should be the responsibility of the Consultant's Project Manager to ensure compliance by the Contractor to this requirement.

- At his own expense, provide appropriate and approved type of Personal Protective Equipment (PPE) to all workers and require all workers to wear appropriate PPE within the construction site at all times. Specialty workers such as welders, painters, etc. shall be provided with special PPE as appropriate.
- Assign at least the minimum required safety personnel, as follows:
  - A full time safety officer as the general construction safety and health officer to oversee full time the overall management of the CHASP;
  - Additional safety officer, as necessary, depending on the total number of personnel assigned in the construction site per Rule 1033 of the OSHS;
  - One construction and Health Officer for every 10 units of heavy equipment assigned to the project;
  - The services of a full-time registered nurse, a part time physician and dentist, and an emergency clinic if total number of workers is 200-300; a full time registered nurse if the total number of workers is 50-200; and a first aider if the total number of workers is less than or equal to 50.
  - Provide the minimum inventory of medicines, supplies and equipment per Table 47 of OSHS.

Each subcontractor should provide a Safety Man to oversee the management of the CHASP for the subcontractor's work force.

- Provide and maintain construction safety signages to warn workers and the public of hazards existing in the workplace to be posted at prominent positions and strategic locations, in the language understandable to most workers, to include:
  - Mandatory requirement on the usage of PPE prior to entry at the worksite,
  - Areas where there are potential risk of falling objects,
  - Areas where there are potential risk of falling,

- Areas where explosives and flammable substances are used or installed,
- Areas where there are tripping or slipping hazards,
- Approaches to working areas where danger from toxic or irritant airborne contaminants may exist,
- Places where contact with or proximity to electrical facility or equipment can cause danger,
- All places where workers may come in contact with dangerous moving parts of machineries or equipment,
- Instructions on the usage of specific construction equipment
- Periodic updating of man-hours lost.

- Ensure that appropriate certification is obtained from DOLE-accredited organization for all heavy equipment and all heavy equipment operators assigned at the project site, as well as for skilled workers requiring TESDA certification.
- Ensure that all persons deployed in the construction site has undergone appropriate safety and health awareness seminar or training conducted by the Occupational Safety and Health Center (OSHC), BWC or other DOLE offices or by safety professionals or safety organizations accredited or recognized by DOLE.
- Ensure that a monthly construction safety and health report is submitted to BWC or to the DOLE Regional Office.

To ensure that sufficient funding is available for the implementation of the measures specified above during the construction stage, the requirements should be incorporated in the Bill of Quantities and in the Contract Specifications.

It is expected that with consistent implementation and compliance with the requirements of DOLE DO No. 13, the safety and health of the construction workers and the public will be safeguarded and accidents or incidents will be prevented or at least minimized.

6.2 Natural Environment

6.2.1 Terrestrial flora

(1) Baseline Environment

The survey of terrestrial flora was conducted twice to cover the two seasons in the Philippines. Sampling activities for the dry season was conducted on April 5 to 6, 2013 and the wet season sampling was later conducted on Sep. 7 to 8 of the same year.

1) Survey locations

A) Dry Season

Figure 6.2.1 shows the different transect lines of the terrestrial flora survey during the dry season.

Secondary data from the 2011 Feasibility Study (F/S) were available, which included terrestrial flora along the downstream river stretches from the river mouth up to the immediate upstream point of Kagayan Bridge. Results of the F/S are summarized under Chapter 3 of this report. The surveys conducted during the F/S covered five transects, including:

- Secondary Data S1: From the river mouth to Puntod Kauswagan Bridge;
- Secondary Data S2: From Puntod Kauswagan Bridge to Maharlika Bridge;
- Secondary Data S3: From Maharlika Bridge to Ysalina Bridge;
- Secondary Data S4: From Ysalina Brdige to upstream of Kagayan Bridge; and
- Secondary Data S5: Upstream of Kagayan Bridge

Since these five transects cover the downstream stretches of the CDO River where the Project components will be installed, additional transects were set-up on areas located from the upstream of Kagayan Bridge until the Pelaez Bridge. Three transects were established for terrestrial flora surveys during the dry season as follows:

- Transect 5 (T5): Between Kagayan Bridge and Calacala,
- Transect 6 (T6): From Calacala to Balulang,and
- Transect 7 (T7): From Balulang to Puntod Island.

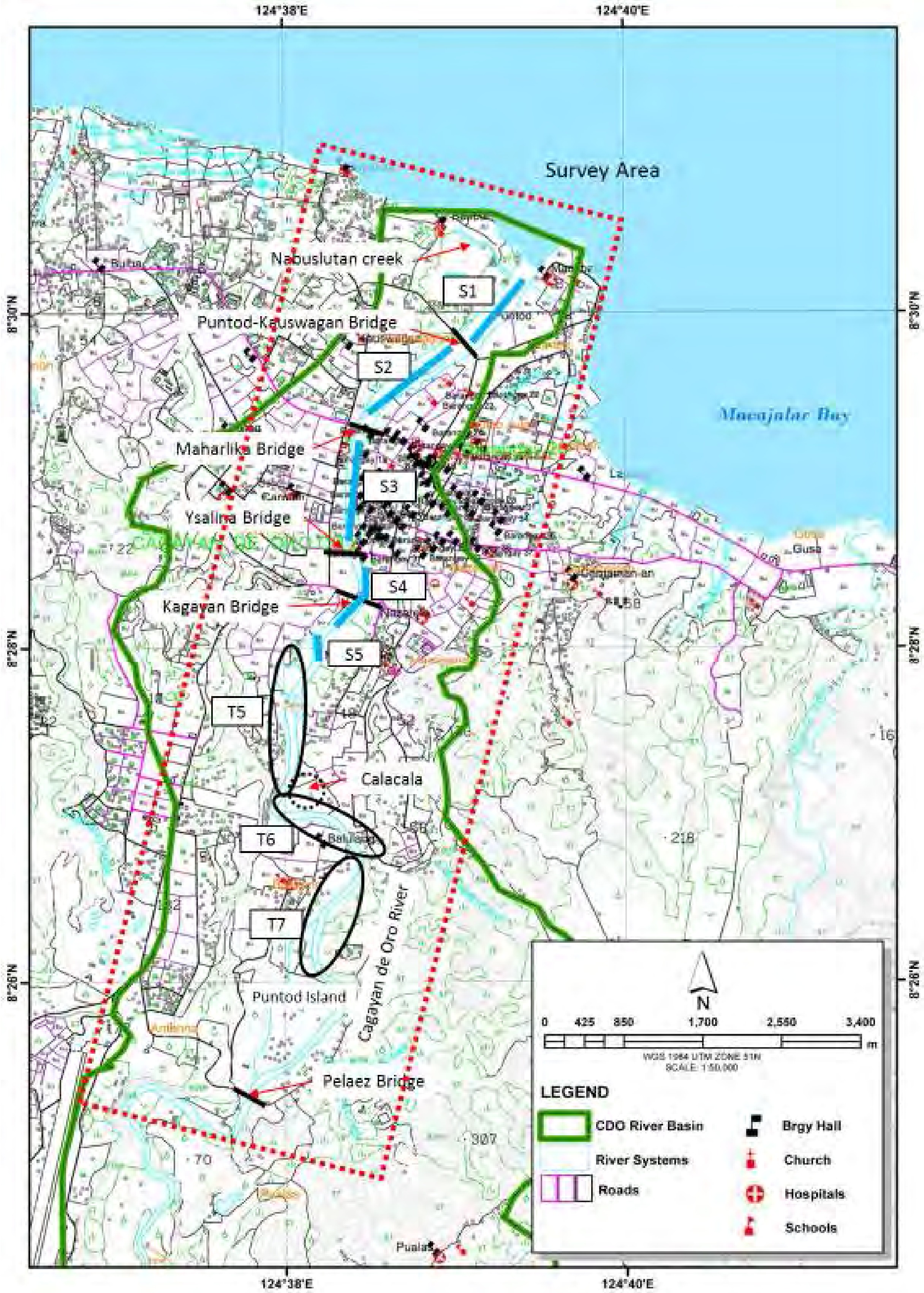


Figure 6.2.1 Location map of terrestrial flora survey during the dry season

B) Wet Season

For the wet season, the terrestrial flora survey was conducted along transects from the river mouth up to Puntod Island located downstream of Pelaez Bridge (**Figure 6.2.2**). There were seven transects established, namely:

- Transect 1 (T1): From River mouth to Puntod-Kauswagan Bridge,
- Transect 2 (T2): From Puntod-Kauswagan Bridge to Maharlika Bridge,
- Transect 3 (T3): From Maharlika Bridge to Ysalina Bridge,
- Transect 4 (T4): From Ysalina Bridge to upstream of Kagayan Bridge,
- Transect 5 (T5): From upstream of Kagayan Bridge to Calacala,
- Transect 6 (T6): From Calacala to Balulang,and
- Transect 7 (T7): From Balulang to Puntod Island.

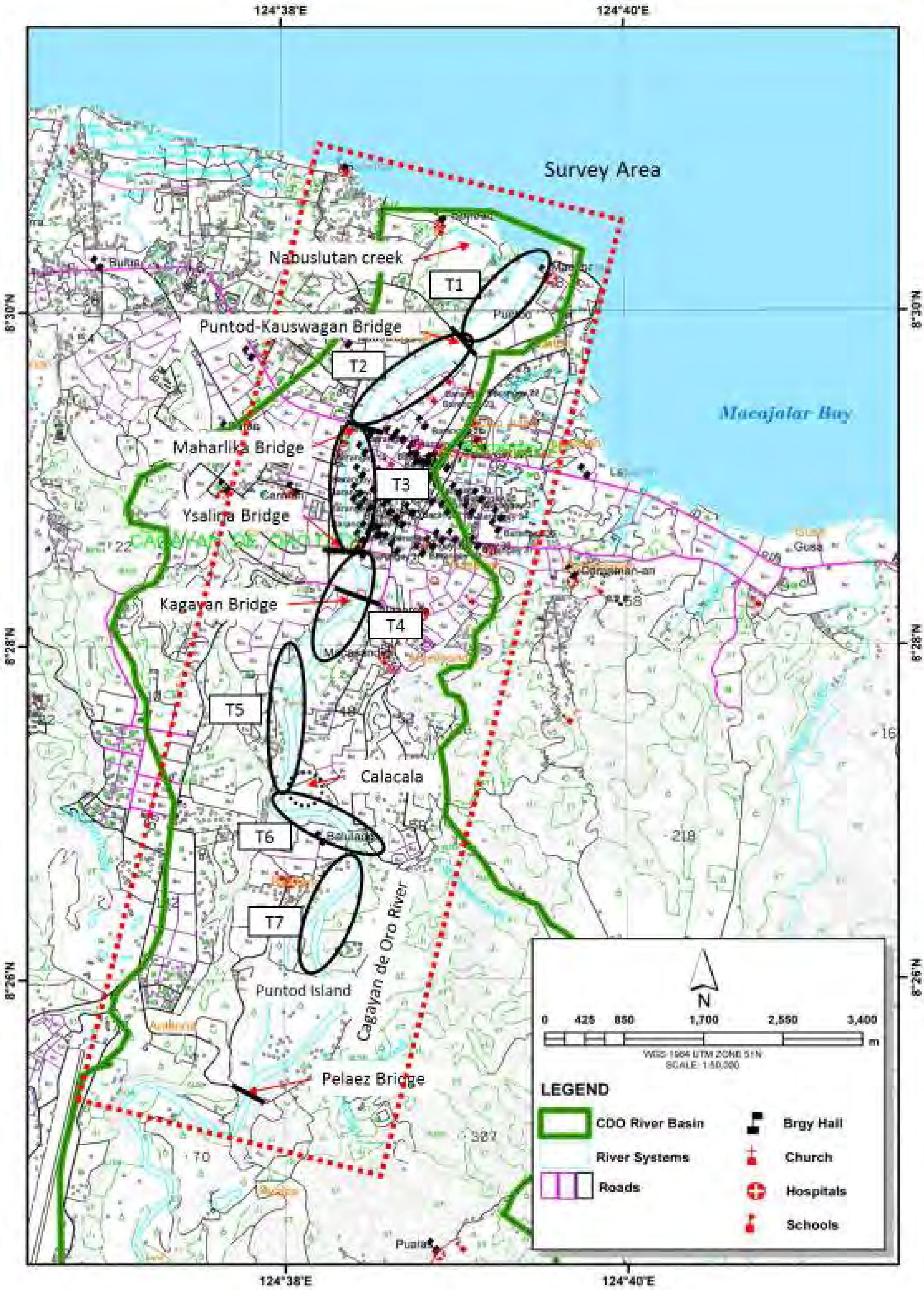


Figure 6.2.2 Location map of flora survey stations during wet season

2) Survey Method

A) Site Survey

All vegetation types and its flora observed in both bank sides of the river along the transect routes were recorded up to the lowest taxa possible based on standard references on field botanical surveys. Where vegetation types were widely disparate in any portion, more focused observations were undertaken by establishing survey plots in the riverbank in order to record species diversity and distribution-dominance index.

Opportunistic/Qualitative observation was undertaken in the survey areas. Samples of endemic flora and those that cannot be identified in the field or need to be verified in terms of proper scientific name were collected for taxonomic confirmation at the University of the Philippines herbarium in Los Baños, Laguna.

B) Data Evaluation/Analysis

The survey determined the vegetation types and habitat, species composition and relative abundance, the dominant species and structure. The Diversity Indices used for the floral analysis were the following:

- Species Richness, which refers to the number of species in each transect and the complete route.
- The Shannon -Wiener Index of Diversity (H') is a statistical information used as a measure of diversity and is probably the nearest thing to a common standard.

$$H' = -\sum_{i=1}^{R} p_i \ln p_i$$

In addition, identification of exotic and endemic species was undertaken using the 2007 Philippine National Red List of Threatened Plants or Department of Environment and Natural Resources Administrative Order No. 1, series of 2007 (DAO 2007-01) and IUCN Red List of Threatened Species as references to determine conservation status of the plants in the area. The survey also included an inventory of economically important species.

4) Survey Results

A) Vegetation Type

Along the surveyed area, the following vegetation types were observed:

- Transect 1 (T1): Mangrove forest and associated vegetation
- Transect 2 (T2): Mixed Secondary Vegetation – Secondary vegetation
- Transect 3 (T3): Mixed Agricultural Plantation – Secondary Vegetation
- Transect 4 (T4): Mixed Agricultural Plantation – Secondary Vegetation
- Transect 5 (T5): Mixed Agricultural Plantation – Secondary Vegetation
- Transect 6 (T6): Agricultural orchards- Tree Plantation
- Transect 7 (T7): Mixed Agricultural Plantation Secondary Vegetation.

B) Identified Plant Species

a) Dry Season

Table 6.2.1 lists the identified plant species along the Transect 5 (T5). This transect is dominated by agricultural plantation species such as Coconut, Banana, Corn, and other cash crops and vegetables. Other agricultural fruit trees were also present with the likes of Mango, Caimito, Papaya and Avocado. Presence of pioneer species was dominant from the Ficus family and the Grass Family.

Table 6.2.1 List of Plant Species Identified along Transect 5 (T5) in the Dry Season

Common Name (Local name)	Scientific Name	Family Name	Life Form	Bank present	
				Right	Left
African tulip	*Spathodea campanulata*	Bignoniaceae	Tree		√
American Kapok	*Ceiba pentandra*	Bombacaceae	Tree		√
Antipolo	*Artocarpus blacoi*	Moraceae	Tree		√
Atis	*Annona squamosa*	Annonaceae	Tree		√
Avocado	*Persea americana*	Lauraceae	Tree		√
Balete/ Salisi	*Ficus benjamina*	Moraceae	Tree		√
Banana	*Musa sapientum*	Musaceae	Tree	√	√
Bougainvillea	*Bougainvillea spectabilis*	Nyctaginaceae	Shrub		√
Broadleaf Mahogany	*Swietenia macrophylla*	Meliaceae	Tree	√	√
Cacao	*Theobroma cacao*	Malvaceae	Tree		√
Coconut	*Cocos nucifera*	Arecaceae	Tree	√	√
Cogon	*Imperata cylindrica*	Poaceae	Herb	√	√
Corn	*Zea mays*	Poaceae	Herb	√	
Coronitas	*Lantana camara*	Verbenaceae	Herb		√
Datiles	*Muntingia calabura*	Malvaceae	Tree	√	√
Dieffenbachia	*Dieffenbachia maculata*	Araceae	Herb		√
Firetree	*Delonix regia*	Caesalpiniaceae	Tree		√
Gabi	*Colocasia esculentum*	Araceae	Herb	√	
Gmelina	*Gmelina arborea*	Lamiaceae	Tree		√
Gonoi	*Chromolaena odorata*	Asteraceae	Herb		√
Guyabano	*Annona muricata*	Annonaceae	Tree		√
Hauili	*Ficus septica*	Moraceae	Tree		√
Igyo	*Dysoxylum gaudichaudianum*	Meliaceae	Tree		√

Common Name (Local name)	Scientific Name	Family Name	Life Form	Bank present	
				Right	Left
Ilang-ilang	*Cananga odorata*	Annonaceae	Tree	√	√
Indian lanutan	*Polyalthia longifolia*	Annonaceae	Tree		√
Ipil-ipil	*Leusina leucochepala*	Fabaceae	Tree		√
Kaimito	*Chrysophyllum cainito*	Sapotaceae	Tree	√	√
Kakauate	*Gliricidia sepium*	Fabaceae	Tree		√
Kamoteng kahoy	*Manihot esculenta*	Euphorbiacea	Herb	√	√
Kangkong	*Ipomoea aquatica*	Convolvulaceae	Herb		√
Kaong	*Arenga pinnata*	Arecaceae	Palm		√
Kawayan kiling	*Bambusa vulgaris*	Poaceae	Bamboo	√	√
Langka	*Artocarpus heterophyllus*	Moraceae	Tree		√
Malungay	*Moringa oleifera*	Moringaceae	Tree		√
Mango	*Mangifera indica*	Anacardiaceae	Tree	√	√
Okra	*Abelmoschus esculentus*	Malvaceae	Herb		√
Papaya	*Carica payaya*	Caricaceae	Tree		√
Patola	*Luffa acutangula*	Cucurbitaceae	Vine		√
Raintree	*Samanea saman*	Fabaceae	Tree	√	√
Riccinus	*Riccinus communis*	Euphorbiacea	Herb	√	√
Rimas	*Artocarpus altilis*	Moraceae	Tree		√
Saluyot	*Chorchorus acutagulus*	Malvaceae	Herb		√
San francisco	*Codiaenum variegatum*	Euphorbiaceae	Shrub		√
Santol	*Sandoricum koetjape*	Meliaceae	Tree		√
Smooth Narra	*Pterocarpus indicus spp. indicus*	Fabaceae	Tree	√	
Talahib	*Saccharum spontaneum*	Poaceae	Herb	√	√
Talisay	*Terminalia catappa*	Combretaceae	Tree	√	√
Talong punay	*Datura metel*	Solanacea	Herb	√	
Tan-ag	*Kleinhovia hospita*	Malvaceae	Tree	√	
Tangisang bayawak	*Ficus variegata*	Moraceae	Tree		√
Tibig	*Ficus nota*	Poaceae	Tree		√
Uray	*Amaranthus spinosus*	Amaranthaceae	Herb	√	√

Source: JICA Survey Team

Table 6.2.2 lists the identified plant species along the Transect 6 (T6). This transect is primarily represented by the Grass Family (Poacea) especially in the Calacala area where most of the vegetation were swept during the floods. Tree plantations were also observed most specially from the Gmelina, Mahogany, and Teak tree species.

Table 6.2.2 List of Plant Species Identified along Transect 6 (T6) in the Dry Season

Common Name (Local name)	Scientific Name	Family Name	Life Form	Bank present	
				Right	Left
Acapulco	*Cassia alata*	Fabaceae	Shrub	√	
African tulip	*Spathodea campanulata*	Bignoniaceae	Tree	√	
Alim	*Melanolepis multiglandulosa*	Euphorbiaceae	Tree		
American kapok	*Ceiba pentandra*	Bombacaceae	Tree	√	
Amorseco	*Andropogon aciculatus*	Poaceae	Herb	√	

Common Name (Local name)	Scientific Name	Family Name	Life Form	Bank present	
				Right	Left
Anabiong	*Trema orientalis*	Celtidaceae	Tree	√	
Anabiong	*Trema orientalis*	Celtidaceae	Tree	√	
Antipolo	*Artocarpus blancoi*	Moraceae	Tree	√	√
Balete/Salisi	*Ficus benjamina*	Moraceae	Tree	√	√
Banana	*Musa sapientum*	Musaceae	Tree	√	√
Bani	*Pongamia pinnata*	Fabaceae	Tree	√	
Binayuyu	*Antidesma ghaesembilia*	Phyllantaceae	Tree	√	
Bo Tree	*Ficus religiosa*	Moraceae	Tree	√	
Bougainvillea	*Bougainvillea spectabilis*	Nyctaginaceae	Shrub	√	
Broadleaf Mahogany	*Swietenia macrophylla*	Meliacea	Tree	√	
Buri	*Corypha utan*	Areacaceae	Palm	√	
Cacao	*Theobroma cacao*	Malvaceae	Tree	√	
Coconut	*Cocos nucifera*	Arecaceae	Tree	√	√
Cogon	*Imperata cylindrica*	Poaceae	Herb	√	√
Datiles	*Muntingia calabura*	Malvaceae	Tree	√	
Duhat	*Syzygium cumini*	Myrtaceae	Tree	√	√
Firetree	*Delonix regia*	Fabaceae	Tree	√	
Gabi	*Colocasia esculentum*	Araceae	Herb	√	√
Galamay-amo	*Schefflera elliptica*	Araliaceae	Herb	√	
Gmelina	*Gmelina arborea*	Lamiaceae	Tree	√	√
Gonoi	*Chromolaena odorata*	Asteraceae	Herb	√	
Guava	*Psidium guajava*	Myrtaceae	Tree	√	
Guyabano	*Annona muricata*	Annonaceae	Tree	√	
Hauili	*Ficus septica*	Moraceae	Tree	√	√
Igyo	*Dysoxylum gaudichaudianum*	Meliaceae	Tree	√	
Ilang-ilang	*Cananga odorata*	Annonaceae	Tree	√	
Indian lanutan	*Polyalthia longifolia*	Annonaceae	Tree	√	
Ipil-ipil	*Leusina leucochepala*	Fabaceae	Tree	√	√
Kaatoang bangkal	*Anthocephalus chinensis*	Rubiaceae	Tree	√	
Kaimito	*Chrysophyllum cainito*	Sapotaceae	Tree	√	
Kalios	*Streblus asper*	Moraceae	Tree	√	√
Kamachile	*Pithecellobium dulce*	Fabaceae	Tree	√	√
Kamoteng kahoy	*Manihot esculenta*	Euphorbiacea	Herb	√	
Kang-kong	*Ipomea aquatica*	Convulvolaceae	Herb	√	
Kaong	*Arenga pinnata*	Arecaceae	Palm	√	
Karunggut	*Passiflora foetida*	Passifloraceae	Vine	√	
Kawayang kiling	*Bambusa vulgaris*	Poaceae	Bamboo	√	√
Koronitas	*Lantana camara*	Lamiaceae	Herb	√	
Lagundi	*Vitex Negundo*	Lamiaceae	Shrub	√	
Langka	*Artocarpus heterophyllus*	Moraceae	Tree	√	√
Mais	*Zea mays*	Poaceae	Herb	√	
Makahiya	*Mimosa pudica*	Fabaceae	Herb	√	√

Common Name (Local name)	Scientific Name	Family Name	Life Form	Bank present	
				Right	Left
Manga	*Mangifera indica*	Anacardiaceae	Tree	√	√
Molave	*Vitex parviflora*	Lamiaceae	Tree	√	
Mutha	*Cyperus rotundus*	Cyperaceae	Herb	√	√
Neem tree	*Azadirachta indica*	Meliaceae	Tree	√	
Niog-niogan	*Ficus pseudopalma*	Moraceae	Tree	√	
Okra	*Abelmoschus esculentum*	Lamiaceae	Herb	√	
Papaya	*Carica payaya*	Caricaceae	Tree	√	
Rambutan	*Nephelium lappaceum*	Sapindaceae	Tree	√	
Riccinus	*Riccinus communis*	Euphorbiaceae	Herb	√	
Sampaloc	*Tamarindus indicus*	Fabaceae	Tree	√	√
San francisco	*Codiaeum variegatum*	Euphorbiaceae	Shrub	√	
Santol	*Sandoricum koetjape*	Meliacea	Tree	√	√
Sky flower	*Thunbergia grandiflora*	Acanthaceae	Vine	√	
Smooth Narra	*Pterocarpus indicus spp. indicus*	Fabaceae	Tree	√	√
Talahib	*Saccharum spontaneum*	Poaceae	Herb	√	
Talisay	*Terminalia catappa*	Combretaceae	Tree	√	√
Talong punay	*Datura metel*	Solanaceae	Herb	√	
Tan-ag	*Kleinhovia hospita*	Malvaceae	Tree	√	√
Tawa-tawa	*Euphorbia hirta*	Euphorbiaceae	Herb	√	
Teak	*Tectona grandis*	Lamiaceae	Tree	√	
Uray	*Amaranthus spinosus*	Amarantahaceae	Herb	√	

Source: JICA Survey Team

Table 6.2.3 lists the identified plant species along the Transect 7 (T7). This transect were observed with various agricultural plantations and fruit trees. It mostly dominated by Coconuts and Banana and fruit trees such as Mango, Santol, Papaya, Bayabas, Kaimito, and Pomelo. Grass and Ficus species were still dominant as secondary vegetation sparse with few vines and weeds from the aroids and aster families.

Table 6.2.3 List of Plant Species Identified along Transect 7 (T7) in the Dry Season

Common Name (Local name)	Scientific name	Family name	Life form	Bank present	
				Right	Left
African Tulip	*Spathodea campanulata*	Bignoniaceae	Tree	√	√
American Kapok	*Ceiba pentandra*	Bombacaceae	Tree	√	
Amorseco	*Andropogon aciculatus*	Poaceae	Shrub	√	√
Banana	*Musa sepientum*	Musaceae	Tree	√	√
Bani	*Pongamia pinnata*	Fabaceae	Tree	√	
Bayabas	*Psidium guajava*	Myrtaceae	Tree	√	
Biriba	*Rollinia mucosa*	Annonaceae	Tree	√	
Broadleaf Mahogany	*Swietenia macrophylla*	Meliacea	Tree	√	√
Carabao grass	*Paspalum congugatum*	Poaceae	Herb	√	√
Coconut	*Cocos nucifera*	Arecaceae	Palm	√	√
Cogon	*Imperata cylindrica*	Poaceae	Herb	√	√

Common Name (Local name)	Scientific name	Family name	Life form	Bank present	
				Right	Left
Duhat	*Syzygium cumini*	Myrtaceae	Tree	√	
Gabi	*Colocasia esculentum*	Araceae	Herb	√	
Gmelina	*Gmelina arborea*	Lamiaceae	Tree	√	
Gonoi	*Chromolaena odorata*	Asteraceae	Herb	√	√
Hauili	*Ficus septica*	Moraceae	Tree	√	√
Igyo	*Dysoxylum gaudichaudianum*	Meliaceae	Tree	√	
Ipil-ipil	*Leusina leucochepala*	Fabaceae	Tree	√	√
Kaimito	*Chrysophyllum cainito*	Sapotaceae	Tree	√	
Kakauate	*Gliricidia sepium*	Fabaceae	Shrub	√	
Kalios	*Streblus asper*	Moraceae	Tree	√	
Kamachile	*Pithecellobium dulce*	Fabaceae	Tree	√	
Kaong	*Arenga pinnata*	Arecaceae	Palm	√	√
Kawayan kiling	*Bambusa vulgaris*	Poaceae	Bamboo	√	√
Lantana	*Lantana camara*	Verbenaceae	Herb	√	
Makahiya	*Mimosa pudica*	Fabaceae	Herb	√	√
Manga	*Mangifera indica*	Anacardiaceae	Tree	√	√
Molave	*Vitex parviflora*	Lamiaceae	Tree	√	
Mutha	*Cyperus rotundus*	Cyperaceae	Herb	√	√
Pandakaki	*Tabernaemontana pandacaqui*	Apocynaceae	Shrub	√	
Papaya	*Carica payaya*	Caricaceae	Tree	√	
Raintree	*Samanea saman*	Fabaceae	Tree	√	
Riccinus	*Riccinus communis*	Euphorbiaceae	Herb	√	√
Santol	*Sandoricum koetjape*	Meliacea	Tree	√	
Smooth Narra	*Pterocarpus indicus spp. indicus*	Fabaceae	Tree	√	√
Talahib	*Saccharum spontaneum*	Poaceae	Herb	√	√
Talong Punay	*Datura metel*	Solanaceae	Herb	√	√
Tan-ag	*Kleinhovia hospita*	Malvaceae	Tree	√	√
Tibig	*Ficus nota*	Poaceae	Tree	√	
Tubang bakod	*Jatropha curcas*	Euphorbiaceae	Shrub	√	
Uray	*Amaranthus spinosus*	Amaranthaceae	Herb	√	√

Source: JICA Survey Team

b) Wet season

Table 6.2.4 lists the identified plant species along the Transect 1 (T1). This transect is composed mainly of mangrove species with other associated vegetation. Dominant in terms of number belongs to *Nypa fruticans* of the Arecaceae family followed by true mangroves such as *Sonneratia alba* (Pagatpat) and Rhizopora species such as Bakauan Lalaki and Bakauan Babae. Other species common in riverine and/or shoreline environment are Talisay, Malubago, and Bitaog.

Table 6.2.4 List of Plant Species Identified along Transect 1 (T1) in the Wet Season

Common Name (Local name)	Scientific Name	Family Name	Life Form	Bank Present	
				Left	Right
American Kapok	*Ceiba pentandra*	Bombacaceae	Tree		√
Atsuete	*Bixa Orillina*	Bixaceae	Tree		√
Avocado	*Persia americana*	Annonaceae	Tree		√
Bakauan Babae	*Rhizopora mucrunata*	Rhizophoraceae	Tree	√	
Bakauan Lalaki	*Rhizopora apiculata*	Rhizophoraceae	Tree	√	
Banana	*Musa sepientum*	Musaceae	Tree	√	√
Bitaog	*Callophylum inophyllum*	Gutifferae	Tree		√
Bougainvilla	*Bougainvillea spectabilis*	Nyctaginaceae	Shrub		√
Coconut	*Cocos nucifera*	Areacaceae	Palm		√
Cogon	*Imperata cylindrica*	Poaceae	Tree	√	√
Datiles	*Muntingia calabura*	Malvaceae	Tree	√	√
Guyabano	*Annona muricata*	Annonaceae	Tree		√
India Lanutan	*Polyalthia longifolia*	Annonaceae	Tree		√
Ipil-ipil	*Leusina leucochepala*	Fabaceae	Shrub	√	√
Kaimito	*Chrysophyllum cainito*	Sapotaceae	Tree		√
Kamoteng	*Ipomoea batatas*	Convolvulaceae	Vine		√
Kurungut	*Passiflora foetida*	Passifloraceae	Vine		√
Mahogany	*Swietenia macrophylla*	Meliacea	Tree		√
Malubago	*Hibiscus tiliaceus*	Malvaceae	Tree		√
Malungay	*Moringa oleifera*	Moringaceae	Tree		√
Mango	*Mangifera indica*	Anacardiaceae	Tree		√
Mutha	*Cyperus rotundus*	Cyperaceae	Herb		√
Narra	*Pterocarpus indicus spp. Indicus*	Fabaceae	Tree	√	√
Nipa	*Nypa fruticans*	Areacaceae	Palm	√	√
Okra	*Abelmoschus esculentum*	Lamiaceae	Herb		√
Pagatpat	*Sonneratia alba*	Sonneratiaceae	Tree		√
Paminta	*Pipper nigrum*	Pippiraceae	Herb		√
Papaya	*Carica papaya*	Caricaceae	Tree		√
Rain tree	*Samanea saman*	Meliacea	Tree	√	
Saluyot	*Chorchorus olitorius*	Malvaceae	Herb		√
Santol	*Sandoricum koetjape*	Meliacea	Tree		√
Talihib	*Saccharum spontaneum*	Poaceae	Herb		√
Talisay	*Terminalia cattapa*	Combretaceae	Tree	√	√
Tan-ag	*Kleinhovia hospita*	Malvaceae	Tree		√
Tangisang bayawak	*Ficus variegata*	Moraceae	Tree		√
Tawa-tawa	*Euphorbia hirta*	Euphorbiaceae	Herb		√
Tipa	*Typa Angustifolia*	Typaceae	Herb	√	
Uray	*Amaranthus spinosus*	Amaranthaceae	Herb		√

Source: JICA Survey Team

Table 6.2.5 lists the identified plant species along the Transect 2 (T2). This transect have patches of mangrove species (Pagatpat) but mostly dominated by mangrove associates such as Talisay Tree and Malubago. Other dominant species are come from the "Figs" and "Custard" Families such as Nangka and Guyabano which mainly provide economic uses to the community near the river.

Table 6.2.5 List of Plant Species Identified along Transect 2 (T2) in the Wet Season

Common Name (Local name)	Scientific Name	Family Name	Life Form	Bank Present	
				Left	Right
Acapulco	*Cassia alata*	Fabaceae	Shrub	√	√
Anabiong	*Trema orientalis*	Celtidaceae	Tree	√	
Banana	*Musa sepientum*	Musaceae	Tree	√	√
Baston de San Jose	*Cordyline fruiticosa*	Agavaceae	Herb		√
Botong	*Barringtonia asiatica*	Lecythidaceae	Tree	√	
Champagne Palm	*Hyophorbe indica*	Arecaceae	Palm	√	
Cogon	*Imperata cylindrica*	Poaceae	Herb		√
Datiles	*Muntingia calabura*	Malvaceae	Tree	√	√
Fire tree	*Delonix regia*	Caesalpiniaceae	Tree	√	
Guava	*Psidium guajava*	Mrytaceae	Shrub		√
Guyabano	*Annona muricata*	Annonaceae	Tree	√	
Ipil-ipil	*Leucina leucocephala*	Fabaceae	Shrub	√	√
Kaatoang Bangkal	*Anthocephalus chinensis*	Rubiaceae	Tree	√	
Kaimito	*Chrysophyllum cainito*	Sapotaceae	Tree	√	√
Kangkong	*Ipomea aquatica*	Convulvolaceae	Herb	√	√
Karunggut	*Passiflora foetida*	Passifloraceae	Vine		√
Kawayan kiling	*Bambusa vulgaris*	Poaceae	Bamboo	√	
Kawayan tinik	*Bambusa spinosa*	Poaceae	Bamboo	√	
Lantana	*Lantana camara*	Malvaceae	Herb		√
Mahogany	*Swietenia macrophylla*	Meliaceae	Tree	√	
Malubago	*Hibiscus tilliaceus*	Malvaceae	Tree	√	
Malunggay	*Moringa oleifera*	Moringaceae	Shrub	√	√
Mango	*Mangifera indica*	Anacardiaceae	Tree		√
Manila Palm	*Adonidia merilli*	Arecaceae	Palm	√	
Mc Acthur Palm	*Ptychosperma macarthurii*	Arecaceae	Palm	√	
Nangka	*Arthocarphus heterophyllus*	Moraceae	Tree	√	
Neem tree	*Azadirachta indica*	Meliaceae	Tree	√	
Nipa	*Nypa fruticans*	Arecaceae	Palm		√
Pagatpat	*Sonneratia alba*	Sonneratiaceae	Tree		√
Papaya	*Carica papaya*	Caricaceae	Herb	√	
Rain tree	*Samanea saman*	Caesalpiniaceae	Tree	√	√
Riccinus	*Riccinus communis*	Euphorbiaceae	Herb	√	
Sampaloc	*Tamarindus indicus*	Meliaceae	Tree	√	
San Francisco	*Codiaeum variegatum*	Euphorbiaceae	Herb		√
Santol	*Sandoricum koetjape*	Meliaceae	Tree	√	√
Talahib	*Saccharum spontaneum*	Poaceae	Herb	√	√
Talisay	*Terminalia catappa*	Combretaceae	Tree	√	√
Tan-ag	*Kleinhovia hospita*	Malvaceae	Tree	√	

Common Name (Local name)	Scientific Name	Family Name	Life Form	Bank Present	
				Left	Right
Tangisang bayawak	*Ficus variegata*	Moraceae	Tree	√	
Tawa-tawa	*Euphorbia hirta*	Euphorbiaceae	Herb	√	
Tibig	*Ficus nota*	Moraceae	Tree	√	
Uray	*Amaranthus spinosus*	Amaranthaceae	Herb	√	√
Water hyacinth	*Eichhornia crassipes*	Pontederiaceae	Herb		√
Yellow bell	*Allamanda cathartica*	Apocynaceae	Vine		√

Source: JICA Survey Team

Table 6.2.6 lists the identified plant species along the Transect 3 (T3). This transect are predominantly vegetated by ornamental plants and other economically useful species proving the high presence of settlements along the riverbanks. Most of the economically useful species were from the Moraceae, Anacardiaceae, Anonaceae, and Convulvulaceae. On the other hand, the ornamental plants belong to the Caesalpiniaceae, Malvaceae, and Arecaceae.

Table 6.2.6 List of Plant Species Identified along Transect 3 (T3) in the Wet Season

Common Name (Local name)	Scientific Name	Family Name	Life Form	Bank Present	
				Left	Right
American Kapok	*Ceiba pentandra*	Bombaceae	Tree		√
Antipolo	*Artocarpus blancoi*	Moraceae	Tree		√
Banana	*Musa sepientum*	Musaceae	Herb	√	√
Bani	*Pongamia pinnata*	Fabaceae	Tree	√	
Buri	*Corypha elata*	Areaceae	Palm		√
Coconut	*Cocos nucifera*	Areaceae	Palm	√	√
Cogon	*Imperata cylindrica*	Poaceae	Herb	√	√
Datiles	*Muntingia calabura*	Malvaceae	Tree		√
Fire Tree	*Delonix regia*	Caesalpinia	Tree	√	
Gabi	*Colocasia esculentum*	Araceae	Herb	√	
Gmelina	*Gmelina arborea*	Verbenaceae	Tree		√
Gumamela	*Hibiscus rosa-sinensis*	Malvaceae	Shrub		√
Guyabano	*Annona muricata*	Annonaceae	Tree	√	
Hauili	*Ficus septica*	Moraceae	Tree		√
Ilang-ilang	*Cananga odorata*	Annonaceae	Tree		√
Indian Lanutan	*Polyalthia*	Annonaceae	Tree	√	
Ipil-Ipil	*Leucaena leucocephala*	Fabaceae	Shrub	√	√
Kaimito	*Chrysophyllum cainito*	Sapotaceae	Tree		√
Kakauate	*Gliricidia sepium*	Fabaceae	Shrub	√	√
Kalios	*Streblus asper*	Moraceae	Tree		√
Kalumpang	*Sterculia foetida*	Sterculiaceae	Tree		√
Kang-kong	*Ipomoea aquatica*	Convolvulaceae	Herb	√	√
Kawayan Kiling	*Bambusa vulgaris*	Poaceae	Bamboo		√
Kawayan Tinik	*Bambusa spinosa*	Poaceae	Bamboo	√	
Langka	*Artocarpus heterophyllus*	Moraceae	Tree		√
Mahogany	*Swietenia macrophylla*	Meliaceae	Tree		√

Common Name (Local name)	Scientific Name	Family Name	Life Form	Bank Present	
				Left	Right
Malubago	*Hibiscus tilliaceus*	Malvaceae	Tree		√
Mango	*Mangifera indica*	Anacardiaceae	Tree	√	√
McArthurs palm	*Ptychosperma macarthurii*	Areaceae	Palm	√	
Molave	*Vitex parviflora*	Verbenaceae	Tree	√	
Narra	*Pterocarpus indicus spp. Indicus*	Fabaceae	Tree		√
Octopus tree	*Schefflera actinophylla*	Araliaceae	Tree	√	
Papaya	*Carica papaya*	Caricaceae	Herb	√	√
Riccinus	*Riccinus communis*	Euphorbiaceae	Herb		√
Royal palm	*Roystonea regia*	Areaceae	Palm		√
Sweet potato	*Ipomoea batatas*	Convolvulaceae	Vine	√	
Talahib	*Sacharum spontaneum*	Poaceae	Herb	√	√
Talisay	*Terminalia catappa*	Combretaceae	Tree		√
Tan-ag	*Kleinhovia hospita*	Malvaceae	Tree		√
Tangisang bayawak	*Ficus variegata*	Moraceae	Tree	√	
Travellers palm	*Ravenala madagascarienensis*	Strelitziaceae	Palm	√	
Yucca Tree	*Yucca brevifolia*	Asparagaceae	Tree	√	

Source: JICA Survey Team

Table 6.2.7 lists the identified plant species along the Transect 4 (T4). This transect are mostly pioneer species coming from the Grass family (Poaceace) and Figs family (Moraceae). Other noticeable vegetations are utilized primarily for its wood and fruit such as Kaong, Papaya, and Gmelina.

Table 6.2.7 List of Plant Species Identified along Transect 4 (T4) in the Wet Season

Common Name (Local name)e	Scientific Name	Family Name	Life Form	Bank Present	
				Left	Right
African tulip	*Spathodea campanulata*	Bignoniaceae	Tree	√	
American Kapok	*Ceiba pentandra*	Bombacaceae	Tree	√	
Antipolo	*Artocarpus blancoi*	Moraceae	Tree	√	
Avocado	*Persea americana*	Lauraceae	Tree	√	
Balete/ Salisi	*Ficus benjamina*	Moraceae	Tree	√	
Banana	*Musa sapientum*	Musaceae	Herb	√	
Bougainvillea	*Bougainvillea spectabilis*	Nyctaginaceae	Shrub	√	
Coconut	*Cocos nucifera*	Arecaceae	Palm		√
Cogon	*Imperata cylindrica*	Poaceae	Herb	√	√
Datiles	*Muntingia calabura*	Malvaceae	Tree	√	√
Firetree	*Delonix regia*	Caesalpiniaceae	Tree	√	
Gabi	*Colocasia esculentum*	Araceae	Herb	√	√
Igyo	*Dysoxylum gaudichaudianum*	Meliaceae	Tree	√	
Ilang-ilang	*Cananga odorata*	Annonaceae	Tree	√	√
Ipil-ipil	*Leusina leucochepala*	Fabaceae	Shrub	√	
Kaimito	*Chrysophyllum cainito*	Sapotaceae	Tree	√	√
Kamoteng kahoy	*Manihot esculenta*	Euphorbiacea	Shrub		√
Kaong	*Arenga pinnata*	Arecaceae	Palm	√	

Kawayan kiling	*Bambusa vulagaris*	Poaceae	Bamboo	√	√
Mahogany	*Swietenia macrophylla*	Meliaceae	Tree	√	√
Mais	*Zea mays*	Poaceae	Herb	√	√
Malungay	*Moringa oleifera*	Moringaceae	Shrub	√	√
Manga	*Mangifera indica*	Anacardiaceae	Tree	√	√
Nangka	*Artocarpus heterophylus*	Moraceae	Tree	√	
Papaya	*Carica payaya*	Caricaceae	Herb	√	√
Patola	*Luffa acutangula*	Cucurbitaceae	Vine	√	
Raintree	*Samanea saman*	Fabaceae	Tree	√	√
Riccinus	*Riccinus communis*	Euphorbiacea	Herb	√	√
Rimas	*Artocarpus altilis*	Moraceae	Tree	√	
Smooth Narra	*Pterocarpus indicus spp. indicus*	Fabaceae	Tree	√	√
Talahib	*Saccharum spontaneum*	Poaceae	Herb	√	√
Talisay	*Terminalia catappa*	Combretaceae	Tree	√	√
Talong punay	*Datura metel*	Solanacea	Herb	√	
Tan-ag	*Kleinhovia hospita*	Malvaceae	Tree		√
Uray	*Amaranthus spinosus*	Amaranthaceae	Herb	√	√

Source: JICA Survey Team

Table 6.2.8 lists the identified plant species along the Transect 5 (T5). This transect is vegetated mostly by Agricultural plantation species such as Coconut, Banana, Corn, and other cash crops and vegetables. Other agricultural fruit trees were also present with the likes of Mango, Caimito, Papaya and Avocado. Presence of pioneer species was dominant from the Ficus family and the Grass Family.

Table 6.2.8 List of Plant Species Identified along Transect 5 (T5) in the Wet Season

Common Name (Local name)	Scientific Name	Family Name	Life Form	Bank present	
				Right	Left
African tulip	*Spathodea campanulata*	Bignoniaceae	Tree		√
American Kapok	*Ceiba pentandra*	Bombacaceae	Tree		√
Antipolo	*Artocarpus blacoi*	Moraceae	Tree		√
Atis	*Annona squamosa*	Annonaceae	Tree		√
Avocado	*Persea americana*	Lauraceae	Tree		√
Balete/ Salisi	*Ficus benjamina*	Moraceae	Tree		√
Banana	*Musa sapientum*	Musaceae	Tree	√	√
Bougainvillea	*Bougainvillea spectabilis*	Nyctaginaceae	Shrub		√
Broadleaf Mahogany	*Swietenia macrophylla*	Meliaceae	Tree	√	√
Cacao	*Theobroma cacao*	Malvaceae	Tree		√
Coconut	*Cocos nucifera*	Arecaceae	Tree	√	√
Cogon	*Imperata cylindrica*	Poaceae	Herb	√	√
Corn	*Zea mays*	Poaceae	Herb	√	
Datiles	*Muntingia calabura*	Malvaceae	Tree	√	√
Dieffenbachia	*Dieffenbachia maculata*	Araceae	Herb		√
Firetree	*Delonix regia*	Caesalpiniaceae	Tree		√
Gabi	*Colocasia esculentum*	Araceae	Herb	√	
Gmelina	*Gmelina arborea*	Lamiaceae	Tree		√

Common Name (Local name)	Scientific Name	Family Name	Life Form	Bank present	
				Right	Left
Gonoi	*Chromolaena odorata*	Asteraceae	Herb		√
Guyabano	*Annona muricita*	Annonaceae	Tree		√
Hauili	*Ficus septica*	Moraceae	Tree		√
Igyo	*Dysoxylum gaudichaudianum*	Meliaceae	Tree		√
Ilang-ilang	*Cananga odorata*	Annonaceae	Tree	√	√
Indian lanutan	*Polyalthia longifolia*	Annonaceae	Tree		√
Ipil-ipil	*Leusina leucochepala*	Fabaceae	Tree		√
Kaimito	*Chrysophyllum cainito*	Sapotaceae	Tree	√	√
Kakauate	*Gliricidia sepium*	Fabaceae	Tree		√
Kamoteng kahoy	*Manihot esculenta*	Euphorbiacea	Herb	√	√
Kangkong	*Ipomoea aquatica*	Convolvulaceae	Herb		√
Kaong	*Arenga pinnata*	Arecaceae	Palm		√
Kawayan kiling	*Bambusa vulgaris*	Poaceae	Bamboo	√	√
Koronitas	*Lantana camara*	Verbenaceae	Herb		√
Langka	*Artocarpus heterophyllus*	Moraceae	Tree		√
Malungay	*Moringa oleifera*	Moringaceae	Tree		√
Mango	*Mangifera indica*	Anacardiaceae	Tree	√	√
Okra	*Abelmoschus esculentus*	Malvaceae	Herb		√
Papaya	*Carica payaya*	Caricaceae	Tree		√
Patola	*Luffa acutangula*	Cucurbitaceae	Vine		√
Raintree	*Samanea saman*	Fabaceae	Tree	√	√
Riccinus	*Riccinus communis*	Euphorbiacea	Herb	√	√
Rimas	*Artocarpus altilis*	Moraceae	Tree		√
Saluyot	*Chorchorus acutagulus*	Malvaceae	Herb		√
San francisco	*Codiaenum variegatum*	Euphorbiaceae	Shrub		√
Santol	*Sandoricum koetjape*	Meliaceae	Tree		√
Smooth Narra	*Pterocarpus indicus spp. indicus*	Fabaceae	Tree	√	
Talahib	*Saccharum spontaneum*	Poaceae	Herb	√	√
Talisay	*Terminalia catappa*	Combretaceae	Tree	√	√
Talong punay	*Datura metel*	Solanacea	Herb	√	
Tan-ag	*Kleinhovia hospita*	Malvaceae	Tree	√	
Tangisang bayawak	*Ficus variegata*	Moraceae	Tree		√
Tibig	*Ficus nota*	poaceae	Tree		√
Uray	*Amaranthus spinosus*	Amaranthaceae	Herb	√	√

Source: JICA Survey Team

Table 6.2.9 lists the identified plant species along the Transect 6 (T6). This transect is dominated by the Grass Family (Poacea) especially in the Calacala area where most of the vegetation were swept during the floods. Other Tree plantations were also observed most specially from the Gmelina, Mahogany, and Teak tree species.

Table 6.2.9 List of Plant Species Identified along Transect 6 (T6) in the Wet Season

Common Name (Local name)	Scientific Name	Family Name	Life Form	Bank present	
				Right	Left
Acapulco	*Cassia alata*	Fabaceae	Shrub	√	
African tulip	*Spathodea campanulata*	Bignoniaceae	Tree	√	
Alim	*Melanolepis multiglandulosa*	Euphorbiaceae	Tree		
American kapok	*Ceiba pentandra*	Bombacaceae	Tree	√	
Amorseco	*Andropogon aciculatus*	Poaceae	Herb	√	
Anabiong	*Trema orientalis*	Celtidaceae	Tree	√	
Anabiong	*Trema orientalis*	Celtidaceae	Tree	√	
Antipolo	*Artocarpus blancoi*	Moraceae	Tree	√	√
Balete/Salisi	*Ficus benjamina*	Moraceae	Tree	√	√
Banana	*Musa sepientum*	Musaceae	Tree	√	√
Bani	*Pongamia pinnata*	Fabaceae	Tree	√	
Binayuyu	*Antidesma ghaesambilia*	Phyllantaceae	Tree	√	
Bo Tree	*Ficus religiosa*	Moraceae	Tree	√	
Bougainvillea	*Bougainvillea spectabilis*	Nyctaginaceae	Shrub	√	
Broardleaf Mahogany	*Swietenia macrophylla*	Meliacea	Tree	√	
Buri	*Corypha utan*	Areacaceae	Palm	√	
Cacao	*Theobroma cacao*	Malvaceae	Tree	√	
Coconut	*Cocos nucifera*	Arecaceae	Tree	√	√
Cogon	*Imperata cylindrica*	Poaceae	Herb	√	√
Datiles	*Muntingia calabura*	Malvaceae	Tree	√	
Duhat	*Syzygium cumini*	Myrtaceae	Tree	√	√
Firetree	*Delonix regia*	Fabaceae	Tree	√	
Gabi	*Colocasia esculentum*	Araceae	Herb	√	√
Galamay-amo	*Schefflera elliptica*	Araliaceae	Herb	√	
Gmelina	*Gmelina arborea*	Lamiaceae	Tree	√	√
Gonoi	*Chromolaena odorata*	Asteraceae	Herb	√	
Guava	*Psidium guajava*	Myrtaceae	Tree	√	
Guyabano	*Annona muricata*	Annonaceae	Tree	√	
Hauili	*Ficus septica*	Moraceae	Tree	√	√
Igyo	*Dysoxylum gaudichaudianum*	Meliaceae	Tree	√	
Ilang-ilang	*Cananga odorata*	Annonaceae	Tree	√	
Indian lanutan	*Polyalthia longifolia*	Annonaceae	Tree	√	
Ipil-ipil	*Leusina leucochepala*	Fabaceae	Tree	√	√
Kaatoang bangkal	*Anthocephalus chinensis*	Rubiaceae	Tree	√	
Kaimito	*Chrysophyllum cainito*	Sapotaceae	Tree	√	
Kalios	*Streblus asper*	Moraceae	Tree	√	√
Kamachile	*Pithecellobium dulce*	Fabaceae	Tree	√	√
Kamoteng kahoy	*Manihot esculenta*	Euphorbiacea	Herb	√	
Kang-kong	*Ipomea aquatica*	Convulvolaceae	Herb	√	
Kaong	*Arenga pinnata*	Arecaceae	Palm	√	
Karunggut	*Passiflora foetida*	Passifloraceae	Vine	√	

Common Name (Local name)	Scientific Name	Family Name	Life Form	Bank present	
				Right	Left
Kawayang kiling	*Bambusa vulgaris*	Poaceae	Bamboo	√	√
Koronitas	*Lantana camara*	Lamiaceae	Herb	√	
Lagundi	*Vitex negundo*	Lamiaceae	Shrub	√	
Langka	*Artocarpus heterophyllus*	Moraceae	Tree	√	√
Mais	*Zea mays*	Poaceae	Herb	√	
Makahiya	*Mimosa pudica*	Fabaceae	Herb	√	√
Manga	*Mangifera indica*	Anacardiaceae	Tree	√	√
Molave	*Vitex parviflora*	Lamiaceae	Tree	√	
Mutha	*Cyperus rotundus*	Cyperaceae	Herb	√	√
Neem tree	*Azadiractha indica*	Meliaceae	Tree	√	
Niog-niogan	*Ficus pseudopalma*	Moraceae	Tree	√	
Okra	*Abelmoschus esculentum*	Lamiaceae	Herb	√	
Papaya	*Carica payaya*	Caricaceae	Tree	√	
Rambutan	*Nephelium lappaceum*	Sapindaceae	Tree	√	
Riccinus	*Riccinus communis*	Euphorbiaceae	Herb	√	
Sampaloc	*Tamarindus indicus*	Fabaceae	Tree	√	√
San francisco	*Codiaeum variegatum*	Euphorbiaceae	Shrub	√	
Santol	*Sandoricum koetjape*	Meliacea	Tree	√	√
Sky flower	*Thunbergia grandiflora*	Acanthaceae	Vine	√	
Smooth Narra	*Pterocarpus indicus spp. indicus*	Fabaceae	Tree	√	√
Talahib	*Saccharum spontaneum*	Poaceae	Herb	√	
Talisay	*Terminalia catappa*	Combretaceae	Tree	√	√
Talong punay	*Datura metel*	Solanaceae	Herb	√	
Tan-ag	*Kleinhovia hospita*	Malvaceae	Tree	√	√
Tawa-tawa	*Euphorbia hirta*	Euphorbiaceae	Herb	√	
Teak	*Tectona grandis*	Lamiaceae	Tree	√	
Uray	*Amaranthus spinosus*	Amarantahaceae	Herb	√	

Source: JICA Survey Team

Table 6.2.10 lists the identified plant species along the Transect 7 (T7). In this transect, most species observed and identified were various agricultural plantations and fruit trees. It mostly dominated by Coconuts and Banana and fruit trees such as Mango, Santol, Papaya, Bayabas, Kaimito, and Pomelo. Grass and Ficus species were still dominant as secondary vegetation sparse with few vines and weeds from the aroids and aster families.

Table 6.2.10 List of Plant Species Identified along Transect 7 (T7) in the Wet Season

Common Name (Local name)	Scientific name	Family name	Life Form	Bank present	
				Right	Left
African Tulip	*Spathodea campanulata*	Bignoniaceae	Tree	√	√
American Kapok	*Ceiba pentandra*	Bombacaceae	Tree	√	
Amorseco	*Andropogon aciculatus*	Poaceae	Shrub	√	√
Banana	*Musa sepientum*	Musaceae	Tree	√	√
Bani	*Pongamia pinata*	Fabaceae	Tree	√	

Bayabas	*Psidium guajava*	Myrtaceae	Tree	√	
Biriba	*Rollinia mucosa*	Annonaceae	Tree	√	
Broadleaf Mahogany	*Switenia macrophylla*	Meliacea	Tree	√	√
Carabao grass	*Paspalum congugatum*	Poaceae	Herb	√	√
Coconut	*Cocos nucifera*	Arecaceae	Palm	√	√
Cogon	*Imperata cylindrica*	Poaceae	Herb	√	√
Duhat	*Syzygium cumini*	Myrtaceae	Tree	√	
Gabi	*Colocasia esculentum*	Araceae	Herb	√	
Gmelina	*Gmelina arborea*	Lamiaceae	Tree	√	
Gonoi	*Chromolaena odorata*	Asteraceae	Herb	√	√
Hauili	*Ficus septica*	Moraceae	Tree	√	√
Igyo	*Dysoxylum glaudichaudianum*	Meliaceae	Tree	√	
Ipil-ipil	*Leusina leucochepala*	Fabaceae	Tree	√	√
Kaimito	*Chrysophyllum cainito*	Sapotaceae	Tree	√	
Kakauate	*Gliricidia sepium*	Fabaceae	Shrub	√	
Kalios	*Streblus asper*	Moraceae	Tree	√	
Kamachile	*Pithecellobium dulce*	Fabaceae	Tree	√	
Kaong	*Arenga pinata*	Arecaceae	Palm	√	√
Kawayan kiling	*Bambusa vulagaris*	Poaceae	Bamboo	√	√
Lantana	*Lantana camara*	Verbenaceae	Herb	√	
Makahiya	*Mimosa pudica*	Fabaceae	Herb	√	√
Manga	*Mangifera indica*	Anacardiaceae	Tree	√	√
Molave	*Vitex parviflora*	Lamiaceae	Tree	√	
Mutha	*Cyperus rotundus*	Cyperaceae	Herb	√	√
Pandakaki	*Tabernaemontana pandacaqui*	Apocynaceae	Shrub	√	
Papaya	*Carica payaya*	Caricaceae	Tree	√	
Raintree	*Samanea saman*	Fabaceae	Tree	√	
Riccinus	*Riccinus communis*	Euphorbiaceae	Herb	√	√
Santol	*Sandoricum koetjape*	Meliacea	Tree	√	
Smooth Narra	*Pterocarpus indicus*	Fabaceae	Tree	√	√
Talahib	*Saccharum spontaneum*	Poaceae	Herb	√	√
Talong Punay	*Datura metel*	Solanaceae	Herb	√	√
Tan-ag	*Kleinhovia hospita*	Malvaceae	Tree	√	√
Tibig	*Ficus nota*	poaceae	Tree	√	
Tubang bakod	*Jathropa curcas*	Euphorbiaceae	Shrub	√	
Uray	*Amaranthus spinosus*	Amaranthaceae	Herb	√	√

Source: JICA Survey Team

C) Species Richness and Composition

a) Dry season

Table 6.2.11 shows a total of 82 species belonging to 38 different families recorded during the survey.

Table 6.2.11 Number of Species Recorded per Life Form (Dry Season)

Life Form	Number of Species	Percentage (%)
Tree	46	56.1
Shrub	9	11.0
Herb	20	24.4
Vine	3	3.7
Bamboo	1	1.2
Palm	3	3.7
Total	82	100

Source: JICA Survey Team

The dominating life form came from trees comprising 46 different species, followed by the herb family (20 species) where grasses of various species belong. Shrubs comprise 9 different species followed by the Vines and Palms with 3 species a piece. The dominant tree species came from the Ficus family while palms were primarily dominated by the coconut genus. Only 1 species of bamboo was observed (*Bambusa vulgaris*) scattered along the three transects. The most species rich families came from the Family Poaceae, Moracea, and Palmae.

Table 6.2.12 shows the result of the computed diversity indices used for the analysis of the flora identified during the survey.

Table 6.2.12 Biodiversity Index for Terrestrial Flora (Dry Season)

Index	Transect 5 (T5)	Transect 6 (T6)	Transect 7 (T7)
Shannon -Wiener Biodiversity Index (H')	1.26	1.36	1.20

Source: JICA Survey Team

The Shannon-Wiener index (H’) describes the level of diversity in a community being studied. This parameter, H’, is usually between 0 to 5 and as H’ increases, the uncertainty of finding the same individual species increases, implying that there is higher species diversity. Among the transects, Transect 6 had the highest diversity index with H’ = 1.36, which can be attributed with the majority of human settlements present in the area. As the humans settled on the riverbanks and used it mainly for agricultural purposes, they introduced several species of plants mostly are agricultural crops and fruit trees. In addition, Transect 6 is where majority of the vegetation was wiped out during TS Sendong, making several pioneer species such as grasses of several species to grow and dominate.

b) Wet season

Table 6.2.13 shows that a total of 107 species belonging to 45 different families were recorded during the wet season

Table 6.2.13 Number of Species Recorded per Life Form (Wet Season)

Life Form	Number of Species	Percentage
Tree	57	53.3
Shrub	10	9.3
Herb	22	20.6
Vine	7	6.5

Bamboo	2	1.9
Palm	9	8.4
Total	**107**	**100**

Source: JICA Survey Team

The dominant life form came from trees comprising of 57 different species, followed by Herb family (22 species) where grasses of various species belong to. Shrubs comprise of 10 different species followed by the Palms (9) and vines (7). The dominant tree species came from the Ficus family while palms were primarily dominated by the coconut genus. There are 2 species of bamboo observed *Bambusa vulgaris* and *Bambusa spinosa* scattered along the seven transects. The most species rich families came from the Family Poaceae, Moracea, and Palmae.

Table 6.2.14 shows the computed biodiversity indices for terrestrial flora species encountered during the wet season. Transect 6 had the highest H' (1.34), indicating high diversity, which was the same as the result of dry season.

Table 6.2.14 Biodiversity Indix for Terrestrial Flora (Wet Season)

Biodiversity Index	T1	T2	T3	T4	T5	T6	T7
Shannon -Wiener Biodiversity Index (H')	1.15	1.27	1.16	1.06	1.25	1.34	1.18

Source: JICA Survey Team

D) Economically Important Species

With the proximity of the project area to human settlements, various economically important species were recorded (**Table 6.2.15**). There were a total of 28 species listed which has economic importance which is mostly consumed for its fruits.

Table 6.2.15 List of Economically Important Species

Common name	Scientific name	Life form	Economic importance
Okra	*Abelmoschus esculentum*	Shrub	Fruit
Guyabano	*Annona muricata*	Tree	Fruit
Rimas	*Artocarpus altilis*	Tree	Fruit
Nangka	*Artocarpus heterophyllus*	Tree	Fruit
Kawayan kiling	*Bambusa vulgaris*	Bamboo	Stem
Ilang-ilang	*Cananga odorata*	Tree	Flower
Papaya	*Carica papaya*	Tree	Fruit
Caimito	*Chrysophyllum caimito L.*	Tree	Fruit
Pomelo	*Citrus maxima*	Tree	Fruit
Coconut	*Cocos nucifera*	Palm	Fruit
Gabi	*Colocasia esculentum*	Herb	Fruit
Buri	*Corypha utan*	Palm	Leaves
Gmelina	*Gmelina arborea*	Tree	Wood
Kang-kong	*Ipomea aquatica*	Herb	Leaves
Patola	*Luffa acutangula*	Vine	Fruit
Kamoteng Kahoy	*Manihot esculenta*	Shrub	Leaves and Roots
Mangga	*Mangifera indica* L.	Tree	Fruit
Banana	*Musa sapientum*	Tree	Fruit

Common name	Scientific name	Life form	Economic importance
Nipa	*Nypa fruticans* Wurmb.	Palm	Sap and shingles
Smooth Narra	*Pterocarpus indicus spp. indicus*	Tree	Wood
Rain tree	*Samanea saman*	Tree	Wood
Santol	*Sandoricum koetjape*	Tree	Fruit
Mahogany	*Swietenia macrophylla*	Tree	Wood
Teak	*Toona Grandis*	Tree	Wood
Sampalok	*Tamarindus indica* L.	Tree	Fruit
Cacao	*Theobroma cacao* L.	Tree	Fruit
Molave	*Vitex parviflora*	Tree	Wood
Mais	*Zea mays*	Herb	Fruit

Source: JICA Survey Team

E) Evaluation of Terrestrial Flora in the Area

Varying vegetation types were observed along the seven transects surveyed throughout the year, including mixed agricultural plantation, agricultural orchards, mangrove forests, and secondary vegetation.

Plant species identified in each transect included agricultural plantation species, fruit trees, tree plantations, plants with various economic uses and other species common in riverine and/or shoreline environments.

For both surveys conducted for the dry and wet season, the dominating life form came from trees, followed by herbs, shrubs, vines, palms and bamboos.

Relatively high diversity indices observed in the some transects are estimated to be attributed to human settlements found in the area. As the community used the riverbanks for agricultural purposes, they eventually introduced several species of plants, mostly agricultural crops and fruit trees, in the area. It seems that the TS Sendong had a negative impact in majority of the areas near the river as it wiped out several species of plants. The TS Sendong allowed pioneer species of grasses to grow in the affected areas and dominate.

(2) Potential Impacts

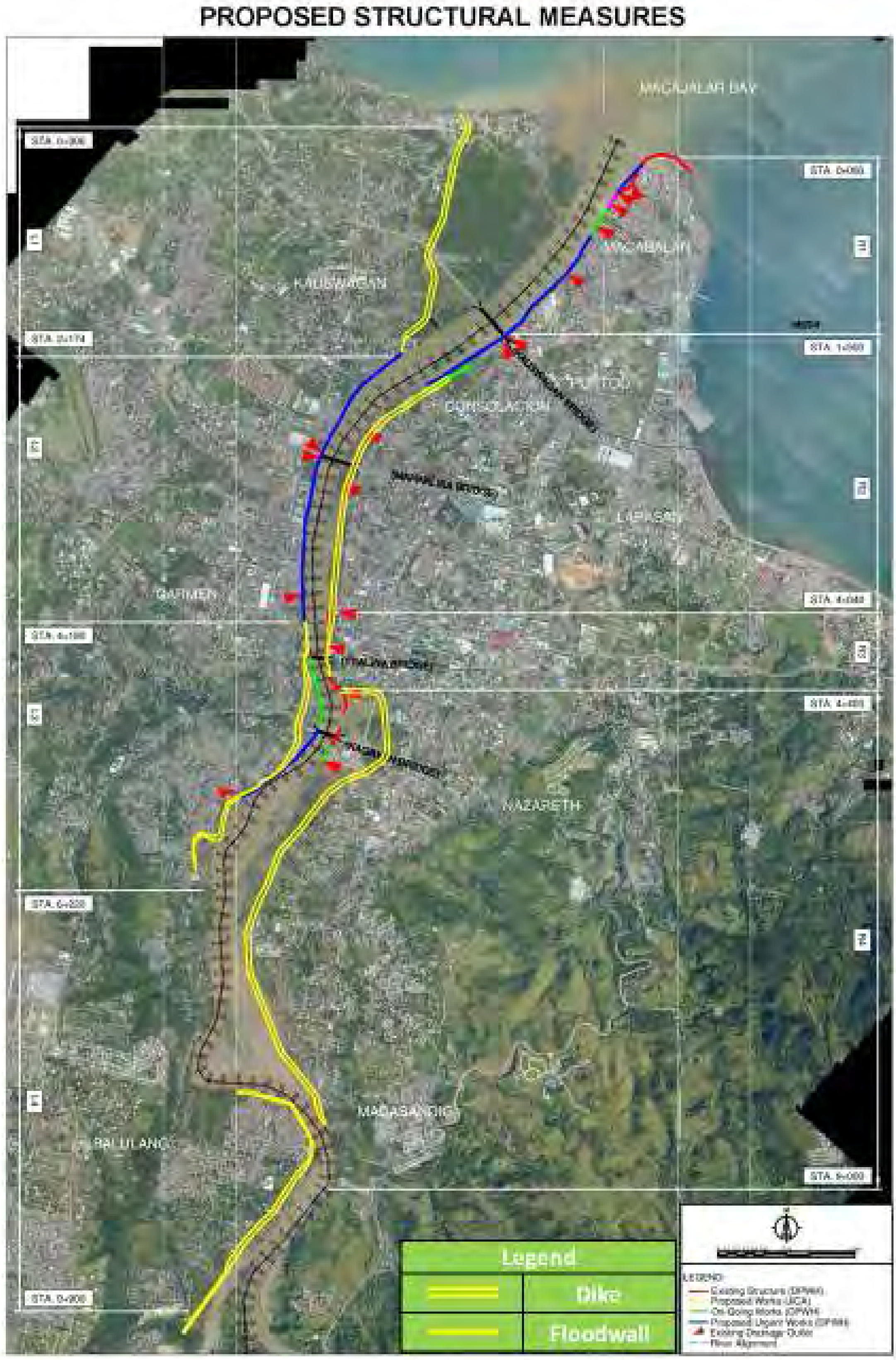
During the construction phase, various activities of construction will be conducted that likely cause the following impacts on terrestrial flora:

1) Change of inhabiting environment

Due to the installation of structures, like dikes and floodwalls, areas on the further side of the dike/floodwall can become drier as flooding is lessened by these structures. This alternation of habitat condition could affect the constituents and dominancy of flora species in the further side of the structures (dike and floodwall) gradually. However, this impact is predicted to be minor taking into account the overall moisture conditions having moderate rainfall in this area.

2) Loss of vegetative cover

Some of the trees within the project site and other vegetation (forests) could be removed to give way to the construction of structural measures including dikes, floodwalls and evacuation roads (**Figure 6.2.3**), and other temporary facilities such as construction yard, access roads and office.



Source: JICA Survey Team

Figure 6.2.3 Planned Location of Dike and Floodwall of the Project

Table 6.2.16 shows the estimated area of vegetation to be cleared along the CDOR by section of the construction works. The removal of trees could lead the decrease and disturbance of the habitat of wildlife. In addition, it would bring about soil erosion, unless any appropriate measures are provided, during periods of high rainfall.

Table 6.2.16 Estimated Area of Vegetation Clearance

River Stretch	Area for clearance (m^2)	River Stretch	Area for clearance (m^2)
L1	13,866	R1	-
L2	-	R2	14,462
L3	2,541	R3	3,493
L4	10,940	R4	25,348
Total	27,347	Total	43,303
Grand Total: 70,650 m^2 (approx. 7.1 ha)			

Source: JICA Survey Team

3) Damage to plants

Land clearance and other construction works could give trauma physically by inflicting injuries to some vegetative parts (i.e. stems, leaves, roots, etc.) or even at some point the totality of plants. Injuries incurred could be fatal to plants since it could disrupt the physical and physiological processes in occurring in plants.

In addition, an increase in Total Suspended Particulates (TSP), i.e. dust, concentration may affect the photosynthetic activities of plants once the particulate matter settles in the leaves. This will tend to hinder/disrupt the photosynthetic process of plants with the clogging of micro particles into the stomata of the leaves, limiting intake of oxygen and hence, hampering the evapotranspiration process. In worst cases, the effect could go as far as to result in stunted growth of the affected plants or cause them to wither.

(3) Mitigation Measures

1) Loss of Vegetative Cover

In case trees are to be uprooted or removed, the Project Proponent or its Contractor must coordinate with the CENRO, DENR 10 to determine the permit required (i.e. if allowed to be cut or ball-out). As much as possible, affected trees should be transferred to other sites or nearby areas. In case ornamental plants are to be removed, the affected area must be immediately rehabilitated and planted with the equivalent species.

In summary, the Project Proponent or the Contractor must consider the following:

- Compliance with the conditions stipulated in the permits/clearances (e.g. ECC, Tree Cutting Permit, Excavation Permit, etc.) issued for the Project,
- Providing a temporary fencing to vegetation that will be retained and not to give trauma physically by inflicting injuries to vegetative parts,
- Limiting land and vegetation clearance as much as possible by considering the construction method,
- To enhance the general environment of the project site, greening of its vicinity shall be implemented, and
- Appropriate plant species for greening and compensation should be planted by consulting CENRO, DENR 10.

2) Physical damage to vegetation

To address this impact of physical damage to the vegetation, the following measures are effective:

- Cutting/trimming of vegetation should be minimized.
- Using markers and fences to direct heavy equipment in the construction site and minimize damage to trees/vegetation,
- Fencing of important species of plants such as those considered threatened (i.e . Molave and Narra species (refer to Chap. 6.2.6) or with high economic value in considerable size or length away from direct disturbance of construction equipment.
- In case that the tree leaves are heavily covered by dust around the construction sites, especially reclamation work sites, watering shall on the trees shall be done.

6.2.2 Mangrove forest

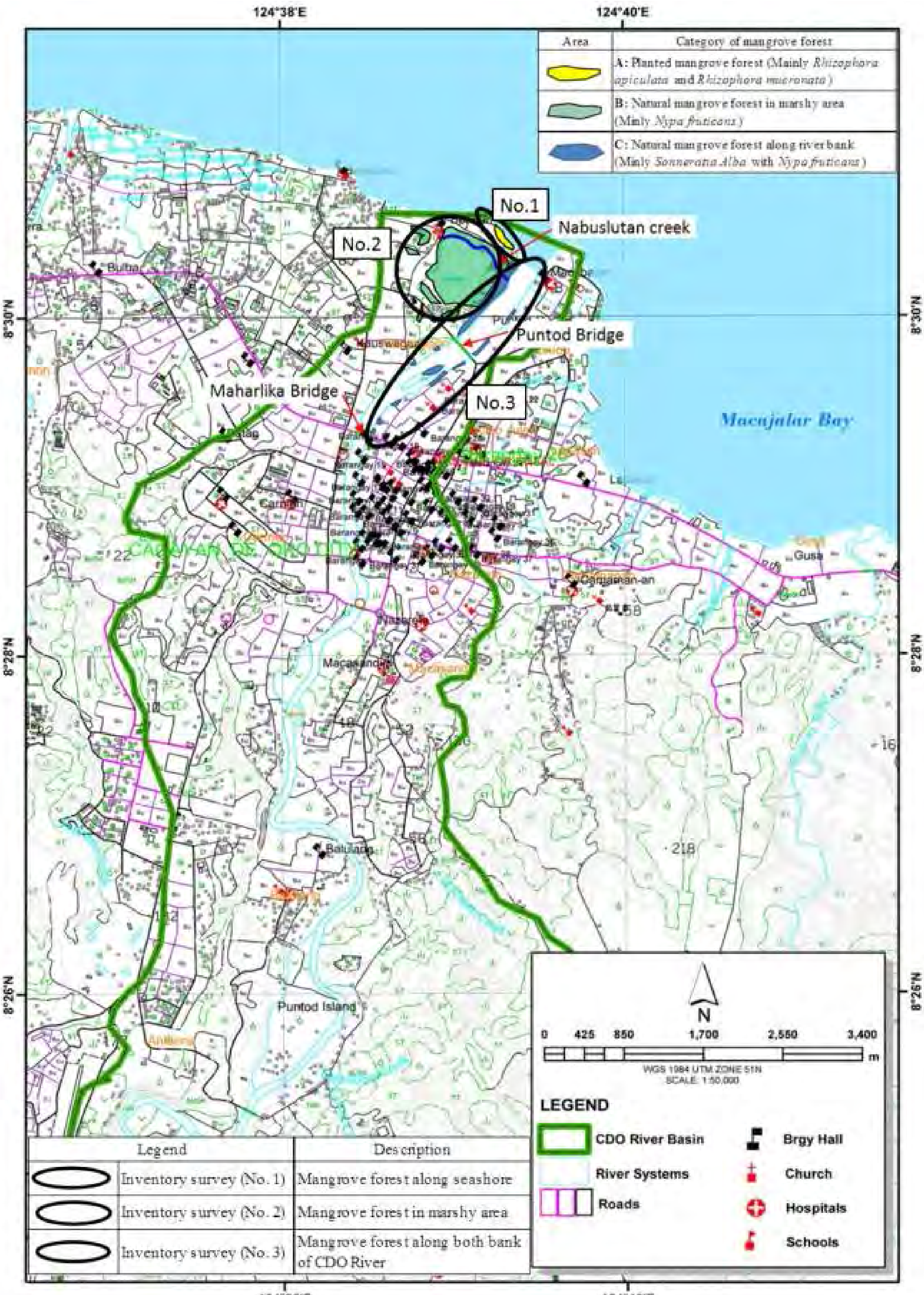
(1) Baseline Environment

1) Survey Location

A map below (**Figure 6.2.4**) was created based on the map (**Figure 6.2.5**) of the preliminary survey results of mangrove conducted by JICA Survey Team in February, 2013, indicating the location of the three mangrove forests in the Survey area. The map was used to guide for delineating the mangrove forests in the required survey area.

Source: JICA Survey Team

Figure 6.2.4 Preliminary Base Map Used During the Survey



Source: JICA Survey Team

Figure 6.2.5 Location Map of Mangrove Forests

The approximate area of the mangrove forests to be surveyed was calculated as table below using the base map above, showing that the area of mangrove forest is 71.78 ha in total in the survey area.

Table 6.2.17 Preliminary Calculation of the Area of the Three Mangrove Forests

Class	Area (Ha.)
1. Planted Mangrove Forest	1.85
2. Natural Mangrove Forest along river bank	14.95
3. Natural Mangrove Forest in Marshy area	54.98
Total	**71.78**

*Note) * Map and preliminary data sources were the result of preliminary survey conducted by JICA Survey Team in February 2013*

2) Survey Method

A) Site Survey

After the process of base mapping and calculation of mangrove forests based on preliminary survey, the following tasks were done on site from May 29 to June 1, 2013:

- Site reconnaissance was conducted to check the margin/boundary of the mangrove forests.
- The coordinate data were recorded at every point of the margin/boundary at an interval of approximately 100 meter or less
- The location of the mangrove forest area was plotted for confirmation whether the coordinates data is correct or not.
- After every record has been completed during site reconnaissance, the mangrove forests map was delineated.
- As the results of all the work, all location/distribution of mangrove forest map was developed.

B) Secondary Data Collection

Data from local government units such as Agricultural Office of Cagayan de Oro City are collected to verify the base map.

C) Mangrove Forest Inventory

After the conduct of site reconnaissance, the terrestrial flora expert recorded the species of the identified mangrove trees and together with their corresponding locations. The species of mangrove forest were identified accurately referring to the information provided by the local authority.

3) Survey results

A) Delineation of mangrove forest

As shown on Figure 6.2.3, there are three types of mangrove forests in the survey area; namely A: planted mangrove forests, B: natural mangrove forests in marshy land, and C: natural mangrove forest along the river bank.

Tables 6.2.18 to 6.2.20 show the coordinates data showing the boundary of these three types of mangrove forests.

Table 6.2.18 Coordinates Data of Planted Mangrove Forest

No.	Long	Lat
1	124° 39' 16.600" E	8° 30' 29.700" N
2	124° 39' 16.100" E	8° 30' 27.900" N
3	124° 39' 14.600" E	8° 30' 29.100" N
4	124° 39' 13.200" E	8° 30' 30.700" N
5	124° 39' 11.700" E	8° 30' 32.200" N
6	124° 39' 10.600" E	8° 30' 38.400" N

Source: JICA Survey Team

Table 6.2.19 Coordinate Data of Mangrove Forest along Riverbanks

No.	Long	Lat
1	124° 39' 19.540" E	8° 30' 13.431" N
2	124° 39' 13.740" E	8° 30' 4.931" N
3	124° 39' 2.140" E	8° 29' 53.131" N
4	124° 39' 3.540" E	8° 29' 55.931" N
5	124° 39' 16.540" E	8° 30' 16.731" N
6	124° 39' 19.303" E	8° 30' 24.100" N
7	124° 38' 55.440" E	8° 29' 48.631" N
8	124° 38' 31.568" E	8° 29' 19.845" N
9	124° 38' 33.482" E	8° 29' 23.260" N
10	124° 38' 38.653" E	8° 29' 29.531" N
11	124° 38' 41.553" E	8° 29' 30.531" N
12	124° 38' 50.440" E	8° 29' 37.731" N
13	124° 38' 52.240" E	8° 29' 38.432" N
14	124° 38' 57.440" E	8° 29' 42.531" N
15	124° 38' 55.440" E	8° 29' 39.531" N
16	124° 39' 1.140" E	8° 29' 42.932" N
17	124° 39' 6.575" E	8° 29' 46.931" N
18	124° 39' 10.175" E	8° 29' 49.131" N
19	124° 39' 20.940" E	8° 30' 0.731" N
20	124° 39' 22.240" E	8° 30' 2.331" N
21	124° 38' 54.161" E	8° 29' 42.527" N
22	124° 38' 50.520" E	8° 29' 41.135" N
23	124° 38' 48.593" E	8° 29' 39.957" N
24	124° 39' 20.214" E	8° 30' 20.787" N
25	124° 39' 23.065" E	8° 30' 18.560" N

Source: JICA Survey Team

Table 6.2.20 Coordinates Data of Natural Mangrove in Marshy Area

No.	Long	Lat
1	124° 39' 5.369" E	8° 29' 59.831" N
2	124° 39' 3.168" E	8° 29' 58.232" N
3	124° 39' 0.513" E	8° 29' 56.347" N
4	124° 38' 58.114" E	8° 29' 57.546" N
5	124° 38' 56.316" E	8° 29' 58.232" N
6	124° 38' 54.174" E	8° 30' 0.202" N

No.	Long	Lat
7	124° 38' 54.602" E	8° 30' 1.658" N
8	124° 38' 58.371" E	8° 30' 3.200" N
9	124° 39' 3.083" E	8° 30' 4.228" N
10	124° 38' 50.748" E	8° 30' 6.541" N
11	124° 38' 49.805" E	8° 30' 8.853" N
12	124° 38' 50.426" E	8° 30' 17.291" N
13	124° 38' 53.210" E	8° 30' 22.216" N
14	124° 38' 53.960" E	8° 30' 26.499" N
15	124° 38' 57.815" E	8° 30' 31.318" N
16	124° 39' 4.989" E	8° 30' 29.819" N
17	124° 39' 10.021" E	8° 30' 27.784" N
18	124° 39' 12.912" E	8° 30' 24.679" N
19	124° 39' 16.017" E	8° 30' 23.394" N
20	124° 39' 18.373" E	8° 30' 23.823" N
21	124° 39' 16.553" E	8° 30' 16.756" N
22	124° 38' 48.820" E	8° 30' 22.166" N
23	124° 38' 45.908" E	8° 30' 22.852" N
24	124° 38' 44.880" E	8° 30' 25.165" N
25	124° 38' 47.450" E	8° 30' 24.394" N
26	124° 38' 48.906" E	8° 30' 23.366" N
27	124° 38' 51.047" E	8° 30' 25.593" N
28	124° 38' 48.820" E	8° 30' 27.991" N
29	124° 38' 48.820" E	8° 30' 29.876" N
30	124° 38' 47.193" E	8° 30' 32.531" N
31	124° 38' 50.105" E	8° 30' 32.446" N
32	124° 38' 53.103" E	8° 30' 30.818" N
33	124° 38' 49.591" E	8° 30' 3.921" N
34	124° 38' 50.533" E	8° 30' 1.437" N
35	124° 38' 48.735" E	8° 29' 59.381" N
36	124° 38' 47.878" E	8° 30' 1.094" N
37	124° 38' 53.817" E	8° 29' 58.781" N
38	124° 38' 52.789" E	8° 29' 59.466" N
39	124° 38' 53.389" E	8° 30' 0.066" N
40	124° 38' 53.860" E	8° 29' 59.466" N
43	124° 39' 19.715" E	8° 30' 21.176" N

Source: JICA Survey Team

B) Description of Mangrove Forests

a) Planted mangrove forest

The planted mangrove forest is situated along the seashore of Barangay Bonbon located at the northern most tip of the study area. **Tables 6.2.21** and **Table 6.2.22** show the list of species identified in the area and other data recorded during the survey.

Table 6.2.21 Coordinate data of *Rhizopora sp*ecies in Planted Mangrove Forest, April 2013

No.	Long	Lat	Species (Local name)	No. of Trees	Ave. Height (m)	Ave. DBH (cm)
1	124° 39' 20.170" E	8° 30' 25.749" N	Bakauan babae	93	5	20
2	124° 39' 18.372" E	8° 30' 28.026" N	Bakauan lalaki	9	5	18
3	124° 39' 16.814" E	8° 30' 30.903" N	Regenerations	more than 1,000	1	-

Source: JICA Survey Team

Table 6.2.22 Coordinates data of *Sonneratia alba* in Planted Mangrove Forest, April 2013

No.	Long	Lat	No. of Trees	Ave. Height (m)	Ave. DBH (cm)
1	124° 39' 11.308" E	8° 30' 37.018" N	1	13	30
2	124° 39' 12.251" E	8° 30' 33.078" N	1	10	25

Source: JICA Survey Team

The species identified consist of mainly Bakauan Babae (*Rhizopora mucronata*), Bakauan Lalaki (*Rhizopora apiculata*), and Pagatpat (*Sonneratia alba*). Identified species were the same species identified by the Agricultural Officer of the CDO City Agricultural Office who is facilitating the mangrove reforestation in this area. The *Rhizopora spp.* in the area seems to have been planted in recent years and thus not large trees in height, averaging 5 meters, and with smaller bole diameter.

b) Natural mangrove forest along river bank

Tables 6.2.23 and **6.2.24** show the list of the recorded mangrove trees along the river banks during survey.

The mangrove forest (left bank) in this area consists primarily of dense natural mangrove, Pagatpat (*Sonneratia alba*), and patches of understorey Nipa (*Nypa fruticans*) starting from the mouth of the CDO river up to Puntod-Kauswagan Bridge. The right bank, on the other hand, is comprised of fragmented Pagatpat trees with few Nipa palms.

Table 6.2.23 Coordinates data of *Sonneratia alba* in Mangrove Forest along River Bank (left bank)

No.	Long	Lat	No. of Trees	Ave. Height (m)	Ave. DBH (cm)
1	124° 38' 54.479" E	8° 29' 48.527" N	1	12	60
2	124° 39' 21.517" E	8° 30' 17.094" N	257	16	50

Source: JICA Survey Team

Table 6.2.24 Coordinates data of *Sonneratia alba* in Mangrove Forest along River Bank (right bank)

No.	Long	Lat	No. of Trees	Ave. Height (m)	Ave. DBH (cm)
1	124° 38' 32.345" E	8° 29' 19.608" N	1	7	15
2	124° 38' 34.379" E	8° 29' 23.248" N	2	8	18
3	124° 38' 40.054" E	8° 29' 29.245" N	35	12	20
4	124° 38' 52.475" E	8° 29' 40.274" N	47	13	30
5	124° 38' 58.685" E	8° 29' 40.916" N	63	13	25
6	124° 39' 8.643" E	8° 29' 47.876" N	31	14	10
7	124° 39' 21.171" E	8° 30' 1.582" N	21	10	40

Source: JICA Survey Team

Since the mangrove trees at the right bank are few and possible to be counted, manual counting of the exact number and average sizes were conducted. However, the dense mangrove forest at the left bank of the river is practically difficult for counting manually. To determine the number of species opportunistic counting were made to approximate the number of individual tree species.

Table 6.2.25 shows the result of quadrant sampling to represent the species richness of the mangrove area.

Table 6.2.25 Tabulated Result of Quadrant Sampling along River Bank (left bank), April 2013

Tree No.	Identified species of the individuals	Height (m)	Other individuals
1	*Sonneratiaa alba (Pagatpat)*	17	1. 10 seedlings of *Sonneratia alba* 2. 11 clusters of *Nypa fruticans*
2	*Sonneratiaa alba (Pagatpat)*	18	
3	*Sonneratiaa alba (Pagatpat)*	16	
4	*Sonneratiaa alba (Pagatpat)*	18	
5	*Sonneratiaa alba (Pagatpat)*	16	
6	*Sonneratiaa alba (Pagatpat)*	15	
7	*Sonneratiaa alba (Pagatpat)*	15	
8	*Sonneratiaa alba (Pagatpat)*	14	
9	*Sonneratiaa alba (Pagatpat)*	17	
10	*Sonneratiaa alba (Pagatpat)*	18	
11	*Sonneratiaa alba (Pagatpat)*	14	
12	*Sonneratiaa alba (Pagatpat)*	18	
13	*Sonneratiaa alba (Pagatpat)*	16	
14	*Sonneratiaa alba (Pagatpat)*	18	
Average		**15.1 m**	

Source: JICA Survey Team

Characteristically, the *Sonneratia sp*. grows more rectilinear and thus the average height of the trees in the Quadrat was measured at 15.1 m. The average height and diameter have been assessed to be good to excellent category indicating that there has been very little disturbance and no marked of deterioration in the current density of the mangroves.

c) Natural mangrove forest in marshy area

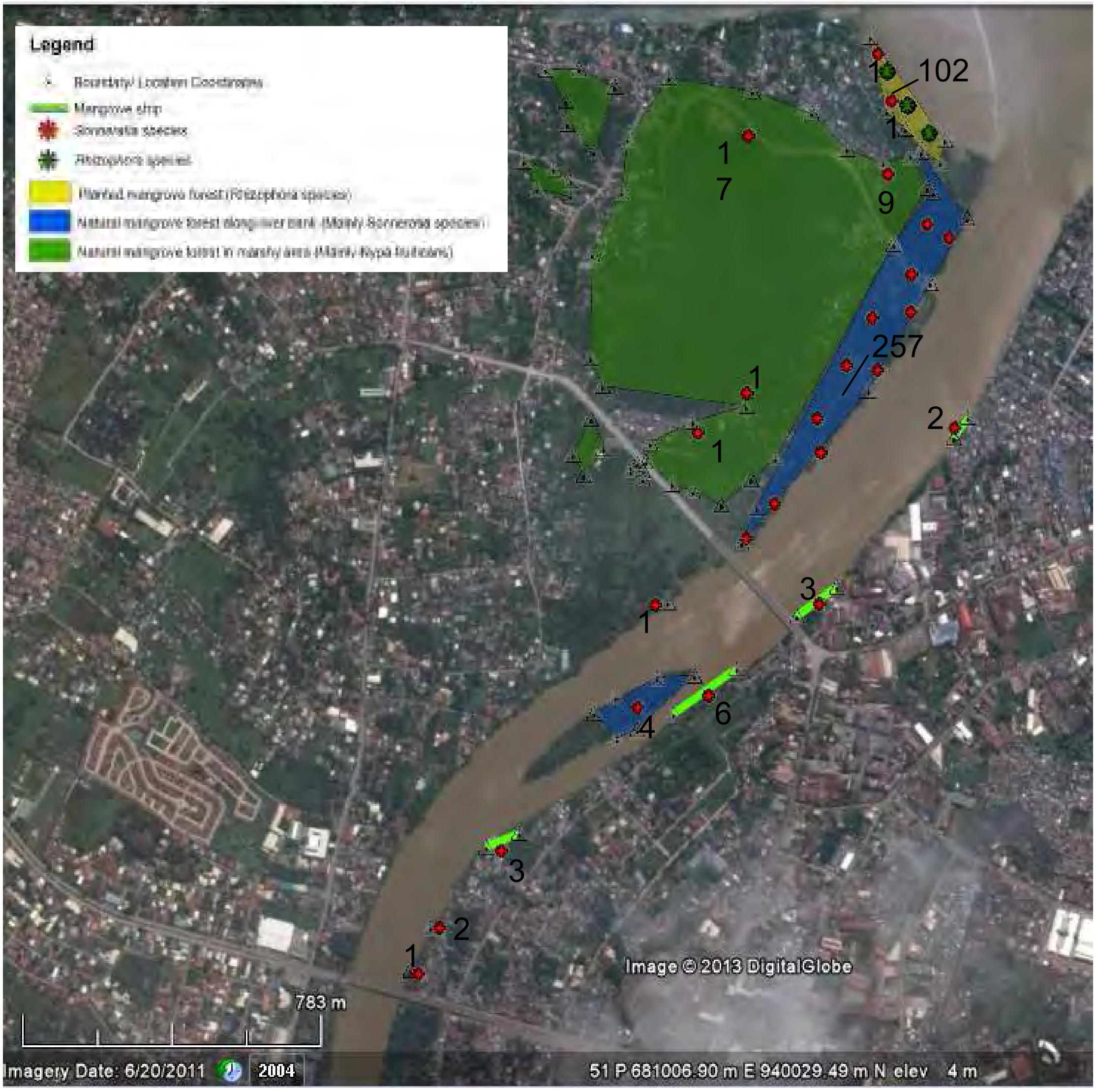
The natural forest is mainly located in the marshy area of Barangay Bonbon. Mainly, the vast marshy area is thickly vegetated with species of *Nypa fruiticans* and with patches of *Sonneratia alba* identified during the survey. Other fragmented areas were seen with vegetation associated with mangrove forest but dominantly with only the Nipa species. **Table 6.2.26** shows the list of mangrove recognized during the survey in the marshy area. Human settlements are evident in the area recognizing the economic value of Nipa as the leading commodity of the community residing along or near the mangrove area.

Table 6.2.26 Coordinates data of *Sonneratia alba* in Mangrove Forest (Marshy area)

No.	Long	Lat	No. of Trees	Ave. Height (m)	Ave. DBH (cm)
1	124° 38' 59.751" E	8° 30' 30.911" N	17	12	25
2	124° 38' 58.466" E	8° 30' 10.031" N	1	15	30
3	124° 38' 54.076" E	8° 30' 07.033" N	1	11	22
4	124° 39' 11.637" E	8° 30' 27.163" N	9	9	25

C) Distribution and area of mangrove forest

Using the same methodology of plotting the mangrove forest, a new set of map was produced showing the distribution of the mangrove trees including the three types of mangrove forests encountered during the survey. The location of the entire mangrove encountered in the survey were plotted and mapped. **Figure 6.2.6** shows the extent of all the identified mangroves trees of the three mangrove forests overlaid satellite image.



Source: JICA Survey Team

Figure 6.2.6 Map showing distribution of mangroves as the survey results

The number in the image represents the actual and approximate number of mangroves identified and recorded except for Nipa during the survey in May and June, 2013. As for the area of the newly delineated mangrove forest (**Table 6.2.27**), there is a slight increase in the total area despite the removal of some patches of mangrove areas seen originally on the base map. The total area of mangrove forest is estimated to be 76.5 ha in the survey/ area.

Table 6.2.27 Survey Result of the Area of the Three Mangrove Forests

Mangrove Type	Area (Ha.)
Planted mangrove forest	1.81
Natural Plantation along River Bank	14.36
Natural Plantation in Marshy area	60.33
Total	**76.5**

Source: JICA Survey Team

(2) Potential Impacts

Potential impacts of the implementation of the Project on mangrove forest are the following:

- Impacts on mangrove forests due to the obstruction of water flow by project facility (evacuation road), and
- Clearance of mangrove forest (cutting mangrove trees) for construction of evacuation road.

1) Impacts on mangrove forests due to the change of water regime

Figure 6.2.7 shows the location of dike (evacuation road) and floodwall construction of the Project in the downstream area of CDO River. Most of the mangrove forests are located near side to the river than the location of dike (evacuation road) in the area of Brgy. Bonbon. However there is the area of mangrove forests at west (further side) of the dike construction in Bonbon (Site A and B: Nipa mangrove on **Figure 6.2.7**).

Source: JICA Survey Team

Figure 6.2.7 Potential Impact Area of Mangrove Forests

In case that existing water channel which supplies water to mangrove forests is obstructed by the evacuation road, the west side (further side) of the dike, including the Site A and B of Nipa mangrove, would become drier than the current status.

According to the basic design of the Project, however, the water channel is to be constructed so that the water can flow passing underneath the evacuation road. It is, therefore, the possibility that the mangrove area is to be dried up is predicted as minimal.

2) Clearance of mangrove forest (cutting mangrove trees) for construction of project facility (evacuation road)

Based on the location of dike construction and mangrove forests, the area and location where the mangrove forests need to be cleared for the construction of evacuation road are checked on site. **Figures 6.2.8 to 6.2.11** show the location necessary for clearance for the implementation of the Project.

The area of the clearance is approx. 0.69 ha in total, locating along the evacuation road on dike in Brgy. Bonbon and Kauswagan.

The mangrove trees located along the right bank side, on the other hand, will not need to be cut because the location of dike of the Project is located further side from the river channel and locations where the mangrove trees are growing.

Table 6.2.28 Area of mangrove forests (Nipa) situated along the planned evacuation road in Brgy. Bonbon

Location Code*	Area (m^2)	Location Code*	Area (m^2)
A	935	**H**	198
B	181	**I**	89
C	89	**J**	196
D	2,395	**K**	56
E	565	**L**	254
F	829	**M**	937
G	132	***Total***	***6,856 (Approx.0.69 ha)***

Note) * refer to Figure 6.2.8 to 6.2.11

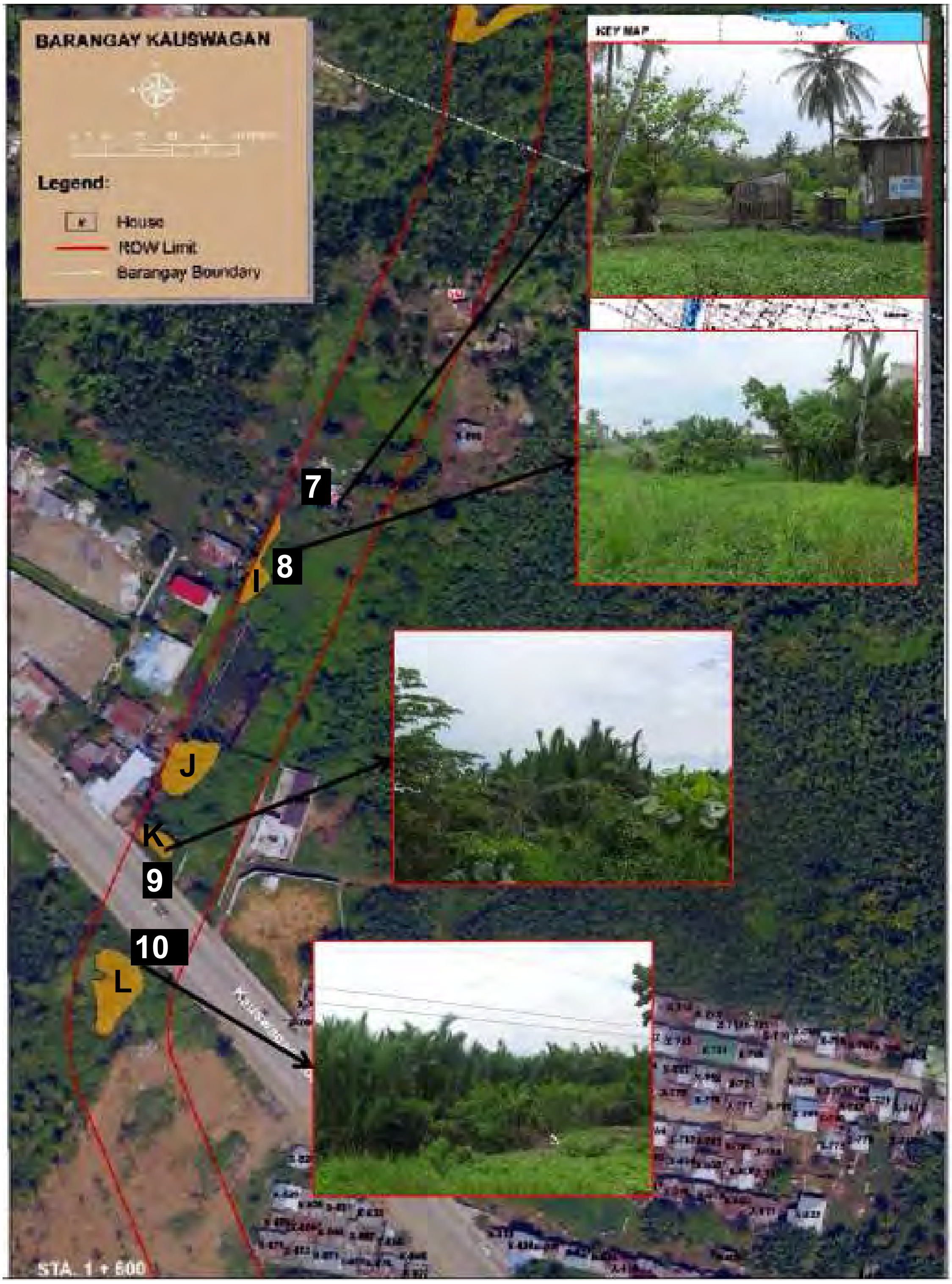
Source: JICA Survey Team

Source: JICA Survey Team

Figure 6.2.8 Mangrove forest to be affected by construction of project facility (evacuation road) near Barangay Bonbon (1 of 4 figures)

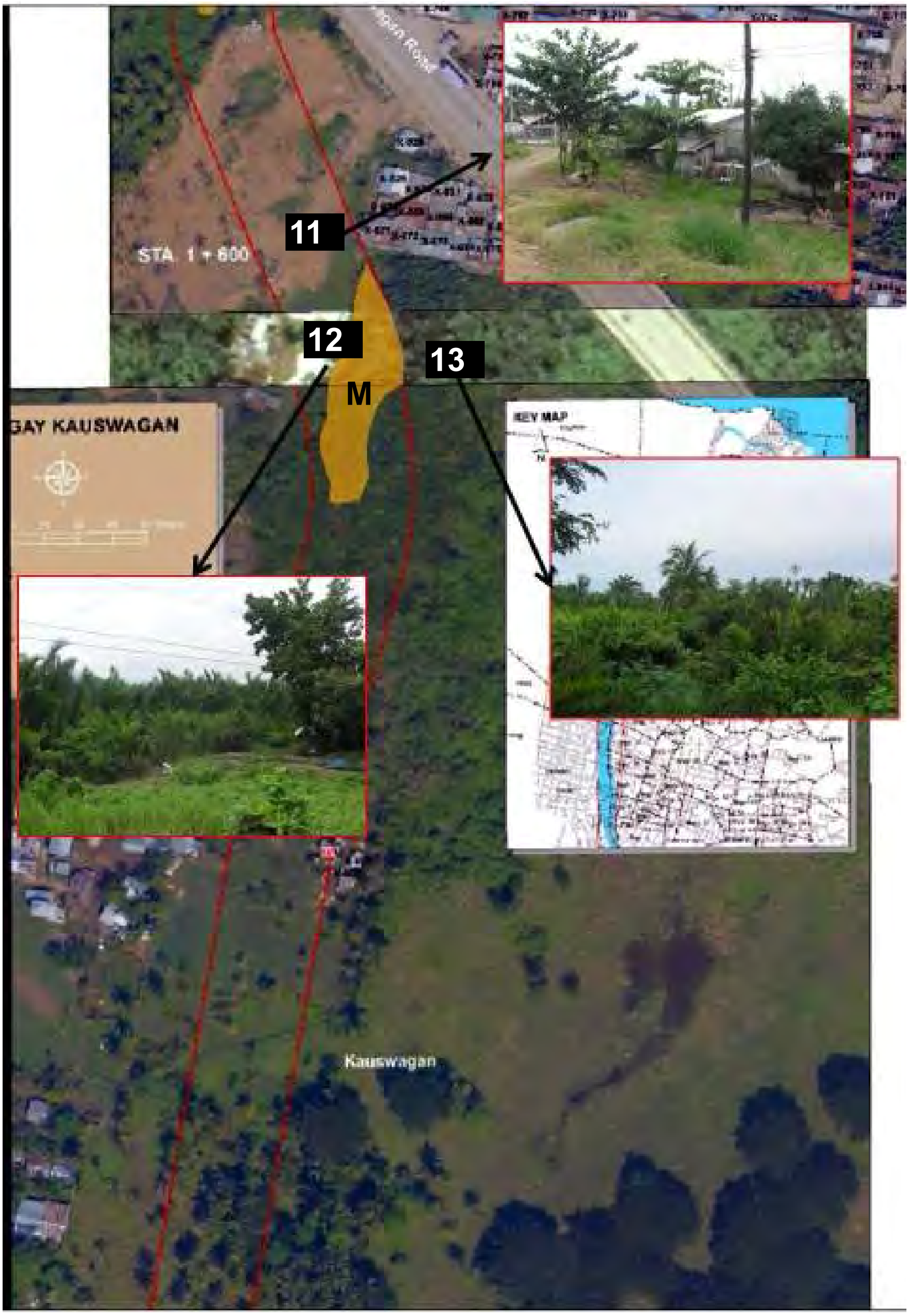
Source: JICA Survey Team

Figure 6.2.9 Mangrove forest to be affected by construction of project facility (evacuation road) near Barangay Bonbon (2 of 4 figures)



Source: JICA Survey Team

Figure 6.2.10 Mangrove forest to be affected by construction of project facility (evacuation road) near Barangay Kauswagan (3 of 4 figures)



Source: JICA Survey Team

Figure 6.2.11 Mangrove forest to be affected by construction of project facility (evacuation road) near Barangay Kauswagan (4 of 4 figures)

(3) Mitigation measures

Mitigation measures for the mangrove forests to be affected include the following:

1) Potential impacts of the obstruction of water flow by project facility (evacuation road)

- Confirmation of existing creek which supply water to mangrove forests of Nipa and ensuring the installation of water flow function passing underneath the evacuation road in the following stage of D/D and Construction.
- Confirmation of the water flow function passing underneath the evacuation road during the Operation and Maintenance stage,

2) Clearance of mangrove forest (cutting mangrove trees) for construction of project facility (evacuation road)

Mitigation measures for the mangrove forests to be affected are composed of the two aspects:

- Minimizing the mangrove trees to be cut for the construction of project facilities,
- Necessary permission including the compensation of mangrove trees to cut.

As for the first aspect, the following activities shall be carried out in the construction phase.

- To minimize the area of mangrove forest clearance by consideration of construction methodology,
- Providing a temporary fencing to the mangrove forest that will be retained for limiting land clearing as much as possible,
- Using markers and fences to direct heavy equipment in the construction site and minimize damage to mangrove trees,

Regarding the second aspect, clearance of mangrove forests compensation for it has to be treated following legal basis:

- RA 7161 (An Act incorporating certain sections of the National Internal Revenue Code)
- RA 8550 (Fisheries Code)
- PD 705 (Revised Forestry Code)

In the legislation above, clearance of mangrove trees is basically prohibited. When needed to cut them, it is necessary to obtain permission from the authority. In the case of the Project, the following procedures shall be taken:

- Consultation with CECRO, DENR R-10 for site inspection by the authority upon the letter to intent to be issued the Proponent.
- Based on the site inspection results, the request of mangrove clearance will be resolved to the DNER, Central Office for approval.
- After the approval of the DNER, Central Office, the clearance of the mangrove forests are to be eventually permitted in the construction stage.
- During the consultation for obtaining the permission of cutting mangrove forest, the necessary compensation including the replacement of the mangrove trees to be cut will be instructed by the authority, DENR Region 10 for the Project.

6.2.3 Terrestrial fauna

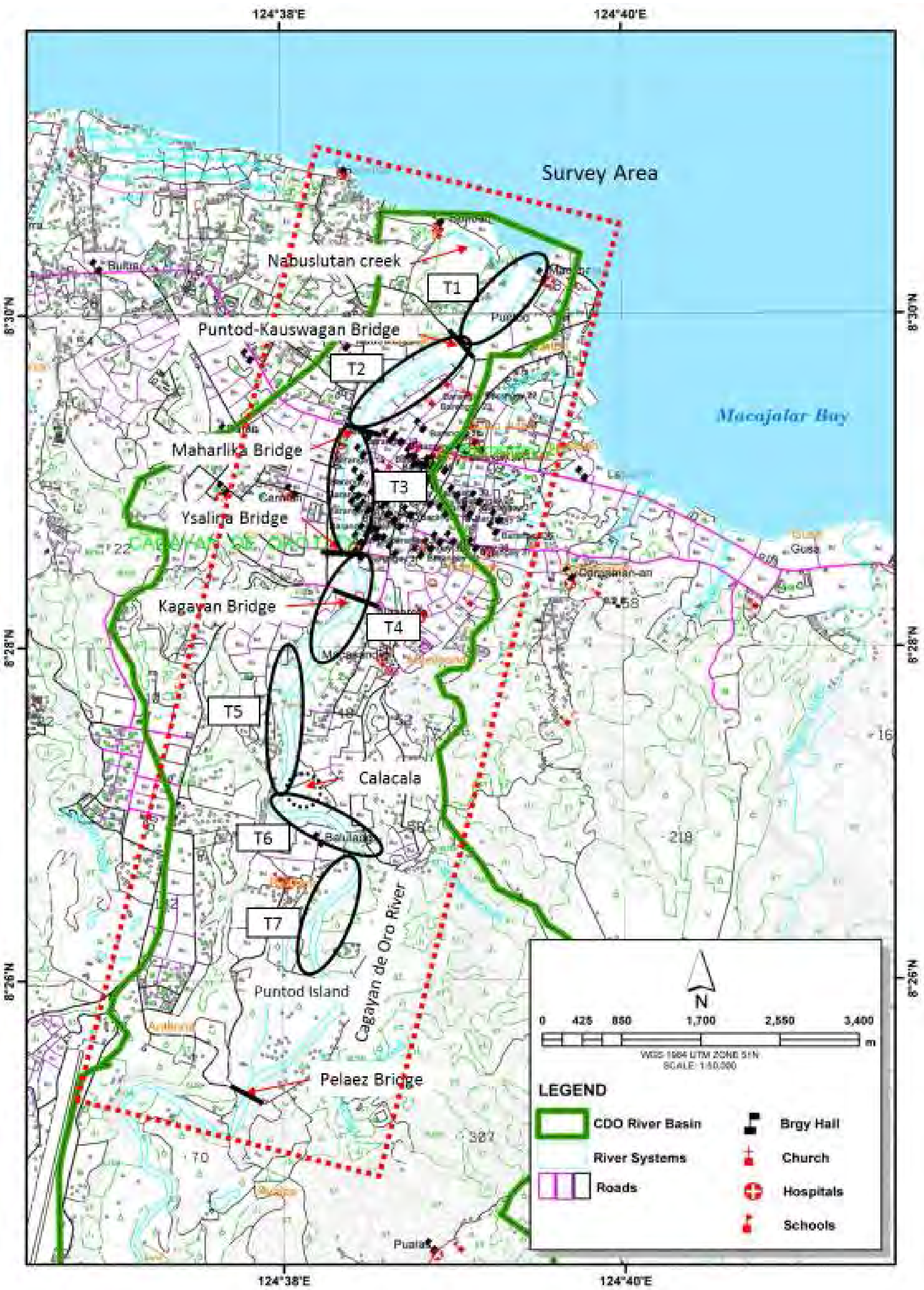
(1) Baseline Environment

The survey of terrestrial fauna was conducted twice from April 5 to 6, 2013 and from Sep. 7 to 8 2013 for the dry and wet season, respectively.

1) Survey location

Figure 6.2.12 shows the survey area for the fauna survey. The survey locations of the terrestrial fauna were the same for both the dry and rainy seasons. The survey started from the river mouth of the CDO River and continued southward upstream up to the Pelaez Bridge. Additional data of the target fauna groups were gathered through opportunistic observations and validated along the said pathways. The established transects are as follows:

- Transect 1 (T1): From River mouth to Puntod-Kauswagan Bridge,
- Transect 2 (T2): From Puntod-Kauswagan Bridge to Maharlika Bridge,
- Transect 3 (T3): From Maharlika Bridge to Ysalina Bridge,
- Transect 4 (T4): From Ysalina Bridge to upstream of Kagayan Bridge,
- Transect 5 (T5): From upstream of Kagayan Bridge to Calacala,
- Transect 6 (T6): From Calacala to Balulang,and
- Transect 7 (T7): From Balulang to Puntodo Island.



Source: JICA Survey Team

Figure 6.2.12 Location Map of Terrestrial Fauna Survey (Dry and Wet Season)

2) Survey method

A) Site Survey

Census survey was done along the transects to identify birds, mammals, amphibians and reptiles by conducting opportunistic observations of all wildlife encountered on-board a boat along the CDO River. The survey was done during early morning (0600h-1000h) and late afternoon (1400h-1800h). During each census survey, the following information were recorded for wildlife observed: (i) species name, (ii) number of individuals, (iii) habitat, (iv) composition (if seen singly or in a group, feeding singly, as a group or in mixed flocks -for birds), and endemicity or exoticity.

As for avian fauna, at least two observers carried out the observations. Opportunistic observations of raptors were also included.

Mammals were assessed using opportunistic observations along the cruise lines, stopping where points along the banks of the river indicate presence of wildlife such as tracks, fecal matter, skin remains, etc.

Herpeto-fauna (amphibians and reptiles) were assessed by close ocular inspection of habitats where they are found (e.g. streams, rock crevices, tree trunks and branches). Whenever a specimen or group of specimen is spotted, their number and general behavior were noted. Taxonomy for amphibians and reptiles followed standard field guides. Opportunistic surveys for stream amphibians were supplemented by key informant interviews.

B) Analysis

Community diversity was determined via the Shannon-Weiner Index (H') of Diversity that takes into account both species richness and the relative abundance of each species in a community (transect area). Relative abundance refers to the number of individuals of a given species divided by the total number of individuals of all species found.

The value of the Shannon-Weiner Index (H') is determined by the following formula:

$$H' = -\sum_{i=1}^{R} p_i \ln p_i$$

3) Survey Results

A) General Feature of Habitat

The riverbanks and surrounding portions of the associated landscape along the transects at are characterized by urban development consisting mostly of houses and commercial buildings. It is, however, noteworthy that mangrove stands are also present, mostly at the northern part (creek at river outlet) and some extending upstream towards Maharlika Bridge. Further upstream, mixed ecosystems of grass, woodland and shrub are dominant as well as some wetlands, although since the survey was conducted during the dry season, only ample patches were observed. Bamboo, fig trees, mangoes and other tree species are present but in arrays along the banks. From Transect T3 to T4, there are relatively less urbanized areas, and more of agricultural farmland, particularly corn as the primary produce.

B) Identified Species

a) Dry season

i) Summary

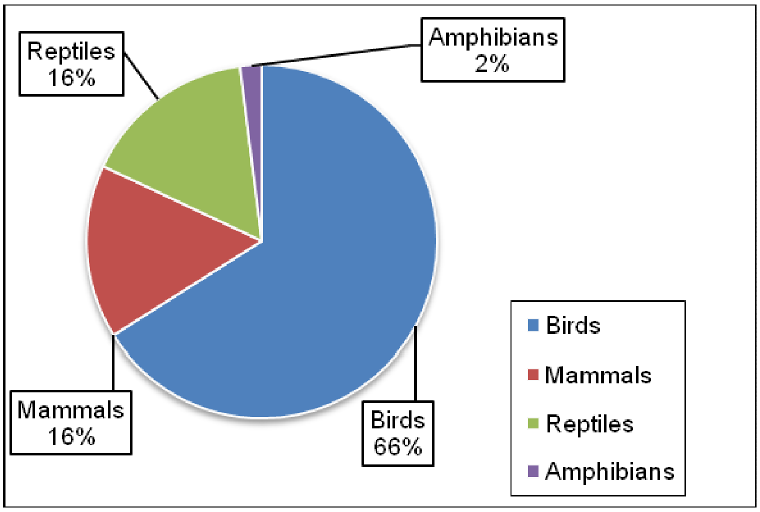
Table **6.2.29** shows the list of species observed during the survey conducted in the dry season. As a result, a total of 38 species of wildlife vertebrates were recorded present in the study area, consisting of 25 species of birds (66%), 6 species of mammals (16%), 6 species of reptiles (16%) and one (1) species of amphibian 2%) as shown on **Figure 6.2.13.**

Table 6.2.29 Terrestrial Fauna Species Identified during the Survey (Dry Season)

Common Name	Scientific Name	Family	Residency Status[1]
AVES			
Little egret	*Egretta garzetta*	Ardeidae	Migrant
Cattle egret	*Bubulcus ibis*	Ardeidae	Resident/Migrant
Malaysian plover	*Charadrius peronii*	Charadriidae	Resident
Marsh sandpiper	*Tringa stagnatilis*	Scolopacidae	Migrant
Common sandpiper	*Actitis hypoleucos*	Scolopacidae	Migrant
Little tern	*Sterna albifrons*	Sternidae	Migrant
Zebra dove	*Geopelia striata*	Columbidae	Resident
Lesser coucal	*Centropus bengalensis*	Cuculidae	Resident
Eurasian tree sparrow	*Passer montanus*	Passeridae	Resident/Migrant
Glossy swiflet	*Collocalia esculenta*	Apodidae	Resident
Pygmy swiftlet	*Collocalia troglodytes*	Apodidae	Resident
Pacific swallow	*Hirundo tahitica*	Hirundinidae	Resident
Barn swallow	*Hirundo rustica*	Hirundinidae	Resident
Yellow-vented bulbul	*Pycnonotus goiavier*	Pycnonotidae	Resident
Golden-bellied flyeater	*Gerygone sulphurea*	Acanthizidae	Resident
Arctic warbler	*Phylloscopus borealis*	Sylviidae	Migrant
Pied fantail	*Rhipidura nigritorguis*	Rhipiduridae	Resident
White breasted wood swallow	*Artamus leuchorynchus*	Artamidae	Resident
Olive-backed sunbird	*Nectarinia jugularis*	Nectariniidae	Resident
Red-keeled flowerpecker	*Dicaeum australe*	Dicaeidae	Resident
White collared kingfisher	*Halcyon chloris*	Alcedinidae	Resident
Stork-billed kingfisher	*Pelargopsis capensis*	Alcedinidae	Resident
Brahminy kite	*Haliastur indus*	Accipitridae	Resident
Phil Glossy Starling	*Aplonis panayensis*	Sturnidae	Resident
Striated heron	*Butorides striata*	Ardeidae	Resident
MAMMALS			
Phil. field rat	*Rattus norvegicus*	Muridae	Resident
Asian house shrew	*Suncus murinus*	Soricidae	Introduced/pest
Common fruit bat	*Cynopterus brachyotis*	Pteropodidae	Resident
Musky fruit bat	*Ptenochirus jagori*	Pteropodidae	Resident
Common Rousette	*Rousettus amplexicaudatus*	Pteropodidae	Resident
Lesser Asian house bat	*Scotophilus kuhlii*	Verpertilionidae	Resident
REPTILE			
Many-keeled Mabouya	*Mabuya multicarinata*	Scincidae	Resident
Common mabouya	*Mabuya multifaciata*	Scincidae	Resident
Flat-bodied house gecko	*Cosymbotus platyrus*	Gekkonidae	Resdient
Tender-skinned house	*Gehyra mutilata*	Gekkonidae	Resident

Common Name	Scientific Name	Family	Residency Status[1]
gecko			
Common house gecko	*Hemidactylus frenatus*	Gekkonidae	Resident
Reticulated Python	*Python reticulatus*	Pythonidae	Resident
AMPHIBIAN			
South American Toad	*Bufo marinus*	Bufonidae	Introduced

[1]*Based on Heaney, et al., A Synopsis of the Mammalian Fauna fo the Philippine Islands (1998)*
**All data are primary data*
Source: JICA Survey Team



Source: JICA Survey Team

Figure 6.2.13 Composition of Terrestrial Fauna Species Identified during the Survey (Dry Season)

Figure 6.2.14 shows the percentage composition of residency status of the wildlife species recorded during the dry season.

The total species tally in terms of residency status revealed 24 species that are considered residents (63%). Three species are listed to be Philippine endemics (8%); these are the Pygmy Swiftlet (*Collocalia troglodytes*), the Red-keeled Flowerpecker (*Dicaeumaustrale australe*), and Musky Fruit Bat (*Ptenochirus jagori*). There were six migratory avifauna recorded (16%), two species from the heron and egret family taxa that are considered migratory or resident (5%); these are the Striated Heron (*Butorides striata*) and Cattle Egret (Ardeidae: *Bubulcus ibis*). Lastly, three species are introduced and considered invasive (8%); one is the single amphibian found: South American Toad (*Bufo marinus*), and two mammals which are also labeled as pests to human habitations: Asian House Shrew (*Suncus murinus*) and Norway Rat (*Rattus norvegicus*).

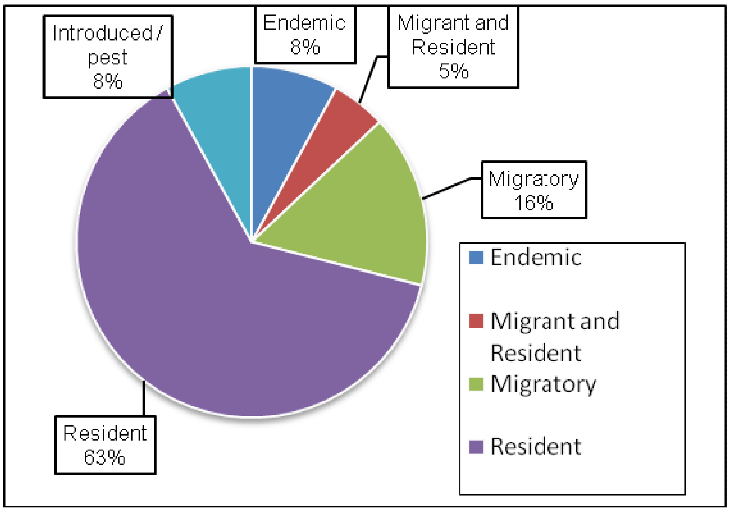


Figure 6.2.14 Composition of Residency Status of Wildlife Species Recorded during the Dry Season

ii) Avifauna (Birds)

A total of 309 individuals representing 25 species were recorded along the transects (**Table 6.2.30**). Based on residency status, the percentage composition is shown on **Figure 6.2.15**, indicating 15 species resident breeders (60%), two endemic species (8%), six migratory species (24%), and two migrant/resident species (8%).

Majority of the observed birds are associated with disturbed habitats like agricultural and residential areas. Some exceptions are those that can be found in woodland areas, secondary growth forest patches, or wetland habitats like mangroves and mudflats. At least four species are ecologically associated with forest habitats like the Brahminy Kite, Pygmy Swiftlet, Red-keeled Flowerpecker, and Arctic Warbler (*Phylloscopus borealis*).

It is noteworthy that the recorded endemic species are also associated with forested habitats; or woodland areas in this case. There were also eight species that are associated with wetland habitats, either for feeding/foraging or having embedded nests within the water-logged soil or sand. These are: Striated Heron, Cattle Egret, Little Egret (*Egretta garzetta*), Malaysian Plover (*Charadrius peronii*), Marsh Sandpiper (*Tringa stagnatilis*), Common Sandpiper (*Actitis hypoleucos*), Little Tern (*Sterna albifrons*), and Stork-billed Kingfisher (*Pelargopsis capensis*).

Table 6.2.30 shows the summary of the avifaunal tally and relevant data in the survey conducted in the study area within the Cagayan de Oro River.

Table 6.2.30 Summary of Avifauna Data during the Dry Season

Species	Common Name	Transects							Total[1]	Residency Status[2]
		T1	T2	T3	T4	T5	T6	T7		
Family ARDEIDAE										
Egretta garzetta	Little Egret	2		2			1	1	6	Migratory
Butorides striata	Striated Heron			1	1				2	Migrant and Resident
Bubulcus ibis	Cattle Egret			5	2		2		9	Migrant and Resident
Family ACCIPITRIDAE										
Haliastur indus	Brahminy Kite		1					1	2	Resident
Family CHARADRIIDAE										
Charadrius peronii	Malaysian Plover				1				1	Resident
Family SCOLOPACIDAE										
Tringa stagnatilis	Marsh Sandpiper					1			1	Migratory
Actitis hypoleucos	Common Sandpiper				1				1	Migratory
Family STERNIDAE										
Sterna albifrons	Little Tern	2	4	1					7	Migratory
Family COLUMBIDAE										
Geopelia striata	Zebra Dove			1			2	2	5	Resident
Family CUCULIDAE										
Centropus bengalensis	Lesser Coucal						1	1	2	Resident
Family APODIDAE										
Collocalia esculenta	Glossy Swiftlet		10	8	5		2	2	27	Resident
Collocalia troglodytes	Pygmy Swiftlet	5	8		5	2			20	Endemic
Family ALCEDINIDAE										
Halcyon chloris	White-collared Kingfisher	2	1	1	2	2	2	2	12	Resident
Pelargopsis capensis	Stork-billed Kingfisher		1						1	Resident
Family HIRUNDINIDAE										
Hirundo rustica	Barn Swallow				1				1	Migratory
Hirundo tahitica	Pacific Swallow	10	12	15	20				57	Resident
Family PYCNONOTIDAE										
Pycnonotus goiavier	Yellow-vented Bulbul	4	5	2	1		1		13	Resident
Family ACANTHIZIDAE										
Gerygone sulphurea	Golden-bellied Flyeater		1						1	Resident
Family SYLVIIDAE										

Species	Common Name	Transects							Total[1]	Residency Status[2]
		T1	T2	T3	T4	T5	T6	T7		
Phylloscopus borealis	Arctic Warbler		1						1	Migratory
Family RHIPIDURIDAE										
Rhipidura nigritorguis	Pied Fantail		2	4	1		2	2	11	Resident
Family ARTAMIDAE										
Artamus leucorhynchus	White-breasted Wood Swallow				1				1	Resident
Family STURNIDAE										
Aplonis panayensis	Asian Glossy Starling	6	12		8		2	2	30	Resident
Family NECTARINIIDAE										
Nectarinia jugularis	Olive-backed Sunbird	1	1	1	2		1	1	7	Resident
Family DICAEIDAE										
Dicaeum australe	Red-keeled Flowerpecker		2		1		2	1	6	Endemic
Family PASSERIDAE										
Passer montanus	Eurasian Sparrow	15	10	20	15	5	10	10	85	Resident
Total Count of Individuals		29	26	29	56	24	24	22	250	

1-Based on Kennedy, et al., A Guide to the Birds of the Philippines (2000)
**All data collected are primary data*
Source: JICA Survey Team

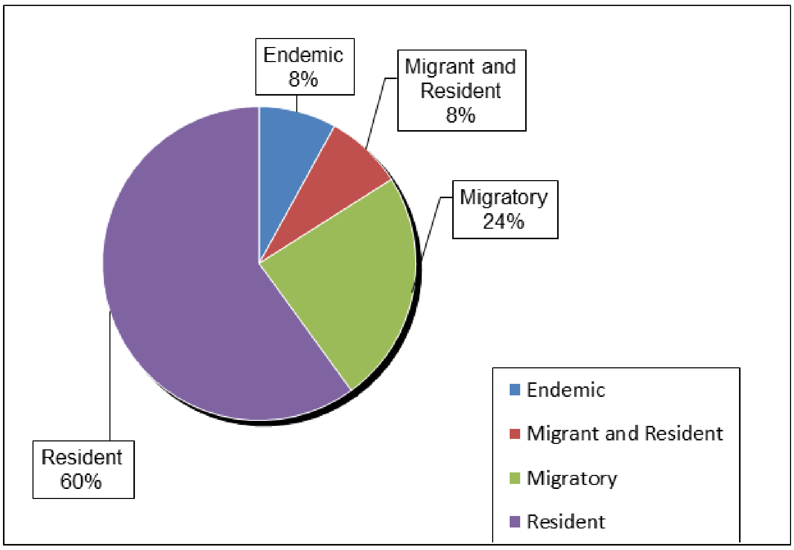


Figure 6.2.15 Residency Status of Avifauna Recorded in the Dry Season

Table 6.2.31 shows the Shannon -Wiener Diversity Index (H') for the avifauna observed during the dry season. Highest species diversity was found in Transect 2. Overall, the diversity of avifauna in the study area is high and infers that the bird species are well distributed in the study area. Noteworthy are the recorded species found in T2, T4, T6, and T7, have variety of habitats and with some species crossing over possibly for food sources.

Table 6.2.31 Biodiversity Indices for Avifauna Observed during the Dry Season

Biodiversity Index	Transect						
	T1	T2	T3	T4	T5	T6	T7
Shannon -Wiener Dibersity Index (H')	1.89	2.31	1.92	2.15	1.22	2.16	2.02

Source: JICA Survey Team

iii) Mammals

Six species of mammals were recorded in the survey during the dry season (**Table 6.2.32**). These consist of: one shrew, the Asian House Shrew; four bats, the Common Short-nosed Fruit Bat (*Cynopterus brachyotis*), the Common Rousette (*Rousettus amplexicaudatus*), the Lesser Asian House Bat (*Scotophilus kuhlii*); and the Musky Fruit Bat; and lastly, one rodent, the Norway Rat.

Table 6.2.32 Summary of Mammals Data during the Dry Season

Species*	Common Name	Transects							Residency Status[2]
		T1	T2	T3	T4	T5	T6	T7	
Family SORICIDAE									
Suncus murinus	Asian House Shrew	x	x	x	x	x			Introduced / pest
Family PTEROPODIDAE									
Cynopterus brachyotis	Common Short-nosed Fruit Bat	x	x	x	x		x	x	Resident
Ptenochirus jagori	Musky Fruit Bat				x		x	x	Endemic
Rousettus amplexicaudatus	Common Rousette				x				Resident
Family VESPERTILIONIDAE									
Scotophilus kuhlii	Lesser Asian House Bat	x	x	x	x	x			Resident
Family MURIDAE									
Rattus norvegicus	Norway Rat	x	x	x	x	x			Introduced / pest

2- Based from Heaney, et al., A Synopsis of the Mammalian Fauna of the Philippine Islands (1998)

**All data collected are primary data*

Source: JICA Survey Team

Based on residency status, the percentage composition is shown on **Figure 6.2.16** indicating one endemic species (17%), three species resident or native (50%), and two introduced/pest species (33%). The four bat species are all residents, or “native”; that breed in the country, especially the endemic Musky Fruit Bat. These vertebrate groups are mainly identified via relative sizes, like wingspan flight patterns, acoustic signals, and general behavior. Three fruit bats are associated with forested or woodland habitats, while the Lesser Asian House Bat, which is an insectivore; is strongly associated with human habitations. Two of the other recorded mammals are meanwhile considered as invasive and often regarded as pests. These are the Asian

House Shrew and the Norway Rat.

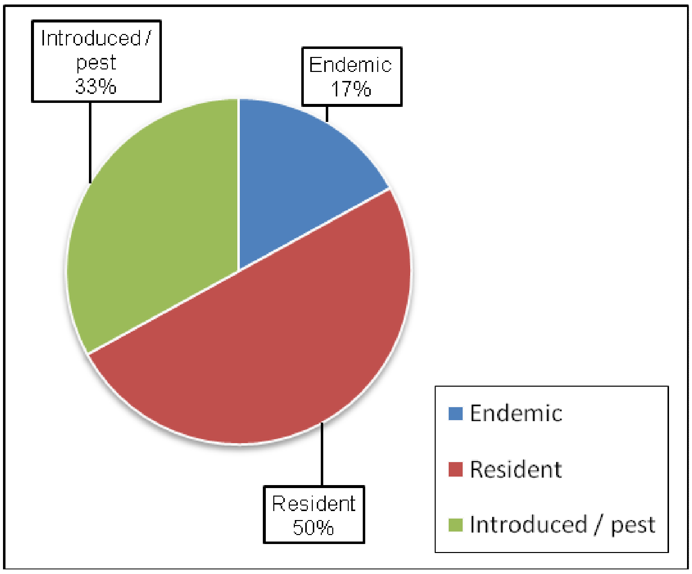


Figure 6.2.16 Residency Status of Mammals Recorded in the Dry Season

iv) Herpetofauna (Reptiles and Amphibians)

A total of six species of reptiles and one amphibian were recorded (**Table 6.2.33**). These consist of: two skinks (vegetation lizards), the Many-keeled Mabouya (*Mabuya multicarinata*) and the Common Mabouya (*Mabuya multifasciata*); three geckos (large house lizards), Flat-bodied House Gecko (*Cosymbotus platyurus*), Tender-skinned House Gecko (*Gehyra mutilata*), and Common House Gecko (*Hemidactylus frenatus*); the Reticulated Python; and lastly, the single amphibian, the South American Toad.

Table 6.2.33 Summary of Herpetofauna Data during the Dry Season

Species*	Common Name	Transects							Residency Status[3]
		T1	T2	T3	T4	T5	T6	T7	
REPTILES									
Family SCINCIDAE									
Mabuya multicarinata	Many-keeled Mabouya				x	x	x	x	Resident
Mabuya multifasciata	Common Mabouya				x		x	x	Resident
Family GEKKONIDAE									
Cosymbotus platyrus	Flat-bodied House Gecko	x	x		x	x			Resident
Gehyra mutilata	Tender-skinned House Gecko	x	x	x	x	x			Resident
Hemidactylus frenatus	Common House Gecko	x	x		x	x			Resident
Family PYTHONIDAE									
Python reticulatus	Reticulated Python				x		x	x	Resident
AMPHIBIANS									
Family BUFONIDAE									
Bufo marinus	South American Toad	x	x	x	x	x			Introduced

*3- Based on Alcala, Guide to Philippine Flora and Fauna, Vol X (1986); *All data collected are primary data*such areas. Source: JICA Survey Team

Based on residency status, the percentage composition is presented in **Figure 6.2.17**, indicating six resident species of reptiles (86%); and one introduced species of amphibian (14%). This lone amphibian which is usually a gregarious species was recorded in the majority of the transects since it was seen in human habitations along river banks, as well as grass and woodland areas near a water body. On the other hand, the six resident reptile species are all strongly associated with residential, agricultural areas, and occasionally scrub-type vegetation.

It is noteworthy that there is still the presence of the Reticulated Python, although it was only noted via descriptions in anecdotal information from key informant interviews.

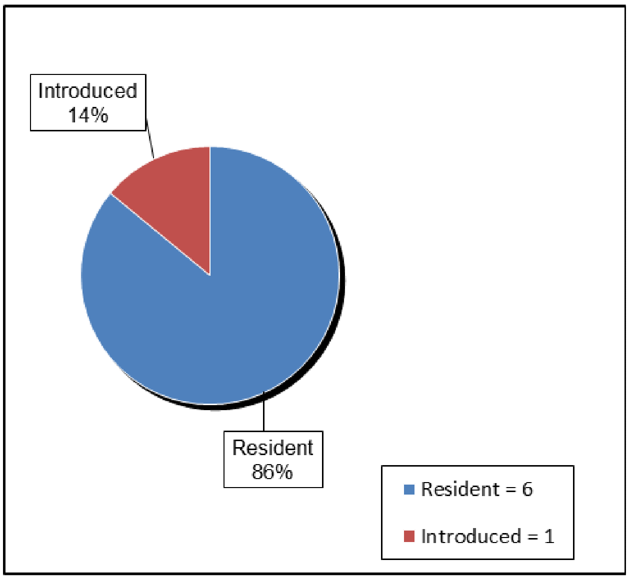


Figure 6.2.17 Residency Status of Herpetofauna Recorded in the Dry Season

b) Wet Season

i) Summary

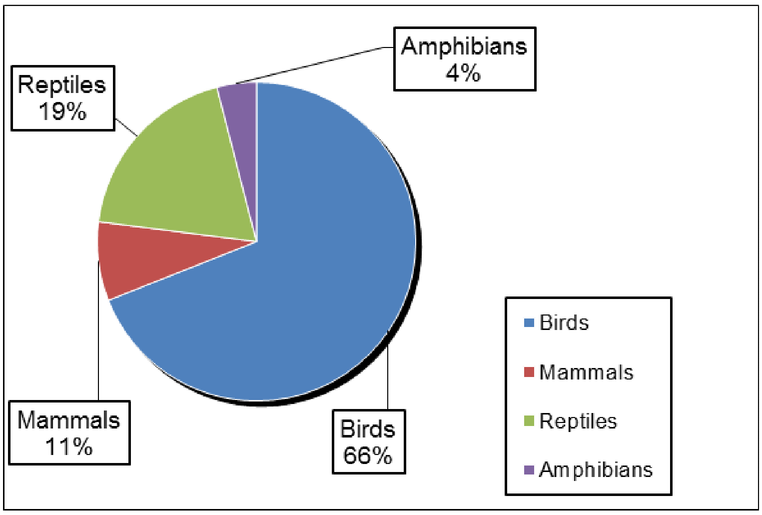
Table 6.2.34 shows the list of species observed during the survey conducted in the wet season. As a result, a total of 28 species of wildlife vertebrates were recorded present in the study area, consisting of 18 species of birds (66%), three (3) species of mammals (11%), five (5) species of reptiles (19%) and one (1) species of amphibian (4%) as shown on **Figure 6.2.18.**

Table 6.2.34 Terrestrial Fauna Species Identified during the Survey (Wet season)

Common Name	Scientific Name	Family	Residency Status
AVES			
Eurasian tree sparrow	*Passer montanus*	Passeridae	Resident
Glossy swiflet	*Collocalia esculenta*	Apodidae	Resident
Pacific swallow	*Hirundo tahitica*	Hirundinidae	Resident
White breasted wood swallow	*Artamus leuchorynchus*	Artamidae	Resident
Barn swallow	*Hirundo rustica*	Hirundinidae	Migratory
Olive-backed sunbird	*Nectarinia jugularis*	Nectariniidae	Resident
Yellow wagtail	*Montacilla flava*	Motacillidae	Migrant/resident
Striated Cane grass warbler	*Megalurus palustris*	Locustellidae	Migrant/resident
Brown shrike	*Lanius cristatus*	Laniidae	Migrant/resident

Common Name	Scientific Name	Family	Residency Status
Shack shrike	*Lanius schach*	Laniidae	Migrant/resident
White collared kingfisher	*Halcyon chloris*	Alcedinidae	Resident
Philippine Flowerpecker	*Dicaeum australe*	Dicaeidae	Resident
Philippine Coucal	*Centropus viridis*	Cuculidae	Resident
Brahminy kite	*Haliastur indus*	Accipitridae	Resident
Large billed crow	*Corvus macrorhynchos*	Corvidae	Resident
Barred rail	*Gallirallus torquatus*	Rallidae	Resident
Pied triller	*Lalage nigra*	Campephagidae	Migratory
Phil Glossy Starling	*Aplonis panayensis*	Sturnidae	Resident
Little heron	*Butorides striata*	Ardeidae	Migratory
MAMMALS			
Phil. field rat	*Rattus norvegicus*	Muridae	Resident
Asian house shrew	*Suncus murinus*	Soricidae	Introduced
Common fruit bat	*Cynopterus brachyotis*	Pteropodidae	Resident
REPTILE			
Tree snake	*Chrysopelea paradisi*	Colubridae	Resident
Monitor lizard	*Varanus salvator*	Varanidae	Resident
Reticulated Python	*Python reticulatus*	Pythonidae	Resident
Philippine Cobra	*Naja philipinensis*	Elapidae	Resident
Gecko Lizard	*Gekko gecko*	Geckonidae	Resident
AMPHIBIAN			
South American Toad	*Bufo marinus*	Bufonidae	Introduced

Source: JICA Survey Team



Source: JICA Survey Team

Figure 6.2.18 Composition of Terrestrial Fauna Species Identified during the Survey (Wet Season)

ii) Avifauna (Birds)

A total of 250 individuals representing 19 species were recorded along the transects (**Table 6.2.35**). Based on residency status, the percentage composition is shown on **Figure 6.2.19)**, indicating 13 species resident breeders (68%), three (3) migratory species (16%), and three (3) migrant/resident species (16%).

Table 6.2.35 Recorded Avifauna Data from the Transect Lines Along the Cagayan de Oro River

Species	Common Name	Transects							Total[1]	Residency Status[2]
		T1	T2	T3	T4	T5	T6	T7		
Family ARDEIDAE										
Butorides striata	Little Heron		2	1		1			4	Migratory
Family ACCIPITRIDAE										
Haliastur indus	Brahminy Kite	1						1	2	Resident
Family RALIIDAE										
Gallirallus torquatus	Barred Rail					1				Resident
Family MONTACILLIDAE										
Montacilla flava	Yellow Wagtail						1		1	Migratory/ Resident
Family CUCULIDAE										
Centropus viridis	Philippine Coucal				1		1		2	Resident
Family APODIDAE										
Collocalia esculenta	Glossy Swiftlet			5			3	6	14	Resident
Family ALCEDINIDAE										
Halcyon chloris	White-collared Kingfisher			2		2			4	Resident
Lalaga nigra	Pied triller				1				1	Migratory
Family HIRUNDINIDAE										
Hirundo rustica	Barn Swallow				15				15	Migratory
Hirundo tahitica	Pacific Swallow		6	3	10	15			34	Resident
Family CORVIDAE										
Corvus macrorhyncus	Large Billed Crow	2		2	3			1	8	Resident
Family LANIIDAE										
Lanius cristatus	Brown Shrike						20		20	Migratory/Resident
Lanius schack	Shack shrike					14			14	Migratory/Resident
Family COLUMBIDAE										
Megalurus palustris	Striated Cane grass warbler						2	2	4	Resident
Family ARTAMIDAE										
Artamus leucorhynchus	White-breasted Wood Swallow				1				1	Resident
Family STURNIDAE										
Aplonis panayensis	Asian Glossy Starling	6	12		8		2	2	30	Resident
Family NECTARINIIDAE										
Nectarinia jugularis	Olive-backed Sunbird	1	1	1	2		1	1	7	Resident

Species	Common	Transects							Total[1]	Residency
Family DICAEIDAE										
Dicaeum australe	Philippine Flowerpecker		2		1		2	1	6	Resident
Family PASSERIDAE										
Passer montanus	Eurasian Tree Sparrow	20	5	15	15	6	13	9	83	Resident
Total		**29**	**26**	**29**	**56**	**24**	**24**	**22**	**250**	

[1] *Actual total is based on actual count of the number of species and residency statuses regardless of transect since a species may be found in more than one transect.*
[2] *Based on Kennedy, et al., A Guide to the Birds of the Philippines (2000)*
[3] *Based on observations during the conduct of this survey*
Source: JICA Survey Team

Majority of the observed birds are associated with disturbed habitats like agricultural and residential areas. Some exceptions are those that can be found in woodland areas, secondary growth forest patches, or wetland habitats like mangroves and mudflats. At least two species are ecologically associated with forest habitats like the Brahminy Kite and the Philippine Flower-pecker.

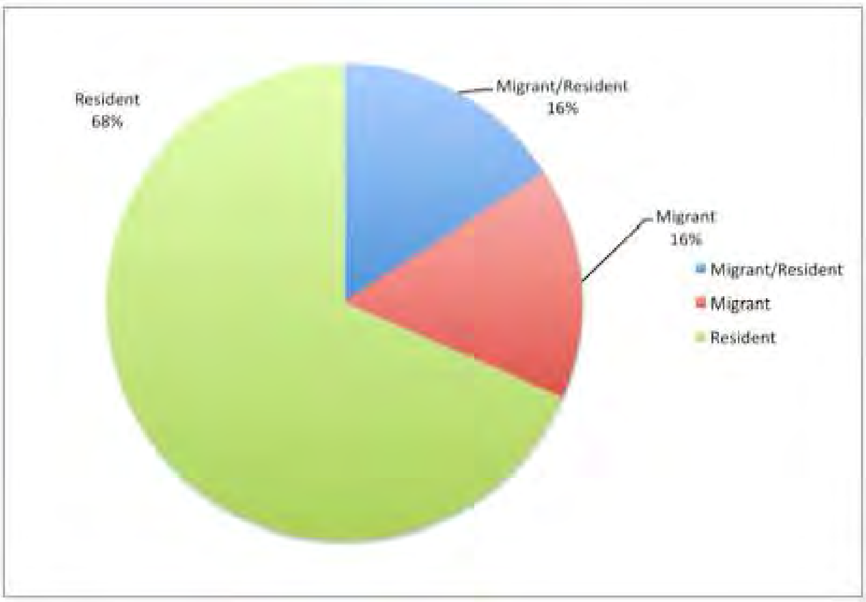


Figure 6.2.19 Residency Status of Avifauna Recorded in the Wet Season

Table 6.2.36 shows the Shannon -Wiener Diversity Index (H') for the avifauna observed during the wet season. Highest species diversity was found in Transect 4. Dibersity Index (H') during wet season was smaller than that of dry season.

Table 6.2.36 Biodiversity Indices for Avifauna Observed during the Wet Season

Biodiversity Index	Transect						
	T1	T2	T3	T4	T5	T6	T7
Shannon -Wiener Dibersity Index (H')	1.00	1.49	1.23	1.84	1.36	1.42	1.51

Source: JICA Survey Team

iii) Mammals

Three (3) species of mammals were recorded in the survey during the wet season (**Table 6.2.37**). These consist of: one shrew, the Asian House Shrew (*Suncus murinus*); one bat, the Common Short-nosed Fruit Bat (*Cynopterus brachyotis*); and one rodent, the Phil. Field Rat (*Rattus norvegicus*).

Table 6.2.37 Recorded mammalian data from the transect lines along the Cagayan de Oro River (Wet Season)

Species	Common Name	Transects							Residency Status[1]
		T1	T2	T3	T4	T5	T6	T7	
Family SORICIDAE									
Suncus murinus	Asian House Shrew	x	x	x	x	x			Introduced / pest
Family MURIDAE									
Rattus norvegicus	Phil. Field Rat			x	x		x	x	Resident
Family PTEROPODIDAE									
Cynopterus brachyotis	Common Short-nosed Fruit Bat			x	x		x	x	Resident

1- *based from Heaney, et al., A Synopsis of the Mammalian Fauna of the Philippine Islands (1998)*
2 - *based from observations during the conduct of this survey*
X – *present*

Source: JICA Survey Team

Based on residency status, the percentage composition is shown on **Figure 6.2.20**, indicating two species resident (67%), and two introduced/pest species (33%).

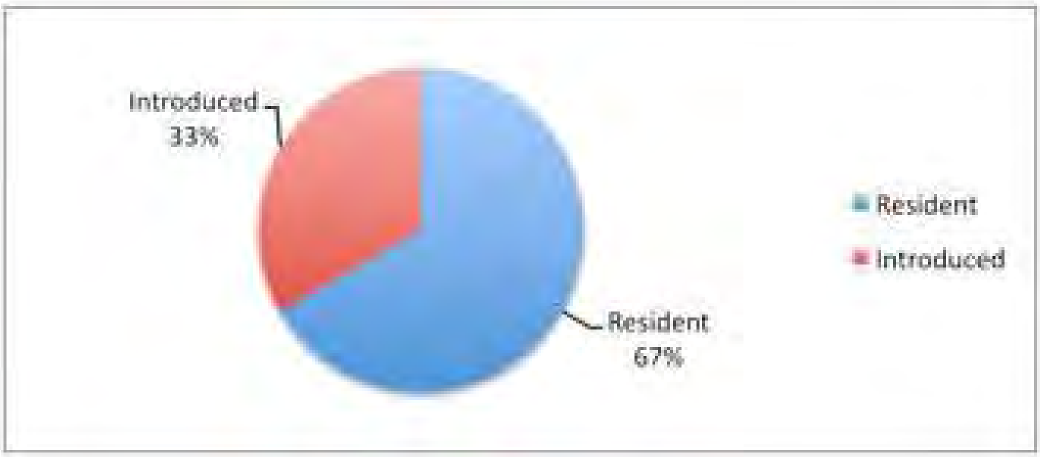


Figure 6.2.20 Residency Status of Mammals Recorded in the Wet Season

iv) Herpetofauna (Amphibians and Reptiles)

A total of 6 species of reptiles and one amphibian were recorded (**Table 6.2.38**). These consist of: two geckos, Common House Gecko (*Hemidactylus frenatus*) and Gecko Lizard (*Gecko gecko*); three species of snakes, the Reticulated Python (*Python reticulatus*); Tree Snake (*Chrysopelea paradisi*), and Phil. Cobra (*Naja philipinensis*); amphibious lizards, Monitor Lizard (*Varanus salvator*); and lastly, the single amphibian, the South American Toad (*Bufo marinus*).

Table 6.2.38 Summary of Herpetofauna Data during the Wet Season

Species	Common Name	Transects							Residency Status[2]
		T1	T2	T3	T4	T5	T6	T7	
REPTILES									
Family VARANIDAE									
Varanus salvator	Monitor Lizard	x			x		x		Resident
Family GEKKONIDAE									
Gekko gecko	Gecko Lizard				x				Resident
Hemidactylus frenatus	Common House Gecko		x	x					Resident
Family PYTHONIDAE									
Python reticulatus	Reticulated Python	x		x					Resident
Family COLUBRIDAE									
Chrysopelea paradisi	Tree Snake					x			Resident
Family ELAPIDAE									
Naja philipinensis	Phil. Cobra					x			Resident
AMPHIBIANS									
Family BUFONIDAE									
Bufo marinus	South American Toad				x	x	x	x	Introduced

1- *based on Alcala, Guide to Philippine Flora and Fauna*
2 - *based on observations during the conduct of this survey*
X - *present*

Source: JICA Survey Team

Based on residency status, the percentage composition is presented in **Figure 6.2.21**, indicating six resident species of reptiles (83%); and one introduced species of amphibian (17%).

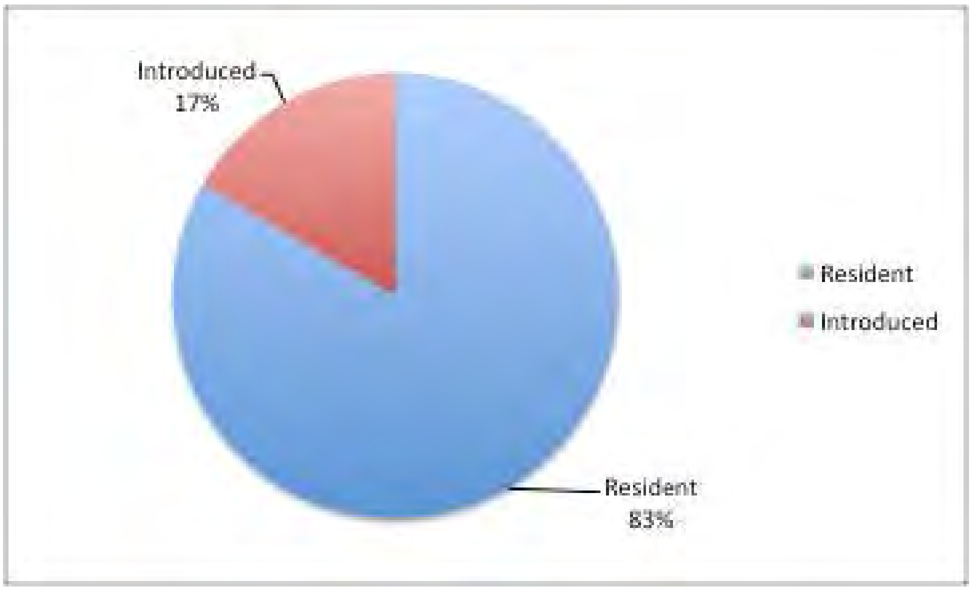


Figure 6.2.21 Residency Status of Herpetofauna Recorded in the Wet Season

(2) Potential Impacts

During the construction phase, several activities of construction will be conducted that likely cause the following impacts on terrestrial fauna:

1) Change of habitat

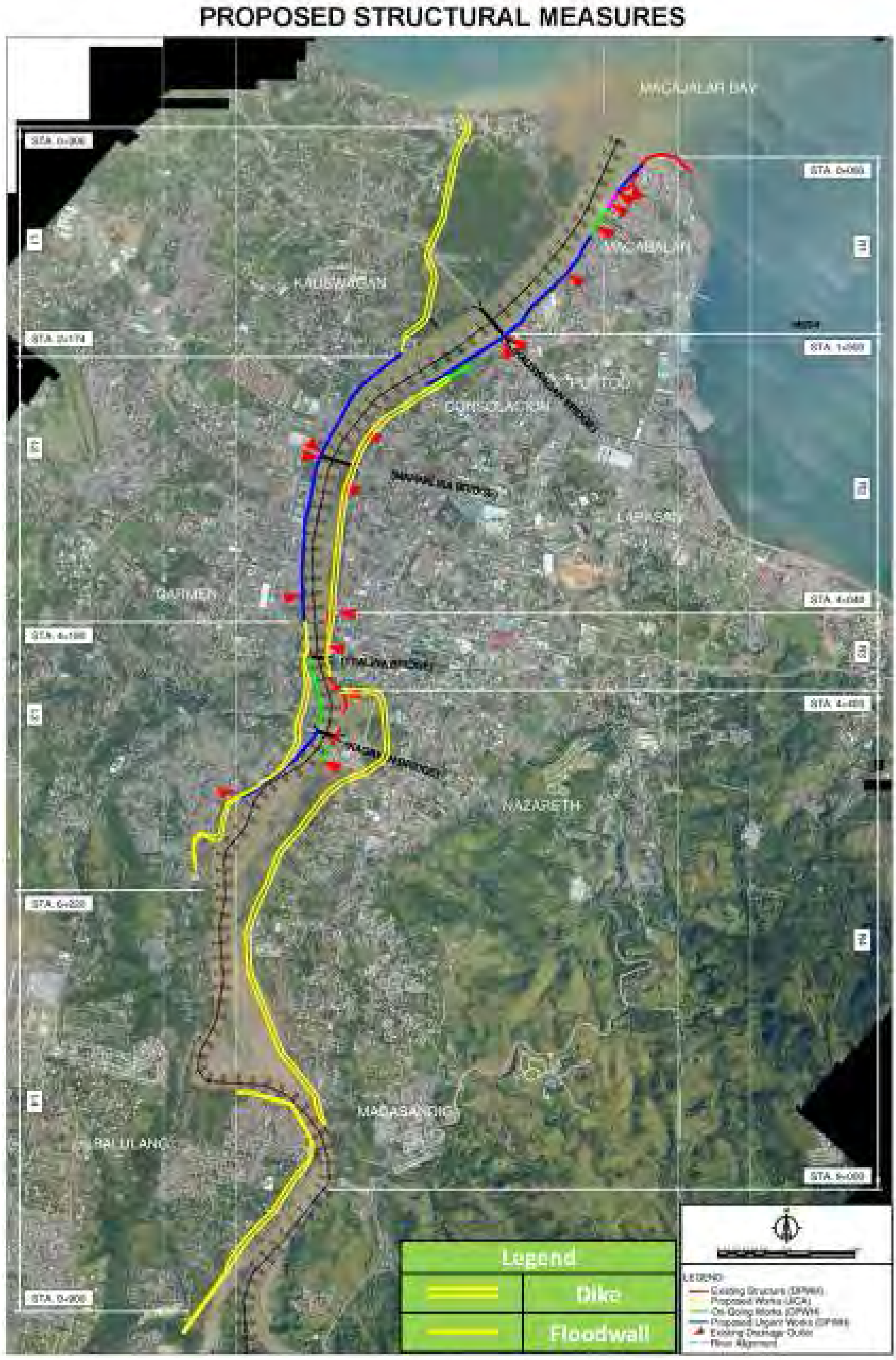
Vegetation clearance and temporary denudation of top soil for the construction or planned structures (dike and floodwall) of the Project will be not minor disturbance to wildlife. Among others, this impact would be the relatively significant on birds as they inhabit owing to forests most. The impact on habitat disturbance would be not minor for herpetofauna (reptiles and amphibians) because the soil is the basis for their habitat.

The area to be disturbed is shown on **Table 6.2.39** and **Figure 6.2.22**. The total area of vegetation clearance will be 7.1 ha. However, this area is not always critical comparing with the whole area of forests and vegetation along the CDO River from river mouth until Pelaez Bridge. The impacts of habitat change is, therefore, not critical but moderate.

Table 6.2.39 Estimated Area of Vegetation Clearance

River Stretch	Area for clearance (m^2)	River Stretch	Area for clearance (m^2)
L1	13,866	R1	-
L2	-	R2	14,462
L3	2,541	R3	3,493
L4	10,940	R4	25,348
Total	27,347	Total	43,303
Grand Total: 70,650 m^2 (approx. 7.1 ha)			

Source: JICA Survey Team



Source: JICA Survey Team

Figure 6.2.22 Planned Location of Dike and Floodwall of the Project

2) Loss of individuals

Disturbance of wildlife may cause terrestrial fauna species to leave their current habitat. In some cases, mortality may be observed in terrestrial fauna species due to stress or accidents while construction activities occur. However, the case of such accidents and reach to death of individuals will not be many as they usually escape before the construction works commences from their habitat.

3) Disturbance of behavior of wildlife due to construction activities and structures

Construction works to use heavy equipment generating noise and vibration will cause behavioral alteration in the vicinity of construction work sites, which might cause disruption of reproduction and movement activities of animals in the worst case.

The existence of the constructed structures (dike and floodwall) might cause obstruction of movement of animals. Considering the current baseline condition of the habitat which are substantially modified by the human activities and man-made structures, however, the impacts of the existence of the constructed structures woul be minor.

Other potential cause to the behavioral altercations during construction works would include the following:

- The use of artificial lighting during night shift activities/ construction.
- Establishment of temporary facilities such as construction yards, access roads, accommodation facilities, if necessary.
- Running vehicles for transportation of construction and spoil materials between construction work sites and borrow / disposal area.

(3) Mitigation measures

The following are proposed mitigating measures for the identified potential impacts outlined above. Since the habitat basis of terrestrial fauna is land and vegetation, the mitigation measures below are duplicated as those for terrestrial flora.

- Minimal clearing of vegetation/ wildlife habitat to decrease disturbance to wildlife.
- Providing a temporary fencing to vegetation that will be retained and not to give trauma physically by inflicting injuries to vegetative parts,
- Fencing is suggested to delineate clearly any unnecessary expansion of clearing activities.
- To enhance the general environment of the project site, greening of its vicinity shall be implemented.
- Appropriate plant species for greening and compensation should be planted by consulting CENRO, DENR 10.
- Hunting of animals near or within the project sites shall be avoided and enforced with the personnel staying in the Project Site. Signs could be established to provide information for personnel or even community living the area.
- Construction activities during night time should be minimized to avoid artificial lighting and noise disturbances.

6.2.4 Aquatic biota

(1) Baseline Environment

The survey of aquatic biota was conducted two times: one in dry season on April 5 and 6, 2013 and the other is rainy season on July 26 to 28, in the same year.

1) Survey location

A) Dry Season (on April 5 and 6, 2013)

Sampling was conducted in three stations located in the estuary, the middle portion of the river and in the upper reaches of the river (**Figure 6.2.23**). Two sampling stations (Station 1 and 2) were established in accordance with the TOR and another station (Station 3) was set-up to supplement the data from the two stations.

These stations are located in:

- Station 1: Area near the river mouth; and
- Station 2: Vicinity of Ysalina Bridge
- Station 3: Location between Calacala and Pelaez Bridge

Surveys for plankton and macroinvertebrates were conducted in Stations 1 to 3, while survey for fish was conducted in Stations 1 and 2 only.

B) Wet Season (July 26 to 28, 2013)

a) Plankton

The survey for plankton included three (3) stations as shown in **Table 6.2.40 and Figure 6.2.13**.

Table 6.2.40 Survey Stations for Plankton (Wet Season)

Station	Coordinates	
	Latitude	*Longitude*
1	N 08° 30’ 01”	E 124° 39’ 08”
2	N 08° 29’ 19”	E 124° 38’ 22”
3	N 08° 28’ 29”	E 124° 38’ 23”

b) Macroinvertebrates

The survey for macroinvertebrates included six (6) stations as shown in **Table 6.2.41 and Figure 6.2.24**.

Table 6.2.41 Survey Stations for Macroinvertebrates (Wet Season)

Station	Coordinates	
	Latitude	*Longitude*
1	N 08° 29’ 47.0”	E 124° 38’ 51.9”
2	N 08° 29’ 47.3”	E 124° 38’ 51.7”
3	N 08° 28’ 32.1”	E 124° 38’ 20.2”
4	N 08° 30’ 30.2”	E 124° 39’ 18.1”
5	N 08° 30’ 31.2”	E 124° 39’ 19.0”
6	N 08° 30’ 28.4”	E 124° 39’ 15.9”

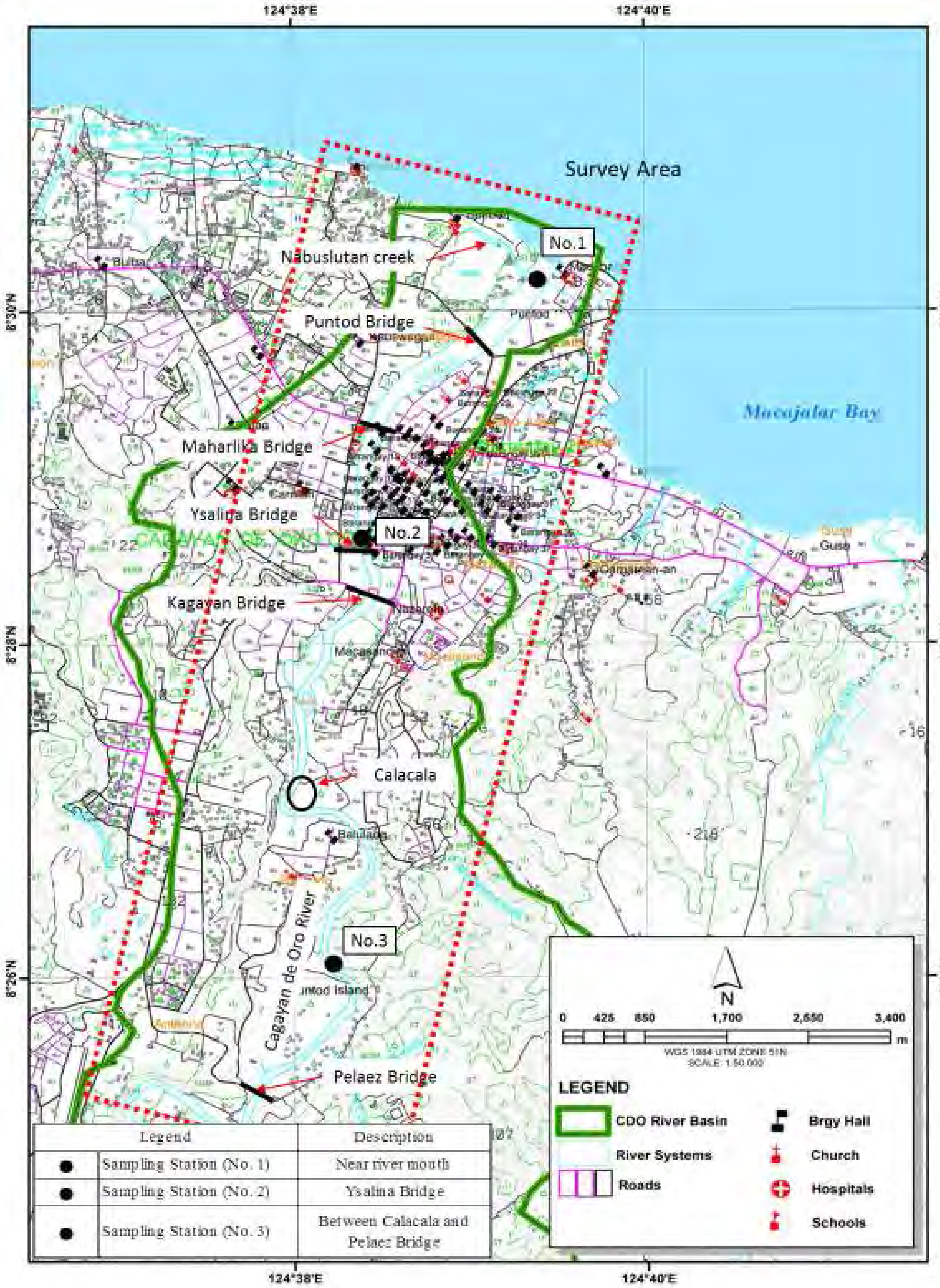


Figure 6.2.23 Location of Sampling Stations (Dry Season)

c) Fish

The survey for fish species was conducted by test fishing, using gillnet or cast net. The survey stations included one station by gillnet and 6 stations by cast net as shown in **Table 6.2.42** and **Figure 6.2.24**.

Table 6.2.42 Survey Station of Fishing (Rainy Season)

Station	Waypoints	
	Latitude	***Longitude***
1) Gillnet		
Start	N 08° 29’ 53.3”	E 124° 38’ 52.3”
End	N 08° 31’ 52.8”	E 124° 38’ 51.9”
2) Cast net		
1	N 08° 29’ 46.4”	E 124° 38’ 52.2”
2	N 08° 29’ 46.7”	E 124° 38’ 52.5”
3	N 08° 29’ 47.0”	E 124° 38’ 52.6”
4	N 08° 28’ 32.8”	E 124° 38’ 20.0”
5	N 08° 28’ 33.0”	E 124° 38’ 19.8”
6	N 08° 28’ 33.1”	E 124° 38’ 19.7”

2) Condition of the survey

The objective of the aquatic ecology baseline study is to evaluate important components of the aquatic ecosystems in the primary impact area of the Project – phytoplankton, zooplankton, periphyton, infaunal benthos, benthic macroinvertebrates (macrobenthos), and fish including species of crustaceans. At each location, biotic sampling covered phytoplankton, zooplankton, infaunal soft bottom benthos, epibenthic macroinvertebrates, and fish.

3) Survey methods

The following sections describe the survey methods used for the various components of the aquatic biota survey.

A) Plankton

Plankton sampling was conducted in an adequate number of representative sampling stations within and near the primary impact area of the Project. Plankton samples were collected using a 20-μm plankton net with a mouth diameter of 0.3 m. In every station, the plankton net was lowered at 1 m and hauled at a rate of about 0.5 m/sec. Duplicate samples of zoo- and phytoplankton were collected for each station and placed in properly labeled plastic containers.

Phytoplankton samples were preserved with Lugol’s solution, while samples of zooplankton were fixed with 10% formalin immediately after collection. All samples were gravimetrically settled and excess liquid was carefully decanted until about 20 ml of the samples were left. For phytoplankton samples, a 1-mL aliquot subsample was placed in a Sedgewick-Rafter cell counter and was examined under a Nikon Alphaphot II YS2 microscope. For zooplankton samples, a 1-mL aliquot subsample was placed in a Petri dish with grids and examined under a microscope.

Phytoplankton were counted and identified to the lowest taxonomic level (genera) possible using standard taxonomic guide. Zooplankton was identified to major groups using available references.

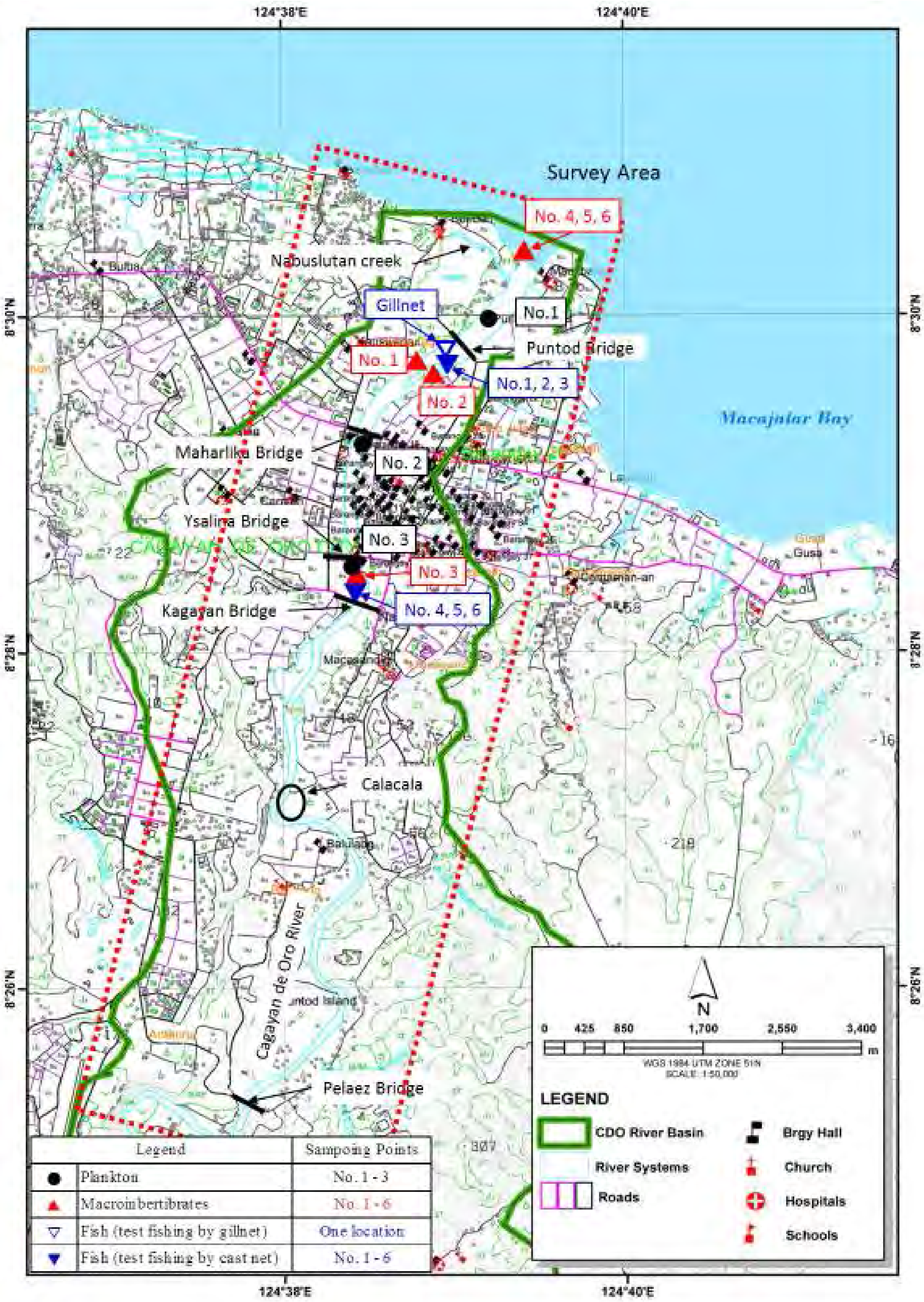


Figure 6.2.24 Location of Sampling Stations (Wet Season)

The composition, abundance and density of phytoplankton communities was determined using standard methodologies, including plankton net surveys, Shannon-Weaver Diversity/Evenness Indices and bio-assessment metrics.

B) Macroinvertebrates

A macroinvertebrate survey was conducted in exposed and submerged portions of the river where ideal conditions exist for the presence of macroinvertebrates. Since macroinvertebrates, like mollusks and bivalves, are sessile organisms and support important components of the marine food chain (e.g. main source of food for fish and crustaceans), they are often used for the assessment of site–specific effects. Their sedentary nature allows effective analyses of pollutants and effects of benthic disturbance. Therefore, the presence of macroinvertebrates in the sediment is one of the best biological indicators on fertility of the bottom sediment. Conversely, the type of benthic substrate dictates the viable existence of macroinvertebrate populations.

Actual observation of gleaning activities for edible shellfish in the sandy headland along the mouth of the river was conducted in two consecutive days. Sediment collection was done through a fabricated core sampler made of a 1 m x 10 cm PVC pipe. Sampling points/cores were randomly established in riverine flats, streambeds and riverbanks. Upon collection of sediment samples, these are sieved through a screen mesh, hand-sorted and coarsely identified up to species level, if possible.

C) Fish

Test fishing was conducted in Stations 1 and 2 in dry season. The first station was established in the river mouth in order to account for marine and brackish water species that spend portions of their life stages in estuaries or migrate to inner reaches of rivers. The second station was established near the Ysalina Bridge to reflect species that dwell in largely freshwater environments. Results were supplemented by rapid fisheries appraisal through key informant interviews (8 fishers) and observations of actual fishing operations in Barangay Bonbon, near the river mouth. The information gathered was directed at obtaining a snapshot of the state of coastal and river municipal fisheries in terms of (i) most common fishing gears used, (ii) common catch composition, (iii) estimated catch rates and (iv) issues that may be heightened with the establishment and operation of the Cagayan de Oro River Project.

For the sampling conducted during the dry season, fish were sampled using two types of gear at each station; a large cast net, locally known as “laya” and a gill net locally known as a “pukot” were used to catch fish in the stations. Bottom-dwelling aquatic animals of sessile nature were collected using grab samplers.

For the sampling conducted during the rainy season, test fishing was undertaken through actual fishing operations. Test fishing was undertaken using the cast net near the Ysalina Bridge and three additional cast net fishing stations was done near the river mouth. The two gillnets were set in one contiguous fishing area near the estuary. The gillnets measured 100 m in length and was set for three (3) hours.

4) Survey results

A) Plankton

a) Dry season

i) Zooplankton

From the three (3) stations surveyed, a total of only four (4) zooplankton species were identified (**Table 6.2.43**). Zooplankton observed consisted of adult stage (50.77%) and larval stage (49.23%). A large portion of the adult zooplanktons observed were rotifers (33.85%). On the other hand, flatworm larva (12.31%) dominated larval stage zooplanktons. Most of the zooplanktons counted were observed in water samples taken at Station 1 (estuary) and 2 (middle portion), while fewer organisms were encountered at Station 1 (upstream). The mean estimates of abundance ranged from 133 to 633 individuals/m^3 among stations with a mean of 361.

The index of species diversity (H') was low ranging from 0.69 to 1.40 across all the stations. Also, index of evenness slightly varied from 0.76 to 1.00.

Table 6.2.43 Survey Results of Zooplankton Community Structure (Dry Season)

Unit: individuals/m^3

Taxa	1		2		3		Grand total	% Comp
	A	B	A	B	A	B		
Adult Form	**67**	**167**	**233**	**333**	**100**	**200**	**1,100**	**50.77**
Cladorceran	33	100	-	33	-	-	133	6.15
Cyclopoid	67	67	-	-	-	33	167	7.69
Harpacticoid	-	-	-	67	-	-	67	3.08
Rotifer	-	-	233	233	100	167	733	33.85
Larval form	**67**	**33**	**67**	**133**	**333**	**433**	**1,067**	**49.23**
Flatworm larvae	67	33	-	67	-	100	267	12.31
Nematode	-	-	-		133	67	200	9.23
Unidentified egg	-	-	67	67	200	267	600	27.69
Grand Total	**133**	**200**	**300**	**467**	**433**	**633**	**2,166**	**100**
Mean Abundance	55	67	150	93	144	127	361	-
Total No. of Species	3	3	2	5	3	5	-	-
Species Diversity	0.69	1.01	0.53	1.37	1.06	1.40	-	-
Evenness	1.00	0.92	0.76	0.85	0.96	0.87	-	-

Source: JICA Survey Team

ii) Phytoplankton

A total of 21 phytoplankton species were identified across the three sampling stations, dominated by the diatoms, which comprised 90% of the phytoplankton community. Among the diatoms, the Genus *Fragillaria* dominated, accounting for 26 % of diatoms, flowed by *Navicula* at 13% and *Surirella* at 11%. A total of 1994 phytoplankton organisms were counted from all the stations combined. Dinoflagellates (*Dinophyceae*) and Green Algae comprised the remaining phytoplankton community, albeit in much smaller densities. *Prorocentrum* spp.was the lone species of dinoflagellate while the green algae are mostly represented by the species *Closterium lunula* (**Table 6.2.44**).

Table 6.2.44 Survey Results of Phytoplankton Species Composition and Abundance (cells/L) (Dry Season)

Taxa	1		2		3		Grand Total	% Comp
	A	B	A	B	A	B		
Cyanophyte	**9**	**9**	**-**	**4**	**17**	**19**	**58**	**2.91**
Oscillatoria	9	9	-	4	17	19	58	2.91

Taxa	1		2		3		Grand Total	% Comp
	A	B	A	B	A	B		
Diatom	**161**	**189**	**351**	**424**	**299**	**366**	**1,790**	**89.78**
Chaetoceros	-	-	2	11	13	13	39	1.97
Cymbella	6	11	32	35	32	41	157	7.87
Epithemia	-	-	-	6	4	4	13	0.66
Eunotia	-	-	7	13	2	6	28	1.41
Fragilaria	26	15	116	120	118	120	514	25.77
Isthmia	-	-	4	9	4	9	26	1.31
Licmophora	-	-		2	4	7	13	0.66
Melosira	-	-	26	30	4	11	71	3.56
Nauplius	-	-	-	-	-	4	4	0.19
Navicula	41	47	41	47	34	41	250	12.56
Nitzschia	11	15	7	9	2	9	54	2.72
Orthoneis sp.	7	11	7	11		4	41	2.06
Pinnularia	11	15	37	41	35	41	181	9.09
Pleurosigma	32	41	24	34	26	30	187	9.37
Surirella	26	34	47	56	22	26	211	10.59
Dinoflagellates	**-**	**4**	**7**	**9**	**7**	**9**	**37**	**1.87**
Prorocentrum spp.	-	4	7	9	7	9	37	1.87
Green algae	**4**	**4**	**22**	**30**	**17**	**32**	**108**	**5.44**
Closterium lunula	4	4	11	15	2	6	41	2.06
Cosmarium	-	-	6	9	11	19	45	2.25
Pandorina	-	-		-	4	7	11	0.56
Spirogyra sp.	-	-	6	6	-	-	11	0.56
Grand Total	**174**	**206**	**381**	**467**	**340**	**426**	**1,994**	**100**
Mean Abundance	17	19	24	25	19	21	-	-
Total No. of Species	10	11	16	19	18	20	-	-
Species Diversity	2.1	2.1	2.3	2.5	2.2	2.5	-	-
Evenness	0.9	0.9	0.8	0.8	0.8	0.8	-	-

Source: JICA Survey Team

The estimates of the mean abundance of phytoplankton ranged from 17 to 21 cells/L, with the highest mean cell density observed in Station 2 while the lowest is in Station 3.

The computed H' for the phytoplankton community across all stations ranged from 2.1 to 2.5, with the highest H' observed at Station 2, followed by Station 3 and Station 1.

b) Rainy season

i) Zooplankton

A total of five zooplankton groups (adult and larval forms) were identified (**Table 6.2.45***)* from the three stations surveyed. Zooplankton observed consisted of adult stage (77.42%) and larval stage (22.2%). A large portion of the adult zooplanktons were rotifers (38.71%) and nematodes (29.03%). More zooplankton were counted in water samples taken from Station 1 (estuary) and 2 (middle portion) than from Station 3 (upstream, near Pelaez bridge). Other important groups like the bivalve veliger, were observed at very low abundance (33 to 67 individuals/m^3) in Station 2, but were not present in the two other stations. No fish larvae were observed in the sampling stations. The mean estimates of abundance ranged from 42 to 67 individuals/m^3 among stations with a mean of 57.

Table 6.2.45 Survey Results of Zooplankton Community Structure (Wet Season)

Unit: individuals/m^3

Taxa	1		2		3		Grand	%
	A	B	A	B	A	B	Total	Comp
Adult stage	**200**	**100**	**200**	**167**	**100**	**33**	**800**	77.42
Cladoceran	67	33	-	-	-	-	100	9.677
Nematode	33	0	100	67	67	33	300	29.03
Rotifer	100	67	100	100	33	0	400	38.71
Larval stage	**-**	**-**	**67**	**67**	**33**	**67**	**233**	22.58
Bivalve veliger	-	-	33	67	-	-	100	9.677
Unidentified Egg	-	-	33	0	33	67	133	12.9
Grand Total	**200**	**100**	**267**	**233**	**133**	**100**	**1,033**	112.90
Mean Abundance	67	33	75	58	42	42	-	-
Total No. of groups	3	2	4	3	3	2	-	-
Species Diversity	1.01	0.64	1.26	1.08	1.04	0.64	-	-
Evenness	0.92	0.92	0.91	0.98	0.95	0.92	-	-

Source: JICA Survey Team

The calculated H' was low, ranging from 0.64 to 1.08 across all the stations. Also, index of evenness slightly varied from 0.91 to 0.98.

ii) Phytoplankton

A total of 19 phytoplankton species were identified across the three sampling stations, dominated by the diatoms, which comprised 63% of the phytoplankton community. Among the diatoms, the genus *Fragillaria* dominated, accounting for 13.27 % of diatoms, followed and *Pinnularia* at 13%. A total of 1,994 phytoplankton organisms were counted from all the stations combined. During this sampling period, Cyanobacteria dominated by *Oscillatoria sp.* increased in abundance accounting for 15% of the phytoplankton. Green Algae comprised the remaining phytoplankton community, albeit in much smaller densities. Green algae are mostly represented by the species *Spirogyra sp. and Closterium lunula* (**Table 6.2.46*)***.

The estimates of the mean abundance of phytoplankton ranged from 36to 85 cells/L with the highest mean cell density observed in Station 2 while the lowest is in Station 3. The cell densities observed in the area were still relatively low which could possibly indicate an oligotrophic water condition.

The computed index of species diversity (H') for the phytoplankton community across all stations ranged from 2.01 to 2.54, with the highest observed at Station 3 and lowest in Station 1 and 2. The low diversity index observed in Station 1 and 2 could be attributed to the turbid water observed in the station, which impedes photosynthetic activity resulting to low cell count and number of species.

Table 6.2.46 Survey Results of Phytoplankton Species Composition and Abundance (cells/L) (Rainy Season)

Taxa	1		2		3		Grand	%
	A	B	A	B	A	B	Total	Comp
Cyanobacteria	**93**	**65**	**93**	**149**	**168**	**177**	**831**	21.39

Taxa	1		2		3		Grand Total	% Comp
	A	B	A	B	A	B		
Chroococcus	-	-	-	-	37	47	84	2.163
Lyngbya	-	-	28	37	37	65	168	4.327
Oscillatoria	93	65	65	112	131	112	579	14.9
Diatom	**532**	**691**	**234**	**374**	**271**	**355**	**2,457**	63.22
Achnanthes	47	84	-	-	-	-	131	3.365
Bacillaria	84	37	-	-	-	-	121	3.125
Chaetoceros	-	-	9	37	9	37	93	2.404
Cymbella	-	-	28	65	-	-	93	2.404
Eunotia	37	159	-	-	19	37	252	6.49
Fragillaria	140	47	84	112	47	65	495	12.74
Melosira	37	28	-	-	9	28	103	2.644
Navicula	56	112	9	56	19	47	299	7.692
Pinnularia	84	140	93	65	84	37	504	12.98
Pleruosigma	-	-	-	-	19	37	56	1.442
Surirella	47	84	9	37	28	19	224	5.769
Green algae	**103**	**177**	**56**	**93**	**65**	**103**	**598**	15.38
Closterium lunula	19	56	-	-	28	37	140	3.606
Oedigonium	-	-	-	-	19	28	47	1.202
Scenedesmus	-	-	37	56	-	-	93	2.404
Spirogyra sp.	84	121	19	37	-	-	262	6.731
Zygnema	-	-	-	-	19	37	56	1.442
Grand Total	**729**	**934**	**383**	**617**	**504**	**635**	**3,886**	100
Mean Abundance	66	85	38	62	36	45	57	-
Total No. of Species	11	11	10	10	14	14	-	-
Species Diversity	2.28	2.28	2.01	2.21	2.33	2.54	-	-
Evenness	0.95	0.95	0.87	0.96	0.88	0.96	-	-

Source: JICA Survey Team

B) Macroinvertebrates

a) Dry Season

Very few benthic macro-invertebrates of commercial importance were encountered in the three survey stations, including three species of bivalves and two species of crabs. In Station 1, in the upper portion of the river, no bivalve or crustacean species were seen. The species encountered are listed in **Table 6.2.47**.

Table 6.2.47 Survey Results of Macro-invertebrates (Dry Season)

Common Name	Scientific Name
Pacific sugar limpet	*Patelloida saccharina*
pyramid periwinkle	*Nodilittorina pyramidalis*
Luzon troughshell	*Mactra luzonica*
box crab	*Callapa spp*
shore crab	*Varuna litterata*

Source: JICA Survey Team

Among the shellfish encountered, only *Mactra sp.* is known to be popularly edible. In addition, the survey team encountered several fishers in search of mud crabs (*Scylla serrata*) and spider prawns (*Nematopalaemon tenuipes)*, a crustacean locally known as 'pasayan'.

Fishermen claim that flooding brought about by recent typhoons have scoured the river banks and eroded bivalve habitats, resulting to the loss of bivalve stocks that are already heavily suffering due to sediment intrusion.

b) Rainy season

Only a few species of epibenthic as well as in-faunal macro-invertebrates were observed in the areas surveyed. Core samples revealed the presence of common Cerith mollusks belonging to two species, namely, *Clypeomorus batillariaeformis* or necklace cerith and *Terebralia palustris* or mud creeper (**Table 6.2.48**). Both species consumed by coastal communities in the Indo-Pacific region. Other univalve species that were encountered in the core samples include the gastropod periwinkle, *Cerithium coralium* and the nerite shell *Neritina turrita*. These species constitute an important component of the food chain in the river as they are deposit and suspension feeders that support the breakdown of organic matter, triggering a chain of food dependencies and ecological linkages. Crustaceans sorted from the core samples were few – the common shore crab *Varuna litterata* and the box crab – *Callapa spp.*; none of which have commercial value for food or for trade. Remnants of the bivalve Mactra luzonica (troughshell) were also collected in the estuary. None of these species are considered as rare, endemic or threatened.

Table 6.2.48 Survey Results of Macro-invertebrates (Rainy Season)

English name	Scientific name
Necklace cerith	*Clypeomorus batillariaeformis*
Mangrove whelk	*Terebralia palustris*
Coral cerith	*Cerithium coralium*
Nerite shell	*Neritina turrita*
Shore crab	*Varuna litterata*
Box crab	*Callapa sp*

Source: JICA Survey Team

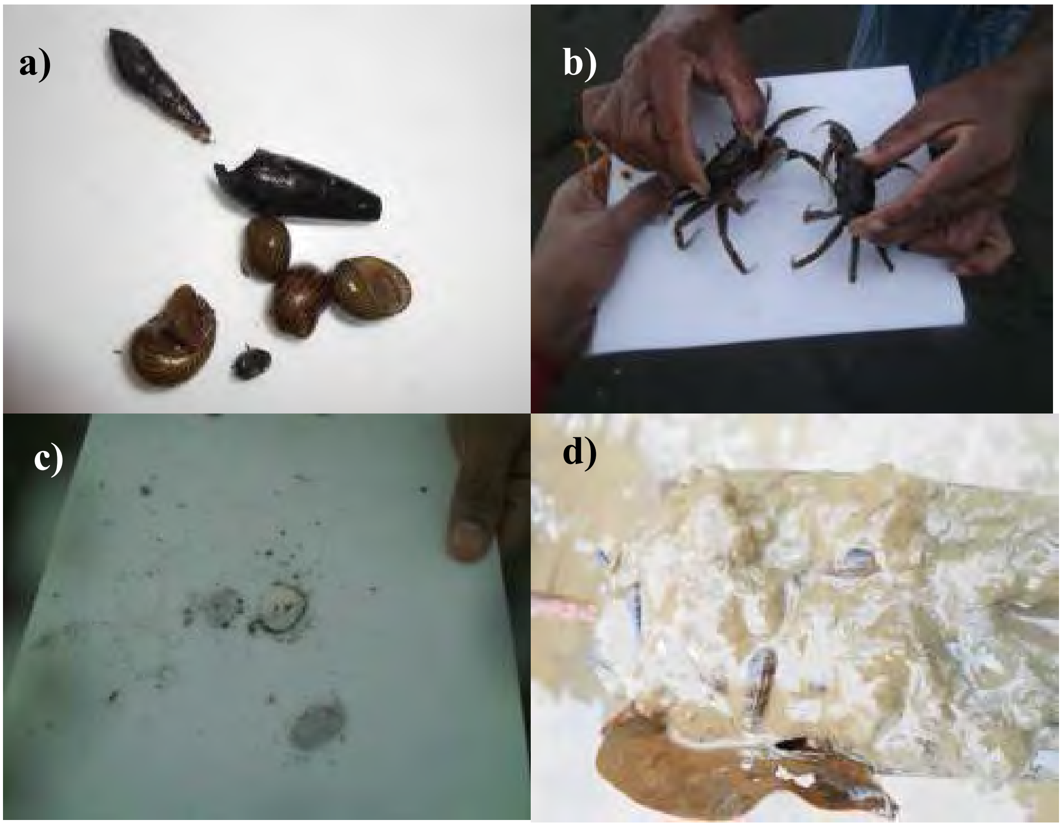


Figure 6.2.25 Specimens of Macro-invertebrates Collected in Cagayan de Oro River
a) cerith gastropods and green snails, b) shore crabs, c) dead troughshells and d) molluscs in muddy substrate.

C) Fish

a) Dry season

Key informants said that fishers from Barangay Bonbon are the most frequent users of the near-shore fishing grounds in the interface of the river and coastal seas. There are allegedly more than 60 small fishing crafts using different capture fishing gear in the estuary and the near-shore areas fronting the Barangay, employing mostly set gill nets (pukot), traps (bubo; panggal), hook and line (kawil), cast nets and beach seines (baling).

Anecdotal accounts reveal that over the last two decades, catch rates in fishing have been declining both by volume and species diversity. Key informants claim that major fishing grounds are situated farther out into Macajalar Bay, with more than one hour of navigation by a motorized boat. In deeper waters, the use of fish aggregating devices (FADs-Payao) is being practiced to catch hairtails (*Trichiurus lepturus*), commonly called espada, and an assortment of large pelagic species of tuna and tuna-like species (e.g., *Thunnus tonggol*, *Euthynnus affinis*, and *Katsuwonus pelamis*), dolphin fish (*Coryphaena hipporus*), Spanish mackerel (*Scomberomorus commerson*), round scad (*Decapterus macrosoma*) and frigate tuna (*Auxis thazard thazard*). For hairtails and its associated by-catch, an average of 10 kg per day is captured by large fishing boats. Present catch for near-shore fisheries is allegedly less than 2 kg/day/fisher.

The catch composition of municipal capture fisheries, near the Cagayan de Oro River includes different fishes presented in **Table 6.2.49**.

Table 6.2.49 Common Species of Fish caught near the river mouth of Cagayan De Oro River based on interview with fisherfolk

Common Name	Local Name	Scientific Name
Indian sardines	Tamban	*Sardinella longiceps*
Hairtail	Espada	*Trichiurus lepturus*
Mackerels	Alumahan/Matang baka	*Scomber australasicus* *Selar boops*
Frigate tuna	Tulingan	*Auxis thazard thazard*
Spanish mackerel	Tanguige	*Scomberomorus commerson*
Lizardfish	Kambabalo	*Saurida micropectoralis*
Eastern little tuna	Tuna/bariles	*Euthynnus affinis*
Moontail bullseye		*Pricanthus hamrur*
Rabbitfish	Danggit	*Siganus spp.*
Gray mullet	Banak	*Mugil cephalus*

Note: Based on Anecdotal Information from Local Fishers in Brgy. Bonbon, Cagayan de Oro City
Source: JICA Survey Team

In the river itself, only five fishing crafts were encountered by the survey team during the two-day field observation. Using mostly cast nets and small crab lift nets, the catch is limited to a few species, the most common of which consist of mullet (*Mugil cephalus*), 'pasayan' (*Nematopalaemon tenuepsis*), rabbitfish (*Siganidae*), juvenile snappers (*Lutjanidae*) and Tilapia (*Oreochromis sp.*). Actual fishing in two stations yielded only 11 individuals belonging to five species and weighing less than 1 kilogram altogether due to the small sizes of the catch, as shown in **Table 6.2.50.**

Table 6.2.50 Species of Fish Caught in Test Fishing Operations (Dry Season)

Common Name	Local Name	Scientific Name
Goatfish	Timbungan	*Parupeneus barberinoides*
Slipmouth	Sap-sap	*Leiognathus spp.*
Mullet	Banak	*Mugil cephalus*
Mackerel	Anduhaw/Alumahan	*Selar boops*
Tilapia	Tilapia	*Oreochromis sp.*
River therapon	Pigok	*Mesopristes cancellatus*

Source: JICA Survey Team

Fishers claim that these lucrative species that sell expensively at PHP 800/kg, have not been caught in the last 3 to 5 months prior to the sampling activity. Research undertaken by the present survey team revealed that the pigok (*Mesopristes cancellatus*) is from the same species known as the Tapiroid Therapon Pigek, which was previously thought to be endemic in the Abra River and the Rio Grande de Mindanao. Currently, the fish is captured rarely and residents suspect that the practice of capturing spawning females as they migrate downstream to lay eggs during the southwest monsoon is the main reason for the disappearance of the fish.

The habitats of the rare fish, pigok, have already been negatively affected by intense sedimentation and scouring of riverbanks during heavy floods. The fish is known to migrate upstream in the upper zones of the Cagayan de Oro River where it seeks pristine feeding grounds and cleaner shelters. They travel back downstream in periodic events to spawn or mate. During these periods they become highly susceptible to fishing mortality. The capture of spawning males and females has led to a presumption that the species has been reduced to very few individuals (undocumented). The conservation status of the "Pigek" to date has not been declared as protected species in any local or international organizations such as by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

b) Rainy Season

In spite of its relatively lesser fishing efficiency, the cast net captured a greater number of fish than the gillnets, albeit consisting of only two (2) species, namely Goby and Mullet. The gobies from the cast net accounted for not less than 64% of fish abundance, followed by the glassy perchlet at 14% and common whiting, at 10% relative abundance. This can be supported by the fact that it is the season when freshwater gobies are most abundant. It is also notable that all specimens of gobies captured were of adult size, raising a presumption that it could be spawning season for the species in the river estuary. Apart from fish, two crustacean shrimps were also captured in the cast net, consisting of the brackish water species *Penaeus indicus*, locally known as hipong puti.

For gillnetting, the bottom set gill net did not capture any fish but the encircling gillnet harvested a total of 17 pieces of fish consisting of four (4) species - Mullet, Ponyfish, Common whiting, and the Glassy Perchlet, all of which are known to enter estuarine environments to graze.

Results of the fishing operations are presented in **Table 6.2.51**. Pictures of the various species of fish are presented in **Figure 6.2.26.**

Table 6.2.51 Species of Fish Caught in Test Fishing Operations (Rainy Season)

Common Name	Local Name	Scientific Name	Number of individuals
Gray Mullet	Banak	*Mugil cephalus*	4
Toothed ponyfish	Sap-sap	*Gazza minuta*	3
Glassy perchlet	Gabot	*Ambassis gymnocephalus*	8
Common whiting	Asohos	*Sillago sihama*	6
Ocellated Goby	Biya	*Valencienna longippinis*	37
Total number of fish			58
Shrimp	Hipong puti	*Penaeus indicus*	2

Source: JICA Survey Team

Source: JICA Survey Team

Figure 6.2.26 Species of fish caught through gillnet and cast net in the Cagayan de Oro River a) gobies, b) common whiting, c) white shrimp and d) glassy perchlet.

5) Evaluation of Survey Results

A) Overall aquatic Biota

The survey results in terms of species composition per module are summarized in **Table 6.2.52.** There is no big difference in the number of species recorded between the two surveys in dray season and rainy seasons. The survey results are summarized as below:

Table 6.2.52 Number of Species Recorded during the Surveys

Component	Dry season		Rainy Season	
	Number of Species	No. of surveyed locations	Number of Species	No. of surveyed locations
Phytoplankton	21	3	19	3
Zooplankton	7	3	5	3
Macroinvertebrates	5	3	6	6
Fish	6	2	5	6
Total	**39**	**-**	**35**	**-**

Source: JICA Survey Team

B) Plankton

The overall interpretation from results of the plankton survey is that the plankton community within the river and its estuary is relatively low. Cell density measurements during the dry and wet season suggest oligotrophic water conditions at the plankton sampling stations. Low plankton diversity indices are attributed to high turbidity in sampling stations, which may prevent photosynthetic activity and lower cell counts and species numbers.

A threshold of algal blooms, especially harmful algal bloom-causing organisms, as well as toxic microalgal species were not detected during the dry season. During the wet season, potentially harmful/toxic microalgal species (Carmichael, 1992) found were *Lyngbya sp.* and *Oscillatoria sp*., but the cell density of these two species is very low. The present plankton community in the project area signifies normal levels of these organisms in the sea. The likelihood of algal blooms is ruled out by the findings in the study, due to the extremely low number of HAB-causing planktons, oligotrophic water conditions and a free flowing river system present in the Cagayan de Oro River.

C) Macroinvertebrates

The presence of only a few commercially-important macro-invertebrates in the survey stations indicates that there is a relatively low biodiversity and population of benthic macro-invertebrate communities at the survey sites.

The macro-invertebrates and inter-tidal crustaceans are unimpressive but remains an important source of nutrients that can sustain a robust for the riverine food chain. If anthropogenic impacts and residues from the project are well managed to prevent further disturbance to river substrates, it is not foreseen that the establishment of the project will result to the loss of shellfish resources but the project should nonetheless pursue initiatives to ensure sustainability of populations of commercially important macro-invertebrates near the project site, especially the edible bivalves. Improvements in macro-invertebrate populations are not anticipated to improve unless some forceful strategies to restore benthic ecosystem integrity are introduced over the long term.

D) Fish

A total of 6 species of fish were caught during the fish testing conducted during the dry season, whilst only 5 species were caught during the wet season. It must be noted that only the gray mullet (*Mugil cephalus*) was the species caught on both seasons. Marine fish species, like those caught during the test fishing activity, have not been used as indicators of pollution, except where biotixins are involved (e.g. plankton-filtering fish species in PSP-affected areas). On the contrary, some species of fish have been used as “indicators” of a relatively good coral reef habitat and its ecosystem functions. In the case of the coastal area fronting the project site, species of the butterfly fish *Chaetodontidae* have been seen in the survey but the numbers are very few and were not caught during the test fishing activity.

The use of certain types of fishing gear (e.g. baling) and unsustainable fishing practices may contribute to a decline in fish catch. The results further indicate that near-shore fisheries have declined in terms of productivity as the present catch rate is allegedly less than 2 kg/day/fisher. This decline may be due to extremely intense sedimentation and excessive fishing efforts.

(2) Potential impacts

A) General

During the construction stage, water pollution and sedimentation caused by the Project may have negative impacts on aquatic biota. In particular, the removal of the riverbed sediment during the construction stage, especially dredging in the riverbed and excavation works along the riverbank, may result in a decline in aquatic biota. The details of the anticipated impact by category of aquatic biota are as follows:

B) Plankton

The survey data showed that plankton community remains to be stable but are already low in diversity and distribution due to extremely turbid condition of the river waters during the southwest monsoon season. However, it is still likely that the hydrodynamic system in the area still replenishes the plankton population profusely and that organic nutrient loading is being flushed extensively during forceful tidal events. Disturbance on the riverbed immediately within the project's structural measures will cause temporary dislocation of phytoplankton communities as turbid waters reduce photosynthetic intensity. However, planktons are resilient and will readily re-colonize the river waters even in turbid conditions. More importantly, survey results do not show any indication that red tides may occur as a result of the project's activities.

C) Macro-invertebrates

Physical alteration in the riverbed and riverbanks near the project site such as dredging works and excavation will likely lead to temporary disturbance or dislocation of the habitat of the community of bivalves and univalves which are already heavily reduced in numbers and distribution.

D) Fish

Impacts on fish inhabiting in the river and estuary will be temporarily affected by dredging and construction activities near the river banks. However, the fish can escape during these activities and the impacts will be limited.

The habitats of the rare fish *Mesopristes cancellatus* have already been disturbed by intense sedimentation and scouring of riverbanks during heavy rains. Few of this species allegedly remain, and these surviving ones are known to migrate upstream in the upper zones of the CDO River where it seeks undisturbed feeding grounds and cleaner shelters. They travel back downstream in periodic events to spawn or mate. During these periods they become highly susceptible to fishing mortality. The capture of spawning males and females has led to a presumption that the species has been reduced to very few individuals (undocumented). Project activities will not have any significant impact on the survival and distribution of the fish, nor the loss of its habitats upstream because there is no planned structure of the project, which is to obstruct the migration of the fish, to be constructed in the river.

(3) Mitigation measures

The direct impacts of dredging work and excavation on the aquatic biota for the microbenthos or crustacean are inevitable. However, the impacts of turbid water discharge due to the dredging or excavation works can be minimized with the proper mitigation measures, such as usage of less agitation type of dredging method.

The underpinning strategic consideration in order to reduce disturbance to fish populations and macro-invertebrate communities near the project site is to ensure that any construction activity, wastewater plume and sediment intrusion will not result to extensive damages to the river banks where macro-invertebrates occur. To conserve and protect benthic macro-invertebrate habitats, the following measures are recommended:

- Sediment intrusion shall be reduced through the use of adequate and efficient filtration devices laid in critical point areas to prevent sediment plumes from reaching coral colonies.
- Installation of silt curtains and screens in front of the project's outfall areas during construction period and the adoption of measures within the project complex itself that are aimed at preventing spillage of construction materials and wastes.
- Proper stockpiling of spoils during earthmoving and construction works to avoid discharging into the river.

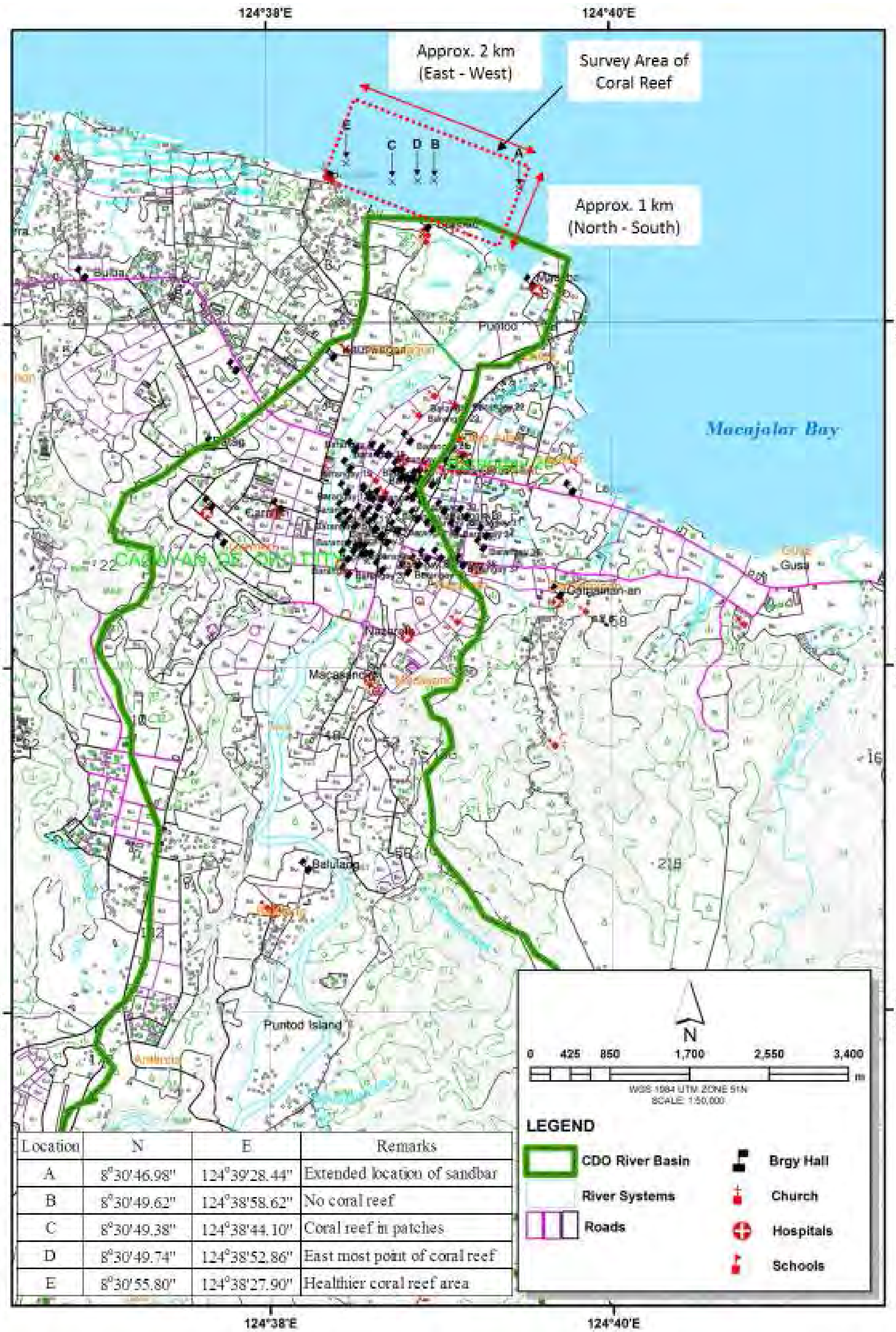
Moreover, the Project will advocate for the adoption of long term initiatives to reduce sediment and silt loads in the River through riverbank rehabilitation measures and mangrove reforestation. Finally, the project will adopt measures to ensure the free-flow and exchange of water in portions of the river that are likely to be affected by the project operations.

6.2.5 Coral Reef

(1) Baseline Environment

1) Survey location

The specific study stations for coral reef baseline assessment are found in the coastal waters immediately contiguous to the Cagayan River estuary. The survey covered a linear swath of coastal waters of approx. 2 × 1 km in front of the boundary of Bgy. Bonbon and Bgy. Bayabas, which is located west of the river mouth of the CDO River (**Figure 6.2.27**). The survey of coral reef was conducted on July 26 to 28, 2013.



Location	N	E	Remarks
A	8°30'46.98"	124°39'28.44"	Extended location of sandbar
B	8°30'49.62"	124°38'58.62"	No coral reef
C	8°30'49.38"	124°38'44.10"	Coral reef in patches
D	8°30'49.74"	124°38'52.86"	East most point of coral reef
E	8°30'55.80"	124°38'27.90"	Healthier coral reef area

Note) A to E shows the locations of preliminary survey conducted by JICA Survey Team in Feb. 2013.

Figure 6.2.27 Location Map of Survey Area (area in dotted lines)

2) Condition of the Survey

The survey involved the verification and, if present in significant quantity, determination of distribution and primary composition of coral cover and associated coral life forms supported by analysis of present conditions of the coral reefs and the factors that lead to coral mortality. The survey data generated represents a fairly reasonable baseline data set that portrays the condition of the coral habitat on a "without the project" scenario obtained through standard scientific assessment protocols. Survey results portray a general view of the types and current condition of the reef area in specific study stations at the time of sampling and cannot represent an irreversible situation. However, the charting of presence and condition of coral reefs through numerous and successive manta tow pathways that were conducted presents a fairly accurate picture of the characteristics of corals over a broad portion of the costal environment nearest to the CDO River estuary.

3) Survey Method

The method for coral reef survey is the standard marine resource survey techniques prescribed by English et al (1994). With this regard, the techniques are modified in accordance with in-situ conditions following rapid appraisal techniques for coastal resources.

A) Initial Reconnaissance for Confirmation of Coral Existence

Initial reconnaissance for confirmation of the existence of the coral was conducted by trial diving over the survey area shown on Figure 6.2.18. It is aiming to identifying the location/area of the conduct of manta survey for the next step as described in the succeeding section.B) Conduct of Manta Survey Method for Corals and General Coastal Habitat Configuration

Based on the results of initial reconnaissance, manta tow surveys were conducted in fifteen (15) continuous stations as shown on **Figure 6.2.29** and in **Table 6.2.53.** It is aimed at to determine benthic condition over a long stretch of seabed in the survey area. Manta tow is a useful method in generating a general profile of benthic resources as it permits observation of the condition, distribution and abundance of benthic habitats at specific intervals in the more productive shallow coastal zone of the sea.

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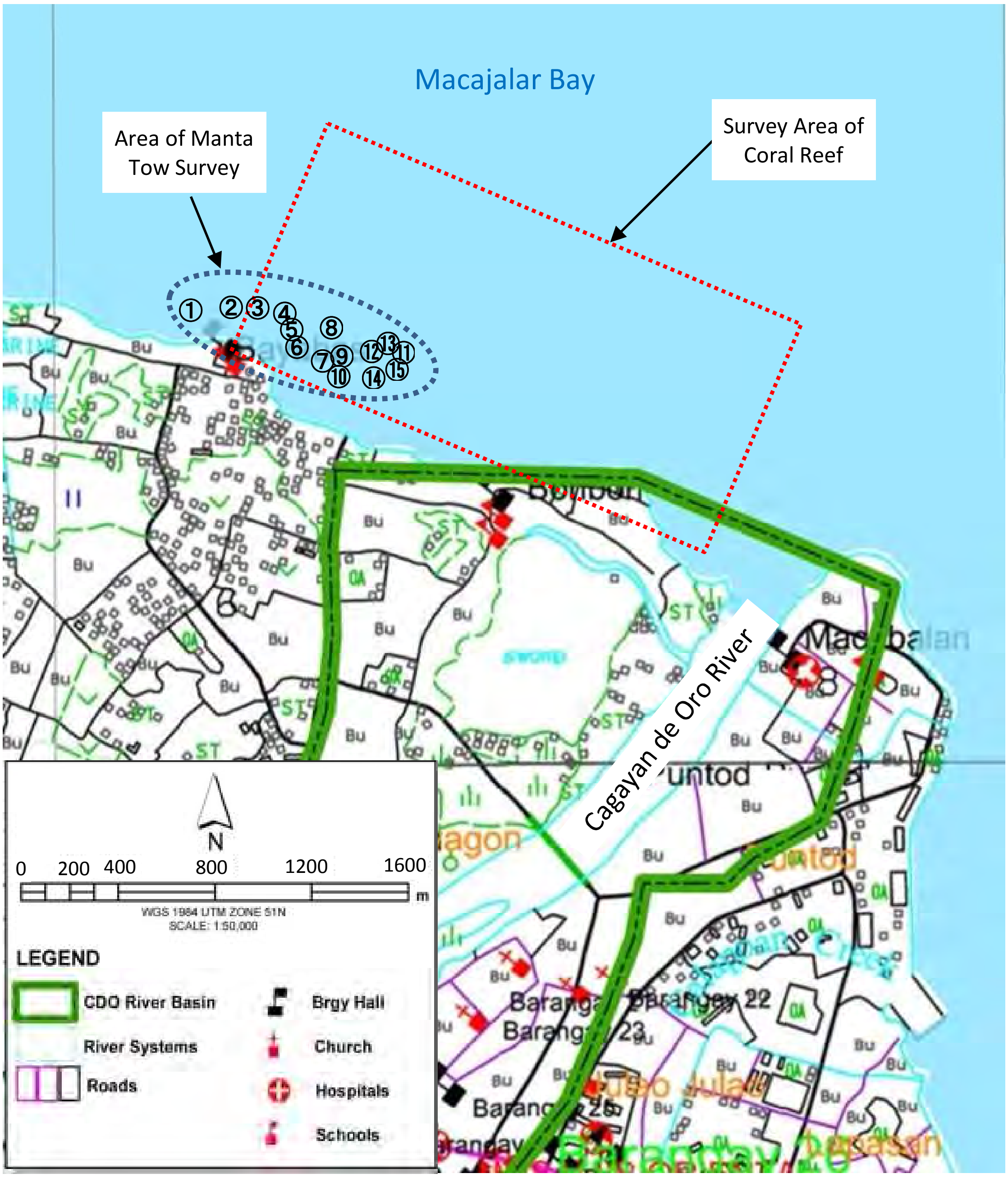
Figure 6.2.28 Picture of Manta Tow Survey for Coral



Source: JICA Survey Team

Figure 6.2.29 Location Map of Manta Tow Survey for Coral Reef in the Study

Table 6.2.53 Station of Manta Tow Survey for Coral Reef

Tow number		Coordinates	
		Latitude	Longitude
1	Start	N 08° 31’ 01.3”	E 124° 38’ 11.3”
	End	N 08° 31’ 01.9”	E 124° 38’ 14.9”
2	Start	N 08° 31’ 01.5”	E 124° 38’ 15.2”
	End	N 08° 31’ 01.2”	E 124° 38’ 18.0”
3	Start	N 08° 31’ 01.0”	E 124° 38’ 18.2”
	End	N 08° 31’ 00.0”	E 124° 38’ 21.3”
4	Start	N 08° 30’ 59.9”	E 124° 38’ 21.5”
	End	N 08° 30’ 57.7”	E 124° 38’ 23.5”
5	Start	N 08° 30’ 57.5”	E 124° 38’ 23.6”
	End	N 08° 30’ 56.4”	E 124° 38’ 25.0”
6	Start	N 08° 30’ 56.2”	E 124° 38’ 25.3”
	End	N 08° 30’ 55.5”	E 124° 38’ 26.3”
7	Start	N 08° 30’ 54.1”	E 124° 38’ 28.2”
	End	N 08° 30’ 57.7”	E 124° 38’ 28.0”
8	Start	N 08° 30’ 58.0”	E 124° 38’ 28.6”
	End	N 08° 30’ 56.3”	E 124° 38’ 30.0”
9	Start	N 08° 30’ 54.6”	E 124° 38’ 30.0”
	End	N 08° 30’ 52.7”	E 124° 38’ 29.7”
10	Start	N 08° 30’ 52.9”	E 124° 38’ 29.4”
	End	N 08° 30’ 55.5”	E 124° 38’ 27.5”
11	Start	N 08° 30’ 54.0”	E 124° 38’ 38.5”
	End	N 08° 30’ 53.4”	E 124° 38’ 39.3”
12	Start	N 08° 30’ 54.4”	E 124° 38’ 35.0”
	End	N 08° 30’ 55.3”	E 124° 38’ 36.4”
13	Start	N 08° 30’ 55.0”	E 124° 38’ 36.5”
	End	N 08° 30’ 51.3”	E 124° 38’ 35.8”
14	Start	N 08° 30’ 51.2”	E 124° 38’ 35.7”
	End	N 08° 30’ 51.8”	E 124° 38’ 38.0”
15	Start	N 08° 30’ 52.0”	E 124° 38’ 38.4”
	End	N 08° 30’ 52.2”	E 124° 38’ 41.9”

Source: JICA Survey Team

Estimates of percentage distribution of coral reefs and associated benthos observed within the tow stations are recorded in accordance with standard categories to document distribution of coral life forms and the collective picture generated can show a fairly accurate description of the overall state of the coastal area under study.

C) Method for detailed coral reef assessment

In coral reefs where significant live corals occur as compared to other stations surveyed in the manta tows, transect lines are laid out in order to more precisely estimate the relative abundance of living and nonliving things on the sea floor by diving (**Figure 6.2.30**).

Figure 6.2.30 Picture showing LIT Survey

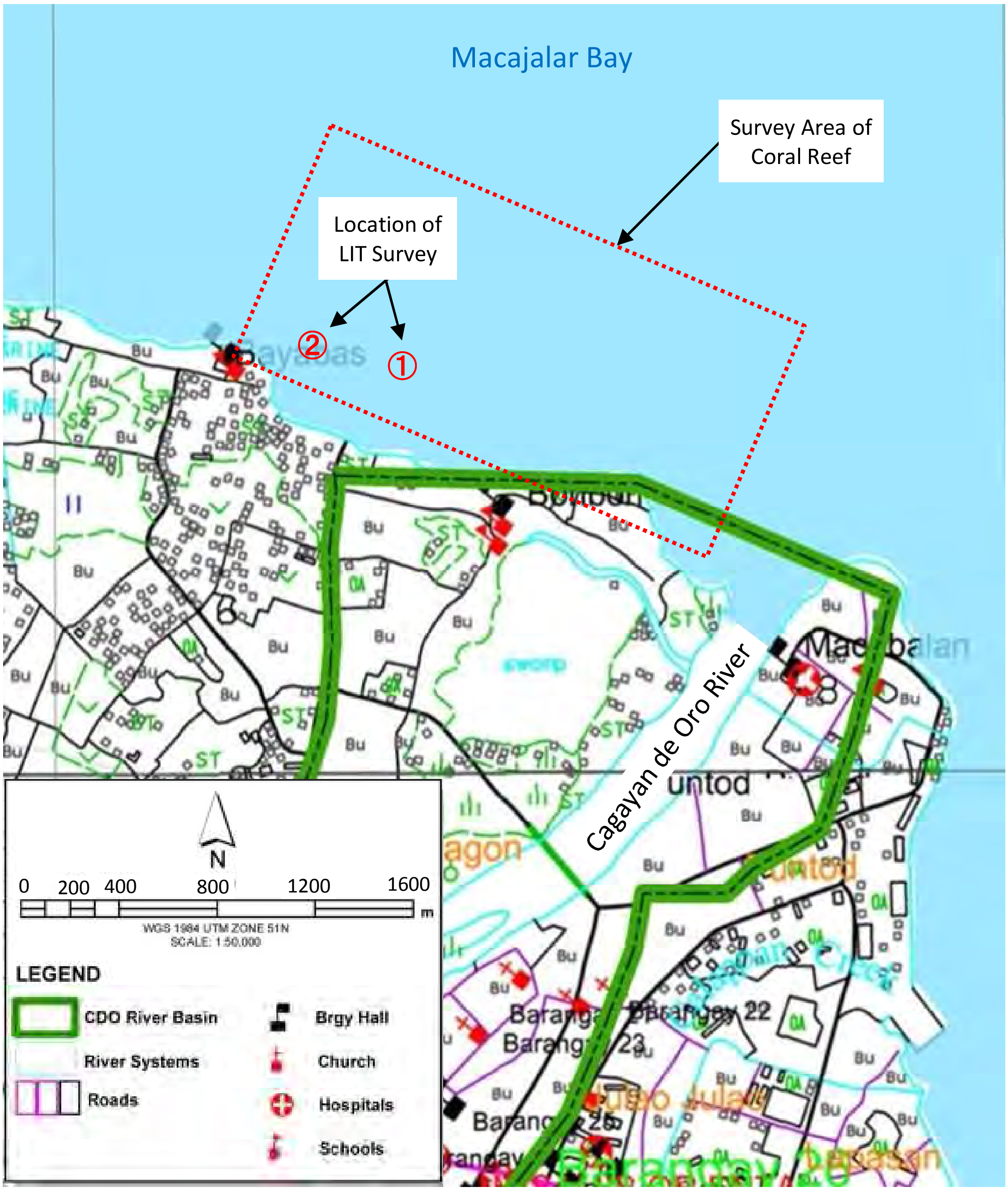
The survey involved the laying out of 50-m transects parallel to the shoreline and following the reef contour in two stations identified in the manta tows. LIT was conducted at two locations. **Table 6.2.54** and **Figure 6.2.31** shows the survey locations. Data generated from the LIT method for coral reef assessment provides more rigid data sets on percent live coral cover as well as species distribution that can be ultimately used for comparative evaluation if the same survey stations are monitored in the future, under the Project's environmental monitoring plan.

Table 6.2.54 Survey Station of Line Intercept Transect (LIT) Survey

Survey Station No.		Coordinates	
		Latitude	Longitude
1	Start	N 08° 30' 54.0"	E 124° 38' 38.5"
	End	N 08° 30' 53.4"	E 124° 38' 39.3"
2	Start	N 08° 30' 57.2"	E 124° 38' 27.6"
	End	N 08° 30' 57.9"	E 124° 38' 28.8"

Source: JICA Survey Team

The categories utilized for classifying coral cover follow standard ratings (Gomez *at al*, 1981) used for live coral distribution, i.e., 76-100% live coral cover = Excellent; 51-75% coverage live coral cover = Good, 26-50% coverage live coral cover = Fair, and 0-25% coverage live coral cover = Poor coral cover.



Source: JICA Survey Team

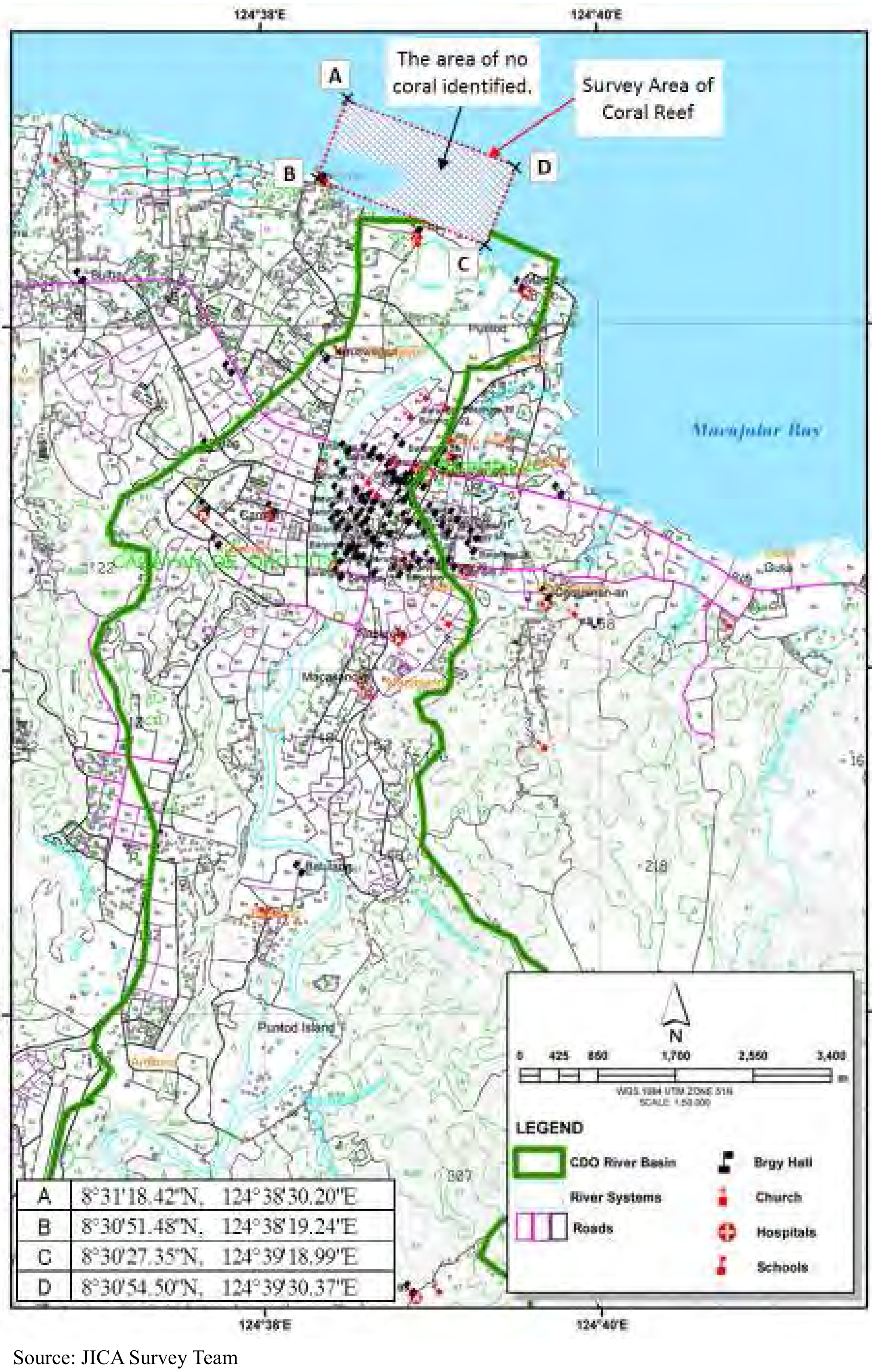
Figure 6.2.31 Survey Station of Line Intercept Transect (LIT) Survey

4) Survey Results

A) Results of Initial Reconnaissance

The survey and profiling covered a linear expanse of coastal waters covering more than 2 kilometers east to west in front of the boundary of Bgy. Bonbon and Bgy. Bayabas in Cagayan de Oro City, located in coastal waters with depths ranging from 5 to 8 meters during low tide.

Initial reconnaissance through broad area snorkeling revealed that corals are only found in the shallow landward side of the study area and corals can no longer be found in the deeper seaside portion but only silt and sediments covered the substrate **(Figure 6.2.32)**



Source: JICA Survey Team

Figure 6.2.32 The Area of No Coral Identified based on Initial Reconnaissance

B) Coral Reef Distribution and Condition

a) Manta-tow and systematic snorkeling

Observations in fifteen manta tow pathways and systematic snorkeling in the survey area revealed that patches of coral reefs are found in only eight (8) out of the fifteen stations surveyed and three out of these eight stations have very little live coral cover (**Table 6.2.55**).

Table 6.2.55 Results of Manta Tow Survey for Coral Reef

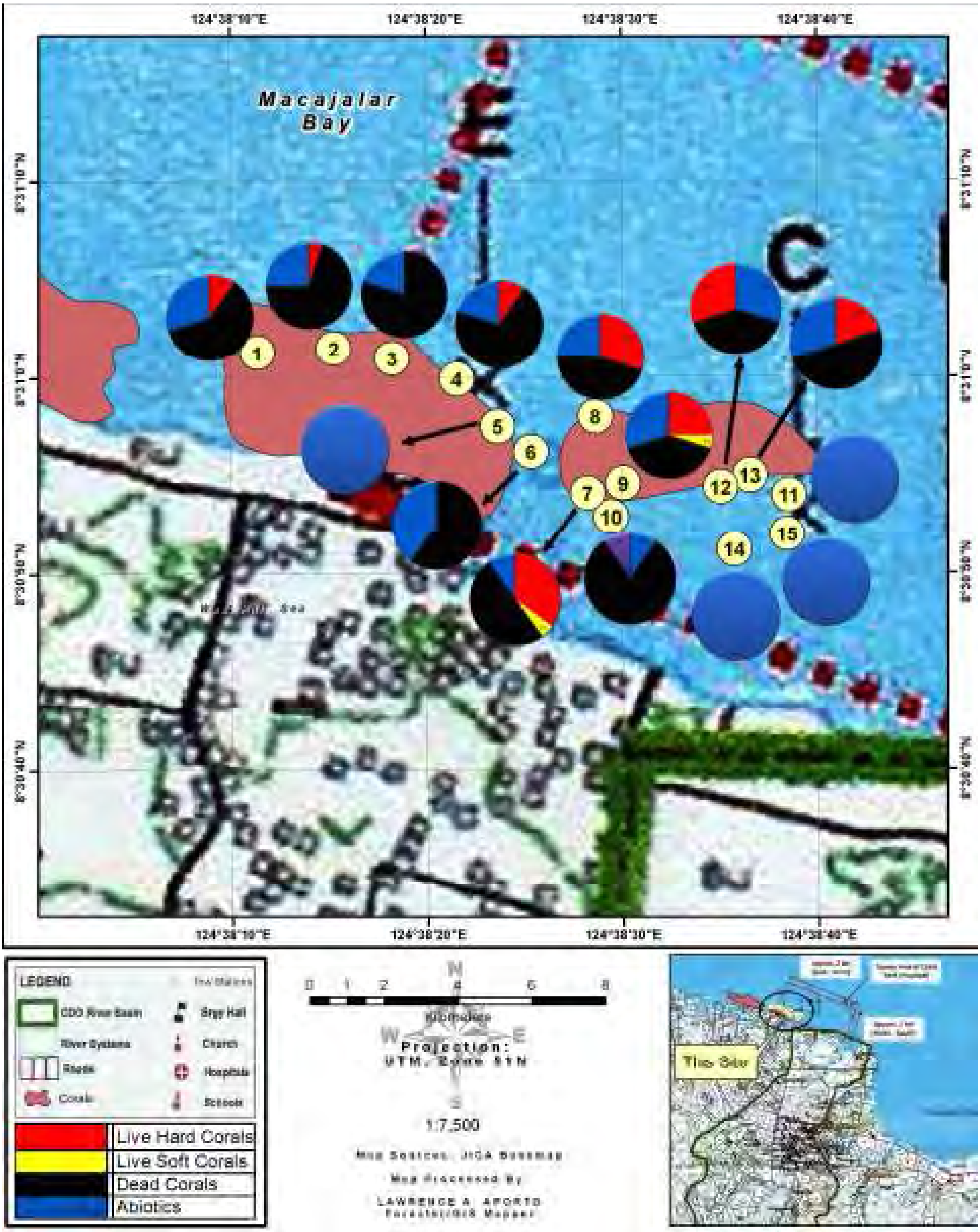
Tow No.		Geographical Coordinates		Coral Reef Condition (in %)				Total (%)	Remarks
		Latitude	Longitude	Live Hard Corals	Live Soft Corals	Dead Corals	Abiotics (Sand, Silt or Rubble)		
1	Start	N 08° 31' 01.3"	E 124° 38' 11.3"	10		60	30	100	Murky and poor coral cover.
	End	N 08° 31' 01.9"	E 124° 38' 14.9"						
2	Start	N 08° 31' 01.5"	E 124° 38' 15.2"	5		70	25	100	Murky and poor coral cover.
	End	N 08° 31' 01.2"	E 124° 38' 18.0"						
3	Start	N 08° 31' 01.0"	E 124° 38' 18.2"			80	20	100	Dominant are dead coral with algae.
	End	N 08° 31' 00.0"	E 124° 38' 21.3"						
4	Start	N 08° 30' 59.9"	E 124° 38' 21.5"	10		70	20	100	Murky and poor coral cover.
	End	N 08° 30' 57.7"	E 124° 38' 23.5"						
5	Start	N 08° 30' 57.5"	E 124° 38' 23.6"				100	100	Sandy bottom.
	End	N 08° 30' 56.4"	E 124° 38' 25.0"						
6	Start	N 08° 30' 56.2"	E 124° 38' 25.3"			60	40	100	Dominant are dead coral with algae.
	End	N 08° 30' 55.5"	E 124° 38' 26.3"						
7	Start	N 08° 30' 54.1"	E 124° 38' 28.2"	35	5	50	10	100	Dominant live coral lifeforms are massive; few coral branching recruits.
	End	N 08° 30' 57.7"	E 124° 38' 28.0"						
8	Start	N 08° 30' 58.0"	E 124° 38' 28.6"	30		45	25	100	Dominant live coral lifeforms are massive.
	End	N 08° 30' 56.3"	E 124° 38' 30.0"						
9	Start	N 08° 30' 54.6"	E 124° 38' 30.0"	25	5	40	30	100	Dominant live coral lifeforms are massive with infestation of crown-of-thorns.
	End	N 08° 30' 52.7"	E 124° 38' 29.7"						
10	Start	N 08° 30' 52.9"	E 124° 38' 29.4"	10		80	10	100	Murky and poor coral cover.
	End	N 08° 30' 55.5"	E 124° 38' 27.5"						
11	Start	N 08° 30' 54.0"	E 124° 38' 38.5"				100	100	Sandy-muddy bottom.
	End	N 08° 30' 53.4"	E 124° 38' 39.3"						
12	Start	N 08° 30' 54.4"	E 124° 38' 35.0"	30		40	30	100	Dominant live coral lifeforms are massive.
	End	N 08° 30' 55.3"	E 124° 38' 36.4"						
13	Start	N 08° 30' 55.0"	E 124° 38' 36.5"	20		50	30	100	Murky and poor coral cover.
	End	N 08° 30' 51.3"	E 124° 38' 35.8"						
14	Start	N 08° 30' 51.2"	E 124° 38' 35.7"				100	100	Sandy/Silt bottom.
	End	N 08° 30' 51.8"	E 124° 38' 38.0"						
15	Start	N 08° 30' 52.0"	E 124° 38' 38.4"				100	100	Sandy/silt bottom.
	End	N 08° 30' 52.2"	E 124° 38' 41.9"						
Average Percentage Cover				**11.67**	**0.67**	**43**	**44.67**	**100**	**12.3%** **Live coral cover**

Note: Status Category: Poor = 0 - 24.9; Fair = 25 - 49.9%; Good = 50 - 74.9%; Excellent = 75 - 100% (Gomez et al. 1981); Source: JICA Survey Team.

The rest of the fringing reef area completely comprised of sand and silt substrates, dead corals and dead corals with algae. The highest live coral cover can be found in only 5 stations in between coordinates E and C. Overall, the live hard coral (LHC) from 15 survey stations are categorized as very poor, averaging 12.3 percent. Dead corals consisted of 43.0 % of the area surveyed while abiotics – mostly silt and sediments from the river, comprised 44.7 % (**Table 6.2.55** and **Figure 6.2.32**).

Manta-tow pathways number 7, 8 and 12 had the highest and most diverse live hard coral cover averaging 30%. Tow number 7, located close to the shoreline southwest of Station C had the highest coral cover at 35% LHC. In this area the reef flat is narrow, extending to about 50 x 50 meters in a gradual slope towards Area C, covering only approximately a quarter of a hectare northward. Other patches of reef flats close to the shoreline are heavily silted with extensive colonization of macro-algae. On the other hand, the deeper portion of the survey area as well as those in stations A, B and D, host mostly silt-laden substrates, coral rubble and coral patches are absent.

The most dense coral colony occurs in the middle points E and C, in stations 7 and 8 where colonies of the silt-resilient fire coral *Millepora sp.* occur alongside massive hard corals of the species *Porites sp.* In spite of this, dead corals are also extensive, covering about 40-80% of all stations in the reef flat where live corals were encountered. Other coral species belong to the foliose group and encrusting corals are also thriving in consistent small patches, albeit heavily stressed with silt and sediments. Occasional colonies of soft corals appear in isolated patches, comprising only 5 % of the total cover. Evidence of previously dynamited corals were also observed in coral rubbles scattered on the seabed.



Source: JICA Survey Team

Figure 6.2.33 Survey Results on the Existing Condition of Coral at 15 Manta Tow Survey Stations

b) Results of detailed coral reef assessment through Line Intercept Method (LIT)

The LIT transects were laid across the most dense portion of the reef in Manta Tow pathways number 7 and 8, near Station C. The detailed coral survey revealed a consistent pattern of reef patches interrupted by colonies that are heavily degraded as results of the manta tows revealed. Transect 1 showed 42% live coral cover which is quite robust amidst heavy siltation. Transect 2 revealed a 39% LHC (**Table 6.2.57**). In both stations, dead corals are significant, accounting for about 38% on average. Silt and sediments comprised 12 to 20% of substrate.

Table 6.2.56 Survey Result of o Line Intercept Transects (LIT) s

Lifeform Categories		Code	Condition per LIT Transects (%)	
			1	2
Acropora	Coral Branching	ACB	0.0	0.4
	Tabulate	ACT	1.2	0.6
Non-Acropora	Coral Branching	CB	0.4	0.2
	Encrusting	CE	7.6	5.2
	Massive	CM	19.2	25.4
	Sub-massive	CS	5.6	7.6
	Millepora	CME	6.2	0.0
	Heliopora	CHL	2.0	0.0
Total			***42.2***	***39.4***
Dead Coral		DC	32.8	32.6
Dead Coral with Algae		DCA	4.0	7.4
Other Fauna	Sponges	SP	0.4	0.8
Abiotic	Sand	S	8.4	0.0
	Silt	Si	12.4	19.8

Note: Status Category: Poor = 0 - 24.9; Fair = 25 - 49.9%; Good = 50 - 74.9%; Excellent = 75 - 100% (Gomez et al. 1981).

Source: JICA Survey Team

Table 6.2.57 Percentage of Coral by Condition

Transect No:	Live Hard Coral		Dead Coral	Other Fauna (OT)	Abiotic	Criteria (LHC)	Condition
	Acropora	Non-Acropora					
01	1.20%	41.0%	36.8%	0.4%	20.8%	42.2%	Fair
02	1.00%	38.4%	40.0%	0.8%	19.8%	39.4%	Fair
Average	1.10%	39.6 %	38.4%	0.6%	20.3%	40.7%	Fair

Note: Status Category: Poor = 0 - 24.9; Fair = 25 - 49.9%; Good = 50 - 74.9%; Excellent = 75 - 100% (Gomez et al. 1981).

Source: JICA Survey Team

Total live coral cover on the sites was 40.7% (**Table 6.2.57**). Majority of the coral species are comprised of the non-acropora scleratinian types, with the massive *Porites sp.* dominating coral cover (28.8%) (**Figure 6.2.34a)**, followed by non-acropora massive *Favites sp.* (6.4%) and the fire coral *Millepora sp.* (3.1%) (**Figure 6.2.34b)**.

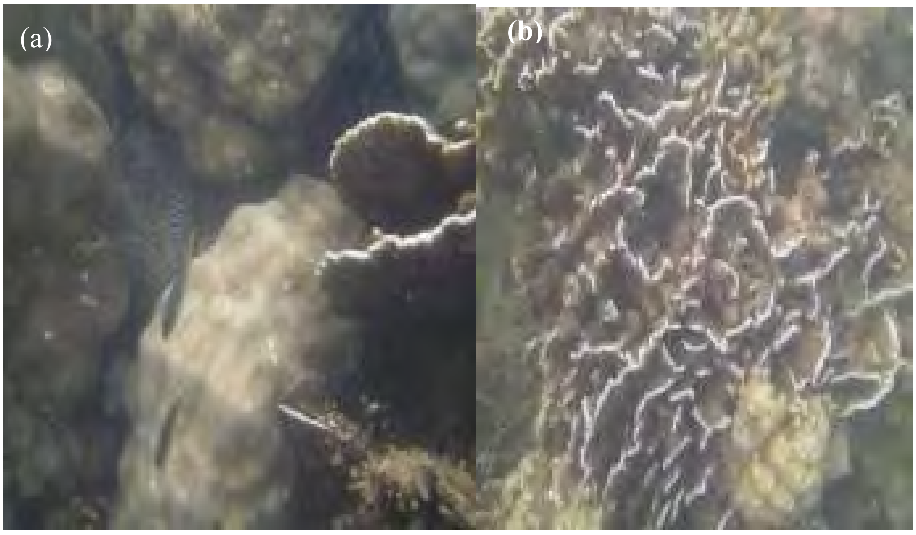


Figure 6.2.34 Dominant Coral Species (a) *Porites sp.*and (b) *Millepora sp.* at coral reef survey sites

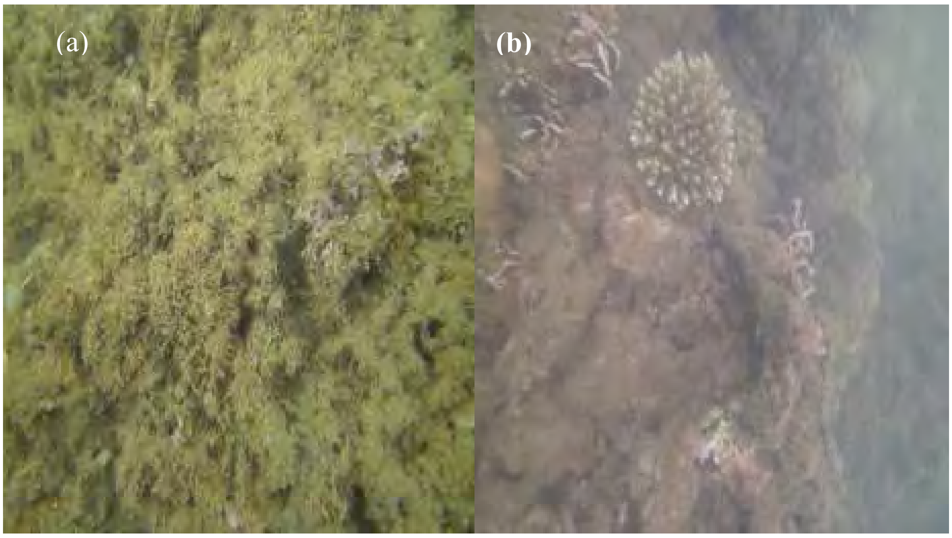


Figure 6.2.35 Dead *Acropora sp.* Corals (a) Surviving *Acropora sp.* amidst smothered corals (b)

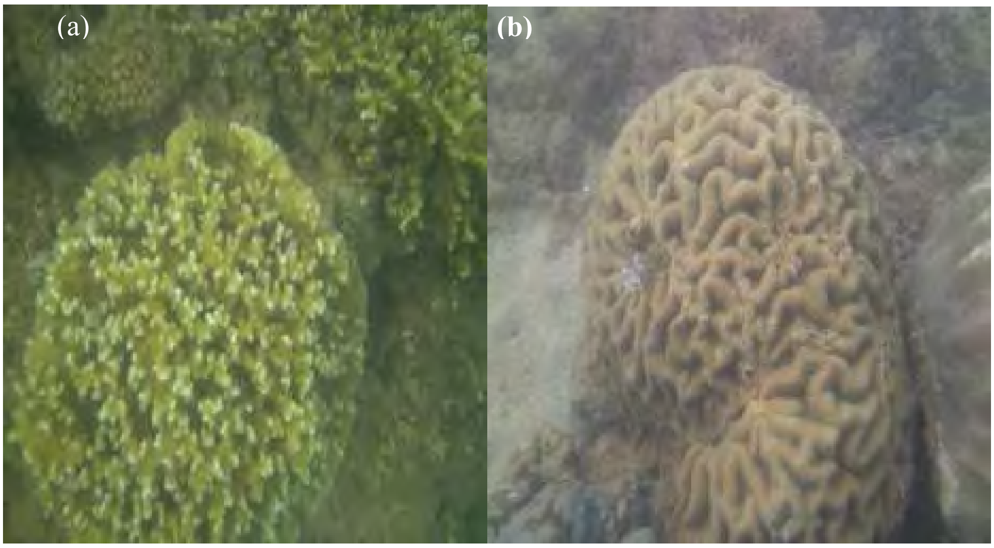


Figure 6.2.36 Identified Corals in the Survey a) *Acropora palmate* and (b) the large brain root coral, *Lobophyllia hemprichii*

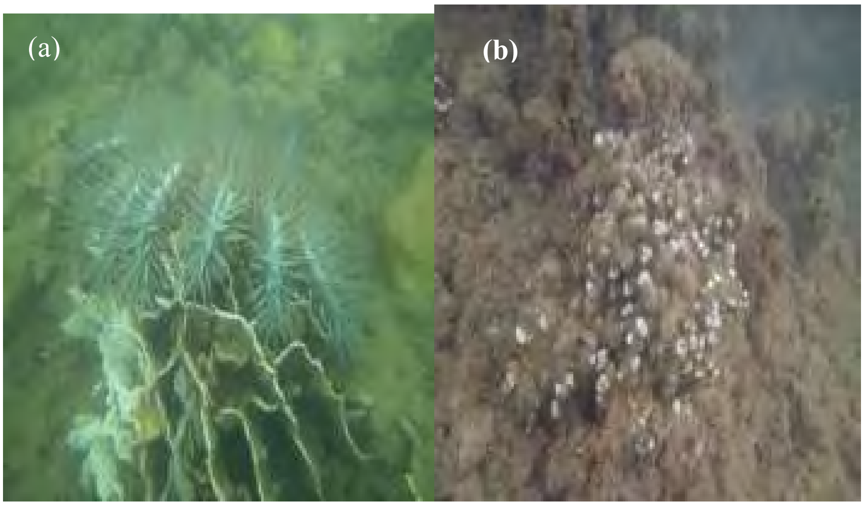


Figure 6.2.37 Prey of Coral and Condition of Coral Habitat (a) Crown-of-thorns starfish preying on a fire coral and (b) smothered branching *Acropora sp.* due to heavy sediment loading at the survey sites.

The branching species of blue coral *Heliopora sp.*, *Acropora sp*. and *Seriatopora sp.* were found to be ≤1% of the live coral cover. The dominance of the massive varieties as opposed to the branching types is brought about by the fact that massive coral species are more resilient and therefore, survive better in turbid and silty waters.

The corals in all stations were vividly suffering from sediment intrusion and many branching and encrusting species of corals were appear to be smothered with silt, which is one of the leading causes of coral mortality. Moreover, it was seen that the crown-of-thorns starfish, *Acanthaster sp.*, are present in the area and are preying on live corals and adding to mortality. Other physical damage in the colonies in shallower water are most probably due to boat anchors and possibly hunting of shellfish and Holothurians.

Table 6.2.58 Average Percentage Distribution of Coral Species

Coral Species	Average Percentage of Lice Coral Cover
Porites sp.	22.2 %
Porites lichen	6.6 %
Favites bestae	6.4 %
Millepora sp.	3.1 %
Heliopora sp.	1.0 %
Acropora indonesia	0.9 %
Seriatopora sp.	0.3 %
Acropora palmate	0.2 %
Total Live Coral Cover	40.7 %

Status Category: Poor = 0 - 24.9; Fair = 25 - 49.9%; Good = 50 - 74.9%; Excellent = 75 - 100% (Gomez et al. 1981)
Source: JICA Survey Team

5) Evaluation of Survey Results

The overall result of the assessments indicates that coral reef habitats are largely impaired due to heavy silt and sediment intrusion from the river. Vivid signs of coral polyp suffocation were observed to be pervasive in all the stations surveyed and coral mortality is already high.

Corals need sunlight and are sensitive to turbid waters. The turbidity of the coastal sea in front of the project site is potentially brought about by sediment and silt plumes from the nearby rivers such as the Iponan River, CDO River and waste water from the settlement along the shoreline. The impact is manifested by the wide occurrence of coral colonies that have been blanketed by silt and are now covered with algae. Massive corals belonging to the taxa Faviidae and Poritidae are known to resist sediment intrusion, and these species are found dominant in the remaining coral reefs in front of the project site. Based on observations of DCA values across all coral reef assessment stations undertaken in the survey, siltation and contiguous coastal environment are occurring and may potentially become extreme as river water and coastal environment continue to deteriorate.

(2) Potential Impacts

Civil works that will have potential impacts on the coastal environment are (i) earth moving and run-off of sediment plumes and (ii) construction of facilities and structures near the river. Specifically, the potentially unfavorable impacts on coral reef during construction activity include, as a general case, the following:

- Smothering of corals due to increased sediment intrusion, the disturbance of silt and increase of other organic debris due to construction activities that may carry sediment run-off from the project site to the identified coral reef areas.
- Although temporary in nature and spatial extent, this may cause surges in silt loads in the water column and exacerbate water turbidity that can contribute to further coral polyp suffocation and drive away fish populations as well.
- Accidental spillage of oil and grease from project facilities can cause river and seawater pollution. In certain times, such oil slicks can be forced to the bottom by tidal action and thereafter pollute coral colonies within its pathway, aside from negatively affecting the water quality.

The potential issues enumerated above can directly or indirectly lead to coral mortality and loss of remaining coral reef resources. Silt and sediment plumes from a project can be carried to nearby waters where patches of corals still occur, further enhancing sediment blanketing. Moreover, such sediment streams will likely amplify coastal water turbidity, in the form of total suspended solids (TSS) and further reduce sunlight penetration into the water column. In extreme cases, turbidity will lead to reduced photosynthetic function and negatively affect microscopic primary producers of phytoplankton and algae that have a symbiotic relationship with corals. The most serious impact would be the smothering of other coral reef patches, which can depress coral larval growth and recruitment.

The description above in the worst case where the project site is located near coral reef and no adequate measures for protection of the coral are provided. In the case on the CDO River, the distance of the river mouth and the location of coral is approx. 1.5 km. the possibility of the direct impact of silt plume due to the construction works to reach the coral areas is minor.

But it is necessary to examine whether or not the possibility of flood water with high turbidity to reach the corals because it might extend the flow distance into the sea from the river mouth at the same scale of flood during the operation stage. The possibility for the floodwater of the CDO river to reach the coral areas located west of river mouth depends on the current direction in the Makajalar Bay.

According to the information of Philippine Ports Authority, "On the southern part of the Mindanao sea, where the Makajalar bay is located, the currents are variable and tend to follow the wind direction. Thus, it is possible for an anti-clockwise current to exist in Macajalar Bay, varying in intensity throughout the year." URL: http://www.ppa.com.ph/PMO%20CDO%20Webpages/about_us01.htm. This means that the dominant direction of the tidal current in the Makajalar Bay is from west to east, suggesting the floodwater from the river mouth of the CDO River is to be affected by the current from west to east. This indicates the floodwater with high turbidity will not flow apart from the coral areas.

In conclusion, the possibility of direct impacts due to the construction works of the Project on the coral reef in front of the Brgy. Bonbon and Bayabas is minor, and the possibility of the impacts of flood water during the operation phase on the coral reef in front of the Brgy. Bonbon and Bayabas is minor.

(3) Mitigation Measures

Although the possibility of direct impacts of the Project on the coral reefs is anticipated to be minor, the following measures shall be ensured for minimizing the generation of silt plume and its diffusion:

- Installation of silt curtain for enhancing the entrapment mechanism during the dredging work,
- As for the dredging work, adoption of less agitating type of dredging, such as pumping dredger, to minimize the re-suspension of sediments during dredging work..

In order to prevent, the intrusion of turbid water from construction yard / site to the river, the following measures which are the same measures as those for river water quality, shall be done:

- To avoid the construction works during rainy season or rainy day as much as possible,
- Installation of temporary embankment and drainage at the boundary of periphery of project site,
- Installation of sedimentation pond at appropriate location to avoid the turbid water discharge into the river for settlement the laden with soil particles.
- Provision of portable toilet (portalet) for the workers at the construction work sites.

6.2.6 Threatened species

(1) Criteria for Threatened Species

Table 6.2.59 shows the international and local databases and regulations used to determine any threatened species found in surveyed areas in the survey area. It should be noted that there are no existing databases/regulations applicable to plankton species.

Table 6.2.59 International and local databases and regulations listing threatened species

Module	Database/Regulation			
	IUCN Red List 1)	DAO 2007-01 2)	DAO 2004-15 3)	CITES 4)
Terrestrial Flora	✔	✔	-	✔
Terrestrial Fauna	✔	-	✔	✔
Fish	✔	-	✔	✔
Macroinvertebrates	✔	-	✔	✔
Plankton	-	-	-	-
Corals	✔	-	-	✔

Note 1): Red List (2013) of International Union for Conservation of Nature (IUCN)
2): DAO 2007-01, Establishing the National List of Threatened Philippine Plants and their Categories, and the List of Other Wildlife Species,
3): DAO 2004-15, Establishing the List of Terrestrial Threatened Species and Their Categories,
4): Convention on International Trade in Endangered Species of Wild Fauna and Flora

(2) Identified Threatened Species

1) Terrestrial Flora

A) Survey Locations

Threatened species of terrestrial flora were noted in the transects surveyed for the baseline terrestrial flora surveys (refer to Sec. 6.2.1). The data were based on the opportunistic/qualitative observation was undertaken in the Cagayan de Oro River spanning the general areas where terrestrial vegetative cover transects are positioned along the river stretches from the river mouth up to Pelaez Bridge.

B) Survey Results

Threatened species observed along the terrestrial flora transects included Narra (*Pterocarpus indicus*) and Molave (*Vitex parviflora*). Conservation status are as shown in the table below:

Table 6.2.60 List of Threatened Species

Species	Common Name	Conservation Status	
		DAO 2007-01	IUCN Red List
Pterocarpus indicus	Narra	Vulnerable	Category A: Critically Endangered Species
Vitex parviflora	Molave	Vulnerable	Category B: Endangered Species

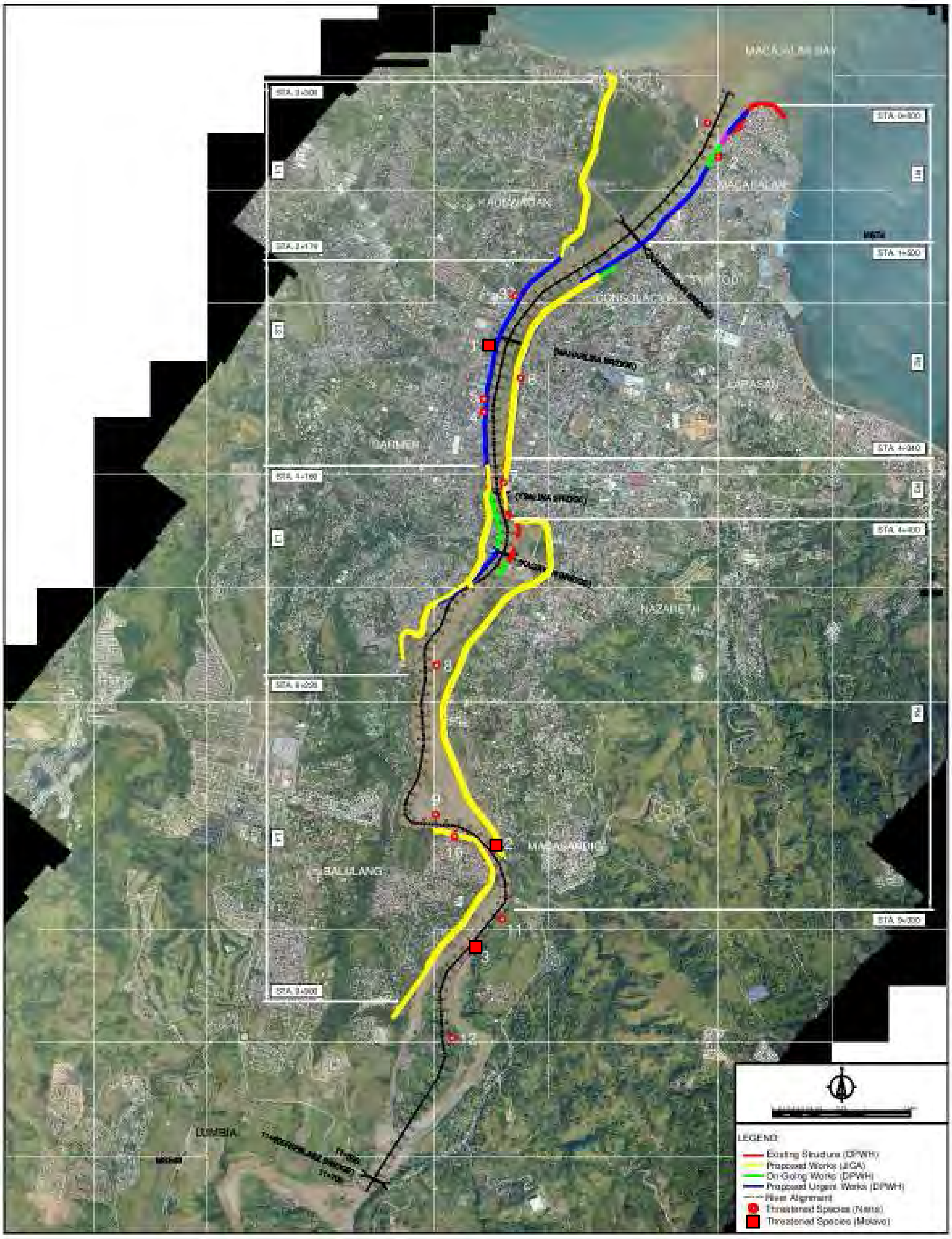
Source: JICA Survey Team

Narra (*Pterocarpus indicus),* the Philippine national tree, is a critically endangered species (i.e. facing extremely high risk of extinction in the wild in the immediate future), Molave (*Vitex parviflora*) is an Endangered species (i.e. not critically endangered but whose survival in the wild is unlikely if the causal factors continue operating).

They are common reforestation species especially in riverbanks stabilization. They are both leguminous, which makes barren land soil enriched with nitrogen and other important soil nutrients.

The locations of the identified individuals during the survey are shown on Figure 6.2.38. The coordinates data and the life stage are listed in Table 6.2.60. The individuals identified are seen along the CDO River.

Some individuals of the threatened species area located closely to the ROW of the planned structures of the Project, including No. 6, 7, and 10 of Narra, and No. 2 of Molave. But it was found out based on the checking coordinates that none of the identified individuals were superimposed in the ROW of the structures of the Project.



Source: JICA Survey Team

Figure 6.2.38 Locations of Threatened Tree Species along the Project Area

Table 6.2.61 Location of Identified Threatened Species of Flora

Common name	Scientific name	Coordinates	Life Stage
Narra	*Pterocarpus indicus*	1. 8° 30’ 20.3”, 124° 39’ 25.6”	Mature
		2. 8° 30’ 10.6”, 124° 39’ 28.7”	Mature
		3. 8°29’17.11”, 124°38’21.9”	Mature
		4. 8°28’ 57.9”, 124° 38 20.8”	Mature
		5. 8°29”01.6”, 124°38”20.8”	Mature
		6. 8°29’7.58”, 124°38’31.44”	Sapling
		7. 8°28’37.62”, 124°38’26.45”	Sapling
		8. 8°27’45.40”, 124°38’6.92”	Mature
		9. 8°27’2.72”, 124°38’6.47”	Sapling
		10. 8°26’56.37”, 124°38’11.92”	Mature
		11. 8°26’32.76”, 124°38’25.54”	Sapling
		12. 8°25’58.71”, 124°38’11.01”	Mature
Molave	*Vitex parviflora*	1. 8° 29’ 31.19”, 124° 38’ 30.08	Mature
		2. 8°26’53.19”, 124°38’23.72”	Mature
		3. 8°26’24.59”, 124°38’17.37”	Mature

Source: JICA Survey Team

Figure 6.2.39 and (Narra 4 & 5 and 7 on map) and **6.2.40** (Molave 1 and Narra 3 on map) shows Narra and Molave tree species found in the vicinity of the Project site.

Normally, Narra and Molave trees do not usually thrive in riverine environments like the river banks unless there is a supply of seeds or human settlers to have planted these trees. Based on the assessment of the survey team of the Sub-Contractor and the natural conditions on the sites where these species are growing, the individuals of the threatened species encountered are likely to be planted ones and most of them are currently under the management of the human.

Source: JICA Survey Team

(a) No. 4 at its mature stage and (b) No. 7 at its sapling stage

Figure 6.2.39 Identified Individuals of Threatened Species, Narra

Source: JICA Survey Team

(a) No. 7 Molave located the river bank and (b) No. 3, Narra found inside Liceo de Cagayan University

Figure 6.2.40 Identified Individuals of Threatened Species

2) Terrestrial Fauna

A) Survey Locations

Threatened species of terrestrial fauna were noted in the transects surveyed for the baseline terrestrial fauna surveys (refer to Sec. 6.2.3). The data were based on the opportunistic observations of all wildlife encountered in the same transects using board a boat in the Cagayan de Oro River from the river mouth up to Pelaez Bridge.

B) Survey Results

As mentioned earlier, the IUCN, DAO 2004-15 and CITES list were used to determine threatened species among identified terrestrial fauna species.

Survey results showed the following:

- There were no species considered on a threatened status by the IUCN Red List.
- Based on DAO 2004-15, certain species of the monitor lizard, *Varanus salvator*, are Vulnerable.
- The CITES list includes the following fauna found in the vicinity of the project site: Brahminy Kite (*Haliasturindus indus*), Reticulated Python (*Python reticulatus*) and Monitor Lizard (*Varanus salvator*).

3) Aquatic Biota and Coral

A) Survey Locations

Threatened species of aquatic biota were noted in the transects surveyed for the baseline aquatic biota and coral surveys (refer to Sec. 6.2.4 and 6.2.5). The data were based on the aquatic biota species sampled in the Cagayan de Oro River from the river mouth up to Pelaez Bridge, and the corals encountered the sea before the Brgy. Bonbon and Bayabas.

B) Survey Results

a) Plankton

As mentioned earlier, there are no applicable laws/standards for determining the conservation status of plankton.

b) Macroinvertebrate

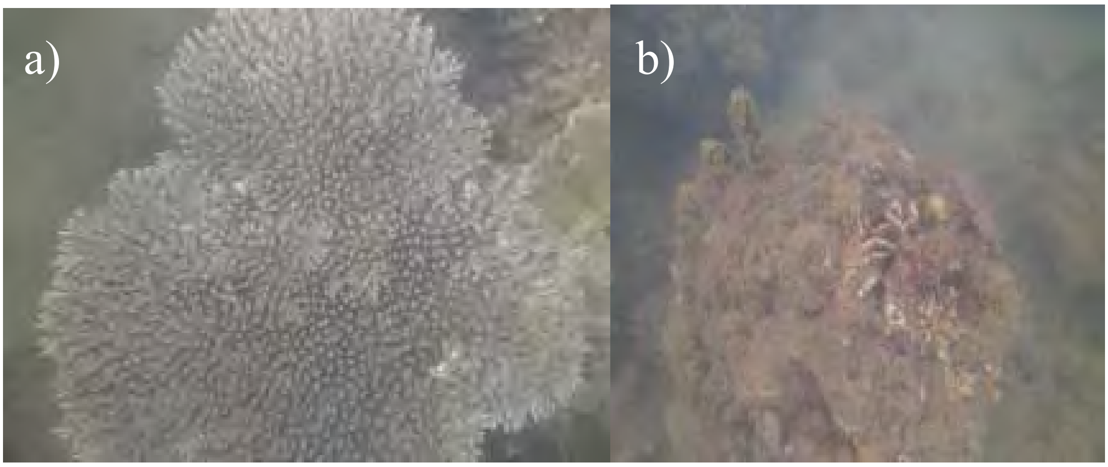
Most of the macroinvertebrate species identified onsite were unclassified under the IUCN Red List, whilst others were considered Least Concern. In addition, the macroinvertebrate species found at the Project site were not listed under DAO 2004-15 or CITES.

c) Fish

Similar to the macroinvertebrates, most fish species found were either unclassified under the IUCN Red List or Least Concern. There were no fish species found onsite that were listed under DAO 2004-15 or CITES.

d) Coral

Threatened coral species identified under the IUCN Red List include vulnerable species of *Heliopora sp.*and *Acropora indonesia,* and critically endangered *Acropora palmate*. In the survey area, *Heliopora* was seen in 1 transect and it comprised 1.0% of the total average coral composition. The *Acropora indonesia* (Figure 6.2.37) was also few, comprising an average of 0.9%. These species are considered vulnerable because they can easily break. *Acropora palmata* is quite less as it comprised insignificant at 0.2 % of average total cover. These corals are susceptible not only to silt suffocation but also breakage caused by anchor and fishing gear, etc.



Source: JICA Survey Team

Acropora Indonesia (a) and *Acropora palmate* (b) observed in the transect located near Brgy. Bonbon and Bayabas

Figure 6.2.41 Identified Threatened Coral Species in the Survey Area

Under the CITES list, the following coral species found at the transect lines are restricted for trade:

- *Heliopora sp.*
- *Seriatopora hystrix*
- *Acropora indonesia*
- *Poritis lichen*
- *Lobophyllia hemprichii*
- *Favites bestae*

(2) Potential Impacts

Potential impacts of the implementation of the Project are predicted as follows:

1) Threatened tree species

Identified tree species are Narra and Molave. As to Narra, 12 individuals are found along the CDO River while 3 individuals area identified for Molave. According to the coordinates data of them, it was confirmed that none of the identified individuals were superimposed in the ROW of the planned structures of the Project although No. 6, 7, and 10 of Narra, and No. 2 of Molave shown on Figure 6.2.34 are located close to the ROW.

Thus, the direct impact of the construction works, such as necessity of clearance or cutting, is not predicted. There is, however, a possibility that growing conditions of them might be altered if the surrounding vegetation of these individuals are cleared during the construction works. In addition, there is another possibility that these individuals of the threatened species would receive physical trauma or injury due to the construction activity.

2) Terrestrial fauna species

There are three (3) threatened species of terrestrial fauna identified as follows:

- Monitor lizard (*Varanus salvator):*, Vulnerable based on DAO 2004-15,
- The CITES list includes the following fauna found in the vicinity of the project site: Brahminy Kite (*Haliasturindus indus*), Reticulated Python (*Python reticulatus*) and Monitor Lizard (*Varanus salvator*).

The potential impacts on these species are the anticipated below:

- The direct impact such as physical trauma and injury of these species will be minor but the implementation of the project will cause the change of habitat due to the vegetation clearance.

3) Aquatic biota

There is no identified species listed as threatened species in the survey.

4) Coral

The following species are identified in the survey:

- IUCN Red List includes vulnerable species of *Heliopora sp.*and *Acropora indonesia,* and critically endangered *Acropora palmate*.
- CITES List includes *Heliopora sp., Seriatopora hystrix, Acropora Indonesia, Poritis lichen, Lobophyllia hemprichii,* and *Favites bestae.*

As described in Sec. 6.2.5 Coral Reef, the impacts of the implementation of the Project are predicted as follows:

- Direct impact of excavation / dredging work to the corals is minor, and
- The possibility of flood water with high turbidity to reach to the corals will be minor.

The impacts on the corals including these threatened species, therefore, will also be minor.

(3) Mitigation Measures

The following are proposed mitigating measures for the potential impacts outlined above:

1) Mitigation measures for threatened tree species:

- Minimal clearing of vegetation to minimize the alteration of growing conditions.
- Fencing is suggested to delineate clearly any unnecessary expansion of clearing activities, especially when the construction work is done near the threatened species.

2) Mitigation measures for threatened fauna species:

- Minimal clearing of vegetation/ wildlife habitat to decrease disturbance to wildlife.
- Hunting of animals near the or within projects sites is strictly prohibited and enforced with the personnel staying in the Project Site.
- Activities during night time should be minimized to avoid artificial lighting and noise disturbances.

3) Mitigation measures for threatened coral species:

- Installation of silt curtain for enhancing the entrapment mechanism during the dredging work,
- As for the dredging work, adoption of less agitating type of dredging, such as pumping dredger, to minimize the re-suspension of sediments during dredging work,
- Monitoring of the corals during the construction phase and after the completion of the works.

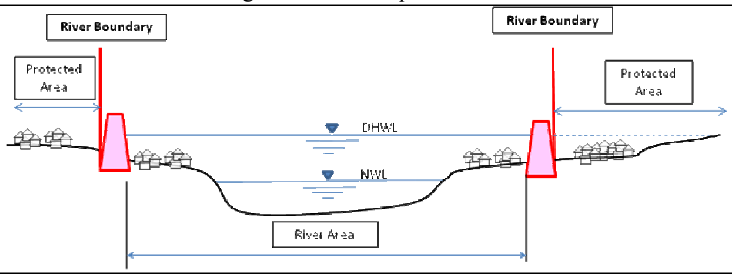
6.3 Social Environment

6.3.1 Involuntary Resettlement

(1) Baseline Environment

The elements of impacts by involuntary resettlement under the project are described in Table 6.3.1 below and termed as reasons of resettlement under the project and the number of affected structures by the project. The resettlement under the project shall be provided as a preventive measure to flood disaster risk reduction, in order to safeguard the lives and assets of persons at a high flood risk and economically and socially improve or at least restore their living condition by relocating affected population.

Table 6.3.1 Elements of Impacts by Resettlement under Project

	Contents of Impacts
Reasons of Resettlement under the Project	For Structure: Land required for structure of the project, such as dike and floodwall, for example
	For River Area: Lands with high flood risk acquired in river area
ROW Area and River Area	

The census and socioeconomic survey were done to determine the number of people affected by the project within the designated project area. The table below shows the number of project affected households, business establishments and institutional facilities by barangay in the project area.

Table 6.3.2 Number of Project Affected Units in the Project Area

Barangay	Project Affected Units		Total	%
	Households	Business Establishments, Community Facilities		
Bonbon	74	3	77	6.6
Kauswagan	3	0	3	0.3
Carmen	183	9	192	16.6
Balulang	43	0	43	3.7
Consolacion	447	21	468	40.4
Barangay 17	85	3	88	7.6
Barangay 15	49	13	62	5.3
Barangay 13	38	6	44	3.8
Barangay 10	20	4	24	2.1
Barangay 7	45	8	53	4.6
Barangay 6	0	1	1	0.1
Barangay 2	0	0	0	0.0
Barangay 1	0	0	0	0.0

Table 6.3.2 Number of Project Affected Units in the Project Area

Barangay	Project Affected Units		Total	%
Nazareth	3	0	3	0.3
Macasandig	97	4	101	8.7
Total	**1,087**	**72**	**1,159**	**100.0**

(2) Potential Impacts

There are 1,159 households, business establishments, and community facilities affected by the project. Of the total number, 94% are households while the barangay with the most number of affected households, establishments, and facilities is Barangay Consolacion at 40.4%. Since involuntary resettlement is unavoidable, viable alternative designs were explored to minimize involuntary resettlement while taking into account reducing the flood risk level in the project area. Resettlement measures, meaning compensation, relocation, and rehabilitation are in the Resettlement Action Plan (RAP) prepared for this project. All activities related to resettlement will be completed at least a month prior to the start of construction. After resettlement, monitoring will still continue to check if the measures that were executed restored or improved the living condition and income of project affected people. If the conditions are found worse-off, DPWH in coordination with concerned institutions will provide assistance like functional livelihood programs, sourcing job opportunities, and capital or loans for small business enterprises.

6.3.2 Poverty Group

(1) Baseline Environment

The socioeconomic survey conducted for the project validates the incidence of households in the poverty group as shown in the following table.

Table 6.3.3 Poverty Group of Project Affected Households

Monthly Income	Number	Percentage	Total Number of Project Affected Households	Percentage of Poor Households to Total Number of Project Affected Households
500 or less	12	2.0		
501 - 2,000	40	6.6		
2,001 - 5,000	189	31.0		
5,001 - 10,000	369	60.5		
Total	610	100.0	1,087	56.1

More than half, 56.15%, of the project affected households are living below poverty line or are within the poverty threshold set at PhP10,000 and below for the Cagayan de Oro City by the National Economic and Development Authority (NEDA).

(2) Potential Impacts

Poverty makes a household more vulnerable to disruptive impacts brought about by the project implementation. Poor households are less resilient and unable to recover from loss because resources are limited in the first place and there will be little or nothing left for contingency. Where poverty is a pre-existing condition, restoration of living conditions and income will not be enough. Formulation and provision of sustainable income or livelihood measures that will improve the affected households' pre-project circumstances must be done to bring them out from poverty. The project affected persons have to be better off and lives in general have to be improved otherwise they will be back in the project area or seek other areas to settle informally again.

6.3.3 Local Economy

(1) Baseline Environment

Data from the socioeconomic survey shows a variety of businesses among households in the project area. The majority of businesses are engaged in trading, comprising mostly of small convenience stores. Other businesses like boarding houses are also common, as are home and small-scale industries, transport businesses, livestock-raising and personal services. The percentage of employable household members in the project area without a source of income stands at 59%. Of the remaining 41% with sources of income, businesses and self-employment (7%) are often cited as primary income source among household members, the same percentage as laborers and unskilled workers. Service workers, shops and market sales workers, construction workers, and other trades and related workers comprise 15%. On the other hand, 6% state primary source of income as professionals, technicians and associate professionals, government officials and workers, corporate executives, and managers. Other sources account for 5% of employable household members' primary source of income.

Table 6.3.4 Primary Source of Income of the Project Affected Household Members

Type of Primary Source of Income	Number	%
Business/self-employed	342	7
Labourers & unskilled workers	340	7
Service workers	289	6
Shop and market sales workers	147	3
Other trades and related workers	135	3
Construction workers	123	3
Pension / 4Ps	115	2
Professionals	106	2
Remittance	80	2
Clerks	66	1
Technicians and associate professionals	41	1
LGU officials/workers	33	1
Employees and staff of government line agencies	26	1
Officials of Government, Corporate Executives, Managers	25	1
Farm workers & fishermen	19	0
Entertainment & recreation workers	18	0
Special occupations	16	0
Rental	8	0
None	2814	59
TOTAL	**4743**	**100**

(2) Potential Impacts

The possible loss of livelihoods and access to income sources may lead to further impoverishment for some PAPs as involuntary resettlement could deprive some of their existing livelihood patterns. Taking into account the existing skills and preferred businesses and skills training of PAPs, measures to restore PAPs standard of living need to be developed in coordination with the Department of Social Welfare and Development (DSWD), Department of Labor and Employment (DOLE) and its associated offices (Technical Education and Skills Development Authority (TESDA) and Public Employment Service Office (PESO), Department of Trade and Industry (DTI) and the local government unit. The measures should include skills training, job placement and capital assistance for small-scale industries.

6.3.4 Water Use in River

(1) Baseline Environment

The common usage of the river and its water by local residents were found: (a) bathing, (b) washing of clothes and (c) watering of plants, which are observed to have been practiced by local residents in a routine manner. In addition, river banks are also utilized by local residents for leisure activities such as picnicking in some barangays. However, the number of local residents who are living along the river and using the river for bathing, washing of clothes and watering of plants is observed and found not significant. The river water for portable use was not identified, since portable water is widely provided to 65 barangays out of 80 barangays by a local water supply system through the Cagayan de Oro Water District. The results of the socioeconomic survey, which was conducted for project affected area along the river, also indicate that about 60% of respondents sourced their drinking water from piped water or public taps and about 40% from water refilling stations. Use of river and its water by local residents is identified mostly part of daily living such as household chores and its related activities as mentioned in the above, but largely limited in terms of its number of users.

(2) Potential Impacts

The construction of flood control structures of the project such as dike and floodwall may disturb access of local residents to the river and its use to some extent, but may not be a significant impact, since use of the river by local residents is limited to daily living of households and its related activities, limited in terms of the number of users and not for obtaining portable water. It is noted, however, that a certain impact may still be remained since there may be still a certain number of local residents who wish to continue having access to the river and its use for daily living during construction and operation stages of the project.

6.3.5 Land Use and Utilization of Local Resources

(1) Baseline Environment

The common economic activity of local residents found in the river is quarrying or sand and gravel business for producing construction materials, which are observed in Barangays Carmen and Balulang on the left bank and Barangays Consolacion and Macasandig on the right bank. These local businesses are operated in both small and large scales. It is noted that, according to the record of the city government in 2010, the annual mineral production of sand and gravel of Barangays Balulang, Consolacion and Macasandig was totaled at about 41,800 cubic meters. The production for each of the above barangays is: 3,300 m^3 in Balulang, 32,000 m^3 in Consolacion and 6,500 m^3 in Macasandig. Fishing is also found in the area nearby the river as an economic activity of local residents, but mainly observed at the coastal area of the river mouth area such as Barangay Bonbon on the left bank and Barangay Macabalan on the right bank.

(2) Potential Impacts

The construction of flood control structures along the river by the project may have an impact on local quarrying or sand and gravel businesses, due to the difficulty accessing to the river by construction of continuous dike or levee. Further, operations of these businesses may necessarily be limited, controlled and managed to some extent by concerned authorities such as the city government, Department of Environment and Natural Resources (DENR) and DPWH, considering hydrological requirements to bring about a full effect of the project.

6.3.6 Social Infrastructure and Sensitive Facilities

(1) Baseline Environment

The total number of major sensitive facilities identified is 42, which are classified into 6 categories with respective counts indicated in parenthesis, such as: barangay facilities (15), religious institutions (5), government institutions (4), schools (3), financial institutions (3) and fire hydrants (12). It is noted that the sensitive facilities were identified based on the area tentatively set within a 200-meter distance from both left and right banks of the river, in order to see an impact of the project in a range wider than the project affected area. Therefore, the identified sensitive facilities are considered as potential sensitive facilities.

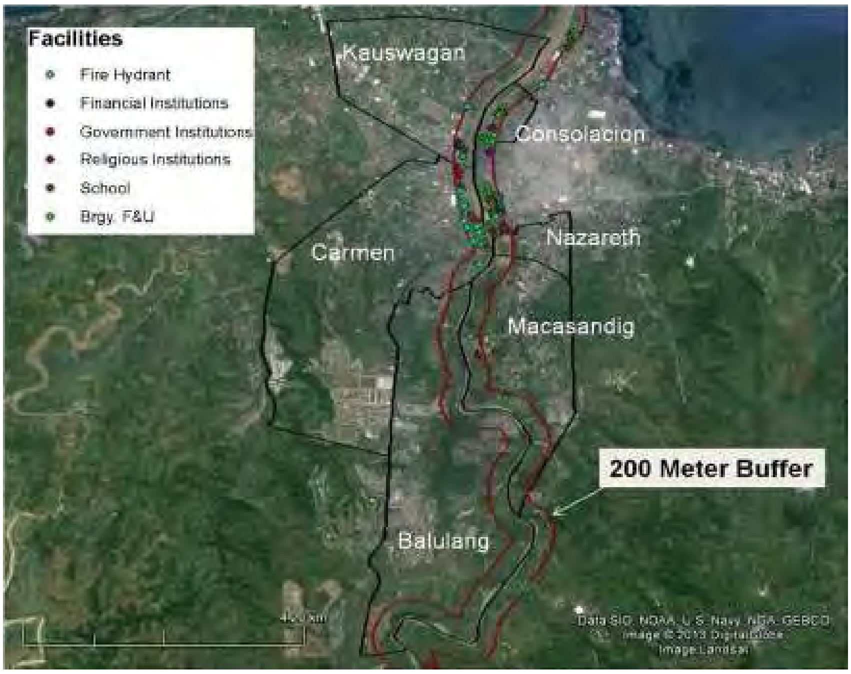


Figure 6.3.1 Location Map Showing Sensitive Facilities

Within a 200-meter distance area, there is an institution of cultural importance, which is called the Huluga Cave. The cave has the accession number (X-91-QW2) of the National Museum indicative of the historical and cultural importance of the site. The cave area is elevated with 2 levels. The upper level is a hill rising above the plateau which is below it. It contains two caves and also an open site termed as the Huluga Open Site located on the north side towards the plateau. The cave is located in a limestone cliff, above 100 feet from the ground. The 2 caves have small openings and lie adjacent to each other and differ in elevation. The cave on the north is about 2 meters high and 1.5 meters wide. Based on several secondary sources, the cave on the north has 3 chambers and the inside closing in as a result of limestone formation due to the increased water seepage from the top. Further, the cave on the north were presumed to be burial sites of the first settlements in the area because of human skeleton, potteries, Philippine Metal or Iron Age wares and body ornaments, evidences of human burial activities were unearthed in the area in 1970 by the National Museum. The open site on the other hand was believed to be the habitation site of the community.

Figure 6.3.2 Views of the Huluga Cave

The cave is located near the Pelaez Bridge about 11 kilometers upstream from the river mouth of the Cagayan de Oro River. As shown in the map below, the cave is located approximately 2.00 kilometer south from the end of the project structure in Barangay Balulang on the left bank of the Cagayan de Oro River. The elevation of the cave is approximately 60 meter. The open site with the accession number (X-91-QW2) of the National Museum was near the cave and is believed to be the early human settlement of the original Cagayanons because of many acheological found in the place. It was located west of about 300 meters from the Pelaez bridge. The open site was unfortunately destroyed by the road construction for the Pelaez Bridge in 2001, and its site was transformed into a quarry site in 2007.

Figure 6.3.3 Location Map of Huluga Cave

(2) Potential Impacts

Among the identified sensitive facilities, some facilities were identified located within the project affected areas where the area is identified either at high flood risk or inside the river boundary, according to the proposed alignment of flood control structures of the project at present. Such facilities are barangay halls, chapels and daycare centers located in local communities and need to be relocated, due to the land acquisition of the right-of-way required for the construction of flood control structures of the project and the necessity of transfer to a safe place in the protected area from the flood. Regarding the Huluga Cave, the location of the cave is about 2 kilometers away from the end of the proposed flood control structures of the project, and the elevation of the location is about 60 meters. The impact of the project on the cave is, therefore, not expected.

6.3.7 Misdistribution of Benefits and Damage / Local Conflicts of Interest

(1) Baseline Environment

The extent of impact of the project is not the same per barangay. The location of the flood mitigating structures designed to produce the optimum result of reducing flood risk level plus land area and population of each barangay along the Cagayan de Oro River brought about the difference in severity of adverse impacts. For instance, Barangay Consolacion has the most number of project affected people because a large part of land area of the barangay is beside the river and is densely populated.

(2) Potential Impacts

Provision of just compensation is mandated by law for all project affected people as well as other entitlements depending on eligibility. The amount of compensation is equitable and commensurate to the value of the assets lost, whether permanent or temporary. Loss of asset/s like land, structures, improvements, etc. is not limited to ownership but to use and access. Aside from monetary compensation, assistance in the form of skills training, job placements, and other livelihood programs will be provided to offset loss of income. Even programs to take care of the psychosocial well-being of the individual in a new environment will be given before and after project implementation.

6.3.8 Gender and Social Vulnerable Groups

(1) Baseline Environment

The socially vulnerable groups were identified through the socioeconomic survey conducted in the project area for the project. The number of household heads belonging to several socially vulnerable groups is shown in the table below.

Table 6.3.5 Socially Vulnerable Groups of Project Affected Household Heads

Vulnerability	Number	Percentage	Total Number of Project Affected Households	Percentage of Vulnerable Households to Total Number of Project Affected Households
Disabled	22	13.5		
Elderly	94	57.7		
Female-headed	35	21.5		
Indigenous People	1	0.6		
Solo Parent	10	6.1		
Child-headed	1	0.6		
Total	163	100.00%	1,087	15.00%

Of the total 1,087 project affected households, or 163 household heads or 15% are classified as socially vulnerable. Majority of the said households are headed by the elderly and women at 57.7% and 21.5% respectively. For these households, vulnerability signifies their inability to withstand, cope with, and recover from adverse impacts brought about by the project like involuntary resettlement. Vulnerable households are at a higher risk of falling into poverty or may be pushed below or even further down the poverty line and their standard of living may be worse-off after project implementation.

(2) Potential Impacts

The adverse impacts of the project on these households will be greater and more immediate considering their limited capacity or access to resources as compared to those without vulnerability. Special attention must be given in form of added compensation or sustainable income generating programs appropriate for each group to counteract the disadvantages inherent to their vulnerable circumstances. Improvement more than restoration of living conditions and income must be taken into account when developing said programs. Gender sensitive approaches in creating and providing income opportunities ensure inclusion of both men and women although additional assistance and participation in the decision-making process may be designed for women especially for those who head households like further education, skills training, job placement, and access to capital.

6.3.9 Rights of Children

(1) Baseline Environment

The socioeconomic survey corroborates that project affected people includes numerous children as shown in the table below:

Table 6.3.6 Number of Children Among Project-Affected Persons

Age Range (in Year)	Number	Percentage	Total Number of Project Affected Persons (PAPs)	Percentage Children to Total Number of PAPs
0 - 6	698	34		
7 - 12	577	28		
13 - 16	380	19		
17 - 20	372	18		
Total	**2,027**	**100**	**4,849**	**42**

Children, from 0 to 20 years old, at 2,027 comprise 42% of the total number of project affected persons. This means that resettlement measures must take into account the rights and welfare of children. The rights of children include the right to education, and to live in a healthy and safe environment to support well-rounded development.

(2) Potential Impacts

Generally, relocation may provide children a safer and flood-free shelter but it may also disrupt schooling and affect their psycho-social well-being since they will be uprooted from a community they are accustomed with to a new and unfamiliar environment. The proposed relocation sites identified in RAP will have decent housing with basic utilities and facilities before the project affected people can move in. There are also schools and health centers in the host communities that can accommodate the needs of the new residents. Open spaces for play and recreation aside from programs to help children adjust to the new environment contribute to their overall growth. Making these facilities and programs available and accessible to children lessens the drawback of the lack of education and skills as root cause of few economic opportunities in the future. The creation and implementation of these have to be done at the pre and post project stages to prepare and let the children resume normal lives and eventually become productive individuals.

6.3.10 Infectious Disease Such As HIV/AIDS

(1) Baseline Environment

In January 2013, the HIV/AIDS Registry of the Department of Health has reported 380 newly diagnosed HIV cases in the Philippines of which 1% was registered from Northern Mindanao. The greater part of these cases came from NCR (48%), Region IVA (15%), Region 3 (9%), Region XI (8%) and Region VII (6%). Since 1984, the total reported HIV cases in the country have reached 12,082. The Philippines has been known as a low-prevalent country in so far as HIV/AIDS is concerned, however, comparing the same period for the past three years indicates an alarming increase in the figures.

Table 6.3.7 Number of New HIV Cases in January

January	No. of New HIV Cases	Increase
2011	152	-
2012	212	39%

Table 6.3.7 Number of New HIV Cases in January

January	No. of New HIV Cases	Increase
2013	380	79%

In particular, the table below shows the incidence of HIV in the Cagayan de Oro City from 2008 to 2012.

Table 6.3.8 HIV Cases in CDO

Year	No. of New HIV Cases	Increase
2008	6	-
2009	9	33%
2010	14	36%
2011	27	48%
2012	52	48%

Based on DOH records, there were also 25 new cases of AIDS reported in January 2013 of which five are from Northern Mindanao. Region X has recorded at least 102 AIDS cases from 1991 until 2013. The breakdown of these cases is as follows: Misamis Oriental including Cagayan de Oro City (60); Lanao del Norte including Iligan City (19); Misamis Occidental including Ozamiz City (14); Bukidnon (7) and Camiguin (2). The cumulative number of AIDS cases in the Philippines is 1,194; recorded from1984 until 2013.

Table 6.3.9. Prevalence of STI in the Cagayan de Oro City in 2009

Infection / Disease	(%)
Gonorrhea	3.4
Non-gonorrheal Infection	1.15
Bacterial Vaginosis	0.5
Genital Wart	0.15
Trichomoniasis	0.7
Herpes Infection	0.06
Candidiasis	2.7

The prevalence rate of Sexually Transmitted Infections (STI) in 2011 data was 8.66.

Given this situation, collaborative efforts among the related government agencies (e.g. DOH, DSWD, DILG), civil society (e.g. ALAGAD or Alliance Against AIDS, MOCAN or Misamis Oriental-CDO AIDS Network) and the local government unit (e.g. City Health office, City Social Welfare and Development Office, barangay officials) are being undertaken not only on HIV/AIDS and STI prevention and control but also on lessening its impact at the individual, family and community level.

(2) Potential Impacts

Among those who are likely to be at risk for contracting HIV/AIDS and STI are the persons who usually travel away from home to work in unfamiliar places that include the construction workers. Being far from their homes and families and oftentimes young, they tend to be more risky in their behavior, thus enhancing the possibility of either being exposed to or being the ones to introduce HIV/AIDS and STI to the community. Immigrant laborers should be required to undergo check-ups to ensure that they are not introducing other diseases to the community, like STI. In addition, the Company or Contractor that hires them should offer a range of HIV/AIDS and STI prevention and care interventions or facilitate the access of its workers for such services (e.g. peer counseling, voluntary HIV testing and counseling, treatment of STI).

6.3.11 Landscape

(1) Baseline Environment

At present, there are some existing dikes and floodwalls along the Cagayan de Oro River, but provided only for limited portions. Further, the height of the existing dikes and floodwalls are observed not so high, due to the estimated design standard of the flood returning period of about 5 to 10 years. Along river banks of the Cagayan de Oro River, concentration of residential houses, commercial facilities and institutional facilities are observed, due to the river passing through the central part of the city, the majority of which are residential houses and some of which are commercial facilities such as local hotels and restaurants and institutional facilities such as schools. Considering the low height of the existing dikes and floodwalls and located at limited portions of the river, scenery along the river seems not to be impaired.

(2) Potential Impacts

There may be a possibility of alteration of scenery due to the construction of flood control structures of the project such as dikes and floodwalls. Due to the applied design standard of flood returning period of 25 years, the height of dikes and floodwalls are most likely higher than the existing dikes and floodwalls, assuming to be about 3 to 5 meter. Further, construction of continuous dikes and floodwalls is proposed and, its impact on scenery along the river may possibly be observed.

6.3.12 Labor Environment

(1) Baseline Environment

The socioeconomic survey results showed that of the 4,743 project-affected persons, there are 1,734 who are self-employed or employed mainly in trading and service related industries as indicated in the table below. Although mainly comprised of men (1,084 or 63%), there are also women (650 or 37%) who are involved in income-generating activities. The bulk (80%) of the PAPs is involved in occupation that would just have minimal requirements (e.g. basic skills, at least high school education) to be employed but which could only provide minimum income. Minimum wage rate for Cagayan de Oro City is P306 for non-agriculture and P294 for non-agriculture as of June 2013 (Source: DOLE).

Table 6.3.10 Main Occupation of Project-Affected Persons Who are Self-Employed or Employed

Occupation	Men	Women	Total	%
Business/self-employed	135	215	350	20
Labourers and unskilled workers	226	114	340	20
Service workers	239	50	289	17
Shop and market sales workers	62	85	147	8
Other trades and related workers	104	31	135	8
Construction workers	121	2	123	7

Table 6.3.10 Main Occupation of Project-Affected Persons Who are Self-Employed or Employed

Occupation	Men	Women	Total	%
Professionals	42	64	106	6
Clerks	28	38	66	4
Technicians and associate professionals	30	11	41	2
LGU officials & employees	20	13	33	2
Employees & staff of government line agencies	16	10	26	1
Government/private officials, managers	19	6	25	1
Farm workers & fishers	16	3	19	1
Entertainment & recreation workers	13	5	18	1
Special occupation	13	3	16	1
Total	1,084	650	1,734	100
%	63	37	100	

Given this situation, the existing skills of most of the employables (15 years old and above) are not highly specialized as shown in the table below. A significant number (20%) has no skill at all. There are 3,260 employables out of the total 4,743 project-affected persons; of which 1,766 (54%) are men and 1,494 (46%) are women.

Table 6.3.11 Existing Skills of Employable Project Affected Persons

Type of Skill	Men	Women	Total	%
Commercial cooking	253	496	749	23
Driving	274	58	332	10
PC operations	108	84	192	6
Entrepreneurship/marketing, sales	93	96	189	6
Carpentry	128	20	148	5
Performing arts	42	59	101	3
Household services	17	55	72	2
Electrical installation and maintenance	61	9	70	2
Tailoring	22	43	65	2
Drawing,/painting/arts	36	19	55	2
Beauty care/grooming	26	37	63	2
Welding	35	11	46	1
Masonry	37	7	44	1
Auto servicing	23	13	36	1
Construction painting	27	6	33	1
Other construction related skills	24	7	31	1
Crop production	20	9	29	1
Dressmaking	9	18	27	1
Auto body repairing	19	7	26	1
Secretarial skills	13	9	22	1
Consumer electronics servicing	20	1	21	1
Computer hardware servicing	13	6	19	1
Others	106	76	182	6
No skills	360	348	708	22
TOTAL	1,766	1494	3,260	100
%	54	46	100	-

Although limited in number, there are women in the project affected area who are now trained in areas of work that have been generally associated with men such as auto servicing, welding as well as construction related activities.

(2) Potential Impacts

Relocating to areas far from their economic base is seen as more costly in terms of transportation cost. Those who are drawing their income from the river as sand miners and boat operators will likewise be displaced. There are also around 140 households with business at residence (mostly sari-sari stores) that would be affected if the project would be implemented. They would have to be assisted to continue their business or find alternative means to earn an income after resettlement.

The PAPs can be the priority source of labor force during construction in agreement with the contractor by DPWH since there are residents who are already employed or are skilled in construction related trades. The increased employment opportunities should benefit the affected communities first. The employment of qualified PAPs and other local residents during the construction phase should be given priority over migrant labor. As much as possible, the latter should be limited to specialized skills not available in the area. Although the priority source for labor force will be the local residents, there may be a need to bring in outside labor force which will need housing in specially constructed suitable camps and provided with safe and healthy work environment. When earth-moving activities are undertaken, the workers must be outfitted with the standard safety gears as required by law and oriented on the standard safety and emergency measure that will be implemented. The safety gears and orientation of workers should ensure minimization and/or prevention of accidents caused by moving machines and altered terrain. The General and Special Conditions of Contract as well as the Technical Specifications are part and parcel of the Construction Contract. In these documents, provisions for the safety of the public and the workers within the construction Zone should be stipulated.

CHAPTER 7 IMPACT ASSESSMENT

7.1 Comparison of Scoping and Impact Assessment based on Survey Results

Based on the survey on baseline environmental conditions, impact prediction as well as the mitigation measures to be incorporated in the project described in Chap. 7, the environmental and social impacts of the project are evaluated as listed in the table below.

Table 7.1.1 Comparison of Scoping and Impact Assessment based on Survey Results

Environmental components			Assessment at scoping		Assessment based on survey results		Explanations for the evaluation
			Period I and II	Period III	Period I and II	Period III	
Physical-Chemical Environment (Pollution)	1	Air Pollution	B-	D	B-	D	[Construction] Air pollution due to dust and emission gas by earth works and operation of construction equipment and vehicles will occur. These impacts are inevitable to some extent as long as construction works are implemented. [Operation] No air pollution which is attributed to the project components will occur because the project facilities are not pollution source.
	2	Water Pollution	B-	C-	B-	C-	[Construction] Suspension of sediments and release of sediment pollutants will occur as a result of excavation/dredging in the river. Waste water from contractor base camp and/or office would also cause water pollution in the river unless an appropriate measure is provided. [Operation] Flood mitigation structures of the Project will not alter existing river system and there will be no impact on water quality. But the water volume with high turbid water would increase during flooding, by which the turbid flood water would reach further in the sea if comparing the same scale of floods. But the possibility and magnitude of this impact are not always clarified.
	3	Soil Contamination	C-	D	C-	C-	[Construction] Survey results of the riverbed sediment quality indicate that the riverbed sediment is non-hazardous materials, and deemed not to cause contamination. But the data of riverbed sediment is limited, and the possibility of contamination is not completely denied. [Operation] Dredging work, if included as maintenance operation in operation phase, would cause the same situation above.
	4	Wastes (As for dredged materials, refer to No.3 Soil Contamination and No.8 Riverbed Sediment Contamination)	B-	C-	B-	D	[Construction] Wastes from the affected area due to the demolition of buildings and structures would be substantial although most of them can be re-used or recycled. Thus the impact of waste is evaluated as not minor. [Operation] Possibility of the increase of illegal waste dumping can be avoided by maintenance activity by the Proponent in collaboration with concerned LGUs and police.

	5	Noise and Vibration	B-	D	B-	C-	[Construction] Noise and vibration to be generated by construction activities such as piling works will cause public nuisance or impacts on existing buildings in the vicinity of construction activities. [Operation] In case of dredging work is included as maintenance operation, would cause noise when it is done along the river bank where there are settlement area.
	6	Ground Subsidence	D	D	D	D	No ground subsidence is anticipated during both construction and operation stage because pumping of groundwater, deep excavation work, or tunneling work is not included in the project activities.
	7	Offensive Odor	C-	C-	D	D	[Construction] Offensive odor during the dredging work will be minimal because the source of the odor accumulated in the river is not recognized based on the geological survey results. [Operation] Generation of offensive odor is not anticipated because the source of the odor accumulated in the river is not recognized as mentioned above.
	8	Riverbed Sediment Contamination	C-	C-	C-	C-	[Construction] Survey results of the riverbed sediment quality indicate that the riverbed sediment is non-hazardous materials, and deemed not to cause contamination. But the data of riverbed sediment is limited, and the possibility of contamination is not completely denied. [Operation] During maintenance dredging, if included during operation phase, the same situation would occur.
	9	Accidents	C-	D	D	D	[Construction] Accidents during the construction works can be avoided by ensuring safety measures following the Occupational Safety and Health Standards (OSHS) and Department of Labor and Employment (DOLE) Order No. 13. [Operation] Project components will not become a source of accidents.
Natural Environment	1	Topography and Geology	B-	D	B-	D	[Construction] Construction of structures (dike and floodwall) for river improvement with the average height of approx. 3.5 m and the length of approx.12km would cause the modification of topography. [Operation] There is no topographical or geological change.
	2	Soil Erosion	B-	D	B-	D	[Construction] Vegetation clearance will temporarily cause soil erosion over the cleared land. Embankment of earth for construction of dike and floodwall will cause soil erosion unless appropriate mitigation measures are provided. [Operation] The possibility of soil erosion is minimal because the vegetation-cleared land will be recovered by greening, and the constructed dike and floodwall will be protected by masonry.
	3	Groundwater	C-	C-	D	D	[Construction/ Operation] No pumping of groundwater, deep excavation work, or tunneling work is included in the Project. But the project includes piling works, which may cause obstruct the flow of shallow groundwater. As the survey results, the directions and groundwater flow and the alignment of sheet pile are the same or similar and thus the possibility to obstruct the shallow groundwater flow is minor.

	4	Hydrological Situation	D	A+	D	A+	Construction of dike and floodwall, which are the main project components of the Project, will increase the discharge capacity of the CDO River, and thus, which will mitigate the flood risks in the residential areas along the river.
	5	Coral Reef	C-	C-	D	D	[Construction] There is coral reef at about 400 m offshore of Barangay Bonbon and Bayabas, and the corals are 1.5 km westward from the river mouth of CDO River. The growing condition of the coral reef is not healthy but characterized by a lot of dead coral. The possibility of the impact of excavation/dredging activity is estimated to be minimal considering the distance between the river mouth and corals. [Operation] The river flow discharge during flooding will increase and the flood water will reach further in the sea if comparing the same scale of flood before and after the project implementation. But the possibility of the flood water to reach the corals is minor owing to the dominant tidal current from west to east in the Makajalar Bay, and thus the impact will be minor.
	6	Mangrove Forest	B-	C-	B-	D	[Construction] There are mangrove forests along the downstream reaches of the CDO River. It is necessary to cut some mangrove trees (estimated to be 0.69 ha of Nipa mangrove) in order to construct the structures of the Project as long as the permission of DENR is given. [Operation] The possibility of the impact on the mangrove forests can be avoided owing to the installation of drainage channel underneath the structure to be constructed in the project.
	7	Terrestrial Flora, Fauna and Biodiversity	B-	C-	B-	D	[Construction] Vegetation along the CDO River will be partially cleared for the construction of structures (dike and floodwall) of the project facilities or temporary facilities such as access road, construction yards or offices. The terrestrial flora and fauna, therefore, will be affected by the land vegetation clearance. The magnitude of the impact is predicted not to be significant considering the whole areas of forest and vegetation. [Operation] With greening and recovery of disturbance of the vegetation clearance, the residual impacts will be recovered in the operation phase.
	8	Aquatic Biota	B-	C-	B-	B-	[Construction] Excavation and dredging work in the river channel will cause impacts on aquatic biota, especially on macroinvertebrates because the removal of riverbed sediment will direct cause the disturbance of habitat. [Operation] Dredging work, if included as maintenance operation in operation phase, would cause the same situation above.
	9	Protected Area	D	D	D	D	There is no protected area in and around the presumed project area from river mouth of the CDO River until the Pelaez Bridge.

	10	Threatened species	C-	C-	B-	D	[Construction] Baseline survey of the plants and wildlife (terrestrial flora and fauna, aquatic biota and corals) revealed that there inhabit several threatened species in the survey area. The vegetation clearance would cause the alteration of habitat in the ROW and its vicinity, including the threatened species. But the direct impact of necessary of cutting individuals of threatened trees species or loss of threatened species can be avoided. [Operation] There is no possibility of the impact on threatened species because no clearance of vegetation is included.
	11	Meteorology	D	D	D	D	Not affected or least likely affected by the construction works or project components.
	12	Global Warming	－	D	D	D	Not affected or least likely affected by the construction works or project components.
Social Environment:	1	Involuntary Resettlement	A-	C-	A-	B-	[Pre-Construction/Construction] There will be a total of 1087 households of involuntary resettlement required by the project, consisting of 201 households as formal settlers and 886 households as informal settlers. Resettlement of the affected households needs to be completed before construction is commenced. During construction stage, there may have still an impact on restoration of livelihood of relocated households. [Operation] Even after construction is completed, status of livelihood restoration still needs to be monitored if necessary measures are to be provided.
	2	Poverty Group	C-	C-	B-	B-	[Pre-Construction/Construction/Operation] More than half, 56.15%, of project affected households are living below the poverty line. Additional measures aimed at improving standard of living need to be provided to project affected impoverished households before construction begins, with monitoring during operation.
	3	Indigenous Peoples	D	D	D	D	No indigenous peoples are observed along the river stretch of the downstream areas of CDO River.
	4	Local Economy such as Employment and Livelihood	C-	C-	B-	B-	[Pre-Construction/Construction] Some loss of income is expected among PAPs. 41% of all household members are with primary source of income, of which 7% are engaged in businesses. [Operation] In case maintenance dredging is deemed necessary, quarrying businesses operating in the river may also be affected.
	5	Land Use and Utilization of Local Resources	C-	C-	B-	B-	[Construction / Operation] The local residents and companies making living or doing business by utilization of the river such as quarrying or sand and gravel mining for producing construction materials may affect income or revenue of local residents or local companies, respectively, since access to the river and its use is limited by construction of flood control structures of the project and also regulated by concerned authorities, considering maintaining natural environment and hydrological requirements of the river.

	6	Water Usage	B-	B-	B-	B-	[Construction / Operation] Local residents living along the riverbanks may have difficulty getting access to the river and its use for daily living activities, due to construction of flood control structures such as dike and floodwall. The river water for portable use was not identified, since water supply system is well operated in the city.
	7	Existing Social Infrastructures and Services (Sensitive Facilities)	B	D	B-	B-	[Pre-Construction / Construction / Operation] There are some public and/or community facilities such as barangay facilities, health facilities, education facilities located within the project affected area and required to be relocated. Recovery and restoration of activities and operations may take some time even after construction of the project is completed.
	8	Social Institutions such as Social Infrastructure and Local Decision - making Institutions	D	D	D	D	This project aims at flood risk mitigation and alleviation, and the resolution to endorse the project was raised by City Development Council of the Cagayan de Oro City which is the competent entity to approve development projects in the city. Thus, it is expected that this project is supported by the local decision-making institutions.
	9	Misdistribution of Benefits and Damage	C-	D	B-	D	[Pre-Construction/Construction] Project impact differs among the affected barangays. Brgy. Consolacion has the most number of project affected people because a large part of land area of the barangay is beside the river and is densely populated.
	10	Local Conflicts of Interest	C-	D	B-	D	[Pre-Construction/Construction] Project impact differs among the affected barangays. Brgy. Consolacion has the most number of project affected people because a large part of land area of the barangay is beside the river and is densely populated.
	11	Cultural Heritage, Historical and Religious Sites (Sensitive Facilities)	C-	D	B-	B-	[Pre-Construction / Construction / Operation] There are some small community chapels located within the project affected and required to be relocated, while there are no cultural and historical sites found to be affected.
	12	Landscape	D	B-	B-	B-	[Construction / Operation] Construction of flood control structures such as dike and floodwall may cause impairment of scenery along riverbanks, depending on locations where different design and scale of structures are applied and constructed. Since these structures are permanent and continued dikes, impact of scenery may still be observed after construction is completed.
	13	Gender / Socially Vulnerable Groups	C-	C-	B-	B-	[Pre-Construction/ Construction] Of the total 1,087 project affected households, 163 households are classified as socially vulnerable. Majority of socially vulnerable households are headed by the elderly and women at 57.7% and 21.5% respectively. [Operation] Monitoring also needs to be conducted for any rehabilitation assistance targeting women and other socially vulnerable groups.
	14	Rights of Children	C-	D	B-	B-	[Pre-Construction/ Construction] 43% of project affected persons are aged 0 to 20 years old. Relocation may disrupt schooling for children and affect their psycho-social well-being. [Operation] Monitoring also needs to be conducted for any rehabilitation assistance targeting children.

	15	Infectious Diseases such as HIV/AIDS	C-	D	B-	B-	[Construction/Operation] Influx of construction workers would have a possibility of infectious disease brought to the site and in the city, since cases of HIV in the Cagayan de Oro City was found only 6 in 2008, but already 52 in 2013, of which increase in 5 years needs to be considered.
	16	Labor Environment (Including Occupational Safety)	C-	D	B-	B-	[Pre-Construction / Construction / Operation] Displacement of PAPs earning their income within the vicinity and in the city needs to be considered, since the majority of PAPs is involved in occupation required the minimum requirements and provides minimum income. Labor environment of construction works is also considered, since the construction work of the project is in a certain scale and therefore needs consideration on safety and work environment.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Possibility of impact and its magnitude are unknown. (A further examination is needed, and the impact could be clarified as the study progresses.)
D: No impact is expected.
Period I: Pre-construction, Period II: Construction, Period III: Operation

Source: JICA Survey Team

7.2 Conclusion of Environmental Impact Assessment

7.2.1 Physical-Chemical Components (Pollution)

Among nine (9) components of pollution, there is no component of which potential impact is evaluated as A- (Significant positive/negative impact is expected.). Four (4) components are evaluated as B- based on the survey results, including 1) Air pollution, 2) Water pollution, 3) Wastes, and 4) Noise and vibration. As the same as the natural environment components, the impacts on these components are to be caused by the construction works.

As to soil contamination and riverbed sediment contamination, the impacts during construction phase are evaluated as C- (Possibility of impact and its magnitude are unknown. A further examination is needed, and the impact could be clarified as the study progresses.). This is because the potential impacts cannot be denied completely based on the limited data of riverbed sediment quality of this EIA Study. Impact on water quality during operation phase, Noise and vibration are also evaluated as C- because the possibility and magnitude of the impact are not always clarified. Regarding the other components, the potential impacts are evaluated as D (No impact is expected.) during both construction and operation phases.

7.2.2 Natural Environment

Among 12 components of natural environment, there is no component of which potential impact is evaluated as A- (Significant positive/negative impact is expected.). Six (6) components are evaluated as B- based on the survey results, including 1) Topography and geology, 2) Soil erosion, 3) Mangrove forest, 4) Terrestrial flora, fauna and biodiversity, 5) Aquatic biota, and 6) Threatened species. The impacts on these components are to be caused by the construction works as the same case as Physical-chemical environment (pollution).

Except for these components, the potential impacts are evaluated as D (No impact is expected.) during both construction and operation phases.

7.2.3 Social Environment

Among social environment elements, the most considerable impact induced by the project is the involuntary resettlement required under the project to relocate a total of 1087 households, of which 201 households are formal settlers and 886 households are informal settlers. However, it is specifically noted that these affected households are currently living in the hazard area within the river boundary where a flood risk level is very high and, therefore, relocated to a safe place by the project where these affected household can live well without a fear of flood hazards, which is based on a concept of the preventive resettlement. It is, further, noted that the involuntary resettlement is not considered as a single impact, but rather closely and widely related to other social environment elements such as impacts on poverty group, local economy, sensitive facilities, misdistribution of benefits and damage, local conflicts of interest, gender and socially vulnerable groups, rights of children and labor environment, all of which are related to impacts on either persons, communities or facilities affected by the project. Therefore, comprehensive approaches to mitigate these social environment impacts are recommended to be prepared, one of which is the Resettlement Action Plan (RAP) prepared for the project to provide a policy and a plan for the mitigation measures related to the said social environment elements in terms of procedures and activities of the implementation of RAP such as eligibility and compensation, livelihood assistance, resettlement sites, monitoring.

Aside from the involuntary resettlement, there are some social environment elements which are effects of the construction of flood control structures of the project on local residents and communities, particularly for those located along the river. These effects are the use of the river and also the utilization of resources in the river by local residents and communities, both of which are concerned with impacts on access to the river for using the river and its water for daily living activities by local residents and also for utilizing the resources of the river for producing construction materials by quarrying and sand and gravel mining as an opportunity for livelihood of local residents or business of local companies. While construction of flood control structures of the project is necessary to mitigate flood risk of the river, mitigation measures such as a user-friendly design of structures to provide certain access to local residents for daily living activities and also regulated operations of quarrying and sand mining by concerned authorities, for example, can still be sought and provided.

CHAPTER 8 ENVIRONMENTAL MANAGEMENT PLAN

8.1 Physical-Chemical Environment

Environmental impacts and mitigation measures for physical-chemical environment components are described in Environmental Management Plan (Table 8.1.1)

Table 8.1.1 Environmental Management Plan for Potential Impacts on Physical-Chemical Environment

Environmental Component / Project Phase	Potential Impact	Mitigation Measures / Perspective on Impact Mitigation	Implementation organization / Responsible (supervisory) organization	Cost
1. Air Quality				
(1) Construction	Air pollution by dust due to earth works for embankment and excavation, etc.	• Excavation materials must be properly stockpiled and properly disposed of immediately from the construction site when not needed. • Provision of covers to stockpiles that will be left idle for a long time, • Dust generation will be mitigated with watering at dusty place during dry season and covering the load of trucks by tarpaulin, • Periodical and timely cleaning of the spilled materials on road or other public space along the transportation route of construction materials and spoil materials	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and DENR	Included in the construction cost
	Air pollution by emission gas due to the operation of construction equipment and vehicles	• Regular maintenance of heavy equipment and vehicles, • Consideration of operation manner of the equipment due to the regular education to the operators.	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and DENR	Included in the construction cost
2. Water Quality				
(1) Construction	Water pollution of the river water due to earth works near the river bank, excavation and dredging works in the river	• To avoid the construction works during rainy season or rainy day as much as possible, • Installation of temporary embankment and drainage at the boundary of periphery of project site, • Installation of sedimentation pond at appropriate location to avoid the turbid water discharge for settlement the laden with soil particles, • Selection of less agitation method of dredging and its proper implementation.	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and DENR	Included in the construction cost
	Water pollution by waste water (effluent and used oil)	• To ensure not to directly drain the waste water from construction yard and offices to the river,	Implementation organization: Contractor,	Included in the construction cost

Environmental Component / Project Phase	Potential Impact	Mitigation Measures / Perspective on Impact Mitigation	Implementation organization / Responsible (supervisory) organization	Cost
	from construction yards and offices, and accidental oil spill	• Waste water is to be properly treated and disposed using septic tank or other appropriate treatment method • Provision of portable toilet (portalet) for the workers at the construction work sites. • To ensure not to cause accidental oil spill and other chemicals. • Hazardous wastes shall be strictly controlled based on RA 6969.	Responsible (supervisory) organization: Proponent and Consultant	
(2) Operation	Water pollution by alteration of hydrological regime	• There is no practical mitigation measure to avoid the hydrological change during flooding because it is inevitable as long as the project is implemented. • Monitoring of sea water quality in the river mouth and Macajalar Bay, can detect the impacts and is recommended to conduct during operation phase.	Implementation organization: Proponent DPWH) Responsible (supervisory) organization: DENR	Included in the operation and maintenance cost
3. Soil Contamination				
(1) Pre-construction, construction and operation	Soil contamination at the dumping site by dumping of excavated / dredged materials	Mitigation measures: • Confirmation of riverbed sediment quality through sediment quality analysis by creasing the sampling points during the Detail Design stage for further clarification of the possibility of soil contamination.	Implementation organization: Contractor, Proponent and Consultant/ Responsible (supervisory) organization: DENR	Included in the Detail Design Study, construction cost as well as operation and maintenance cost
4. Waste (As for dredged materials, mitigation measures are described in No. 3 Soil Contamination or No. 8. Riverbed Sediment Contamination)				
(1) Construction	Waste generation associated with demolition of buildings and structures in the affected areas (ROW and river area)	• Reduction of wastes generation by segregation, re-use and recycle of the materials used in the demolished buildings and structures in the affected areas. • Reduction of wastes can be facilitated through the auction, selling to recycler and/or junkshop. • Appropriate treatment and disposal of the wastes from demolished structures by delegating to the accredited waste contractor.	Implementation organization: Contractor / Responsible (supervisory) organization: Proponent and Consultant, and CLENRO, CDO City, Concerned LGUS	Included in the construction cost

Environmental Component / Project Phase	Potential Impact	Mitigation Measures / Perspective on Impact Mitigation	Implementation organization / Responsible (supervisory) organization	Cost
	Waste generation from vegetation clearance (cutting trees glowing in ROW)	• To minimize the area of vegetation clearance by consideration of construction methodology such as: - providing a temporary fencing to vegetation for limiting land clearing as much as possible, - Using markers and fences to direct heavy equipment in the construction site for minimizing the damage to trees/ vegetation - Affected trees should be transferred to other sites or nearby areas as much as possible. • Burning or incineration of wastes is strictly prohibited by RA 9003. Instead, to reduce the wastes from the cut trees, in the form of twigs, leaves and roots, etc. composting is to be utilized.	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, CENRO, DENR, Concerned LGUs	Included in the construction cost
	Waste generation from the construction works, construction yards, offices, and accommodation facility, it any.	• Reduction of wastes generation by continuous efforts of segregation, re-use and recycle of the residual construction materials. • Construction wastes cannot be collected and transported through City's waste disposal system done by CLENRO, CDO City and accordingly the collection, collection, transportation and disposal shall be based on the MOA among the Proponent, CDO City and the Construction Contractor. • Excavated / dredged materials from the CDO River shall be disposed in the disposal area, which is to be developed for this Project or existing one. • In case to develop a new disposal area, it is necessary to acquire a permission including ECC before the construction works in timely manner based on the requirement of PEISS and instruction of the authority (DENR EMB 10). • Oil or some chemicals including paint and solvent containers, in case of used and generated, are to be	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, CLENRO, CDO city, Concerned LGUs	Included in the construction cost

Environmental Component / Project Phase	Potential Impact	Mitigation Measures / Perspective on Impact Mitigation	Implementation organization / Responsible (supervisory) organization	Cost
		temporarily stocked under strictly managed. • The used oil and chemical wastes are to be treated based on the accredited waste contractor and appropriately re-used or disposed pursuant to Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990/Republic Act 6969 (RA 6969) and its IRR, DAO 92-29.		
5. Noise and vibration				
(1) Construction and operation	Noise and vibration during construction works due to operation of heavy equipment and vehicles	• Good maintenance of dump trucks other vehicles and heavy equipment, • Education of drivers and operators to observe and respect driving and operation manners, • Regular communication with local residents about the methodology and implementation schedule of construction works, • Adjustments in the operation time of heavy equipment and dump trucks, transportation route, transportation method (by land or river), etc. • Installation of sound abatement wall during construction work in the vicinity of residents and sensitive facilities such as schools or settlement areas, if necessary. • Installation of temporary trench between the vibration source (civil work) and residential area and sensitive facilities, if necessary. • Request of temporary relocation during the anticipated period of critical noise and vibration, if necessary. • Survey of structures and existing cracks of residents in the vicinity of civil works which are anticipated to cause critical vibration prior to the civil works, which is the basis for the compensation when necessary	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and DENR	Included in the construction cost as well as operation and maintenance cost
6. Riverbed Sediment Contamination				

Environmental Component / Project Phase	Potential Impact	Mitigation Measures / Perspective on Impact Mitigation	Implementation organization / Responsible (supervisory) organization	Cost
(1) Construction and operation	Riverbed sediment contamination associated with excavation and dredging	• Adoption of less agitating type of dredging, such as pumping dredger, to minimize the re-suspension of sediments during dredging work • Installation of silt curtain for enhancing the entrapment mechanism to minimize diffusion of turbid water during the dredging work.	Implementation organization: Contractor during operation phase, Responsible (supervisory) organization: The Proponent and DENR	Included in the construction cost as well as operation cost and maintenance cost
7 Traffic				
(1) Construction	Traffic congestion and accidents at the transportation routes and the roads near the construction sites	• The Project Proponent and the Construction Contractor may coordinate with the concerned LGU for assistance in land and traffic management, • Appropriate route selection for transportation including establishment of temporary road for construction works, • Education of drivers and operators to observe and respect driving and operation manners, • Regular communication with local residents about the methodology and implementation schedule of construction works, • Adjustments in the operation time of heavy equipment and dump trucks, transportation route, transportation method (by land or river), etc. • Placement of traffic control persons depending on the situation, • Provide on-site medical services and supplies for any emergency, through institutional and administrative arrangements with the barangay health unit.	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and concerned LGUs	Included in the construction cost
	Obstruction of existing river traffic including the economic activities and increase of accidents	• Consultation with concerned LGUs, fisherfolk association, individual fisherman, and sand miners in the CDO River, etc. prior to dredging work and hauling activity of the FRIMP-CDOR. • Establishment of appropriate procedural manual for river transportation by consulting with the Philippine Coast	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and Philippine Coast Guard (PCG), concerned LGUs	Included in the construction cost as well as operation and maintenance cost

Environmental Component / Project Phase	Potential Impact	Mitigation Measures / Perspective on Impact Mitigation	Implementation organization / Responsible (supervisory) organization	Cost
		Guard (PCG), LGUs, and/or other concerned agencies. • Education of construction workers / verge operators to be used for construction works on proper operation.		

8.2 Natural Environment

Environmental impacts and mitigation measures for natural environment components are described in Environmental Management Plan (Table 8.2.1).

Table 8.2.1 Environmental Management Plan for Potential Impacts on Natural Environment

Environmental Component / Project Phase	Potential Impact	Mitigation Measures / Perspective on Impact Mitigation	Implementation organization / Responsible (supervisory) organization	Cost
1. Topography, Geology and Soil Erosion				
(1) Construction	Topographic modification and soil erosion due to vegetation clearance and vegetation clearance, embankment and other earth works	• To minimize the area of vegetation clearance by consideration of construction methodology, • Providing a temporary fencing to vegetation that will be retained for limiting land clearing as much as possible, • To enhance the general environment of the Project Site, greening of its vicinity may be implemented • To avoid the construction works during rainy season or rainy day as much as possible, • To conduct careful grading and clearing of the site for minimizing slope, and greening after grading/ clearing of the site, • Installation of temporary dike and drainage at the boundary of periphery of project site. • Use of silt fences on all disturbed areas to minimize erosion and siltation into adjacent streams, rivers, or bodies of water.	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant	Included in the construction cost
2. Coral Reef				
(1) Construction	Siltation on existing corals due to operation of excavation / dredging	Impacts on corals are predicted as minimal but the following measures should be provided for ensuring to minimize the potential impacts: • Installation of silt curtain for enhancing the entrapment mechanism during the dredging work, • As for the dredging works, adoption of less agitating type of dredging, such as pumping dredger, to minimize the re-suspension of sediments during dredging works, • Installation of sedimentation pond at appropriate location to avoid the turbid water discharge into the river by settlement the laden with soil particles,	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, DENR	Included in the construction cost

Environmental Component / Project Phase	Potential Impact	Mitigation Measures / Perspective on Impact Mitigation	Implementation organization / Responsible (supervisory) organization	Cost
		• Installation of temporary embankment and drainage at the boundary of periphery of project site		
3. Mangrove Forests				
(1) Pre-construction	Clearance of mangrove trees in the ROW of the Project	• Basically, clearance of mangrove forests compensation for it has to be treated pursuant to the following legal basis: - RA 7161 (An Act incorporating certain sections of the National Internal Revenue Code) - RA 8550 (Fisheries Code) - PD 705 (Revised Forestry Code) • Consultation with CENRO, DENR R-10 for site inspection by the authority upon the letter to intent to be issued the Proponent. • Based on the site inspection results, the request of mangrove clearance will be resolved to the DNER, Central Office for approval. • After the approval of the DENR, Central Office, the clearance of the mangrove forests are to be eventually permitted in the construction stage. • During the consultation for obtaining the permission of cutting mangrove forest, the necessary compensation including the replacement of the mangrove trees to be cut will be instructed by the authority, DENR Region 10 for the Project.	<u>Implementation organization:</u> Proponent and Consultant, <u>Supervisory organization:</u> CENRO, DENR	Included in the Detailed Design Study
(2) Construction	Clearance of mangrove trees in the ROW of the Project	• To minimize the area of mangrove forest clearance by consideration of construction methodology, • Providing a temporary fencing to the mangrove forest that will be retained for limiting land clearing as much as possible, • Using markers and fences to direct heavy equipment in	<u>Implementation organization:</u> Contractor, <u>Responsible (supervisory) organization:</u> Proponent and Consultant, CENRO, DENR	Included in the construction cost

Environmental Component / Project Phase	Potential Impact	Mitigation Measures / Perspective on Impact Mitigation	Implementation organization / Responsible (supervisory) organization	Cost
		the construction site and minimize damage to mangrove trees.		
4. Terrestrial Flora, Fauna and Biodiversity				
(1) Construction	Loss of vegetation cover and change of habitat of wildlife	• Compliance with the conditions stipulated in the permits/clearances (e.g. ECC, Tree Cutting Permit, Excavation Permit, etc.) issued for the Project, • Providing a temporary fencing to vegetation that will be retained and not to give trauma physically by inflicting injuries to vegetative parts, • Limiting land and vegetation clearance as much as possible by considering the construction method, • To enhance the general environment of the project site, greening of its vicinity shall be implemented, • Appropriate plant species for greening and compensation should be planted by consulting CENRO, DENR 10, • Hunting of animals near or within the project sites shall be avoided and enforced with the personnel staying in the Project Site. Signs could be established to provide information for personnel or even community living the area. • Construction activities during night time should be minimized to avoid artificial lighting and noise disturbances.	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, DENR	Included in the construction cost
	Physical damage to vegetation due to operation of heavy equipment and dust coverage on leaves of trees	• Using markers and fences to direct heavy equipment in the construction site and minimize damage to trees/vegetation • Fencing of important species of plants such as those considered threatened (i.e . Molave and Narra species (refer to Chap. 7.2.6)) or with high economic value in considerable size or length away from direct disturbance of construction equipment.	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, DENR	Included in the construction cost

Environmental Component / Project Phase	Potential Impact	Mitigation Measures / Perspective on Impact Mitigation	Implementation organization / Responsible (supervisory) organization	Cost
		• In case that the tree leaves are heavily covered by dust around the construction sites, especially reclamation work sites, watering shall on the trees shall be done.		
5. Aquatic Biota				
(1) Construction and operation	Disturbance of habitat of aquatic biota, especially of macroinvertebrates	• Sediment intrusion shall be reduced through the use of adequate and efficient filtration devices laid in critical point areas to prevent sediment plumes from reaching coral colonies. • Installation of silt curtains and screens in front of the project's outfall areas during construction period and the adoption of measures within the project complex itself that are aimed at preventing spillage of construction materials and wastes, • Proper stockpiling of spoils during earthmoving and construction works to avoid discharging into the river.	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, DENR	Included in the construction cost as well as operation and maintenance cost
6. Threatened Species				
(1) Construction	Habitat disturbance of threatened species due to clearance of vegetation and alteration of land	Mitigation measures for threatened species are the same as those described above, including the following: • Minimal clearing of vegetation/ wildlife habitat to decrease disturbance to wildlife • Hunting of animals near the or within projects sites is strictly prohibited and enforced with the personnel staying in the Project Site. • Activities during night time should be minimized to avoid artificial lighting and noise disturbances. • Fencing of important species of plants such as Molave and Narra species in considerable size or length away from direct disturbance of construction equipment. • adoption of less agitating type of dredging, such as pumping dredger, to minimize the re-suspension of sediments during dredging works,	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, DENR	Included in the construction cost

Environmental Component / Project Phase	**Potential Impact**	**Mitigation Measures / Perspective on Impact Mitigation**	**Implementation organization / Responsible (supervisory) organization**	**Cost**
		• Installation of sedimentation pond at appropriate location to avoid the turbid water discharge into the river by settlement the laden with soil particles.		

8.3 Social Environment

Environmental impacts and mitigation measures for social environment components are described in Environmental Management Plan (Table 8.3.1).

Table 8.3.1 Environmental Management Plan for Potential Impacts on Social Environment

Environmental Component / Project Phase	Impact	Mitigation Measures	Responsible Organization	Implementation Organization	Cost
2. Poverty Group					
(1) Pre-Construction					
	Increased vulnerability of impoverished PAPs to disruptive impacts of project implementation	Mitigation measures: • Provision of additional income and livelihood measures specifically targeting poor households affected by the project. Measures include skills training, job placement, and access to capital. • Offer mental health and psychosocial support services.	LGU-CDO	LGU-CDO NHA DSWD DOLE DTI RIC	To be determined
(2) Construction					
	Increased vulnerability of impoverished PAPs to disruptive impacts of project implementation	Mitigation measures: • Provision of additional income and livelihood measures specifically targeting poor households affected by the project. Measures include skills training, job placement, and access to capital. • Offer mental health and psychosocial support services.	LGU-CDO	LGU-CDO NHA DSWD DOLE DTI RIC	To be determined
(3) Operation					
	Increased vulnerability of impoverished PAPs to disruptive impacts of project implementation	Mitigation measures: • Regular monitoring of poor project affected households' standard of living by line agency and local government unit.	LGU-CDO	LGU-CDO NHA DSWD DOLE DTI RIC	To be determined
3. Local Economy					
(1) Pre-Construction					
	Loss of business in the local communities	Mitigation measures: • Provide PAPs whose business was affected with assistance	LGU-CDO	LGU-CDO NHA	To be determined

Environmental Component / Project Phase	Impact	Mitigation Measures	Responsible Organization	Implementation Organization	Cost
		measures to restore their business and its income and employment including opportunities to restore their business nearby the project affected area and contribute to business restoration in local communities.		DSWD DOLE DTI RIC	
(2) Construction					
	Loss of business in the local communities	<u>Mitigation measures:</u> • Implement and monitor measures to restore local economy through providing assistance to affected local business.	LGU-CDO	LGU-CDO NHA DSWD DOLE DTI RIC	To be determined
(3) Operation					
	Loss of business in the local communities	<u>Mitigation measures:</u> • Further implement and monitor measures to restore local economy through providing assistance to affected local business, since restoration may still take time after construction is completed.	LGU-CDO	LGU-CDO NHA DSWD DOLE DTI RIC	To be determined
4. Water Use					
(2) Construction					
	No access and/or difficulty accessing to the river and its use	<u>Mitigation measures:</u> • If a user friendly design or usability is agreed to be made to structures, such as dike and floodwall, for providing access to the river, river area and the river water for local residents, status of portions of dike and floodwall where access is made shall be regularly monitored and repaired if necessary, in order to maintain designed quality and functions of structures.	DPWH	DPWH DENR LGU-CDO	To be determined

Environmental Component / Project Phase	Impact	Mitigation Measures	Responsible Organization	Implementation Organization	Cost
(3) Operation					
	No access and/or difficulty accessing to the river and its use	Mitigation measures: • Status of portions of dike and floodwall where access is made shall be regularly monitored and repaired if necessary, in order to maintain designed quality and functions of structures.	DPWH	DPWH DENR LGU-CDO	To be determined
5. Land Use and Utilization of Local Resources					
(2) Construction					
	Limited utilization of resources of the river	Mitigation measures: • DPWH in coordination with DENR and LGU-CDO to jointly regulate and manage operations of quarrying and sand mining, such as permit, location of operations and so on, according to mandate of respective agencies, in terms of maintaining physical and hydrological conditions of the river.	DPWH	DPWH DENR LGU-CDO	To be determined
(3) Operation					
	Limited utilization of resources of the river	Mitigation measures: • Status of portions of dike and floodwall where access is made shall be regularly monitored and repaired if necessary, in order to maintain designed quality and functions of structures.	DPWH	DPWH DENR LGU-CDO	To be determined
6. Social Infrastructure and Sensitive Facilities					
(1) Pre-Construction					
	Consideration of sensitive facilities nearby the construction site and/or relocation of sensitive facilities located in the project affected area.	Mitigation measures: • If sensitive facilities are not required to be relocated, but located near to construction site, construction plan and method shall be well prepared and carefully implemented so that sensitive facilities must not to be damaged. • Even though all possible measures to avoid relocation of sensitive facilities are sought, if sensitive facility is still	DPWH	LGU-CDO	To be determined

Environmental Component / Project Phase	Impact	Mitigation Measures	Responsible Organization	Implementation Organization	Cost
		considered needed to be relocated, appropriate consultation and coordination must be made among all concerned agencies and communities for further seeking possible measures not to relocate and if not, for seeking measures for proper relocation.			
(2) Construction					
	Consideration of sensitive facilities nearby the construction site and/or relocation of sensitive facilities located in the project affected area.	Mitigation measures: • For sensitive facilities which are not required to be relocated, but located nearby construction site, construction plan and method shall be well prepared and carefully implemented so that sensitive facilities must not to be damaged by construction work of the project.	DPWH	LGU-CDO	To be determined
(3) Operation					
	Consideration of sensitive facilities nearby the construction site and/or relocation of sensitive facilities located in the project affected area.	Mitigation measures: • Activities and operations of the sensitive facilities in the previous location before relocation may take time to be recovered and/or restored, so status of relocated facilities and its activities and operations must be monitored by a proponent agency and a local government unit, in order to assist in improving activities and operations.	DPWH	LGU-CDO	To be determined
7. Misdistribution of Benefits / Local Conflicts of Interest					
(1) Pre-Construction					
	Differing severity of adverse impacts, and unequal compensation among PAPs	Mitigation measures: • Provide all PAPs with just and equitable compensation and entitlements depending on eligibility as mandated by law, and as commensurate to value of assets lost. • Offset income loss with appropriate monetary compensation, assistance in the form of skills training, job placements, or other livelihood programs, as applicable.	DPWH	LGU-CDO NHA DSWD DOLE DTI RIC	To be determined

Environmental Component / Project Phase	Impact	Mitigation Measures	Responsible Organization	Implementation Organization	Cost
		• Disseminate grievance procedures to PAPs. • Offer mental health and psychosocial support services.			
(2) Construction					
	Differing severity of adverse impacts, and unequal compensation among PAPs	Mitigation measures: • Provide all PAPs with just and equitable compensation and entitlements depending on eligibility as mandated by law, and as commensurate to value of assets lost. • Offset income loss with appropriate monetary compensation, assistance in the form of skills training, job placements, or other livelihood programs, as applicable. • Disseminate grievance procedures to PAPs. • Offer mental health and psychosocial support services.	DPWH	LGU-CDO NHA DSWD DOLE DTI RIC	To be determined
8. Gender and Socially Vulnerable Groups					
(1) Pre-Construction					
	Vulnerable households at a higher risk of falling into poverty or becoming financially worse-off after project implementation.	Mitigation measures: • Provide added compensation or sustainable income generating programs appropriate for vulnerable groups to counteract the disadvantages inherent to their circumstances. • Ensure adequate access to services in the resettlement sites, including livelihood options, schools, health facilities, water supply, and transport to mitigate adverse effects of relocation for vulnerable groups. • Offer mental health and psychosocial support services.	LGU-CDO	LGU-CDO NHA DSWD DOLE DTI RIC	To be determined
(2) Construction					
	Vulnerable households at a higher risk of falling into poverty or becoming financially worse-off after project	Mitigation measures: • Provide added compensation or sustainable income generating programs appropriate for vulnerable groups to counteract the disadvantages inherent to their	LGU-CDO	LGU-CDO NHA DSWD DOLE	To be determined

Environmental Component / Project Phase	Impact	Mitigation Measures	Responsible Organization	Implementation Organization	Cost
	implementation.	circumstances. • Ensure adequate access to basic services in the resettlement sites, including schools, health facilities, water supply, and transport and livelihood options. • Offer mental health and psychosocial support services.		DTI RIC	
(3) Operation					
	Vulnerable households at a higher risk of falling into poverty or becoming financially worse-off after project implementation.	Mitigation measures: • Regular monitoring of relocated project affected vulnerable groups.	LGU-CDO	LGU-CDO NHA DSWD DOLE DTI RIC	To be determined
9. Rights of Children					
(1) Pre-Construction					
	Disruption of schooling and possible harm to children's well-being.	Mitigation measures: • Ensure decent housing and presence of fully functional basic utilities and facilities like schools and clinics before project-affected children are relocated. • Include open spaces for play and recreation in the relocation sites. • Offer mental health and psychosocial support services.	LGU-CDO	LGU-CDO NHA DSWD DOLE DTI RIC	To be determined
(2) Construction					
	Disruption of schooling and possible harm to children's well-being.	Mitigation measures: • Ensure decent housing with basic utilities and facilities like schools and clinics before project-affected children can move to relocation sites. • Include open spaces for play and recreation in the relocation sites. • Offer mental health and psychosocial support services.	LGU-CDO	LGU-CDO NHA DSWD DOLE DTI RIC	To be determined

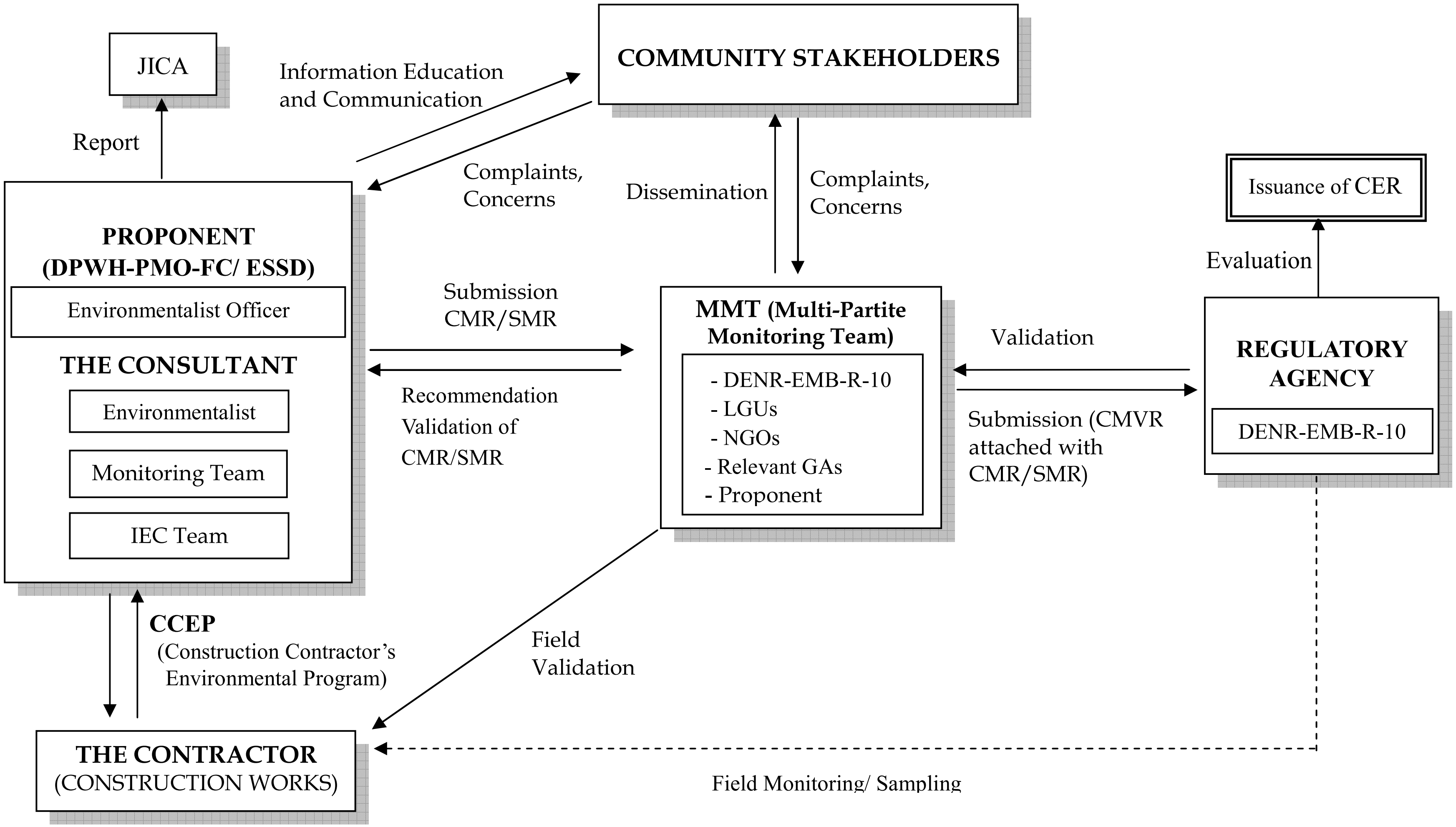
Environmental Component / Project Phase	Impact	Mitigation Measures	Responsible Organization	Implementation Organization	Cost
(3) Operation					
	Ppossible harm to children's well-being.	Mitigation measures: • Regular monitoring of children's standard of living in relocation sites.	LGU-CDO	LGU-CDO NHA DSWD DOLE DTI RIC	To be determined
10. Infectious diseases such as HIV/AIDS					
(2) Construction					
	Infectious disease of locally hired construction workers	Mitigation measures: • Immigrant workers to be hired should be cleared of any infectious disease. • Conduct of information and education program for construction personnel and workers on HIV/AIDS and STI. • Construction personnel and workers should be encouraged to undergo voluntary HIV testing and counseling. • Conduct of regular monitoring if these measures have been/being complied with by the Contractor.	DPWH	DOH DILG DSWD LGU-CDO, Concerned Organizations	To be determined
(3) Operation					
	Infectious disease of locally hired construction workers	Mitigation measures: • Intensified and sustained Information and Educational Campaign on HIV/AIDS and STI in the community. Availability of free voluntary HIV testing and counseling, STI diagnosis and treatment. • Diligent monitoring of new cases of HIV/AIDS and STI within the vicinity.	DPWH	DOH DILG DSWD LGU-CDO, Concerned Organizations	To be determined
11. Landscape					

Environmental Component / Project Phase	Impact	Mitigation Measures	Responsible Organization	Implementation Organization	Cost
(2) Construction					
	Impairment of scenery by flood control structures such as dike and floodwall	Mitigation measures: • Scenery of the river may be impaired by construction of flood control structures, but incorporation of water amenities and/or recreational functions and/or facilities into design of the project may necessary be arranged by DPWH and/or LGU-CDO, in order to ease feeling and/or impression of local residents and communities on impairment of scenery by construction of flood control structures.	DPWH	LGU-CDO	To be determined
(3) Operation					
	Impairment of scenery by flood control structures such as dike and floodwall	Mitigation measures: • Impairment of scenery by constructed flood control structures may still hinder local residents and communities, depending on design and scale of the constructed structures, so efforts to be made for improvement and utilization of water amenities and/or recreational functions and/or facilities may necessary be done by DPWH and/or LGU-CDO.	DPWH	LGU-CDO	To be determined
12. Labor Environment					
(1) Pre-Construction					
		Mitigation measures: • Job placement services for affected PAPs whose employment has been disrupted due to resettlement/who would be looking for work. • Conduct of appropriate training program to improve probability of employment • Qualified PAPs to be the priority for the hiring of manpower for the Construction Stage • Provision of financial and non-financial services for	LGU-CDO	LGU-CDO TESDA DOLE DTI TESDA Concerned Organizations	To be determined

Environmental Component / Project Phase	Impact	Mitigation Measures	Responsible Organization	Implementation Organization	Cost
		micro-business implementation			
(2) Construction					
		Mitigation measures: • Strict compliance of Contractor/s to prioritize hiring of qualified PAPs and other local residents. • Conduct of regular monitoring by DPWH to ensure compliance of Contractor/s on hiring of qualified PAPs and other local residents. • Conduct of training of qualified PAPs to enhance probability of hiring for this Stage. • Availability of financial and non-financial services to qualified PAPs to operate allied businesses.	LGU-CDO	LGU-CDO TESDA DOLE DTI TESDA Concerned Organizations	To be determined
(3) Operation					
		Mitigation measures: • Extension of job placement services. • Conduct of market-oriented training programs. • Provision of financial and non-financial services to micro entrepreneurs.	LGU-CDO	LGU-CDO TESDA DOLE DTI TESDA Concerned Organizations	To be determined

8.4 Organizational Chart for Implementation of Environmental Management and Monitoring

Expected organizational chart for implementation of environmental management and monitoring is shown in Figure 8.4.1.



CMR: Compliance Monitoring Report	CMVR: Compliance Monitoring and Validation Report
SMR: Self-Monitoring Report	CER: Compliance Evaluation Report

Figure 8.4.1 Organization Chart for Environmental Management and Monitoring for FRIMP-CDOR

CHAPTER 9 ENVIRONMENTAL MONITORING PLAN

9.1 Physical-Chemical Environment

Environmental monitoring plan for physical-chemical environment components are described in Environmental Monitoring Plan (Table 9.1.2). The following table summarizes the cost until the completion of construction work of the Project.

Table 9.1.1 Cost Estimate of Environmental Monitoring (physical-chemical environment components)

1	Remuneration	Months / Year	Years	Total	Unit		Unit Cost / Mon. (PHP)	Amount (PHP)
1.1	Team Leader / Environmental Engineer	1.0	4.5	4.5	M/M		150,000.00	675,000.00
1.2	Experts							
	a. Air quality expert	1.0	4.5	4.5	M/M		120,000.00	540,000.00
	b. Noise and vibration Expert	2.0	4.5	9.0	M/M		120,000.00	1,080,000.00
	c. Water Quality Expert	2.0	4.5	9.0	M/M		120,000.00	1,080,000.00
	d. Sediment quality Expert	2.0	4.5	9.0	M/M		120,000.00	1,080,000.00
	SUB-TOTAL (1)							**4,455,000.00**
2	**Direct Expenses**		**Total Years**		**Unit**		**Unit Cost /Year (PHP)**	**Amount (PHP)**
			4.5		**LS**		**500,000.00**	**2,250,000.00**
3	**Survey cost**	**Monitoring Times**				**Number of monitoring locations**	**Unit Cost / Time (PHP)**	**Amount (PHP)**
		Pre-construction	Construction	At completion	Total			
3.1	Air quality	1	24	1	26	4	45,000.00	4,680,000.00
3.2	Noise and vibration	1	24	1	26	8	40,000.00	8,320,000.00
3.3	Water quality 1 (Limited parameters, Bi-monthly)	1	24	1	26	4	30,000.00	3,120,000.00
3.4	Water quality 2 (Complete sets, Semi-annually)	1	8	1	10	4	40,000.00	1,600,000.00
3.5	Sediment quality	1	8	1	10	10	35,000.00	3,500,000.00
	SUB-TOTAL (2)							**21,220,000.00**
	SUB-TOTAL (3)							**27,925,000.00**
	VAT (Sub-total (1) * 12%)							534,600.00
	GRAND TOTAL							**28,459,600.00**

Source: JICA Survey Team

Table 9.1.2 Environmental Monitoring Plan for Physical-Chemical Environment

Environmental Component / Monitoring item	Methodology	Monitoring Locations	Monitoring Period / Frequency	Implementation organization / Responsible (supervisory) organization	Cost* (Direct survey cost)
1. Air Quality					
Dust (TSP), NO_2, SO_2	Sampling and laboratory analysis	Nearest receptor from the project site and sensitive facilities / 4 points	Pre-construction Phase: • Once immediately before the construction work Construction Phase: • Bi-monthly (once / 2 months) throughout the construction phase Operation Phase: • Once within 3 months after completion of construction work	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and DENR	Refer to Table 9.1.1.
2. Water Quality					
Temp. pH, DO, BOD, TSS, TDS, Oil and grease, Total Coliform, Fecal Coliform	Sampling and laboratory analysis	CDO River from the river mouth until Pelaez Bridge / 4 points	Construction Phase: • Bi-monthly (once / 2 months) throughout the construction phase	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and DENR	Refer to Table 9.1.1.
Temp. pH, DO, BOD, COD, TSS, TDS, Oil and grease, Nitrate, Phosphate, Total Coliform, Fecal Coliform, 7 parameters of heavy metals (Cupper (Cu), Chromium (Cr), Mercury (Hg), Lead (Pb), Cadmium (Cd), Cyanide (CN) and Arsenic (As)) and others, if necessary (to	Sampling and laboratory analysis	CDO River from the river mouth until Pelaez Bridge / 4 points	Pre-construction Phase: • Once immediately before the construction work Construction Phase: • Semi-annually (once / 6 months) throughout the construction phase Operation Phase: • Once within 3 months after completion of construction work	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and DENR	Refer to Table 9.1.1.

Environmental Component / Monitoring item	Methodology	Monitoring Locations	Monitoring Period / Frequency	Implementation organization / Responsible (supervisory) organization	Cost* (Direct survey cost)
be proposed by the Sub-contractor))					
3. Riverbed Sediment Quality					
7 parameters of heavy metals (Cupper (Cu), Chromium (Cr), Mercury (Hg), Lead (Pb), Cadmium (Cd), Cyanide (CN) and Arsenic (As))	Sampling and laboratory analysis	10 locations along the CDO River at the locations of excavation / dredging works are to be conducted.	Detailed Design Stage • Once during the D/D Stage Pre-construction Phase: • Once immediately before the construction work Construction Phase: • Semi-annually (once / 6 months) throughout the construction phase Operation Phase: • Once within 3 months after completion of construction work	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and DENR	To be included in the cost for D/D study, Refer to Table 9.1.1. (for Construction Phase)
4. Waste					
Generation of waste (type, volume, treatment (re-use, recycle, etc.) and disposal method)	Checking the data and consolidation on waste generation and disposal to be sub-contracted to accredited waste contractor	All the affected areas where the demolition of structures is to be done, and where vegetation clearance is to be carried out.	Construction Phase: • Bi-monthly (once / 2 months) throughout the construction phase	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and CLENRO, CENRO, DENR	To be included in the construction cost
5. Noise and Vibration					
Noise level and vibration level (including velocity, acceleration, frequency)	Field measurement	Nearest receptor from the project site and sensitive facility / 8 points	Pre-construction Phase: • Once immediately before the construction work Construction Phase: • Monthly (once / months) throughout the construction	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and DENR	Refer to Table 9.1.1.

Environmental Component / Monitoring item	Methodology	Monitoring Locations	Monitoring Period / Frequency	Implementation organization / Responsible (supervisory) organization	Cost* (Direct survey cost)
			phase Operation Phase: • Once within 3 months after completion of construction work		

9.2 Natural Environment

Environmental monitoring plan for natural environment components are described in Environmental Monitoring Plan (Table 9.2.2). The following table summarizes the monitoring cost until the completion of construction work of the Project.

Table 9.2.1 Cost Estimate of Environmental Monitoring (Natural environment components)

1	**Remuneration**	**Months / Year**	**Times**	**Total**	**Unit**		**Unit Cost / Mon. (PHP)**	**Amount (PHP)**
1.1	Team Leader / Environmental Engineer	1.5	3	4.5	M/M		150,000.00	675,000.00
1.2	Experts							
	a. Coral Reef	1.5	3	4.5	M/M		120,000.00	540,000.00
	b. Flora and fauna	1.5	3	4.5	M/M		120,000.00	540,000.00
	c. Aquatic Biota Expert	1.5	3	4.5	M/M		120,000.00	540,000.00
1.3	Assistant experts	1.5	3	4.5	M/M		120,000.00	540,000.00
	SUB-TOTAL (1)							**2,835,000.00**
2	**Direct Expenses**		**Total Times**		**Unit**		**Unit Cost / Time (PHP)**	**Amount (PHP)**
			3		**LS**		**500,000.00**	**1,500,000.00**
3	**Survey cost**	**Monitoring Times**				**Number of monitoring areas**	**Unit Cost / Time (PHP)**	**Amount (PHP)**
		Pre-construction	Construction	At completion	Total			
3.1	Coral Reef	1	1	1	3	1	100,000.00	300,000.00
3.2	Flora and fauna	1	1	1	3	1	150,000.00	450,000.00
3.2	Aquatic biota	1	1	1	3	1	100,000.00	300,000.00
	SUB-TOTAL (2)							**1,050,000.00**
	SUB-TOTAL (3)							**5,385,000.00**
	VAT (Sub-total (1) * 12%)							340,200.00
	GRAND TOTAL							**5,725,200.00**

Source: JICA Survey Team

Table 9.2.2 Environmental Monitoring Plan for Natural Environment

Environmental Component /Monitoring Item	Methodology	Monitoring Locations	Monitoring Period / Frequency	Implementation organization / Responsible (supervisory) organization	Cost
1. Soil Erosion					
Location and area of soil erosion occurrence	Ocular inspection	In and around the project area	Pre-construction Phase: • Once immediately before the construction work Construction Phase: • At any time throughout the construction phase Operation Phase: • Immediately after completion of construction work	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and DENR	Included in the construction cost
2. Coral reef					
Areas of corals with describing its condition (healthy/dead, etc.), species of coral identified, other features	Ocular inspection by diving (such as manta tow survey and Line Intercept Transect (LIT) method)	The sea in front of Brgy. Bonbon and Bayabas (same location as the EIA Survey)	Pre-construction Phase: • Once immediately before the construction work Construction Phase: • Once in the middle of construction phase Operation Phase: • Once within 3 months after completion of construction work	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and DENR	Refer to Table 9.2.1.
3. Mangrove forests					
Affected area (area of cutting mangrove trees)	Checking the ROW and cut area of mangrove by ocular inspection	Brgy. Bonbon and Kauswagan (River Stretch: L1)	Pre-construction Phase: • Once immediately before the construction work Construction Phase: • At any time throughout the construction phase Operation Phase: • Once within 3 months after	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and CENRO, DENR, LGUs	Included in the construction cost

Environmental Component /Monitoring Item	Methodology	Monitoring Locations	Monitoring Period / Frequency	Implementation organization / Responsible (supervisory) organization	Cost
			completion of construction work		
4. Terrestrial Flora and Fauna including Threatened species.					
Affected area (area of vegetation clearance)	Checking the ROW and cut area of trees by ocular inspection	All the project area (ROW and the river area and its vicinity)	Pre-construction Phase: • Once immediately before the construction work Construction Phase: • At any time throughout the construction phase Operation Phase: • Once within 3 months after completion of construction work	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and CENRO, DENR, LGUs	Included in the construction cost
Terrestrial flora and fauna and biodiversity	Inventory (transect and census surveys)	All the project area (from river mouth up to Pelaez Bridge)	Pre-construction Phase: • Once immediately before the construction work Construction Phase: • Once in the middle of construction phase Operation Phase: • Once within 3 months after completion of construction work	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and CENRO, DENR, LGUs	Refer to Table 9.2.1.
6. Aquatic Biota					
Phytoplankton, zooplankton, macro-benthos and fish, and biodiversity of each element.	Inventory survey (sampling and identification of the species)	CDO River at the locations of excavation / dredging works are to be conducted. / 3 locations (in the whole are of the project)	Pre-construction Phase: • Once immediately before the construction work Construction Phase: • Once in the middle of construction phase Operation Phase: • Once within 3 months after completion of construction work	Implementation organization: Contractor, Responsible (supervisory) organization: Proponent and Consultant, and CENRO, DENR, LGUs	Refer to Table 9.2.1.

9.3 Social Environment

Environmental measures for social environment components are described in Environmental Monitoring Plan (Table 9.3.1).

Table 9.3.1 Environmental Monitoring Plan for Social Environment

Environmental Component	Monitoring Item	Monitoring Location	Monitoring Period / Frequency	Responsible Entity / Supervision	Cost
2. Poverty Group					
	• Number of households living below the poverty line. • Number of skills training programs conducted and total number of participants • Number of qualified PAPS referred and placed for employment • Number of PAPs provided with financial assistance and amounts received • Number of impoverished PAPs offered with mental health and psychosocial support service.	• On-site for monthly monitoring, and offices of concerned agencies for quarterly and bi-annual monitoring	<u>Pre-Construction Phase:</u> • Posterior to start of land acquisition of the project, the monthly monitoring of RAP to be started. • Every six month after start of monthly monitoring, semi-annual monitoring and evaluation to be conducted. <u>Construction Phase:</u> • Every month after three month of start of construction of the project to conduct the monthly monitoring of RAP • Every six month after three month of start of construction of the project to conduct the semi-annual monitoring and evaluation. <u>Operation Phase:</u> • One year after the completion of the project to conduct the post evaluation monitoring	DPWH, LGU-CDO, DSWD	To be determined
3. Local Economy					
	• Number of skills training programs conducted for small and medium scale business for restoration of local business and economy and its total number of participants • Number of qualified persons referred and	• On-site for monthly monitoring, and offices of concerned agencies for quarterly and bi-annual monitoring	<u>Pre-Construction Phase:</u> • Posterior to start of land acquisition of the project, the monthly monitoring of RAP to be started. • Every six month after start of monthly monitoring, semi-annual monitoring and evaluation to be conducted. <u>Construction Phase:</u> • Every month after three month of start of	DPWH, LGU-CDO, DSWD, DENR	To be determined

Environmental Component	Monitoring Item	Monitoring Location	Monitoring Period / Frequency	Responsible Entity / Supervision	Cost
	placed for local employment		construction of the project to conduct the monthly monitoring of RAP • Every six month after three month of start of construction of the project to conduct the semi-annual monitoring and evaluation. Operation Phase: • One year after the completion of the project to conduct the post evaluation monitoring		
4. Water Use					
	Conditions of structures such as physical damages and usability which were designed to provide user-friendly access measures to the river	At the site of flood control structures of the project where access measure for the local residents were made along the riverbank.	Construction Phase: • Twice a year (semi-annually) through ocular visit of maintenance monitoring. Operation Phase: • Twice a year (semi-annually) through ocular visit of maintenance monitoring.	DPWH	To be determined
5. Land Use and Utilization of Local Resources					
	Status of issuing operation permits for and the volume of operations of quarrying and sand and gravel mining	Designated operation sites of quarrying and sand and gravel mining determined by DPWH, DENR and LGU-CDO	Construction Phase: • Twice a year (semi-annually) through ocular visit of maintenance monitoring. Operation Phase: • Twice a year (semi-annually) through ocular visit of maintenance monitoring.	DPWH, DENR, LGU-CDO	To be determined
6. Social Infrastructure and Sensitive Facilities					
	(1) Status of coordination with concerned local parties, documentation procedures and physical relocation of sensitive facilities,	Identified sensitive facilities in and around project affected area	Pre-Construction Phase: • As needed prior to construction in coordination with concerned local parties. Construction Phase:	DPWH, LGU-CDO	To be determined

Environmental Component	Monitoring Item	Monitoring Location	Monitoring Period / Frequency	Responsible Entity / Supervision	Cost
	(2) Status of building of sensitive facilities through daily patrolling record during construction stage (3) Status of recovery and restoration of activities and operations of sensitive facilities from the previous location after construction is completed		• As needed during the construction Operation Phase: • As needed		
7. Misdistribution of Benefits / Local Conflicts of Interest					
	• Number of complaints filed with the RIC/DPWH • Number of cases escalated to courts of law • Number of resolved cases dealing with complaints over valuation • Number of PAPs offered with mental health and psychosocial support service.	• On-site for monthly monitoring, and offices of concerned agencies for quarterly and bi-annual monitoring	Pre-Construction Phase: • Posterior to start of land acquisition of the project, the monthly monitoring of RAP to be started. • Every six month after start of monthly monitoring, semi-annual monitoring and evaluation to be conducted. Construction Phase: • Every month after three month of start of construction of the project to conduct the monthly monitoring of RAP • Every six month after three month of start of construction of the project to conduct the semi-annual monitoring and evaluation.	DPWH, LGU-CDO	To be determined
8. Gender and Socially Vulnerable Groups					
	• Number of households headed by the socially vulnerable and living below the poverty line. • Number of women and	• On-site for monthly monitoring, and offices of concerned	Pre-Construction Phase: • Posterior to start of land acquisition of the project, the monthly monitoring of RAP to be started. • Every six month after start of monthly	DPWH, LGU-CDO, DSWD	To be determined

Environmental Component	Monitoring Item	Monitoring Location	Monitoring Period / Frequency	Responsible Entity / Supervision	Cost
	other socially vulnerable PAPs given skills training • Number of qualified women and other socially vulnerable PAPs referred and placed for employment • Number of women and other socially vulnerable PAPs provided with financial assistance • Number of women and other socially vulnerable PAPs provided with health and psychosocial support service.	agencies for quarterly and bi-annual monitoring	monitoring, semi-annual monitoring and evaluation to be conducted. Construction Phase: • Every month after three month of start of construction of the project to conduct the monthly monitoring of RAP • Every six month after three month of start of construction of the project to conduct the semi-annual monitoring and evaluation. Operation Phase: • One year after the completion of the project to conduct the post evaluation		
9. Rights of Children					
	• Number of children belonging to households living below the poverty line. • Number of school-age children not in school • Number of educational and health facilities in resettlement sites • Number of children provided with health and psychosocial support service.	• On-site for monthly monitoring, and offices of concerned agencies for quarterly and bi-annual monitoring	Pre-Construction Phase: • Posterior to start of land acquisition of the project, the monthly monitoring of RAP to be started. • Every six month after start of monthly monitoring, semi-annual monitoring and evaluation to be conducted. Construction Phase: • Every month after three month of start of construction of the project to conduct the monthly monitoring of RAP • Every six month after three month of start of construction of the project to conduct the semi-annual monitoring and evaluation. Operation Phase:	DPWH, LGU-CDO, DSWD	To be determined

Environmental Component	Monitoring Item	Monitoring Location	Monitoring Period / Frequency	Responsible Entity / Supervision	Cost
			• One year after the completion of the project to conduct the post evaluation		
10. Infectious Diseases such as HIV/AIDS					
	(1) Frequency, content and resource persons of sessions on information and education program on HIV/AIDS and STI, enhancement of awareness of participants, (2) Number of personnel and workers who undertake free HIV testing and counseling, (3) Frequency, number of participants on information and education campaign in the community	Construction worker's camps	<u>Construction Phase:</u> • Before start of construction for review of medical/health certification or results. • Quarterly for review of session report, evaluation results • Monthly for review of report of involved agencies	DPWH	To be determined
11. Landscape					
	Conditions of scenery at and around the structures and also water amenity functions and/or facilities	Along the river banks, particularly at the locations of the (1) structures which impairment of scenery is significant and (2) structures with water amenity functions and/or facilities are provided.	<u>Construction Phase:</u> • Twice a year (semi-annually) through ocular visit of maintenance monitoring. <u>Operation Phase:</u> • Twice a year (semi-annually) through ocular visit of maintenance monitoring.	DPWH, LGU-CDO	To be determined
12. Labor Environment					
	(1) Number of qualified PAPs	On-site for monthly	<u>Pre-Construction Phase:</u>	DPWH	To be

Environmental Component	Monitoring Item	Monitoring Location	Monitoring Period / Frequency	Responsible Entity / Supervision	Cost
	referred and placed for employment (2) Number of training programs conducted & number of participants, number employed after training (if possible) (3) No of PAPs provided financial and non-financial assistance, type of non-financial assistance extended, status of business	monitoring Offices of concerned agencies for quarterly monitoring Offices of concerned agencies for bi-annual monitoring	• Monthly monitoring for review of monitoring and progress reports of concerned agencies • Quarterly monitoring for discussion and/or meeting with concerned agencies Construction Phase: • Monthly monitoring for observation on-site • Quarterly monitoring for discussion with the contractor as the need arise. Operation Phase: • Bi-annual monitoring for discussion with concerned agencies on-site • Bi-annual monitoring for review of reports of involved agencies		determined

CHAPTER 10 STAKEHOLDER MEETINGS

10.1 Stakeholder Meetings for Outline of the Project

Stakeholder meetings for presenting the outline of the project were held four times in January 2013. The discussions in the stakeholder meetings are summarized below:

10.1.1 Cluster Meetings for Outline of the Project at Municipality of Talakag

Stakeholder meeting at Talakag, Bukidnon (23 January 2013, 9:00 to 12:00 NN at Mayor's Office Conference Hall, Talakag Bukidnon.

1) Participants

Table 10.1.1 Number of participants from Talakag, Bukidnon

Group/Sector	*Number of Participants*
Municipal Government Offices	15
Barangays	24
NGOs/CSOs	7
Department of Public Works and Highways	2
JICA Survey Team (FRIMP-CDOR)	9
Total	57

2) Minutes of the Meeting

The meeting officially started at 9:39 AM and ended at 11:45 AM

The DPWH representative made the presentation covering both the purpose and importance of holding the stakeholder meeting and the objectives; outline; initial findings and outcome of the Preparatory Survey for Flood Risk Management for Cagayan de Oro River. The stakeholder meeting is conducted to explain the objectives and necessity of the survey and the project to stakeholders; to generate appropriate understanding and awareness of stakeholders on the project and the necessity of its implementation; and to obtain opinion and information from stakeholders.

After the presentation, the participants raised some questions and comments about the Survey. Similar questions or concerns from some participants were integrated.

1) XXXXX, Municipal Councilor and Chair of the Committee on Environment

A) Question/s

What is the basis for declaring a certain area "NO BUILD ZONE"? The local government of Talakag is planning to make an ordinance on "NO BUILD ZONE" area/s and we need assistance in formulating technical guidelines.

B) Responses

a) **XXXXX**, JICA Survey Team

As of the moment, there is no concrete definition or guidelines for declaring an area as "NO BUILD ZONE". The guidelines are still being polished by the Philippine

Government.

b) **XXXXX**, DPWH, Major Flood Control

In the Water Code of the Philippines, easement is contingent on the location of the river, that is, 20 meters from the edge of the river channel in urban areas and 40 meters in forested areas. My opinion is that one of the bases should be the history of flooding in the area itself where great damage to properties and high death toll occurred.

2) XXXXX, Barangay San Antonio

A) Question/s

When will the reconstruction of Ugiaban Bridge start and when will it be finished?

B) Responses

a) **XXXXX**, DPWH, Major Flood Control

The reconstruction of Ugiaban Bridge is not included in the study. The rehabilitation and reconstruction of the bridge is under the jurisdiction of DPWH Regional Office.

3) XXXXX, Municipal Councilor of Talakag

A) Question/s

Can JICA extend assistance to the people affected by typhoon?

B) Responses

a) **XXXXX**, JICA Survey Team

The objective of this study is to formulate plans to prevent great damage caused by flood and to cater to the damages brought about by flood is not part of this study.

4) XXXXX, Chairperson of Cacaon Lantaw Livelihood Association

A) Question/s

What can the NGOs do or contribute to the study?

B) Responses

a) **XXXXX**, JICA Survey Team

The NGOs can help in the non-structural measures of the study. The group is requested to cooperate in the activities related to the study such as participation in the stakeholder surveys. The NGOs can give their inputs/suggestions that may be considered and incorporated into the Master Plan.

b) **XXXXX**, JICA Survey Team

NGOs can help by cooperating and supporting the Watershed Management Specialists of the Survey Team during their consultations with the stakeholders.

5) XXXXX, LIDASAFA/Integrated Social Forestry (ISF) Multi-Purpose Cooperative

A) Comment/Suggestion

A task force must be created to assist in this study.

B) Responses

a) **XXXXX**, Association of Barangay Captains (ABC)

Talakag has its own Disaster Risk Reduction and Management Council (DRRMC) already that could extend assistance to this study. This DRRMC has identified 8 barangays for the maintenance of the river basin.

b) **XXXXX**, Municipal Councilor and Chair of the Committee on Environment

The municipality has the Barangay Disaster Risk Reduction and Management Council and Municipal Disaster Risk Reduction and Management Council despite the fact that Talakag is not a flood-prone area.

6) XXXXX, DIMAACBAT People's Organization of Tikalaan

A) Question

Is there funding for activities like planting trees? People cannot be prevented from building houses near the river banks; the stakeholders are to make plans to prevent floods like planting trees.

B) Responses

a) **XXXXX**, JICA Survey Team

The objective of the survey is for the in-depth study of flood mitigation.

b) **XXXXX**, DPWH, Major Flood Control

Tree planting activities should be administered by DENR.

c) **XXXXX**, BENRO of Talakag

The city government of Cagayan de Oro could at least assist in funding the projects related to river basin rehabilitation such as tree planting and perhaps JICA could do so also. The upland areas are willing to plant trees but the problem is the lack of funding to produce seedlings.

d) **XXXXX**, Municipal Councilor and Chair of the Committee on Environment

The Municipality of Talakag gave two hundred thousand pesos for the protection of forests land and the City of Cagayan de Oro, however, gave nothing.

e) **XXXXX**, Municipal Local Government Operating Officer, DILG

Through executive Order No. 26, barangays are required to plant trees. The city government of Cagayan de Oro should assist them on this activity since it is a national concern.

7) XXXXX, Municipal Councilor and Chair of the Committee on Environment

A) Question

Can you clarify the difference between CDOR-BMC and FRIMP-CDOR?

B) Responses

a) **XXXXX**, JICA Survey Team

The CDOR-BMC is a council composed of different sectors committed to facilitate, monitor, and oversee the activities related to the Cagayan de Oro River Basin. It is a council that is permanent. FRIMP-CDOR, on the other hand is a preparatory

Survey with the intention of coming up with measures to mitigate flood in the Cagayan de Oro River Basin. The study is scheduled for completion in November 2013.

8) XXXXX, JICA Survey Team

A) Question

Members of the Talakag community were requested to confirm the findings of the study in the barangays (shown during the presentation) affected by the Tropical Storms Sendong and Pablo and provide additional data on the on the damages incurred and cause/s of these damages from the said tropical storms. Were there other barangays affected but was not included in the presentation?

B) Responses

a) All the Participants

The participants affirmed that the barangays affected by Tropical Storm Sendong; San Antonio, Sto. Nino, Cacaon, and Lingoan are correctly presented in the map.

b) **XXXXX**, Municipal Councilor and Chair of the Committee on Environment

More houses were damaged in TS Pablo than in TS Sendong because of very strong winds. The reported extensively damaged houses were because of landslide (2), washed out by flood (2), and falling trees (2).

c) All the Participants

Almost all barangays were affected by TS Pablo. The biggest damage incurred is in the agricultural sector and the main cause is very strong winds, not flood. The single death recorded was due to the insistence of the person to cross the river despite the high water level and strong current.

9) JICA Survey Team

A) Announcement

Notice of the survey and data gathering on disaster risk reduction and management plan in mid –February in the municipal and barangay levels was announced at the end of the meeting. The Survey Team requested for the support and cooperation of the participants in the forthcoming data gathering activity.

10) XXXXX, Municipal Planning Development Officer

A) Comment

The Survey Team is asked to provide the schedule of the survey in advance so the barangays and communities can prepare.

10.1.2 Cluster Meetings for Outline of the Project at Municipality of Baungon

Stakeholder meeting at Baungon, Bukidnon (24 January 2013, 9:00 to 12:00 NN at Baungon Multipurpose Hall, Baungon, Bukidnon.

1) Participants

Table 10.1.2 Number of participants from Baungon, Bukidnon

Group/Sector	*Number of Participants*
Municipal Government Offices	15
Barangays	5
NGOs/CSOs	2
Department of Public Works and Highways	2
JICA Survey Team (FRIMP-CDOR)	7
Total	31

2) Minutes of the Meeting

The meeting officially started at 10:00 AM and ended at 12:00 Noon

The DPWH representative made the presentation covering both the purpose and importance of holding the stakeholder meeting and the objectives; outline; initial findings and outcome of the Preparatory Survey for Flood Risk Management for Cagayan de Oro River. The stakeholder meeting is conducted to explain the objectives and necessity of the survey and project to stakeholders; to generate appropriate understanding and awareness of stakeholders on the project and the necessity of its implementation; and to obtain opinion and information from stakeholders.

After the presentation, the participants raised some questions and comments about the Survey. Similar questions or concerns from some participants were integrated.

1) XXXXX, IP Main Representative/Municipal Tribal Chieftain

A) Question

This is addressed to all concerned, what can be done to help the Municipality of Baungon especially with the damaged Cabula Bridge that greatly affected transportation of agricultural products and conveyance of the riding public from Baungon to Cagayan de Oro City?

B) Response

a) **XXXXX**, DPWH, Major Flood Control

Funding for the said damaged Cabula Bridge due to Tropical Storm Sendong is directly under the jurisdiction of DPWH Region 10, the office of Regional Director. There is a need to follow-up the status of the Program of Works (POW) and Design of proposed structures needed for the repair.

2) XXXXX, Municipal Mayor's Office

A) Comment

The release of budget intended for the damaged Cabula and Tumalaong Bridges costing PhP 370 million is being allocated by the Department of Budget and Management (DBM) through Secretary Abad. We have already made follow-ups with the Planning and Design Division at DPWH Region 10. The Program of Works (POW) and Proposed Redesign of Damaged Bridge Construction (Cabula and Tumalaong) were already forwarded to Manila DPWH Central Office for approval.

3) XXXXX, DPWH, Major Flood Control

A) Suggestion

The proposed repair of the damaged Cabula Bridge should be reviewed to carry/accommodate huge volume of water from upstream sections of Cagayan de Oro River.

4) XXXXX, Municipal Mayor's Office

A) Question

What would be the best recommendation/s to prevent erosion along river banks in the vicinity of Cabula Bridge which was damaged by Tropical Storm Sendong?

B) Responses

a) **XXXXX**, JICA Survey Team

Flexible and not costly structures such a gabion mattress would be useful to prevent river bank erosion, even though it is a temporary structure and needs periodical maintenance.

b) **XXXXX**, DPWH, Major Flood Control

Planting trees in the watershed areas is one of the measures to prevent soil erosion aside from using coconuts to protect slopes. The tree planting activities should be closely coordinated with the DENR Region 10 for appropriate funding while slope protection works is under DPWH Regional and District offices.

5) XXXXX, Municipal Tribal Coordinator, Office of the Municipal Mayor

A) Question

What government agency would be directly responsible for watershed management project especially tree planting activities to facilitate assistance/funding?

B) Responses

a) **XXXXX**, DPWH, Major Flood Control

DENR is the agency responsible for watershed management and tree planting activities. These matters should be coordinated with the said agency for funding assistance.

6) XXXXX, Baungon Federation of Irrigators Association –BAFIA

A) Question

How can the study of the JICA Survey Team help in terms of financial assistance for the repair of damaged structures in the NIA Project, particularly the NIA Mabuhay Project Phase II, due to Tropical Storm Sendong?

B) Response

a) **XXXXX**, JICA Survey Team

The on-going JICA Preparatory Study will focus on gathering data on the directly affected barangays by Tropical Storm Sendong, however funding assistance is not part of the study.

7) XXXXX, Municipal Agricultural and Fisheries Council

A) Question

Due to Typhoon Sendong, the original course of the waterways in Bubunawan River has been divided that caused many river courses to be formed and large amounts of sediment deposited in the river. Is there any plan for this study to conduct dredging works along the river to regulate flood waters easily?

B) Response

a) **XXXXX**, JICA Survey Team

No dredging works is conceivable in the middle/upstream of the rivers such as Bubunawan River.

8) XXXXX, JICA Survey Team

A) Question

The participants were presented with the list of information and findings from the Study Team that needed confirmation from the members of the Baungon community. Were there other damages/barangays affected by Tropical Storms Sendong and Pablo but not included in the presentation? What were the causes of these damages?

B) Response

a) All the Participants

The participants affirmed that the damaged structures due to Tropical Storm Sendong are Cabula Bridge, Langaon Bridge, Bubunawan River Irrigation Project (RIP) in Diversion Works and Bench Flume, and Tumalaong Causeway.

b) **XXXXX**, Barangay Liboran

Response is summarized in the table below:

Table 10.1.3 Summary of Damage Caused by TS Sendong and TS Pablo to various Barangays

Barangay	TS Sendong Damages			TS Pablo Damages		
	Structure / Property	People	Cause	Structure / Property	People	Cause
Poblacion (Imbatug)	None	Missing - 11	Flash Flood – People were residing in danger zones.	Houses	Dead – 1	Very strong winds – 1 casualty, insisted on crossing the river despite strong current
Lingating	Bridge, Spillways – (Danatag) 1 Sitio – Washed-out	Dead – 35 Missing – 24 Injured – 7	Flash Flood – Strong current	Houses	None	Very strong winds

Mabunga	Agricultural crops	None	Flash Flood	Agricultural crops, houses	None	Very strong winds
Balintao	Agricultural crops	None	Flash Flood	Agricultural crops, houses	None	Very strong winds
San Vicente	Agricultural crops, couses	None	Flash Flood	Agricultural crops, houses	None	Very strong winds
Tumalaong	Bridge	None	Flash Flood – Strong current with uprooted trees	Houses	None	Very strong winds

There was only one casualty during TS Pablo because the people were prepared and have evacuated to higher grounds. Details of damages from TS Sendong and TS Pablo will be given by the Municipal Social Welfare and Development Office (MSWDO), Baungon.

9) JICA Survey Team

A) Announcement

Notice of the survey and data gathering on disaster risk reduction and management plan in mid –February in the municipal and barangay levels was announced at the end of the meeting. The Survey Team requested for the support and cooperation of the participants in the forthcoming data gathering activity.

10.1.3 Cluster Meetings for Outline of the Project at Municipality of Libona

Stakeholder meeting at Libona, Bukidnon (24 January 2013, 2:00 to 5:00 PM at Mayor's Office Conference Hall, Libona, Bukidnon.

1) Participants

Table 10.1.4 Number of participants from Libona, Bukidnon

Group/Sector	*Number of Participants*
Municipal Government Offices	20
Barangays	8
NGOs/CSOs	10
Department of Public Works and Highways	2
JICA Survey Team (FRIMP-CDOR)	7
Total	47

2) Minutes of the Meeting

The meeting officially started at 2:40 PM and ended at 5:05 PM

The DPWH representative made the presentation covering both the purpose and importance of holding the stakeholder meeting and the objectives; outline; initial findings and outcome of the Preparatory Survey for Flood Risk Management for Cagayan de Oro River. The stakeholder meeting is conducted to explain the objectives and necessity of the survey and the project to stakeholders; to generate appropriate understanding and awareness of stakeholders on the project and the necessity of its implementation; and to obtain opinions and information from stakeholders.

After the presentation, the participants raised some questions and comments about the Survey. Similar questions or concerns from some participants were integrated.

1) XXXXX, Municipal Councilor

A) Question

When will the repair of the bridge (commonly called Camp 9 Bridge) in Purok Camp 9, Barangay Laturan that was damaged by Tropical Storm Sendong start? The detour used by the riding public is deteriorating and if it deteriorates further there is no other access except the said bridge which is the shortest route to Cagayan de Oro City.

B) Response

a) **XXXXX**, DPWH, Major Flood Control

This would be under the jurisdiction of DPWH District/Regional Office under Regional Director, for the budget and status of repair of the damaged bridge in Purok Camp 9. It is better to inquire from or follow-up the said office for possible calamity fund for the destruction brought about by Tropical Storm Sendong and Tropical Storm Pablo.

b) **XXXXX**, Municipal Social Welfare and Development Officer and Chairperson, MDRRMC

The Office of Civil Defense (OCD) has allocated certain funds for the repair of the damaged bridge. **XXXXX**, Municipal Engineer of Libona has already made follow up to the DPWH regarding the preparation of Program of Works (POW) and proposed design of the structure to be built to facilitate the immediate repair of the damaged bridge in Purok Camp 9.

2) XXXXX, Supervisor, Agrinanas Industry

A) Question

What causes the delay in the proposed repair of the damaged bridge in Purok Camp 9? It is now almost two years and it has not been repaired?

B) Response

a) **XXXXX**, DPWH, Major Flood Control

There is a need to follow-up DPWH District/Regional Office for the status of the repair and rehabilitation of the bridge.

3) XXXXX, MCDC Kiliog

A) Question

Is there available funding assistance or support from the National Government especially the DENR to rehabilitate existing forest lands in barangays devastated by

Tropical Storm Sendong? Soil erosion on sloping areas occurred due to cutting of trees.

B) Response

a) **XXXXX**, DPWH, Major Flood Control

The DENR is directly responsible for releasing appropriate funds for reforestation in a long term plan where tree planting is best recommended. Cutting of round logs in the declared forest lands when Tropical Storm Sendong occurred caused the debris to be carried away by flash flood that swept away houses and other structures in the low-lying areas especially in Cagayan de Oro City.

4) XXXXX, Barangay Capihan

A) Suggestion

The proposed watershed management project of the DENR should be long term with regards to funding release to make it more sustainable and not affected by changes in political administration. If it is not long term, next releases will be affected by the next administration's priority.

5) XXXXX, MENRO

A) Comment

The Municipal Government of Libona had passed a resolution declaring 20 meters on both sides of the river banks as forest reserve area for the proposed tree planting to be funded by DENR. Erosion can be prevented by way of planting trees that maintains stability on sloping areas.

6) XXXXX, Municipal Agriculture and Fisheries Council (MAFC)

A) Question

Is there any assistance or subsidy from the government for agriculture particularly for crops or livestock damaged by tropical storms?

B) Response

a) **XXXXX**, DPWH, Major Flood Control

Funding source must be sought from the Department of Agriculture. This agency is tasked to fast track the inventory of damaged crops or livestock and other agricultural farmlands after Tropical Storm Sendong hit the province. The Office of Civil Defense (OCD) also made calamity fund assistance for damages brought about by TS Sendong and TS Pablo.

7) XXXXX, JICA Survey Team

A) Question

Members of the Talakag community were requested to confirm the findings of the study in the barangays (shown during the presentation) affected by the Tropical Storms Sendong and Pablo and provide additional data on the on the damages incurred and cause/s of these damages from the said tropical storms. Were there other barangays affected but was not included in the presentation?

B) Responses

a) All the Participants

The participants affirmed that the barangays affected by Tropical Storm Sendong are all included in the presentation.

b) **XXXXX**, Barangay Poblacion

More houses were damaged in TS Pablo than in TS Sendong because of very strong winds.

c) All the Participants

Almost all barangays were affected by TS Pablo. The biggest damage incurred is in the agricultural sector and the main cause is very strong winds, not flood.

8) JICA Survey Team

A) Announcement

Notice of the survey and data gathering on disaster risk reduction and management plan in mid –February in the municipal and barangay levels was announced at the end of the meeting. The Survey Team requested for the support and cooperation of the participants in the forthcoming data gathering activity.

10.1.4 Cluster Meetings for Outline of the Project at Cagayan de Oro City

Stakeholder meeting at Kauswagan, Cagayan de Oro City (25 January 2013, 9:00 to 12:00 PM at Cattleya Function Room, N Hotel, Kauswagan Highway, Cagayan de Oro City.

1) Participants

Table 10.1.5 Number of participants from Kauswagan, Cagayan de Oro City

Group/Sector	*Number of Participants*
House of Representatives	1
City Government Offices	8
Barangays	22
NGOs/CSOs	9
Provincial Government of Misamis Oriental	1
Provincial Government of Bukidnon	1
City Government of Iligan	1
National Government Agencies Regional Offices	12
Department of Public Works and Highways, MFC	2
JICA Survey Team (FRIMP-CDOR)	13
Total	70

2) Minutes of the Meeting

The meeting officially started at 9:45 AM and ended at 12:12 PM

The DPWH representative made the presentation covering both the purpose and importance of holding the stakeholder meeting and the objectives; outline; and initial findings and outcome of the Preparatory Survey for Flood Risk Management for Cagayan de Oro River. The stakeholder meeting is conducted to explain the objectives and necessity of the survey and the project to stakeholders; to generate appropriate understanding and awareness of stakeholders on the project and the necessity of its implementation; and to obtain opinions and information from stakeholders.

After the presentation, the participants raised some questions and comments about the Survey. Similar questions or concerns from some participants were integrated.

1) XXXXX, Congressman, Second Congressional District, Cagayan de Oro City

A) Questions

The JICA Survey Team is requested to consider the following in its formulation of the Master Plan:

a) Can the completion of the Master Plan be fast tracked? This Master Plan is needed to guide the City Government on its revetment projects that are currently implemented in the 2nd district that stretches from Cala-Cala to Macabalan and costs 2.6 billion pesos. Recommendation on how high the revetments should be is requested from the Survey Team. The revetment project already has 600 million pesos funding and part of it was the 399 million pesos released by the President of the Philippines from the calamity fund.

b) To prioritize dredging, identify which areas of the river are for dredging since it is not suitable in all areas and to consider constructing boulevards on the side of the revetments.
c) Secretary Singson has requested the Survey Team to consider construction of Sabo Dam in the upstream areas (i.e. Baungon, Talakag).
d) Water catchments on both sides of the river and possibly construct parks in it; Isla de Oro or Cala-Cala as possible park areas.

B) Response

a) **XXXXX**, JICA Survey Team)

i) The study will be finished by November 2013 as planned but the Survey Team will prepare documents for the next stage of the study and will be presented around July of this year.
ii) With regards dredging and construction of boulevard, the Survey Team must make a plan considering not only structural aspects but also the environmental factors and the cost.
iii) The Survey Team will determine the possibility of Sabo Dam structures in the Master Plan depending on the result of the study.
iv) Relative to the water catchment, as of this stage, the Study Team was not able to identify a place to which a water catchment can be constructed.

2) XXXXX, Barangay Balulang

A) Suggestion

Emily Homes in Balulang needs a river dike (12 ft width by 12 ft length), a boulevard, and to rechannel the river.

B) Response

a) **XXXXX**, DPWH, Major Flood Control

Dike and boulevard construction will be assessed by the Survey Team; the construction of the boulevard will depend on the cost and right of way (ROW) acquisition.

b) **XXXXX**, Vice Mayor, Cagayan de Oro City

Regarding the rechanneling of the river, Mayor **XXXXX** already has a request to the Office of the President of the Philippines and the Mayor is just waiting for the approval of this request. The City Government also requested other personalities and offices of the National Government, particularly, the Congress to follow-up our request.

3) XXXXX, Barangay Nazareth

A) Question/Comment

For the Survey Team to consider following in the study:

a) Protection of the environment
b) Include in the recommendation in the Master Plan the construction of a fish sanctuary located between Barangay 1 and Barangay Nazareth
c) Building more roads leading to higher grounds
d) Building more evacuation centers
e) Include Mt. Kalatungan, an active volcano in the study so that precautionary measures for disaster when the volcano erupts will be studied as well

B) Responses

a) **XXXXX**, Vice Mayor, Cagayan de Oro City

In support of Barangay Kagawad **XXXXX**'s suggestions, the Survey Team should consider the protection of the environment especially in the Bukidnon area since the biggest part of the river is located there.

b) **XXXXX**, JICA Survey Team

The protection of the environment is really being considered by the Survey Team through the non-structural measures of the study and is being worked out by the Watershed Management Experts of the study

c) **XXXXX**, JICA Survey Team

We appreciate the stakeholders' specific recommendations to be included and considered in the Master Plan by the Study Team. The construction of more roads should be a government effort. The volcano and risk of eruption is out of the scope of the study.

Evacuation centers are part of the study and considered in the non-structural measures but the study is to mitigate the damage of the flood and hopefully, the project would minimize the need for more evacuation centers.

d) **XXXXX**, City Councilor, Cagayan de Oro City

The issue on the volcano should be addressed to the right agency, the DENR, specifically the Mines and Geosciences Bureau.

Regarding dredging, the DPWH will follow-up the City Mayor's request for this matter since there is already rehabilitation being done by DPWH along the riverside especially in the Acasia, Carmen area. The earlier the approval for mass dredging, the better to avoid great damage should flood come.

e) **XXXXX**, BENRO, Bukidnon)

In support of the point made by Vice Mayor **XXXXX** relative to the environmental aspect, the suggestion is for the Survey Team to include a reforestation component in the Master Plan. Reforestation is part of Bukidnon's project but we do not have enough funding for it.

4) XXXXX, Promote Cagayan de Oro, Former Chair, Chamber of Commerce

A) Question

Is the Master Plan purely for the river basin; that is flood control, because there are hazard areas as well as people beside the river?

Regarding the suggestions of boulevard and water catchment, the widening of revetments will hit settlements. Instead of constructing big revetments, the Master Plan should include recommendation to systematically move the people away from the river. The City Government has started relocation but the resources are not enough.

B) Response

a) **XXXXX**, JICA Survey Team

The Study Team must consider the appropriate scale of the structure and consider not only revetments but also activities to mitigate flood.

5) XXXXX, Mindanao Development Authority

A) Question

Does the scope of the FRIMP-CDOR Master Plan include the entire river basin? Is there a previous Master Plan and whether that Master Plan only covers the Cagayan de Oro River?

There is a Master Plan for Cagayan de Oro River Basin by the DENR, RBCO in Manila and bidding for the said Master Plan is being conducted. Hopefully, the two Master Plans, FRIMP-CDOR's and the one currently on bid would jive or complement each other.

There are two river basin councils (1 from Cagayan de Oro and 1 from Bukidnon) and these councils are always conducting meetings for the development of the Cagayan de Oro River Basin.

B) Response

a) **XXXXX**, JICA Survey Team

The scope of the study and Master Plan covers the entire Cagayan de Oro River Basin but only for flood risk mitigation.

6) XXXXX, Representative of XXXXX, City Councilor, Cagayan de Oro City

A) Question

Is Iponan River included in the FRIMP-CDOR preparatory study since the river covers 11 barangays and also causes flood?

B) Response

a) **XXXXX**, JICA Survey Team

Iponan River is not part of the study but the City Government has plans for it.

b) **XXXXX**, Vice Mayor, Cagayan de Oro City

The City Government already has preliminary plans for Iponan River, one of which includes dredging.

c) **XXXXX**, Department of Public Works and Highways, Region X

DPWH Region 10 sent a letter to Secretary Singson to request JICA to include the study of 3 rivers (Iponan River, Mandulog River, and Iligan River) but until now there is no response.

7) XXXXX, Economist, City Planning and Development Office, Cagayan de Oro City

A) Question

What is the scope of the project? Does FRIMP-CDOR Master Plan include the 142,000 hectares in which Cagayan de Oro is only about 12% of the river basin? Is it possible to construct a water retention dam upstream to accommodate the water generated by the reported 100-year return period flood?

B) Response

a) **XXXXX**, Team Leader, JICA Survey Team

The Survey Team does not know yet if construction of a dam will be included in the Master Plan of FRIMP-CDOR.

8) XXXXX, Oro Chamber of Commerce, Cagayan de Oro City

A) Question

What is the process of implementing the "NO BUILD ZONE" policy as mentioned in the presentation? The City Government should pass a clear "NO BUILD ZONE" ordinance.

B) Response

a) **XXXXX**, JICA Survey Team

The basis to implement the NO BUILD ZONE in several areas in Cagayan de Oro City is only the direct verbal order of the President of the Philippines immediately after the Typhoon Sendong. The PNP was ordered to implement the NO BUILD ZONE by preventing people from building structures on the devastated areas. There is no other basis for the NO BUILD ZONE other than President Aquino's said declaration.

9) XXXXX, Regional Technical Head, National Housing Authority, Region X

A) Question

How will the occupants who are formal settlers and title holders be addressed in the implementation of the project? The study should consider the cost of relocating people that will be affected and how they will be informed.

B) Response

a) **XXXXX**, JICA Survey Team

Part of the study is the social consideration aspect; specialists are working on what can be done regarding this matter. The Survey Team will consider all options and consult the stakeholders that will be affected during implementation of the project.

10.2 Stakeholder Meetings for Scoping

Stakeholder meetings for public scoping of the EIA Study were held at four times along the CDO River in July, 2013. In addition, another stakeholder meeting for technical scoping was held in September, 2013. The discussions in the stakeholder meetings are summarized below:

10.2.1 Cluster Meetings for Public Scoping

(1) Stakeholder Meeting for Cluster 1 (8:00 to 12:00, Jul. 20, 2013 at Kauswagan Elementary School, Brgy. Kauswagan, Cagayan de Oro City)

The targeted barangays for this stakeholder meeting were Brgy. Bonbon and Brgy. Kauswagan.

1) Participants

Table 10.2.1 Number of participants from Brgy. Bonbon and Kauswagan

Group/Sector	*Number of Participants*
Barangay Residents	105
Barangay Officials	4
City Government Offices	3
DPWH-PMO	4
DPWH Region 10	5
Department of Education (Elementary and High School Teachers	5
JICA Survey Team (FRIMP-CDOR)	5
Total	*131*

2) Program and Presentations

Table 10.2.2 Program schedule for stakeholder meeting for Brgy. Bonbon and Kauswagan

No.	Activity	Person(s) in charge
1	Registration (1 hr)	DPWH 10 & City Government Team
	Over-all Master of Ceremony/Facilitator	**XXXXX** City Information Officer
2	Preliminaries:	
	Opening Prayer	**XXXXX** Resident, Barangay Kauswagan
	National Anthem	**XXXXX** Resident, Barangay Bonbon
	Opening Remarks	**XXXXX** Chair, BDRRMC

No.	Activity	Person(s) in charge
		Barangay Kauswagan
3	Project Rationale & Overview (30 min.)	**XXXXX** Chief, Planning and Design Divison DPWH 10
4	Flood Risk Mitigation Measures (30 min.)	**XXXXX** Project Manager II DPWH - FCSEC
5	Environmental and Social Considerations (45 min.)	**XXXXX** Engineer III DPWH-ESSO-PS
6	Group Discussion by Barangay (30 min.)	DPWH 10 <u>Group Facilitators:</u> **XXXXX** Engr. II **XXXXX** EMS II **XXXXX** Engr. II **XXXXX** Documenters: **XXXXX** **XXXXX**
7	Recapitulation (30 min.)	**XXXXX** Project Manager II DPWH-FCSEC
	Closing Remarks	**XXXXX** Technical Coordinator to the Mayor Cagayan City Government

3) Top Five Issues per Barangay

A) Barangay Bonbon

- Construction of Nabuslutan Creek wall or dike is requested. (Nabuslutan Creek is the one located at the west of CDO River mouth flowing in a large marshy area.) This wall or dike will serve as harbor of fisherman during bad weather.
- Drainage and repair of barangay road through which DPWH heavy vehicle and equipment traverse were requested. Digging, riprap, and heavy use have caused sinking and destruction of the barangay road.
- The alignment of structural measures of the Project may affect the Bonbon National High School. If so, all possible ways should be studied on how to replace or rebuild the Bonbon National High School in another location.

- Relocation/resettlement with livelihood and economic activity should be provided to project-affected residents.
- Preservation/protection of the environment, mangroves, and "Nipa" should be included in the implementation plan because the mangroves sustain the fishing as livelihood in the community and the mangroves are also an important ecosystem.

B) Barangay Kauswagan

- When the time comes that their homes will be removed and they will be asked to move from their land because of the Project, will the government relocate and provide them homes to move in, where and when?
- If they are forced to abandon their place of livelihood, will the government assist to relocate their businesses or train them to new skills for jobs?
- Sand quarrying is a predominant means of livelihood in riverside area of Kauswagan, especially among poor young people employed as sand haulers. Their concern is that they might lose their jobs because the government will stop the sand quarry operations or they will not have access to the river because of the Project.
- What is the procedure and who will approach when seeking assistance regarding relocation and secure livelihood/employment?
- It is unfair that some residents who are not qualified for resettlement assistance, have received assistance; while other residents who are qualified, have not received help.

4) Recapitulation

On Nabuslutan Creek flood wall or dike, **XXXXX** explained the danger and hazards in places near shoreline. But she clarified that harbor construction is not part of the project. She also emphasized that the mangrove area at Bonbon is part of project area of study.

Regarding drainage and road repair, **XXXXX** responded that he will discuss and bring this problem to the attention of the Contractor currently undertaking the on-going riprap project to repair the road that they have destroyed, as result of the transport of heavy loads to the project site. He believes it is the responsibility of contractor to repair the road that they destroyed.

On relocation and livelihood assistance, **XXXXX** of DPWH-ESSO-Planning Services responded that the DPWH 10 will coordinate with local and national agencies, such as the NHA, DSWD and LGUs for the affected resident's relocation package of benefits. A socio-economic survey is now being conducted in the affected barangays by the DPWH, assisted by JICA, as basis for government to properly plan and prepare to provide requirements of affected residents. Also, it is important to improve the system of identifying and granting of relocation and other assistance.

On sand quarrying in the river, **XXXXX** emphasized that continuation of quarrying operations in the river will largely depends on the DENR. And as with all other extractive permits granted to concessionaires, such activities should always be "controlled," (monitored and regulated). Both the DENR and DPWH should identify the area in the river which can be quarried, and determining the access points thereto.

(2) Stakeholder Meeting for Cluster 2 (13:30 to 17:30, Jul. 20, 2013 at West City Central School, Carmen, Cagayan de Oro)

The targeted barangays for this stakeholder meeting were Brgy. Carmen and Brgy. Balulang.

1) Participants

Table 10.2.3 Number of participants from Brgy. Carmen and Balulang

Group/Sector	***Number of Participants***
Barangay Residents	176
Barangay Officials	9
City Government Offices	3
DPWH-PMO	4
DPWH Region 10	5
Department of Education (Elementary and High School Teachers	4
JICA Survey Team (FRIMP-CDOR)	5
Total	*106*

2) Program and Presentations

Table 10.2.4 Program schedule for stakeholder meeting for Brgy. Carmen and Balulang

No.	**Activity**	**Person(s) in charge**
1	Registration (1 hr)	DPWH 10 & City Government Team
	Over-all Master of Ceremony/Facilitator	**XXXXX** City Information Officer
2	Preliminaries:	
	Opening Prayer	**XXXXX** Resident, Barangay Balulang
	National Anthem	**XXXXX** Resident, Barangay Bonbon
	Opening Remarks	**XXXXX** Chair, Committee on Infrastructure Barangay Carmen
3	Project Rationale & Overview (30 min.)	**XXXXX** Chief, Planning and Design Divison DPWH 10
4	Flood Risk Mitigation Measures (30 min.)	**XXXXX** Project Manager II DPWH - FCSEC
5	Environmental and Social Considerations (45 min.)	**XXXXX** Engineer III DPWH-ESSO-PS
6	Group Discussion by Barangay (30 min.)	DPWH 10 Group Facilitators: **XXXXX**

No.	Activity	Person(s) in charge
		Engr. II **XXXXX** EMS II **XXXXX** Engr. II **XXXXX** Documenters: **XXXXX** **XXXXX**
7	Recapitulation (30 min.)	**XXXXX** Project Manager II DPWH-FCSEC

3) Top Five Issues per Barangay

A) Barangay Carmen

- The affected residents inquired about the government's program on relocation and livelihood assistance. As much as possible they would like to be relocated close to the city center where they continue with their enterprises/businesses.
- Residents affected by the overflow and flooding caused of Binono-an Creek, which is located on left bank side between Maharlika bridge and Ysalina bridge, inquired if they will be included in the relocation plans. According to them, strong waters from SM Mall and other more elevated and nearby subdivisions.
- The residents emphasized that affected constituents should be hired as workers during the construction period.
- People affected by calamity should immediately be given psycho-social care, and also given the same intervention once they are relocated to new areas/environs.

B) Barangay Balulang

- Residents feel it is very important to re-design the current drainage system to improve/correct the poor drainage situation in the area, and also include road rehabilitation.
- Residents should be given early notice of the project design, so that they will know if they are affected or not, and to also know how the design will affect the physical lay-out of their community.
- There should be proper planning and implementation to relocate affected households, structures, and institutions (i.e., mosque, schools, community centers, etc.)
- Communities still feel that they are not adequately prepared to respond to flood and other disasters.
- The Project should include, as component, the dredging of Cagayan de Oro River, especially at the Balulang-side of the river.

4) Recapitulation

In response to have concerns expressed by representatives from Balulang, **XXXXX** mentioned that with regards relocation the project really have programs for it and the project will partner with various agencies like NHA, DSWD, LGUs, DENR, CSOs, NGOs, and others to provide these programs to the affected residents and institutions. She also focused on the concerns of women particularly their fear of flooding, when a participant requested for the program for disaster preparedness. **XXXXX** assured them not to fear because there are already government agencies that monitor the condition of the river and there are already early warning device implemented by the City Disaster Risk Reduction Management Council (CDRRMC).

XXXXX, a participant of Barangay Carmen, commented that dredging has never made an effect in reducing flood risk, and that he was surprised that it was being considered in the Project. **XXXXX** responded that dredging, though a palliative measure, does have an effect. When dredging is stopped, it will be observed that after 5 years or so, an "isla" or delta will start to develop. Also, it is important to identify the location of where the dredged material will be stockpiled/disposed.

(3) Stakeholder Meeting for Cluster 3 (8:00 to 12:00, Jul. 27, 2013 at North-1 District Elementary School, Puntod, Cagayan de Oro City)

The targeted barangays for this stakeholder meeting were Brgy. Macabalan, Brgy. Puntod and Brgy. Consolacion.

1) Participants

Table 10.2.5 Number of participants from Brgy. Macabalan, Puntod and Consolacion

Group/Sector	*Number of Participants*
Barangay Residents	272
Barangay Officials	33
City Government Offices	1
DPWH-PMO	4
DPWH Region 10	5
Department of Education (Elementary and High School Teachers	14
JICA Survey Team (FRIMP-CDOR)	7
Total	*336*

2) Program and Presentations

Table 10.2.6 Program schedule for stakeholder meeting for Brgy. Macabalan, Puntod and Consolacion

No.	Activity	Person(s) in charge
1	Registration (1 hr)	DPWH 10 & City Government Team
	Over-all Master of Ceremony/Facilitator	**XXXXX** Engr. II, DPWH 10
2	Preliminaries	Host Barangay
	Opening Prayer	
	National Anthem	
	Opening Remarks	**XXXXX** Barangay Chairman, Puntod
3	Project Rationale & Overview (15 min.)	**XXXXX**

No.	Activity	Person(s) in charge
		Chief, PDD DPWH 10
4	Flood Risk Management Measures (30 min.)	**XXXXX** Project Manager II DPWH - FCSEC
5	Environmental and Social Considerations (30 min.)	**XXXXX** Engineer III DPWH - ESSO-PS
	Refreshment	
6	Group Discussion by Barangay (40 min.)	DPWH 10 Group Facilitators: **XXXXX** Engr. II **XXXXX** Engr. II **XXXXX** EMS II **XXXXX** Engr. II Documenters: **XXXXX** **XXXXX**
7	Recapitulation (30 min.)	**XXXXX** Project Manager II DPWH - FCSEC
	Closing Remarks	CDO City Representative

3) Top Five Issues per Barangay

A) Barangay Macabalan

- Residents inquired as to how much will be the repayment cost of lots and what assistance will each family identified receive, including the renter and sharer; and when, how and where they will be relocated, considering that their livelihood, which is mainly fishing, is linked with Macajalar Bay.
- Pertaining to the on-going dike construction project of DPWH, the residents questioned if there was proper consultation with, and survey of the community, because they observed that some residents at riverside were given relocation assistance while others were not given.
- How many meters from the river can people be considered safe? In the outside of the so-called danger zone, where can the people build their homes?
- Barangay officials asked why the project will take two years to be implemented, considering that calamities usually come every December, each year; and also asked the Project to include the improvement of the large drainage canal at Macabalan.

- Teachers and youth representatives expressed concern about the preparedness of the community to effectively respond to calamity events.

B) Barangay Puntod

- Wish to relocation for all affected families including married sons and daughters living with their parents in the households. The relocation site should have complete amenities like water, lights, good drainage and good roads.
- Priorities of employment for affected families in affected barangays to include livelihood assistance and other economic benefits shall be provided.
- Wish to compensation for affected families to include lots, house, and improvements.
- Drainage and maintenance of drainage and canals shall be included in the Project.
- Regarding maintenance and monitoring of the project, barangay councils of Puntod, Macabalan and Consolacion should monitor and actively participate in the monitoring and maintenance of the project.

C) Barangay Consolacion

- The community inquired if the affected residents would be given relocation and financial assistance. They were especially concerned that the relocation site might not have basic facilities such as cemented road, water, and electricity; and would be far away from the city, and thus, far away from their places of work and micro-enterprises and their children's schools.
- The residents are interested in/want to be clarified as to the processes and procedures for availing of relocation and possible financial assistance (i.e., what office is responsible, timeframe and what are the compensation schemes for land lot and house owners, dwellers of a multi-family house, and renters/sharers; and if materials (wood, roofing, doors, etc.) from the demolition can be kept and re-used by the home owners.
- The residents inquire as to the basis for determining if they will be affected (i.e., distance of their house from the river) and how much longer can those people in Isla Bognao stay now that it is declared as No-Build Zone or Danger Zone.
- The residents want to know more about the FRIMP-CDOR (i.e., when will the project begin, at what point the dike will start from the mouth of the river, its length, and distance from the river bank) and if it is possible to incorporate drainage for Consolacion Elementary School as a mitigating measure since the school is situated near the river.
- Residents expressed concern about how surveys are undertaken in their community (i.e., interviewers used pencil to write the answers of respondents which they say can be edited) and if the outcome will result in fair method of awarding relocation to those who really deserve it (i.e., residents have doubts about Barangay LGU Master List of affected families since those who are closely connected to local officials seem to have the advantage in getting relocation priority).

4) Recapitulation

XXXXX said that relocation has a process that involves the Local Government and concerned agencies. Before, it was purely based on compensation of affected lands and structures, computed on the basis of zonal valuation and fair market values in a particular area. Now, relocation is required component of government projects, where the Local Government acquires the land and the National Housing Authority (NHA) develops the area and assists in formulating easy financing terms for the beneficiaries. However, not all local governments have the means to acquire relocation sites, and so it is fortunate that some projects are provided funds by the national government.

XXXXX continued that when it comes to easement, the law stipulates 40 meters from the riverbank in forestlands and 20 meters for agricultural lands and 3 meters for urban areas. These areas are supposed to be "controlled," meaning that no permanent structure is allowed to be constructed by any private person or entity. Unfortunately, this has not been case in practice. There is now a move by the Department of Environment and Natural Resources (DENR), the Lands Management Service (LMS), Department of Interior and Local Government (DILG) and other agencies to look into penalizing those involved in titling easement areas.

With regard to community consultation concerning the on-going DPWH project, **XXXXX** said that consultations are required to be conducted. However, the on-going projects in the area of Macabalan and Puntod are viewed as on-going repair and enhancement of already existing infrastructure. It is an emergency measure, funded through emergency funds of the national government. Identification of immediately affected residents in the aftermath of Tropical Storm Sendong went through a humanitarian intervention process. Currently, the existing infrastructure and basic facilities cannot keep up with the rapid growth of the population. The area is saturated. Unfortunately, under the on-going project, additional basic facilities cannot be directly provided.

Ms. Baguio emphasized the importance of the community's cooperation in the conduct of the social surveys so that the government can properly plan and allocate resources, and later on determine appropriate beneficiaries and the level assistance to be provided.

Brgy Captain **XXXXX** of Puntod explained that relocation of affected families in the project is different in the relocation of Sendong victims. Situation of Sendong is different because that was an emergency and disasters so all are victims whether you are the house owner, renters, or sharers so they are provided relocation sites. Affected families for this project are not victims but rather affected by the project. So those that will be provided relocation are the house owners and not renters and sharers.

(4) Stakeholder Meeting for Cluster 4 (13:30 to 17:30, Jul. 27, 2013 at Brgy. Nazareth Conference Hall, Barangay Nazareth Cagayan de Oro)

The targeted barangays for this meeting were Brgy. Poblacion 1, 2, 6, 7, 10, 13, 15,17, Brgy. Nazareth and Brgy. Macasandig

1) Participants

Table 10.2.7 Number of participants from Brgy. Poblacion, Nazareth and Macasandig

Group/Sector	*Number of Participants*

Barangay Residents	53
Barangay Officials	26
City Government Offices	1
DPWH-PMO	4
DPWH Region 10	5
Deparment of Education (Elementary and High School Teachers	2
JICA Survey Team (FRIMP-CDOR)	7
Total	*98*

2) Program and Presentations

Table 10.2.8 Program schedule for stakeholder meeting for Brgy. Poblacion, Nazareth and Macasandig

No.	Activity	Person(s) Responsible
1	Registration (1 hr)	**DPWH 10 & City Government**
	Master of Ceremony/Over-all Facilitation	**XXXXX** Engr. II, DPWH 10
2	Preliminaries:	**Host Barangay**
	Opening Prayer	
	National Anthem	
	Opening Remarks	**XXXXX** Barangay Chairperson, Nazareth
3	Project Rationale & Overview (15 min.)	**XXXXX** Engr. II DPWH 10
4	Flood Risk Management Measures (30 min.)	**XXXXX** Project Manager II DPWH-FCSEC
5	Environmental and Social Considerations (30 min.)	**XXXXX** Engineer III DPW- ESSO-PS
	Refreshment	
6	Group Discussion by Barangay (30 min.)	DPWH 10 Group Facilitators: **XXXXX** Engr. II **XXXXX** Engr. II **XXXXX** EMS II **XXXXX** Engr. II Documenters: **XXXXX** **XXXXX**
7	Recapitulation (30 min.)	**Answered by Officials of DPWH-PMOO**

		and DPWH 10
	Closing Remarks	CDO City Representative

3) Top Five Issues per Barangay

A) Barangay Poblacion 10, 17 & Nazareth

- Affected residents must be given relocation and livelihood assistance, because once they are asked to move, they have no place to go. Basic things are really needed, such as water & electricity, market, school, clinic, etc.
- Residents request that they be given ample notice, prior to the time they have to vacate their area
- Will those victims of Tropical Storm Sendong who have not been given relocation assistance, including those living in temporary shelters, be included in the relocation program in the Project?
- There are two streams/channels at Isla de Oro. Will the little stream be filled-up, in other words, will Isla de Oro cease to exist, or will it remain, as is?
- The Cagayan de Oro really needs to be cleaned up because the river swells very quickly when it rains.

B) Barangay Poblacion 15

- Residents who think they are affected say that they would like to be relocated (house and lot) near the city so they can be close to sources of livelihood/jobs, basic services and their children's schools. Suggestions for relocation sites: Indahag, Lumbia and Calaanan.
- Residents are interested in knowing how families in multi-household abodes can avail of relocation benefits and if they can request for livelihood assistance/compensation for the businesses they will lose.
- The residents are requesting for prior notice as to when they will be have vacate the affected areas, so they can prepare themselves.
- Isla de Oro has two channels, one is clean and the other is dirty because it has been clogged/closed. A clean up should be undertaken for the clogged channel.
- Residents inquire about which financial institution will be tapped for the Project, and how soon will implementation be?

C) Barangay Poblacion 6, 7, 13 and Macasandig

- Construction of dike and other project structures shall be done as soon as possible with relocation sites and assistance and just compensation of affected properties.
- The Project shall consolidate drainage of every barangay with the project and include waste water treatment facility so it will not pollute the Macajalar Bay.
- Employment and livelihood assistance to cover priority for affected households in affected barangays shall be ensured.

- Sustainability and operation and maintenance of the project beyond 2016 shall be ensured. It should include plans for maintenance.
- Fish and wildlife sanctuary and protected and wetland in Barangay Nazareth accretion shall be considered.

4) Recapitulation

XXXXX informed the clustered barangays that all affected residents will undergo the process and procedures for relocation and assistance, and this includes adequate prior information to the community, and proper procedures in vacating and clearing the affected areas. By this manner, the community is prepared to move. Those who have claims for compensation must provide and submit proof and other documentary requirements, which will be received and processed by the appropriate offices/agencies of the local and national government that are involved in this project.

The Project is now in the data gathering and analysis phase, there is no such final plan yet regarding Isla de Oro or of Cagayan de Oro River as a whole.

Ms. Baguio said that it is important the community cooperate and answer the question of surveyors so that the DPWH, the City Local Government, and other agencies such as the NHA, can look into the needs of those affected and determine who and the level of assistance to be provided. This is now the data gathering stage and the government agencies can only act according to the information they gather from the community and the applicable national laws, rules and implementation guidelines.

10.2.2 Wrap-up Meeting for Technical Scoping

(1) Date, Time and Venue

The wrap-up meeting was conducted from 8:00 to 12:50 at the Cattleya Function Room, N-Hotel, Kauswagan Highway, Cagayan de Oro City. The targeted barangays for this meeting were Cagayan de Oro City, Poblacion Barangays 1, 2, 6, 7, 10, 13, 15, and 17, Balulang, Bonbon, Carmen, Consolacion, Kauswagan, Macabalan, Macasandig, Nazareth, and Puntod.

(2) Participants

Table 10.2.9 Number of participants in the wrap-up meeting of the 2nd Stakeholder Meeting

Group/Sector	*Number of Participants*
Barangay Officials	18
City Government Offices	11
DPWH-PMO	5
DPWH 10	5
DENR 10 – EMB	2
JICA Survey Team (FRIMP-CDOR)	14
DILG	2
NEDA	3
NHA	1
DSWD	1
CDOR-BMC	1
Xavier University	3

House of Representatives	4
Other Government Offices	4
Private Sector/Media	4
Total	*78*

(3) Program and Presentation

Table 10.2.10 Program schedule for wrap-up meeting held on 5 September 2013

Time	Activity	Person(s) Responsible
8:00 A.M.	Registration	**DPWH 10 Team**
	Opening Prayer	**XXXXX** Head, Social Action Center Metropolitan Archdiocese of Cagayan de Oro
	National Anthem	
9:00 A.M.	Welcome Remarks	**XXXXX** Project Manager II, DPWH – PMO-FC
	Introduction of Participants	
	Talk	Mayor, Cagayan de Oro City
	Rational and overview of Wrap-up Meeting	**XXXXX** Engr. II, Task Force Sendong – DPWH 10
	Refreshment	
9:45 A.M.	Flood Risk Management Measures	**XXXXX** Project Manager II, DPWH – FCSEC
	Refreshment	
	Environmental and Social Considerations	**XXXXX** Engineer III, DPWH - ESSO-PS
	Recapitulation of Comments raised in Stakeholder Meetings	**XXXXX** Project Manager II, DPWH – FCSEC
11:20 A.M.	Forum	
12:45 P.M.	Closing Remarks	**XXXXX** Project Manager II, DPWH – PMO-FC

Master of Ceremony: **XXXXX** – DPWH 10

(4) City Mayor's Remarks

Mayor started his message by conveying how unfortunate the Sendong event for Cagayan de Oro and worst the City was not prepared for it.

He felt hurt upon hearing the information from Engr. Sosa that Cagayan de Oro is one of the 18 major River Basins in the Philippines because as River Basin, Cagayan de Oro River is supposed to have regular budgets and or appropriations for flood control. Yet nothing was done to put up flood control project. He emphasized that we much make up for this generation of neglect. He is not blaming DPWH because they have the whole country to serve. Sendong was a very painful price for the City and there is need to wake up and catch up.

Mayor express his gratitude to everybody for taking part in the process, in particular, he thank the Archdiocese of Cagayan de Oro for taking the initiative in organizing Cagayan de Oro River Basin Management Council (CDOR-BMC). He also mentioned that he is very happy that JICA, the Japanese Government is taking a closer look at the problems. He was informed that the project is now in its finishing stages of the assessment phase and the next stage is the feasibility study. He is hoping that something concrete will happen and will culminate in the signing of the agreement between the Philippines and the Japanese Governments.

The Mayor closed his remarks by saying, "I am glad that everybody is here to do this. Let us not wait for another Sendong to happen. It is not going to be easy. This is not just putting the embankment and other flood control structures. This is where we need the cooperation of Barangay Officials to help relocate those who are residing in the area that will be affected by the project. We need to work together and I hope the Barangay election will not in any way affect our working together. We belong to different parties but this is irrelevant. What is important, we must work for the welfare of the people. Life is at stake and the future of Cagayan de Oro cannot be compromised".

(5) Discussions

1) XXXXX (Party List Representative – ABANTE MINDANAO OR ABAMIN)

A) Question/s

When will the feasibility be finished?

When will construction start?

B) Responses

a) **XXXXX** (Project Manager II, DPWH –FCSEC)

XXXXX responded by providing first some history of the Master Plan. She informed the assembly that in 2009, there was already a National Program Assessment Study, where more than 1,000 river basins in the country were assessed according to some risk criteria and Cagayan de Oro River Basin is one of the 56 river basins prioritized for flood control. In 2009, there was already a local funding to do a Master Plan for Cagayan de Oro River Basin. The Master Plan was completed in 2011 but unfortunately before it can be utilized, Sendong happened. Sendong resulted to the changes in the river configuration and these necessitate the updating of the previous Master Plan. This study was conducted for the purpose of updating the previous master plan.

b) **XXXXX**, JICA Survey Team

When will the feasibility study completed? The schedule to complete the feasibility study is in November. The original schedule was this month but because of some environmental considerations (delays due to election period, the delay in the socio-economic survey, and the JICA security concern), the schedule for the completion of feasibility study was moved to November.

c) **XXXXX** (Project Manager II, DPWH –FCSEC)

When will construction start? President Aquino and DPWH Secretary are willing to invest some local funds to provide preliminary works on flood control so construction for these locally funded works have already started.

The Japanese Mission is coming this September to start ground work for the negotiation of the project.

For those huge projects that need large funds (e.g. retarding basin-to slow down the flow of water from upstream to downstream), According to Director Sosa there is a two years gestation of the loan so the earliest that we can begin construction is by 2016.

2) XXXXX (Party List Representative – ABANTE MINDANAO OR ABAMIN)

A) Question/s

How much is the expected project cost?

B) Responses

a) **XXXXX**, JICA Survey Team

The team estimated preliminary construction cost to 2 billion to 3 billion pesos. This cost may increase depending on the cost of social considerations factors (e.g. right of way acquisition, resettlement of affected residents, compensation, and others).

b) **XXXXX** (Project Manager II, DPWH –FCSEC)

XXXXX mentioned cases that sometimes the cost of construction maybe lower than the cost of right of way acquisition, resettlement, compensation package of affected residents, others.

c) **XXXXX** (Party List Representative, ABANTE MINDANAO/ABAMIN)

I am a member of the Appropriations Committee in Congress and the President has committed at least 2 billion pesos for Cagayan de Oro River. He mentioned that in their part (with Congressman **XXXXX**) they filed a bill in Congress to reforest 3,000 hectares of watershed in upstream barangays of Dansolihon, Tignapoloan,Tagpangi, and other upstream barangays. The reforestation has an approved budget of 37 million pesos.

3) **XXXXX, Barangay Consolacion**

A) Question/s

Not to pre-empt the project study, may we, the LGUs with in the river banks know at this moment, the approximate distance from the bank, which will be affected by the project. This is in order to avoid further construction of new public social infrastructures facilities.

B) Responses

a) **XXXXX** (Project Manager II, DPWH –FCSEC)

River banks under the water code have easements laws. We need to apply these easement laws. Thus, we are discouraging the LGU to put up structures within the easement areas.

b) **XXXXX**, Barangay Macabalan

There is an on-going DPWH project which is the construction of a sea wall in Barangay Macabalan. Thirty seven (37) affected families were already relocated to Pagatpat but I am concerned with the remaining 16 affected families that have been awarded already to be relocated in Pagatpat but have not move yet because they need financial assistance.

c) **XXXXX** (Project Manager II, DPWH –FCSEC)

XXXXX requested **XXXXX** (Eng. II Task Force Sendong- DPWH 10) to talk to **XXXXX** of Macabalan to find out the exact need of the remaining residents to be relocated.

d) **XXXXX** (Party List Representative – ABANTE MINDANAO OR ABAMIN)

He instructed the Barangay Secretary of Macabalan to approach the office of Congressman Rufus Rodriguez because he is willing to assist and help in the moving of the remaining beneficiaries to their relocation sites in Pagatpat.

4) XXXXX, Xavier University

A) Question/s

Before asking her question **XXXXX** made two important points: First, she expressed her appreciation to the study team for considering reforestation and to look into the watershed. She feels that whatever measures we do for flood control without protecting the watershed is useless because it will not be sustainable. Second, she informed the body that there is an NGO, the Psychosocial Association of the Philippines headed by **XXXXX**, a Guidance Councilor and a Sociologist. She informed the Study Team that the group is willing to assist and extend help for those who need Psychosocial assistance during disasters or calamities.

As an Archeologist, I am concerned with the cultural heritage of Cagayan de Oro City. I am wondering why Taguanao one of the barangay of Cagayan de Oro affected by Sendong was not included in your study? Taguanao is the site of Huluga Cave, the heritage site of Cagayan de Oro. The barangay was affected by Sendong.

B) Responses

a) **XXXXX**, JICA Survey Team

Taguanao is one of the Sitio of Barangay Indahag where Huluga Cave is located upstream of Pelaez Bridge. Taguanao is covered by the study including Talakag and Baungon. However, the proposed structures only covers the stretch from the river mouth (Macabalan and Bonbon) up to about 11.6 kilometers, a little upstream of Balulang. The proposed structures are about 2 to 3 kilometers away from the site of Huluga Cave. The proposed project covers only the downstream because these are the areas where more damaged happened during Sendong and therefore there is immediate need of protection from the flood.

b) **XXXXX**, JICA Survey Team

Why are we doing the project only from the river mouth to the downstream of Pelaez bridge? These are the areas where many were affected by the flood.

c) **XXXXX** (Project Manager II, DPWH –FCSEC)

This is good that the matter of Huluga Cave surface so it will be addressed and the Team should pay attention to it. Later when the proposed feasibility study is available, then the group can check whether the Huluga Cave will be affected.

d) **XXXXX** (EMB, DENR-10)

As agreed with JICA Team, this is the last scoping sessions. There will be no more convocations for scoping assessment. It is now up to JICA Survey Team to check whether Huluga Cave will be affected by the proposed structures of the project. The existing law requires 1 kilometer radius or distance from the structure to be considered safe from effects.

5) XXXXX (City Director, DILG Cagayan de Oro City)

A) Question/s

I just wondered why Baungon and Talakag are not part of the study because we are not just talking about the effect of the project to the environment but the future effect of the economic activities upstream to the project and the environment. We need the communities upstream to have co-ownership of the project here in Cagayan de Oro. It is a fact that the City is receiving waste, water and other debris from upstream communities. They must be involved and I am wondering if in the scoping of the project, economic activities upstream were included.

B) Responses

a) **XXXXX** (Project Manager II, DPWH –FCSEC)

The study included and considered economic activities upstream including areas of Huluga Cave and Baungon and Talakag being part of the whole Cagayan de Oro River Basin. Communities upstream were involved in the data gathering to include the socio-economic, hydrologic, environmental data of for the whole River Basin.

b) **XXXXX** (CLENRO, Cagayan de Oro City)

CLENRO is part of the Cagayan de Oro River Basin Management Council (CDOR-BMC) spearheaded by Archbishop Antonio Ledesma. I would like to inform the body that CDOR-BMC involved the communities upstream in the rehabilitation of the forest areas. One of the identified mechanisms of the CDOR-BMC reforestation project is to include a component of reforestation integrating it with the livelihood activities of residents in upstream communities where they get paid for every replanting services that they do.

c) **XXXXX** (EMB, DENR - 10)

The comment on the watershed concept upstream that means involve other activities like reforestation and land and environmental management is a holistic approach. Our study here in Cagayan de Oro is more specific that look into direct impact-primary impact because if we study the whole river system, until 10 years we are still studying and will not see the implementation of the project. We need to limit our concern according to priorities. Otherwise, we will not finish and complete the study.

The purpose of the scoping is to scope what are the primary issues and concern that will come out in the study that we need to respond and mitigate and provide resources for these direct concerns.

d) **XXXXX** (City Director, DILG Cagayan de Oro City)

I would like to propose that this study be presented to the CDOR-BMC because representative of upstream LGUs are also member and part of the council.

Follow –up Written Proposal 2: handed to **XXXXX** by **XXXXX** (Engineering

Resource Center, Xavier University and Representing the Executive Committee of CDOR-BMC).

I am supposed to personally and privately invite the DPWH-JICA team for a presentation to the CDOR-BMC Executive Committee (Execom). But since the matter already surfaced, I am officially inviting the DPWH-JICA team to present the project before it gets finalized and especially because there is also a Cagayan de Oro River Basin Master Plan.

(**XXXXX** JICA Survey Team, after the session, personally talked with Engr. **XXXXX** and explained that the JICA Survey Team (JST) will present the Master Plan in the next Stakeholder Meeting scheduled next month instead of presenting it in CDOR-BMC conference. Engr. **XXXXX** agreed to this proposal.)

6) XXXXX (CLENRO, Cagayan de Oro City)

A) Question/s

Have you taken into consideration the Hydroelectric Dam to be constructed at Cagayan de Oro River in the side of Barangay Lumbia? (**XXXXX**) What is the impact of this dam to the dike?

B) Response/s

a) **XXXXX**, JICA Survey Team

According to our study, there are no existing hydroelectric power dams in the midstream of mainstream of Cagayan de Oro Rivers that will be affected by the proposed project. In the course of the study, it was found that there is a proposed hydroelectric power dam which is approximately 120 meters in height. Our study considered this power generation dam but it will not be affected by the project. One idea is to use the dam as multipurpose structure not only for hydroelectric power generation but also to use for flood control.

7) XXXXX (Cagayan de Oro City Administrator)

A) Question/s

I would like to react first to the issue of turning over flood control structures to LGUs. I believed flood control structures are not just a concern of any one LGU but involved a lot of LGUs. So I would like to support the previous discussion that it should remain under the management of DPWH.

This is important especially that the local government is now in the process of looking into the application for renewal of quarrying permits. What is the role of local government agencies? What is the plan of the city, where and how to extract very important resources? Resources like gravel and sand that comes from the river that is important to our infrastructures development in the city. We cannot just say no to this quarrying business because the city needs this resource from the river. The project will construct embankment in the river banks. Are there provisions and considerations for entry and exit to and from the river?

B) Response/s

a) **XXXXX** (Project Manager II, DPWH –FCSEC)

The design of the dike considers several important stop gates for maintenance purposes. But in addition to this, there are some social considerations entries and exits (e.g. gender considerations) provided in the planned or proposed structures. If there are quarrying activities present in an area, the design of the structures should facilitate entrance and exits in the area.

It is important that LGUs be involved. There are instances in other project of stealing of expensive equipments for flood control. LGUs contribute so much in informing barangay residents to take care of these equipments.

b) **XXXXX**, JICA Survey Team

Small sand mining and excavation is considered by the study, in particular if in midstream. The proposed structures will consider providing exits and entrances for small sand mining and quarrying in the river.

c) **XXXXX** (EMB, DENR-10)

With regards the question of the City Administrator asking for the existence of institutional mechanisms with regards the issuance of quarrying of sand and gravel permits. Actually DPWH now is directly involve because issuance of permits need consent of DPWH whether the group or business is allowed or not allowed to quarry in that particular area of the river. The mechanism is between the LGU that issue the quarrying permits and DPWH that give clearance whether the area of the river is allowed for quarrying or not. Technically speaking, there is a need to define the gradient that one is allowed to quarry. How far from the structure downstream and upstream of the structure is allowed? Who and where the guidelines should come from? Who should monitor and maintain that the guidelines are followed? Otherwise, the tendency of the group is to quarry in areas that are easy and most accessible.

I think there must be a master plan and we should follow a master plan. What gradient should be maintained adjacent to the structure. Is it possible that the Technical Team of JICA will be able to come up with the prescribed gradient from Taguanao to the mouth of the river? This is the gradient that we should follow.

These small sand mining and quarrying excavation must be regulated and plan properly by the City and by DPWH. Which part of the river should it be allowed and what amount of sand should be taken out? The City and DPWH must regulate these extraction activities.

d) **XXXXX** (Project Manager II, DPWH –FCSEC)

As a follow-up to points made by **XXXXX**, **XXXXX** explained that not only elevation and gradient study are needed but also sedimentation study. What kinds of sediments are present and in what part or area of the river? In dredging project, we required clearance from EMB of what will be dredged and what volume of materials will be taken out. What is the plan elevation of the river that should be maintained and that you want to achieve upstream and downstream. The actual shape of river elevation desired must be maintained so we cannot just allow dredging anywhere without clearance from EMB of DENR. In similar manner, the LGU and EMB of DENR must not only monitor the dredging part but also where the spoilage is dumped.

The hydraulic part is the main concern of DPWH but the extraction of sediments or quarrying of sand and gravel and other mining activities are DENR and LGU matters. Thus, LGU should monitor those entities that she gave quarrying and or dredging permits.

10.3 Stakeholder Meetings for Master Plan and the Examination of Alternatives

Stakeholder meeting for Master Plan and Alternative Studies for the Project was held in CDO City on Oct. 25, 2013, 8:30 to 12:00 at the Cattleya Function Room, N-Hotel, Kauswagan Highway, Cagayan de Oro City. The following are the minutes of discussion in the meeting:

(1) Participants

Table 10.3.1 Number of participants from Brgy. Bonbon and Kauswagan

Group/Sector	*Number of Participants*
City Government Officials	1
Barangay Government Officials	10
Municipal Government Officials	2
Civil Society/Non-Government Organizations	9
Government Regional Offices/Agencies	10
Utilities	2
Academe	2
Business/Private Sector	4
DPWH – PMO	6
DPWH 10	10
JICA Study Team	7
Total	**63**

(2) Program and Presentation

Table 10.3.2 Program schedule for wrap-up meeting held on 25 October 2013

Time	Program Activities	Speaker/In-charge
8:00-9:00	1. Registration	**DPWH Team** assisted by **XXXXX & XXXXX**
9:00-9:20 AM	2. Opening Ceremonies Opening Prayer National Anthem	Master of Ceremonies: **XXXXX**, Admin. Officer V DPWH Team
9:20-9:40	3. Welcome/Inspirational Message	**XXXXX** Chief, PDD, DPWH 10
9:40 – 9:50	4. Short Message	City Mayor, Cagayan de Oro City
9:50-10:10	5. Project Rationale and Overview	**XXXXX** Asst. Head, Task Force Sendong, DPWH 10
REFRESHMENT		
10:10-10:40	6. The FRIMP-CDOR Master Plan	**XXXXX** Project Manager II, DPWH-FCSEC
10:40 – 11:10	7. Environmental Evaluation and the Examination of Alternatives	**XXXXX** DPWH-ESSO-PS
11:10 – 11:50	8. Open Forum	Moderator: **XXXXX**
11:50 - 12:00 noon	9. Closing Remarks	**XXXXX** Project Manager II, DPWH – FCSEC

(3) Minutes of the Meeting

1) Welcome Remarks on behalf of DPWH 10 Regional Director

The Chief Planning and Design Division, **XXXXX** of the DPWH 10 welcomed the participants to the Third Stakeholders' Meeting in half of the Regional Director **XXXXX**. He reminded that other areas were hit by Tropical Storm Sendong in 2011, but it was in Cagayan de Oro that the greatest devastation was experienced. He said that prudent policies and plans with an informed community will can sustain life and avert damages. That is why there is a need for greater assessment and study for the Cagayan de Oro River which is being conducted by the DPWH in cooperation with the JICA Study Team. He invited the participants to actively participate in the open forum. He added that with support of local officials and cooperation of stakeholders, the DPWH will be able to implement a Flood Risk Management Project that can cope with the demands of the inhabitants, in order to have a flood-free Cagayan de Oro in the future.

2) Discussion (Questions and Answers)

A) XXXXX

a) Question/Comment

He requested the DPWH/JICA study team to facilitate an orientation/consultation for all of the Cagayan de Oro River Basin Management Council members.

He noted that in the past, Cagayan de Oro River used to be a main transport route and the riverbanks were still a source of a scenic beauty. Then, with regard to the design, specifically the walkway, he pointed out that it is too narrow and then suggested to the study team to consider widening the walkway so that in the future, it can be utilized for the construction of concrete structures to create parks/recreation areas in hopes of creating a scenic view close, if not similar, to Han River in South Korea.

If the retarding basin could not be utilized for the parks, **XXXXX** pointed out that there are still areas/portions of land that can be utilized without requiring a right of way.

b) Responses

i) **XXXXX** (Project Manager II, DPWH –FCSEC)

XXXXX commented that the study team shares the same vision with **XXXXX** regarding the possibility of constructing park/recreation area structures. However, because of the structures, mostly residential, which are built in the riverbanks without taking into consideration the 3-meter rule of the water code, the riverbanks do not have enough easements to cater to the construction of parks/recreation areas. Also, financially, Philippines just could not afford such developments at the moment. The walkway provided in the project should be enough to let the people maximize/enjoy the ambiance of the present river scenery. In addition, she explained that the walkway is just part of the rehabilitation of the existing walkway since there are people and properties that need to be protected in the area. Buying these properties so that it could be fully utilized will be more costly than the proposed project itself.

ii) **XXXXX**, JICA Survey Team

XXXXX said that if there are recommendations from the local government or DENR on how to utilize the area, citing Isla de Oro as an example, maybe the Study Team will consider. But temporarily, the Study Team is recommending a river station for navigation around the river.

B) XXXXX (NEDA 10)

a) Question/Comment

XXXXX noted that Case 3 alternative, which is designed for a 25-year flood return period and would cost the lowest compared to the 1st and 2nd alternatives, would not be enough to accommodate the volume of the water released from Bulanog-Batang dam in case of the 50-year flood return period. Once the water is released from it, then there is a possibility that water could still overflow from the river despite the dike. And in addition to his question, he asked if the project will be implemented one-time or by tranche.

b) Responses

i) **XXXXX** (Project Manager II, DPWH –FCSEC)

XXXXX responded that the 12.6 KM project will be a one-time implementation since that is the scope of this short-term project.

ii) **XXXXX**, JICA Survey Team

XXXXX said the concept for construction for 50-year flood event will be a dam in the upstream. Sendong level flood was around 2,700 m^3/sec. and will go directly downstream without dam, but if a dam is constructed upstream the flow can be reduced to 1,000 m^3/second. This is the effect of the dam. So the dike should be complemented with dam.

iii) **XXXXX** (Project Manager II, DPWH – PMO-FC)

XXXXX added that although the project is designed to address a 25-year flood return, aside from the design's elevation, a 1.2-meter freeboard within the framework of the design was suggested to the study team by the DPWH Bureau of Design. With the freeboard, the structure may be able to accommodate a 50-year flood return period. Currently, the study team is evaluating the said proposal.

C) XXXXX (Safer River Life Saver Foundation and Liceo de Cagaya University)

a) Question

Does study team consider the storm well as an alternative for mitigate flood?

b) Responses

i) **XXXXX**, JICA Survey Team

XXXXX explained that storm well in the urban environment of Cagayan de Oro will not be effective because the floodwater is coming from the upstream. It might be effective if the drainage system in the city will be improved.

ii) **XXXXX** (Project Manager II, DPWH –FCSEC)

XXXXX added that storm well should be compatible with the drainage network, it needs accessories to be linked to the drainage network, it is dangerous and could pollute the ground water which is the source of drinking water from some residents in the city and lastly, storm well is expensive and CDO would need a lot of storm wells for a 2700 m^3/sec. flow.

D) XXXXX, Regional Development Council 10

a) Question

XXXXX inquired about total the cost of the project which is PhP 8 to PhP 9 Billion including the right-of-way, which was affirmed by **XXXXX**. He suggested to the Study Team to spend the PhP 9 Billion relocating all the people occupying the flood areas instead of constructing a structure that could still possibly not work to mitigate flood.

b) Responses

i) **XXXXX** (Project Manager II, DPWH –FCSEC)

According to **XXXXX**, it is very difficult to remove the people from the affected area. There are about 10,000 houses (40,000 -50,000 people) to be relocated. Buying the lands would cost more than the proposed flood mitigation structure itself. Also, there are government structures which are just not possible to remove. With the help of LGUs, the study team is devising plans on what could be done for the people without spending too much.

E) XXXXX

a) Question/Comment

XXXXX asserted to address “natural problems” rather than infrastructure constraints. In the case of Cagayan de Oro River, he asked the study team to look in to the mouth of the river and deal with the silted area.

b) Responses

i) **XXXXX** (Project Manager II, DPWH –FCSEC)

XXXXX emphasized that the analysis of the situation in the mouth of the river is part of the study along with watershed activities, economic implications and other issues. The reason for the infrastructure component of the study is to protect the existing activities in the affected area. Also, she noted that United Nations Framework for climate change recommends one basic strategy, which is to remove the people at risk that is why the study is also looking at relocating people occupying the river area.

F) XXXXX (MINDA)

a) Question/Comment

With regard to the question of **XXXXX** pointed out that the Bulanog-Batang Dam project is not within the control of the study and can be further discussed separately. If so, would the discussions be with the Department of Energy (DOE) or National Power Corporation (NPC)?

He suggested to CDORBMC to invite the agencies who are developing the master plan for the Cagayan de Oro River Basin in their next meeting. He also mentioned to include inviting the Macajalar Bay Development Alliance for the discussion regarding the reefs in the affected area.

He asked if the track of the funding would be ODA or PPP. He is concerned that the proposal might change track from ODA to PPP, and yet reversed again, as with the case of the Mindanao Railways Project.

b) Responses

i) **XXXXX** (Project Manager II, DPWH –FCSEC)

XXXXX made a clarification on the concept for the dam. She explained that for the requirements of this project, it would not involve the whole or total storage of capacity of the dam, in order to address the 50-year flood. Rather, since there is already that hydropower dam proposal, this flood control project would only "ride-on" to the dam's storage capacity. So for example, if the existing height of the dam is 50 meters, then the project would only add 10 meters to that, order address the long-term flood mitigation requirement.

XXXXX maintained that the track of the project is ODA since it is protection from disaster which is basically a government undertaking, and will less likely generate income. Hence, it could not be in a PPP track. But this will not stop DPWH from putting up funds for other components. It has already been putting up funds for the immediate restoration of the destroyed infrastructures during previous flood events, including protection of some dikes. But bulk of this will be ODA.

XXXXX said that according to BOT Office of the Department of Finance, there would be a need to lump this flood mitigation component with other projects within the basin to make it an attractive for PPP. She added that perhaps with the dam, PPP is feasible since there is income in power generation. She added, this can be an area of discussion in the future that perhaps, DPWH subsidizes a portion of the construction of the dam, and then, other components would be through PPP. It is a financing mechanism that can be studied in the future.

G) XXXXX

a) Question/Comment

XXXXX added that if the Philippines is looking at the 50-year flood protection level, holistic approach should be considered and the master plan should be created as comprehensive as possible.

b) Responses

i) **XXXXX** (Project Manager II, DPWH –FCSEC)

XXXXX, agreed with **XXXXX**'s suggestion, however, according to her, it is difficult to integrate all the plans for the river basin because apparently, in the Philippines, there are more than 30 water agencies. This makes it difficult to synchronize the activities.

H) XXXXX, the Regional Development Council 10

a) Question/Comment

XXXXX reiterated that MINDA is supposed to be the super body for Mindanao. He also concurred on the previous statement of **XXXXX** that holistic approach is important. Then, he asked if there is a way to converge all the activities in the CDO River Basin to come up a long-term solution to the problems. And in addition, he said there is a PhP50 Billion budget allocated by the Philippine government for moving people away from the danger zones in the different parts of the country. Lastly, he requested the different agencies for CDO river basin to get access at least part of the PhP50 Billion budget to start moving away the people living along Cagayan de Oro river.

b) Response

i) **XXXXX** (Project Manager II, DPWH –FCSEC)

XXXXX expressed that in order to start making the plans in moving people away from the riverbanks, the group would need a Basin Plan which is currently not yet available. RBCO is tasked to do it but unfortunately, the focused is on administrative planning.

I) XXXXX, CDORBMC

a) Question/Comment

XXXXX is inviting the JICA Study Team to present to the Council on its next board meeting, possibly on December this year, the result of the study.

He also suggested that the model used by the study team in the analysis be integrated with the LiDAR model of **XXXXX**, UP.

With regard to the design of the project with consideration of the water from hinterland, **XXXXX** asked if how the drainage water will flow out to the river if the river has a wall (dike) and especially if the water in the river is already at a high level.

b) Responses

i) **XXXXX**, DPWH 10

XXXXX of the DPWH 10 reported that there would be outfall and flood gates to accommodate the water flowing out from the drainage. He noted that the project actually applies a holistic approach.

J) XXXXX, Barangay Bonbon

a) Question

XXXXX inquired about the design, why the design of the project traverses inside the Barangay tramping almost 1/3 of the barangay’s total land area.

b) Responses

i) **XXXXX**, JICA Survey Team

XXXXX explained that the reason for the design traversing big part of the barangay is for protection and for access from the side of the raised road, so that it could be used for evacuation should the need arise.

ANNEXES

Annex 1 Bibliography

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Annex 2 Certificate of Laboratory Analysis / Raw Data

(1) Air Quality

EI-ADMINFORM-34-REV1

ELARSI, INC.

Unit 201-202 Rizalina Annex Bldg. 1877 Quezon Avenue, Quezon City
Tel. No. 927-77-15 Fax No. 929-4824 Email: info@elarsi.com

CLIENT	**CAGAYAN DE ORO RIVER FLOOD CONTROL PROJECT**	Lab. Report No.	131060
ADDRESS	Quezon City	Date Sampled	04-04-13 to 04-08-13
		Date Received	04-10-13
Nature of Sample/s	Ambient Air Sample	Date Analyzed	04-12-13 to 04-15-13
No. of Sample/s Submitted	Three (3)	Date Reported	04-16-13

[REPORT OF ANALYSES]

Sample No.	Sample ID	TSP, µg/Ncm
ES-1306245	Sta 1 – Puntod	392.08
ES-1306246	Sta 2 – Kauswagan	351.20
ES-1306247	Sta 3 – Tibasak, Macasandig	275.81
Method		**Gravimetric**
Detection Limit		**0.0020**

Reference:
James P. Lodge, Methods for Ambient Air Sampling & Analysis, 3rd edition

Checked By:

RENATO M. GOFREDO JR.
Chemist

Certified By:

RESSAN K. ARBUTANTE
Laboratory Manager

DENR RECOGNIZED LABORATORY C.R. No. 005/2011

PAO ACCREDITED TESTING LABORATORY PNS ISO/IEC 17025:2005 LA-2009-147/0A

DOH ACCREDITED LABORATORY C.A. No. 018/2012

Test results reflect the quality of the samples as received.

Page 1 of 1 Page/s

EI-ADMINFORM-34-REV1

ELARSI, INC.

Unit 201-202 Rizalina Annex Bldg. 1677 Quezon Avenue, Quezon City
Tel. No. 927-77-15 Fax No. 929-4824 Email: info@elarsi.com

CLIENT	CAGAYAN DE ORO RIVER FLOOD CONTROL PROJECT	Lab. Report No.	131061
ADDRESS	Quezon City	Date Sampled	04-04-13 to 04-08-13
		Date Received	04-10-13
Nature of Sample/s	Ambient Air Sample	Date Analyzed	04-12-13 to 04-16-13
No. of Sample/s Submitted	Three (3)	Date Reported	04-16-13

[REPORT OF ANALYSES]

Sample No.	Sample ID	SO_2, µg/Ncm
ES-1306248	Sta 1 – Puntod	1.230
ES-1306249	Sta 2 – Kauswagan	1.353
ES-1306250	Sta 3 – Tibasak, Macasandig	1.967
Method		Pararosaniline
Detection Limit		0.04

[illegible]
James P. Lodge, Methods for Ambient Air Sampling & Analysis, 3rd edition

Checked By:

RENATO M. GOFREDO JR.
Chemist

Certified By:

RESSAN K. ARBUTANTE
Laboratory Manager

DENR RECOGNIZED LABORATORY C.R. No. 005/2011

PAO ACCREDITED TESTING LABORATORY PNS ISO/IEC 17025:2005 LA-2009-147/8A

DOH ACCREDITED LABORATORY C.A. No. 018/2012

Test results reflect the quality of the samples as received.

Page 1 of 1 Page/s

EI-ADMINFORM-34-REV1

ELARSI, INC.

Unit 201-202 Rizalina Annex Bldg. 1677 Quezon Avenue, Quezon City
Tel. No. 927-77-15 Fax No. 929-4824 Email: info@elarsi.com

CLIENT	CAGAYAN DE ORO RIVER FLOOD CONTROL PROJECT	Lab. Report No.	131062
ADDRESS	Quezon City	Date Sampled	04-04-13 to 04-08-13
Nature of Sample/s	Ambient Air Sample	Date Received	04-10-13
No. of Sample/s Submitted	Three (3)	Date Analyzed	04-10-13 to 04-16-13
		Date Reported	04-16-13

[REPORT OF ANALYSES]

Sample No.	Sample ID	NO_2, µg/Ncm
ES-1306251	Sta 1 – Puntod	1.599
ES-1306252	Sta 2 – Kauswagan	1.846
ES-1306253	Sta 3 – Tibasak, Macasandig	0.623
Method		Griess-Saltzman
Detection Limit		0.01

Reference:
James P. Lodge. Methods for Ambient Air Sampling & Analysis 3rd edition.

Checked By:

RENATO M. GOFREDO JR.
Chemist

Certified By:

RESSAN K. ARBUTANTE
Laboratory Manager

DENR RECOGNIZED LABORATORY C.R. No. 005/2011

PAO ACCREDITED TESTING LABORATORY PNS ISO/IEC 17025:2005 LA-2009-147/8A

DOH ACCREDITED LABORATORY C.A. No. 018/2012

Test results reflect the quality of the samples as received.

Page 1 of 1 Page/s

AERONICS INCORPORATED

ENVIRONMENTAL LABORATORY DIVISION

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Mobile Phone: 0918-9243546
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CLIENT : WOODFIELDS CONSULTANT INC.

ADDRESS : 153 Kamias St., Diliman,
Quezon City

DATE : September 12, 2013

REFERENCE NO. : 09-13-063AA

SAMPLE DESCRIPTION : Air - Ambient

SAMPLE IDENTIFICATION #: 13-09A196 - A198

COLLECTED BY : Aeronics Staff

CERTIFICATE OF ANALYSIS

Sample ID Number	Station Number	Station Description	Date and Time of Sampling	CONCENTRATION (µg/Ncm)			
				PM_{10}	TSP	SO_2	NO_2
13-09A196	1	Beside riverbank retaining wall, approx. 40 m away from Brgy. Macabalan basketball court N8°30'14.2488" E124°39'29.682"	9/3 - 4/2013 1600H-1600H	34	75	40	31
13-09A197	2	Godornes residence, St. Ignatius St. Zone 3, Brgy. Kauswagan, approx. 70 m away from CDO river N8°29'31.4952" E124°38'29.5908"	9/4 - 5/2013 1700H-1700H	52	111	46	39
13-09A198	3	Zone 4 Tibasak, Macasandig basketball court, approx. 150 m away from CDO river N8°27'0.3168" E124°38'24.5868"	9/5 - 6/2013 1800H-1800H	27	49	29	20
		Standard (µg/Ncm) / 24 hours		150	230	180	150

REMARKS:

1) Method of Analysis used: Methods of Air Sampling and Analysis, Third Edition.
pp. 427-436, 389-394, 493-498.
4) The results obtained are all within the National Ambient Air Quality Standards set by the DENR.
5) Report of analysis refers only to the sample collected last September 3 - 6, 2013.

ANALYZED BY:
CHRISTINE M. MIRALLES

CERTIFIED BY:
ANNABELLE A. ZAMUDIO PRC No. 07499

NOTED BY:
REO F. FECA PRC No. 69225
Laboratory Head

Signed for the Company by:
SUSAN M. ALMANZOR
Operations Manager

DENR Recognized Laboratory
Air, Water, Wastewater
C.R. No. 034

DENR Accredited
Source Emission Testing Firm
SAT. No. 2011 - 04

DOH Accredited
Drinking Water
Accreditation No. 008

(2) River Water Quality

Results of Analyses

Woodfields Consultants, Inc.
153, Kamias Rd. Ext., Kamias
Quezon City

PAO ACCREDITED TESTING LABORATORY PNS ISO/IEC 17025:2005 LA-2008-118A

SN: F00014692.018

Date Received: 04/04/2013

Lab No.:P00043370

Project Name: CDO FLOOD CONTROL PROJECT

Attention: Ms. Marilynn Musa

Test Description	Results	Units	MDLs	Test Methods	Date Analyzed	By	Ref
Sample No.: P00043370-01			**DateSampled: 04-04-13 09:45**				
Sample ID: STATION 1			**Matrix: Surface Water**				
-Metals-							
Arsenic	ND	mg/L	0.01	SDDC, Spectrophotometry	04/10/13	MVTM	
Cadmium	ND	mg/L	0.006	Flame AAS	04/10/13	PPG	
Copper	ND	mg/L	0.02	Flame AAS	04/10/13	GGR	
Lead	ND	mg/L	0.04	Flame AAS	04/10/13	PPG	
Mercury	ND	mg/L	0.0001	Manual Cold Vapor AAS	04/12/13	MVTM	
-Microbiology-							
Total Coliforms	24,000	MPN/100mL	N/A	Multiple Tube Fermentation Technique	04/05/13	JGE	
Fecal Coliforms	13,000	MPN/100mL	N/A	Multiple Tube Fermentation Technique	04/05/13	JGE	
-Wet Chemistry-							
pH, Laboratory @ 23.5°C	7.4	-	0.1*	Electrometric Method	04/05/13	JMG	
Biological Oxygen Demand	4	mg/L	1	Azide Modification Winkler (SM 5210B)	04/05/13	JMG	
Chemical Oxygen Demand	29	mg/L	4.0*	Open Reflux Method (SM5220B)	04/10/13	MCP	
Total Suspended Solids	9.0	mg/L	2.5	Gravimetry (SM2540 D)	04/10/13	BRIP	
Oil & Grease	0.56	mg/L	0.40	Pet. Ether Extraction (DENR-EMB Modified)	04/05/13	WBD	
Hexavalent Chromium	ND	mg/L	0.003	Diphenylcarbazide, Colorimetric Method (SM3500-Cr B)	04/05/13	JCA	
Cyanide, Free	0.03	mg/L	0.02	Ion Selective Electrode (SM 4500 CN-F)	04/10/13	MPT	
Nitrate - N	ND	mg/L	0.02	Colorimetry - Brucine	04/05/13	LCR	
Phosphate-P	ND	mg/L	0.006	Stannous Chloride Method (SM4500-P D)	04/05/13	JCA	
			>>> end of result set for Sample No.:P00043370-01 <<<				
Sample No.: P00043370-02			**DateSampled: 04-04-13 12:30**				
Sample ID: STATION 2			**Matrix: Surface Water**				
-Metals-							
Arsenic	ND	mg/L	0.01	SDDC, Spectrophotometry	04/10/13	MVTM	
Cadmium	ND	mg/L	0.006	Flame AAS	04/10/13	PPG	
Copper	ND	mg/L	0.02	Flame AAS	04/10/13	GGR	
Lead	ND	mg/L	0.04	Flame AAS	04/10/13	PPG	
Mercury	ND	mg/L	0.0001	Manual Cold Vapor AAS	04/12/13	MVTM	
-Microbiology-							
Total Coliforms	3,500	MPN/100mL	N/A	Multiple Tube Fermentation Technique	04/05/13	JGE	
Fecal Coliforms	1,100	MPN/100mL	N/A	Multiple Tube Fermentation Technique	04/05/13	JGE	
-Wet Chemistry-							
pH, Laboratory @ 23.4°C	7.8	-	0.1*	Electrometric Method	04/05/13	JMG	
Biological Oxygen Demand	1	mg/L	1	Azide Modification Winkler (SM 5210B)	04/05/13	JMG	
Chemical Oxygen Demand	5.0	mg/L	2.0	Open Reflux Method (SM5220B)	04/10/13	MCP	
Total Suspended Solids	16	mg/L	2.5	Gravimetry (SM2540 D)	04/10/13	BRIP	
Oil & Grease	0.51	mg/L	0.40	Pet. Ether Extraction (DENR-EMB Modified)	04/05/13	WBD	
Hexavalent Chromium	ND	mg/L	0.003	Diphenylcarbazide, Colorimetric Method (SM3500-Cr B)	04/05/13	JCA	
Cyanide, Free	ND	mg/L	0.02	Ion Selective Electrode (SM 4500 CN-F)	04/10/13	MPT	
Nitrate - N	ND	mg/L	0.02	Colorimetry - Brucine	04/05/13	LCR	
Phosphate-P	ND	mg/L	0.006	Stannous Chloride Method (SM4500-P D)	04/05/13	JCA	
			>>> end of result set for Sample No.:P00043370-02 <<<				

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Sample No.: P00043370-03
Sample ID: STATION 3
DateSampled: 04-04-13 13:35
Matrix: Surface Water

Test Description	Results	Units	MDLs	Test Methods	Date Analyzed	By	Ref*
-Metals-							
Arsenic	ND	mg/L	0.01	SDDC, Spectrophotometry	04/10/13	MVTM	
Cadmium	ND	mg/L	0.006	Flame AAS	04/10/13	PPG	
Copper	ND	mg/L	0.02	Flame AAS	04/10/13	GGR	
Lead	ND	mg/L	0.04	Flame AAS	04/10/13	PPG	
Mercury	ND	mg/L	0.0001	Manual Cold Vapor AAS	04/12/13	MVTM	
-Microbiology-							
Total Coliforms	7,900	MPN/100mL	N/A	Multiple Tube Fermentation Technique	04/05/13	JGE	
Fecal Coliforms	4,900	MPN/100mL	N/A	Multiple Tube Fermentation Technique	04/05/13	JGE	
-Wet Chemistry-							
pH, Laboratory @ 23.3°C	7.7	-	0.1*	Electrometric Method	04/05/13	JMG	
Biological Oxygen Demand	1	mg/L	1	Azide Modification Winkler (SM 5210B)	04/05/13	JMG	
Chemical Oxygen Demand	5.0	mg/L	2.0	Open Reflux Method (SM5220B)	04/10/13	MCP	
Total Suspended Solids	6.0	mg/L	2.5	Gravimetry (SM2540 D)	04/10/13	BRP	
Oil & Grease	0.43	mg/L	0.40	Pet. Ether Extraction (DENR-EMB Modified)	04/05/13	WBD	
Hexavalent Chromium	ND	mg/L	0.003	Diphenylcarbazide, Colorimetric Method (SM3500-Cr B)	04/05/13	JCA	
Cyanide, Free	ND	mg/L	0.02	Ion Selective Electrode (SM 4500 CN-F)	04/10/13	MPT	
Nitrate - N	ND	mg/L	0.02	Colorimetry - Brucine	04/05/13	LCR	
Phosphate-P	ND	mg/L	0.008	Stannous Chloride Method (SM4500-P D)	04/05/13	JCA	

>>> end of result set for Sample No.:P00043370-03 <<<

>>> end of result set for Lab No.:P00043370; Total no. of samples analyzed: 3 <<<

N/A = Not Applicable
MPN = Most Probable Number
ND = Not Detected (Below MDL)
MDL = Method Detection Limit/s
*IDL = Instrument Detection Limit/s
Results are reported "as received basis".
^DLR = Detection Limit/s for Reporting (MDL x Dilution Factor)
This report supersedes CRL Laboratory Report with SN: F00014892:017
Perkin Elmer / Varian / Shimadzu Analytical Methods, Atomic Absorption Spectrophotometry (AAS)
Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WEF, 22nd Edition.
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Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020

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Certified by:

Geraldine T. Yabut
PRC License No.: 0027218
Microbiological Testing

Date: 08/13/13

Ronald S. Espiritu
PRC License No.: 9248
Chemical Testing

Date: 08/13/13

Juliana C. Oriña
PRC License No.: 8174
Chemical Testing

Date: 8/17/13

Chas C. Arroyo
PRC License No.: 8701
Chemical Testing

Date: 8/17/13

SN: F00014892.018

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Results of Analyses

Woodfields Consultants, Inc.
153, Kamias Rd. Ext., Kamias
Quezon City

PAO ACCREDITED TESTING LABORATORY PNS ISO/IEC 17025:2005 LA-2008-119A

PAO ACCREDITED TESTING LABORATORY PNS ISO/IEC 17025:2005 LA-2008-118A

SN: F00016915.001

Date Received: 09/04/201

Lab No.:P00045540

Project Name: CDO EIA

Attention: Ms. Marilynn Musa

Test Description	Results	Units	MDL	Test Methods	Date Analyzed	By	Ref*
Sample No.: P00045540-01			**DateSampled: 09-04-13 08:20**				
Sample ID: STATION 1			**Matrix: Surface Water**				
-Metals-							
Arsenic	< 0.01	mg/L	0.01	SDDC, Spectrophotometry	09/08/13	MVTM	
Cadmium	< 0.006	mg/L	0.006	Flame AAS	09/09/13	PPG	
Copper	< 0.02	mg/L	0.02	Flame AAS	09/06/13	GGR	
Lead	< 0.04	mg/L	0.04	Flame AAS	09/09/13	PPG	
Mercury	< 0.0001	mg/L	0.0001	Manual Cold Vapor AAS	09/10/13	MVTM	
-Microbiology-							
Total Coliforms	16,000	MPN/100mL	N/A	Multiple Tube Fermentation Technique	09/05/13	GTY	
Fecal Coliforms	1,700	MPN/100mL	N/A	Multiple Tube Fermentation Technique	09/05/13	GTY	
-Wet Chemistry-							
Biological Oxygen Demand	5	mg/L	1	Azide Modification Winkler (SM 5210B)	09/06/13	WBD	
Chemical Oxygen Demand	9.7	mg/L	2.0	Open Reflux Method (SM5220B)	09/09/13	MCP	
Total Suspended Solids	32	mg/L	2.5	Gravimetry (SM2540 D)	09/09/13	IRC	
Oil & Grease	0.6	mg/L	0.3	Pet. Ether Extraction (DENR-EMB Modified)	09/10/13	REB	
Hexavalent Chromium	< 0.003	mg/L	0.003	Diphenylcarbazide, Colorimetric Method (SM3500-Cr B)	09/05/13	JCA	
Cyanide, Free	< 0.02	mg/L	0.02	Ion Selective Electrode (SM 4500 CN-F)	09/06/13	MPT	
Nitrate - N	0.2	mg/L	0.02	Brucine	09/05/13	LCR	
Phosphate-P	0.05	mg/L	0.006	Stannous Chloride Method (SM4500-P D)	09/05/13	JCA	
>>> end of result set for Sample No.:P00045540-01 <<<							
Sample No.: P00045540-02			**DateSampled: 09-04-13 09:45**				
Sample ID: STATION 2			**Matrix: Surface Water**				
-Metals-							
Arsenic	< 0.01	mg/L	0.01	SDDC, Spectrophotometry	09/09/13	MVTM	
Cadmium	< 0.006	mg/L	0.006	Flame AAS	09/09/13	PPG	
Copper	< 0.02	mg/L	0.02	Flame AAS	09/06/13	GGR	
Lead	< 0.04	mg/L	0.04	Flame AAS	09/09/13	PPG	
Mercury	< 0.0001	mg/L	0.0001	Manual Cold Vapor AAS	09/10/13	MVTM	
-Microbiology-							
Total Coliforms	35,000	MPN/100mL	N/A	Multiple Tube Fermentation Technique	09/05/13	JGE	
Fecal Coliforms	210	MPN/100mL	N/A	Multiple Tube Fermentation Technique	09/05/13	GTY	
-Wet Chemistry-							
Biological Oxygen Demand	11	mg/L	1	Azide Modification Winkler (SM 5210B)	09/06/13	WBD	
Chemical Oxygen Demand	19	mg/L	2.0	Open Reflux Method (SM5220B)	09/09/13	MCP	
Total Suspended Solids	81	mg/L	2.5	Gravimetry (SM2540 D)	09/09/13	IRC	
Oil & Grease	0.7	mg/L	0.3	Pet. Ether Extraction (DENR-EMB Modified)	09/10/13	REB	
Hexavalent Chromium	< 0.003	mg/L	0.003	Diphenylcarbazide, Colorimetric Method (SM3500-Cr B)	09/05/13	JCA	
Cyanide, Free	< 0.02	mg/L	0.02	Ion Selective Electrode (SM 4500 CN-F)	09/06/13	MPT	
Nitrate - N	0.2	mg/L	0.02	Brucine	09/05/13	LCR	
Phosphate-P	0.08	mg/L	0.006	Stannous Chloride Method (SM4500-P D)	09/05/13	JCA	
>>> end of result set for Sample No.:P00045540-02 <<<							
Sample No.: P00045540-03			**DateSampled: 09-04-13 10:30**				
Sample ID: STATION 3			**Matrix: Surface Water**				
-Metals-							
Arsenic	< 0.01	mg/L	0.01	SDDC, Spectrophotometry	09/09/13	MVTM	
Cadmium	< 0.006	mg/L	0.006	Flame AAS	09/09/13	PPG	

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Test Description	Results	Units	MDL	Test Methods	Date Analyzed	By	Ref*
-Metals-							
Copper	< 0.02	mg/L	0.02	Flame AAS	09/06/13	GGR	
Lead	< 0.04	mg/L	0.04	Flame AAS	09/09/13	PPG	
Mercury	< 0.0001	mg/L	0.0001	Manual Cold Vapor AAS	09/10/13	MVTM	
-Microbiology-							
Total Coliforms	24,000	MPN/100mL	N/A	Multiple Tube Fermentation Technique	09/05/13	JGE	
Fecal Coliforms	2,200	MPN/100mL	N/A	Multiple Tube Fermentation Technique	09/05/13	JGE	
-Wet Chemistry-							
Biological Oxygen Demand	8	mg/L	1	Azide Modification Winkler (SM 5210B)	09/06/13	WBO	
Chemical Oxygen Demand	14	mg/L	2.0	Open Reflux Method (SM5220B)	09/10/13	MCP	
Total Suspended Solids	80	mg/L	2.5	Gravimetry (SM2540 D)	09/09/13	IRC	
Oil & Grease	0.6	mg/L	0.3	Pet. Ether Extraction (DENR-EMB Modified)	09/10/13	REB	
Hexavalent Chromium	< 0.003	mg/L	0.003	Diphenylcarbazide, Colorimetric Method (SM3500-Cr B)	09/05/13	JCA	
Cyanide, Free	< 0.02	mg/L	0.02	Ion Selective Electrode (SM 4500 CN-F)	09/06/13	MPT	
Nitrate - N	0.1	mg/L	0.02	Brucine	09/05/13	LCR	
Phosphate-P	0.05	mg/L	0.006	Stannous Chloride Method (SM4500-P D)	09/05/13	JCA	

>>> end of result set for Sample No.:P00045540-03 <<<

>>> end of result set for Lab No.:P00045540; Total no. of samples analyzed: 3 <<<

N/A = Not Applicable

MPN = Most Probable Number

MDL = Method Detection Limit/s

Results are reported "as received basis".

Perkin Elmer / Varian / Shimadzu Analytical Methods, Atomic Absorption Spectrophotometry (AAS)

Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WEF, 22nd Edition.

Test Methods for Evaluating Solid Wastes, Vol 1A, USEPA, Third Edition

Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020

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Certified by:

Geraldine T. Yabut
PRC License No.: 0027218
Microbiological Testing

Date: 09/12/13

Ronald G. Espiritu
PRC License No.: 9248
Chemical Testing

Date: 09/12/13

Juliana C. Oriña
PRC License No.: 8774
Chemical Testing

Date: 9/12/13

Chas C. Arroyo
PRC License No.: 6701
Chemical Testing

Date:

SN: F00016915.001

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(3)Riverbed Sediment Quality

Results of Analyses

Woodfields Consultants, Inc.
153, Kamias Rd. Ext., Kamias
Quezon City

PAO ACCREDITED TESTING LABORATORY PNS ISO/IEC 17025:2005 LA-2008-119A

SN: F00014892 016

Date Received: 04/04/2013

Lab No.:P00043370

Project Name: CDO FLOOD CONTROL PROJECT

Attention: Ms. Marilynn Musa

Test Description	Results	Units	MDLs	REG LIMITs	Test Methods	Date Analyzed	By	Ref
Sample No.: P00043370-04			**DateSampled: 04-04-13 09:45**					
Sample ID: STATION 1			**Matrix: TCLP Extract**					
-Metals-								
Arsenic	0.004	mg/L	0.001^	5.0	Gaseous Hydride AAS	04/17/13	PPG	14
Cadmium	ND	mg/L	0.008	5.0 / 1.0	Flame AAS	04/15/13	PPG	14
Copper	ND	mg/L	0.02	-	Flame AAS	04/16/13	GGR	
Lead	ND	mg/L	0.04	5.0	Flame AAS	04/15/13	PPG	14
Mercury	ND	mg/L	0.0001	0.2	Manual Cold Vapor AAS	04/12/13	MVTM	14
-Wet Chemistry-								
Hexavalent Chromium	ND	mg/L	0.003	-	Diphenylcarbazide, Colorimetric Method (SM3500-Cr B)	04/11/13	JCA	
#Reactive, Cyanide as HCN	1.8	mg/kg	1.0^	> 250	EPA 9213 - ISE	04/19/13	MPT	14
>>> end of result set for Sample No.:P00043370-04 <<<								
Sample No.: P00043370-05			**DateSampled: 04-04-13 09:45**					
Sample ID: STATION 1			**Matrix: Elutriate Extract**					
-Metals-								
Arsenic	0.004	mg/L	0.001^	0.1	Gaseous Hydride AAS	04/17/13	PPG	80
Cadmium	ND	mg/L	0.008	0.02	Flame AAS	04/15/13	PPG	80
Copper	ND	mg/L	0.02	-	Flame AAS	04/16/13	GGR	
Lead	ND	mg/L	0.04	0.1	Flame AAS	04/15/13	PPG	80
Mercury	ND	mg/L	0.0001	0.005	Manual Cold Vapor AAS	04/16/13	MVTM	80
-Wet Chemistry-								
Cyanide, Free	0.12	mg/L	0.02	0.1	Ion Selective Electrode (SM 4500 CN-F)	04/19/13	MPT	80
Hexavalent Chromium	ND	mg/L	0.003	0.05	Diphenylcarbazide, Colorimetric Method (SM3500-Cr B)	04/11/13	JCA	80
>>> end of result set for Sample No.:P00043370-05 <<<								
Sample No.: P00043370-06			**DateSampled: 04-04-13 11:30**					
Sample ID: STATION 2			**Matrix: TCLP Extract**					
-Metals-								
Arsenic	0.002	mg/L	0.001^	5.0	Gaseous Hydride AAS	04/17/13	PPG	14
Cadmium	ND	mg/L	0.008	5.0 / 1.0	Flame AAS	04/15/13	PPG	14
Copper	ND	mg/L	0.02	-	Flame AAS	04/16/13	GGR	
Lead	ND	mg/L	0.04	5.0	Flame AAS	04/15/13	PPG	14
Mercury	ND	mg/L	0.0001	0.2	Manual Cold Vapor AAS	04/12/13	MVTM	14
-Wet Chemistry-								
Hexavalent Chromium	ND	mg/L	0.003	-	Diphenylcarbazide, Colorimetric Method (SM3500-Cr B)	04/11/13	JCA	
#Reactive, Cyanide as HCN	ND	mg/kg	1.0^	> 250	EPA 9213 - ISE	04/19/13	MPT	14
>>> end of result set for Sample No.:P00043370-06 <<<								
Sample No.: P00043370-07			**DateSampled: 04-04-13 11:30**					
Sample ID: STATION 2			**Matrix: Elutriate Extract**					
-Metals-								
Arsenic	0.004	mg/L	0.001^	0.1	Gaseous Hydride AAS	04/17/13	PPG	80
Cadmium	ND	mg/L	0.008	0.02	Flame AAS	04/16/13	PPG	80
Copper	ND	mg/L	0.02	-	Flame AAS	04/16/13	GGR	
Lead	ND	mg/L	0.04	0.1	Flame AAS	04/15/13	PPG	80
Mercury	ND	mg/L	0.0001	0.005	Manual Cold Vapor AAS	04/16/13	MVTM	80

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Test Description	Results	Units	MDLs	REG LIMITs	Test Methods	Date Analyzed	By	Ref
-Wet Chemistry-								
Cyanide, Free	ND	mg/L	0.02	0.1	Ion Selective Electrode (SM 4500 CN-F)	04/19/13	MPT	80
Hexavalent Chromium	ND	mg/L	0.003	0.05	Diphenylcarbazide, Colorimetric Method (SM3500-Cr B)	04/11/13	JCA	80

>>> end of result set for Sample No.:P00043370-07 <<<

>>> end of result set for Lab No.:P00043370; Total no. of samples analyzed: 4 <<<

as Sediments

*Reporting Limit/s

N/S = Not Supplied

MDL = Method Detection Limit/s

Results are reported "as received basis".

ND = Not Detected (Below MDL / Reporting Limit/s)

This report supersedes CRL Laboratory Report with SN: F00014892.013

Perkin Elmer / Varian / Shimadzu Analytical Methods, Atomic Absorption Spectrophotometry (AAS)

Test Methods for Evaluating Solid Wastes, Vol 1A, USEPA, Third Edition

*** Regulatory Limit Reference**

[14] RA 6969 / USEPA Stds.

[80] DENR Administrative Order, No. 35, Effluent Standards: Toxic and other Deleterious Substance, Class A.

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Certified By:

Ronald G. Espiritu
PRC License No.: 9248
Chemical Testing

Date: 05/29/13

Juliana C. Oriña
PRC License No.: 8774
Chemical Testing

Date: 5/29/13

Chas C. Arroyo
PRC License No.: 8701
Chemical Testing

Date: 5/29/13

SN: F00014892.016

CRL Environmental Corporation

- Sales Office: Unit 609 Cityland 10 Tower 1 * 6815 H.V. dela Costa, Ayala Ave., North * Makati City, Philippines 1226
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- Laboratory: Bldg. 2, Berthaphil Compound 1, Berthaphil Inc. Industrial Park
  Jose Abad Santos Ave., CFZ Clarkfield Pampanga, Philippines
  Tel.: (6345) 599-3943 * (6345) 499-6529 * (632) 299-3826 * Fax (6345) 599-3963

Results of Analyses

Woodfields Consultants, Inc.
153, Kamias Rd. Ext., Kamias
Quezon City

PAB PAO ACCREDITED TESTING LABORATORY PNS ISO/IEC 17025:2005 LA-2008-119A

SN: F00016525.009
Date Received: 07/31/20
Lab No.:P00045110

Project Name: CDO FLOOD CONTROL

Attention: Ms. Marilynn Musa

Test Description	Results	Units	MDL	REG LIMIT	Test Methods	Date Analyzed	By	Ref*
Sample No.: P00045110-01			**DateSampled: 07-31-13 00:00**					
Sample ID: CDO STATION 1			**Matrix: TCLP Extract**					
-Metals-								
Arsenic**	0.005	mg/L	0.001^	5.0	Gaseous Hydride AAS	08/12/13	PPG	14
Cadmium**	ND	mg/L	0.006	5.0 / 1.0	Flame AAS	08/07/13	PPG	14
Chromium**	ND	mg/L	0.02	5.0	Flame AAS	08/07/13	NAP	14
Copper**	ND	mg/L	0.02	-	Flame AAS	08/08/13	GGR	
Lead**	ND	mg/L	0.04	5.0	Flame AAS	08/07/13	PPG	14
Mercury**	ND	mg/L	0.0001	0.2	Manual Cold Vapor AAS	08/07/13	MVTM	14
-Wet Chemistry-								
#Reactive Cyanide as HCN	0.8	mg/kg	0.5^	> 250	EPA 9213 - ISE	08/05/13	MPT	14
>>> end of result set for Sample No.:P00045110-01 <<<								
Sample No.: P00045110-02			**DateSampled: 07-31-13 00:00**					
Sample ID: CDO STATION 2			**Matrix: TCLP Extract**					
-Metals-								
Arsenic**	0.007	mg/L	0.001^	5.0	Gaseous Hydride AAS	08/12/13	PPG	14
Cadmium**	ND	mg/L	0.006	5.0 / 1.0	Flame AAS	08/07/13	PPG	14
Chromium**	ND	mg/L	0.02	5.0	Flame AAS	08/07/13	NAP	14
Copper**	ND	mg/L	0.02	-	Flame AAS	08/08/13	GGR	
Lead**	ND	mg/L	0.04	5.0	Flame AAS	08/07/13	PPG	14
Mercury**	ND	mg/L	0.0001	0.2	Manual Cold Vapor AAS	08/07/13	MVTM	14
-Wet Chemistry-								
#Reactive Cyanide as HCN	ND	mg/kg	0.5^	> 250	EPA 9213 - ISE	08/05/13	MPT	14
>>> end of result set for Sample No.:P00045110-02 <<<								
Sample No.: P00045110-03			**DateSampled: 07-31-13 00:00**					
Sample ID: CDO STATION 3			**Matrix: TCLP Extract**					
-Metals-								
Arsenic**	ND	mg/L	0.001^	5.0	Gaseous Hydride AAS	08/12/13	PPG	14
Cadmium**	ND	mg/L	0.006	5.0 / 1.0	Flame AAS	08/07/13	PPG	14
Chromium**	ND	mg/L	0.02	5.0	Flame AAS	08/07/13	NAP	14
Copper**	ND	mg/L	0.02	-	Flame AAS	08/08/13	GGR	
Lead**	ND	mg/L	0.04	5.0	Flame AAS	08/07/13	PPG	14
Mercury**	ND	mg/L	0.0001	0.2	Manual Cold Vapor AAS	08/07/13	MVTM	14
-Wet Chemistry-								
#Reactive Cyanide as HCN	ND	mg/kg	0.5^	> 250	EPA 9213 - ISE	08/05/13	MPT	14
>>> end of result set for Sample No.:P00045110-03 <<<								
Sample No.: P00045110-06			**DateSampled: 07-31-13 00:00**					
Sample ID: CDO STATION 1			**Matrix: Elutriate Extract**					
-Metals-								
Arsenic**	0.003	mg/L	0.001^	0.1	Gaseous Hydride AAS	08/12/13	PPG	80
Cadmium**	ND	mg/L	0.006	0.02	Flame AAS	08/07/13	PPG	80
Chromium**	ND	mg/L	0.02	-	Flame AAS	08/12/13	GGR	
Copper**	ND	mg/L	0.02	-	Flame AAS	08/08/13	GGR	
Lead**	ND	mg/L	0.04	0.1	Flame AAS	08/07/13	PPG	80
Mercury**	ND	mg/L	0.0001	0.005	Manual Cold Vapor AAS	08/07/13	MVTM	80
-Wet Chemistry-								
Cyanide, Free**	ND	mg/L	0.02	0.1	Ion Selective Electrode (SM 4500 CN-F)	08/12/13	MPT	80

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Test Description	Results	Units	MDL	REG LIMIT	Test Methods	Date Analyzed	By	Ref*

>>> end of result set for Sample No.:P00045110-06 <<<

Sample No.: P00045110-07 **DateSampled: 07-31-13 00:00**
Sample ID: CDO STATION 2 **Matrix: Elutriate Extract**

Test Description	Results	Units	MDL	REG LIMIT	Test Methods	Date Analyzed	By	Ref*
-Metals-								
Arsenic**	0.002	mg/L	0.001^	0.1	Gaseous Hydride AAS	08/12/13	PPG	80
Cadmium**	ND	mg/L	0.006	0.02	Flame AAS	08/07/13	PPG	80
Chromium**	ND	mg/L	0.02	-	Flame AAS	08/12/13	GGR	
Copper**	ND	mg/L	0.02	-	Flame AAS	08/08/13	GGR	
Lead**	ND	mg/L	0.04	0.1	Flame AAS	08/07/13	PPG	80
Mercury**	ND	mg/L	0.0001	0.005	Manual Cold Vapor AAS	08/07/13	MVTM	80
-Wet Chemistry-								
Cyanide, Free**	ND	mg/L	0.02	0.1	Ion Selective Electrode (SM 4500 CN-F)	08/12/13	MPT	80

>>> end of result set for Sample No.:P00045110-07 <<<

Sample No.: P00045110-08 **DateSampled: 07-31-13 00:00**
Sample ID: CDO STATION 3 **Matrix: Elutriate Extract**

Test Description	Results	Units	MDL	REG LIMIT	Test Methods	Date Analyzed	By	Ref*
-Metals-								
Arsenic**	0.007	mg/L	0.001^	0.1	Gaseous Hydride AAS	08/12/13	PPG	80
Cadmium**	ND	mg/L	0.006	0.02	Flame AAS	08/07/13	PPG	80
Chromium**	ND	mg/L	0.02	-	Flame AAS	08/12/13	GGR	
Copper**	ND	mg/L	0.02	-	Flame AAS	08/08/13	GGR	
Lead**	ND	mg/L	0.04	0.1	Flame AAS	08/07/13	PPG	80
Mercury**	ND	mg/L	0.0001	0.005	Manual Cold Vapor AAS	08/07/13	MVTM	80
-Wet Chemistry-								
Cyanide, Free**	ND	mg/L	0.02	0.1	Ion Selective Electrode (SM 4500 CN-F)	08/08/13	MPT	80

>>> end of result set for Sample No.:P00045110-08 <<<

>>> end of result set for Lab No.:P00045110; Total no. of samples analyzed: 6 <<<

as Sludge
^Reporting Limit/s
**PAO approved parameter/s
MDL = Method Detection Limit/s
Results are reported "as received basis".
ND = Not Detected (Below MDL / Reporting Limit/s)
This report supersedes CRL Laboratory Report with SN: F00016525,003
Perkin Elmer / Varian / Shimadzu Analytical Methods, Atomic Absorption Spectrophotometry (AAS)
Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WEF, 22nd Edition.
Test Methods for Evaluating Solid Wastes, Vol 1A, USEPA, Third Edition

*** Regulatory Limit Reference**

[14] RA 6969 / USEPA Stds.

[80] DENR Administrative Order, No. 35, Effluent Standards: Toxic and other Deleterious Substance, Class A.

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Certified By:

Ronald G. Espiritu
PRC License No.: 9248
Chemical Testing

Date: 08/16/13

Juliana C. Oriña
PRC License No.: 8774
Chemical Testing

Date: 8/16/13

Chas C. Arroyo
PRC License No.: 8701
Chemical Testing

Date: 8/16/13

SN: F00016525.009

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(4) Traffic

a. Road Traffic

Road Name: Puntod (R01)
Day 1

Direction: CDO City Proper-Pier

Time	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	NMT	Total
0600-0700	20	30	50	50	9	1		14	5	6		46		231
0700-0800	20	30	50	44	15			16	10	1	1	66		253
0800-0900	42	63	73	34	9			26	7	1		78		333
0900-1000	38	57	80	65	23			27	8	2	2	71		373
1000-1100	38	57	77	60	12			26	19	2	5	85		381
1100-1200	46	70	115	30	15			16	9	2	4	90		397
1200-1300	28	42	64	11	6			11	3			34		199
1300-1400	46	68	71	35	21			28	6	1		73		349
1400-1500	57	85	73	42	18			26	11		3	68		383
1500-1600	54	80	57	39	19			20	17			66		352
1600-1700	41	61	74	50	29	0	0	26	8	1	4	51		346
1700-1800	27	41	49	34	19	0	0	18	6	1	2	34		230
1800-1900	64	96	103	180	7			6	1	1	6			464
1900-2000	48	73	66	114	5			4	5		6			321
2000-2100	49	74	58	83	2			8	4					278
2100-2200	31	46	29	51	1			4	2	3				167
2200-2300	39	59	32	36	1			1	2	12				182
2300-2400	31	47	16	26				5		4				129
2400-0100	22	34	11	13	1			2	1	1				85
0100-0200	21	32	11	3	1									68
0200-0300	16	23	4	6	0									49
0300-0400	18	26	9	24	1			1						79
0400-0500	15	23	11	44				1		9				103
0500-0600	13	19	28	54	1			3		4				122
Total	824	1236	1211	1128	215	1	0	289	124	51	33	762		5874

Direction: Pier-CDO City Proper

Time	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	NMT	Total
0600-0700	25	37	63	75	10			10	1	1	2	57		281
0700-0800	35	52	65	62	15			9	4	2	2	36		282
0800-0900	30	45	60	61	10			13	12	1	4	49		285
0900-1000	32	48	62	72	16			22	11	4	4	71		342
1000-1100	32	47	72	71	21			35	11	4	9	47		349
1100-1200	58	86	70	91	20	1		19	6	1	5	46		403
1200-1300	50	76	37	61	13			6	6		1	25		275
1300-1400	58	88	46	94	14			19	7	2	1	46		375
1400-1500	58	88	57	87	20			18	8	1	3	30		370
1500-1600	69	103	64	93	8			23	11	2		42		415
1600-1700	68	102	81	94	18			18	23		10	49		463
1700-1800	84	127	90	94	11			7	9	1				423
1800-1900	0	0												-
1900-2000	57	86	82	109	7			15	6	4				366
2000-2100	45	68	54	60	6			3	5	3	2			246
2100-2200	38	58	29	59	5			2	1	6				198
2200-2300	33	50	21	33	2				2	4				145
2300-2400	26	40	7	19				3	3	4				102
2400-0100	18	26	9	8				2	2					65
0100-0200	22	34	6	3				1	1					67
0200-0300	13	19	5	6	0			1	2					46
0300-0400	15	22	4	13	4			1						59
0400-0500	12	18	3	14	1				1					49
0500-0600	14	22	22	45	1									104
Total	894	1340.4	1009	1324	202	1	0	227	132	40	43	498		5710

Day 2

Direction: CDO City Proper-Pier

Time	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	NMT	Total
0600-0700	68	102	66	37	2			7	8		2	31		323
0700-0800	78	117	66	46	14			16	13	1	1	65		417
0800-0900	82	123	55	50	5			9	3			45		372
0900-1000	86	129	90	73	17			35	12	1	3	100		546
1000-1100	88	132	94	64	15			32	11	2	2	80		520
1100-1200	86	129	52	37	25			16	5		7	46		403
1200-1300	88	132	52	42	8			17	6	6	4	50		405
1300-1400	96	144	22	27	4			11	6	3	1	28		342
1400-1500	84	126	48	45	11			19	2		5	42		382
1500-1600	76	114	51	24	17			11	9	3	3	40		348
1600-1700	84	126	66	51	16			21	10	3	1	65		443
1700-1800	64	96	129	24	9			7	1		3	28		361
1800-1900	74	112	91	143	13	5		11	3	10				462
1900-2000	51	77	56	117	7	2		4		6				320
2000-2100	34	51	45	76	1			2		2				211
2100-2200	27	40	51	44	2			2	2					168
2200-2300	31	47	31	52	2			2	4					169
2300-2400	23	35	21	23						2				104
2400-0100	17	25	13	11				2		1				69
0100-0200	11	16	10	12	1			1						51
0200-0300	13	20	5	6					1					45
0300-0400	16	25	6	17	1				3					68
0400-0500	28	41	9	60	3			1	2					144
0500-0600	26	40	26	52	1				2					147
Total	1,332	1998	1155	1133	174	7	0	226	103	40	32	620		6820

Direction: Pier-CDO City Proper

Time	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	NMT	Total
0600-0700	76	114	81	58	1			3	2	1	1	26		363
0700-0800	80	120	56	66	9			5	10	1	1	44		392
0800-0900	82	123	85	95	10			8	4		2	20		429
0900-1000	88	132	115	100	27			21	15	5	3	71		577
1000-1100	78	117	107	135	20			24	15		6	78		580
1100-1200	48	72	65	46	19			20	9		3	38		320
1200-1300	20	31	52	35	17			6	6		3	27		197
1300-1400	39	58	30	37	8			16	6		6	28		228
1400-1500	44	66	91	75	15			10	5	4	5	42		357
1500-1600	38	57	70	57	11			13	8		12	26		292
1600-1700	74	111	91	78	9			22	10		10	54		459
1700-1800	18	26	32	40	4			6	6		4	26		162
1800-1900	58	86	109	132	6			10	9	4				414
1900-2000	56	85	76	100	6			9	2	3				337
2000-2100	26	39	36	55	3			5	4	5				173
2100-2200	22	32	37	34	2			1	2					130
2200-2300	20	31	35	39	1	1		2	3	2				134
2300-2400	21	32	22	17	2			1	3	1				99
2400-0100	14	21	8	6	1			7	1	2				60
0100-0200	8	12	1	9	1		1							32
0200-0300	7	11	4	8	1			2	4					37
0300-0400	17	25	2	8	1			1	2	1				57
0400-0500	22	33	7	15	1			2	1					81
0500-0600	17	26	25	50	1			2	1	1				123
Total	973	1459.8	1237	1295	176	1	1	196	128	30	56	480		6033

Road Name: Kauswagan (R02)
Day 1

Direction: Kauswagan-Liceo de Cagayan

Time	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	NMT	Total
0600-0700	55	82	57	76	8			7	1		1	31		318
0700-0800	84	126	90	96	16			6	1	2		50		471
0800-0900	102	153	165	116	22			21	3	3		83		668
0900-1000	70	106	130	94	27			28	9	10		89		563
1000-1100	42	64	53	56	12			7	1	2		42		279
1100-1200	32	47	75	68	11		1	13	2	1		40		290
1200-1300	44	66	75	31	10			3	1			31		261
1300-1400	38	56	74	75	7			15	8	1	1	66		341
1400-1500	44	66	70	74	15			20	3	2		59		353
1500-1600	32	48	66	80	10			5	1			26		268
1600-1700	63	94	64	72	18			23	4	1		53		392
1700-1800	62	93	80	90	21			8	6			50		410
1800-1900	80	121	103	78	15			17	6			124		544
1900-2000	85	128	81	53	13			4	1	2		96		463
2000-2100	62	94	62	30	4			4	3			62		321
2100-2200	49	73	49	14	5			1	2			53		246
2200-2300	36	55	29	7	2		1		3	1		30		164
2300-2400	24	36	25		3							35		123
2400-0100	17	25	24									36		102
0100-0200	4	7	5	2								5		23
0200-0300	8	12	20	15	3							11		69
0300-0400	9	13	18	10	1							6		57
0400-0500	1	1	33	30				4				22		91
0500-0600	40	61	49	68	6			4		1		33		262
Total	1,084	1626	1497	1235	229	0	2	190	55	26	2	1133		7079

Direction: Liceo de Cagayan-Kauswagan

Time	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	NMT	Total
0600-0700	69	103	41	74	8			7				31		333
0700-0800	40	59	31	37	10			4				16		197
0800-0900	68	103	143	93	12			8	4	1		58		490
0900-1000	59	89	111	74	21			14	3	1		44		416
1000-1100	64	96	70	56	18			6	3	4		45		362
1100-1200	58	86	123	97	28			9	4	3		51		459
1200-1300	42	63	75	62	15			5				28		290
1300-1400	50	75	73	65	20			7	2	1		31		324
1400-1500	40	60	59	59	22			7	5			30		282
1500-1600	51	77	82	68	18			12	5	1		45		359
1600-1700	32	48	80	59	11			6	3	1		51		291
1700-1800	45	67	101	85	8			1				27		334
1800-1900	96	144	81	87	11			20	4			101		544
1900-2000	92	138	68	72	3			13	2	1		95		484
2000-2100	82	124	50	46	3			19				83		407
2100-2200	69	103	30	26	1			8	1	3		61		302
2200-2300	62	92	24	6				8				45		237
2300-2400	34	51	19	3	3		1	4	1			26		142
2400-0100	22	33	15		1							34		105
0100-0200	22	33	3	1								14		73
0200-0300	12	18	10	8	0			1				12		61
0300-0400	15	23	30	20	2							11		101
0400-0500	18	27	23	26								17		111
0500-0600	25	38	14	19	2			2				19		119
Total	1,167	1750.2	1356	1143	217	0	1	161	37	16	0	975		6823

Day 2

Direction: Kauswagan-Liceo de Cagayan

Time	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	NMT	Total
0600-0700	20	30												50
0700-0800	48	72	52	41	4			1				27		245
0800-0900	76	114	131	95	15			16	2	2		80		531
0900-1000	64	97	100	62	21			15	3	2		73		437
1000-1100	56	85	136	140	10			7	4	1		85		524
1100-1200	54	81	130	109	25			15	4	2		56		476
1200-1300	37	56	47	64	10			5		1		47		267
1300-1400	56	84	50	60	25			14	3			51		343
1400-1500	88	132	112	113	21			10	2	3		54		535
1500-1600	55	83	91	58	17			14	6	2		78		404
1600-1700	76	114	120	90	13			6	3	1		70		493
1700-1800	80	120	130	100	24			15	2	2		55		528
1800-1900	48	72	80	52	10			11	8			90		371
1900-2000	44	66	107	75	6			3	2			56		359
2000-2100	40	61	75	55	3		1					52		287
2100-2200	32	48	30	23	2			2				33		170
2200-2300	28	42	55	12	3			2	1			40		183
2300-2400	0	0												-
2400-0100	19	28	33	2	1			2				22		107
0100-0200	18	27	32									25		102
0200-0300	14	22	22	2	1	0	0					17		78
0300-0400	15	23	27	12	2					1		12		92
0400-0500	16	25	27	22	2							17		109
0500-0600	23	34	18	37	2			3		1		27		145
Total	1,009	1513.8	1605	1224	217	0	1	141	40	18	0	1067		6836

Direction: Liceo de Cagayan-Kauswagan

Time	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	NMT	Total
0600-0700	68	102	72	50	5			11		2		26		336
0700-0800	94	140	110	86	5			3	1			28		467
0800-0900	58	87	100	90	15			11		1		70		432
0900-1000	60	90	103	81	18			14	1	1		81		449
1000-1100	50	75	50	65	6			9	4	2		60		321
1100-1200	51	76	62	83	5			17		5		79		378
1200-1300	32	47	48	60	4			10	1			46		248
1300-1400	40	60	58	60	8			10		3		58		297
1400-1500	41	61	85	71	9			16	3	2		62		350
1500-1600	32	47	70	75	5			22		2		68		321
1600-1700	34	51	50	65	14			15				61		290
1700-1800	58	87	62	60	3			9	5	1		65		350
1800-1900	68	102	70	120	10			9	1	1		100		481
1900-2000	88	132	105	170	5			5	1			95		601
2000-2100	44	66	100	140	5			4	3			105		467
2100-2200	54	81	40	30	2			10				54		271
2200-2300	40	60	65	50	2			3				45		265
2300-2400	28	42	55	35								40		200
2400-0100	20	30	30	15								35		130
0100-0200	16	24	30	15								25		110
0200-0300	18	27	35	20	0							25		125
0300-0400	24	36	40	25								20		145
0400-0500	24	36	30	40								35		165
0500-0600	36	54	45	60	6			15	3			30		249
Total	1,076	1614.6	1515	1566	127	0	0	193	23	20	0	1313		7448

Road Name: Macanhan (R03)

Day 1

Direction: CDO City Proper-Balulang

Time	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	NMT	Total
0600-0700	62	93	40	75	2				3			15	18	290
0700-0800	88	132	88	115	1			4		2		22	21	452
0800-0900	76	114	153	165	6			16	2			37	32	569
0900-1000	84	126	8	140	5			11	2			30	21	406
1000-1100	74	111	81	100	10			6	4			16	17	402
1100-1200	43	64	63	80	6			5	1			12	14	274
1200-1300	112	168	61	115	13			7	1			23	20	500
1300-1400	103	155	90	62	8			3	2			12	17	435
1400-1500	88	132	52	75	10			4	3			11	10	375
1500-1600	107	161	77	71	10			5	1			15	17	447
1600-1700	98	147	83	84	7			9				23	11	451
1700-1800	120	180	121	111	14			8	2			29	17	585
1800-1900	107	160	97	123	7			10	3			82	19	589
1900-2000	85	128	166	114	16			7	1			74		591
2000-2100	125	187	103	116	2			3	1			46	13	583
2100-2200	98	146	78	62				5	2			43	17	434
2200-2300	34	51	63	42	1			2				29	9	222
2300-2400	38	56	41	12		1						15	3	163
2400-0100	31	46	24	4	2			1				13	3	121
0100-0200	21	31	13	7		1		1				9		83
0200-0300	17	25	12	5	2							4	1	65
0300-0400	18	28	9	7				1				4		67
0400-0500	43	64	30	15				3				18	2	173
0500-0600	56	84	16	13				3	1					173
Total	1,727	2590.2	1569	1713	122	2	0	114	29	2	0	582		8450

Direction: Balulang-CDO City Proper

Time	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	NMT	Total
0600-0700	74	110	41	65	1			2				24	24	317
0700-0800	109	164	69	85	3			6	1			37	34	474
0800-0900	132	198	103	105	2			12				63	27	615
0900-1000	117	176	83	98	7			14	2			52	25	549
1000-1100	92	138	71	92	3			13	2			36	13	447
1100-1200	42	64	38	66	3			4	5			26	12	248
1200-1300	91	137	44	70	4			8	1			17	13	372
1300-1400	86	128	82	77	9			12	2			22	13	418
1400-1500	78	118	54	64	1			5	1			15	10	336
1500-1600	96	144	65	70	9			8	2			16	19	410
1600-1700	90	135	39	80	3			7	4			17	11	375
1700-1800	118	176	83	93	2			7	2			26	18	507
1800-1900	49	74	56	83	2			6				27	14	297
1900-2000	31	46	47	23	1			1				8	6	157
2000-2100	82	122	64	33	2							22	16	325
2100-2200	70	106	51	26	1			2				16	5	272
2200-2300	44	65	51	11	1			1				14	4	187
2300-2400	22	33	11	1	1							7		75
2400-0100	21	32	19										1	72
0100-0200	17	25	9	1								5		57
0200-0300	17	25	9	5	3			3				4		66
0300-0400	20	29	10	5				1				4	1	69
0400-0500	27	41	14	6	1							5	4	94
0500-0600	60	90	40	36	1			1				18	12	246
Total	1,584	2376.6	1153	1195	60	0	0	113	22	0	0	481		6985

Day 2

Direction: CDO City Proper-Balulang

Time	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	NMT	Total
0600-0700	73	109	31	41	1			2				19	12	276
0700-0800	55	82	33	81				5				11	18	267
0800-0900	112	168	77	103	3			5	4			13	12	485
0900-1000	108	162	77	96	4			10	4	1		12	20	474
1000-1100	90	136	55	59	4			5	2			12	8	363
1100-1200	58	87	50	55	4			6				16	4	276
1200-1300	75	112	64	60	2			3				11	7	327
1300-1400	72	108	65	47	4			6	4			11	4	317
1400-1500	95	142	72	69	5			1	3			12	9	399
1500-1600	104	157	74	63	4			10	2			33	12	447
1600-1700	114	171	75	74	2			9	3			28	15	476
1700-1800	120	180	103	85	1			10	1			31	33	531
1800-1900	113	170	108	115	7			3				37	11	553
1900-2000	112	167	145	103	3			5				33	6	568
2000-2100	79	119	86	115	3			1				31	3	434
2100-2200	65	98	48	94	1			1				30		337
2200-2300	41	62	17	36	2			1		1		11	1	171
2300-2400	34	50	37	44	1							16		182
2400-0100	30	46	37	71	1			2				11		198
0100-0200	12	19	22	2	1							3	1	59
0200-0300	11	17	11	16	0			3				4		62
0300-0400	15	23	5	15				2				8		68
0400-0500	47	71	74	79				3				22	2	296
0500-0600	83	125	78	99	8			6				32	7	431
Total	1,720	2579.4	1444	1622	61	0	0	99	23	2	0	447		7997

Direction: Balulang-CDO City Proper

Time	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	NMT	Total
0600-0700	101	152	49	63	1			6				18	30	390
0700-0800	153	229	120	121	2			11	1			48	37	685
0800-0900	118	178	135	120	2			11	4			43	12	611
0900-1000	105	158	85	88	4			12	3			33	15	488
1000-1100	84	127	66	64	4			8	1			27	11	381
1100-1200	62	92	42	47	2			4	2			14	9	265
1200-1300	71	107	47	63	6			4	1			11	11	310
1300-1400	99	149	60	71	2			8	2			26	10	417
1400-1500	99	149	80	67	5			7	2			16	13	425
1500-1600	102	153	68	68	5			7	3			19	9	425
1600-1700	94	141	62	75	3			6	2			20	9	403
1700-1800	100	150	75	75	2			2	1			23	20	428
1800-1900	74	110	81	77	2			6	2			17	12	369
1900-2000	86	130	66	47	2							18	15	349
2000-2100	63	94	50	35	1							18	9	261
2100-2200	50	76	38	13								17		194
2200-2300	33	50	27	39								8	1	157
2300-2400	30	44	52	28	1							3		158
2400-0100	19	28	24	13								6	1	90
0100-0200	14	20	21		1							4	1	60
0200-0300	8	13	8	3	0			1				3		36
0300-0400	13	19	5	10				2				5		54
0400-0500	48	73	22	21	3			4	1			12	6	184
0500-0600	75	112	25	61	2			4				17	2	296
Total	1,702	2553	1308	1269	50	0	0	103	25	0	0	426		7436

Road Name: Calacala (R04)
Day 1

Direction: CDO City Proper-Taguanao

Time	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	NMT	Total
0600-0700	41	5	5	3	1							2		57
0700-0800	46	5	2	1	1			1				1		57
0800-0900	41	5	5	4	3			2				2		62
0900-1000	49	5	11	3	3			1	4			1		77
1000-1100	37	4	6	3	1			2	5			2		60
1100-1200	36	4	3	1				1	1			2		48
1200-1300	41	5	8		1			5				2		62
1300-1400	29	3	7	1				3	1			4		48
1400-1500	29	3	10					4	1			1		48
1500-1600	22	2	4					1				3		32
1600-1700	26	3	8					2	1			2		42
1700-1800	43	5	14	2				2				3		69
1800-1900	81	9	11	1					1			6		109
1900-2000	71	8	14	1				2				2		98
2000-2100	50	6	9	3								2		69
2100-2200	32	4	4		1							2		43
2200-2300	19	2	2	2				1						26
2300-2400	5	1	2											8
2400-0100	6	1												7
0100-0200	2	0												2
0200-0300	1	0	1		0									2
0300-0400	3	0												3
0400-0500	2	0		1										3
0500-0600	26	3	3									2	1	34
Total	738	82	129	26	11	0	0	27	14	0	0	39		1066

Direction: Taguanao-CDO City Proper

Time	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	NMT	Total
0600-0700	77	9	19	5	1							4		115
0700-0800	91	10	21	7				3				1		133
0800-0900	32	4	17	3				2	1			2		61
0900-1000	59	7	12	1	2			3	8			8	1	99
1000-1100	46	5	8	3	2			4	8			1	3	77
1100-1200	28	3	7									2		40
1200-1300	32	4	18	2				2				5		63
1300-1400	43	5	4	1				4	4					61
1400-1500	32	4	10	1	1			2	3			2		54
1500-1600	36	4	7	2	1			3	4			2		59
1600-1700	40	4	11	2					3			5		65
1700-1800	50	6	10	3	1			2	2			3		77
1800-1900	66	7	14	2					1			1		91
1900-2000	46	5	4	2					1			1		59
2000-2100	45	5	4	3					1			3		61
2100-2200	21	2	4					1						28
2200-2300	19	2	3	1								2		27
2300-2400	4	0												4
2400-0100	2	0												2
0100-0200	3	0												3
0200-0300	1	0	1		0									2
0300-0400	2	0												2
0400-0500	3	0												3
0500-0600	36	4	2										1	42
Total	812	90.2	176	38	8	0	0	26	36	0	0	42		1228

Day 2

Direction: CDO City Proper-Taguanao

Time	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	NMT	Total
0600-0700	41	5	3	1				2	1			1		53
0700-0800	44	5	3					1	1					54
0800-0900	32	4	10		3			1	1			4		54
0900-1000	64	7	10		1			3	2			2		89
1000-1100	28	3	9					1	1			4		46
1100-1200	39	4	7		2			1				1		54
1200-1300	32	4	4		1			1	1			3		45
1300-1400	29	3	10	2	1			1				3		49
1400-1500	39	4	9					2	2			4		60
1500-1600	33	4	17					1	1			2		58
1600-1700	50	6	13					2	1			2		73
1700-1800	45	5	7					2	1			2		62
1800-1900	95	11	20	5	2							9		142
1900-2000	41	5	9	2				1				2		59
2000-2100	25	3	4									1		33
2100-2200	15	2	4	1								2		24
2200-2300	10	1	5											16
2300-2400	6	1	1	1								1		10
2400-0100	6	1												7
0100-0200	4	0	1											5
0200-0300	3	0			0									3
0300-0400	2	0	1											3
0400-0500	5	1	1									1		7
0500-0600	13	1	1		1							2		18
Total	698	77.5	149	12	11	0	0	19	12	0	0	46		1024

Direction: Taguanao-CDO City Proper

Time	Motorcycle	Motorized Tricycle	Cars	Passenger Utility	Goods Utility	Small Bus	Big Bus	2-axle Truck	3-axle Truck	Semi-Trailer 3&4 axles	Semi-Trailer 5 axles	SUV	NMT	Total
0600-0700	95	11	14	2	2			3				4		130
0700-0800	78	9	15	2				3	1			7		115
0800-0900	59	7	9	3	1			2	3			6		89
0900-1000	68	8	10	2	2			3	2				1	95
1000-1100	35	4	9	2				3	1			6		60
1100-1200	37	4	5	2					3			2		53
1200-1300	41	5	7	1				2	1			2		59
1300-1400	39	4	9	3				2	1			1		59
1400-1500	54	6	12		1			3	7			1		84
1500-1600	20	2	10	1				2	5			2		42
1600-1700	35	4	8	1	2				5			4		59
1700-1800	47	5	6		2							2		62
1800-1900	74	8	10	3					2			4		101
1900-2000	24	3	6									1		34
2000-2100	17	2	1	1								3		24
2100-2200	14	2	1	1								1		19
2200-2300	12	1												13
2300-2400	4	0		1										5
2400-0100	3	0												3
0100-0200	3	0	1											4
0200-0300	4	0			0									4
0300-0400	1	0												1
0400-0500	9	1	1											11
0500-0600	19	2	1	1								3		26
Total	790	87.8	135	26	10	0	0	23	31	0	0	49		1152

b. River Traffic

Name of River: CDO River — Location of Station: RS01 Barra, Macabalan
Direction of Trave to Sea / Macajalar bay/Downstream — Date of Survey: April 3, 2013

Time	Type of Boat: Bangka	Fishing Pumpboat		Barges					Passenger Pump Boat		Total
	Non-motorized	Small	Big	Non-Motorize	Self-Propelled Small	Self-Propelled Big	Towed by Launch Small	Towed by Launch Big	Small	Big	
6:00 - 7:00											0
7:00 - 8:00	5	1							5		11
8:00 - 9:00	9		4						2		15
9:00 - 10:00	3	1							3		7
10:00 - 11:00	1		1								2
11:00 - 12:00	1										1
12:00 - 13:00	1	1									2
13:00 - 14:00	1										1
14:00 - 15:00	2	1							1		4
15:00 - 16:00	1	1									2
16:00 - 17:00	3										3
17:00 - 18:00	6								1		7
18:00 - 19:00	13	1							2		16
19:00 - 20:00	5	3							3		11
20:00 - 21:00	3	3							1		7
21:00 - 22:00	5	3	1						2		11
22:00 - 23:00	3	2	1						2		8
23:00 - 0:00	2	1							1		4
0:00 - 1:00	1	1							1		3
1:00 - 2:00	2								1		3
2:00 - 3:00	3	1							1		5
3:00 - 4:00	3	2							2		7
4:00 - 5:00	5	2	1						1		9
5:00 - 6:00	8	7	1						3		19
Total	**86**	**31**	**9**	**0**	**0**	**0**	**0**	**0**	**32**	**0**	**158**

Name of River: CDO River — Location of Station: RS01 Barra, Macabalan
Direction of Travel: to CDO City/Upstream — Date of Survey: April 3, 2013

Time	Type of Boat: Bangka	Fishing Pumpboat		Barges					Passenger Pump Boat		Total
	Non-motorized	Small	Big	Non-Motorize	Self-Propelled Small	Self-Propelled Big	Towed by Launch Small	Towed by Launch Big	Small	Big	
6:00 - 7:00											0
7:00 - 8:00	6	4	1						2		13
8:00 - 9:00	7	2	4								13
9:00 - 10:00	9		2						2		13
10:00 - 11:00	7	1	1						1		10
11:00 - 12:00	2	1									3
12:00 - 13:00		1									1
13:00 - 14:00	2										2
14:00 - 15:00	3	2									5
15:00 - 16:00	2								1		3
16:00 - 17:00	1										1
17:00 - 18:00	1										1
18:00 - 19:00	2	1							2		5
19:00 - 20:00	1		2						2		5
20:00 - 21:00	1	1							1		3
21:00 - 22:00	1	1							1		3
22:00 - 23:00		2							1		3
23:00 - 0:00		1									1
0:00 - 1:00	1								1		2
1:00 - 2:00	1	2							1		4
2:00 - 3:00	2	2							1		5
3:00 - 4:00	2	1									3
4:00 - 5:00		2							1		3
5:00 - 6:00	2	2							2		6
Total	**53**	**26**	**10**	**0**	**0**	**0**	**0**	**0**	**19**	**0**	**108**

Name of River: CDO River | Location of Station: RS01 Barra, Macabalan

Direction of Trave to Sea / Macajalar bay/Downstream | Date of Survey: April 4, 2013

Time	Type of Boat										Total
	Bangka	Fishing Pumpboat		Barges					Passenger Pump		
	Non-motorized	Small	Big	Non-Motorize	Self-Propelled Small	Self-Propelled Big	Towed by Launch Small	Towed by Launch Big	Small	Big	
6:00 - 7:00	1								1		2
7:00 - 8:00	10	1									11
8:00 - 9:00	2										2
9:00 - 10:00	3	1							2		6
10:00 - 11:00	2										2
11:00 - 12:00	4										4
12:00 - 13:00	1								1		2
13:00 - 14:00		2									2
14:00 - 15:00	2										2
15:00 - 16:00	1										1
16:00 - 17:00		1									1
17:00 - 18:00	1								1		2
18:00 - 19:00	12	1							4		17
19:00 - 20:00	5	5							3		13
20:00 - 21:00	2	4							1		7
21:00 - 22:00	2	1	1						1		5
22:00 - 23:00	1	2							2		5
23:00 - 0:00	2	1									3
0:00 - 1:00		1									1
1:00 - 2:00	2	1							1		4
2:00 - 3:00	3		1						1		5
3:00 - 4:00	2	3							1		6
4:00 - 5:00	3	2							2		7
5:00 - 6:00	9	3							2		14
Total	**70**	**29**	**2**	**0**	**0**	**0**	**0**	**0**	**23**	**0**	**124**

Name of River: CDO River | Location of Station: RS01 Barra, Macabalan

Direction of Travel: to CDO City/Upstream | Date of Survey: April 4, 2013

Time	Type of Boat										Total
	Bangka	Fishing Pumpboat		Barges					Passenger Pump		
	Non-motorized	Small	Big	Non-Motorize	Self-Propelled Small	Self-Propelled Big	Towed by Launch Small	Towed by Launch Big	Small	Big	
6:00 - 7:00	3	5							1		9
7:00 - 8:00	8	7							1		16
8:00 - 9:00	4	3							1		8
9:00 - 10:00	2										2
10:00 - 11:00	3	2							1		6
11:00 - 12:00	3	2									5
12:00 - 13:00	2								1		3
13:00 - 14:00		1									1
14:00 - 15:00	2										2
15:00 - 16:00	1	1									2
16:00 - 17:00	2										2
17:00 - 18:00	1	1									2
18:00 - 19:00	1	1							1		3
19:00 - 20:00	2										2
20:00 - 21:00	1								1		2
21:00 - 22:00											0
22:00 - 23:00											0
23:00 - 0:00											0
0:00 - 1:00											0
1:00 - 2:00	1	1									2
2:00 - 3:00											0
3:00 - 4:00		2									2
4:00 - 5:00	1	1									2
5:00 - 6:00	1	2									3
Total	**38**	**29**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**0**	**74**

Name of R CDO River — Location of Station: RS02 Maharlika Bridge, Consolacion

Direction of Travel: Macabalan/Downstream — Date of Survey: April 3, 2013

Time			Type of Boat										Total
			Bangka	Fishing Pumpboat		Barges					Passenger Pump		
			Manually Operated	Small	Big	Non-Motorized	Self-Propelled		Towed by Launch		Small	Big	
							Small	Big	Small	Big			
6:00	-	7:00											-
7:00	-	8:00											-
8:00	-	9:00											-
9:00	-	10:00				3							3
10:00	-	11:00				2							2
11:00	-	12:00				3							3
12:00	-	13:00	2			2							4
13:00	-	14:00				3							3
14:00	-	15:00				1							1
15:00	-	16:00											-
16:00	-	17:00				2							2
17:00	-	18:00											-
18:00	-	19:00											-
19:00	-	20:00	1										1
20:00	-	21:00											-
21:00	-	22:00											-
22:00	-	23:00											-
23:00	-	0:00											-
0:00	-	1:00											-
1:00	-	2:00											-
2:00	-	3:00											-
3:00	-	4:00											-
4:00	-	5:00											-
5:00	-	6:00				1							1
		Total	**3**	**0**	**0**	**17**	**0**	**0**	**0**	**0**	**0**	**0**	**20**

Name of R CDO River — Location of Station: RS02 Maharlika Bridge, Consolacion

Direction of Travel: CDO City/Upstream — Date of Survey: April 3, 2013

Time			Type of Boat										Total
			Bangka	Fishing Pumpboat		Barges					Passenger Pump		
			Manually Operated	Small	Big	Non-Motorized	Self-Propelled		Towed by Launch		Small	Big	
							Small	Big	Small	Big			
6:00	-	7:00											-
7:00	-	8:00											-
8:00	-	9:00				3							3
9:00	-	10:00				2							2
10:00	-	11:00				3							3
11:00	-	12:00	1										1
12:00	-	13:00				3							3
13:00	-	14:00				2							2
14:00	-	15:00				2							2
15:00	-	16:00	1										1
16:00	-	17:00				1							1
17:00	-	18:00											-
18:00	-	19:00											-
19:00	-	20:00	1										1
20:00	-	21:00											-
21:00	-	22:00											-
22:00	-	23:00											-
23:00	-	0:00											-
0:00	-	1:00											-
1:00	-	2:00											-
2:00	-	3:00											-
3:00	-	4:00											-
4:00	-	5:00											-
5:00	-	6:00											-
		Total	**3**	**0**	**0**	**16**	**0**	**0**	**0**	**0**	**0**	**0**	**19**

Name of River:	CDO River		Location of Station: RS02 Maharlika Bridge, Consolacion
Direction of Travel:	Macabalan/Downstream	Date of Survey:	April 4, 2013

Time			Type of Boat										
			Bangka	Fishing Pumpboat		Barges					Passenger Pump Boat		Total
			Non-motorized	Small	Big	Non-Motorized	Self-Propelled		Towed by Launch		Small	Big	
							Small	Big	Small	Big			
6:00	-	7:00				1							1
7:00	-	8:00	1	1		2							4
8:00	-	9:00			1	2							3
9:00	-	10:00			2	3							5
10:00	-	11:00		1	1	1							3
11:00	-	12:00			1	2							3
12:00	-	13:00				1							1
13:00	-	14:00											-
14:00	-	15:00											-
15:00	-	16:00											-
16:00	-	17:00											-
17:00	-	18:00											-
18:00	-	19:00											-
19:00	-	20:00											-
20:00	-	21:00											-
21:00	-	22:00											-
22:00	-	23:00	1										1
23:00	-	0:00											-
0:00	-	1:00											-
1:00	-	2:00											-
2:00	-	3:00											-
3:00	-	4:00											-
4:00	-	5:00											-
5:00	-	6:00	1										1
		Total	**3**	**2**	**5**	**12**	**0**	**0**	**0**	**0**	**0**	**0**	**22**

Name of River:	CDO River		Location of Station: RS02 Maharlika Bridge, Consolacion
Direction of Travel:	CDO City/Upstream	Date of Survey:	April 4, 2013

Time			Type of Boat										
			Bangka	Fishing Pumpboat		Barges					Passenger Pump Boat		Total
			Non-motorized	Small	Big	Non-Motorized	Self-Propelled		Towed by Launch		Small	Big	
							Small	Big	Small	Big			
6:00	-	7:00											-
7:00	-	8:00		1		3							4
8:00	-	9:00				2							2
9:00	-	10:00				1							1
10:00	-	11:00	1										1
11:00	-	12:00		1	1	3							5
12:00	-	13:00			1	1							2
13:00	-	14:00				1							1
14:00	-	15:00											-
15:00	-	16:00											-
16:00	-	17:00											-
17:00	-	18:00											-
18:00	-	19:00											-
19:00	-	20:00	1										1
20:00	-	21:00											-
21:00	-	22:00											-
22:00	-	23:00											-
23:00	-	0:00											-
0:00	-	1:00											-
1:00	-	2:00											-
2:00	-	3:00											-
3:00	-	4:00											-
4:00	-	5:00											-
5:00	-	6:00											-
		Total	**2**	**2**	**2**	**11**	**0**	**0**	**0**	**0**	**0**	**0**	**17**

Name of River:			CDO River					Location of Station: RS03		Kagayan Bridge			
Direction of Travel:			To Balulang/Upstream					Date of Survey:		April 3, 2013			
Time			Type of Boat										
			Bangka	Fishing Pumpboat		Barges					Passenger Pump		Total
			Non-motorized	Small	Big	Non-Motorized	Self-Propelled		Towed by Launch		Small	Big	
							Small	Big	Small	Big			
6:00	-	7:00											-
7:00	-	8:00											-
8:00	-	9:00											-
9:00	-	10:00											-
10:00	-	11:00	1										1
11:00	-	12:00											-
12:00	-	13:00											-
13:00	-	14:00	1										1
14:00	-	15:00											-
15:00	-	16:00											-
16:00	-	17:00											-
17:00	-	18:00											-
18:00	-	19:00											-
19:00	-	20:00											-
20:00	-	21:00											-
21:00	-	22:00											-
22:00	-	23:00											-
23:00	-	0:00											-
0:00	-	1:00											-
1:00	-	2:00											-
2:00	-	3:00											-
3:00	-	4:00											-
4:00	-	5:00											-
5:00	-	6:00											-
		Total	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**

Name of River:			CDO River					Location of Station: RS03		Kagayan Bridge			
Direction of Travel:			Bonbon/Downstream					Date of Survey:		April 3, 2013			
Time			Type of Boat										
			Bangka	Fishing Pumpboat		Barges					Passenger Pump		Total
			Non-motorized	Small	Big	Non-Motorized	Self-Propelled		Towed by Launch		Small	Big	
							Small	Big	Small	Big			
6:00	-	7:00											-
7:00	-	8:00											-
8:00	-	9:00											-
9:00	-	10:00											-
10:00	-	11:00											-
11:00	-	12:00											-
12:00	-	13:00											-
13:00	-	14:00											-
14:00	-	15:00											-
15:00	-	16:00											-
16:00	-	17:00											-
17:00	-	18:00											-
18:00	-	19:00											-
19:00	-	20:00											-
20:00	-	21:00											-
21:00	-	22:00											-
22:00	-	23:00											-
23:00	-	0:00											-
0:00	-	1:00											-
1:00	-	2:00											-
2:00	-	3:00											-
3:00	-	4:00											-
4:00	-	5:00											-
5:00	-	6:00											-
		Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Name of River:	CDO River					Location of Station: RS03		Kagayan Bridge			
Direction of Travel:	To Balulang/Upstream					Date of Survey:	April 4, 2013				

Time	Type of Boat										Total
	Bangka	Fishing Pumpboat		Barges					Passenger Pump		Total
	Non-motorized	Small	Big	Non-Motorized	Self-Propelled		Towed by Launch		Small	Big	
					Small	Big	Small	Big			
6:00 - 7:00	4										4
7:00 - 8:00	1	1									2
8:00 - 9:00			1								1
9:00 - 10:00											-
10:00 - 11:00		1									1
11:00 - 12:00		1									1
12:00 - 13:00											-
13:00 - 14:00											-
14:00 - 15:00											-
15:00 - 16:00	1										1
16:00 - 17:00											-
17:00 - 18:00											-
18:00 - 19:00											-
19:00 - 20:00											-
20:00 - 21:00											-
21:00 - 22:00											-
22:00 - 23:00											-
23:00 - 0:00											-
0:00 - 1:00											-
1:00 - 2:00											-
2:00 - 3:00											-
3:00 - 4:00											-
4:00 - 5:00											-
5:00 - 6:00											-
Total	**6**	**3**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**10**

Name of River:	CDO River					Location of Station: RS03		Kagayan Bridge			
Direction of Travel:	Bonbon/Downstream					Date of Survey:	April 4, 2013				

Time	Type of Boat										Total
	Bangka	Fishing Pumpboat		Barges					Passenger Pump		Total
	Non-motorized	Small	Big	Non-Motorized	Self-Propelled		Towed by Launch		Small	Big	
					Small	Big	Small	Big			
6:00 - 7:00	3										3
7:00 - 8:00	2	1									3
8:00 - 9:00											-
9:00 - 10:00											-
10:00 - 11:00											-
11:00 - 12:00	1	1									2
12:00 - 13:00		1									1
13:00 - 14:00											-
14:00 - 15:00											-
15:00 - 16:00											-
16:00 - 17:00											-
17:00 - 18:00											-
18:00 - 19:00											-
19:00 - 20:00											-
20:00 - 21:00											-
21:00 - 22:00											-
22:00 - 23:00											-
23:00 - 0:00											-
0:00 - 1:00											-
1:00 - 2:00											-
2:00 - 3:00											-
3:00 - 4:00											-
4:00 - 5:00											-
5:00 - 6:00											-
Total	**6**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**9**

(5) Groundwater Quality

Results of Analyses

Woodfields Consultants, Inc.
Room 200, 2nd Floor, S&L Bldg.
Roxas Blvd., Ermita, Manila

PAO ACCREDITED TESTING LABORATORY PNS ISO/IEC 17025:2005 LA-2008-118A

PAO ACCREDITED TESTING LABORATORY PNS ISO/IEC 17025:2005 LA-2008-118A

SN: F00016828.002

Date Received: 08/29/2013

Lab No.:P00045449

Project Name: EIA CDO FLOOD CONTROL

Attention: Ms. Ma. Lourdes C. Canon

Test Description	Results	Units	REG LIMIT	Test Methods	Date Analyzed	By	Ref*
Sample No.: P00045449-01			**DateSampled: 08-29-13 10:45**				
Sample ID: STATION 1			**Matrix: Groundwater**				
-Metals-							
Arsenic**	< 0.001	mg/L	0.01	Gaseous Hydride AAS	09/03/13	PPG	15
Cadmium**	< 0.003	mg/L	0.003	Flame AAS	09/03/13	PPG	15
Chromium**	< 0.02	mg/L	0.05	Flame AAS	09/03/13	NAP	15
Copper**	< 0.02	mg/L	1.0	Flame AAS	09/02/13	GGR	15
Lead	< 0.0001	mg/L	0.01	Graphite Furnace AAS	09/02/13	GGR	15
Mercury**	< 0.0001	mg/L	0.001	Manual Cold Vapor AAS	09/03/13	MVTM	15
-Microbiology-							
Total Coliforms**	>23	MPN/100mL	< 1.1	Multiple Tube Fermentation Technique	08/30/13	JGE	15
Fecal Coliforms**	>23	MPN/100mL	< 1.1	Multiple Tube Fermentation Technique	08/30/13	JGE	15
-Wet Chemistry-							
Biological Oxygen Demand**	1	mg/L	-	Azide Modification Winkler (SM 5210B)	08/30/13	WBD	
Chemical Oxygen Demand**	4.9	mg/L	-	Open Reflux Method (SM5220B)	09/02/13	MCP	
Total Suspended Solids**	3.0	mg/L	-	Gravimetry (SM2540 D)	09/02/13	IRC	
Oil & Grease**	< 0.3	mg/L	-	Pet. Ether Extraction (DENR-EMB Modified)	09/03/13	REB	
Nitrate**	17	mg/L	50	Cadmium Reduction Method	08/30/13	LCR	15
Cyanide, Total**	< 0.02	mg/L	0.07	Distillation - ISE	09/05/13	MPT	15
Phosphate-P**	0.4	mg/L	-	Stannous Chloride Method (SM4500-P D)	08/30/13	JCA	
>>> end of result set for Sample No.:P00045449-01 <<<							
Sample No.: P00045449-02			**DateSampled: 08-29-13 11:30**				
Sample ID: STATION 2			**Matrix: Groundwater**				
-Metals-							
Arsenic**	< 0.001	mg/L	0.01	Gaseous Hydride AAS	09/03/13	PPG	15
Cadmium**	< 0.003	mg/L	0.003	Flame AAS	09/03/13	PPG	15
Chromium**	< 0.02	mg/L	0.05	Flame AAS	09/03/13	NAP	15
Copper**	< 0.02	mg/L	1.0	Flame AAS	09/02/13	GGR	15
Lead	< 0.0001	mg/L	0.01	Graphite Furnace AAS	09/02/13	GGR	15
Mercury**	< 0.0001	mg/L	0.001	Manual Cold Vapor AAS	09/03/13	MVTM	15
-Microbiology-							
Total Coliforms**	>23	MPN/100mL	< 1.1	Multiple Tube Fermentation Technique	08/30/13	JGE	15
Fecal Coliforms**	>23	MPN/100mL	< 1.1	Multiple Tube Fermentation Technique	08/30/13	JGE	15
-Wet Chemistry-							
Biological Oxygen Demand**	2	mg/L	-	Azide Modification Winkler (SM 5210B)	08/30/13	WBD	
Chemical Oxygen Demand**	4.9	mg/L	-	Open Reflux Method (SM5220B)	09/02/13	MCP	
Total Suspended Solids**	< 2.5	mg/L	-	Gravimetry (SM2540 D)	09/02/13	IRC	
Oil & Grease**	< 0.3	mg/L	-	Pet. Ether Extraction (DENR-EMB Modified)	09/03/13	REB	
Nitrate**	17	mg/L	50	Cadmium Reduction Method	08/30/13	LCR	15
Cyanide, Total**	< 0.02	mg/L	0.07	Distillation - ISE	09/05/13	MPT	15
Phosphate-P**	0.06	mg/L	-	Stannous Chloride Method (SM4500-P D)	08/30/13	JCA	
>>> end of result set for Sample No.:P00045449-02 <<<							
Sample No.: P00045449-03			**DateSampled: 08-29-13 10:10**				
Sample ID: STATION 3			**Matrix: Groundwater**				
-Metals-							
Arsenic**	0.002	mg/L	0.01	Gaseous Hydride AAS	09/03/13	PPG	15
Cadmium**	< 0.003	mg/L	0.003	Flame AAS	09/03/13	PPG	15
Chromium**	< 0.02	mg/L	0.05	Flame AAS	09/03/13	NAP	15

Page 1 of 3

CRL Environmental Corporation

- **Sales Office:** Unit 609 Cityland 10 Tower 1 * 6815 H.V. dela Costa, Ayala Ave., Makati City, Philippines 1226 Tel. (632) 840-4071 ; (632) 817-5307 * Fax (632) 816-0329 * E-mail: crl@crllabs.com * http://www.crllabs.com
- **Laboratory:** Bldg. 2, Berthaphil Compound 1, Berthaphil Inc. Industrial Park Jose Abad Santos Ave., CFZ Clarkfield Pampanga, Philippines Tel. (6345) 599-3943 * (6345) 499-6529 * (632) 522-5100 * Fax (6345) 599-3963

Test Description	Results	Units	REG LIMIT	Test Methods	Date Analyzed	By	Ref*
-Metals-							
Copper**	< 0.02	mg/L	1.0	Flame AAS	09/02/13	GGR	15
Lead	0.001	mg/L	0.01	Graphite Furnace AAS	09/02/13	GGR	15
Mercury**	< 0.0001	mg/L	0.001	Manual Cold Vapor AAS	09/03/13	MVTM	15
-Microbiology-							
Total Coliforms**	>23	MPN/100mL	< 1.1	Multiple Tube Fermentation Technique	08/30/13	JGE	15
Fecal Coliforms**	>23	MPN/100mL	< 1.1	Multiple Tube Fermentation Technique	08/30/13	JGE	15
-Wet Chemistry-							
Biological Oxygen Demand**	8	mg/L	-	Azide Modification Winkler (SM 5210B)	08/30/13	WBD	
Chemical Oxygen Demand**	29	mg/L	-	Open Reflux Method (SM5220B)	09/02/13	MCP	
Total Suspended Solids**	27	mg/L	-	Gravimetry (SM2540 D)	09/02/13	IRC	
Oil & Grease**	0.6	mg/L	-	Pet. Ether Extraction (DENR-EMB Modified)	09/03/13	REB	
Nitrate**	32	mg/L	50	Cadmium Reduction Method	08/30/13	LCR	15
Cyanide, Total**	< 0.02	mg/L	0.07	Distillation - ISE	09/05/13	MPT	15
Phosphate-P**	0.8	mg/L	-	Stannous Chloride Method (SM4500-P D)	08/30/13	JCA	

>>> end of result set for Sample No.:P00045449-03 <<<

Sample No.: P00045449-04 **DateSampled: 08-29-13 09:30**

Sample ID: STATION 4 **Matrix: Groundwater**

Test Description	Results	Units	REG LIMIT	Test Methods	Date Analyzed	By	Ref*
-Metals-							
Arsenic**	0.001	mg/L	0.01	Gaseous Hydride AAS	09/03/13	PPG	15
Cadmium**	< 0.003	mg/L	0.003	Flame AAS	09/03/13	PPG	15
Chromium**	< 0.02	mg/L	0.05	Flame AAS	09/03/13	NAP	15
Copper**	< 0.02	mg/L	1.0	Flame AAS	09/02/13	GGR	15
Lead	0.002	mg/L	0.01	Graphite Furnace AAS	09/02/13	GGR	15
Mercury**	< 0.0001	mg/L	0.001	Manual Cold Vapor AAS	09/03/13	MVTM	15
-Microbiology-							
Total Coliforms**	>23	MPN/100mL	< 1.1	Multiple Tube Fermentation Technique	08/30/13	JGE	15
Fecal Coliforms**	1.1	MPN/100mL	< 1.1	Multiple Tube Fermentation Technique	08/30/13	JGE	15
-Wet Chemistry-							
Biological Oxygen Demand**	5	mg/L	-	Azide Modification Winkler (SM 5210B)	08/30/13	WBD	
Chemical Oxygen Demand**	68	mg/L	-	Open Reflux Method (SM5220B)	09/02/13	MCP	
Total Suspended Solids**	10	mg/L	-	Gravimetry (SM2540 D)	09/02/13	IRC	
Oil & Grease**	0.5	mg/L	-	Pet. Ether Extraction (DENR-EMB Modified)	09/03/13	REB	
Nitrate**	2.2	mg/L	50	Cadmium Reduction Method	08/30/13	LCR	15
Cyanide, Total**	< 0.02	mg/L	0.07	Distillation - ISE	09/05/13	MPT	15
Phosphate-P**	0.2	mg/L	-	Stannous Chloride Method (SM4500-P D)	08/30/13	JCA	

>>> end of result set for Sample No.:P00045449-04 <<<

>>> end of result set for Lab No.:P00045449; Total no. of samples analyzed: 4 <<<

**PAO approved parameter/s

MPN = Most Probable Number

Results are reported "as received basis".

Perkin Elmer / Varian / Shimadzu Analytical Methods, Atomic Absorption Spectrophotometry (AAS)

Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WEF, 22nd Edition.

Test Methods for Evaluating Solid Wastes, Vol 1A, USEPA, Third Edition

*** Regulatory Limit Reference**

[15] Philippine National Standards for Drinking Water, 2007

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