# Supporting Report Appendix G Preliminary Design of Structural Measures for Flood Mitigation

#### PREPARATORY SURVEY FOR FLOOD RISK MANAGEMENT PROJECT FOR CAGAYAN DE ORO RIVER (FRIMP-CDOR) IN THE REPUBLIC OF THE PHILIPPINES

# FINAL REPORT

# VOLUME III SUPPORTING REPORT (I)

# Appendix G PRELIMINARY DESIGN OF STRUCTURAL MEASURES FOR FLOOD MITIGATION

#### **Table of Contents**

#### Page

CHAPTE	R 1 G	ENERAL	G-1
1.1	Introduc	tion	G-1
	1.1.1	Type of Structural Measure	G-1
	1.1.2	Locations of Structural Measures	G-1
	1.1.3	Classification and Design of Structural Measures	G-4
1.2	Site Con	ditions	G-7
	1.2.1	Topographic Condition	G-7
	1.2.2	Geographic Conditions	G-9
	1.2.3	Existing River Structures	G-11
1.3	Design S	Standards and Criteria	G-14
	1.3.1	Design Standards	G-14
	1.3.2	Design Criteria	G-14
1.4	Design S	Scale of the Project	G-16
	1.4.1	Previous Design	G-16
	1.4.2	Design Scale for Initial Design	G-16
	1.4.3	Design Scale for Master Plan and Feasibility Study	G-20
1.5	Initial St	tudy for Alternatives of Preliminary Design (Initial Design)	G-20
1.6	Preparat	ion of Preliminary Design (Second Draft Design)	G-20
	1.6.1	Second Draft Design	G-20
	1.6.2	Basic Conditions for Second Draft Design	G-24
	1.6.3	Basic Concept of Second Draft Design	G-26
	1.6.4	Design High Water Level for Second Design	G-27
CHAPTE	R 2 B	ASIC DESIGNS OF STRUCTURAL MEASURES	G-35
2.1	Earth Di	ke and Concrete Floodwall	G-35
	2.1.1	Distance and Height of Dike System	G-35

	2.1.2	Earth Dike and Concrete Floodwall	G-36	
2.2	Evacuat	Evacuation Roads and Raising of the Existing RoadG-48		
	2.2.1	Introduction	G-48	
	2.2.2	Basic Design	G-48	
2.3	Improve	ement of the Kagay-an Bridge and Raising Approach	G-51	
	2.3.1	Introduction	G-51	
	2.3.2	Basic Designs	G-52	
2.4	Gates a	nd Drainage Outlets	G-54	
	2.4.1	Introduction	G-54	
	2.4.2	Basic Designs	G-55	
2.5	Retardi	ng Basin	G-56	
	2.5.1	Effective Use of Existing Retarding Basin	G-56	
	2.5.2	Basic Designs	G-60	
2.6	Weak F	oundation Improvement Works	G-63	
	2.6.1	Introduction	G-63	
	2.6.2	Basic Design	G-63	
2.7	Dam Op	peration	G-64	
	2.7.1	Long Term Measures	G-64	
	2.7.2	Existing Dam Plan and Proposed Sites	G-64	
	2.7.3	Advantage of Multi-purpose Dam	G-67	
	2.7.4	Flood Regulation Effect by Dam Reservoir	G-67	
	2.7.5	Typical Operation Plan for Flood Risk Management	G-69	

# List of Tables

Table 1.1.1	Areas of Project SiteG-1
Table 1.1.2	Section of Structural Measures
Table 1.1.3	Structural Measures of the Priority Project at River SectionsG-2
Table 1.1.4	Classification of Earth Dike and FloodwallG-4
Table 1.2.1	Stratigraphic Sequence
Table 1.2.2	In-Situ and SPT Results from BoreholesG-10
Table 1.2.3	Summary of Existing River Structures
Table 1.2.4	Proposed Flood Control Structures (1/4)G-30
Table 1.2.4	Proposed Flood Control Structures (2/4)G-31
Table 1.2.4	Proposed Flood Control Structures (3/4)G-32
Table 1.2.4	Proposed Flood Control Structures (4/4)G-33
Table 1.2.5	Existing, On-Going Construction and Proposed Flood Control Structures G-34
Table 1.3.1	Guidelines and Standards for Design of River Structure
Table 1.4.1	Design Scale of Major Rivers in the PhilippinesG-17
Table 1.6.1	Design Discharge at Kauswagan, Pelaez and Cabula Bridges and Bubunawan River
Table 1.6.2	Relation between Design Discharge and Desirable River WidthG-25

Table 1.6.3	Allowable Maximum Flood Water Level and Flow Capacity at Bridge Section	G-26
Table 1.6.4	Target Riverbed Elevation for Maintenance Dredging/Excavation	G-28
Table 1.6.5	Design High Water Level for Initial Design	G-28
Table 2.1.1	Total Length of Dike System (Earth Dike & Concrete Floodwall)	G-35
Table 2.1.2	Height of Dike System (Earth Dike & Concrete Floodwall)	G-35
Table 2.4.1	List of Gates and Drainage Outlets Works	G-55
Table 2.5.1	Basic Dimension of Retarding Basin	G-60
Table 2.6.1	Category of Weak Foundation	G-63
Table 2.7.1	Result of Flood Routing	G-68
Table 2.7.2	Typical Operation Plan for Flood Regulation in the Batang-Bulano Dam (Presumed)	G-69

## List of Figures

Figure 1.1.1	Location and Outline of the Structures	G-3
Figure 1.1.2	Basic Designs of Earth Dike (1/2)	G-4
Figure 1.1.2	Basic Designs of Earth Dike (2/2)	G-5
Figure 1.1.3	Designs of Concrete Floodwall	G-5
Figure 1.1.4	Location of Structures (Earth Dike and Floodwall) and Work Section	G-6
Figure 1.2.1	General Map of the Cagayan de Oro River Basin	G-7
Figure 1.2.2	3-D image of the Cagayan de Oro River in the Downstream Part	G-8
Figure 1.2.3	Designed Profiles of the Cagayan de Oro River in the Downstream Part	G-8
Figure 1.2.4	Cross Section of the Cagayan de Oro River (City Area)	G-9
Figure 1.2.5	Location of Existing River Structures	.G-13
Figure 1.4.1	Flow Capacity of Existing River (Right Bank)	.G-16
Figure 1.4.2	Flow Capacity of Existing River (Left Bank)	.G-17
Figure 1.4.3	Location Map of Potential Dam Site	.G-19
Figure 1.6.1	Design Discharge Distribution (25-year flood)	.G-21
Figure 1.6.2	Methodology for Creation of River Cross Section Data	.G-22
Figure 1.6.3	Monthly Highest High Tide and Lowest Low Tide in Macajalar Bay (2007-2011)	.G-22
Figure 1.6.4	Tide Levels in Macajalar Bay	.G-23
Figure 1.6.5	Observed Tide Level in Macajalar Bay during Sendong	.G-23
Figure 1.6.6	Tide Level in Macajarar Bay During TY Pablo (December 4, 2012)	.G-24
Figure 1.6.7	Observed Hourly Rainfall in Talakag (above) and Observed Hourly Discharge Data at Cabla Bridge (below) (December 4, 2012)	.G-24
Figure 1.6.8	Comparison of Existing River Width with Desirable River Width	.G-25
Figure 1.6.9	Typical Cross Section	.G-26
Figure 1.6.10	Case Study for Tide Level and Water Surface Profile in downstream of CDO River	.G-28
Figure 1.6.11	Design High Water Level for Second Design in Cagayan de Oro River	.G-29
Figure 2.1.1	Typical Section of Earth Dike (Types of Earth Dike-1)	.G-36

Figure 2.1.2	Typical Section of Earth Dike (Types of Earth Dike-2)	G-36
Figure 2.1.3	Typical Section of Earth Dike (1)	G-37
Figure 2.1.4	Typical Section of Earth Dike (1) and 3-D image	G-38
Figure 2.1.5	Two Stages (1st & 2nd Stage) Construction Procedures	G-39
Figure 2.1.6	Typical Section of Earth Dike (3) and 3-D image	G-40
Figure 2.1.7	Typical Section of Earth Dike (4)	G-40
Figure 2.1.8	Typical Section of Concrete Floodwall (Types of Floodwall-1)	<b>G-4</b> 1
Figure 2.1.9	Typical Section of Concrete Floodwall (Types of Floodwall-2)	<b>G-4</b> 1
Figure 2.1.10	Alternative Designs of Structural Measure in R2	G-42
Figure 2.1.11	Selected Designs of Alternative -2 (Floodwall and Boulevard) in R2	G-43
Figure 2.1.12	Typical Section of Floodwall and Boulevard in R4 section	G-43
Figure 2.1.13	3D-Image of Floodwall with Boulevard	G-44
Figure 2.1.14	Typical Sections of Concrete Floodwall (6)	G-44
Figure 2.1.15	Designs of Concrete Floodwall (7) and (8)	G-46
Figure 2.1.16	Plan of River Structures (Dike and Floodwall) at Narrow River Area	G-46
Figure 2.1.17	Designs of Concrete Floodwall (9)	G-47
Figure 2.1.18	Alignment of Floodwall (9) (Right Bank: Ysalina Bridge – Cathedral)	G-47
Figure 2.2.1	Location and Alignment of Road Dike at L1 Section	G-49
Figure 2.2.2	Typical Section and Elevation of Road Dike (1)	G-50
Figure 2.2.3	Conceptual Design of Road Dike (2)	G-50
Figure 2.2.4	Typical Section of Road Dike (2)	G-51
Figure 2.3.1	Aerial Photo at Approach Road of Kagay-an Bridge	G-51
Figure 2.3.2	Pictures of Damages along the Acasia Street During Sendong Flood (Left Bank downstream of the Kagay-an Bridge)	G-52
Figure 2.3.3	Plan of the Kagay-an Bridge and Approach Roads	G-53
Figure 2.3.4	Typical Section and 3-D Image of Improvement of the Kagav-an Bridge	G-53
Figure 2.3.5	Improvement of Left Abutment and Approach of the Kagay-an Bridge	G-54
Figure 2.3.6	Improvement of Right Abutment and Approach of the Kagay-an Bridge	G-54
Figure 2.4.1	Typical Design of Flap and Slide Gates	G-55
Figure 2.4.2	Typical Designs of Drainage Outlet with Steel Slide Gate	G-56
Figure 2.4.3	Typical Designs of Drainage Outlet with Fiber Glass Flap Gate	G-56
Figure 2.5.1	Location Map of Retarding Basins	G-57
Figure 2.5.2	Flooding Situation in Upstream of St. Augustine Cathedral during TY Pablo on December 4, 2012	G-58
Figure 2.5.3	Area of Proposed Retarding Basin and Proposed Dike Alignment (Aerial Photo around the Kagay-an Bridge).	G-59
Figure 2.5.4	Drainage Area of Retarding Basin in Upstream of the Cathedral	G-60
Figure 2.5.5	Aerial Photo and Location Map of Retarding Basin	G-61
Figure 2.5.6	Layout Plan of Retarding Basin (Structural Plan)	G-62
Figure 2.5.7	Plan of Improvement of Existing Drainage Channel (Arrovo Creek)	G-62
Figure 2.5.8	Section of Spillway and Existing Channel Improvement of Retarding	
6	Basin	G-63

Figure 2.6.1	Typical Design of Floodwall with Boulevard and Sand Compaction Pile (SCP) in R2 section	.G-64
Figure 2.7.1	Existing and Proposed Dam Sites in Upstream of Cagayan de Oro River	.G-66
Figure 2.7.2	Hydrograph at Proposed Dam Site	.G-67
Figure 2.7.3	Result of Flood Routing	.G-68
Figure 2.7.4	Design Discharge at Pelaez and Cabula Bridges and Bubunawan River	.G-68
Figure 2.7.5	Schematic Reservoir Allocation	.G-69

# CHAPTER 1 GENERAL

#### 1.1 Introduction

1.1.1 Type of Structural Measure

The followings are selected as structural measures in the project site along the Cagayan de Oro River (CDOR). Earth Dike and Concrete Floodwall are major structures in the priority project for flood control / river improvement works.

- (A) Earth Dike and Concrete Floodwall
  - (A-1) Earth Dike,
  - (A-2) Concrete Floodwall,
- (B) Raising Road and Evacuation Road,
- (C) Improvement of the Kagay-an Bridge,

Five (5) Areas:

- (D) Drainage Outlet Facilities and Gates, and
- (E) Retarding Basin

Each design of the structures (A) to (E) are examined considering of the site conditions at each work sites, technical, economic and social/environmental view points, which are explained in chapter mentioned below.

#### 1.1.2 Locations of Structural Measures

Structural measures of the priority project are proposed to be provided along the CDOR from river mouth to the Pelaez Bridge located about 11 km upstream from the river mouth. The project site is divided into the following five (5) areas as shown in Table 1.1.1.

Area – 1, 2, 3, 4 and 5

Areas	Location in the Cagayan de Oro City
Area – 1:	- River Mouth (Sta. 0+000)
	- 1) Kauswagan - Pontod Bridge (Sta.1+500)
Area – 2:	- 2) <u>Maharlika Bridge</u> (Sta. 2+960)
	- Isla de Oro Area (Consolasion)
Area – 3:	- Commission on Audit Office (COA) (Sta. 4+200L)
	- City Hall (4+040R)
	- 3) <u>Ysalina Bridge</u> (Sta. 4+340)
	- 4) <u>Kagay-an Bridge</u> (Sta. 4+880L)
Area – 4:	- Nazareth
	- Cala – Cala Area (Macasandig, right bank)
	- Hilly Area (Cala-CalaArea~PelaezBridge) (Right bank)
	- Carmen Area ~ Balulang Downstream Area (Left bank)
	- Balulang Upstream Area (Left bank)
	- Isla Puntod Area (Delta Area)
Area – 5:	- 5) Pelaez Bridge (Sta. 11+660)

Source: JICA Survey Team

The following ten (10) work sections are set up in the both river banks (right and left banks) for design and construction works of the structural measures as summarized in Table 1.1.2.

Ten (10) Sections: Right Bank (5 sections): R-1, 2, 3, 4 and 5 Left Bank (5 sections): L-1, 2, 3, 4 and 5

Aroo	Sections at River Banks			
Alea	Left Bank (L)	Right Bank (R)		
	L1: River Mouth (Sta. 0+000) – 1)	R1: River Mouth (Sta. 0+000) – 1)		
Aroa 1	Kauswagan - Pontod Bridge (Sta.1+500) -	Kauswagan - Pontod Bridge (Sta.1+500) -		
Alea – I	500 m upstream of Kauswagan-Pontod	500 m upstream of Kauswagan-Pontod		
	Bridge (Sta.2+060L)	Bridge (Sta.2+050R)		
	L2: 500 m upstream of Kauswagan-Pontod	R2: 500 m upstream of Kauswagan-Pontod		
Aron 2	Bridge (Sta.2+060L) – 2) Maharlika Bridge	Bridge (Sta.2+060R) – 2) Maharlika Bridge		
Alea – 2	(Sta. 2+960) – Downstream of Commission	(Sta. 2+960) – Downstream of City Hall		
	on Audit Office (Sta. 4+200L)	(4+040R)		
	L3: Downstream of Commission on Audit	R3: Downstream of City Hall $(4+040R) - 3)$		
Ar00 2	Office (COA) (Sta. 4+200L) – 3) Ysalina	Ysalina Bridge (Sta. 4+340) – 200 m		
Alea – 5	Bridge (Sta. 4+340) – 4) Kagay-an Bridge	upstream of the Ysalina Bridge (Sta.		
	(Sta. 4+880) - 1.2 km upstream of the	4+520R)		
	Kagay-an Bridge (Sta. 6+100L)			
	L4: 1.2 km upstream of the Kagay-an Bridge	R4: 200 m upstream of the Ysalina Bridge		
Area – 4	(Sta. 6+100L) - 1.5 km downstream of	(Sta. 4+520R) - 4) Kagay-an Bridge (Sta.		
	Pelaez Bridge (Sta. 10+100)	6+100L) – 3.6 km upstream of Kagay-an		
		Bridge (Sta. 8+500)		
Area – 5	L5: 1.5 km downstream from 5) Pelaez	R5: 3.1 km downstream from 5) Pelaez		
	Bridge (Sta. 11+660)	Bridge (Sta. 11+660)		

Source: JICA Survey Team

Proposed structures measures at each section are summarized in Table 1.1.3. Locations of the structure measures along the CDOR are shown in Figure 1.1.1, in which the proposed structures are shown. The structural measures are basically situated along the river boundary declared from the Secretary of DPWH on March 2013.

	Secti	Secti Priority Project		Works	Remarks
	on	Dike/Floodwall	Other Structures	by DPWH	Location (Barangay)
	L1	- Road Dike	- Slide Gates		Road Dike (Earth Dike):
		(Earth Dike)	- Drainage outlet		- Raising Existing Road
		- Floodwall + Earth-fill		_	- Evacuation Road
					(Bonbon, Kasuwangan)
k	L2			Floodwall	DWPH's Urgent Works
an					(Kasuwangan, Carmen)
t B	L3	- Earth Dike,	- Asphalt road	Sheet Pile	(COA office, Carmen)
,efi		- Floodwall	- Gate and Drainage outlet	revetment	Low water channel revetment
Γ			- Kagay-an Bridge		works are provided by DPWH's
			Improvement		Urgent Works.
	L4	- Earth Dike,	- Asphalt road		(Carmen, Balulang)
		- Floodwall	- Gates and Drainage outlet	—	
			Works		
	R1			Concrete	DWPH's Urgent Works
				Dike	(Puntod, Macabalang)
	R2	- Floodwall	- Asphalt road	Floodwall	(Consolacion, Pablacion)
			- Gates and Drainage outlet		
			Works		
ank	R3	- Floodwall	- Gates and Drainage outlet	Floodwall	(Pablacion; City Hall &
B		- Earth Dike	Works	(partial)	Cathedral).
tht					DWPH's Urgent Works will be
Rig					made partially.
Ι	R4	- Floodwall	- Retarding Basin		(Nazareth, Macasanding)
		- Earth Dike	- Gates and Drainage outlet		
			Works	—	
			- Kagay-an Bridge		
			Improvement		

 Table 1.1.3
 Structural Measures of the Priority Project at River Sections

Source: JICA Survey Team

As shown in Table 1.1.3 and Figure 1.1.1, DPWH\_Region-10 (DPWH-10) has schedule to implement river improvement works in the following section on their budget.

- Section R-1 (Concrete Face Rock-fill Dike), and
- Section L-3 (1st stage construction of Temporary Dike).
- Section R-3 (at partial of Concrete floodwall), and
- Section L-2 (Concrete floodwall).



Source: JICA Survey Team



#### 1.1.3 Classification and Design of Structural Measures

Designs of earth dike and floodwall are classified as shown in Table 1.1.4. Basic designs of Earth Dike and Concrete Floodwall were prepared as feasibility design level showing below. Work quantity and project cost were estimated based on the basic designs.

Tupo of Structure		Classification	Location			
Тур	e of Structure	of Design	Section	Station (Length: m)		
Earth	Earth Dike-1	Road Dike (2)	L1	Sta. 0+200 to 2+100 (L=1,680m)		
Dike	(Type-1)	(Earth fill)				
		Earth Dike (1)	L4	Sta. 8+500 to 9+000 (L=280m)		
			R2	Sta. 3+800 to 4+220 (L=350m)		
			R4	Sta. 5+100 to 5+200 (L=190m)		
		Earth Dike (3)	L3	Sta. 4+340 to 5+300 (L=780m)		
		Earth Dike (4)	R3	Sta. 4+600 (L=220m)		
	Earth Dike-2	Earth Dike (2)	L4	Sta. 9+000 to 10+100 (L=1,310m)		
	(Type-2)		R4	Sta. 5+200 to 8+200 (L=870m)		
Concrete	Flood wall	Road Dike (1)	L1	Sta. 0+250 to 0+450 (L=950m)		
Flood	(Wall + Earth-fill)					
wall	Flood wall	Floodwall (5)	R2	Sta. 1+880 to 2+980 (L=1,000m)		
	(Wall + Road		R2	Sta. 2+980 to 3+880 (L=350m)		
	Embankment)		R4	Sta. 4+600 to 5+100 (L=940m)		
	Flood wall	Floodwall (6)	L3	Sta. 5+300 to 6+000 (L=910m)		
	(Wall + Road)					
	Flood wall	Floodwall (7)	L3	Sta. 4+220 to 4+340 (L=165m)		
	(COA Office)		L4	Sta. 7+760 to 8+500 (L=690m)		
	Flood wall	Floodwall (8)	R3	Sta. 4+220 to 4+340 (L=130m)		
	(City Hall)					
	Flood wall	Floodwall (9)	L3	Sta. 6+000 to 6+100 (L=160m)		
	(Narrow River		R3	Sta. 4+340 to 4+600 (L=200m) *		
	Area)			*Constructed by DPWH		

 Table 1.1.4
 Classification of Earth Dike and Floodwall

Source: JICA Survey Team

Each design of (A) Earth Dike and Concrete Floodwall are shown in Figures 1.1.2 and 1.1.3, and other designs of structural measures; (B) Dike Road, (C) Bridge Improvement, (D) Drainage Outlet and Gates, and (E) Retarding Basin are shown in chapter below.

#### Earth Dike

Basic designs of the Earth Dike are prepared as shown in below.





Source: JICA Survey Team



Figure 1.1.2 Basic Designs of Earth Dike (2/2)

#### Concrete Floodwall

Basic designs of the Concrete Floodwall are prepared as shown below



Figure 1.1.3 Designs of Concrete Floodwall



Location of major structures (Earth Dike and Floodwall), typical section and work sections are shown in Figure 5.2.4.

Source: JICA Survey Team

Figure 1.1.4 Location of Structures (Earth Dike and Floodwall) and Work Section

#### 1.2 Site Conditions

#### 1.2.1 Topographic Condition

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 as shown in Figure 1.2.1.



Source: JICA Survey Team

Figure 1.2.1 General Map of the Cagayan de Oro River Basin

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.

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. 3-D image of the Cagayan de Oro River in the downstream part is shown in Figure 1.2.2.





**Figure 1.2.2 3-D image of the Cagayan de Oro River in the Downstream Part** Longitudinal profile of the Cagayan de Oro River is shown in Figure 1.2.3.





Figure 1.2.3 Designed Profiles of the Cagayan de Oro River in the Downstream Part

River cross sections at Lower (River Mouth), Middle (Narrow River Area) and Upper (Macasandig – Carman Areas) are shown in Figure 1.2.4 indicating of structural measures.



Source: JICA Survey Team



#### 1.2.2 Geographic Conditions

(1) Regional Geology and Stratigraphic Sequence

General Geology of Cagayan de Oro Watershed consists of the following geological layers, in which surface layer along the Cagayan de Oro River is almost Alluvium Layer.

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 as shown in Table 1.2.1.

Geological Map	Stratigaraphic Sequence	Geological Contents
Quaternary Alluvium	Alluvium	Quaternary Alluvium
	Cagayan Terrace Gravel	Cagayan Terrace Gravel
Bukidonon Formation	Bukidonon Formation	Bukidonon Formation
Quaternary Volcanics		
Taution ( Sadimanta	Indahag Limestone	Indahag Limestone
Tertiary Sediments	Opol Formation	
Diswite	Andesite Porphyry	
Diorite	Diorite	
Metamorphosed Shales and	Tood Formation	
Pyroclastics	Himalyan Formation	
Ultramafics	Ultramafics	Ultramafics Complex
basement Rocks (Shist)	Tago Shist	

 Table 1.2.1
 Stratigraphic Sequence

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;Retouch

#### (2) Results of Boring Investigations

Consistent with the general geology of CDOR, one finds thick beds of alluvial deposits that extend to at least 40.0m, the maximum investigation depth. Presented hereunder as Table 1.2.2 is the summary of in-situ and Standard Penetration Test (SPT) results from boreholes. Foundation of proposed river structure along the river bank of CDOR is almost composed of sand and sandy slit which have soft soil with N-value less than 15.

Denth	BOREHOLE													
ixpui	FB-1	FB-2	FB-4	FB-6	FB-7	FB-8	FB-10	FB-11	FB-12	FB-13	FB-14			
1	Brown Silt N=5	Silty Sand	Coarse Sand with gravel N=15	Brown Silt №2	Brown San dy Silt N=3	Silty Sand N=10 Brown Silt N=5	Brown Clayey Silt N=1	Sandy Silt N=3	Fine Sand N=4	Sandy Silt N=4	Sand with gravel N=10			
3		N=3	Fin e Sand N=7	Silty Sand N=8		FinetoCoarse Sand N=10		Coarse Sand	Sand with gravel N=27 Cobbles +	Silty Sand N=5	Cobbles + Gravel N=60			
5 6 7	Silty Sand N=7	Coarse Sand N=17	Coarse Sand	Claura Cilt	Silty Sand N=6	C ob bles N=60	Fin e Sand N=5	N=10	Gravel N=60	Sand with gravel N=20				
8		Clayey Silt N=8	with gravel N=16	N=4		Clay N=5		Cl ayey Silt N=4	Sand with gravel N=21	C db bles N=60				
10 11 12	Sandy Silt N=8		Fine to Sil ty Sand N=11	Silty Sand	Clayey Silt N=3		Cobbles + Gravel	Clayey Sand N=5		Coarse Sand N=22	Condouide			
13 14 15	Silty Sand	Silty Sand N=13			Fine to Silty Sand N=7		N=60	N=24		Clayey Silt N=1	gravel N=31			
17 18 19	N=18	Sandy Silt	SandySilt N=14		Cand shall at		Slty to Coarse Sand N=51	Fine to Coarse Sand N=39		Sandy Silt N=12 Fine S and				
20 21 22	Sandy Silt N=27	N=14	N=14	Citra Cand	City ford			wood N=16					N=19	
23 24 25 26	Silty Sand N=16	N=19 Sandy Silt	SiltySand N=18		Sandyto			Sandy Silt N=11						
27 28 29 30	Sandy Silt N=11 Gray Clay	Silty Sand with gravel N=31	SandySilt N=20		clayey Silt N=7			Fine Sand N=16						
31	N=11 Sandy Silt N=14		NOTE : N	-values show	vn represent	the average	of similar su	ccessive laye	ers.					
35 36 37 38 39 40	Silty Sand N=33													

 Table 1.2.2
 In-Situ and SPT Results from Boreholes

Source: the Survey Team

#### 1.2.3 Existing River Structures

The existing river structures and related facilities are summarized below (Table 1.2.3). The location of the Existing River Structures is shown in Figure 1.2.5.

Sia.0+240 - Sta.0+360 (120 m)LaftDikeRip Rap Store FillExisting-Sta.0+000 (140 m)RightDikeConcrete faced rock-fill dikeExisting-Sta.0+100-Sta.0+320 (180 m)RightDikeConcrete faced rock-fill dikeExistingRe-construct On-goingSta.0+220RightOutletRC Open DrainExisting-Sta.0+320RightOutletRCPCNewCompletedSta.0+320RightOutletRCPCNewCompletedSta.0+320Sta.phtOutletRCPCNewCompletedSta.0+320RightOutletConcrete faced (0-k-fill dikeExisting-Sta.0+400RightDikeConcrete faced (3-1.2 m. dia.)Existing-Sta.0+570RightOutletConcrete Faced (3-1.2 m. dia.)Existing-Sta.0+940Sta.1+340 (30 m)RightOutletConcrete Drain (2-1.2 m. dia.)Existing-Sta.0+940Sta.1+510RightOutletRC Sheet Pile with Pile Cap (CATIMCO)Existing-Sta.2+050Sta.2+100RightOutletRC Concrete Bank ProtectionExisting-Sta.2+200Sta.phtOutletRC Concrete Bank ProtectionExisting-Sta.2+200Sta.phtOutletRC Concrete Bank ProtectionExisting-Sta.2+200LeftRevement RevementConcrete Bank ProtectionExisting- <th>Location/Station</th> <th>River Bank</th> <th>Type of Structure</th> <th>Design of Structure</th> <th>Existing / Planned</th> <th>Plan to Rehabilitate</th>	Location/Station	River Bank	Type of Structure	Design of Structure	Existing / Planned	Plan to Rehabilitate
(120 m)ConstructEffDikeRip Rap Stone FillExisting-Sta.0-060-Sta.0+080RightDikeConcrete facedExistingRe-construct(140 m)RightDikeConcrete facedExistingRe-construct(180 m)RightOutletRC Open DrainExistingCompletedSta.0+120RightOutletRCPCNewCompletedSta.0+320RightOutletRCPCNewCompletedSta.0+300RightOutletRCPCNewCompletedSta.0+400RightDikeConcrete facedExistingRe-construct(320 m)RightDikeConcrete facedExistingOSta.0+400RightOutletConcrete facedExisting-Sta.0+300RightOutletConcrete PrainExisting-Sta.0+940Sta.1+340RightOutletConcrete PrainExisting-Sta.0+940Sta.1+340RightOutletRC Open DrainExisting-Sta.1+520RightOutletRC Open DrainExisting-Sta.2+500Sta.2+100LeftRevermentConcrete Bank ProtectionExisting-Sta.2+200Sta.2+400LeftRevermentConcrete Bank ProtectionSta.2+200Sta.2+400LeftRevermentConcrete Bank ProtectionSta.2+200Sta.2+400LeftRevermentConcrete	Sta 0+240 - Sta 0+360	Dalik	Structure		Tianneu	Kenabintate
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	(120 m)	Left	Dike	Rip Rap Stone Fill	Existing	-
	Sta.0-060-Sta.0+080	Diaht	Dilto	Concrete faced	Evictina	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	(140 m)	Right	Dike	rock-fill dike	Existing	
	Sta.0+140- Sta.0+320	Right	Dike	Concrete faced	Existing	Re-construct
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	(180 m)	Right	DIKC	rock-fill dike	LAIsting	On-going
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Sta. 0+220	Right	Outlet	RC Open Drain	Existing	-
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Sta. 0+320	Right	Outlet	RCPC	New	Completed
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Sta. 0+400	Right	Outlet	RCPC	New	Completed
	Sta.0+320 - Sta.0+460	Right	Dike	Concrete faced	Re-const'n	Completed
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	$\frac{(140 \text{ III})}{\text{Sto} 0 + 460 - \text{Sto} 0 + 780}$			Compared a faced	(INEW)	De construct
	(320  m)	Right	Dike	rock fill dike	(Damaged)	On going
Sta. 0+570RightOutletNext Control (3-1.2 m. dia.)ExistingOSta. 0+600LeftOutletCorceteExisting-Sta. 0+940RightOutletConcrete DrainExisting-Sta. 0+940 - Sta. 1+340RightRightOutletConcrete DrainExisting-(400 m)RightOutletRC Open DrainExistingOPuntod-KauswaganLeft & RightBridgeConcrete Bridge with Concrete PiersExisting-Sta. 1+520RightOutletRC Open DrainExisting-Sta. 2+050 - Sta.2+100 (30 m)LeftRevetmentConcrete Bank 	(320 III)			RCPC Outlet	(Dallageu)	Oll-going
Sta. 0+600LeftOutletCreekExistingSta. 0+940RightOutletConcrete DrainExisting-Sta. 0+940Sta. 1+340RightRiver WallPile Cap (CATIMCO)ExistingOSta. 1+500RightOutletRC Open DrainExistingOPuntod-KauswaganLeft & RightBridgeConcrete Bridge with Concrete Bridge with ProtectionExistingOSta. 1+510RightOutletRC Open DrainExistingOSta. 1+510RightOutletRC Open DrainExistingOSta. 1+510RightOutletRevetmentConcrete Bank ProtectionExisting-Sta. 2+000Sta. 2+000LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+200Sta. 2+400LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+200Sta. 2+400LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+700Sta. 2+830LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+800LeftOutletRCPon DrainExisting-Sta. 2+960LeftOutletRC Open DrainExisting-Sta. 2+960LeftOutletRC Open DrainExisting-Sta. 2+960LeftOutletRC Open DrainExisting-Sta. 2+960LeftOutletRC Open DrainExisting-<	Sta. 0+570	Right	Outlet	(3-1.2  m/dia)	Existing	0
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Sta 0+600	Left	Outlet	Creek	Existing	_
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	Sta $0+940$	Right	Outlet	Concrete Drain	Existing	_
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Sta.0+940 - Sta.1+340	- i i i i i i i i i i i i i i i i i i i		RC Sheet Pile with		_
Sta. 1+500RightOutletRC Open DrainExistingOPuntod-Kauswagan Bridge Sta. 1+510Left & RightBridge OutletConcrete Bridge with Concrete PiersExisting-Sta. 1+520RightOutletRC Open DrainExistingOSta. 2+050 - Sta.2+100 (50 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+420 - Sta.2+400 (140 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+400 - Sta.2+470 (30 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+470 - Sta.2+470 (130 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+700 - Sta.2+830 (130 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+700RightOutletRCPC OutletExisting-Sta. 2+960LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+960LeftOutletRC Open DrainExisting-Sta. 2+980LeftOutletRC Open DrainExisting-Sta. 3+120RightOutletRCPC OutletExistingOSta. 3+30 - Sta.3+420 (100 m)LeftOutletRCPC OutletExisting-Sta. 4+030RightOutletRC Open DrainExisting-Sta. 4+030RightOutletRC Open DrainExisting-Sta. 4+040 - Sta. 4+340	(400 m)	Right	River Wall	Pile Cap (CATIMCO)	Existing	0
Puntod-Kauswagan Bridge Sta. 1+510Left & RightBridge RightConcrete Bridge with Concrete PiersExisting-Sta. 1+520RightOutletRC Open DrainExistingOSta. 2+050 - Sta. 2+100 (140 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+260 - Sta. 2+400 (140 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+260 - Sta. 2+400 (140 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+440 - Sta. 2+470 (30 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+700 - Sta. 2+830 (130 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+700 - Sta. 2+830 (15 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+960LeftOutletRC Open DrainExisting-Sta. 2+970RightOutletRC Open DrainExisting-Sta. 2+970RightOutletRC Open DrainExisting-Sta. 2+980LeftOutletRCPC OutletExistingOSta. 3+120RightOutletRCPC OutletExisting-Sta. 3+300RightOutletRCPC OutletExisting-Sta. 3+300RightOutletRCPC OutletExisting-Sta. 3+910LeftOutletRC Open DrainExisting-Sta. 4+030	Sta. 1+500	Right	Outlet	RC Open Drain	Existing	0
Bridge Sta. 1+510RightBridge BridgeConcrete PiersExisting-Sta. 1+520RightOutletRC Open DrainExistingOSta. 2+050 - Sta.2+100 (50 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta.2+260 - Sta.2+400 (140 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta.2+260 - Sta.2+400 (140 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta.2+400 - Sta.2+470 (30 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta.2+700 - Sta.2+830 (130 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta.2+700RightOutletRCPC OutletExisting-Sta.2+700RightOutletRCPC OutletExisting-Sta.2+845 - Sta.2+860 (15 m)LeftOutletRC Open DrainExisting-Sta.2+960LeftOutletRC Open DrainExisting-Sta.2+980LeftOutletRC Open DrainExistingOSta.3+120RightOutletRCPC OutletExistingOSta.3+300RightOutletRCPC OutletExisting-Sta.3+300LeftOutletRCOpen DrainExisting-Sta.3+300RightOutletRCOpen DrainExisting-Sta.3+300LeftOutletRCOpen DrainExisting-Sta.3+300 <td>Puntod-Kauswagan</td> <td>Left &amp;</td> <td>Dallar</td> <td>Concrete Bridge with</td> <td>E-i-time</td> <td></td>	Puntod-Kauswagan	Left &	Dallar	Concrete Bridge with	E-i-time	
Sta. 1+520RightOutletRC Open DrainExistingOSta. 2+050 - Sta. 2+100 (50 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+260 - Sta. 2+400 (140 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+440 - Sta. 2+470 (30 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+440 - Sta. 2+470 (30 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+700 - Sta. 2+830 (130 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 2+700RightOutletRCPC OutletExisting-Sta. 2+700RightOutletRCPC OutletExisting-Sta. 2+845 - Sta. 2+860 (15 m)LeftOutletRCO Open DrainExisting-Sta. 2+960LeftOutletRC Open DrainExisting-Sta. 2+970RightOutletRC Open DrainExisting-Sta. 2+980LeftOutletRC Open DrainExistingOSta. 3+120RightOutletRCPC OutletExistingOSta. 3+30LeftOutletRCPC OutletExisting-Sta. 3+10LeftOutletRC Open DrainExisting-Sta. 4+030RightOutletRC Open DrainExisting-Sta. 4+030LeftOutletRC Open DrainExisting-Sta. 4+040-	Bridge Sta. 1+510	Right	Bridge	Concrete Piers	Existing	-
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Sta. 1+520	Right	Outlet	RC Open Drain	Existing	0
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	Sta.2+050 - Sta.2+100	Laft	Revetment	Concrete Bank	Existing	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	(50 m)	Len	Kevennent	Protection	Existing	-
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Sta.2+260- Sta.2+400	Left	Revetment	Concrete Bank	Existing	_
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	(140 m)	2011		Protection	Linsting	
$\begin{array}{ c c c c c c } \hline (30 \text{ m}) & \hline (10 \text{ m}) & \hline $	Sta.2+440 - Sta.2+470	Left	Revetment	Concrete Bank	Existing	-
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	(30 m)			Protection		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Sta.2+700 - Sta.2+830	Left	Revetment	Concrete Bank Protection	Existing	-
Sta.2+700RightOutletRevetmentConcrete Bank ProtectionExistingSta.2+845 - Sta.2+860 (15 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta.2+960LeftOutletRC Open DrainExisting-Maharlika Bridge Sta.2+970LeftBridge 	(130  III) Sta 2+700	Right	Outlet	RCPC Outlet	Existing	
Stall 2 1949LeftRevetmentConcrete Bank ProtectionExisting-Stall 2 + 960LeftOutletRC Open DrainExisting-Maharlika Bridge Stall 2 + 970Left & RightBridge RightConcrete Bridge with 	5ta.2+700 Sta 2+845 - Sta 2+860	Right	Outlet	Concrete Bank	Existing	
Sta. 2+960LeftOutletRC Open DrainExisting-Maharlika BridgeLeft & RightBridgeConcrete Bridge with Concrete PiersExisting-Sta. 2+970LeftOutletRC Open DrainExisting-Sta. 2+980LeftOutletRC Open DrainExistingOSta. 3+120RightOutletRC Open DrainExistingOSta. 3+120RightOutletRCPC OutletExistingOSta. 3+360RightOutletRCPC OutletExistingOSta. 3+320 - Sta. 3+420LeftRevetmentConcrete Bank ProtectionExisting-Sta. 3+910LeftOutletRC Open DrainExisting-Sta. 4+030RightOutletRC Open DrainExisting-Sta. 4+030RightOutletScorcrete Bank (U/S)Existing-Sta. 4+040 - Sta. 4+340 	(15  m)	Left	Revetment	Protection	Existing	-
Maharlika Bridge Sta. 2+970Left & RightBridgeConcrete Bridge with Concrete PiersExistingSta. 2+980LeftOutletRC Open DrainExistingOSta. 3+120RightOutletIsla de Oro Creek (D/S)ExistingOSta. 3+360RightOutletRCPC OutletExistingOSta. 3+360RightOutletRCPC OutletExistingOSta. 3+320 - Sta. 3+420 (100 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 3+910LeftOutletRC Open DrainExisting-Sta. 4+030RightOutletRC Open DrainExisting-Sta. 4+030LeftRevetmentIsla de Oro Creek (U/S)Existing-Sta. 4+040 - Sta. 4+340 (140 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 4+040 - Sta. 4+440 (400 m)RightFloodwallRC Retaining Wall with concrete pilesExistingO	Sta. 2+960	Left	Outlet	RC Open Drain	Existing	_
Sta. 2+970RightBridgeConcrete PiersExisting-Sta. 2+980LeftOutletRC Open DrainExistingOSta. 3+120RightOutletIsla de Oro Creek (D/S)ExistingOSta. 3+120RightOutletRCPC OutletExistingOSta. 3+360RightOutletRCPC OutletExistingOSta. 3+320 - Sta. 3+420 (100 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 3+910LeftOutletRC Open DrainExisting-Sta. 4+030RightOutletIsla de Oro Creek (U/S)Existing-Sta. 4+030LeftRevetmentIsla de Oro Creek (U/S)Existing-Sta. 4+040 - Sta. 4+340 (140 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 4+040 - Sta. 4+440 (400 m)RightFloodwallRC Retaining Wall with concrete pilesExisting (Damaged)O	Maharlika Bridge	Left &	D : 1	Concrete Bridge with		
Sta. 2+980LeftOutletRC Open DrainExistingOSta. 3+120RightOutletIsla de Oro Creek (D/S)ExistingOSta. 3+360RightOutletRCPC OutletExistingOSta. 3+360RightOutletRCPC OutletExistingOSta. 3+320 - Sta. 3+420 (100 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 3+910LeftOutletRC Open DrainExisting-Sta. 4+030RightOutletIsla de Oro Creek (U/S)Existing-Sta. 4+030RightOutletConcrete Bank ProtectionExisting-Sta. 4+030RightOutletRevetmentExisting-Sta. 4+040 - Sta. 4+340 (140 m)LeftRevetmentConcrete Bank ProtectionExistingOSta. 4+040 - Sta. 4+440 (400 m)RightFloodwallRC Retaining Wall with concrete pilesExisting (Damaged)O	Sta. 2+970	Right	Bridge	Concrete Piers	Existing	-
Sta. 3+120RightOutletIsla de Oro Creek (D/S)ExistingOSta. 3+360RightOutletRCPC OutletExistingOSta. 3+320 - Sta. 3+420 (100 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 3+910LeftOutletRC Open DrainExisting-Sta. 4+030RightOutletIsla de Oro Creek (U/S)Existing-Sta. 4+030 - Sta. 4+340 (140 m)LeftRevetmentConcrete Bank (U/S)Existing-Sta. 4+040 - Sta. 4+440 (400 m)RightRevetmentConcrete Bank ProtectionExistingO	Sta. 2+980	Left	Outlet	RC Open Drain	Existing	0
Sta. 3+120RightOutlet(D/S)ExistingOSta.3+360RightOutletRCPC OutletExistingOSta.3+320 - Sta.3+420 (100 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 3+910LeftOutletRC Open DrainExisting-Sta. 4+030RightOutletIsla de Oro Creek (U/S)Existing-Sta. 4+030 - Sta. 4+340 (140 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta. 4+040 - Sta. 4+440 (400 m)RightFloodwallRC Retaining Wall with concrete pilesExisting (Damaged)O	Sta 3+120	Right	Outlot	Isla de Oro Creek	Evicting	0
Sta.3+360RightOutletRCPC OutletExistingOSta.3+320 - Sta.3+420 (100 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta.3+910LeftOutletRC Open DrainExisting-Sta.4+030RightOutletIsla de Oro Creek (U/S)Existing-Sta.4+200 - Sta.4+340 (140 m)LeftRevetmentConcrete Bank ProtectionExisting-Sta.4+040 - Sta.4+440 (400 m)RightFloodwallRC Retaining Wall with concrete pilesExistingO	51a. 5+120	Kigiti	Outlet	(D/S)	Existing	0
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Sta.3+360	Right	Outlet	RCPC Outlet	Existing	0
(100 m)LeftOutletProtectionEastingSta. 3+910LeftOutletRC Open DrainExisting-Sta. 4+030RightOutletIsla de Oro Creek (U/S)Existing-Sta. 4+200 - Sta. 4+340 (140 m)LeftRevetmentConcrete Bank ProtectionExistingOSta. 4+040- Sta. 4+440 (400 m)RightFloodwallRC Retaining Wall with concrete pilesExisting (Damaged)O	Sta.3+320 – Sta.3+420	Left	Revetment	Concrete Bank	Existing	-
Sta. 3+910LeftOutletRC Open DrainExisting-Sta. 4+030RightOutletIsla de Oro Creek (U/S)Existing-Sta. 4+200 - Sta. 4+340 (140 m)LeftRevetmentConcrete Bank ProtectionExistingOSta. 4+040 - Sta. 4+440 (400 m)RightFloodwallRC Retaining Wall with concrete pilesExisting (Damaged)O	(100 m)	TC		Protection	<b>D</b> : .:	
Sta. 4+030RightOutletIsla de Oro Creek (U/S)Existing-Sta. 4+200 - Sta. 4+340 (140 m)LeftRevetmentConcrete Bank ProtectionExistingOSta. 4+040 - Sta. 4+440 (400 m)RightFloodwallRC Retaining Wall with concrete pilesExistingO	Sta. 3+910	Left	Outlet	RC Open Drain	Existing	-
Sta.4+200 - Sta.4+340 (140 m)LeftRevetmentConcrete Bank ProtectionExistingOSta.4+040- Sta. 4+440 (400 m)RightFloodwallRC Retaining Wall with concrete pilesExisting (Damaged)O	Sta. 4+030	Right	Outlet	Isla de Oro Creek (U/S)	Existing	-
Sta.4+040- Sta. 4+440 (400 m)RightFloodwallRC Retaining Wall with concrete pilesExisting (Damaged)O	Sta.4+200 – Sta.4+340 (140 m)	Left	Revetment	Concrete Bank Protection	Existing	Ο
	Sta.4+040– Sta. 4+440 (400 m)	Right	Floodwall	RC Retaining Wall with concrete piles	Existing (Damaged)	0

 Table 1.2.3
 Summary of Existing River Structures

Sta. 4+260	Right	Outlet	RC Pipe Drain	Existing	-
<b>Ysalina Bridge</b> Sta. 4+340	Left & Right	Bridge	Steel Truss and Concrete Piers	Existing	-
Sta.4+340 – Sta.4+460 (120 m)	Left	Dike	Concrete faced rock-fill dike	Existing (Damaged)	Re-const'n On-going
Sta. 4+360	Left	Outlet	RCPC Drain	New	Re-const'n On-going
Sta. 4+455	Left	Outlet	RCPC Drain	Existing	Re-const'n On-going
Sta.4+460 – Sta.4+580 (120 m)	Left	Dike	Concrete faced rock-fill dike	Existing	Ο
Sta. 4+760	Left	Outlet	RC Box Drain	Existing	-
Sta. 4+480 - Sta.4+610 (130 m)	Right	Dike	Concrete faced rock-fill dike	Existing (Damaged)	0
Sta. 4+640	Right	Outlet	RC Open Channel	Existing	-
Sta. 4+680	Right	Outlet	RC Open Drain	Existing	-
Sta. 4+640 – Sta. 4+730 (90m)	Right	Dike	Concrete faced rock-fill dike	Existing	-
Kagay An Bridge Sta. 4+890	Left & Right	Bridge	Concrete Bridge with Concrete Piers	Existing	-
Sta. 4+830 – Sta. 4+950 (120 m)	Right	Dike	Concrete faced rock-fill dike	Existing (Damaged)	-
Sta. 4+950 – Sta. 5+040 (90 m)	Right	Dike	Concrete faced rock-fill dike	New	Construction On-going
Sta. 5+040	Right	Outlet	RC Culvert	New	Construction On-going
Sta. 5+140 - Sta.5+480 (340m)	Left	Dike	Concrete faced rock-fill dike	Existing (Damaged)	0
Sta. 5+580	Left	Outlet	RC Open Canal	Existing	-
Pelaez Bridge Sta. 11+660	Left & Right	Bridge	Concrete Bridge with Concrete Piers	Existing	-

Source: JICA Survey Team

The following existing structures are identified along the Cagayan de Oro River, until 11.5 km upstream from the river mouth.

1) Dike and Bank Protection Works

	- Dike:	1,790 m
	- Revetment:	605 m
	- Floodwall	400 m
	- River wall	400 m
2)	Drain Outlet:	20 units
3)	Bridge	5 units

Tables 1.2.4 and 1.2.5 shows the locations of existing and planned river strictures along the river stations of the Cagayan de Oro River.



Source: JICA Survey Team

Figure 1.2.5 Location of Existing River Structures

#### **1.3** Design Standards and Criteria

#### 1.3.1 Design Standards

The following design guidelines, standards and code are identified, which will be used for the structural design in the Survey. The guidelines specified herein shall be of the latest edition. Design standards were rearranged based on item of "Planning & Design" and "Construction Materials" as shown in Table 1.3.1.

- (1) Standards of the Philippines
  - (a) Design Guidelines, Criteria and Standards for Public Works and Highways, Department of Public Works and Highway (DPWH), Volumes I and II;
  - (b) DPWH / JICA Technical Standards and Guidelines for Design of Flood Control Structures (2010 Edition)
  - (c) National Structural Code of the Philippines, Volume I Building, Towers and other Vertical Structures, 5<sup>th</sup> Edition, 2001;
  - (d) National Structural Code of the Philippines, Volume II Bridges, 2<sup>nd</sup> Edition, 1997;
  - (e) National Building Code of the Philippines (NBCP); and
  - (f) Philippines National Standards.
- (2) Standards of the Other Countries
  - (a) Standard Specifications for Highway Bridges, Seventeenth Edition, American Association of State Highway and Transportation Officials (AASHTO), 2002;
  - (b) American Concrete Institute (ACI);
  - (c) American Institute of Steel Construction (AISC);
  - (d) American Iron and Steel Institute (AISI);
  - (e) American Society for Testing Materials (ASTM);
  - (f) Engineering Manual for Engineering and Design, Department of US Army Corps of Engineers;
  - (g) Technical Standards for River and Sabo Works River Association of Japan;
  - (h) Manual on Design and Construction for Liquefaction Measures on Dike, Public Works Research Institute (PWRI), Japan
  - (i) Design Specification for River Gate, River Association of Japan; and
  - (j) Japanese Industrial Standards (JIS).
- 1.3.2 Design Criteria

The followings are specified as design criteria for feasibility design, which are described in Annex – G.1.

- 1) Materials
- 2) Design Flood Return Period and Discharge
- 3) Design Loads
- 4) Stability of Structures
- 5) Foundation
- 6) Protection Works
- 7) Pavement
- 8) Bridge
- 9) Weak Foundation Improvement Works

		1401C 1.5.1	Guidelines and Standards for Design of River Structure					
Item	River Structure	Type of Structure	Design Guideline • Standard					
Plan & Design	Dike	Earth Fill Dike	<ol> <li>Manual on Design of Flood Control Structures, January 2005, JICA-ENCA (Chapter 4 Dike)</li> <li>Technical Standards for River and Sabo Works River Association of Japan</li> <li>Design Standards of U.S. Army Corps of Engineer</li> <li>Standard Specifications for Highway Bridges, Seventeenth Edition, American Association of State Highway and Transportation Officials (AASHTO), 2002</li> </ol>					
		Concrete Floodwall	1) Manual on Design of Flood Control Structures, January 2005, JICA-ENCA, (Chapter 5 Revetment)					
	Revetment	Reinforced Concrete Face	<ol> <li>Manual on Design of Flood Control Structures, January 2005, JICA-ENCA, (Chapter 5 Revetment)</li> <li>Technical Standards for River and Sabo Works River Association of Japan</li> <li>Design Standards of U.S. Army Corps of Engineer</li> </ol>					
		Wet Stone Masonry	<ol> <li>Manual on Design of Flood Control Structures, January 2005, JICA-ENCA, (Chapter 5 Revetment)</li> <li>Technical Standards for River and Sabo Works River Association of Japan</li> <li>Design Standards of U.S. Army Corps of Engineer</li> </ol>					
		Sheet Pile	1) Technical Standards for River and Sabo Works River Association of Japan					
	Drain Outlet	Slide & Flap Gate	<ol> <li>Technical Standards for River and Sabo Works River Association of Japan</li> <li>Design Specification for River Gate, River Association of Japan</li> </ol>					
	Foundation Improvement	<ul> <li>Earth Fill Dike</li> <li>Concrete Floodwall</li> </ul>	1) Manual on Design and Construction for Liquefaction Measures on Dike, Public Works Research Institute (PWRI), Japan					
	Bridge	Pier, Girder	1) National Structural Code of the Philippines, Volume II – Bridges, 2 <sup>nd</sup> Edition, 1997;					
Construction Materials	Embankment	Soil (River Channel Excavation Materials)	<ol> <li>American Society for Testing Materials (ASTM)</li> <li>Standard Specifications for Highway Bridges, Seventeenth Edition, American Association of State Highway and Transportation Officials (AASHTO), 2002</li> </ol>					
	Sheet Pile	Concrete	1) Philippines National Standards 2) Japanese Industrial Standards (JIS)					
		Steel Sheet Pile	1) Philippines National Standards 2) Japanese Industrial Standards (JIS)					
	Gate	<ul> <li>Steel Slide Gate</li> <li>Steel Flap Gate</li> <li>FRP Flap Gate</li> </ul>	<ol> <li>Design Specification for River Gate, River Association of Japan</li> <li>Philippines National Standards</li> <li>Japanese Industrial Standards (JIS)</li> </ol>					

#### ndards for Dosia r Sti Table 131 Cuidelin d Cto f Div moti

Source: JICA Survey Team

#### 1.4 Design Scale of the Project

#### 1.4.1 Previous Design

Previous M/P and F/S in June 2011 adopted 25-year probability as an optimum design scale both for M/P and F/S. However, as mentioned in Chapter 3 in Main Report the return period of Tropical Storm Sendong was evaluated at around 50 year probability which exceeds the design scale of the previous M/P and F/S.

#### 1.4.2 Design Scale for Initial Design

The design scale is determined for each level of the plan i.e. the Frame Work Plan and Master Plan and Short-Term Plan in general. In this survey, the design scale is studied taking into account of the existing flow capacity, design scales of other major rivers in the Philippines, existing river improvement works and site development conditions, technical viability, economic feasibility and social impacts.

(1) Flow Capacity of Existing River Channel

Flow capacity of the some sections of existing river was estimated at 700-1,500m<sup>3</sup>/s (2-5yr) based on the non-uniform flow analysis adopting the latest survey result as shown in figure below. This would have decreased due to sediment deposition in the channel after typhoon Pablo.



Source JICA Survey Team

Figure 1.4.1 Flow Capacity of Existing River (Right Bank)



Source JICA Survey Team

#### Figure 1.4.2 Flow Capacity of Existing River (Left Bank)

(2) Design Scales in Other Major Rivers in the Philippines

The design scales of the major rivers in the Philippines are mainly set at 100 year for the Frame Work Plan and at 10 - 30 year for the Short Term Plan for actual implementation of the river improvement projects as shown in table below. Comparing the Cagayan de Oro River with other major rivers in term of size of river, catchment area, flood damages and value of properties in the basin, it is considered reasonable to adopt the similar design scale of other major rivers (10-30 year).

If the design scale is raised much higher, for example up to the highest magnitude such as the Sendong flood, it needs to re-evaluate the overall priority of the whole major rivers in the Philippines and prioritize the Cagayan de Oro River basin among the other rivers in the Philippines.

			Drainaga	Loval	A		Desi	gn Scale	
No.	Name of River Basin	Region	Area (km²)	Area *(km²)	Runoff (MCM)	Frame Works Plan	Master Plan	Short Term Plan	Implemente d Project(s)
1	Cagayan	Cagayan Valley	25,694	3,546	53,943	100 yr	25 yr	25 yr	
2	Agusan	Northern Mindanao	10,921	2,494	27,880	100 yr	-	30 yr	20 yr
3	Pampanga	Central Luzon	9,759	6,660	10,930	100 yr	-	20 yr	20 yr
4	Agno	Central Luzon	5,952	1,883	6,654	100 yr	25 yr	10yr	10 yr
5	Pasig-Laguna	Southern Luzon	4,678	1,065	7,485	100 yr	100 yr	30 yr	
6	llog-Hilabangan	Western Visayas	1,945	645	2,474	-	100 yr	25 yr	
7	Panay	Western Visayas	1,843	430	2,344	100 yr	25 yr	3-10 yr	
8	Cagayan de Oro***	Northern Mindanao	1,521	86	3,883		25 yr	25 yr	
9	Laoag	llocos Norte				25 yr			
10	Pinatubo (Pampanga)	Central Luzon	322					20 yr	20 yr
11	Ormoc					50 yr			
	Note * : Plain includes the le	vel land with slopes of less than	n 3% which	is suitable f	or irrigation	developm	ent.		
	** Rivers in Philippines 1997								
	*** F/S2011								
	Source: Pricipal River Basin	s of the Philippines-NWRC							

Table 1.4.1Design Scale of Major Rivers in the Philippines

Source JICA Survey Team

#### (3) Constraint of River Width and High Water Level

The existing river channel has a flow capacity of 2-5 years flood only. However, in case the design scale is raised up to the highest magnitude such as the Sendong flood at one time, it would need extraordinary river width or structures along the river.

The existing three (3) bridge sections in the downstream have flow capacity of 2,700  $-3,100 \text{ m}^3$ /s. In case the river discharge exceeds 2,800m<sup>3</sup>/s, the Maharlika and Kagay-an Bridges will have to be considered replacement or upgraded against the design flood water level.

(4) Social Impacts

The river improvement plan adopting the design scale of TS Sendong would cause serious social impacts due to increase of the number of affected residents, resettlement and Right-of-Way acquisition even though the flood walls could be constructed along the bank. In addition, construction of higher dike/flood wall in the low lying area will make the flood risk higher against the extraordinary flood.

#### (5) Potential Dam Site in Upstream Basin

In the upstream basin, NPC-NORMECA (Northern Mindanao Electric Cooperatives Association) had formulated the Implementation Program for the Dam Construction for a hydro power plant with the dam height of around 100 m and the storage capacity of 100 million cu.m. According to a key member of the project, they are trying to start the project as soon as possible, and ECC was already issued. They also started negotiation for land acquisition. The purpose of the dam construction is for the hydropower development, but it has a big storage capacity which would be capable for utilization as flood control measures.



Source: JICA Survey Team

Figure 1.4.3 Location Map of Potential Dam Site

#### 1.4.3 Design Scale for Master Plan and Feasibility Study

As mentioned above, it is not reasonable to adopt higher design scale for the actual implementation of the project in the Cagayan de Oro River considering the existing flow capacity, design scales of other major rivers in the Philippines, existing river improvement works and site development conditions, and social impacts.

On the other hand, the return period of the TS Sendong is evaluated at around 50-year probability and the memorandum from the DPWH Secretary Singson dated June 21, 2011 was issued to upgrade the design standard of flood control works up to 50-year flood level with freeboard which can contain the 100-year flood for adaptation of the climate change.

The long term plan to be proposed in the Master Plan will be formulated taking into account the return period of TS Sendong and the memorandum :

- a) Design Scale of Master Plan : Sendong (around 50-year probability)
- b) Design Scale of Feasibility Study : 25-year flood

#### 1.5 Initial Study for Alternatives of Preliminary Design (Initial Design)

The initial design for the river improvement plan of the CDO River was prepared in order to provide the concept and approach for the rehabilitation works undertaken by the GOP after TS Sendong while conducting the Basic Survey. In addition, based on the proposed initial design, DPWH established the river boundary along the CDO River which was needed to be determined prior to start the Master Plan Study and Feasibility Study.

The design scale of the initial design was adopted 25-year probable flood and design discharge of 2,500 m<sup>3</sup>/s referring to the hydrograph prepared in M/P 2011. The results of study for the initial design were summarized in the Draft Progress Report (DP/R) in December 2012.

#### **1.6** Preparation of Preliminary Design (Second Draft Design)

1.6.1 Second Draft Design

After preparation of Initial Design in the DP/R on December 2012, the second draft design of the river improvement plan of CDO River was studied and summarized in Progress Report in March 2013 based on the discussions on the DP/R with the JICA and GOP and results of the Basic Survey including such as the latest topographic data and hydrological study in this Survey. Main points of second draft design to be noted for the Master Plan study are presented as below:

(1) Basic Alternatives for Second Draft Design

The basic alternative measures for comprehensive flood risk management project i.e. large retarding basin and storm drainage will be studied in the Master Plan. In the second draft design in the Basic Survey stage, basic alternatives of the river improvement plan are proposed considering the potential dam construction in the upstream basin as the same as the initial design as sated below:

-	Structural measures	:	River improvement in downstream (for 25-year flood)
		:	Dam construction for flood control (for the floods exceeding
			25-year probability)

Non-structural measures : FFWS, evacuation system, flood fighting
 : Definition of river boundary, land use management

#### (2) Objective Area

The objective area for the second draft design is 12 km long stretching from the river mouth to Pelaez Bridge considering the flood damage in TS Sendong as well as the topographic, social and development conditions in the area. In this stretch the floodwaters were frequently spilled out from the lower bank sections and caused serious flood inundation and damages in the residential and commercial areas during the recent floods, i.e. flood in January 2009, TS Sendong in December 2011 and TY Pablo in December 2012.

(3) Design Scale

Design Scale of the second draft design is 25-year. The memorandum from the DPWH Secretary regarding upgrade the design standard of flood control works up to 50-year flood level with freeboard which can contain the 100-year flood for adaptation of the climate change is incorporated in the Master Plan study.

(4) Design Discharge

As mentioned in Chapter 6, flood hydrograph for each return period 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. For the second draft design of the initial river improvement plan downstream of the Cagayan de Oro River, the design scale adopted is 25-year probable flood as presented in the figure below.

The design of the structure in the objective stretch from river mouth to the Pelaez Bridge is designed adopting the design discharge at Kauswagan-Puntod Bridge of  $3,400 \text{ m}^3/\text{s}$ .

Table 1.6.1Design Discharge at Kauswagan, Pelaez and Cabula Bridges and<br/>Bubunawan River

	Kauswagan –	Pelaez Bridge	Cabula Bridge	
Return Period	Puntod	(River mouth –	(upstream of	Bubunawan River
	Bridge.	Bubunawan Conf.)	Bubunawan Conf.)	
25-year	$3,400 \text{ m}^3/\text{s}$	3,300 m <sup>3</sup> /s	$2,700 \text{ m}^{3}/\text{s}$	$600 \text{ m}^{3}/\text{s}$



Source: JICA Survey Team

#### Figure 1.6.1 Design Discharge Distribution (25-year flood)

#### (5) Survey Data

Cross sections and longitudinal profile of the river were prepared based on the latest river survey. Topographic survey in the downstream stretches of the Cagayan de Oro River was completed with provision of orthophoto data of the scale of 1/1,000, and DEM and contour line data were produced from the topographic survey. Thus, cross section data

are prepared adopting the river corss section survey in the river channel and the DEM in the inundation area as shown in figure below.

The vertical datum of the survey uses Mean Sea Level (MSL) referring to the bench marks of NAMRIA as mentioned in Chapter 3 in Main Report.



Source: JICA Survey Team



#### (6) High Tide Level at River Mouth

Water level at the river mouth of the Cagayan de Oro River is affected by the tide of Macajalar Bay.

The hourly tide level is monitored at Macajalar Bay by NAMRIA from 2007 to present. In this period, the recorded maximum tide level of MSL + 1.34 m which was set at the highest high tide in the river mouth and no extraordinary high tide was recorded.

The design high tide level is adopted the High Water Level of MSL +1.01 m.



Source: NAMRIA

Figure 1.6.3 Monthly Highest High Tide and Lowest Low Tide in Macajalar Bay (2007-2011)

Recorded	~~	H.H.W.L +1.34
Maximum Tide		
High Water Level		H.W.L +1.01
	//	
	77	
Mean Sea Level		M.S.L +0.00
Mean Lower Low Water		M.L.L.W -0.62
	22	
Low Water Level		L.W.L
Recorded Minimum Tide		L.L.W.L -1.12

Source: NAMRIA

#### Figure 1.6.4 Tide Levels in Macajalar Bay

### (7) Tide Level during TS Sendong

The observed tide level at Macajaral Bay during Sendong taken by NAMRIA together with the hourly rainfall record at Talakag is presented in figure below. At the time of peak rainfall on Dec.17 1:00 a.m, the tide level was at daily peak of 0.71 m above MSL. No tidal surge was observed at this station.



Source: Tide level from NAMRIA, Rainfall from PAGASA

#### Figure 1.6.5 Observed Tide Level in Macajalar Bay during Sendong

(8) Tide Level during TY Pablo

Observed tide level and the astronomical tide data during TY Pablo in December 4, 2012 is presented figure below. From 1:00 to 17:00, the observed tide level is higher than the astronomical one. The maximum variance of +22 cm was recorded on 10:00. Comparing with the discharge hydrograph at Cabla Bridge, the peak flood was recorded on 15:00, but no tidal surge was observed in this period.





Figure 1.6.6 Tide Level in Macajarar Bay During TY Pablo (December 4, 2012)



Source: JICA Survey Team



#### 1.6.2 Basic Conditions for Second Draft Design

(1) Constraint of River Width

The relation between river width and discharge was studied as shown below. The table and the equation below show the desirable river width and corresponding discharge based on the past experience in the river improvement works. The desirable river width is estimated at 220-360m or more for the design discharge of 3,400  $\text{m}^3$ /s, and at 300-480 m or more for the discharge of TS Sendong flood magnitude.

Present river width	: 100 - 270  m
Desirable river width	$: 220 - 360 \text{ m} (\text{Q}=3,400 \text{ m}^3/\text{s})$
Desirable river width	: $300-480 \text{ m}$ (Sendong: Q= 5,100 m <sup>3</sup> /s)

Equation for River Width and Design Discharge (source: "Practical River Planning", Riko Tosyo, Japan(1971))

B=0.50 ~ 0.80 Q  $^{(3/4)}$ 

where, B : River width (m) (bank to bank) Q : Design discharge  $(m^3/s)$ 

In case  $Q_{25}=3,400 \text{ m}^3/\text{s}$ , river width (B) is estimated at 220 ~ 360 m.

Design Discharge (m <sup>3</sup> /s)	Desirable River Width (m)
300	40-60
500	60-80
800	80-110
1,000	90-120
1,500	120-170
2,000	160-220
3,000	200-330
5,000	350-450

Table 1.6.2	Relation between Desi	gn Discharge and	<b>Desirable River Width</b>
-------------	-----------------------	------------------	------------------------------

Source: JICA Survey Team

The figure below shows the comparison of the existing river width and desirable width of 200 m for 25-year flood along the Cagayan de Oro River. The section from Sta.2+000 to Sta.9+500 is generally narrower than the desirable width. If the desirable river width for TS Sendong (300-480 m) is adopted, it would be much wider than the existing river width and considered unrealistic option. Though it is better to make the waterway wider adopting the desirable river width of 220-360 m as much as possible, there are still several bottle neck sections that are difficult to widen due to existing land use, development condition and structures such as the section at the back of the City Hall.



Source: The Survey Team

Figure 1.6.8 Comparison of Existing River Width with Desirable River Width

#### (2) Flow Capacity at Bridge Section

At the time of TS Sendong flood, the floodwaters at the Ysalina Bridge reached the bridge deck level. There was a possibility for breaking/crashing down of the bridge like the Cabula Bridge which collapsed during TS Sendong. In general, the design high water level should be set lower below the bridge girder to keep a required clearance above the high water level at bridge sections.

Table below shows the flow capacity at each bridge section based on the result of the non-uniform flow calculation adopting the latest survey. The crest levels of existing revetments along the Cagayan de Oro River are also lower than the allowable flood water level of each bridge. As shown in the table, the three (3) bridge sections at Maharika, Ysalina and Kagayan Bridges has flow capacity of  $2,700 - 3,100 \text{ m}^3/\text{s}$ .

The said flow capacity is assessed referring to the lowest portion of the bridge girder. In case referring to the center portion, the design discharge can be accommodated with

required freeboard (1.5m). However, the Ysalina and Kagayan Bridges are formulating the bottleneck sections in the river channel. It should be considered to be widened or improved of these bridge sections.

No.	Name of Bridge	Flow Capacity (m <sup>3</sup> /s)			
		Left	Center	Right	
1	Kauswagan-Puntod	5,700	>10,000	9,000	
2	Maharlika	2,800	6,500	2,900	
3	Ysalina	3,100	3,900	3,400	
4	Kagayan	2,700	3,800	2,700	
5	Pelaez	>10,000	>10,000	>10,000	

 Table 1.6.3
 Allowable Maximum Flood Water Level and Flow Capacity at Bridge Section

\* Based on the non-uniform analysis

\* Freeboard is assumed to be 1.5m. (Design Guide Lines, Standards for DPWH) Source: JICA Survey Team

1.6.3 Basic Concept of Second Draft Design

(1) Channel Alignment

The Cagayan de Oro River flows from south to north passing through the City proper which is highly developed as the center of the City in the Province of Misamis Oriental in Northern Mindanao. There is no potential site found for construction of new diversion channel at both sides of the river. Therefore, the alignment of the proposed river improvement work shall basically follow the alignment of the existing channel.

- (2) Typical Cross Section
- 1) Compound Section

River width in the downstream varies from approximately 100 m to 270 m, and some sections have wider flood plain with sand bars. Seasonal discharge of the river varies in wider range due to topographic and hydro-meteorological characteristics in the basin. The design cross section is, therefore, proposed to have compound section composed with low water channel and high water channel.

2) Low Water Channel

The design riverbed width of the low water channel is set at 120 m in normal section and 100 m in narrow section considering the existing river width in the area so as not to affect the dike and structures along the bank. The side slope of the low water channel is set at 1v:3.0h.

The flow capacity of low water channel is estimated at 650-800  $\text{m}^3$ /s which is corresponding to existing channel flow capacity of around 2-year flood.



#### 3) High Water Channel

As discussed in Sub Section 1.6.2, the desirable river width in the downstream of the Cagayan de Oro River is estimated at 220 - 360 m for the design flood of 3,400  $m^3$ /s. If there is enough open space without any houses/structures over the both sides of dike, the desirable river width can be adopted. However there are many residential houses along the banks in the CDO River, therefore, the high water channel will be designed in relation to the definition of the River Boundary

(4) Longitudinal Profile

A riverbed profile surveyed in F/S 2011 was made before TS Sendong. This riverbed profile had been generated through morphology of waterway and process of sediment transportations and depositions for longer period without affected by extreme flood event like TS Sendong. As considering the trend of siltation in the river mouth and downstream of the CDO river, it is proposed to remove siltation in the downstream stretch in case of massive siltation would occur. The target riverbed level for maintenance dredging and excavation of the low water channel is prepared referring to the riverbed profile in F/S 2011

1.6.4 Design High Water Level for Second Design

The design high water level for the initial design is preliminary set referring to the result of non-uniform flow analysis taking into the consideration the conditions below:

- Cross section : results of cross section survey in 2012 in this Survey
- Water level at downstream : H.W.L +1.01 m above MSL
- DHWL is designed not to be lower than the calculated water level in whole stretch and recorded high tide level of +1.34 m (above MSL) in the downstream
- DHWL is set to consider required clearance at bridge sections, previous highest flood levels, flood risk against extraordinary flood, land use, environmental aspect.

### DHWL in River Mouth

Since the observed tide level data in Macajarar Bay is available only for limited period from 2007 to 2012, the highest high tide level is not exactly known yet at this moment.

Assuming the several cases of the highest high tide level, case study on non-uniform analysis was conducted in order to see how influence the high tide level to the water surface profiles in the downstream stretch of the CDO River.

As shown in the figure, the affected area of high tide is limited only for 500 to 1,000 m stretch from the river mouth.





#### Figure 1.6.10 Case Study for Tide Level and Water Surface Profile in downstream of CDO River

The design river bed elevation and design riverbed slope, and design high water level at control sections for the initial design are presented in table below:

e	,	
Station	Target Riverbed	Design Riverbed Slope
Sta.0+000	-2.00 m	1/2500
Sta $5 \pm 0.00$	0.00m	1/2500
Sta.5+000	0.0011	1/1000
Sto 8   000	+ 3 00m	1/1000
Sta.8+000	+5.0011	1/350
Sta.10+000	+8.71m	1/330

 Table 1.6.4
 Target Riverbed Elevation for Maintenance Dredging/Excavation

Source: JICA Survey Team

 Table 1.6.5
 Design High Water Level for Initial Design

Station	Design High Water Level	Gradient of DHWL		
Sta.0+000	+1.34 m (HHWL)			
	+2.50 m	1/1200		
Sto8   000	10.17m			
5120+000	+9.17111	1/250		
Sta.10+000	+14.88m	1/330		

Source: JICA Survey Team



### Final Report Appendix G

Source: JICA Survey Team

Figure 1.6.11 Design High Water Level for Second Design in Cagayan de Oro River

LEFT BANK				RIGHT BANK		2	
Proposed		STATION		The second	Proposed		
DPWH - R10	DPWH	Existing	31	ATION	Existing	DPWH	DPWH - R10
District 1	M/P and F/S		1.2			M/P and F/S	District 2
			0 -	60			
			0 -	40	-		
			0 +	20	Rockfill Seawall		-
		5	0 +	20.00	with RC Facing		
-			0+	40.00	and sheet piles		
			0+	60.00	and the second second		
			0+	80.00		Ē	(a)
			0 +	100.00		Ň	5 0 6
			0+	140.00		Bu	in sie ktil
			0 + 0 + 10 + 10 + 10 + 10 + 10 + 10 + 1	160.00	Rockfill Seawall	ain	stru Roc et j
			0+	180.00	with RC Facing	Ret	G to de d
			0+	200.00		*	0
			0+	220.00	DO-1	S Z	cti ss
			0+	240.00	Rockfill Seawall	it/	pile let
		Slope	0+	260.00	with RC Facing	Je	- tet
		Protection (Dry	0+	280.00	and sheet piles	ver	Col Dil
		Riprap)	0+	340.00	DO-2	bro	12 0 V 2
			0+	360.00	with PC Easing	Ē	as as
	1		0+	380.00	(damaged)		with
-			0+	400.00	DO-3		tet
	1		0+	450.00	and the second second		O Pic ec
			0+	460.00	Rockfill Seawall		R.C.
			0 +	500.00	(damaged)		it.
		Crook	0 + 0 + 0	570.00	DO 4		he
		CIECK	0 +	620.00	D0-4		с S
			0+	670.00	Rockfill Seawall		wit
			0+	750.00	(damaged)		Jall
			0+	780.00	and the second se		aw
			0 +	860.00			Š
-			0 + 0 + 0	940.00	DO-5		es es
-			1+	0.00	to -		bi lo
			1+	50.00	O)		μ μ
			1+	100.00	MOM		5
2	1		1+	150.00	IL		ctic
			1+	200.00	C) ee		tr.
			1 + 1 + 1	250.00	ਗ ਨ		suo
			1+	300.00	SR		ec
			1+	340.00			œ.
	-		1+	400.00	1	e	a)
			1+	450.00	BOA	ctio	Dike
PUNTOD-KAUS	WAGAN BRID	GE	1+	510.00	DO-6	and a	of I
			1+	520.00	DO-7	us	5
			1+	580.00	004	ပိ	loti
			1+	650.00		<u>e</u>	stru
			1+	700.00		ā	iuo
-			1+	100.00		Ň	it/o
			1+	850.00		N.	nen
			1+	900.00	1C		/eu
			1+	950.00			Dro
			2+	0.00			ŭ
		Concrete Bank	2+	50.00			
of		Protection	2+	150.00			
tion			2+	200 00			
unc			2+	270.00	DO-8		
nst		Concrete Bank	2+	300.00			-
ike C	New Dike	Protection	2+	350.00			10 mm 20
D	Construction	TOLEGION	2+	350.00			-
me		Concrete Bank	2+	400.00			-
ove		Protection	$\frac{2}{2}$ +	470.00			
bud		Frotection	2+	550.00		3	
E			2 +	600.00			

<b>Table 1.2.4</b>	Proposed Flood Control Structures (1	/4)					
--------------------	--------------------------------------	-----					
LEFT BANK				RIGHT BANK			
---------------------	------------------	-----------------------	-----------------	------------	------------------	--------------	--------------------
Prop	osed	20200	STATION		100 m 100 mm	Proposed	
DPWH - R10	DPWH	Existing	51	ATION	Existing	DPWH	DPWH-R10
District 1	M/P and F/S		. L	Culle.		M/P and F/S	District 2
Ŧ			2+	650.00			
ruc.			2+	700.00			
List		Concrete Bank	2+	750.00	-		
Sax	New Retaining	Protection	2+	800.00			
50	Wall	And the second second	2+	830.00			
u o	Construction		2+	840.00			
ver or		Concrete Bank	2+	845.00			1
oro		Protection	2+	00.00			
Ĕ			2+	960.00	00.0		
MAHARLIKA B	RIDGE		$\frac{2}{2}$ +	970.00	DO-9		-
	New Retaining		2+	980.00	DO-10		
			3+	0.00	00 10	io	
			3+	50.00		nct	1
	-		3+	120.00	Creek	st	
Q			3+	150.00	1	6	2
ă			3+	200.00			
of		1	3+	250.00		ž	
5			3+	300.00		2	i =
ctic		A CONTRACTOR OF	3+	320.00		tev	
tru		Concrete Bank	3+	360.00	DO-11	2	
SUC	-	Protection	3+	400.00			
ğ			3+	420.00			
ant.			3+	500.00			-
Ĕ			3+	540.00	- 2		
ove			3+	550.00			
bro			3+	600.00	- 0		
E			3+	650.00	- 15 -		-
			3+	700.00			
			3+	720.00	1		
			3+	750.00			
			3+	800.00			
On-going Borja Br.			3+	850.00		말을	
L.		DO-12	3+	910.00		ie g	
ctio	New Retaining		3+	950.00		nsti	On-going Borja Br.
Ę	Wall		4+	0.00	+	A DO	
SU	Construction	DO-5	4+	30.00	Creek	a =	
S al			4+	00.00		Z S	
f D			4+	80.00	î		
e o			4 +	100.00	/all	#	-
ove			4 +	150.00	S c	ng	
pro			4+	170.00	lde	sti	-
E			4+	190.00	E G	D IX N	
		Dilko with	4+	200.00	S	n l B/R	-
	Dillo Inconstant	Dike with	4+	270.00		io lo	
	Dike improvement	(COA)	4 +	290.00	DO-13	Val	1
		(COA)	4+	320.00	- 0	A	1
<b>YSALINA BRID</b>	GE		4+	340.00	Mile		
	e	DO-14	4 +	360.00	N P		
es	Dik	A	4+	400.00	oo		
ā	str		4+	430.00	E 8		
e e	Ne	00.45	4+	440.00	)		
ts t	U	DO-15	4+	450.00		2	-
÷	Ę	-	4+	480.00	Ē	, it	
3	e	Concrete Faced	4+	530.00	m with	me	
Jks	Dik	Rock-Fill Dike	4+	540.00	Pile	Kei	
ng	d	rivor i m Dirio	4 +	570.00	the the	2	
			4+	590.00	Ca	đ	
ate			4+	610.00	Re	0	
50	5	(	4 +	640.00	DO-16	Dik	
lov	cti		4 +	660.00	Rock fill Dike	9	1
of	stru		4 +	680.00	DO-17		
uo	uo	DO-18	4 +	700.00	Rock fill Dike		
Icti	eo		4+	130.00	with Steel Sheet		
stru	Dik		4+	790.00			
suo	M		4+	700.00		New Dia	
Ŭ	ž	-	4+	790.00		New Dike	
			4 +	800.00		Construction	

LEFT BANK			RIGHT BANK			
Prop	osed		OTATION	STATION		posed
DPWH - R10	DPWH	Existing	STATION	Existing	DPWH	DPWH-R10
District 1	M/P and E/S	LAISting	1 1	-Aloting	M/P and E/S	District 2
Construction of	No Other		4 + 830.00		ingr and the	District 2
low water banks	New Dike		4 + 850.00	Rock fill Dike		1
with sheet piles	Construction		4 + 870.00	with Steel Sheet		
KAGAY-AN BR	IDGE		4 + 890.00	Pile		J
of ks es			4 + 900.00	(Paseo del Rio	<u></u>	
	-		4 + 950.00			1 million (1997)
et p			4 + 967.76	iviality		
- de la tru			5+ 0.00	20.40		
Shy to to	-		5 + 40.00	DO-19		
vit Co			5 + 150.00			
		0 8	$5 \pm 210.00$			
-		SK	5 + 260.00	1		1
		0	5 + 310.00			
		te te	5 + 360.00	1		
	( )	octo	5 + 397.88			1.L
		S &	5 + 410.00			
			5 + 490.00			
		DO 00	5 + 580.00	-		
-		DO-20	5 + 630.00	Farth Canal		-
			5 + 680.00	Lantin Galial		
			5 + 730.00			
-			5 + 780.00			
1.1			5 + 830.00	1000		
			5 + 880.00	Earth Canal		
			5 + 930.00			$j = \dots $
	-		5 + 980.00			3
			6+ 0.00			
			6 + 100.00	-		
			6 + 150.00	-	5	
			6 + 200.00		et	
			6 + 250.00		글	
	( )		6 + 300.00	Earth Canal	suc	Q ()
			6 + 350.00		ŏ	
			6 + 400.00		e A	
			6 + 450.00	_	õ	
			6 + 550.00		ew	
			6 + 600.00		Ž	-
			6 + 650.00			
			6 + 700.00			1
[			6 + 750.00			
			6 + 800.00			
<b>_</b>			6 + 850.00	1		
; ; ; ;			6 + 900.00			1
tec.			7 + 950.00			
2 Co	-		7 + 50.00			
¥			7 + 100.00			1
an			7 + 150.00	1 T		
-			7 + 200.00	· · · · · · · · · · · · · · · · · · ·		i
			7 + 250.00	a		
		-	7 + 300.00	1		
		Earth Canal	7 + 350.00	-		
			7 + 400.00			
			7 + 500.00			-
			7 + 513 64			
			7 + 550.00			
	6		7 + 600.00	2		
			7 + 650.00			
-	4		7 + 700.00			
	c		7 + 760.00	2		1 <u> </u>
	tion		7 + 800.00	100		1 million
	in D		7 + 850.00			
	str		7 + 950.00			
	N NO		8+ 0.00			
	0		8 + 50.00	1		-

LEFT BANK		I I	RIGHT BANK				
Propo	osed		Proposed		2.0.0	Proposed	
DPWH - R10	DPWH	Existing	STATION	Existing	DPWH	DPWH-R10	
District 1	M/P and F/S		1 - 2012 L		M/P and E/S	District 2	
			8 + 100.00			C.C.T.C.	
			8 + 150.00		-		
			8 + 200.00		e jo		
			8 + 250.00		i i i i i		
			8 + 300.00		it s		
			8 + 350.00		leve		
			8 + 400.00		- 20		
			8 + 450.00				
			8 + 500.00				
			8 + 500.00				
			8 + 650.00			-	
			8 + 700.00	_			
			8 + 750.00				
			8 + 800.00		1		
	-		8 + 850.00				
	jo i		8 + 900.00				
	lot lot		8 + 950.00				
	str.		9+ 0.00				
	SUC		9 + 50.00				
	ŭ .		9 + 100.00				
	0 U		9 + 150.00				
	ā		9 + 200.00		· · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·	
	3	· · · · · · · · · · · · · · · · · · ·	9 + 250.00				
	ž.		9 + 300.00				
	-		9 + 350.00				
			9 + 400.00				
			9 + 400.00				
			9 + 550.00			-	
			9 + 600.00				
			9 + 650.00			5	
			9 + 700.00				
-			9 + 750.00				
-			9 + 800.00				
1			9 + 850.00		1	1 m m m m m m m m m m m m m m m m m m m	
			9 + 900.00				
			9 + 950.00				
			10 + 0.00			2	
			10 + 50.00				
			10 + 100.00				
			10 + 150.00				
-			10 + 200.00				
			10 + 200.00				
			10 + 350.00	_		-	
-			10 + 400.00				
			10 + 450.00				
			10 + 500.00				
			10 + 550.00				
· · · · · · · · · · · · · · · · · · ·			10 + 600.00				
			10 + 650.00			3	
			10 + 700.00				
			10 + 750.00		1 ·····		
			10 + 800.00		1		
			10 + 850.00		· · · · · · · · · · · · · · · · · · ·		
			10 + 900.00				
			10 + 950.00		2	1	
	-		11 + 0.00	-			
			11 + 100.00			-	
			11 + 150.00	-			
-			11 + 200.00			1	
			11 + 250.00			-	
			11 + 300.00				
1			11 + 350 00			5	
	-		11 + 400.00	-			
			11 + 450.00				
	1		11 + 500.00		Sector and the sector		
			11 + 660.00		ELAEZ BRIDO	it.	



Source: JICA Survey Team

# CHAPTER 2 BASIC DESIGNS OF STRUCTURAL MEASURES

### 2.1 Earth Dike and Concrete Floodwall

2.1.1 Distance and Height of Dike System

### (1) Distance of Dike System

Total length of Dike and Floodwall are summarized in the Table 2.1.1, total length of proposed dike system (Earth Dike & Concrete Wall) for the CDOR is 13,005 m (13.0 km) of the both river banks.

Total Length of Structure (Left & Right Bank)		
Dike & Floodwall		
Dike	L =	5,590 m
Floodwall	L =	3,845 m
Road Dike	L =	2,630 m
Floodwall (outer of Retarding Basin)	L=	940 m
Total (Left & Right)	L=	13,005 m

Source: JICA Survey Team

(2) Height of Dike System

Weighted average height of the dike system (Earth Dike & Concrete Floodwall) are H=3.49m as shown in Table 2.1.2, in which the average height of the dikes along left and right banks are 3.15m and 3.88m respectively.

 Table 2.1.2
 Height of Dike System (Earth Dike & Concrete Floodwall)

 Left Bank

			Mean Height of
Section	Structures	Distance (m)	Structures (m)
11	Road Dike (1) Road Raising	950	2.00
	Road Dike (2)	1,680	3.20
L2	Flood Wall by DPWH	-	-
	Flood Wall (7)	165	2.90
L3	Earth Dike (3) with Asphalt Road	780	4.20
	Flood Wall (6) with Asphalt Road	910	1.70
	Flood Wall (9)	160	1.70
1.4	Flood Wall (7)	690	3.92
24	Earth Dike (1) with Asphalt Road	280	3.92
	Earth Dike (2) with Asphalt Road	1,310	3.92
Total Leng	oth & Weighted Average Height (Left Bank)	6,925	3.15
Right Bank			
Section	Structures	Distance (m)	Mean Height of Structures (m)
R1	Concrete Seawall by DPWH	-	-
	Concrete Wall (5) + Road Embankment	1,000	4.04
R2	Concrete Wall (5) + Road Embankment	790	3.52
	Earth Dike (1) with Asphalt Road	350	3.52
R3	Flood Wall (8)	130	3.61
R3	Flood Wall by DPWH	-	-
R3	Earth Dike (4) without Asphalt Road	220	3.61
	Concrete Wall (5) + Road Embankment	940	3.85
	Earth Dike (1) with Asphalt Road	190	4.03
P4	Earth Dike (2) with Asphalt Road	890	4.03
114	Earth Dike (2) with Asphalt Road + PC Sheet Pile	350	4.03
	Earth Dike (2) with Asphalt Road	870	4.03
	Earth Dike (1) without Asphalt Road	350	4.03
Total Leng	th & Weighted Average Height (Right Bank)	6,080	3.88
Left & Right Banks			
L	Left Bank (Total Length and Average Height)	6,925	3.15
R	Right Bank (Total Length and Average Height)	6,080	3.88
Total Length &	Weighted Average Height (Left & Right Bank)	13,005	3.49

: Construction works done by DPWH

Source: JICA Survey Team

### 2.1.2 Earth Dike and Concrete Floodwall

- (1) Earth Dike
  - 1) Design Concept

Two types of earth dike designs are applied considering constriction of Right of Way Acquisition (ROWA) based on construction space of river structures, for which the designs of two type of earth dike are basically classified based on embankment slope as mentioned below, Figures 2.1.1 and 2.1.2.

Riverbed sandy soils of the Cagayan de Oro River will be used as earth fill materials of the Earth Dike. The sandy soils have low cohesive but sufficient shear strength so that designed slope of 1:2.0 to 1:1.5 can be adopted.

Earth Dike-1: Designed slope of 1:1.5 covered with concrete slope protection and sheet pile foundation for the areas with limited land. Required length of sheet pile is applied to avoid seepage failure and lateral slide of soil.



Earth Dike-1 (Case of Flood Plain Area Width: less than 10m) Source: JICA Survey Team

#### Figure 2.1.1 Typical Section of Earth Dike (Types of Earth Dike-1)

Earth Dike-2: Designed slope of 1:2.0 without sheet pile foundation for the areas with sufficient land space. Sufficient seepage length (width of dike) and sufficient width of flood plain are designed to avoid seepage failure and lateral slide of soil.



Earth Dike-2 (Case of Flood Plain Area Width: more than 10m)

Source: JICA Survey Team



### 2) Basic Designs

Features of the basic designs of the Earth Dike are mentioned as below. Feasibility designs are made with the following conditions, design approach / concept.

- i) Road Dike (2)
- a) Section of the Structures: L1 (River Mouth Area at Left Bank)
- b) Design Approach

Embanked road dike is designed to be located behind the mangrove habitat area maintaining the existing mangrove area as natural flood retarding basin.

Road Dike (2) is designed as mentioned in below "(2) *Evacuation Roads and Raising of the Existing Road* ", Construction of Evacuation Roads and Raising of the Existing Road.

ii) Earth Dike (1)

a)	Section of the Structures:	R2 (Borja Bridge – City Hall)
		R4 (Macasandig – Cala-Cala Area)
		L4 (Upstream of Balulang Area)

### b) Design Approach

Earth Dike (1) is basically provided at limited land space applying of dike slope of 1:1.5 which should be protected by reinforced concrete frame with stone masonry fill.

Sheet pile foundation should be installed at toe of the dike slope in the river side against slope or foundation sliding and keeping of required seepage length. However the length of sheet piles should be calculated not only for keeping of seepage length but also against sliding failure on slope and foundation of dike.

Earth Dike (1) is designed as shown below Figure 2.1.3, in which asphalt road (width=5 to 9 m) will be provided for operation and maintenance on the earth dike, public traffic uses at normal time and evacuation during natural disaster such as heavy rain and flooding.



Slope of the Earth Dike at river side shall be provided with concrete frame wet stone masonry, and sod facing or riprap shall be provided on the land side slopes. The following designs are made against slope failure and erosion / scouring the earth dike and structural foundation.

- Each slope of the dike face shall be 1:2.0,
- Reinforced Concrete Square Pile (depth L= 3.0m) should be installed at foundation of concrete of the concrete fame on the slope in the river side,
- Concrete cutoff wall (depth more than L= 1.0m) or sheet pile should be provided to prevent sliding on the dike slope or foundation, and
- Foundation of dike or low water channel should be protected with gabion matters and revetment / footing against erosion/scouring.

Crest width of the earth dike shall have a minimum 5.0m for maintain of seepage length on hydraulic design, construction works, operation / maintenance activities and evacuation road.

Suitable width of road and side drain ditch will be provided at toe of the dike slope on the land side for the operation and maintenance of the dike. In addition, Boulevard road (2-lane highway road: width = 10.5m) is designed at toe of the dike for not only operation & maintenance on the dike but also public traffic use at all the time of normal and disaster conditions as shown in the following, Figure 2.1.4 including 3-D image.





#### Figure 2.1.4 Typical Section of Earth Dike (1) and 3-D image

Dain Outlet Structures (Fiber Glass Plastic Flap Gate / Slide Gate) will be provided at the earth dike meeting with design requirement of earth dike and drainage gate & outlet structures as mentioned in Chapter 5.2.4 below.

- iii) Earth Dike (3)
- a) Section of the Structures: L3 (Ysalina Bridge to Carmen Area)
- b) Design Approach / Concept

Based on the design modification made to maintain river flow area in the section as much as possible, the following two (2) steps/stage of construction procedure was discussed to be applied at this section.

1 <sup>st</sup> Construction Stage:	Temporary works of earth dike / sand bags will be provided under the Urgent Rehabilitation Works of DPWH, which should be set back as much as possible and have same height of the existing dike.
2 <sup>nd</sup> Construction Stage:	Permanent works of earth dike will be provided after setting of river boundary and resettlement of affected houses as per design high water level to be determined at F/S stage of this study.

Design of retaining dike or concrete wall with sheet pile will be applied at limited river bank section.

Installed steel sheet piles under the Urgent Rehabilitation Works will be used as low water channel revetment, and earth materials for embankment or sand bags provided at  $1s^{t}$  Construction Stage will be reused at the  $2^{nd}$  Construction Stage. Earth dike will be provided at the  $2^{nd}$  Construction Stage as permanent works as shown in the following figures.



Source: JICA Survey Team

Figure 2.1.5 Two Stages (1<sup>st</sup> & 2<sup>nd</sup> Stage) Construction Procedures

Typical section of the Earth Dike (3) constructed at  $2^{nd}$  stage construction work is designed as shown in below, Figure 2.1.6. Sheet pile (depth L= 14.0m) should be designed at toe of the dike in the river side against dike and foundation sliding based geological condition of the site.



Source: JICA Survey Team



iv) Earth Dike (4)

- R3 (Cathedral to Kagay-an Bridge)
- b) Design Approach / Concept

a) Section of the Structures:

Earth Dike (4) is provided along the river bank immediate upstream of the St. Augustine Cathedral following the river boundary. Concrete frame with stone masonry slope protection (slope= 1:1.5) and sheet pile foundation (depth L=6.0m) is required in the river side for stability of the earth embankment. Typical section of the Earth Dike (4) is shown in Figure 2.1.7 as below.



Source: JICA Survey Team

Figure 2.1.7 Typical Section of Earth Dike (4)

- (2) Concrete Floodwall
  - 1) Design Concept

Concrete flood walls are designed for the areas with very limited land space in order to minimize land acquisition and social impacts.

Typical sections of floodwalls are designed as the following figures, Figures 2.1.8 and 2.1.9.

Floodwall-1: Retaining type of masonry wall and embanked river-sidewalk (width=4.0m) are constructed with reinforced concrete and sheet pile to stabilize and maintain seepage length of the wall. Asphalt road will be provided in just behind of the river-sidewall embankment for the purposes of inspection on river structures and public road use.



Source: JICA Survey Team



Floodwall-2: This type of floodwall is designed for quite limited land space such as narrow river area in front of City Hall and Commission on Audit (COA) office located along the upstream and downstream of the Ysalina Bridge, for which width of crest of the wall and inspection sidewalk are minimized.





Figure 2.1.9 Typical Section of Concrete Floodwall (Types of Floodwall-2)

#### 2) Basic Designs

Design approaches and concept of each type of Concrete Floodwall are described in the followings.

- i) Road Dike (1)
- a) Section of the Structures: L
- L1 (River Mouth Area at Left Bank)

b) Design Approach

Retaining concrete walls and earth-fill embankment structures are designed with raising of the existing road along coastal area, which are constructed as evacuation road during flood. Concrete drainage pipes are provided under the raising road to flow flood or tidal water to maintain natural water conditions of the mangrove and coastal areas.

Road Dike (1) is designed as mentioned in "(2) *Evacuation Roads and Raising of the Existing Road* ", Construction of Evacuation Roads and Raising of the Existing Road.

- ii) Floodwall (5)
- a) Section of the Structures: R2 (Isla Delta and Isla de Oro)

R4 (Outer of the Retarding Basin)

b) Design Approach

### R2 Section

River boundary has been set up along the existing public road "Burgos Street" (natural river bank), therefore the following alternatives designs (Alternative -1 & 2) of structural measure in this stretch for high water channel were examined.

Alternative Designs of Structural Measures at R2 section



Floodwall is designed with masonry retaining wall and reinforced concrete installing concrete sheet pile at toe of the wall. Concrete sheet pile (L=9-12m) is designed to be installed at toe of the concrete floodwall as foundation protection structure, for which riprap stone boulder shall be provided against scouring if required.

The followings has been considered into the design of the structural measures to be done by JICA based on requests from DPWH after setting of River boundary at river bank along the Burgos Street,;

- a) To provide Boulevard (2-lanes asphalt road) with the Floodwall / dike in urban development view point;
- b) To maintain the existing drainage channel;
- c) To maintain the existing road "Burgos Street"; and
- d) To improve water environmental conditions around /along the river bank

Design of Alternative-2 (Floodwall) has been selected as structural measures in this section in a hydraulic view point, which are designed subject to provision of Boulevard (2-lanes asphalt road) as shown in Figure 2.1.11.



Source: JICA Survey Team

Figure 2.1.11 Selected Designs of Alternative -2 (Floodwall and Boulevard) in R2

For the improvement of river side environment, utilization of floodplain space will be considered as "River Amenity & Ecology Space" such as sports and recreation fields, promenade (river side walk, jogging / cycling course etc.), mooring place, river side approach step, and river-side park or public event space.

#### R4 Section

Floodwall with Boulevard (2-lanes road) structure as same design as structure situated at section R2 will be provided along the outer line of proposed retarding basin which is running along the river boundary. Typical section of structure at R4 section is shown in Figure 2.1.12, and designs and alignment of the structures is described in the following chapter.





Figure 2.1.12 Typical Section of Floodwall and Boulevard in R4 section

### 3D Image of Structure at R2 and R4 Sections

3D image of the Floodwall with Boulevard along the Burgos Street is shown in the following figure.



Source: JICA Survey Team



- iii) Floodwall (6)
- a) Section of the Structures: L3 (<u>Carmen Downstream of Balulang Area</u>)
- b) Design Approach

Concrete floodwall is designed as structural measure in this section to minimize the land acquisition that should be incurred at unprotected bank sections with sufficient height for the DHWL. The designs of the floodwall (sheet pile, L-shape wall, retaining wall and block types) has been examined as to applicability and appropriateness in (FS) stage of this Study as shown below, Figure 2.1.14.



Source: JICA Survey Team

Figure 2.1.14 Typical Sections of Concrete Floodwall (6)

Minimum ten (10) m width of land space from edge of embankment part shall be required for construction works / access, maintenance/operation activities and use as public road after the construction. Accordingly, asphalt road and side drain ditch are designed at back side of the floodwall in land side.

Concrete/steel sheet pile (L=9-16m) is designed to be installed at toe of the concrete floodwall as foundation of structure, moreover, stone boulder riprap shall be provided against scouring if required.

- iv) Floodwall (7) and (8)
- a) Section of the Structures: R3 (City Hall to Ysalina Bridge)
  - L3 (COA office to Ysalina Bridge)
- b) Design Approach

River channel width at the narrow area was examined for the design of river improvement works based on river boundary;

To widen river channel up to the original river bank (by removal of the existing buildings),

To maintain the existing river width (by rehabilitation of existing river structures); and

To widen up to the existing City Hall and COA buildings (by avoidance of removal of the existing buildings).

It is decided that river structures at narrow river area are designed along river channel to be widened up to the existing buildings under condition of item (c).

The City Hall Office of CDO are located at just downstream at right abutment of the Ysalina Bridge, which had been extended toward river side additionally as one of "Golden Miles Plans" including of construction of revetment, as boardwalk, in front of the city office building. As shown on cadastral map, the additional area of city office buildings was constructed with extension of 20-30 m toward into the river side where river width of 100 m became narrower and posed as a bottle neck to floodwaters.

The COA Office and its concrete dike were constructed at the left bank just downstream of Ysalina Bridge located at opposite bank of the City Hall, which has been extended by 30–40 m to the river side from abutment of the Bridge, thereby, creating a narrow river section. The back water is developed at this location directly and seriously affected the upstream area causing inundation during the Sendong Flood.

The floodwall (Sheet pile, L-shaped reinforced concrete, masonry retaining wall, block face of sidewalk and side drainage) is designed for the narrow river area as mentioned below. Each typical section of the floodwall in front of City Hall and COA office is shown in Figure 2.1.15.

Crest width of masonry retaining wall is minimized to be 2.1m,

Concrete/steel sheet pile (L=6.0m to 9.0m) is designed to be installed at toe of the concrete floodwall as foundation structure, for which riprap stone boulder also will be placed against scouring,

Maintenance road and side drain ditch is designed at back side of the floodwall in land side within 2.5m width, and

Basic designs of the Concrete Floodwall are prepared as shown below.





Floodwall (7): COA Office Site (Left Bank)

Source: JICA Survey Team

Floodwall (8): City Hall Cite (Right Bank)





Source: JICA Survey Team

Figure 2.1.16 Plan of River Structures (Dike and Floodwall) at Narrow River Area

- v) Floodwall (9)
- a) Section of the Structures: R3 (Ysalina Bridge to Cathedral)
- b) Design Approach

According to DPWH, they will construct floodwall at this section adopting the following JICA's design concepts to coordinate with JICA design sections.

The floodwall (Sheet pile, L-shaped reinforced concrete, masonry retaining wall, access and side drainage) is designed at limited space.

- Crest width of masonry retaining wall is minimized to be 1.3m,
- Concrete/steel sheet pile (L=16.0m) is designed to be installed at toe of the concrete floodwall,
- Riprap stone boulder will be placed at the foundation against scouring if required.
- Side drain ditch is designed at toe of floodwall within 1.5m width.

3-D Image of Concrete Floodwall

Typical section of the floodwall and its 3-D image illustration are shown in Figure 2.1.17. Alignment of structures of the floodwall (9) at this section between the Ysalina Bridge and St. Augustine Cathedral is shown in Figure 2.1.18.



Floodwall (9) (R3: Right Bank)

Source: JICA Survey Team



(9)







### 2.2 Evacuation Roads and Raising of the Existing Road

### 2.2.1 Introduction

Habitat area of mangrove is located in the left bank floodplain under control of the Department of Environment and Natural Resources (DENR). There are limited houses and residents in the swampy mangrove habitat area which often occur flood inundation like a natural retarding basin. Construction site are in limited space due to existing of the mangrove habitat and house / residents therefore, design of structural measure should be made carefully for the environmental and social aspects.

Design of structural measures such as dike, floodwall and drainage facilities should be made with the following functions considering of the site conditions.

- Flood protection measures to prevent of spread of inundation into residential areas,
- Flood mitigation measures to evacuate residents from the inundation prone areas, and
- Structural measures to maintain function of the existing natural retarding basin for flood and tidal water

Geological condition of the low swampy area has been evaluated to be soft foundation based on geological survey results at Boring Hole of FB-1 and 2 in section L1 (sand / sandy silt: N-value < 10 to 15) as shown in Table 1.2.2.

Dredging works were conducted by small scale dredger "Water Master" (capacity of 20m3/day) and Large-Scaled Backhoe on pontoon under DPWH, Regional Office-10 (DPWH-10), and dredging materials were transported / deposited into the disposal area located at the end of the river mouth protected by the stone boulder dike which had been constructed extending toward seaside was partially washed away during the Sendong Flood, December 2011.

#### 2.2.2 Basic Design

(1) Design Concept

The proposed structural measures along the left bank of the river mouth are road dike has the following functions against flood damages such as;

- i) Evacuation road from flood inundation or damages, and
- ii) Protection of inundation into residential area or public spaces.

The road dike (Evacuation road) will be provided on left bank of the river mouth area, low-laying area along the outer line of the Mangrove Protection Area, (distance about 2.6 km) between Sta. 0+000 and Sta. 2+200. Design of Road Dike is basically made with the following conditions:

- a) To construct new embanked road dike, raise / rehabilitate the existing road within the available area and existing road right of way (ROW);
- b) To provide new drain ditch along the new embanked road dike or the raising road;
- c) To connect to existing / new river protection works such as dike or revetment with smooth transition; and
- d) To construct embankment dike by Pre-loading Method with consideration of settlement and consolidation of foundation under proper construction plan.

- e) To set design dike level of structural measures at L1 section adding 0.6m of freeboard from design high water level (DHWL) considering of special hydraulic conditions at the natural retarding basin nearby river mouth.
- f) To provide concrete drainage pile (designed diameter size=1.0m and 4.0m intervals) under the floodwall dike located along the seashore line (east west direction) to flow flood or tidal water.
- (2) Basic Design

The following type of road dike will be provided in the left bank of river mouth, section L1 as shown in Figure 2.2.1.

- a) Road Dike (1): Floodwall type Coastal Line (East – West Line: Sta. 0+000 to Sta. 0+ 200) Distance L= 950m
- b) Road Dike (2): Earth Dike type Outer line of Mangrove Area (South- North Line: Sta. 0+200 to Sta. 2+ 100) Distance L= 1,680 m



Source: JICA Survey Team

Figure 2.2.1 Location and Alignment of Road Dike at L1 Section

(a) Road Dike (1)

Road Dike (1) is designed as shown in Figures 2.2.2, in which concrete floodwall will be provided at both sides of embankment of road dike with installation of concrete square pile into foundation and cross drainage pipe (dia.=1.0m) to flow flood or tidal water.



Source: JICA Survey Team



#### (b) Road Dike (2)

Road Dike (2) is designed as shown in Figures 2.2.3 and 2.2.4, in which slope of the dike at river side shall be protected with gabion mattress, and sod facing or riprap will be covered on the land side slope of the dike.



Source: JICA Survey Team

Figure 2.2.3 Conceptual Design of Road Dike (2)



Source: JICA Survey Team

Figure 2.2.4 Typical Section of Road Dike (2)

### 2.3 Improvement of the Kagay-an Bridge and Raising Approach

### 2.3.1 Introduction

The Kagay-an Bridge is located at the narrow river section (Sta. 4+000 to Sta.5+000). The photograph in next page is an aerial photo showing the river stretch from the Ysalina Bridge to up/downstream of the Kagayan Bridge. As shown in the photo, the approach road of the Kagayan Bridge on the left bank is made with embankment. This portion would work as if a spur dike blocks water flow going to downstream. On the other hand, the intersection located at the end of the approach road on the right bank was not passable during TS Sendong and TY Pablo due to inundation. The improvement of bridge approach roads of the Kagayan Bridge both left and right banks shall be considered necessary in parallel with the construction of dike system.

The photograph in Figure 2.3.1 shows the situation of flood damage in the downstream of the box culvert under the left approach road after TS Sendong. At that time of TS Sendon, flood water had passed through the culvert, and the houses/buildings in the downstream of the culvert were seriously damaged due to flood flow with high velocity.



Source: Above photo is provided by PARASAT

Figure 2.3.1 Aerial Photo at Approach Road of Kagay-an Bridge



Source: JICA Survey Team



The proposed improvement of the Kagayan Bridge will contribute to decrease water level in the upstream of the bridge by 5-10 cm and mitigate the fast flow velocity at immediately downstream of the box culvert by replacement of it to a viaduct. In addition, the approach road and intersection on the right bank will be raised above the design bank crest level so that the bridge would be passable during flood as a part of emergency transportation and also be used as an evacuation place in the surrounding area.

# 2.3.2 Basic Designs

(1) Design Concept

Layout plan of the Kagay-an Bridge improvement is shown in Figure 2.3.3.

a) Left Abutment and Approach :	The existing abutment and approach road will be demolished and be replaced with new bridge structures such as piers to provide river flow area.
b) Right Abutment and Approach :	The approach road will be raised to the design bank crest level to maintain public transportation, access and evacuation during flood.

Designs of Improvement works of the Kagay-an Bridge should be made with consideration of temporary detour to maintain traffic during construction time.



Source: JICA Survey Team

Figure 2.3.3 Plan of the Kagay-an Bridge and Approach Roads

### (2) Basic Design

Improvement works at left abutment and approach road of the Kagay-an Bridge is shown in Figures 2.3.4 and 2.3.5.



Section of Improvement on Left Approach of the Kagay-an Bridge



Source: JICA Survey Team Figure 2.3.4 Typical Section and 3-D Image of Improvement of the Kagay-an Bridge

Conceptual design of improvement of the abutment and approach road on the left bank is shown in Figure 2.3.5.





Section of Improvement of Left Abutment

Source: JICA Survey Team

Figure 2.3.5 Improvement of Left Abutment and Approach of the Kagay-an Bridge

Typical designs of raising of approach road of the Kagay-an Bridge on the right bank are shown in Figure 2.3.6.





### 2.4 Gates and Drainage Outlets

#### 2.4.1 Introduction

Gates and drainage outlet facilities are summarized in Table 2.4.1.

							-			
Na	STATION	NAME OF	EXISTING STRUCTURES		LOCATION		PROPOSED		DEMADIZO	
INO.		OUTLET	TYPE	Size	Bank	Barangay	Control Type	Outlet Structure	Size	REMARKS
1	0+520	Creek-1	Lined Canal	W = 2.00 m	Left	Bonbon	Steel Slide Gate	RCBC	2 - 2.0 x 2.0 m	River Mouth
2	1+100	Creek-2			Left	Bonbon	Steel Slide Gate	RCBC	2 - 2.0 x 2.0 m	River Mouth
3	3+180	DO-1			Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	
4	3+360	DO-2			Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	
5	3+440	DO-3			Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	
6	3+600	DO-4			Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	
7	3+740	DO-5	not er	xisting	Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	LI-D-O-A
8	3+800	DO-6			Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	Isia De Oro Area
9	3+880	DO-7			Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	
10	3+940	DO-8				Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	
11	3+990	DO-9			Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	
12	4+060	DO-10				Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	
13	4+260	DO-11	RCPC	1.5 m. dia	Right	Poblacion	Flap Gate	RC Headwall		City Hall
14	4+360	DO-12	RCPC	0.9 m. dia	Left	Carmen	Flap Gate (Steel)	RCPC	0.9 m. dia	COA Office
15	4+460	DO-13	RCPC	0.9 m. dia	Left	Carmen	Flap Gate (Steel)	RCPC	0.9 m. dia	Acasia Area
16	4+640	DO-14 (1)			Right	Nazareth	Flap Gate (FRP)	RCPC	1.52 m	
17		DO-14 (2)	not existing		Right	Nazareth	Flap Gate (FRP)	RCPC	1.52 m	For Retarding Basin
18		DO-14 (3)			Right	Nazareth	Flap Gate (FRP)	RCPC	1.52 m	Drainage
19		DO-14 (4)			Right	Nazareth	Flap Gate (FRP)	RCPC	1.52 m	(Arroyo Creek)
20		DO-14 (5)			Right	Nazareth	Flap Gate (FRP)	RCPC	1.52 m	
21		DO-14 (6)	Existing RCBC		Right	Nazareth	Flap Gate (Steel)	RC Headwall	2 - 1.52 m. dia	Arroyo Creek
22	4+760	DO-15	RC Ditch	0.5 x 0.5 m	Left	Carmen	Flap Gate (Steel)	RCPC	0.9 m. dia	
23	5+040	DO-16	Lined Canal	6 x 2 m	Right	Nazareth	Steel Slide Gate	RCBC	2 - 3.0 x 3.0 m	Paseo del Rio
24	5+040	DO-16a	Existing RCBC		Right	Nazareth	Flap Gate (Steel)	RC Headwall	2 - 1.52 m. dia	U/S of Retarding Basin
25	5+580	DO-17	Lined Canal	3 x 3 m	Left	Carmen	Steel Slide Gate	RCBC	$1 - 30 \times 30 m$	Trapezoidal Section

	<b>Fable 2.4.1</b>	List of Gates	and Drainage	Outlets	Works
--	--------------------	---------------	--------------	---------	-------

Source: JICA Survey Team

#### 2.4.2 Basic Designs

(1) Design Concept

There are several local creeks and local drainages discharging to the river at present. In connection with the construction of dikes, installation and improvement of drainage outlets with gates are to be undertaken in parallel with construction of the dike systems. Installations of five (5) units of gates are proposed on the left bank and 17 gates on the right bank, respectively:

Flap Gate:	- Fiber Grass Plastic Flap Gate (FRP Flap Gate)
	- Steel Flap Gate
Slide Gate:	- Single / Double Spindle Types





Figure 2.4.1 Typical Design of Flap and Slide Gates

### (2) Basic Design

Basic design of drainage outlet facilities crossing under earth dike and concrete floodwall are shown in Figures 2.4.2 and 2.4.3.









Source: JICA Survey Team

Figure 2.4.3 Typical Designs of Drainage Outlet with Fiber Glass Flap Gate

### 2.5 Retarding Basin

- 2.5.1 Effective Use of Existing Retarding Basin
  - (1) Natural Retarding Basins in the CDO River Basin

In the middle and upper basin of the CDO River, there are few potential site for retarding basin. On the other hand, in the downstream stretch, there are some existing natural retarding basins located beside the river channel. Out of these natural retarding basins, the biggest one is located along left bank in the river mouth in Barangay Bonbon and Kauswagan. The second one is located on the right bank between the St. Augustine Cathedral and the Kagay-an Bridge in Barangay Nazaleth and Macasandig. The location map of existing natural basins is presented in Figure 2.5.1.



Source: JICA Survey Team

Figure 2.5.1 Location Map of Retarding Basins

# (2) Function of Retarding Basins

The natural retarding basin has generally several functions, i) to reduce peak flow discharge in the downstream by regulating flood in retarding area, ii) to slower flow velocity in the river channel like a stilling basin, iii) to mitigate backwater to the upstream stretch and iv) to preserve natural environment areas with its ecosystem.

# (3) Natural Retarding Basin in Barangay Bongon and Kauswagan

A retarding basin located along the left bank in downstream stretch near the river mouth is around 97 ha in area and this area is identified as protected area by DENR. This retarding basin is used for mitigation of flood peak water level in surrounding area during flood as well as preservation of habitant area of mangrove which being utilized for livelihoods for the local residents. It is recommended to preserve this area as it is as on-site natural retarding basin.

(4) Natural Retarding Basin in upstream of St. Augustine Cathedral

The right bank of the area between the St. Augustine Cathedral and the Kagay-an Bridge is situated in low-lying area where there is a trace of old river channel and at present a tributary and city drainage channels (Arroyo Creek) entering into. Land reclamation is under proceeding by the private firm. This area is inundated by perennial flood as shown in the photo below and is valued buffer zone against back-water created at the narrow river area located at the Ysalina Bridge downstream of this area.



Source: JICA Survey Team

Figure 2.5.2 Flooding Situation in Upstream of St. Augustine Cathedral during TY Pablo on December 4, 2012

This area is identified as very high risk area (flood risk level 4) where it is very difficult to evacuate as a result of the hydrological and hydraulic study. It is recommended to preserve this area as it is as on-site natural retarding basin. The dike alignment in this area should follow the established river boundary so that the valuable effects of the original natural flood mitigation effects would be maintained as much as possible and the proposed river area could be protected from any obstructions against water flow to the downstream.



Source: JICA Survey Team

### Figure 2.5.3 Area of Proposed Retarding Basin and Proposed Dike Alignment (Aerial Photo around the Kagay-an Bridge)

### Preliminary Study for Multi Purpose Usage of Retarding Basin

Based on the topographic survey and river cross section survey, the dimension of proposed retarding basin is designed as presented in Table 2.5.1. The total area of the retarding basin is around 13 ha and the storage capacity is estimated at around 325,000  $m^3$ .

In addition to preserve the natural retarding basin, though it is a secondary option and need further study, a small dike (spillway) between the river channel and the retarding basin can be constructed, if necessary because this area is very valuable for strategic urban development in the city located adjacent of the center of the city having a wider open space. The area inside of the proposed retarding basin will be used for water storage and stilling basin during the flood, but can be used as an open public space such as sport fields, parks and recreation areas during dry season or non flooding period.

Aside from the above, the retarding basin with apillway can be used to regulate inland water drained from the catchment basin of local creaks with 3.4 km<sup>2</sup> in area. The storage capacity of the retarding basin can accommodate around 2 years rainfalls from the basin. This would also contribute for improvement of drainage conditions in the urbanized area in the center of the city.

Item	Basic Dimension		
Location	Sta.4+500 right bank (upstream of the Cathedral)		
Area of Retarding Basin	13ha		
Storage Capacity	325,000m <sup>3</sup>		
Ground Level of Retarding Basin	EL.1.0m		
Regulation of rainfall	Storage for run-off of local rainwater from the catchment		
	area (3.4km <sup>2</sup> ) under 2-year rainfalls		
Multipurpose Land Use during	Open space for sport filed, recreation area, natural		
Normal Condition	environmental spots etc. (to be discussed with concerned		
	agencies)		

Table 2.5.1	Basic Dimension of Retarding I	Basin
-------------	--------------------------------	-------

Source: JICA Survey Team



Source: JICA Survey Team



# 2.5.2 Basic Designs

(1) Design Concept

The low land area located just upstream of the St. Augustine Cathedral can be considered as a small scale retarding basin or regulating pond for flood mitigation in the city areas, which is proposed to be prohibited for land development and other land use based on the proposed river boundary.

Three (3) lots of retarding basins (around 13 ha in total) are proposed on the right bank of upstream of the St. Augustine Cathedral within the river boundary connecting by concrete culverts to flow regulating water as shown in Figure 2.5.5

The following design concepts of the retarding basin were considered, which are with or without structures. Capacity of the retarding basin with structure can be more than one of without structure.

Natural Retarding Basin (without spillway and deepening of retarding pond) Structural Retarding Basin (with spillway, deepening of the pond and flap-gates)



Plan of Retarding Basin

Source: JICA Survey Team

# Figure 2.5.5 Aerial Photo and Location Map of Retarding Basin

### (2) Basic Design

Basic design of this section is made for the Structural Retarding Basin. The following structural measures of the retarding basin are recommended as an optional flood control works to reduce back water flood water level caused from the narrow river area. Proposed plan and sections of structural measures are shown in Figures 2.5.6, 2.5.7 and 2.5.8.

Structural Retarding Basin (Optional Proposal)

- Rehabilitation of exiting dike, revetment and drainage culvert and channel
- · Construction of Spillway and Retarding Basin (small scale), and
- Construction of new slide gates and flap gates.

Location and its layout plan of the retarding basin (structural plan) are shown in Figure 2.5.6.



Source: JICA Survey Team

### Figure 2.5.6 Layout Plan of Retarding Basin (Structural Plan)

Plan of improvement of the existing drainage channel is shown in Figure 2.5.7, which is located in the northern part of the retarding basin along the existing channel, Arroyo Creek. Cross section of the drain channel improvement and dike protection works are designed as shown in Figure 2.5.8.



Source: JICA Survey Team

### Figure 2.5.7 Plan of Improvement of Existing Drainage Channel (Arroyo Creek)

Spillway is required for the Structural Retarding Basin, which is designed with weir, stilling basin (apron), sub-dam, sheet pile and cutoff concrete as shown in Figure 2.5.6 (Section of Spillway).



Section of Spillway (Section N-N)



Section of Retarding Basin, New Arroyo Creek and Earth Dike (4) (Section L-L)

Source: JICA Survey Team

### Figure 2.5.8 Section of Spillway and Existing Channel Improvement of Retarding Basin

### 2.6 Weak Foundation Improvement Works

#### 2.6.1 Introduction

According to additional geological investigation along the R2 section, the geological conditions on foundation of this section is basically composed of 30m depth of sand / sand soil layer. N-value of standard penetration test (SPT) on the 0 to 20m depth of sandy soil foundation is estimated to be N=0 to 10 - 15 which is categorized as weak foundation as specified by the followings of weak foundation standards.

Weak Foundation is classified based on N-value (SPT) for technical evaluation of Settlement, Stability and Liquefaction

-	Clay foundation:	N-value	< 4
-	Sand foundation:	N-value	< 10 to 15

Geological Condition of Foundation	Thickness of Layer	Cohesion $q_u (kg/cm^2)$	N-value
Clay / Cabasina Clay	Less than 10m	C < 0.6	N < 4
Clay / Collesive Clay	More than 10m	C < 1.0	N < 6
Sand / Sandy Soil	-	0	N < 10 to 15

Table 2.6.1	Category of Weak	Foundation
-------------	------------------	------------

Source: JICA Survey Team

#### 2.6.2 Basic Design

Weak foundation improvement works should be made in the section to prevent structural measures such as earth dike and floodwall from damages due to settlement and liquefaction of the foundation.

Sand Compaction Piling (SCP) method is selected as proper weak foundation improvement works for sandy foundation of this section compared with Cement Deep

Mixing (CDM) Method. Design of structural measures of Alternative -2 and Weak foundation improvement works for loose sand / sandy soil foundation at this section is designed as shown in below.



Source: JICA Survey Team



### 2.7 Dam Operation

2.7.1 Long Term Measures

The target safety level or return period of the design flood discharge to be applied in the Master Plan is the level which is equivalent to the largest recorded flood caused by TS. Sendong which flood scale is assessed to be 50-year probable flood or more. However, the safety level to be secured by the structural measures will be 25 year only in downstream reach of the Cagayan de Oro River in Cagayan de Oro City area. It is required in the upstream reaches to regulate a flood peak discharge of TS. Sendong scale flood to the peak discharge of 25 year probability or less so as not to cause flooding damages in the downstream reaches.

Conceivable measure to meet such flood peak mitigation is to secure regulation effect by dam reservoir in the upstream of the Cagayan de Oro River basin. However, there is no existing dam to provide such discharge regulation capacity and realization of a new dam construction requires an elaborate plan formulation as well as survey and investigation, huge amount of construction cost and long term construction period as well as careful environmental and social considerations. Because of aforementioned various requirements, it would be difficult to attain project completion within rather short period, hence dam construction plan shall be dealt with a long-term measure in the Master Plan.

### 2.7.2 Existing Dam Plan and Proposed Sites

At present, the existing dam facilities in the upstream of the Cagayan de Oro River basin are only small-scale runoff regulating dams and intake weirs in the tributary Bubunawan River.

As for the existing plan and study for the high dam which would have discharge regulation capacity, a feasibility study was conducted for a hydropower dam at the confluence of Batang-Blanog Rivers by NPC-NORMECA(Northern Mindanao Electric Cooperatives Association). The proposed Batang-Bulanog Dam site by NORMECA is located at the mainstream around 50 km upstream from the river mouth of the Cagayan de Oro River in Talakag as shown in Figure 2.7.1.

The proposed Batang-Bulanog dam has a storage capacity of a 100 million cu.m class. Though the purpose of the existing plan for dam development is hydro power generation so far, it could be considered to add flood control purpose on the dam as one of flood risk mitigation measures of Cagayan de Oro River basin.



Source: JICA Survey Team

Figure 2.7.1 Existing and Proposed Dam Sites in Upstream of Cagayan de Oro River
## 2.7.3 Advantage of Multi-purpose Dam

It seems rather difficult to construct a single purpose flood regulating dam which could expect only flood damage mitigation benefit(additional mitigation effect than 25 year-flood to the TS. Sendong scale flood in this "long-term plan" case) and high construction cost is required, hence it is necessary to secure higher benefit to be obtained as multi-purpose use.

In case, the proposed Batang-Bulanog Dam is considered to be developed as a multi-purpose dam including hydropower and flood control, it must be necessary to have an agreement between DPWH who has a responsibility in flood control and the enterpriser of the hydropower development to compromise both benefits to maximize flood control effect and hydropower generation.

Multi-purpose dam project would involve not only flood control and hydropower development purposes but also water supply purposes including irrigation, drinking and industry. However, such water supply component will not be incorporated in the master plan formulation in this survey because particular development plan is not available yet.

## 2.7.4 Flood Regulation Effect by Dam Reservoir

The dam reservoir will regulate a peak inflow discharge of TS. Sendong scale probable flood at dam site to a certain outflow discharge so that the peak flow discharge in the downstream section would be reduced to discharge equivalent to 25-year probable flood. The inflow hydrograph at the proposed dam site is shown in Figure 2.7.2



Source: JICA Survey Team

Figure 2.7.2 Hydrograph at Proposed Dam Site

In order to examine required flood control space in the reservoir, the flood routine analysis is carried out referring to the reservoir inflow hydrographs of TS. Sendong as well as available dam plan data including a reservoir water level - storage curve, etc.

Flood Scale	Maximum Dam Inflow(Q5)	Weir Crest Level	Maximum Dam Outflow(Q4)	Maximum Reservoir Water Level	Maximum Reservoir Volume
	(cu.m)	(El.m)	$(m^3/s)$	(El.m)	(MCM)
Sendong	2,710	471.00	1,000	480.98	87,229
50-yr	2,490	471.00	1,000	480.18	84,995
25-yr	1,770	471.00	1,363	475.74	74,905





Source: JICA Survey Team

Figure 2.7.3 Result of Flood Routing

In Table 2.7.1 and Figure 2.7.3, result of the flood routine analysis is shown that the peak inflow discharge(Q5=2,710m<sup>3</sup>/s) of TS. Sendong scale probable flood is regulated to (Q4=1,000m<sup>3</sup>/s) so that peak discharge at Pelaez Bridge would be reduced to  $(Q1=3,300m^3/s)$  which will be equivalent to 25-year probable flood.

Design discharge distribution of the Cagayan de Oro River based on the regulated outflow of TS. Sendong scale probable flood is shown in Figure 2.7.4.



Source: JICA Survey Team

Figure 2.7.4 Design Discharge at Pelaez and Cabula Bridges and Bubunawan River

# 2.7.5 Typical Operation Plan for Flood Risk Management

To mitigate flood discharge(Outflow) of TS. Sendong class probable flood by inflow regulation in the reservoir, required regulating volume is about at 28.8 MCM(WL.481m – WL.468 m) as shown in Table 2.7.2. To estimate possible hydro energy output when discharge regulation volume is secured under Normal Water Level(NWL), semi-annual operation is assumed as shown in Figure 2.7.5.

Table 2.7.2Typical Operation Plan for Flood Regulation in the Batang-Bulano Dam<br/>(Presumed)

Item	Operation Plan <sup>(1)</sup>
Dam Crest Elevation (Storage vol.)	EL. 485 m
Surcharge Water Level (Storage vol.)	EL. 481 m (87.28MCM)
NWL(Dry Season) (Storage vol.)	EL. 479 m (82.24MCM)
Controlled WL in Flood Season (Storage vol.)	EL. 468 m (58.46MCM)
Required Flood Regulation Volume <sup>(2)</sup>	Vol.(EL.481m - EL.468m) = 28.8MCM
LWL (Storage vol.)	EL. 467m (56.67MCM)
Tail water El	MSL293 m
Max/Min Gross Head	186 /175 m
Max Discharge	$87 \text{ m}^3/\text{s}$
Installed Capacity	133 MW
Annual energy	365 GWh/yr <sup>(2)</sup>

Note: (1) Source : Feasibility Study Report for Batang-Blanog Rivers by NPC-NORMECA(1996)

(2) Estimated based on the existing plan incorporating controlled water level for flood discharge regulation

Source: JICA Survey Team



Source: JICA Survey Team

Figure 2.7.5 Schematic Reservoir Allocation

# CHAPTER 3 STRUCTURAL CALCULATIONS

# 3.1 Conditions for Structural Calculation

# 3.1.1 Introduction

Structural measures should be designed to maintain stability of the structures in the following conditions. Structural measures of the priority project are proposed to be situated in the downstream part of the Cagayan de Oro River from river moth to about 12km upstream of the Pelaez Bridge.

- i) Foundation (Settlement, Liquefaction and Sliding),
- ii) Structures (Sliding and Overturning), and
- iii) Hydraulics.

As mentioned in Chapter 1.2.2, foundation in the downstream of the Cagayan de Oro River is almost composed of alluvium loose deposit materials (sandy or silty soils) with soft soil properties (e.g. N-value less than 15, cohesion C less than 1.0kg/cm2 etc.), therefore necessity or design of foundation improvement measures should be examined based on collected geological data from the view point of stability of structural measures.

Weak foundation improvement methods were studied for countermeasures of (i) Settlement, (ii) Liquefaction and (iii) Circular Slip to achieve stability of foundation and structures. Prior to structural design and its stability calculation, geological and hydraulic conditions are reviewed as described below as well as. classification of weak foundation soil and structural damages due to insufficient weak foundation improvement.

Proposed structural measure at each section is summarized in Table 1.1.3. Location of major structures (Earth Dike and Floodwall), typical section and work sections are shown in Figure 1.1.4.

# 3.1.2 Geological Conditions and Weak Foundation Measures

(1) Standard of Weak Foundation

Weak Foundation (sand or slit) is basically classified based on N-value for technical evaluation of Settlement, Stability and Liquefaction

Weak foundation is standardized as described below.

- Clay foundation:	N value (by SPT)	< 4
- Sand foundation:	N value (by SPT)	< 10 to 15

Table 3.1.1	Classifications of Weak Foundation
Tuble Silli	clussifications of vican roundation

Geological Condition of Foundation	Thickness of Layer	Cohesion $q_u (kg/cm^2)$	N-value
Clay / Cohesive Clay	Less than 10m	C < 0.6	N < 4
	More than 10m	C < 1.0	N < 6
Sand / Sand Soil	-	0	N < 10 to 15

Source: Guidelines for Road Civil Engineering of Construction for weak foundation

Foundation should be checked whether it can be liquefiable layer or not by using of criteria after it is identified as weak/soft soil by N-value standard (Clay : N<6, Sand : N < 10 to 15).

(2) Damages by Weak Foundation

Damages of dike and bridge foundation due to weak foundation are shown in Figure 3.1.1.

Weak foundation improvement works should be constructed to maintain stability of structural measure such as dike with prevention of the following damages.

- (a) Collapse of Dike
- (b) Broken-out of foundation
- (c) Settlement of foundation
- (d) Settlement at connection to structure (Bridge abutment)
- (e) Liquefaction damages



(e) Liquefaction Damages

Figure 3.1.1 Damages by Weak Foundation

(3) Weak Foundation Measures

It was confirmed based on geological investigation results as shown in Chapter 1.2.2, that soft alluvial formation spread over downstream from the Ysalina Bridge (Sta. 4+400). The soft alluvial formation mainly consists of loose liquefiable sand, whose thickness is estimated to be from 5m to 20m in depth underneath which varies at each site.

Soft alluvial layer is deposited thickly in the downstream part of the project area along the Cagayan de Oro River (CDOR), which consist of sand, sandy silt, clay silt and silt with low N-value less than N=10-15, therefore as mentioned in Chapter 2.6 weak foundation improvement works are required to maintain stability of structural measure preventing of the followings on the foundation.

To prevent on foundation for structure's stability

- Settlement,
- Liquefaction, and
- Sliding.

Accordingly structural river section of L1 and R2 situated downstream of the Ysalina Bridge are required to be provided with proper and sufficient foundation improvement works.

Especially section R2 is located in flood prone area of right bank along CDOR, Isla de Oro and Isla Delta areas near the center of Cagayan de Oro City (Sta. 1+880 to 2+980 and Sta.2+980 to 4+220). Structural measures and weak foundation improvement works

should be considered with the following matters comprehensively.

## Features of section R2 :

- Thick soft alluvial formation deposit,
- Flood inundation prone area,
- Densely population, built-up and properties areas, and
- New dike and road construction plans required in the city development plan.

Section R2 requires structural measures for the existing and planned structures against not only flood but also weak foundation damages. Settlement and Liquefaction damages should be avoided in the R2 during and after construction works.

Based on geological condition dominated by sand and sandy silt, Sand Compaction Piling Work (SCP) and Cement Deep mixing Work (CDM) are selected as applicable weak foundation improvement works for R2 site in technical view point as shown in Figure 3.1.2. Common foundation improvement works such as Pre-loading and Vertical drainage methods are not suitable against settlement and liquefaction damages in this section.





#### Figure 3.1.2 Classification of Weak Foundation Improvement Works

However L1 located along left bank of the river mouth (outer of mangrove protection area) will be provided with common foundation improvement work such as pre-loading in economic view point because smaller densely population, built-up and infrastructure / properties are situated at this section compared with R2.

Consolidation and drainage method on the target foundation is adopted as proposed weak foundation work at L1, by which some volume of settlement during construction and no effect of liquefaction measure should be allowable / accepted.

Weak foundation improvement works of are summarized in Table 3.1.3, from which weak foundation improvement works are not required in sections; L3, R3, L4, R4 considering of the geological conditions.

		-	0
Section	Station	Structural Measure	Weak Foundation Improvement
L1	Sta. 0+000 to	Road Dike (Earth	Pre-Loading Method
	Sta. 2+100	Embankment)	L=2,600m
R2	Sta. 1+500 to	Retaining wall +	SCP or CDM works
	Sta. 4+220	Embankment	L= 2,100m
L3	Sta. 4+220 to	Earth Dike	Not be emplied
	Sta. 6+100	Retaining wall	Not be applied
R3	Sta. 4+220 to	Earth Dike	Not be applied
	Sta. 4+600		Not be applied
L4	Sta. 6+100 to	Earth Dike	Not be explicit
	Sta. 10+100	Retaining wall	Not be applied
R4	Sta. 4+600 to	Earth Dike	Not be epplied
	Sta. 8+500		Not be applied

Table 3.1.3	Weak Foundation Improvement Works in the Project Area
-------------	---

In determination of proper weak foundation improvement works for R2, sand compaction piling work (SCP) is selected in a view point of effectiveness against liquefaction as shown in Table 3.1.4.

Table 314	Comparison of We	k Foundation I	mnrovement Work	s hetween SCP 🤉	and CDM
1able 3.1.4	Comparison of wea	ik roundation n	mprovement work	s detween SCI a	

Weak Foundation Improvement	Applicable	Matter of Prevention / Reduction against Weak Foundation		
Works	Foundation Type	Settlement	Sliding / Collapse	Liquefaction
Sand Compaction Piling Work (SCP)	Sandy Soil	Effective	Effective	Effective
Cement Deep mixing Work (CDM)	Silt	Effective	Effective	applicable

Source: JICA Survey Team

Considering of noise and vibration caused in construction of the selected weak foundation improvement of SCP in R2 densely population, built-up and infrastructure / properties, static type of construction equipment should be suitable in social and environment view points as shown in Table 3.1.5.

#### Table 3.1.5 Comparison of Type of Equipment of Sand Compaction Piling Work (SCP)



Table 3.2 Comparison of Weak Foundation Improvement Works (SCP\_Regular Type, SCP\_Static Type and CDM)

Source: JICA Survey Team

Name	Sand Compaction Pile Method (SCP) (Normal Type)	Sand Compaction Pile Method (SCP) (SAVE Composer Type)	Cement Deep mixing Work (CDM)
Discription Of Method	(contraction) (mcAuerr) (contraction) Setting maximum betrainent (contraction) Betrainent (con		CERIADO O DENEIRO O A DENEIRO
	SCP method stabilize the soft ground by installing well compacted sand piles of large diameters through the process to repeat the driving down and extracting motion of a vibrating steel pipe.	SAVE (Silent, Advanced Vibration-Erasing) Composer method is a Non-Vibratory Replacement (Soil densification) method. Basis is the same as that of SCP but silent. This allows construction adjacent to the existing buildings	CDM method that mixes cement slurry with soil in-situ and strengthens soft ground.
Applicable Soil	Sand, clay, and organic soil, and etc almost all type of soil.	Sand, clay, and organic soil, and etc almost all type of soil.	Sand, clay, and organic soil, and etc almost all type of soil.
Max. Depth	45m	25m	50m
Material	Sand, Aggregate, (Slag, Recycled aggregate), etc.	Sand, Aggregate, (Slag, Recycled aggregate), etc.	Cement slurry
Specifications	Steel pipe diameter = 400mm Sand pile diameter = 700mm	Steel pipe diameter = 400mm Sand pile diameter = 700mm	Single Axis : = Dia.1,000 ~ 1,600mm Dual Axis : = Dia.1,000×2 1,300mm×2
Purpose	Liquefaction prevention, Stabilization of embankment, Subsidence reduction, Foundation of tanks	Liquefaction prevention, Stabilization of embankment, Subsidence reduction, Foundation of tanks	Stabilization of soft ground, Subsidence reduction, and Liquefaction prevention (partially)
Noise & Vibration of Equipment	Noise : more than 85dB Vibration : more than 75dB	Noise : less than 85dB Vibration : less than 75dB	Noise : less than 85dB Vibration : less than 75dB
Unit Cost	Dia.= 700mm ¥2,600/m <sup>3</sup> (¥4,000/m)	Dia.= 700mm ¥4,300/m <sup>3</sup> (¥6,600/m)	Dia.=1,000mm ¥5,700/m <sup>3</sup> (¥17,900/m)
Construction Speed	246m³/day = 160m/day	200m³/day = 130m/day	$130m^3/day = 41m/day$

Sand compaction pile (SCP) of static type equipment is proposed as weak foundation improvement works at section R2 based on comparison of each method shown in Figure 3.1.3.

Source: JICA Survey Team

Figure 3.1.3 Alternatives of Weak Foundation Improvement Works

## 3.1.2 Hydraulic Conditions

(1) Design Discharge and High Water Level

The design of the structure in the objective stretch from river mouth to the Pelaez Bridge is designed adopting the design discharge (25-year probable flood) at Kauswagan-Puntod Bridge of  $3,400 \text{ m}^3$ /s as shown in Figure 1.6.1.

Design high water level ( along the Cagayan de Oro River is indicated in Figure 1.2.3 showing design dike level compared with the existing river bank level. The design dike level is basically added to the design high water level by 1.2m freeboard referring to the guideline of DPWH.

Flood water level and ground water level at flood / normal conditions should be considered for analysis on structural stability. Hydraulic phenomena produced by river geometric conditions such as scouring and erosion should be examined in designs of the river structures.

## (2) Design of Retarding Basin (Case of Structural Retarding Basin)

Hydraulic calculation was made for case of Structural Retarding Basin designed as shown in the following conception section and design dimensions, for which the retarding basin will be provided with spillway, apron and sub-dam facilities and regulating pond deepened by about 1.0m depth.

- Overflow width:	L= 200m
- Crest Level of Spillway:	EL. 3.50m

- Surface level of Apron (Pond) : EL. 1.00m



Source: JICA Survey Team

#### Figure 3.1.4 Conception Design of Retarding Basin (Case of Structural Retarding Basin)

The following figure shows hydrograph of the retarding basin under design discharge of 25-year flood level ( $Q_d = 3,400 \text{ m}^3/\text{s}$ ), in which maximum overflow discharge of 209 m<sup>3</sup>/sec and designed water level of EL. 3.76m at the retarding basin is calculated to enter the regulating pond through the designed spillway.



#### Figure 3.1.5 Hydrograph of Retarding Basin

Design discharge into the retarding pond under designed flood of 25-year ( $Q_d = 3,400$ m<sup>3</sup>/s) is determined as 250 m<sup>3</sup>/s for the design of spillway, apron and sub-dam.

- Design Discharge:
- $Q_{d} = 250 \text{ m}^{3}/\text{sec}$
- Overflow width of spillway: L= 200m EL. 3.50m
- Crest Level of spillway:
- Surface level of Apron (Pond): EL. 1.00m

#### 3.2 **Results of Structural Calculations**

#### 3.2.1 Stability of Foundation

(1)Settlement

Weak foundation layers are situated in the following locations of underneath.

l

Thick weak foundation layers of sandy soil (N<15) is estimated to be deposited in downstream part of the Cagayan de Oro River, sections L1, L2, R1 and R2. Settlements of the weak foundations without weak foundation improvement works are analyzed as shown in Table 3.2.1. Settlement of more 50cm and 20-40cm are estimated at L1 and R2 sections, respectively.

Boring Point (Section)	Immediate Settlement Sand Layer (cm)	Immediate Settlement Sand Soil Layer (cm)	Consolidation Settlement (cm)	Total Settlement (cm)
FB 2 (L1)	40.8	5.0	10.9	56.7
FB 4 (R2)	19.2	0.0	0.0	19.2
FB 7 (R2)	21.5	6.2	14.2	41.9

 Table 3.2.1
 Settlement of the Weak Foundation

Settlement will be minimized after weak foundation improvement works (Pre-Loading Method for L1, SCP / CDM for R2).

#### (2) Liquefaction

The two examination methods are applied for judgment of liquefiable foundation for the soil layer which is saturated and situated within 20m from ground surface as shown below.

#### Mrthod-1

Foundation of target layer is considered as highly liquefiable when all of the following three conditions are applicable on the target soil layer.

- a) Ground water level is within 10m from ground surface.
- b) Fine fraction ratio ( $F_c$ ) is more than 35%, or plasticity index ( $I_p$ ) is lower than 15.
- c) Mean particle diameter  $(D_{50})$  is lower than 10mm, and 10% particle diameter is lower than 1mm.

## Mrthod-2

Foundation of target layer is considered as liquefiable when value of Liquefaction Resistivity formula  $(F_L)$  is estimated to be less than 1.0.

At first foundation soil properties are checked by the three (3) conditions of Method-1 preliminary. In the next step, possibility of the liquefaction on foundation should be check by Method-2, based on results of laboratory tests. When Liquefaction Resistivity is less than 1.0, the layer can be judged as liquefiable foundation. Liquefaction judgments, method-1 and 2 are summarized in Table 3.2.2.

	Method-1	Method-2
	(by soil properties data)	(by Liquefaction Resistivity Formula)
a) b) c)	Ground water level is within 10m from ground surface. Fine fraction ratio ( $F_c$ ) is more than 35%, or plasticity index ( $I_p$ ) is lower than 15. Mean particle diameter ( $D_{50}$ ) is lower than 10mm, and 10% particle diameter is lower than 1mm.	Liquefiable Soil : $F_L < 1.0$ $F_L = R/L$ $R = C_W \cdot R_L$ $L = r_d \cdot k_h \cdot (\sigma_v / \sigma_v^*)$ $r_d = 1.0 - 0.015x$ where: $F_L$ : Liquefaction resistivity R : Dynamic shear rigidity ratio L : Shear stress ratio during earthquake $C_W$ : Correction coefficient depending on seismic movement characteristics $R_L$ : Cyclic tri-axial strength ratio $r_d$ : Reduction coefficient of depth direction during earthquake $k_h$ : Design horizontal seismic intensity $\sigma_v$ : Total stress at the depth of $x(m)$ , $kN/m^2$
		x : Depth from ground surface,(m)

 Table 3.2.2
 Liquefaction Judgment Methods

Source: JICA Survey Team

Results of liquefaction judgment by method-1 and 2 are summarized in Figure 3.2.1. Liquefiable judgment on soil layers was evaluated by Method -1 based on criteria as shown in Table 3.2.4. Possibility of liquefiable on foundation is evaluated by the followings:

- High: Applicable on a), b) and c),
- Low: Not applicable in one or two items of a), b), and c)
- Unknown: Not available of soil data

Table 3.2.4	Criteria of Liquefaction Judgment (Method-1)
-------------	--

Check Item of Mathad 1	Liquefiable Potential			
Check Item of Method-1	High	Low	Unknown	
a) Ground water level is within 10m from ground surface.	Applicable	Not		
b) Fine fraction ratio $(F_c)$ is more than 35%, or plasticity index $(I_p)$ is lower than 15.	Applicable	in one or	Not available of	
c) Mean particle diameter $(D_{50})$ is lower than 10mm, and 10% particle diameter is lower than 1mm.	Applicable	of a), b), and c)	soil data	

Source: JICA Survey Team

In judgment by Liquefaction Resistivity  $(F_L)$  formula by Mthod-2, seismic conditions and its coefficient are applied as shown in Table 3.2.3.

 Table 3.2.3
 Adopted Seismic Intensities

Seismic Movement		Ground Classification in Classification -2
Level-1: Seismic Movement		0.15
Laval 2: Saismia Mayamant	Type-1	0.35
Level-2: Seisinic Movement	Type-2	0.70

Source: JICA Survey Team

Results of liquefaction judgment combined with the methods 1 and 2 are shown in Figure 3.2.1. Required depths for weak foundation improvement against not only liquefaction but also settlement at each works section are examined based in Figure 3.2.1 as result of the followings.

Required Depth of Weak Foundation Works (for Section R2 only):

- Isla Delta (Sta. 2+500):	between Kauswagan and Maharlika Bridges:	10.0m depth
- Isla de Oro (Sta. 3+500):	between Maharlika and Ysalina Bridges:	15.0m depth

ED 2	GW	- 0 49m	Method-1		Method-2		1	ED4	CWI -	- 0.0m	Method-1		Method-2	
FD2	GWL	= 0.4011	Method-1			L eu mil O		г Б4	GVVL	= 0.9m	Wethou-1			Laural O
No.	Depth (m)	Thickness (m)	Liquefiable	Level 1 liquefaction resistivity FL	type I liquefaction resistivity FL	type I liquefaction resistivity FL		No.	Depth (m)	Thickness (m)	Liquefiable	Level 1 liquefaction resistivity FL	type I liquefaction resistivity FL	type II liquefaction resistivity FL
1	0 1 2 3 4	4	High	0.5	0.2	0.1		1	0 1 2 3 4	2	High	8.3	3.5	1.8
2	5	2	High	3.9	1.7	0.8		2	5	6	High	1.1	0.5	0.4
3	7 8 9	4	Low	1.3	0.5	0.6		3	7 8 9	1	High	34.4	14.7	7.4
4	10 11 12	2	unknown	1.0	0.4	0.4		4	10 11 12	4	High	1.2	0.5	0.5
5	13 14 15	4	High	1.2	0.5	0.5		5	13 14 15	2	unknown	91.6	39.2	19.6
6	17 18 19	4	Low					6 7	17 18 19	3	unknown Low	5.3	2.3	1.1
	20						J	8	20	6	Low	-	-	-
FB7	GWL	= 2.1m	Method-1		Method-2		]	FB11	GWL	= 2.1m	Method-1		Method-2	
No.	Depth (m)	Thickness (m)	Liquefiable	Level 1 liquefaction resistivity FL	Level 2 type I liquefaction resistivity FL	Level 2 type <u>I</u> liquefaction resistivity FL		No.	Depth (m)	Thickness (m)	Liquefiable	Level 1 liquefaction resistivity FL	Level 2 type I liquefaction resistivity FL	Level 2 type II liquefaction resistivity FL
1	0 1 2 3	3	Low	1.7	0.7	0.5	Ī	1	0 1 2	2	Low	1.8	0.8	0.7
2	4 5 6 7	5	High	1.0	0.4	0.3		2	3 4 5 6 7	4	unknown	-	-	-
3	8 9 10 11 12	4	Low	1.2	0.5	0.4		3	8 9 10 11 12	7	Low			
4	13 14 15 16 17 18 19	7	High	1.2	0.5	0.4		4	13 14 15 16 17 18 19 20	7	High	19.0	8.1	4.1
<u> </u>	20	-	riigii	2.2	0.0	1.0	1		20					
FB13	GWL	= 3.3m	Method-1		Method-2			FB14	GWL	= 3.66m	Method-1		Method-2	
No.	Depth (m)	Thickness (m)	Liquefiable	Level 1 liquefaction resistivity FL	Level 2 type I liquefaction resistivity FL	Level 2 type <u>I</u> liquefaction resistivity FL		No.	Depth (m)	Thickness (m)	Liquefiable	Level 1 liquefaction resistivity FL	Level 2 type I liquefaction resistivity FL	Level 2 type <u>I</u> liquefaction resistivity FL
1	0 1 2	2	Low	3.3	1.4	1.6		1	0 1 2	1	unknown	-	-	-
2	3 4 5	3	unknown	1.4	0.6	0.4		2	3 4 5	5.5	unknown	-	-	-
3	6 7 7.5	2.5	unknown	-	-	-			6 6.5 7					
4	8	0.5	unknown	-	-	-	1	1	8					
5	9 10 11 12	4	unknown	3.8	1.6	2.7		3	9 10 11 12	6.5	High	14.7	6.3	3.1
6	13 14 15	3	High	0.7	0.3	0.2		╞──	13 14 15					
7	16 17 18 19 20	5	Low	0.7	0.3	0.2		4	16 17 18 19 20	7	High	8.6	3.7	1.9
		Gravel &Cob Sand SiltySand Sandy Silt Cleyey Silt Clay	ble		De Im	pth of We provemer	eak nt \	k Four Vork	ndatio (by S0	n CP)				

Source: JICA Survey Team



## (3) Circular Slip

Circular slip analysis was made on all types of structural measure at each works section under the condition of with / without weak foundation improvement works.

In technical, environment and economic reasons, sand compaction piling work (SCP) is proposed as weak foundation improvement works along the Burgos Street (Section R2) for the river structural measure; Retaining Wall and Embankment

i) Design Factors

Safety Factors

a) Normal Condition	$F_n =$	1.2
b) Seismic Condition	$F_s =$	1.0
c) Flood Condition	$F_f =$	1.2

## Seismic Load

A seismic coefficient equal to one – half the acceleration coefficient ( $K_h = A/2$ ) is adopted. Therefore, the value at the project area is computed as follows:

 $K_{\rm h} = 0.40 / 2 = 0.20$ 

A : Acceleration coefficient (A = 0.40)

- $K_{\rm h}$ : Seismic coefficient used to calculate lateral earth pressures and defined above
- ii) Results of Circular Slip Analysis

Sheet pile will be basically adopted against circular slip on earth dike or foundation of the structures, required length of sheet pile at each section was calculated by circular slip analysis described below.

a) Section R2

Without Weak Foundation Improvement (SCP) at R2

Table 3.2.5 shows results of circular slip analysis without weak foundation improvement works (SCP) at Sta.2+500 and Sta.3+500 in Section R2. At least 9m and 13m length of sheet pile is required against circular slip at foundation underneath Sta. 2+500 and Sta. 3+500, respectively.

 Table 3.2.5
 Results of Circular Slip Analysis without Foundation Improvement at R2

Sta. 2+500	without Weak Foundation Improvement (SCP)				
with / without Sheet Pile	Normal	Seismic	After Flood		
Foundation	Fn	Fs	F <sub>f</sub>		
without Sheet Pile	0.92	0.58	0.90		
with Sheet Pile (L=9.0m)	1.83	0.94 = 1.0	1.82		

Sta. 3+500 without Weak Foundation Improvement (SCP) Normal Seismic After Flood with / without Sheet Pile Foundation  $\mathsf{F}_{\mathsf{n}}$  $\mathsf{F}_{\mathsf{s}}$ Ff without Sheet Pile 0.99 0.56 0.94 with Sheet Pile (L=9.0m) 0.99 0.56 0.96 with Sheet Pile (L=12.0m) 0.87 1.62 1.54 with Sheet Pile (L=13.0m) 1.81 0.96 = 1.01.72

: more than minimum safety factor

Source: JICA Survey Team

#### With Weak Foundation Improvement (SCP) at R2

Results of circular slip analysis with weak foundation improvement by SCP at R2 are shown in Table 3.2.6.

Table 3.2.6 Results of Circular Slip Analysis with Foundation Improvement at R2

Sta. 2+500	with Weak Found	ation Improvement	(SCP)	
with / without Sheet Pile	Normal	Seismic	After Flood	
Foundation	Fn	Fs	F <sub>f</sub>	
without Sheet Pile	0.92	0.58	0.90	
with Sheet Pile (L=9.0m)	1.92	0.98 = 1.0	1.91	

+500	with Weak Founda

Sta. 3+500	with Weak Foundation Improvement (SCP)				
with / without Sheet Pile	Normal	Seismic	After Flood		
Foundation	Fn	Fs	F <sub>f</sub>		
without Sheet Pile	0.99	0.56	0.94		
with Sheet Pile (L=9.0m)	0.99	0.56	0.96		
with Sheet Pile (L=12.0m)	1.77	0.96 =1.0	1.71		
with Sheet Pile (L=13.0m)	1.97	1.05	1.92		

more than minimum safety factor

Source: the Survey Team

As results of circular slip analysis with weak foundation improvement works, the safety factor at R2 can be improved.

# b) Sections L1, L2, L3, R2, R3, and R4

The results of circular slip analysis in Section L1, L2, L3, R2, R3, and R4 are summarized in Table 3.2.7, sheet pile is required to be installed to Section L2, L3, R2, and R3 in order to secure the minimum safety factor against circular slip failure. On the other hand, Road Dike (2) at L1 can be stable against circular slip without sheet pile installation.

-L2 (DPWH's section): Concrete wall with (6) with Min. sheet pile L= 16.0 m

-R2:	As mentioned above
	i) Sta.2+500: Concrete wall (5) with Min. sheet pile $L=9.0$ m
	ii) Sta.3+500: Concrete wall (5) with Min. sheet pile $L= 13.0m$
-L3:	Earth Dike (3) with Min. sheet pile L= 14 m
	Concrete wall (6) with Min. sheet pile $L=16$ m
-R3:	Concrete wall (8) with Min. sheet pile $L= 12 \text{ m}$
-R4	Earth Dike (1) with Min. sheet pile $L = 9 m$

		Location Results of Minimum Safety Factor		afety Factor					
No.	River Section	Station	Area	Туре	a	b	C After Flood	Remarks	
1	L1	Sta. 0+500	River Mouth	Road Dike (2)	1.64	1.01	1.33	W/O Sheet Pile (Dike (4) )	
2	L2	DPWH 3+500	DPWH	(6)	2.18	1.13	1.11	W/Sheet Pile L= 16m (Floodwall (6) ), DPWH Works Section	
3	<b>P</b> 2	Sta. 2+500	Isla Delta	(5)	1.92	0.98 = 1.0	1.92	W/ Sheet Pile (L=9.0m) and with SCP	
4	N2	Sta. 3+500	Isla de Oro	(5)	1.97	1.05	1.92	W/ Sheet Pile (L=13.0m) and with SCP	
5		Sta. 4+100	COA	(7)	2.97	1.30	3.66	W/ Sheet Pile (Floodwall (7), COA: Commission on Audit)	
6		Cto 4 1000	Acacia	(2)	0.89	0.62	0.42	W/O Sheet Pile (Earth Dike (3))	
7	L3	Sla. 4+000		(3)	3.23	1.41	2.80	W/ Sheet Pile (Earth Dike (3), Sheet Pile L= 14m)	
8		Sta. 5+300	Carmen	(6)	2.21	1.14	2.17	W/ Sheet Pile (Floodwall (6) Sheet Pile L=16m)	
9	D2	Sta. 4+100	City Hall	(8)	5.04	1.55	5.04	W/ Sheet Pile (Floodwall (8), Sheet Pile L=12m)	
10	- R3	Sta. 4+600	Arroyo Creek	(1)	3.79	1.91	3.34	W/O Sheet Pile (Earth Dike (1))	
11	D4	Sta. 5+000	Magagandia	(1)	3.08	1.58	2.16	W/ Sheet Pile (Earth Dike (1) + Boulevard, Sheet Pile L=9m)	
12	K4	Sta. 7+500		(2)	2.10	1.26	1.12	W/O Sheet Pile (Earth Dike (2) + Boulevard, Cutoff L=1m)	
Note:	W/	: with			Required Minimum Safety Factor on Analysis Conditions (Circular Slip)				
	W/O:without a 1.5 :Normal								
		· DPWH's Work	Section			b	1.0	Seismic	

Table 5.2.7 Results of Circular Silp Analysis (Sections - L1, L2, L5, N2, N5, and F	Slip Analysis (Sections : L1, L2, L3, R2, R3, and R4)
---	---

Weak Foundation Improvement Works (SCP)

iii) Design of Weak Foundation Improvement Works (by SCP)

Sand Compaction Piling Works (SCP) is selected as weak foundation improvement in the project area (section R2) as mentioned above in this chapter. The weak foundation having N-value less than 15 should be improved with N-value more than 15. Designs of SCP will be made for target N-value = 15.

1.2

: After Flood

Diameter of pile of 0.7 m is basically fixed following to size of piling equipment. Interval of piling works can be calculated considering the improvement of the foundation from Initial N-value (N<15) to be Target N-values (N=15) under sand and sandy silt geological conditions. Width of piling works area is designed based on the width of foundation of structures and its affected area. Depth of piling is determined based on examination on results of boring survey, geological formation, settlement and liquefaction as mentioned above chapter 3.2.1 (2) Liquefaction.

Design dimensions of the SCP at R2 section are determined or calculated as below.

Design Dimensions of Sand Compaction Piling Works:

Sta.	1 + 880 - 2 + 980:	
	Diamatan of Dila	

Diameter of Pile :	0.7m
Intervals of Piling:	2.4m
Width of Piling Works :	20.0m
Depth of Piling :	10.0m
Sta. 2+980 – 4+220:	
Diameter of Pile :	0.7m
Intervals of Piling:	1.5 m
Width of Piling Works :	20.0m
Depth of Piling :	15.0m

Typical section and plan of structural measure (Floodwall and Embanked Road) and weak foundation improvement works at Sta. 2+980 - 4+220 is shown in below, Figure 3.2.2.



## Figure 3.2.2 Typical Design of Floodwall with Boulevard and Sand Compaction Pile (SCP) in R2 section

- 3.2.2 Stability of Structures
  - (1) Floodwall

Stability of floodwall can be maintained adopting the standard design under conditions of design criteria and guidelines.

However, bearing capacity of foundation should be improved with sheet piling or foundation improvement works if there are insufficient on the foundation.

(2) Sheet Pile

Sheet pile foundation is installed at toe of structural measure such as dike and floodwall to stabilize foundation and structural measures. Design of the sheet pile is made based on design criteria of sheet pile.

Design dimensions of sheet pile structure into sandy soil foundation can be standardized based on stability calculations results as shown below for this study.

- Sheet Pile (L = 6.0m): 2.0m (above riverbed) and 4.0m (embedded depth)
- Sheet Pile (L = 9.0m): 3.0m (above riverbed) and 6.0m (embedded depth)
- Sheet Pile (L =12.0m): 4.5m (above riverbed) and 7.5m (embedded depth)

Bolder-stone filling in front of the sheet pile should be considered to increase of stability of the structure.

#### 3.2.3 Hydraulic Analysis

## (1) Required Seepage Length

Required seepage lengths at each structure are preliminary calculated by the *Lane* formula, and design dimensions related to foundation should be determined keeping sufficient seepage length under condition of design high water level (DHWL).

It is confirmed that each structural measure is stable against seepage damages having required seepage length as shown in Table 3.2.8.

Type of Structure	<i>⊿H</i> (m)	С	Required Seepage Length (m) Lr=C∠/H	L (m)	Σ <i>I (m)</i>	L =L+2∑ <i>I</i> (m)	Judge L>=Lr	Remarks
Road Dike (4)	2.0	6.0	12.0	21.4	0.0	21.4	ok	
Floodwall (7)	2.9	6.0	17.4	6.3	6.0	18.3	ok	
Earth Dike (3)	4.2	6.0	25.2	18.3	14.0	46.3	ok	SP for stability
Floodwall (6)	3.5	6.0	21.0	12.4	12.5	37.4	ok	
Earth Dike (2)	3.9	6.0	23.5	26.6	0.0	26.6	ok	
Floodwall+Embankment (5)_1	4.0	6.0	24.2	24.4	9.0	42.4	ok	including Boulevard
Floodwall+Embankment (5)_2	3.5	6.0	21.1	24.4	13.0	50.4	ok	including Boulevard
Floodwall (8)	3.6	6.0	21.7	6.3	9.0	24.3	ok	
Earth Dike (1) w/ sheet pile	3.6	6.0	21.7	19.0	9.0	37.0	ok	w/ sheet pile
Floodwall+Embankment (5)	3.9	6.0	23.1	24.4	9.0	42.4	ok	
Earth Dike (1)+Boulevard	4.0	6.0	24.2	19.0	9.0	37.0	ok	Exculding Boulevard
Earth Dike (2)+Boulevard	4.0	6.0	24.2	26.6	0.0	26.6	ok	Exculding Boulevard

 Table 3.2.8
 Required Seepage Length of Each Structural Measure

Source: JICA Survey Team

- (2) Hydraulic Calculation of Spillway
- 1) Type of Spillway and Design Conditions

Type of the spillway is selected to be Type-1 shown in Figurer 3.2.3 in technical and economical view points.



Figure 3.2.3 Type of Spillway of Retarding Basin

As discussed in chapter 3.1.2, the following design conditions are given for design of spillway.

- Design Discharge:
- Overflow width of spillway:
- Crest Level of spillway:
- Surface level of Apron (Pond):

Q<sub>d</sub>= 250 m<sup>3</sup>/sec L= 200m EL. 3.50m EL. 1.00m

Based on the design conditions given above, the followings conditions are also derived

from energy formula for design dimension of the spillway (Type-1) as shown in below.

- Unit Discharge:	$q = 1.25 \text{ m}^3/\text{sec/m}$
- Critical depth:	$h_c = 0.549 \mathrm{m}$
- Critical velocity at overflow:	$V_c = 2.305 \text{ m/sec}$
- Down stream flow velocity:	$V_2 = 0.453 \text{m/sec}$
- Down stream flow depth:	$h_2 = 2.76 \text{m}$

# 2) Length of Sheet Pile

Length of sheet pile installed at spillway is designed maintaining required seepage length under design flood water level. Required seepage length is calculated by the Lane's Method as follow.

 $L > C' \Delta H$  (Lane's Equation)

		Coefficient of Lane's M	ethod
where;		Classification	С
Weighted seepage leng	gth: $L = \Sigma l_v + \Sigma l_h/3$ (m)	Silty sand or clay	8.5
	$l_{v}$ : Vertical Seepage Length	Fine sand	7.0
	<i>l<sub>h</sub></i> : Horizontal Seepage Length	Medium sand	6.0
Lane's Coefficient:	C' = 7.0	Coarse sand	5.0
Maximum Hood:	$\Delta H(m)$	Gravel	4.0
Maximum Head:		Coarse gravel	3.5
		Cobble stone with gravel	3.0
		Rocks with cobble stone	2.5

Required length of 7.0m is applied for design of sheet pile based on the calculation as shown in the Table 3.2.10.

Item		Results	Remarks
Maximum Water Head:	$\Delta H$	2.897 m	$\Delta H = h_c + \Delta Z - h_{1a}$
Length of Weir and Apron:	L	6.1 m	Width of Weir 3.0m, Length of Apron 3.1m
Coefficient of Lane's Equation:	<i>C'</i>	7.0	Fine Sand C' =7
Total vertical seepage length:	$\Sigma l_v$	18.25 m	$\Sigma l_{\nu} > C' \Delta H$ -L/3, C=7
Required vertical seepage length:	l	6.87 m	$l = \Sigma l_v - (D+2d)/2 > 0$

Source: JICA Survey Team

3) Length of Stilling Basin of Spillway

Section of the stilling basin of the spillway consist of hypercritical flow and hydraulic jump sections as shown in below, Figure 3.2.4 below.



#### Figure 3.2.4 Hydraulic Phenomena on Longitudinal Profile of Spillway and Stilling Basin

As the results of the hydraulic calculation of the proposed spillway, the typical section of the spillway and the stilling basin are designed as below:

• Apron length	: 15.0m
• End sill height	: 0.7m
$\cdot$ Length of foundation protection in the downstream of the apron	: 10.0m

# (3) Design of Spillway

Typical section of spillway and stilling basin are designed as shown in Figure 3.2.5



Figure 3.2.5 Typical Section of Spillway

ANNEXES

•

Annex-1

Drawings (Structural Measures)

# LIST OF DRAWINGS

Drawing No.

<b>A:</b>	Gl	ENERAL	
	1.	General Map	A-1
	2.	Location of New Structural Measures and DPWH Work Sections	A-2
B:	PL	AN AND PROFILE	
	3.	Plan and Profile Cagayan de Oro River Sta.0+000 to Sta.4+200	B-1
	4.	Plan and Profile Cagayan de Oro River Sta.4+200 to Sta.8+400	B-2
	5.	Plan and Profile Cagayan de Oro River Sta.8+400 to Sta.11+779	B-3
C:	Riv	ver Cross Sections	
	6.	River Cross Section Sta.0+950 to Sta.1+150	C-1
	7.	River Cross Section Sta.2+970 to Sta.3+490	C-2
	8.	River Cross Section Sta.4+340 to Sta.4+470	C-3
	9.	River Cross Section Sta.5+500 to Sta.5+800	C-4
D:	Ту	pical Section of River Structures	
	10.	Typical Sections of Dikes	
	11.	Typical Sections of Road Raising and Floodwalls	
	12.	Typical Sections of Floodwall & Boulevard and Weak Foundation	
		Improvement Works (Sand Compaction Pile Method)	
E:	Re	tarding Basin	
	13.	Retarding Basin General Layout Plan	E-1
F:	De	sign of Narrow River Area (City Hall & COA)	
	14.	Narrow River Area General Location Map	F-1
G:	Ka	ngay-an Bridge Improvement Works	
	15.	Kagay-an Bridge Improvement Works Plan, Elevation and Sections	G-1
H:	Dr	ainage Outlet Structures	
	16.	Drainage Outlet Structures Plan & Section of Drainage Outlet	
		with Slide Gates at R4 Section	H-1
	17.	Drainage Outlet Structures Plan & Section of Drainage Outlet	
		at L1 Section Road Dike (1)	H-2

















# CROSS SECTION STA. 0+950



## CROSS SECTION STA. 1+510

					NOTE: MFWL (1): TROPICAL STORM SE MFWL (2): TYPHOON PABLO, DE	NDONG, DEC. 2011 C. 2012
	GOVERNMEN	T AGENCIES:	JICA SURVEY TEAM:	PROJECT & LOCATION:	SHEET CONTENTS:	DWG NUM:
jîca	JAPAN Japan International Cooperation Agency	Republic of The Philippines DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	NIPPON KOEI CO., LTD. CTI ENGINEERING INTERNATIONAL CO., LTD. PASCO CORPORATION	Preparatory Survey for Flood Control Managemant Project for Cagayan de Oro River (FRIMP - CDOR)	RIVER CROSS SECTION STA. 0+950 & STA. 1+510 SCALE: VERTICAL 1:500 HORIZONTAL 1:600	G-1 6 17



## CROSS SECTION STA. 2+970



#### CROSS SECTION STA. 3+490

GOVERNMENT AGENCIES:				JICA SURVEY TEAM:	PROJECT & LOCATION:
ji	JAPAN Japan International Cooperation Agency	攀	Republic of The Philippines DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	NIPPON KOEI CO., LTD. CTI ENGINEERING INTERNATIONAL CO., LTD. PASCO CORPORATION	Preparatory Survey for Flood Control Managemant Proj for Cagayan de Oro River (FRIMP - CDOR)

	SHEET CONTENTS:	DWG NUM:		
iject	RIVER CROSS SECTION STA. 2+970 & STA. 3+490	C-2 7 17		
	SCALE: VERTICAL 1.800 HORIZONTAL 1:4000			



## CROSS SECTION STA. 4+340



## CROSS SECTION STA. 4+470

GOVERNMENT AGENCIES:			JICA SURVEY TEAM:	PROJECT & LOCATION:	
JAPAN JAPAN Japan International Cooperation Agency	攀	Republic of The Philippines DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	NIPPON KOEI CO., LTD. CTI ENGINEERING INTERNATIONAL CO., LTD. PASCO CORPORATION	Preparatory Survey for Flood Control Managemant Pro for Cagayan de Oro River (FRIMP - CDOR)	

	SHEET CONTENTS:	DWG NUM:
oject	RIVER CROSS SECTION STA. 4+340 & STA. 4+470	C-3
	SCALE: VERTICAL 1:800 HORIZONTAL 1:4000	

DSS SECTION & STA. 4+470	C-3 8 17



CROSS SECTION STA. 5+540



# CROSS SECTION STA. 5+890

	GOVERNME	NT AGENCIES:		JICA SURVEY TEAM:	PROJECT & LOCATION:	SHEET CONTENTS:	DWG NUM;
jica	JAPAN Japan International Cooperation Agency	*	Republic of The Philippines DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS	NIPPON KOEI CO., LTD. CTI ENGINEERING INTERNATIONAL CO., LTD. PASCO CORPORATION	Preparatory Survey for Flood Control Managemant Project for Cagayan de Oro River (FRIMP - CDOR)	SRIVER CROSS SECTION STA. 5+500 & STA. 5+800 SCALE: VERTICAL 1:800 HORIZONTAL 1:4000	C-4 9 17


















# Supporting Report Appendix H Construction Plan and Cost Estimate

#### PREPARATORY SURVEY FOR FLOOD RISK MANAGEMENT PROJECT FOR CAGAYAN DE ORO RIVER (FRIMP-CDOR) IN THE REPUBLIC OF THE PHILIPPINES

# FINAL REPORT

## VOLUME III SUPPORTING REPORT (I)

# Appendix H COSNTRUCTION PLAN AND COST ESTIMATION

## **Table of Contents**

Page

CHAPTE	ER 1 CO	OST ESTIMATE AND CONSTRUCTION PLAN FOR MASTER PLAN	
	ST	UDY	.H-1
1.1	Summar	ry of Construction Plan for Master Plan Study	.H-1
	1.1.1	General Condition	.H-1
	1.1.2	Scope of Work	.H-1
1.2	Conditio	on of Construction Plan	.H-5
	1.2.1	Climate Condition	.H-5
	1.2.2	Workable Day	.H-5
	1.2.3	Working Hour	.H-7
	1.2.4	Site Condition	.H-7
1.3	Labor, E	Equipment and Material	H-10
	1.3.1	Labor	H-10
	1.3.2	Equipment	H-10
	1.3.3	Material	H-10
1.4	Constru	ction Method	H-10
	1.4.1	General	H-10
	1.4.2	Dike	H-11
	1.4.3	Flood Wall	H-11
	1.4.4	Raising Road	H-12
	1.4.5	Weak Foundation Improvement	H-13
	1.4.6	Maintenance Dredging	H-14
	1.4.7	Retarding Basin	H-14
	1.4.8	Drainage and Hydro Mechanic Work	H-15
	1.4.9	Improvement of Kagayan Bridge	H-15
	1.4.10	Dam	H-16
	1.4.11	Performance of Construction Machines	H-16

1.5	Packagir	ngH-1'
1.6	Construc	tion PlanH-1
1.7	Basic Co	nditions of Cost Estimate
	1.7.1	Price Level
	1.7.2	Exchange Rate
	1.7.3	Currency for Cost Estimates
	1.7.4	Reference Guidelines and Manuals
1.8	Methodo	logy of Cost EstimateH-2
	1.8.1	Construction Cost
	1.8.2	Consulting Service
	1.8.3	Cost for Land Acquisition and Compensation
	1.8.4	Administration CostH-2
1.9	Project C	Cost
	1.9.1	Project Cost for River Improvement Works
	1.9.2	Project Cost for Dam Construction
	1.9.3	Operation and Maintenance Cost
CHAPTE	R 2 COI	NSTRUCTION PLAN AND COST ESTIMATION FOR FEASIBILITY
0.1	STU	JDY
2.1	Construc	tion Plan for Feasibility StudyH-23
	2.1.1	Summary of Construction Plan
	2.1.2	Condition of Construction PlanH-3
	2.1.3	Labor, Equipment and MaterialH-3.
	2.1.4	Construction Method
	2.1.5	Packaging of Contract
	2.1.6	Construction Plan
2.2	Cost Esti	imation for Feasibility StudyH-30
	2.2.1	Basic Conditions of Cost Estimate
	2.2.2	Methodology of Cost Estimate
	2.2.3	Project CostH-30
	2.2.4	Operation and Maintenance Cost

## List of Tables

Table 1.1.1	Length of Major Work for Improvement of Cagayan de Oro River	H-4
Table 1.1.2	Quantity of Major Work	H-5
Table 1.2.1	List of National Holiday in 2013	H-6
Table 1.2.2	Number of Rainy Day	H-6
Table 1.2.3	Number of Workable Day	H-7
Table 1.2.4	List of Drainage Improvement	H-10
Table 1.4.1	Combination of Major Equipment and Productivity for Major Work Item	H-17
Table 1.7.1	Ratio of Foreign Currency Portion for Labor, Material and Equipment in Previously JICA Funded Study	H-20

Table 1.7.2	Ratio of Local and Foreign Currency Portion for Labor, Material and	
	Equipment	.H-20
Table 1.8.1	Summary of Cost for Land Acquisition and Compensation	.H-23
Table 1.9.1	Summary of Project Cost for River Improvement	.H-24
Table 1.9.2	Cost Estimation for Batang-Bulanog Dam Project in 1996	.H-24
Table 1.9.3	Summary of Project Cost for Dam Construction	.H-25
Table 2.1.1	Length of Major Work for Improvement of Cagayan de Oro River	.H-30
Table 2.1.2	Quantity of Major Work	.H-30
Table 2.1.3	Number of Workable Day	.H-31
Table 2.1.4	List of Access Road	.H-32
Table 2.1.5	List of Drainage Improvement	.H-33
Table 2.2.1	Summary of Project Cost for River Improvement in Feasibility Study	.H-36
Table 2.2.2	Operation and Maintenance Costs	.H-36
Table 2.2.3	Breakdown of Preliminary Estimation of Operation and Maintenance Cost and Maintenance Dredging Cost	H37
Table 2.2.4	Breakdown of Preliminary Estimation of Operation and Maintenance Cost for Material costs for River structures and Hydro-Mechanical works	.H-37

## List of Figures

Figure 1.1.1	Location of Project and Target Structure	<b>I</b> -2
Figure 1.1.2	Distribution of Target Structure for River Improvement	<b>I-</b> 3
Figure 1.2.1	Location of Borrow Area and Quarry	I-8
Figure 1.2.2	Location of Temporary and Permanent Disposal Area	I-9
Figure 1.4.1	Standard Cross Section of Dike-1(upper) and Dike-2 (lower)	-11
Figure 1.4.2	Construction Flow of Dike-1 and Dike-2	-11
Figure 1.4.3	Standard Cross Section of Flood WallH-	-12
Figure 1.4.4	Construction Flow of Flood Wall	-12
Figure 1.4.5	Standard Cross Section of Raising RoadHe	-12
Figure 1.4.6	Construction Flow of Raising Road	-13
Figure 1.4.7	Procedure of Sand Compaction Pile MethodH-	-13
Figure 1.4.8	Dredging Flow with PumpH-	-14
Figure 1.4.9	Dredging Flow of with Backhoe Barge	-14
Figure 1.4.10	Construction Flow of Drainage and Hydro Mechanic Work	-15
Figure 1.4.11	Improvement Flow of Kagayan BridgeHe	-16
Figure 1.6.1	Overall Project Schedule	-18
Figure 1.6.2	Construction Schedule of River Improvement in Master Plan	-18
Figure 1.9.1	Schematic Reservoir Allocation	-26
Figure 2.1.1	Distribution of Target Structure for River Improvement	-29
Figure 2.1.2	Road Condition around Cagayan de Oro River	-31
Figure 2.1.3	Cross Section of Access RoadH-	-32
Figure 2.1.4	Concept of Construction Step in L1 (Coastal)He	-34
Figure 2.1.5	Construction Schedule of River Improvement in Feasibility Study	-35

# CHAPTER 1 COST ESTIMATE AND CONSTRUCTION PLAN FOR MASTER PLAN STUDY

## 1.1 Summary of Construction Plan for Master Plan Study

1.1.1 General Condition

The structure measures of Master Plan at Cagayan de Oro River Basin consist of the river improvement and utilization of existing plan of hydropower dam. This chapter describes the construction plan and cost estimation for the Project.

The target area of improvement of the river is stretched from the river mouth to STA. 9+900. The dam site planned by Northern Mindanao Electric Cooperatives Association (NPC – NORMECA) is located at approximately 35km upstream from the river mouth. The construction plan was proposed in this chapter assuming that all of the necessary procedures should be taken by DPWH, such as land acquisition, compensation and acquisition of right of way, and have been completed before the commencement of the each construction package.

## 1.1.2 Scope of Work

(1) Location of Project

Location of the project and the target structures are as shown in Figure 1.1.1. The distribution of the structures is as shown in Figure 1.1.2. Structures in R1, L2, and the slope protection in the L4 will be constructed by DPWH, hence those in L1, R2, R3, L3, R4 and a part of L4 are the target structures in the project.



Source: JICA Survey Team





Source: JICA Survey Team



## (2) Construction of Structure

Main work items in this project are, construction of river structures along Cagayan de Oro River, maintenance dredging at lower reach, construction of a retarding basin with related structures, drainage and hydro mechanic work, Kagayan Bridge improvement and utilization of the dam plan. The river structures consist of dike, floodwall and raising road. Construction of the retarding basin includes excavation of the bed of the basin, construction of slope protection, dike, floodwall, culvert and drainage with gate. Kagayan Bridge improvement shall aims at widening Cagayan de Oro River and requires demolition of the ramp and road pavement, excavation of embankment, construction of new pier, girder, road pavement and embankment with side protection. Since weak ground was observed in a part of R2 and a part of R3, a sand compaction pile method for ground improvement was also proposed. In addition, the result of a feasibility study of the hydropower dam, which was compiled by NPC – NORMECA was also considered in this report.

## (3) Quantity of Major Work

Length of the major works for improvement of the Cagayan de Oro River was summarized in Table 1.1.1.

No.	Major Civil Work	Length (m)
1.	River Structure	
1-1	Dike	5,590
1-2	Floodwall	3,845
1-3	Road Dike (Evacuation Road & Road Raising)	2,630
1-4	Floodwall (Dike around Retarding Basin)	940
2.	Maintenance Dredging	-
3.	Retarding Basin	
3-1	Dike along the Arroyo Creek (Existing Drainage)	220
3-2	Floodwall (Road Raising)	1,285
3-3	Slope Protection around Retarding Basin	175
3-4	Spillway	200
4.	Kagayan Bridge Improvement	500

 Table 1.1.1
 Length of Major Work for Improvement of Cagayan de Oro River

Source: JICA Survey Team

The construction of structures above mentioned includes concrete work, concrete pile work, earth work, road work, dredging work, maintenance drainage work and bridge work.

The quantity of the major works was summarized in Table 1.1.2.

No.	Major Civil Work	Unit	River Structure	Maintenance Dredging	Retarding Basin	Kagayan Bridge Improvement	Total
1	Excavation	m <sup>3</sup>	37,964	-	255,451	36,170	329,586
2	Embankment	m <sup>3</sup>	509,905	-	44,422	42,999	597,326
3	Concrete	m <sup>3</sup>	33,336	-	12,143	12,257	57,736
4	Reinforcement Bar	kg	2,436,091	-	1,023,756	1,622,953	5,082,800
5	Concrete Sheet Pile	m	123,009	-	26,416	7,542	156,967
6	Concrete Square Pile	m	5,565	-	998	667	7,230
7	Bored Pile	m	0	-	-	1,312	1,312
8	Stone Masonry	m <sup>3</sup>	60,044	-	18,043	18,775	96,862
9	Sodding	$m^2$	48,021	-	-	-	48,021
10	Pre-stressed Concrete Girder (L=35.0m)	nos	0	-	-	40	40
11	Asphalt Pavement	m <sup>2</sup>	78,651	-	10,945	-	89,596
12	Gravel Pavement	m <sup>2</sup>	10,708	-	-	27	10,735
13	PCC Pavement	m <sup>2</sup>	0	-	-	1,080	1,080
14	Riprap	m <sup>3</sup>	0	-	-	2,645	2,645
15	Maintenance Dredging	m <sup>3</sup>	0	108491	-	-	108,491
16	Sand Compaction Pile (Total Depth)	m	192,840	-	-	-	192,840
17	Flap Gate	nos	23 (at 21 sites)	-	-	-	23
18	Sluice Gate	nos	7 (at 4 sites)	-	-	-	7

 Table 1.1.2
 Quantity of Major Work

Note: Quantity of the river improvement works in the Master Plan is same as the ones in the Feasibility Study including additional works items.

Source: JICA Survey Team

#### **1.2** Condition of Construction Plan

1.2.1 Climate Condition

According to the chapter 2, PAGASA defined the climate in Cagayan de River Basin as a tropical climate with (2) distinct types, which are Type III and Type IV. Type III shows the wet season from May to October and the dry season from November to April. Type IV indicates that the rainfall throughout the year is evenly distributed.

Hence, in the construction plan, the wet season and the dry season are considered as follows.

- Wet Season: from May to October
- Dry Season; from November to April

#### 1.2.2 Workable Day

The issues to be considered counting workable day are as follows.

- General Number of Working Day per Week
- National Holiday
- Rainy Day
- Work Item
- (1) General Working Day in Week

Generally, the working day in a week is from Monday to Saturday in the Philippines. Hence, the general number of working day per week is six (6) days.

## (2) National Holiday

The list of the national holiday based on 2013 is as in Table 1.2.1. The number of the national holiday in 2013 is seventeen (17) days.

No.	Holiday	Date
1	New Year's Day	January 1
2	Maundy Thursday	March 28
3	Good Friday	March 29
4	Holy Saturday	March 30
5	The Day of Valor	April 9
6	Labor Day	May 1
7	Independence Day	June 12
8	Ninoy Aquino Day	August 21
9	National Heroes Day	August 26
10	Cagayan de Oro City Charter Day	September 15
11	All Saints' Day	November 1
12	All Souls' Day	November 2
13	Bonifacio Day	November 30
14	Christmas Eve	December 24
15	Christmas Day	December 25
16	Rizal Day	December 30
17	New Year's Eve	December 31

 Table 1.2.1
 List of National Holiday in 2013

Source: http://www.gov.ph/2012/08/16/proclamation-no-459-s-2012

## (3) Rainy Day

Table 1.2.2 shows the number of rainy days that has equal to or more than ten millimeters (10mm) and fifty millimeters (50mm) precipitation per hour observed at three rainfall stations. Those are Cagayan de Oro station, Lumbia station and Libuna station.

It is assumed that all of the work items can be performed under the rainfall less than ten millimeters (10mm). If the rainfall is equal to or more than fifty millimeters (50mm), earth related works such as excavation, embankment, backfill, top soil furnishing and road work required the next day suspended.

Month	Ian	Feb	Mar	Δnr	May	Iune	Inly	Δ11σ	Sent	Oct	Nov	Dec	Total	Remarks
Days with Rainfall Over 10mm at CDO station	2.37	1.90	1.41	1.47	2.31	6.36	6.10	5.55	5.93	6.25	3.74	2.76	46.14	from 1980 to 2009
Days with Rainfall Over 50mm at CDO station	0.33	0.21	0.07	0.20	0.17	0.93	0.59	0.69	0.74	0.71	0.56	0.34	5.54	from 1980 to 2009
Days with Rainfall Over 50mm at Lumbia station	0.67	0.00	0.00	0.17	0.33	0.57	0.29	0.14	0.14	0.83	0.17	0.50	3.81	from 2006 to 2012
Days with Rainfall Over 50mm at Libuna station	0.67	0.33	0.67	0.83	0.33	1.57	1.43	1.86	1.17	1.00	0.50	1.50	11.86	from 2006 to 2012

Table 1.2.2Number of Rainy Day

Source: PAGASA

Cagayan de Oro station is closest to the construction site so that the number of the rainy day with and over ten millimeter (10mm) precipitation was counted based on the data obtained there.

-	Number of the rainy day with and	
	over ten millimeters (10mm) precipitation:	47 days
-	Ratio of rainy day in a year:	47 / 365 = 0.13

Considering the recent tendency of heavy rainfall and being safe side on the construction planning, the rainfall data at Libuna station was applied in order to estimate the number of day with over fifty millimeters (50mm) rainfall.

- Number of the rainy day with and
- over fifty millimeters (50mm) precipitation: 12 days
- (4) Workable Day for Each Work Item

With the ratio of rainy days in a year, workable day in weekdays was estimated.

- Sundays in a Year: 52 days
- Holidays in a Year: 17 days

Hence, the rainy days on Sundays and the holidays are

 $-(52+17) * 0.13 = 8.97 \sim 9 \text{ days}$ 

Therefore, the total number of weekdays with rainfall over 10mm is at

 $-47 - 9 = 38 \, days$ 

Hence, the total workable day is as shown in Table 1.2.3.

Table 1.2.5 I tumber of workable Day	<b>Table 1.2.3</b>	Number of Workable Day
--------------------------------------	--------------------	------------------------

Work Itom	Sunday	Public	Rainy Days	Additional	Workable
WORK Itelli	Sunday	Holiday	on Weekday	Suspended Day	Day / Year
Structural Excavation	52	17	38	12	246
Dredging	52	17	38	-	258
Embankment/Backfill	52	17	38	12	246
Concrete Works	52	17	38	-	258
Revetment Works	52	17	38	-	258
Drainage Works	52	17	38	12	246
Road Works	52	17	38	12	246

Source: JICA Survey Team

## 1.2.3 Working Hour

Considering the general condition of work in the Philippines, working hour in a day was set at eight (8) hours.

#### 1.2.4 Site Condition

(1) 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 location of the access roads is proposed in Feasibility Study.

## (2) Borrow Area and Quarry

Region X has qualified the material of borrow areas and quarries. The figures of the qualified borrow area and quarries are shown from Figure H1.1 to Figure H1.4 in Annex. Based on those information, candidates of the borrow area for this project were selected as shown in Figure 1.2.1. While Region X generally uses aggregate materials from Tagoloan River Basin, some can be procured from Cagayan de Oro River basin as long as the quality of the material meets the requirement for the construction. Dredged sands may be also used for the sand compaction after clarifying the quality. The selected borrow area and quarries were investigated and the result was summarized in Table H1.1 in Annex.

Material for embankment should show cohesion for imperviousness, shear strength and workability. In order to obtain such material, quality control of the material is important. Before the commencement of the construction, the laboratory experiment should be done for approval of the material from the borrow areas to investigate soil properties such as water contents, particle size analysis, plasticity indexes and so on. During the construction, visual inspection is always recommended in order to get rid of undesired obstacles and water content should be frequently checked and well controlled for the smooth compaction.



Information from Region X, DPWH Figure 1.2.1 Location of Borrow Area and Quarry

## (3) Disposal Area

Disposal area shall be defined by DPWH before the commencement of the construction. Possible disposal areas have been selected as reference. Temporary disposal area will be required for the dredging work with pump, and permanent disposal area will be necessary for dumping the excavated sand and dried dredged soils. Figure 1.2.2 shows the location of those possible disposal areas. The selected possible disposal areas were investigated and the result was summarized from Table H1.2 to Table H1.4 in Annex.







## (4) Drainage

There are several drainage channels discharging into Cagayan de Oro River. Those channels under the newly constructed structures will be improved. The list of the target drainage channels are shown in Table 1.2.4.

Area	Location	Drainage Type	
R2	3+160	double culvert, 3.0 x 3.0 with sluice gate	
	4+030	single culvert, 2.0 x 2.0 with sluice gate	
R3	4+060	only flap gate for dia. 0.6m	
L3	4+360	pipe culvert dia. 0.6m with flap gate	
	4+460	pipe culvert dia. 0.6m with flap gate	
	4+760	pipe culvert dia. 0.6m with flap gate	
	5+580	single culvert, 3.0 x 3.0 with sluice gate	
R4	(retarding basin)	pipe culvert dia. 1.5m with flap gate	
	(retarding basin)	pipe culvert dia. 1.0m with flap gate	
	(retarding basin)	pipe culvert dia. 1.0m with flap gate	
	(retarding basin)	pipe culvert dia. 1.0m with flap gate	
	(retarding basin)	pipe culvert dia. 1.0m with flap gate	
	5+040	double culvert, 3.0 x 3.0 with sluice gate	

 Table 1.2.4
 List of Drainage Improvement

Source: JICA Survey Team

## **1.3** Labor, Equipment and Material

#### 1.3.1 Labor

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

## 1.3.2 Equipment

All necessary equipment can be found in Cagayan de Oro city, surrounding city or in the Philippines.

## 1.3.3 Material

Most of the material can be procured in Cagayan de Oro city, surrounding city or in the Philippines including a concrete sheet pile and a concrete square pile. However, a flap gate made of fiber reinforced plastic and a sluice gate made of steel are not produced in the Philippines. Hence, those materials and related tools will be procured and transported from Japan or the third countries.

## 1.4 Construction Method

## 1.4.1 General

Most of the construction includes concrete work and earth work. Considering the general market in Cagayan de Oro city and surrounding cities, ready mixed concrete is applied in the construction method and cost estimation for river improvement, then procurement of concrete plant was considered for the construction of the dam.

Although the effect of the rainfall is already counted in the workable day calculation, it is ruled that embankment work for river improvement can be performed only in dry season in order to prevent embankment under construction from flushed away unless continuous work for approximately another month can finish the ongoing embankment work. In addition, dredging work on the river water and drainage and hydro mechanic works should be fundamentally performed during dry season. This aspect on dredging work shall be considered in the construction schedule in Feasibility Study. Consideration on the detail effect of steps of works reflecting the dry and wet season shall be considered in a detailed design stage.

## 1.4.2 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. Standard cross sections for those dikes are shown in Figure 1.4.1.





#### Figure 1.4.1 Standard Cross Section of Dike-1(upper) and Dike-2 (lower)

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 Figure 1.4.2.



Source: JICA Survey Team

Figure 1.4.2 Construction Flow of Dike-1 and Dike-2

## 1.4.3 Flood Wall

Flood wall consists of pile foundation, concrete retaining wall, stone masonry, embankment, road pavement, sodding and pedestrian. Standard cross section of the flood wall is presented in Figure 1.4.3.





Figure 1.4.3 Standard Cross Section of Flood Wall

Flow of construction is shown in Figure 1.4.4.



Source: JICA Survey Team

Figure 1.4.4 Construction Flow of Flood Wall

## 1.4.4 Raising Road

Raising Road, similar to a dike, consists of embankment, slope protection with concrete frame and gabion and road pavement. Standard cross section of the raising road is presented in Figure 1.4.5.







Flow of construction is shown in Figure 1.4.6.



Source: JICA Survey Team

Figure 1.4.6 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).

## 1.4.5 Weak Foundation Improvement

Weak foundation area spreads and was found at R2 section, Isla de Oro and Isla Delta areas. Considering the technical, environment and economic view points, the sand compaction pile method is proposed for the weak foundation improvement measures. Initially, casing pipe is installed into the ground with vibrohammer, charging the casing and hopper filled with specified sand materials. Secondary, after being lowered to the desired depth, the casing is retracted in a designed distance such as fifty centimeters (50cm) as the sand materials are released from the tip of casing. Then it was compacted to the desired strength filling sand materials into the pile. The second procedure is repeated until the optimal densification is achieved for the target layer of the foundation.



Figure 1.4.7 Procedure of Sand Compaction Pile Method

## 1.4.6 Maintenance Dredging

In this project, two kind of dredging methods are proposed. One is with dredging pump and the other is with a backhoe dredger.

Flow of work of pump dredging is shown in Figure 1.4.8. 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 at least ten (10) days of spreading in order to have soil dry enough to haul.





Figure 1.4.8 Dredging Flow with Pump

Flow of backhoe dredging is shown in Figure 1.4.9



Source: JICA Survey Team

Figure 1.4.9 Dredging Flow of with Backhoe Barge

#### 1.4.7 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 flash flood.

## 1.4.8 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 Figure 1.4.10. Structures such as dikes and floodwalls can be constructed in the middle or after the following flow.



Source: JICA Survey Team

## Figure 1.4.10 Construction Flow of Drainage and Hydro Mechanic Work

## 1.4.9 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 in the west side of Cagavan de Oro River includes, the demolition of the existing abutment and the existing ramp installation of bored piles, reconstruction of a new abutment, piers, superstructure with girder, embankment and pavement on them. Improvement in the east side is heightening of an approach road. The flow of improvement of the bridge is as shown in Figure 1.4.11. The existing abutment is composed of the bored piles, inverse t-shaped retaining wall, and soil filled in the retaining wall. Demolition of abutment 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 abutment 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 Broja Bridge, which is under construction presently at approximately 460m in the downstream side of Ysalina Bridge will be completed, it is considered that the necessity of temporary bridge is less.



Figure 1.4.11 Improvement Flow of Kagayan Bridge

1.4.10 Dam

The construction mainly includes construction of access road, construction of diversion tunnel, excavation of the foundation and sides of the dam, foundation treatment, concrete works and gate installation. Installation of the hydraulic power equipment is also included here. The existing dam plan shall be reviewed and updated during implementation of feasibility study of dam construction.

1.4.11 Performance of Construction Machines

Work gang and combination of major equipment for work items were selected based on the Detailed Unit Price Analysis (DUPA) which was obtained from Cagayan de Oro First District Engineer's Office, DPWH and Bureau of Construction, DPWH (BOC). Table 1.4.1 shows the combinations of major equipment for major work items and those productivities.

Work Item	Equipment	Productivity	Remarks	
Excavation	Dump Truck (10 m <sup>3</sup> ) Backhoe (0.8 m <sup>3</sup> )	$20 \text{ m}^3$ / hr./ team	Hauling: 7.5km	
Embankment, Road Work	Motorized Road Grader Vibratory Roller (10 MT) (Dump Truck (10 m <sup>3</sup> ))*	$50 \text{ m}^3$ / hr./ team	* Price of material includes hauling cost	
Dredging (Pump)	Bulldozer (140 HT) Backhoe (1.1 m <sup>3</sup> ) Vibratory Roller (12 MT) Pump Dredger (16" dia.) Anchor Boat, House Boat Motorized Road Grader	254 m <sup>3</sup> / hr./ team (Dredging) 85 m <sup>3</sup> / hr./ team (Spreading)	Including spreading at temporary disposal area Productivity was calculated based on the other project in the Philippines.	
Dredging (Backhoe)	Backhoe Barge (3.6 m <sup>3</sup> .) Backhoe (3.3 m <sup>3</sup> ) Deck Barge (600 MT) Tugboat	128 m <sup>3</sup> / hr./ team	Hauling (on water): 1.0km Productivity was calculated considering the cycle time based on Manual on Cost Estimates in Civil Works at Harbor	
Concrete Sheet Pile (Driving)	Crawler Crane (40 MT) Pile Vibratory Hammer	4.5 m / hr./ team	Productivity based on the information from a contractor was applied since the productivity in DUPA is very small	
Concrete Square Pile (Driving)	Crawler Crane (40 MT) Pile Drop Hammer	3.4 m / hr./ team	Productivity based on the information from a contractor was applied since no DUPA is available for the work item.	

 Table 1.4.1
 Combination of Major Equipment and Productivity for Major Work Item

Information from Region X, DPWH

## 1.5 Packaging

The contract packages are assumed to be broken down into five (5) 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=2,149m), Consolation-Poblacion Stretch (R2: L=1,736m)
- Package 2: Construction of Dike and Floodwalls in Balulang Stretch (L4: L=2,181m), Poblacion Stretch (R3: L=325m), 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 = 2,756m)
- Package 4: Improvement of Kagayan Bridge

Long-Term Measures: Dam Construction

Considering the longitudinal location of the structure therefore the priority of the package, Package 1, Package 3 and Package 4 shall be installed firstly and Package 2 shall be done secondly. Then finally, the dam construction term was adjusted at the last part.

## **1.6** Construction Plan

Figure 1.6.1 shows the overall project schedule of the construction plan and Figure 1.6.2 shows the construction plan for river improvement. The construction period of the dam was defined as 7 years referring to the construction period of similar dams in Japan.



Source: JICA Survey Team

Figure 1.6.1 Overall Project Schedule



Source: JICA Survey Team

Figure 1.6.2 Construction Schedule of River Improvement in Master Plan

## **1.7 Basic Conditions of Cost Estimate**

#### 1.7.1 Price Level

The cost estimate is at the price level as of 1<sup>st</sup> of September, 2013.

1.7.2 Exchange Rate

Monthly average exchange rate between Japanese yen and United States Dollars was referred to in the central rate information issued by Bank of Japan. The one between Philippines Pesos and United States Dollars was referred to in the one in International Monetary Fund (IMF). The data issued in IMF was originally from Philippines Central Bank. As the result, the monthly average rate of August, 2013 (1 Philippine Peso = 2.274 Japanese Yen, 1 United States Dollar = 97.43 Japanese Yen, hence, 1 United States Dollar = 43.4 Philippine Pesos) were applied in this project.

1.7.3 Currency for Cost Estimates

The project cost component shall consist of local and foreign currency portions. Philippine Peso shall be used for both the local and foreign currency portions. The classifications of local and foreign currency portions are as given below.

- (1) Local Currency Portion
  - All labor costs
  - A part of cost for construction materials
  - A part of cost for equipment lease
  - Value Added Tax (VAT)
- (2) Foreign Currency Portion
  - A part of cost of construction materials that requires international quality
  - A part of cost for equipment lease and services that requires international quality

The ratio of local currency portion and foreign currency portion was defined referring to the previously JICA funded projects in the Philippines. Those ratios of foreign currency portion are summarized in Table 1.7.1. Referring those information, the ratio for this project was defined and shown in Table 1.7.2.

Item	Agno	Iloilo	Laoag	Pinatubo Bamban Abacan	West Pinatubo	Cavite Lowland
Labor	0	0	0	0	0	0
Equipment	100	70	70	70	70	70
Material						
Fuel	50	-	-	-	-	-
Fuel and Lubricant	-	80	70	80	70	70
Wood/Stone/Sand	-	10	-	-	-	10
Crushed/ Uncrushed Stone Material	-	-	40	40	40	-
Lumber	-	-	40	40	40	-
Cement	65	70	70	70	70	70
Re-bar	65	90	80	80	80	90
Structural Steel	100	90	90	90		90
Chemical Product	-	90	-	-	-	90
Bituminous Material	-	-	-	60	-	-
Others	0	-	-	-	50	-

Table 1.7.1Ratio of Foreign Currency Portion for Labor, Material and Equipment in<br/>Previously JICA Funded Study

Source: JICA Survey Team

Table 1.7.2Ratio of Local and Foreign Currency Portion for Labor,<br/>Material and Equipment

Item	LC Portion	FC Portion
Labor	100	0
Equipment	30	70
Material		
Fuel and Lubricant	20	80
Wood/Stone/Sand	100	0
Crushed/Uncrushed Stone Material	60	40
Lumber	60	40
Cement	30	70
Re-bar	10	90
Structural Steel	10	90
Chemical Product/ Bituminous Material	10	90
Others	100	0

Source: JICA Survey Team

1.7.4 Reference Guidelines and Manuals

The following department orders, memorandum, guidelines and manuals shall be used as references and indicated in the cost estimate.

- DPWH Department Order No. 72, Series of 2012 (Amendment to D.O. 29, Series of 2011 Re: Revised Guidelines on the Preparation of Approved Budget for the Contract)
- DPWH Department Order No. 40, Series of 2009 (Guidelines for the Establishment of Construction Materials Price Data, Standard Labor and Equipment Rental Rates)
- Memorandum from Assistant Secretary for Planning and PPP, Dr. Maria Cabral to Director, Mr. Patrick Gatan dated on 3<sup>rd</sup> of October, 2013

- Manual on Design and Cost Estimates for JICA Preparatory Study, March 2009
- Manual on Cost Estimates in Civil Works, 2012 Ministry of Land, Infrastructure, Transport and Tourism, Japan
- Manual on Cost Estimates in Civil Works at Harbor, 2012, Ministry of Land, Infrastructure, Transport and Tourism, Japan
- Manual on Cost Estimates, Metropolitan Expressway Company Limited, Japan

## **1.8** Methodology of Cost Estimate

Costs for construction works are essentially estimated on the unit price basis referring to DUPA. The main items of the Project Cost are Construction Cost, Consulting Service, Contingency, Administration Cost, Preparation Cost and Value Added Tax (VAT). Composition of the unit price is basically referred to the DUPA.

The composition of the project cost is as described below.

- 1.8.1 Construction Cost
  - (1) Direct Cost

The direct cost consists of a labor cost, a material cost and an equipment cost. Additional one percent (1%) of the estimated direct cost will be usually added as mobilization and demobilization cost in the Philippines. In this project, those cost for mobilization and demobilization was considered to be included in "Preliminary and General" as mentioned in a clause later.

a) Labor Cost

The labor rates shown in DUPA, Region X were used in the analysis.

b) Material Cost

The costs of construction materials and supplies were obtained mostly from Construction material Price Data, Region X,  $1^{st}$  Quarter of 2013 and DUPA.

c) Equipment Cost

The hourly-operated rental rates issued by the Association of Carriers and Equipment Lessors, Inc. (ACEL) through its Equipment Guidebook are presently applied for DPWH projects and compiled in DUPA. Hence, the equipment costs from DUPA were applied for this project.

As for special equipment and machinery, such as a backhoe barge, the operation costs have been estimated based on the information presented by the local suppliers.

(2) Contractor's Indirect Cost

As shown in D.O. No. 72, the indirect cost generally consists of overhead expenses, temporary construction cost and field expense, (explained as "contingencies" in D.O. No. 72), miscellaneous expenses, contractor's profit margin and Value Added Tax (VAT) component. In this project, VAT portion is excluded from this category and separately estimated.

a) Overhead Expense

The overhead expenses are for engineering and administrative cost, transportation allowance, office expense, a premium on Contractor's All Risk Insurance (CARI), financing costs such as premium on bid security and so on. Since the project cost will be far more than 150 million Philippine Pesos, the overhead expenses will be at five percent (5 %) of the estimated direct cost in D.O. No. 72.

b) Temporary Construction Cost and Field Expense

The temporary construction cost and the field expense are for meetings, coordination with other stakeholders, billboards, stages during ground breaking and inauguration ceremonies and other unforeseen events. These costs are estimated at zero point five percent (0.5 %) of the estimated direct cost in D.O. No. 72.

c) Miscellaneous Expense

The miscellaneous expenses are at zero point five percent (0.5 %) of the estimated direct cost. These include laboratory tests for quality control and plan preparation.

d) Contractor's Profit Margin

The contractor's profit margin shall be eight percent (8%) of the estimated direct cost.

e) VAT

VAT component at twelve percent (12%) will be excluded from the indirect cost and calculated separately.

As a result, the ratio of the contractor's indirect cost excluding VAT becomes fourteen percent (14%) of the direct cost.

(3) Preliminary and General

Mainly before the main construction starts, there are several works or issues shall be done or considered. Clearing and grubbing, mobilization and demobilization, construction safety and health, construction of access roads, construction of craneway, geological survey and so on are categorized as "Preliminary and General." This cost was estimated at five percent (5%) of the sum of direct and indirect cost referring to JICA projects in Philippines.

(4) Miscellaneous

Some works which will be required in a detailed design was categorized as "Miscellaneous." Removal of trees, demolition of existing structures in detailed design level, relocation of utilities, installation of road signs and installation of street lamps can be examples in this item and it was estimated at ten percent (10%) of the sum of direct and indirect cost referring to JICA projects in Philippines.

1.8.2 Consulting Service

Consulting Services are for a detailed design and construction supervision by a consultant. There is no rule to define the amount or percentage of consulting service in DPWH. Hence, referring to Implementing Rules and Regulations on the Procurement of Consulting Services for Government Projects, NEDA, October, 1998, the ceiling costs of the consulting services for the detailed design and the construction supervision were set at six percent (6%) and ten percent (10%) of the construction cost, respectively. Hence, the cost for consulting service was estimated meeting with the ceiling price.

In addition, this project offers the consulting service for the capacity building for non-structural measures.

## 1.8.3 Cost for Land Acquisition and Compensation

The cost for land acquisition was calculated with the land value multiplied by its area. The land value is the zonal value available in Bureau of Internal Revenue (BIR) and target area are the directly affected area by the proposed structure and the area in the river.

The compensation cost was obtained as the replacement cost. The replacement cost was calculated considering the several aspects of the existing buildings. The first aspect was the material of the structure that was categorized into 5 types such as wood, concrete and steel. The second aspect was the number of the story. The last aspect was the area of the floor. The four (4) model house with  $2^{nd}$  stories made of four (4) individual materials and the model structure made of steel were proposed and those construction costs were roughly estimated as the unit price for replacement costs. As the result, the replacement cost in Philippine Pesos per square meter for shanty, wooden building semi-concrete building, concrete building and steel structure are 3,600, 9,200, 11,400, 13,500, and 5,000, respectively.

The numbers of the stories of the existing buildings were investigated at site and the areas of the floor of the existing buildings were obtained from the satellite photo. Combining those information, total construction cost of the buildings in the target area was calculated and it is considered as the replacement cost.

		Project Area	River Area	
Iter	n	(Directly	(Indirectly	Total
		Affected)	Affected)	
Land Acquisition	Area $(in m^2)$	316,250	431,046	747,296
Land Acquisition	Cost (in PHP)	736,593,098	1,232,009,838	1,968,602,935
Companyation	Houses	703	499	1202
Compensation	Cost (in PHP)	583,365,521	384,167,524	967,533,044
Total	Cost (in PHP)	1,319,958,618	1,616,177,361	2,936,135,980

 Table 1.8.1
 Summary of Cost for Land Acquisition and Compensation

Source: JICA Survey Team

## 1.8.4 Administration Cost

Administration cost includes expenses to be incurred by the Project Management Office of the Philippine Government from conception until completion of construction works of the Project. In the previous JICA projects, this cost used to be estimated at three point five percent (3.5%) of the sum of the construction cost, engineering service cost and land acquisition and compensation cost referring to the formula in the cost estimation file given by JICA. However, the memorandum issued and circulated in DPWH on 3<sup>rd</sup> of October, 2013 said that project based administration cost can be no longer a part of the project cost. Hence, administration cost was excluded from the project cost.

This cost is for Price Contingency and Physical Contingency.

The price contingency for foreign currency was set at one point three percent (1.3%) and the one for local currency was set at two point one percent (2.1%) referring to the appraisal guideline in JICA.

In JICA's project which aims at developing a loan project, the physical contingency for unforeseen conditions is generally assumed at five percent (5%) of the construction cost, the administration cost, land acquisition and compensation costs, cost for consultation service. However, the memorandum mentioned above set the ceiling price of the sum of the price contingency and the physical contingency at ten percent (10%) of the cost of

civil works and consultancy service combined including the price contingency. Hence, the ten percent (10%) was applied in the project for the total of contingencies which resulted in one point seven percent (1.4%) of the above mentioned costs for the physical contingencies.

## 1.9 Project Cost

## 1.9.1 Project Cost for River Improvement Works

The total project cost of the river improvement works is as shown in Table 1.9.1.

		(Unit:	Million Philip	opines Pesos)
No.	Item	LC	FC	Total
1	River Improvement Works in Lower Reach	781.3	1,035.1	1,816.4
2	River Improvement Works in Upper Reach	627.0	862.4	1,489.3
3	Evacuation Road	106.3	115.3	221.6
4	Improvement of Kagayan Bridge	205.3	381.9	587.2
	Construction Cost	1,719.8	2,394.7	4,114.6
5	Consultation Service	151.0	453.0	604.0
6	Land Acquisition and Compensation	2,936.1	0.0	2,936.1
7	Administration (to be allocated from GOP budget)	0.0	0.0	0.0
8	Price Contingency	209.9	188.9	398.7
9	Physical Contingency	29.1	42.5	71.6
	Tax and Duties (12% of Construction Cost, Engineering			
10	Service, Land Acquisition, Compensation, Price	622.7	0.0	622.7
	Contingency and Physical Contingency)			
Total Cost 5,668.6 3,079.1 8,74				8,747.7

Table 1 9 1	Summary of Project Cost for River Improvement
1able 1.7.1	Summary of Floject Cost for Kiver improvement

Source: JICA Survey Team

#### 1.9.2 Project Cost for Dam Construction

Project cost for dam construction is estimated for following two (2) cases:

- i) Cost for dam construction based on the existing dam plan
- ii) Cost for flood control use on the existing dam plan
- (1) Cost Estimation for Dam Construction Based on the Existing Dam Plan

The dam construction cost is derived from the cost estimation of the feasibility study of the Batang-Bulano Dam project prepared in 1996 taking into consideration of increase of consumable price index from 1996 to 2013. The cost of consulting service for feasibility study, detailed engineering design and construction supervision of the dam are estimated at 3%, 6% and 10% of the civil works and equipment costs, respectively.

Item	Amount (US\$ millions)
Civil Works (incl. Land Acquisition)	137.52
Elec/Mech. Equipment (incl. Transmission)	50.18
Allowance for Resettlement and Environmental Mitigation	2.01

Source: Consultant's Executive Summary on Bulanog Batang Project (1996)

The total project cost of the dam constructions is as shown in Table 1.9.3.

		(Unit:	Million Philip	ppines Pesos)
No.	Item	LC	FC	Total
1	Multi-Purpose Dam Construction	7,778	10,609	18,387
	Construction Cost	7,778	10,609	18,387
2	Consultation Service	1,772	1,722	3,494
3	Land Acquisition and Compensation	197	0	197
4	Administration (to be allocated from GOP budget)	0	0	0
5	Price Contingency	2,956	2,272	5,228
6	Physical Contingency	175	204	380
	Tax and Duties (12% of Construction Cost, Engineering			
7	Service, Land Acquisition, Compensation, Price	3,322	0	3,322
	Contingency and Physical Contingency)			
	Total Cost	16,200	14,807	31,007

Table 1.9.3	Summary of Project Cost for Dam Construction
-------------	--

Source: JICA Survey Team

(2) Cost Estimation for Flood Control Use on the Existing Dam Plan

In the Master Plan, it is proposed that the existing dam plan for hydropower generation (Batang-Bulanog Dam Plan) will be integrated as multipurpose use with flood control to mitigate flood risk in the Cagayan de Oro River basin.

For economic analysis, the cost of integration of the flood control use with the hydropower generation is preliminary estimated referring to the existing dam plan and cost estimation under the following conditions:

- There would be reduction of energy output of the existing dam plan due to flood control use
- The reduction of energy output due to flood control use is estimated based on a reservoir operation rule to keep reservoir water level lower during wet season in order to regulate the 50-year flood scale of dam inflow to the 25-year flood discharge at base station, which requires flood control space of the dam at about 28.8 MCM; it needs lowering HWL by around 11m during wet season as shown in figure below)
- The dam operation is assumed to be commenced from 2031 based on the implementation schedule. The estimated annual reduction of energy output value from 2031 to 2080 can be converted to net present value at 2013 considering the discount rate of 15%. This NPV is considered as required cost of equivalent to the compensation for integration of the flood control use with the hydropower generation.



Figure 1.9.1 Schematic Reservoir Allocation

The preliminary cost estimation is presented below:

i) Reduction of Energy Output

Total	464.1 GWh/year
Secondary Energy (off peak)	37.0 GWh/year
Secondary Energy (on peak)	140.4 GWh/year
Firm Energy	286.7 GWh/year
Existing Dam Plan	

Revised Dam Plan in case of Average Operating Level during wet Season

Total	365.5 GWh/year
12/12 months x 37.7(off peak)	=37.0 GWh/year (whole season)
5/12 months x 140.4(on peak)	=58.5 GWh/year (in dry season)
Secondary Energy	
	=270.0 GWh/year
7/12 months x 286.7x (90%)	=150.5 GWh/year (in wet season)
5/12 months x 286.7x(100%)	=119.5 GWh/year (in dry season)
Firm Energy	

## Reduction of Energy Output due to Securing Flood Control Space : 98.6 GWh/year (=464.1-365.5)

ii) Annual Cost due to Reduction of Energy Output

• Phn 1 617 Mil/year (-98 6 GWh/yr x 16 4/kWh)		
Annual Cost due to Reduction of Energy Output		
nergy output : Php 16.4/kWh		
nergy Output : 98.6 GWh/year		
nergy Output : 98.6 GWh/year		

iii) Net Present Value of Annual Cost

The dam operation is assumed to be commenced from 2031 based on the implementation schedule. Annual cost of Php 1,617 Million from 2031 to 2080 can be converted as Net Present Value (NPV) at 2013 level of Php 1,001 million with discount rate of 15%. This NPV is considered as investment cost to secure flood control space.

## 1.9.3 Operation and Maintenance Cost

The annual operation and maintenance cost for structures was estimated at zero point five percent (0.5%) of the construction cost referring to the other JICA funded projects in the Philippines. The annual operation and maintenance cost for the dam was estimated at one percent (1.0%) of the construction cost referring to the other similar projects.

# CHAPTER 2 CONSTRUCTION PLAN AND COST ESTIMATION FOR FEASIBILITY STUDY

## 2.1 Construction Plan for Feasibility Study

## 2.1.1 Summary of Construction Plan

(1) General Condition

Feasibility Study aims at improvement of the lower reach of Cagayan de Oro River. The target area is stretched from the river mouth to STA. 9+900. The construction plan was proposed in this chapter assuming that all of the necessary procedures should be taken by DPWH, such as land acquisition, compensation and acquisition of right of way and have been completed before the commencement of each construction package.

(2) Scope of Work

The target area for river improvement is stretched from the river mouth of Cagayan de Oro River to STA. 9+900. The distribution of the structures is as shown in Figure 2.1.1. Structures in R1, L2, and the slope protection in the L4 will be constructed by DPWH. Hence, those in L1, R2, R3, L3, R4 and a part of L4 are the target structures in the project.

Since Master Plan Study and Feasibility Study were conducted in parallel in order to facilitate necessary procedure and approval for the Project Implementation, the Scope of Works and quantity of the river improvement project in the Feasibility Study is basically same as the Master Plan.


Source: JICA Survey Team

Figure 2.1.1 Distribution of Target Structure for River Improvement

Main work items in this project are same as the ones in Master Plan except for dam utilization. Main work items are construction of river structures along Cagayan de Oro River, maintenance dredging at lower reach, construction of a retarding basin with related structures, drainage and hydro mechanic work, Kagayan Bridge improvement. In the retarding basin construction, improvement of Arroyo Creek and heightening of the existing road in the basin were added in Feasibility Study.

Length of the major works for improvement of the Cagayan de Oro River in Feasibility Study was summarized in Table 2.1.1.

No.	Major Civil Work	Length (m)
1	River Structure	
1-1	Dike	5,590
1-2	Floodwall	3,845
1-3	Road Dike (Evacuation Road & Road Raising)	2,630
1-4	Floodwall (Dike around Retarding Basin)	940
2.	Maintenance Dredging	-
3.	Retarding Basin	
3-1	Dike along the Arroyo Creek (Existing Drainage)	220
3-2	Floodwall (Road Raising)	1,285
3-3	Slope Protection around Retarding Basin	175
3-4	Spillway	200
4.	Kagayan Bridge Improvement	500

 Table 2.1.1
 Length of Major Work for Improvement of Cagayan de Oro River

Source: JICA Survey Team

#### (3) Quantity of Major Work

The construction of structures above mentioned includes concrete work, concrete pile work, earth work, road work, dredging work, maintenance drainage work and bridge work. The quantity of the major works was summarized in Table 2.1.2.

No.	Major Civil Work	Unit	River Structure	Maintenance Dredging	Retarding Basin	Kagayan Bridge Improvement	Total
1	Excavation	m <sup>3</sup>	37,964	-	255,451	36,170	329,586
2	Embankment	m <sup>3</sup>	509,905	-	44,422	42,999	597,326
3	Concrete	m <sup>3</sup>	33,336	-	12,143	12,257	57,736
4	Reinforcement Bar	kg	2,436,091	-	1,023,756	1,622,953	5,082,800
5	Concrete Sheet Pile	m	123,009	-	26,416	7,542	156,967
6	Concrete Square Pile	m	5,565	-	998	667	7,230
7	Bored Pile	m	0	-	-	1,312	1,312
8	Stone Masonry	m <sup>3</sup>	60,044	-	18,043	18,775	96,862
9	Sodding	$m^2$	48,021	-	-	-	48,021
10	Pre-stressed Concrete Girder (L=35.0m)	nos	0	-	-	40	40
11	Asphalt Pavement	m <sup>2</sup>	78,651	-	10,945	-	89,596
12	Gravel Pavement	m <sup>2</sup>	10,708	-	-	27	10,735
13	PCC Pavement	$m^2$	0	-	-	1,080	1,080
14	Riprap	m <sup>3</sup>	0	-	-	2,645	2,645
15	Maintenance Dredging	m <sup>3</sup>	0	108,491	-	-	108,491
16	Sand Compaction Pile (Total Depth)	m	192,840	-	-	-	192,840
17	Flap Gate	nos	23 (at 21 sites)	-	-	-	23
18	Sluice Gate	nos	7 (at 4 sites)	-	-	-	7

 Table 2.1.2
 Quantity of Major Work

Note: Quantity of the river improvement works in the Master Plan is same as the ones in the Feasibility Study including additional works items.

Source: JICA Survey Team

#### 2.1.2 Condition of Construction Plan

#### (1) Climate Condition and Workable Day

Climate conditions and workable days are as studied in Master Plan. Therefore, the workable days will be as shown in Table 2.1.3.

Work Item	Sunday	Public Holiday	Rainy Days on Weekday	Additional Suspended Day	Workable Day / Year
Structural Excavation	52	17	38	12	246
Dredging	52	17	38	-	258
Embankment/Backfill	52	17	38	12	246
Concrete Works	52	17	38	-	258
Revetment Works	52	17	38	-	258
Drainage Works	52	17	38	12	246
Road Works	52	17	38	12	246

Table 2.1.3	Number o	of Workable	Dav
I UDIC AILIO	1 umber (	or mornable	Duy

Source: JICA Survey Team

- (2) Site Condition
- a) Access Road

The condition of the road around Cagayan de Oro River was studied. There was no significant traffic congestion except for Ysalina Bridge in the morning. Although detailed traffic conditions should be considered in the detailed design stage, the smooth traffic can be mostly expected during the construction. The road conditions are shown in Figure 2.1.2.



Source: JICA Survey Team



Since the most of the construction area do not have roads between Cagayan de Oro River and above mentioned major roads, the access roads along the river and from the major road to the site are required. Table 2.1.4 shows the approximate location and length of the proposed access road. The width of the access road was estimated at ten meters (10 m). Since the inhabited area is highly dense, widening of the existing road was not available. The surface of the access road will be covered with double bituminous surface treatment.

	Left Side		Right Side				
Location with Distance Mark		Length (m)	Location with Distance Mark		Length (m)		
Along H	River (along propose	d structures)					
L3	4+300 - 6+220	1,430	R2	1 + 800 - 4 + 000	1,880		
L4	7+550-10+000	1,370	R3	4+000 - 4+600	240		
L1	0+000-2+100	1,640	R4	4+600 - 9+100	3,760		
Major F	Road to Site (River In	mprovement)		• •			
To	L1 Road	70	1+800		50		
To L1 Road*		130*	2+400		100		
To	L1 Road	160	5+700		100		
To	o L1 Road*	70*	6+000*		250*		
To	L1 Road	70	6+300*		250*		
	4+900	175	6+700*		290*		
	5+700	80	8+300		40		
	6+000	50		8+600	150		
	6+300	130					
	8+500	130					
	9+700*	40*					
	Total*	5,305		Total*	6,320		

Table 2.1.4List of Access Road

Note: \*: Existing roads are used as one way access road and excluded from Total length. Source: JICA Survey Team



Source: JICA Survey Team

Figure 2.1.3 Cross Section of Access Road

b) Borrow Area and Quarry

The borrow areas and quarries selected in Master Plan were also proposed in Feasibility Study.

c) Disposal Area

The disposal areas selected in Master Plan were also proposed in Feasibility Study.

#### d) Drainage

The locations of drainage channels were examined further. The revised list of the target drainage channels are shown in Table 2.1.5.

No	STATION	NAME OF	EXISTING S	<b>FRUCTURES</b>	LOC	LOCATION PROPOSED		DEMADUS		
NO.	STATION	OUTLET	TYPE	Size	Bank	Barangay	Control Type	Outlet Structure Size		KEWIAKK5
1	0+520	Creek-1	Lined Canal	W = 2.00 m	Left	Bonbon	Steel Slide Gate	RCBC	2 - 2.0 x 2.0 m	River Mouth
2	1+100	Creek-2			Left	Bonbon	Steel Slide Gate	RCBC	2 - 2.0 x 2.0 m	River Mouth
3	3+180	DO-1			Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	
4	3+360	DO-2			Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	
5	3+440	DO-3			Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	
6	3+600	DO-4			Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	
7	3+740	DO-5	not e:	xisting	Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	Isla Da Oro Araa
8	3+800	DO-6			Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	Isia De Olo Alea
9	3+880	DO-7			Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	
10	3+940	DO-8			Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	
11	3+990	DO-9			Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	
12	4+060	DO-10			Right	Poblacion	Flap Gate (FRP)	RCPC	0.9 m. dia	
13	4+260	DO-11	RCPC	1.5 m. dia	Right	Poblacion	Flap Gate	RC Headwall		City Hall
14	4+360	DO-12	RCPC	0.9 m. dia	Left	Carmen	Flap Gate (Steel)	RCPC	0.9 m. dia	COA Office
15	4+460	DO-13	RCPC	0.9 m. dia	Left	Carmen	Flap Gate (Steel)	RCPC	0.9 m. dia	Acasia Area
16	4+640	DO-14 (1)			Right	Nazareth	Flap Gate (FRP)	RCPC	1.52 m	
17		DO-14 (2)			Right	Nazareth	Flap Gate (FRP)	RCPC	1.52 m	For Retarding Basin
18		DO-14 (3)	not e:	xisting	Right	Nazareth	Flap Gate (FRP)	RCPC	1.52 m	Drainage
19		DO-14 (4)			Right	Nazareth	Flap Gate (FRP)	RCPC	1.52 m	(Arroyo Creek)
20		DO-14 (5)			Right	Nazareth	Flap Gate (FRP)	RCPC	1.52 m	
21		DO-14 (6)	Existing	g RCBC	Right	Nazareth	Flap Gate (Steel)	RC Headwall	2 - 1.52 m. dia	Arroyo Creek
22	4+760	DO-15	RC Ditch	0.5 x 0.5 m	Left	Carmen	Flap Gate (Steel)	RCPC	0.9 m. dia	
23	5+040	DO-16	Lined Canal	6 x 2 m	Right	Nazareth	Steel Slide Gate	RCBC	2 - 3.0 x 3.0 m	Paseo del Rio
24	5+040	DO-16a	Existing	g RCBC	Right	Nazareth	Flap Gate (Steel)	RC Headwall	2 - 1.52 m. dia	U/S of Retarding Basin
25	5+580	DO-17	Lined Canal	3 x 3 m	Left	Carmen	Steel Slide Gate	RCBC	1 - 3.0 x 3.0 m	Trapezoidal Section

 Table 2.1.5
 List of Drainage Improvement

Source: JICA Survey Team

2.1.3 Labor, Equipment and Material

Conditions for labor, equipment and material in Feasibility Study are the same as the ones in Master Plan.

#### 2.1.4 Construction Method

(1) General

Although the different shapes from Master Plan were newly proposed in Feasibility Study, the types of the structures remain same. Hence, the same construction methods were basically applied for the proposed structures in Feasibility Study.

In the following clause, only the newly proposed ideas for Feasibility Study were presented.

(2) Raising Road

Before the construction of the river structures starts, access roads are installed, except for L1 (Coastal) area. At L1 (Coastal), the existing road is designed to be raised. Since houses have been built along the existing road, it is difficult to acquire the land for the access road along to it. Considering the less traffic on the road, it is proposed that the road is divided into two sides and the construction will be done in one side at a time. To avoid the traffic congestion, the remaining side is kept open for public during the construction. The concept of the construction steps were shown in Figure 2.1.4.



Source: JICA Survey Team

Figure 2.1.4 Concept of Construction Step in L1 (Coastal)

(3) Maintenance Dredging

In Feasibility Study, pump dredging and backhoe dredging were proposed as in Master Plan. Dredging work on the water shall be performed only in dry season.

(4) Retarding Basin

Retarding basin is proposed at the east side of Kagayan Bridge. In addition to the construction plan in Master Plan, road heightening in the basin and improvement of Arroyo Creek was scheduled. Excavation depth was also modified from one meter (1m) and two meters (2m) to one meter (1m) and three meters (3 m). During construction, in order to assure smooth traffic around the retarding basin, the temporary embankment will be constructed along the road from roundabout to South. Construction method for heightening of road is the same as raising road described in Clause 1.4.4.

(5) Drainage and Hydro Mechanic Work

Location for the drainage and hydro mechanic work was reviewed and newly proposed as shown in Table 2.1.5. Those are to be constructed only in the dry season. The construction method is the same as the one in Master Plan.

(6) Improvement of Kagayan Bridge

In addition to the contents of improvement of Kagayan Bridge proposed in Master Plan, heightening of roundabout, the roads from roundabout to North and East were proposed. Construction method for heightening of road is the same as raising road described in Clause 1.4.4.

2.1.5 Packaging of Contract

The project in Feasibility Study 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=2,015 m), Consolation-Poblacion Stretch (R2: L=2,940m)
- Package 2: Construction of Dike and Floodwalls in Balulang Stretch (L4: L=2,280 m), Poblacion Stretch (R3: L=350 m), Poblacion-Nazareth-Macasandig Stretch (R4: L=2,870m) and Construction of Retarding basin
- Package 3: Construction of New Road and Raising Existing Road for Evacuation in Bonbon-Kauswagan stretch (L1: L = 2,630 m)
- Package 4: Improvement of Kagayan Bridge
- 2.1.6 Construction Plan

Figure 2.1.5 shows the construction schedule for river improvement.



Source: JICA Study Team

Figure 2.1.5 Construction Schedule of River Improvement in Feasibility Study

## 2.2 Cost Estimation for Feasibility Study

2.2.1 Basic Conditions of Cost Estimate

All of the basic conditions of cost estimate are the same as the one in Master Plan.

2.2.2 Methodology of Cost Estimate

Methodology of cost estimate is same as the one in Master Plan except for the method for consulting services and operation and maintenance work that was estimated.

2.2.3 Project Cost

The total project cost is as shown in Table 2.2.1.

		(Unit: M	illion Philip	pines Pesos)
No.	Item	LC	FC	Total
1	River Improvement Works in Lower Reach	781.3	1,035.1	1,816.4
2	River Improvement Works in Upper Reach	627.0	862.4	1,489.3
3	Evacuation Road	106.3	115.3	221.6
4	Improvement of Kagayan Bridge	205.3	381.9	587.2
	Construction Cost	1,719.8	2,394.7	4,114.6
5	Consultation Service	151.0	453.0	604.0
6	Land Acquisition and Compensation	2,936.1	0.0	2,936.1
7	Administration (to be allocated from GOP budget)	0.0	0.0	0.0
8	Price Contingency	209.9	188.9	398.7
9	Physical Contingency	29.1	42.5	71.6
	Tax and Duties (12% of Construction Cost,			
10	Engineering Service, Land Acquisition,	622.7	0.0	622.7
	Compensation, Price and Physical Contingencies)			
	Total Cost	5.668.6	3.079.1	8.747.7

Source: JICA Survey Team

## 2.2.4 Operation and Maintenance Cost

The operation and maintenance cost covers the cost for maintenance of the structures, such as the patrol and inspection of the slope protection, embankment and gate and so on. This cost also includes the cost for operation and maintenance of the facility for the management of the project area. The annual operation and maintenance cost is estimated at 0.5% of the direct cost and it becomes 20.6 million Philippines Pesos per year.

For a reference, breakdown of the annual operation and maintenance cost including maintenance dredging cost is preliminary examined as below

 Table 2.2.2
 Operation and Maintenance Costs

Operation and Maintenance Works	Item	Cost (Php/year)
	Personnel Expense of O&M staff	8,100,000
O&M for Rive Structures	Material costs for River structures and Hydro-Mechanical works	8,950,000
	Sub Total	17,050,000
	Personnel Expense of O&M staff	3,450,000
Maintenance Dredging*	Dredging cost	93,636,000
	Sub Total	97,090,000

\*Maintenance dredging cost along river channel will be calculated depend on sediment condition. It is assumed for the quantity of annual dredging to be 162,000m3/year based on the river cross section data between 2012 and 2013.

Source: JICA Survey Team

	Mainu	enance Dred	iging Co	sl		. Т	Unit (Peso
Personnel	Monthly Rate	Quantity	Linit	Amount (Php)	Remarks	Implementa	tion for OM
r ersonner	Working Rate	Quantity	Onic	(Annual Cost)	Renarks	DPWH	City
1. Personnel Expense							
1.1 Government Staff							
Chief	100,000	12	Month	1,200,000	DPWH	1,200,000	
Co-Chief (River Structure & Kagayan Bridge)	70,000	12	Month	840,000	DPWH	840,000	
Co-Chief (Dreading)	70,000	12	Month	840,000	DPWH	840,000	
Co-Chief (Retarding Basin, Drainage & Hydro-mechanical)	70,000	12	Month	840,000	City		840,00
Staff (1)	50,000	12	Month	600,000	DPWH	600,000	
Staff (2)	50,000	12	Month	600,000	DPWH	600,000	
Staff (3)	50,000	12	Month	600,000	DPWH	600,000	
Staff (4)	50,000	12	Month	600,000	DPWH	600,000	
Staff (5)	50,000	12	Month	600,000	City		600,00
Staff (6)	50,000	12	Month	600,000	City		600,00
1.2 Day Worker (10 persons x3 sections x1.0 months x3 time /y	ear)						
Day Worker (x10) (1)	15,000	30	M/M	450,000	DPWH	450,000	
Day Worker (x10) (2)	15,000	30	M/M	450,000	DPWH	450,000	
Day Worker (x10) (3)	15,000	30	M/M	450,000	City		450,00
1.3 Vehicle Operation							
Vehicle (4WD) including driver (1)	80,000	12	Month	960,000	DPWH	960,000	
Vehicle (4WD) including driver (2)	80,000	12	Month	960,000	DPWH	960,000	
Vehicle (4WD) including driver (3)	80,000	12	Month	960,000	City		960,00
	Sub-total (Pers	sonnel Expense)		11,550,000		8,100,000	3,450,00
2. Operation & Maintenance Cost							
2.1 River Structure & Kagayan Bridge			LS	7,843,178	DPWH	7,843,178	
River Structures			LS	7,318,303			
Kagayan Bridge Improvement			LS	524,875			
2.2 Dreading				93,636,000	DPWH	93,636,000	
Dredging with Backhoe			LS	93,636,000	*		
2.3 Drainage & Hydro-mechanical, Retarding Basin			LS	1,106,858	City		1,106,85
Drainage and Hydro Mechanic Works			LS	144,444			
Retarding Basin			LS	962,414			
	Sub-total (A	Annual OM Cost)	-	102,586,036		101,479,178	1,106.85
							, ,,,,,
Grand Total				114,136,036		109,579,178	4,556,85
Grand Total (Rounded)				114,140,000		109,580,000	4,560,00
Note							
<ul> <li>Dredging (Item 2.2) cost along river channel will be calculated depend on se 162,000m3/year based on the river cross section data between 2012 and 20</li> </ul>	ediment condition. It 013.	is assumed for th	e quantity o	f annual dredging to l	be		

# Table 2.2.3 Breakdown of Preliminary Estimation of Operation and Maintenance Cost and Maintenance Dredging Cost

The Preparatory Survey for Flood Risk Management Project for Cagayan de Oro River (FRIMP-CDOR)

	Material cos	as for River structures and Hydro-Mecha	incar works						
	Assumeing the annual operation and maintenance cost as	follows, the annual OM cost shall be as shown in the table below.							
	Desilting and Removal of Debris and Floating Materials	Cost for backhoe to remove materials equivalent to 0.5% of excavated material							
	Gravel (Road) Surfaceing:	Cost for 3.0% of volume (or Area)							
	Masonry, Stone Filling:	Cost for 0.5% of volume							
	Hydromechanic Work:	Cost for 0.5% of base cost (Direct + Indirect) for sluice gate							
	Concrete	Cost for 0.25% of base cost (Direct + Indirect) for concrete work							
	Gabion:	Cost for 0.1% of volume							
	Sodding:	Cost for cutting and moving three times a year							
NL.	Te	Constant	D. C. and J. A.	11.5	<b>T</b>	11.5	Unit Price	Annual Co	ost
NO.	Item	Concept	Referred Amount	Unit	Target amount	Unit	(PHP)	(including indire	ct cost)
	General		-	cu.m.	-	cu.m.	-	-	PHP/year
1	Desilting and Removal of Debris and Floating Materials	(considered to be included in dredging and retarding basin)	-	cu.m.	-	cu.m.	-	-	PHP/year
	River Structures							7,318,303	PHP/year
2	Concrete including Paving Block and Curb	Cost for 0.25% of base cost (Direct + Indirect) for the target works	338,543,907.51	PHP	846,359.77	PHP	-	964,851	PHP/year
3	Stone Masonry	Cost for 0.5% of volume	60,010.25	cu.m.	300.05	cu.m.	3,249.48	1,111,512	PHP/year
4	Gabion	Cost for 0.1% of volume	5,298.03	cu.m.	5.30	cu.m.	2,720.04	16,429	PHP/year
5	Asphalt Pavement	Cost for 3.0% of volume (or Area)	78,651.00	sq. m.	2,359.53	sq. m.	589.19	1,584,854	PHP/year
6	Gravel Pavement	Cost for 3.0% of volume (or Area)	10,708.46	cu.m.	321.25	cu.m.	889.80	325,870	PHP/year
7	Sodding	Cost for cutting and moving three times a year	48,020.59	sq.m.	144,061.77	sq.m.	19.34	3,176,897	PHP/year
8	Concrete Sheet Pile	(Cost for 0.25% of base cost (Direct + Indirect) for the target works, for only 1m from capping in height)	435,439,211.49	PHP	120,955.34	PHP	-	137,890	PHP/year
	Dredging							7 156 797	PHP/ve or
	Dredging	Cost for dradging with Paalchoa at the amount of 10.00% of total dradging						7,156,797	PHP/year
9	Dredging Dredging with Backhoe	Cost for dredging with Backhoe at the amout of 10.0% of total dredging	108,491.00	cu.m.	10,849.10	cu.m.	578.66	<b>7,156,797</b> 7,156,797	<b>PHP/year</b> PHP/year
9	Dredging Dredging with Backhoe	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume	108,491.00	cu.m.	10,849.10	cu.m.	578.66	<b>7,156,797</b> 7,156,797	<b>PHP/year</b> PHP/year
9	Dredging Dredging with Backhoe Retarding Basin	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume	108,491.00	cu.m.	10,849.10	cu.m.	578.66	7,156,797 7,156,797 26,543,468	PHP/year PHP/year PHP/year
9	Dredging Dredging with Backhoe Retarding Basin Ecavation of Retarding Basin	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two	108,491.00	cu.m. sq.m.	61,750.00	cu.m.	578.66	7,156,797 7,156,797 26,543,468 25,581,054	PHP/year PHP/year PHP/year PHP/year
9	Dredging Dredging with Backhoe Retarding Basin Ecavation of Retarding Basin	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year.	108,491.00 247,000.00	cu.m. sq.m.	61,750.00	cu.m.	578.66 363.39	7,156,797 7,156,797 26,543,468 25,581,054	PHP/year PHP/year PHP/year PHP/year
9 10 11	Dredging Dredging with Backhoe Retarding Basin Ecavation of Retarding Basin Concrete including Paving Block and Curb	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year Cost for 0.25% of base cost (Direct + Indirect) for concrete work	108,491.00 247,000.00 133,067,305.11	cu.m. sq.m. PHP	10,849.10 61,750.00 332,668.26	cu.m. cu.m. PHP	578.66 363.39	7,156,797 7,156,797 26,543,468 25,581,054 379,242	PHP/year PHP/year PHP/year PHP/year
9 10 11 12	Dredging Dredging with Backhoe Retarding Basin Ecavation of Retarding Basin Concrete including Paving Block and Curb Stone Masoury	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.5% of volume	108,491.00 247,000.00 133,067,305.11 19,577.95	cu.m. sq.m. PHP cu.m.	10,849.10 61,750.00 332,668.26 97.89	cu.m. cu.m. PHP cu.m.	578.66 363.39 - 3,249.48 500.10	7,156,797 7,156,797 26,543,468 25,581,054 379,242 362,624 202,519	PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year
9 10 11 12 13	Dredging Dredging with Backhoe Retarding Basin Ecavation of Retarding Basin Concrete including Paving Block and Curb Stone Masonry Asphalt Pavement Concreteing Paving Block and Curb	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.5% of volume Cost for 3.0% of volume (or Area)	108,491.00 247,000.00 133,067,305.11 19,577.95 10,945.06	cu.m. sq.m. PHP cu.m. sq. m.	10,849.10 61,750.00 332,668.26 97.89 328.35	cu.m. cu.m. PHP cu.m. sq. m.	578.66 363.39 - 3,249.48 589.19	7,156,797 7,156,797 26,543,468 25,581,054 379,242 362,624 220,548	PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year
9 10 11 12 13 14	Dredging Dredging with Backhoe Retarding Basin Ecavation of Retarding Basin Concrete including Paving Block and Curb Stone Masonry Asphalt Pavement Concrete Sheet Pile	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.5% of volume Cost for 3.0% of volume (or Area) under structures	108,491.00 247,000.00 133,067,305.11 19,577.95 10,945.06	cu.m. sq.m. PHP cu.m. sq. m. PHP	10,849.10 61,750.00 332,668.26 97.89 328.35	cu.m. cu.m. PHP cu.m. sq. m. PHP	578.66 363.39 - 3,249.48 589.19 -	7,156,797 7,156,797 26,543,468 25,581,054 379,242 362,624 220,548 0	PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year
9 10 11 12 13 14	Dredging Dredging with Backhoe Retarding Basin Ecavation of Retarding Basin Concrete including Paving Block and Curb Stone Masonry Asphal Pavement Concrete Sheet Pile Desingers and Huden Machania Works	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.5% of volume Cost for 3.0% of volume (or Area) under structures	108,491.00 247,000.00 133,067,305.11 19,577.95 10,945.06	cu.m. sq.m. PHP cu.m. sq. m. PHP	10,849.10 61,750.00 332,668.26 97.89 328.35 -	cu.m. cu.m. PHP cu.m. sq. m. PHP	578.66 363.39 - 3,249.48 589.19 -	7,156,797 7,156,797 26,543,468 25,581,054 379,242 362,624 220,548 0	PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year
9 10 11 12 13 14	Dredging Dredging with Backhoe Retarding Basin Ecavation of Retarding Basin Concrete including Paving Block and Curb Stone Masonry Asphalt Pavement Concrete Sheet Pile Drainage and Hydro Mechanic Works Concrete	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.5% of volume Cost for 3.0% of volume (or Area) under structures	108,491.00 247,000.00 133,067,305.11 19,577.95 10,945.06	cu.m. sq.m. PHP cu.m. sq. m. PHP	10,849.10 61,750.00 332,668.26 97.89 328.35 -	cu.m. cu.m. PHP cu.m. sq. m. PHP	578.66 363.39 - 3,249.48 589.19 -	7,156,797 7,156,797 26,543,468 25,581,054 379,242 362,624 220,548 0 144,444 44771	PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year
9 10 11 12 13 14 15	Dredging Dredging with Backhoe Retarding Basin Ecavation of Retarding Basin Concrete including Paving Block and Curb Stone Masoury Asphalt Pavement Concrete Sheet Pile Drainage and Hydro Mechanic Works Concrete Stone Masoury	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.5% of volume Cost for 3.0% of volume (or Area) under structures Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work	108,491.00 247,000.00 133,067,305.11 19,577.95 10,945.06 - 15,709,027.71	cu.m. sq.m. PHP cu.m. sq. m. PHP PHP	10,849.10 61,750.00 332,668.26 97.89 328.35 - - - - - - - - - - - - - - - - - - -	cu.m. PHP cu.m. sq. m. PHP	578.66 363.39 - 3,249.48 589.19 -	7,156,797 7,156,797 26,543,468 25,581,054 379,242 362,624 220,548 0 0 144,444 44,771 881	PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year
9 10 11 12 13 14 15 16 17	Dredging Dredging with Backhoe Retarding Basin Ecavation of Retarding Basin Concrete including Paving Block and Curb Stone Masonry Asphalt Pavement Concrete Sheet Pile Drainage and Hydro Mechanic Works Concrete Stone Masonry Matress	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of volume Cost for 3.0% of volume (or Area) under structures Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of volume Cost for 0.25% of volume Cost for 0.1% of volume	108,491.00 247,000.00 133,067,305.11 19,577.95 10,945.06 	cu.m. sq.m. PHP cu.m. sq. m. PHP PHP cu.m.	10,849.10 61,750.00 332,668.26 97.89 328.35 	cu.m. PHP cu.m. sq. m. PHP PHP	578.66 363.39 - 3,249.48 589.19 - - - - 3,249.48 2,609.24	7,156,797 7,156,797 26,543,468 25,581,054 379,242 362,624 220,548 0 144,444 44,771 881	PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year
9 10 11 12 13 14 15 16 17 18	Dredging Dredging with Backhoe Retarding Basin Ecavation of Retarding Basin Concrete including Paving Block and Curb Stone Masonry Asphalt Pavement Concrete Sheet Pile Drainage and Hydro Mechanic Works Concrete Stone Masonry Matress Handrail	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.5% of volume Cost for 0.30% of volume (or Area) under structures Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.5% of volume Cost for 0.5% of volume Cost for 0.5% of volume	108,491.00 247,000.00 133,067,305.11 19,577.95 10,945.06 - - - 15,709,027.71 47.55 57.00	cu.m. sq.m. PHP cu.m. sq. m. PHP PHP cu.m. cu.m. pHP	10,849.10 61,750.00 332,668.26 97,89 328.35 	cu.m. PHP cu.m. sq.m. PHP PHP cu.m. cu.m. PHP	578.66 578.66 363.39 - - 589.19 - - 3,249.48 2,669.24	7,156,797 7,156,797 26,543,468 25,581,054 379,242 362,624 220,548 0 144,444 44,771 881 170 552	PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year
9 10 11 12 13 14 15 16 17 18 19	Dredging Dredging with Backhoe Retarding Basin Ecavation of Retarding Basin Concrete including Paving Block and Curb Stone Masonry Asphalt Pavement Concrete Sheet Pile Drainage and Hydro Mechanic Works Concrete Stone Masonry Matress Handrail Steel Gate	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of volume (or Area) under structures Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.5% of volume Cost for 0.1% of volume Cost for 0.1% of volume Cost for 0.25% of base cost (Direct + Indirect) for the target work Cost for 0.25% of base cost (Direct + Indirect) for the target work	108,491.00 247,000.00 133,067,305.11 19,577.95 10,945.06 	cu.m. sq.m. PHP cu.m. sq. m. PHP PHP cu.m. cu.m. cu.m. PHP	10,849.10 61,750.00 332,668.26 97.89 328.35 	cu.m. PHP cu.m. sq. m. PHP PHP cu.m. cu.m. pHP PHP	578.66 363.39  3,249.48 589.19  3,249.48 2,609.24 	7,156,797 7,156,797 26,543,468 25,581,054 379,242 362,624 220,548 0 144,444 44,771 881 170 562 84 326	PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year
9 10 11 12 13 14 15 16 17 18 19 20	Dredging Dredging with Backhoe Retarding Basin Ecavation of Retarding Basin Concrete including Paving Block and Curb Stone Masonry Asphalt Pavement Concrete Sheet Pile Drainage and Hydro Mechanic Works Concrete Stone Masonry Matress Handrail Steel Gate Flan Gate Flan Gate	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 3.0% of volume Cost for 3.0% of volume (or Area) under structures Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for the target work Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.1% of base cost (Direct + Indirect) for shice gate Cost for 0.1% of base cost (Direct + Indirect) for shice gate	108,491.00 247,000.00 133,067,305.11 19,577.95 10,945.06 15,709,027.71 47.55 57.00 197,051.98 14,793,958.08 12 044 753.40	cu.m. sq.m. PHP cu.m. sq. m. PHP PHP cu.m. cu.m. PHP PHP PHP	10,849.10 61,750.00 332,668.26 97.89 332,855 39,272.57 0.24 0.06 492.63 73,969.79 12 (047 25	cu.m. pHP cu.m. sq.m. pHP PHP cu.m. cu.m. PHP PHP PHP	578.66 363.39 3,249.48 589.19 3,249.48 2,609.24	7,156,797 7,156,797 26,543,468 25,581,054 379,242 362,624 220,548 0 144,444 44,771 881 170 562 84,326 13,744	PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year
9 10 11 12 13 14 15 16 17 18 19 20	Dredging Dredging with Backhoe Retarding Basin Ecavation of Retarding Basin Concrete including Paving Block and Curb Stone Masonry Asphalt Pavement Concrete Sheet Pile Drainage and Hydro Mechanic Works Concrete Stone Masonry Matress Handrail Steel Gate Flap Gate	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.5% of volume Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of volume Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.1% of base cost (Direct + Indirect) for shice gate Cost for 0.1% of base cost (Direct + Indirect) for shice gate	108,491.00 247,000.00 133,067,305.11 19,577.95 10,945.06 	cu.m. PHP cu.m. sq.m. PHP PHP Cu.m. cu.m. PHP PHP PHP	10,849.10 61,750.00 332,668.26 97.89 328.35 - - - - - - - - - - - - - - - - - - -	cu.m. PHP cu.m. Sq. m. PHP PHP Cu.m. cu.m. PHP PHP PHP PHP	578.66 363.39 3.249.48 589.19 3.249.48 2,609.24	7,156,797 7,156,797 26,543,468 25,581,054 379,242 362,624 220,548 0 0 144,444 44,771 881 170 562 84,326 13,734	PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year
9 10 11 12 13 14 15 16 17 18 19 20	Dredging Dredging with Backhoe Retarding Basin Ecavation of Retarding Basin Concrete including Paving Block and Curb Stone Masonry Asphalt Pavement Concrete Sheet Pile Drainage and Hydro Mechanic Works Concrete Stone Masonry Matress Handrail Steel Gate Flap Gate Kagayan Bridge Improvement	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.5% of volume Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for the target work Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for shice gate	108,491.00 247,000.00 133,067,305.11 19,577.95 10,945.06 - - 15,709,027.71 47.55 57.00 197,051.98 14,793,958.08 12,047,253.40	cu.m. sq.m. PHP cu.m. Sq.m. PHP PHP PHP PHP PHP	10,849.10 61,750.00 332,668.26 97.89 328.35 - - - - - - - - - - - - - - - - - - -	cu.m. PHP cu.m. Sq. m. PHP PHP cu.m. cu.m. PHP PHP PHP	578.66 363.39 - 3,249.48 589.19 - 3,249.48 2,609.24 - - -	7,156,797 7,156,797 26,543,468 25,581,054 379,242 362,624 220,548 0 144,444 44,771 881 170 562 84,326 13,734	PHP/year           PHP/year
9 10 11 12 13 14 15 16 17 18 19 20 21	Dredging Dredging with Backhoe Retarding Basin Ecavation of Retarding Basin Concrete including Paving Block and Curb Stome Masonry Asphalt Pavement Concrete Sheet Pile Drainage and Hydro Mechanic Works Concrete Stone Masonry Matress Handrail Steel Gate Flap Gate Kagayan Bridge Improvement Concrete Concrete	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.5% of volume Cost for 0.30% of volume (or Area) under structures Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for the target work Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.1% of base cost (Direct + Indirect) for shice gate Cost for 0.1% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for shice gate	108,491.00 247,000.00 133,067,305.11 19,577.95 10,945.06 	cu.m. sq.m. PHP cu.m. sq. m. PHP PHP PHP PHP PHP	10,849.10 61,750.00 332,668.26 97.89 328.35 39,272.57 0.24 0.06 492.63 73,969.79 12,047.25	cu.m. PHP cu.m. sq.m. PHP PHP PHP PHP PHP PHP	578.66 363.39 3,249.48 589.19 3,249.48 2,609.24	7,156,797 7,156,797 26,543,468 25,581,054 379,242 362,624 220,548 0 144,444 44,771 881 170 562 84,326 13,734 524,875 483,370	PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year
9 10 11 12 13 14 15 16 17 18 19 20 21 22	Dredging Dredging with Backhoe  Retarding Basin Ecavation of Retarding Basin Concrete including Paving Block and Curb Stone Masonry Asphal Pavement Concrete Sheet Pile Drainage and Hydro Mechanic Works Concrete Stone Masonry Matress Handrail Steel Gate Flap Gate Kagayan Bridge Improvement Concrete Grouted Riorap	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of volume (or Area) under structures Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for the target work Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.1% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.	108,491.00 247,000.00 133,067,305.11 19,577.95 10,945.06 - - - 15,709,027.71 47.55 57.00 197,051.98 14,793,958.08 14,994,943,40 14,793,958.08 14,793,958.08 14,794,944,54 14,794,944,54 14,944,5414,944,54 14,944,544,54 14,944,544,544,544,544,544,544,544,544,54	cu.m. sq.m. PHP cu.m. sq.m. PHP PHP PHP PHP PHP PHP PHP PHP	10,849.10 61,750.00 332,668.26 97.89 3328.35 39,272.57 0.24 0.06 492.63 73,969.79 12,047.25 424,008.55 13,22	cu.m. PHP cu.m. PHP Cu.m. PHP PHP PHP PHP	578.66 363.39  3,249.48 589.19  3,249.48 2,609.24         	7,156,797 7,156,797 26,543,468 25,581,054 379,242 362,624 220,548 0 144,444 44,771 881 170 562 84,326 13,734 524,875 483,370 41,204	PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year
9 10 11 12 13 14 15 16 17 18 19 20 21 22 23	Dredging Dredging with Backhoe  Retarding Basin Ecavation of Retarding Basin Concrete including Paving Block and Curb Stone Masonry Asphalt Pavement Concrete Sheet Pile Drainage and Hydro Mechanic Works Concrete Stone Masonry Matress Handrail Steel Gate Flap Gate Kagayan Bridge Improvement Concrete Grouted Riprap Mattress	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 3.0% of volume Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for the target work Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.1% of base cost (Direct + Indirect) for shice gate Cost for 0.1% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for shice gate Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.1% of volume Cost for 0.1% of vo	108,491.00 247,000.00 133,067,305.11 19,577.95 10,945.06 15,709,027.71 47.55 57.00 197,051.98 14,793,958.08 12,047,253.40 169,603,420.55 2,644.54 101.13	Cu.m. sq.m. PHP cu.m. sq.m. PHP PHP PHP PHP PHP PHP PHP PHP Cu.m.	10,849.10 61,750.00 332,668.26 97.89 328.35 39,272.57 0.24 0.06 492.63 73,969.79 12,047.25 424,008.55 13.22 0.10	cu.m. PHP cu.m. sq.m. PHP PHP PHP PHP PHP PHP	578.66 363.39 3,249.48 589.19	7,156,797 7,156,797 26,543,468 25,581,054 379,242 362,624 220,548 0 144,444 44,771 881 170 562 84,326 13,734 524,875 483,370 41,204 301	PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year
9 10 11 12 13 14 15 16 17 18 19 20 21 22 23	Dredging Dredging with Backhoe Retarding Basin Ecavation of Retarding Basin Concrete including Paving Block and Curb Stone Masonry Asphalt Pavement Concrete Sheet Pile Drainage and Hydro Mechanic Works Concrete Stone Masonry Matress Handrail Steel Gate Flap Gate Kagayan Bridge Improvement Concrete Grouted Riprap Mattress	Cost for dredging with Backhoe at the amout of 10.0% of total dredging volume Cost for excavating retarding basin, 50cm thickness for all area, once two year Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.5% of volume Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for sluce gate Cost for 0.1% of base cost (Direct + Indirect) for sluce gate Cost for 0.1% of base cost (Direct + Indirect) for sluce gate Cost for 0.25% of base cost (Direct + Indirect) for sluce gate Cost for 0.25% of base cost (Direct + Indirect) for sluce gate Cost for 0.25% of base cost (Direct + Indirect) for sluce gate Cost for 0.25% of base cost (Direct + Indirect) for sluce gate Cost for 0.25% of base cost (Direct + Indirect) for sluce gate Cost for 0.25% of base cost (Direct + Indirect) for sluce gate Cost for 0.25% of base cost (Direct + Indirect) for sluce gate Cost for 0.25% of base cost (Direct + Indirect) for sluce gate Cost for 0.25% of base cost (Direct + Indirect) for sluce gate Cost for 0.25% of base cost (Direct + Indirect) for sluce gate Cost for 0.25% of base cost (Direct + Indirect) for sluce gate Cost for 0.25% of base cost (Direct + Indirect) for sluce gate Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete work Cost for 0.25% of base cost (Direct + Indirect) for concrete wo	108,491.00 247,000.00 133,067,305.11 19,577.95 10,945.06 - - - 15,709,027.71 47.55 57.00 197,051.98 14,793,958.08 12,047,253.40 - 169,603,420.55 2,644.54 101.13	Cu.m. sq.m. PHP cu.m. sq. m. PHP Cu.m. Cu.m. PHP PHP PHP PHP PHP Cu.m. Cu.m.	10,849.10 61,750.00 332,668.26 97.89 328.35 - - - - - - - - - - - - - - - - - - -	cu.m. PHP cu.m. sq. m. PHP PHP Cu.m. Cu.m. PHP PHP PHP PHP PHP Cu.m. cu.m.	578.66 363.39 3,249.48 589.19 3,249.48 2,609.24	7,156,797 7,156,797 26,543,468 25,581,054 379,242 362,624 220,548 0 0 144,444 44,771 881 170 562 84,326 13,734 524,875 483,370 41,204 301	PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year PHP/year

# Table 2.2.4Breakdown of Preliminary Estimation of Operation and Maintenance Cost for<br/>Material costs for River structures and Hydro-Mechanical works

Source: JICA Survey Team

# Supporting Report Appendix I Study on Non-Structural Measures

#### PREPARATORY SURVEY FOR FLOOD RISK MANAGEMENT PROJECT FOR CAGAYAN DE ORO RIVER (FRIMP-CDOR) IN THE REPUBLIC OF THE PHILIPPINES

# FINAL REPORT

# VOLUME III SUPPORTING REPORT (II)

# Appendix I NON-STRUCTURAL MEASURES

## **Table of Contents**

CHAPTE	R1 IN	TRODUCTION OF THE WORKS	I-1
1.1	Task of t	the Works	I-1
1.2	Major N	on-Structural Measures and Flow of Study	I-2
CHAPTE	R 2 MA	STUDY ON NON-STRUCTURAL MEASURES (FLOOD NAGEMENT)	I-5
2.1	Assessm Task 1-2	ent of Existing Non-Structural Measures (Flood Management): ICR	I-5
	2.1.1	Philippine Government's Non-Structural Measures for Flood Mitigation	I-5
	2.1.2	Assessment of Existing Non-Structural Measures on Flood Management in the Cagayan de Oro River Basin	I-7
2.2	Formula	tion of Non-Structural Measures (Flood Management): ICR Task 2-11	. I-19
	2.2.1	Basic Approach	. I-19
	2.2.2	Questionnaire Survey for Barangays in the CDO City Flooded by TS Sendong	. I-20
	2.2.3	Interview and Questionnaire Surveys for DRRMCs in the CDO River Basin	. I-21
	2.2.4	FFWS in the CDO River Basin	. I-42
	2.2.5	5-Year DRRM Plan (2013-2017) of the CDO City	. I-44
	2.2.6	MOA signed by Bukidnon province, 3 Municipalities of Bukidnon, (Talakag, Libona and Baungon), CDO City and Iligan City	. I-46
	2.2.7	Non-Structural Measures required for Each Area and Agencies concerned	. I-46
CHAPTE	R 3 FOI TAS	RMULATION OF MASTER PLAN (FLOOD MANAGEMENT): ICR SK 2-12	. I-47
3.1	Non-Stru	uctural Measures (Flood Management)	. I-47
3.2	Impleme	entation Plan (Flood Management)	. I-48
	3.2.1	Reinforcement of DRRMCs	. I-48

	3.2.2	Preparation of Contingency Plan and DRRMP, which includes Preparation/Update of Flood Hazard Map, Evacuation Planning, etc	I-49
	3.2.3	FFWS	I-50
	3.2.4	Community Based Flood Early Warning System (CBFEWS)	I-50
	3.2.5	Information, Education and Communication (IEC)	I-51
	3.2.6	Land Use Regulation for Flood Plain	I-52
CHAPTE	R 4 SEL ME	ECTION OF PRIORITY PROJECTS (NON-STRUCTURAL ASURES): ICR TASK 2-13	I-53
4.1	Priority I	Projects	I-53
	4.1.1	Reinforcement of DRRMCs	I-53
	4.1.2	Preparation of Contingency Plan and DRRMP, which includes Preparation/Update of Flood Hazard Map, Evacuation Planning, etc	I-53
	4.1.3	FFWS	I-54
	4.1.4	Community Based Flood Early Warning System (CBFEWS)	I-54
	4.1.5	Information, Education and Communication (IEC)	I-54
	4.1.6	Land Use Regulation for Flood Plain	I-54
4.2	Scoping	for the Project (Non-Structural Measures): ICR Task 2-15	I-54
	4.2.1	Preparation/Update of Flood Hazard Map, Evacuation Planning	I-55
	4.2.2	FFWS	I-55
	4.2.3	Community Based Flood Early Warning System (CBFEWS)	I-55
	4.2.4	Information Campaign and Publicity for the Project (Structural Measures)	I-55
	4.2.5	Technical Assistance for Land Use Regulation for Habitual Inundation Areas	I-56
CHAPTE	R 5 STU MA	JDY ON NON-STRUCTURAL MEASURES (WATERSHED NAGEMENT)	I-57
5.1	Ass Rive	essment of Land Classification and Forest Distribution in the CDO er Basin: ICR Task 1-2 & 2-10	I-57
	5.1.1	Land Classification on Forestlands and Alienable & Disposal (A&D) Lands	I-57
	5.1.2	Land uses in the CDO River Basin	I-58
	5.1.3	Vegetative Cover in the CDO River Basin	I-60
	5.1.4	Transition of the Forest Cover in the CDO River Basin	I-62
	5.1.3	Transition of the Forest Cover and Floods in the Lower Portion of CDO River Basin	I-64
5.2	Assessm ICR Tasl	ent of Existing Non-Structural Measures (Watershed Management): x 1-2 & 2-10	I-65
	5.2.1	Organization Structures for the Watershed Management for the CDO River Basin	I-65
	5.2.2	Watershed Management Plans for the CDO River Basin	I-66
	5.2.3	Watershed Management-related Activities in CDO River Basin	<b>I-</b> 71
5.3	Formulat 2-11	tion of Non-Structural Measures (Watershed Management): ICR Task	I-77
	5.3.1	Consideration on the Watershed Management Activities in the CDO River Basin	I-77

	5.3.2	Composition of the Proposed Plan (Watershed Management)	. I-79
5.4	Scoping	for the Project (Watershed Management): ICR Task 2-15	. I-81
	5.4.1	Proposed Activities as the Japanese Yen Loan Project	. I-81
	5.4.2	Profiles of the Proposed Activities	. I-82
	5.4.3	Recommendations on the Watershed Management to DPWH, DENR and LGUs from the JICA Survey Team	. I-84
CHAPTE	R 6 IMI JIC	PLEMENTATION SCHEDULE AND CONSULTANT'S TOR FOR A LOAN PROJECT (FEASIBILITY STUDY): ICR TASK 3-1	. I-86

# List of Tables (Appendix)

Table 2.1.1	Annual Investment Plan for DRRM in 2013 for CDO City I-10
Table 2.1.2	Annual Investment Plan for DRRM in 2013 for Municipality of Talakag in Bukidnon
Table 2.1.3	Annual Investment Plan for DRRM in 2013 for Municipality of Baungon in Bukidnon
Table 2.1.4	Annual Investment Plan for DRRM in 2013 for Municipality of Libona in Bukidnon
Table 2.1.5	Comprehensive Land Use Plans (CLUPs) for Cagayan de Oro River Basin I-15
Table 2.2.1	Results of Questionnaire and Interview Surveys (DRRMC Readiness and DRRM Fund)I-24
Table 2.2.2	Results of Questionnaire and Interview Surveys (CBFEWS, Trainings on DRRM)I-27
Table 2.2.3	Results of Questionnaire and Interview Surveys (Activities during TS Sendong and TY Pablo)
Table 2.2.4	Results of Questionnaire and Interview Surveys (Existing Evacuation Center)
Table 2.2.5	Current Situation/Problems and Measures considered as Necessary for the Four (4) Aspects (Flood Management) I-39
Table 2.2.6	Summary of Budgetary Requirements for 5-Year DRRMP of CDO City (2013-2017)
Table 2.2.7	Non-Structural Measures required for Each Area and Agencies Concerned (Flood Management) I-46
Table 3.1.1	Implementation Plan (Flood Management) for the CDO River Basin (Flood Management)
Table 3.2.1	Rainfall Intensity Classification I-51
Table 4.2.1	Non-Structural Measures proposed for JICA Loan I-56
Table 5.1.1	Distribution of the Forestlands and Alienable & Disposal (A&D) Lands in the CDO River Basin per LGUs
Table 5.1.2	Distribution of the Land Use in the CDO River Basin I-60
Table 5.1.3	Distribution of the Vegetative Cover in the CDO River Basin I-60
Table 5.1.4	Transition of the forest areas between 1900s and 1990s of the Country, and in Mindanao Island and inside the CDO River Basin, based on the Existing Documents Analyses
Table 5.2.1	List of Contents in the Terms of Reference (TOR) for the Integrated River

	Basin Management and Development Master Plan, prepared by RBCO-DENR	I-67
Table 5.2.2	Activities related to the Watershed Management planned in CDRRMP 2013-2020	I-71
Table 5.2.3	CBFMA areas inside the CDO River Basin as of March 2013	I-73
Table 5.2.4	Target and Accomplishment of National Greening Program (NGP), inside the Cagayan de Oro River Basin	I-73
Table 5.2.5	Watershed Management Activities conducted by DENR Region X, as the Recommendation by CDORBMC	I-74
Table 5.2.6	Watershed Management Activities conducted by CLENRO inside the CDO River Basin	I-75
Table 5.2.7	Watershed Management Activities conducted by BENRO/MENRO in Bukidnon Province inside the CDO River Basin	I-75
Table 5.2.8	Conservation Activities conducted by APO of CDO City inside the CDO River Basin	I-76
Table 5.3.1	Current Status and Constraints, Necessary Measures and Present Implementation Status on the Watershed Management inside the CDO River Basin	I-77
Table 5.3.2	Implementation Plan (Watershed Management) for the CDO River Basin	I-79
Table 5.4.1	Non-Structural Measures proposed for JICA Loan on the Watershed Management	I-84
Table 6.1.1	TOR of the Consultant	I-86

# List of Figures (Appendix)

Figure 2.1.1	Organizational Structure of DRRMCs and Concerned Agencies I-7
Figure 2.1.2	Flood Inundation Map of the CDO City (TS Sendong) I-14
Figure 2.2.1	Flood Management Cycle I-19
Figure 2.2.2	Locations of the Barangays for Questionnaire Survey for Barangays Flooded by TS Sendong, conducted in September, 2012 I-20
Figure 2.2.3	Locations of Barangays seriously damaged by TS Sendong in the Upper Watershed of Cagayan de Oro River Basin
Figure 2.2.4	Track of TS Sendong I-23
Figure 2.2.5	Track of TY Pablo I-23
Figure 2.2.6	Location of Designated Evacuation Centers in Cagayan de Oro City I-35
Figure 2.2.7	Location of Designated Evacuation Centers in Municipality of Baungon I-36
Figure 2.2.8	Location of Designated Evacuation Centers in Municipality of Libona I-37
Figure 2.2.9	Location of Designated Evacuation Centers in Municipality of Talakag I-38
Figure 2.2.10	Location Map of Existing Rainfall and River Water Level Stations and those preliminary planned additionally for the CDO River Basin
Figure 5.1.1	Land Classification on the Forestlands and Alienable & Disposal Lands in the CDO River Basin
Figure 5.1.2	Land Use Map of the CDO River Basin I-59
Figure 5.1.3	Vegetative Cover Map of the CDO River Basin I-61
Figure 5.1.4	Transition of the forest areas between 1900s and 1990s in Mindanao Island and inside the CDO River Basin

Figure 5.1.5	Transition of the Forest Areas inside CDO River Basin and Period of Destructive Tropical Cyclones which hit the Northern Mindanao	I-64
Figure 5.2.1	Location Map on the Watershed Management-related Activities by DENR Region X in the CDO River Basin	. I-72

# CHAPTER 1 INTRODUCTION OF THE WORKS

# **1.1** Task of the Works

This Survey was divided into three (3) phases, i.e., 1) Basic Survey, 2) M/P Study, and 3) Feasibility Study. Based on the Scope of Works (SW) of the contract between JICA and Consultant, and Inception Report in this Survey, tasks for non-structural measures in each phase are explained as follows, except the task related to reporting.

[Basic Survey]

- SW No. (3), vii) Flood Mitigation Plan and Current Situation (Task 1-1 Collection and Review of Necessary Information/Data and Reports in Inception Report (ICR)): Of the flood mitigation measures implemented by the concerned agencies of the GOP and LGUs in the CDO River Basin, plans and current situation of the non-structural measures shall be collected and reviewed.
- SW No. (3), x) Confirmation of Assistant Program from Other Donor Communities, etc. (Task 1-1 Collection and Review of Necessary Information/Data and Reports in ICR): Confirmation shall be done for current situation of assistant program from other donor communities, etc.
- SW No. (4) (Task 1-2 Assessment on Existing Flood Mitigation Facilities in ICR): Based on the above studies, assessment shall be conducted for current situation of the non-structural measures in the CDO River Basin implemented by the concerned agencies of the GOP and LGUs.

The above results of the Survey was reported in the Progress Report (PR) prepared in March 2013, and afterward finalized and submitted to DPWH/JICA based on their comments in June 2013.

[M/P Study]

SW No. (28) (Task 2-1 Collection of Additional Data, Documents and Information in ICR): Additional data, documents and information required for M/P study and F/S shall be collected after review of the data collected used in the Progress Report.

-SW No. (28) (Task 2-1 Collection of Additional Data, Documents and Information in ICR): Additional data, documents and information required for M/P study and F/S shall be collected after review of the data collected used in the Progress Report.

- SW No. (37) (Task 2-10 Assessment of Existing Non-Structural Measures in ICR): Study shall be undertaken for plans and current situation of the non-structural measures in the CDO River Basin formulated and implemented by the concerned agencies of the GOP and LGUs, the, Assessment shall be made for existing non-structural measures.
- SW No. (38) (Task 2-11 Formulation of Non-Structural Measures in ICR): Non-structural measures effective for the CDO River Basin shall be formulated such as land regulation for development inside river area, preparation of flood hazard map, community disaster plan, education activities on disaster mitigation to local residents, community based flood early warning system, etc. based on the results of review for non-structural measures planned and implemented in other areas in the Philippines.
- SW No. (39) (Task 2-11 Formulation of Non-Structural Measures in ICR): In addition to the study and recommendation of the non-structural measures above, watershed management plans by the concerned agencies, such as DENR, etc., and activities on watershed management shall be reviewed. Recommendation on watershed

management for the CDO River Basin shall be made based on the results of discussions with DENR, LGU (CDO, Bukidnon), DPWH, etc., and study on improvement for various plans and activities.

- SW No. (40) (Task 2-12 Formulation of Master Plan in ICR): Master plan shall be formulated for the CDO River Basin based on the results of the above studies. Project long list for structural and non-structural measures shall be prepared, and cost estimate, preparation of implementation schedule, study on effectiveness of the projects, shall be conducted.
- SW No. (41) (Task 2-13 Selection of Priority Projects in ICR): Priority projects for no-structural measures shall be selected from those identified in the master plan. The reasons, justifications for the selection shall be clarified, and cost estimate, preparation of implementation schedule, study on effectiveness of the projects, shall be conducted.
- SW No. (43) (Task 2-15 Scoping for the Project in ICR): Project component recommendable for Japanese Yen Loan project shall be selected.

The results of the Survey above are shown in Draft Final Report.

[F/S]

- SW No. (44), ii) Conduct of F/S and Preparation of Report, iii) Study on Project Cost and Financial Planning, iv) Preparation of Consultant's TOR, v) Study on Project Implementation Schedule, vii) Cost Estimate (Task 3-1 Feasibility Study in ICR)
- SW No. (45), ICR Task 3-2 Proposal for Disaster Risk Reduction and Management): Recommendation for improvement shall be made based on the flood mitigation measures in the CDO River Basin, results of the study for current situation for measures, etc. The recommendation shall be included in the draft final report.

The above results are presented in the draft final report, of which study results of the following tasks are shown in Chapter 3 of the Main Report.

- SW No. (3), vii) Flood Mitigation Plan and Current Situation (Task 1-1 Collection and Review of Necessary Information/Data and Reports in Inception Report (ICR)
- SW No. (3), x) Confirmation of Assistant Program from Other Donor Communities, etc. (Task 1-1 Collection and Review of Necessary Information/Data and Reports in ICR)

# 1.2 Major Non-Structural Measures and Flow of Study

Various kinds of non-structural measures have been planned, designed and implemented in the Philippines. PAGASA has been conducting FFWS and FFWSDO in the five (5) major river basins. DENR has been implementing forest management and watershed conservation based on their plans, etc. DPWH has been undertaking projects on non-structural measures such as preparation of flood hazard maps, capacity development, etc. together with flood structural measures. LGUs • DILG, and other agencies concerned have also been executing various kinds of non-structural measures. These non-structural measures have attained stepwise targets and are aiming at further improvement.

The non-structural measures are necessary to mitigate the flood damages where the area is kept as a natural river basin, the area is not well developed by the structural measures, and the area cannot be protected by the structural measures against the floods beyond the design scale (safety level), even though the designed structural measures are provided. In the CDO River Basin, there are many stretches where the area is kept as a natural river basin, and the area is not well developed by the structural measures. Even if the area will be protected by the structural measures against the floods at a certain design scale (safety level), such as 1/25 years, 1/50 years, etc., the area cannot be protected by the structural measures against the floods beyond the design scale. Therefore, the non-structural measures are necessary to mitigate the flood damages in the CDO River Basin.

Based on the recommendation of DPWH in the previous M/P & F/S, recommendation of Cagayan de Oro River Basin Management Council, and basin characteristics, key issues and findings in this Survey, improvement of existing non-structural measures are judged necessary.

As shown in SW No. (38) (Task 2-11 Formulation of Non-Structural Measures in ICR), non-structural measures effective for the CDO River Basin shall be formulated such as land regulation for development inside river area, preparation of flood hazard map, community disaster plan, education activities on disaster mitigation to local residents, community based flood early warning system, etc. based on the results of review for non-structural measures planned and implemented in other areas in the Philippines. Followings were considered as major non-structural measures for flood management:

- 1) Reinforcement/Re-establishment of Disaster Risk Reduction and Management Council (DRRMC)
- 2) Formulation and Implementation of Disaster Risk Reduction and Management Plan (DRRMP) and contingency plan, especially for preparation of flood hazard map, evacuation plan, flood fighting improvement, reinforcement of information sharing and exchange among DRRMCs, etc.
- 3) Establishment of Flood Forecasting and Warning System (FFWS)
- 4) Establishment of Community Based Flood Early Warning System (CBFEWS)
- 5) Enlightenment to Community, and Information, Education, and Communication (IEC) on flood, risk area, illegal dumping of garbage to river, flood fighting/rescue, training, etc.)
- 6) Formulation and Implementation of Capacity Development for O&M, etc.
- 7) Setting Flood Prone Area (River Boundary) and Land Regulation
- 8) Resettlement
- 9) Others

As shown in SW No. (39) (Task 2-11 Formulation of Non-Structural Measures in ICR), watershed management plans by the concerned agencies, such as DENR, etc., and activities on watershed management shall be reviewed in addition to the study and recommendation of the non-structural measures above. Recommendation on watershed management for the CDO River Basin shall be made based on the results of discussions with DENR, LGU (CDO, Bukidnon), DPWH, etc., and study on improvement for various plans and activities. It is noted that master plan study for the watershed management is not included in this Survey based on the contract. As major watershed management, followings were initially considered:

- 1) Forest Preservation for soil erosion in the watershed
- 2) Reforestation,
- 3) Slope erosion protection
- 4) Others

Based on SW No. (40) (Task 2-12 Formulation of Master Plan in ICR), master plan shall be formulated for the non-structural measures on flood management excluding watershed

management. Then, priority projects for no-structural measures shall be selected based on SW No. (41) (Task 2-13 Selection of Priority Projects in ICR), project component recommendable for Japanese Yen Loan project shall be selected based on SW No. (43) (Task 2-15 Scoping for the Project in ICR), and feasibility study shall be made based on SW No. (44) (Task 3-1 Feasibility Study in ICR).

The results of the Survey are described in the succeeding sections.

# CHAPTER 2 STUDY ON NON-STRUCTURAL MEASURES (FLOOD MANAGEMENT)

# 2.1 Assessment of Existing Non-Structural Measures (Flood Management): ICR Task 1-2 & 2-10

- 2.1.1 Philippine Government's Non-Structural Measures for Flood Mitigation
  - 1) Policies in Disaster Preparedness and Flood Mitigation

In the Philippines, the legal framework of disaster mitigation was initiated on June 11, 1978 by Presidential Decree No.1566 (PD 1566), which established role of National Disaster Coordin ating Council (NDCC). Until the 1990's, response to disasters is quite reactive from the top down. However, after the 1990's, it changed to disaster management, particularly into the measures for "prevention & mitigation", "preparedness", "response" and "recovery". The Local Government Code (RA 7160) enacted on October 10, 1991 provided for a more responsive and accountable local government instituted through a system of decentralization whereby local government units were given more powers, authority, responsibility and resources. Among the responsibilities of the local governments under RA 7160 is to carry out emergency measures as may be necessary during and in the aftermath of man-made or natural disasters or calamities.

On June 6, 1996, Republic Act 8185 amended RA 7160 increasing from 2% to 5% the local government funds to program their disaster preparedness activities. RA 10121 or the Philippine Disaster Risk Reduction & Management Act of 2010 enacted on May 2010, mandating all Local Government Units (LGUs) including the barangays to establish Barangay Disaster Risk Reduction & Management Councils (BDRRMCs), and to formulate a Contingency Plan and Comprehensive Development Plan which integrates disaster risk reduction and climate change adaptation (in reference to earlier law RA 9728 or the Climate Change Act of 2009). Based on the above legal background, LGUs are allowed to program 70% of the 5% Calamity fund for Disaster Risk Reduction Management (DRRM) without the need for actual declaration of a "State of Calamity". Remaining 30% is set aside as a "Quick Response Fund (QRF)" and can only be used upon declaration of a "State of Calamity". RA 10121 acknowledged the need to promote the participation of all sectors, all stakeholders at all levels especially the local community.

The Medium-Term Philippine Development Plan (MTPDP) 1993-1998 listed disaster mitigation policies: (i) implementing appropriate infrastructure projects for flood control and other disaster mitigation schemes, (ii) promoting disaster mitigation activities through enlightenment, disaster restoration, drill and other practices, and (iii) enhancing research on disasters. These policies aim at increasing capacities for disaster mitigation of government agencies and each level of the DRRMCs. The MTPDP 2001-2004 does not proclaim national policies and plans regarding disaster management, but it mentions implementation strategies for flood control, drainage and debris flow schemes in the sub-section on water resources in Chapter 6: Accelerating Infrastructure Development. In the latest MTPDP (2004-2010), there is no particular description of disaster mitigation. However, regarding flood control, there are descriptions in Chapter 3 Environment and

Natural Resources and mentions names of priority flood control projects.

It was assessed that the change of flood disaster management from top-down approach to more responsive and accountable local government approach by decentralization by RA 7160, increase of local government funds to program disaster preparedness activities from 2% to 5% by RA 8185, and 70% of the 5% Calamity fund for Disaster Risk Reduction Management (DRRM) allowed for LGUs to program without the need for actual declaration of a "State of Calamity" by RA 10121 are judged reasonable. Further change in policy by RA on disaster preparedness and flood mitigation was expected according to change in situation in the future.

2) Organization Structure for Flood Management

The National Disaster Risk Reduction and Management Council (NDRRMC) is an agency of the Government of the Philippines, responsible for ensuring protection and welfare of the people during disasters and emergencies, which is a composite organization of representatives from various government and non-government institutions. Among these, Department of Public Works and Highways (DPWH) is mainly tasked to restore and rehabilitate damaged infrastructures, and provide equipments for relief and rescue, etc, and also to conduct non-structural measures such as preparation of flood hazard maps, capacity development, etc. for some major river basins. There are other organizations such as DOST, DILG, DSWD, NEDA.

The Disaster Risk Reduction and Management Councils (DRRMCs) at the national, regional, provincial, municipal/city and barangay together with concerned agencies have played important roles for mitigation of disaster, including flood in the Survey area. The organizational structure of the DRRMCs from the national to the barangay, and concerned agencies is illustrated in the following chart. OCD acts as coordination agency for DRRMCs.



Source: JICA Survey Team

#### Figure 2.1.1 Organizational Structure of DRRMCs and Concerned Agencies

RA10121 was enacted in May 2010, and formulation of DRRMCs/Disaster Risk Reduction and Management Offices (DRRMOs) at the local level has been continuously promoted particularly with the recent linkages with the formulation of Local Disaster Risk Reduction and Management Plan (LDRRMP) and Local Disaster Risk Reduction and Management Fund (LDRRMF) in Mar 2013. Three (3) years has been passed since the enactment, and promotion of actual formulation of LDRRMP including establishment of DRRMOs in local level. Therefore, it can be assessed that there are absolutely needs of capacity development and technical support for institutional development, coordination, information dissemination of DRRMCs and other related agencies.

- 2.1.2 Assessment of Existing Non-Structural Measures on Flood Management in the Cagayan de Oro River Basin
  - 1) Previous Master Plan and Feasibility Study Reports for the CDO River Basin

The following non-structural measures were recommended for the CDO River Basin in the previous Master Plan Report:, which was prepared by DPWH in 2010.

The Community Based Flood Early Warning System (CBFEWS) with six (6) major components and/or procedures such as; 1) consultation with Local Government Units (LGUs), 2) network design, 3) ocular survey of proposed sites, 4) installation and hydrologic survey, 5) training of observers, and 6) pilot testing/dry run of the operation of the CBFEWS

- ii) The Flood Preparedness Plan for people to evacuate to safe areas and minimize flood damages, which cover; 1) organization, 2) information route, 3) evacuation route and method, and 4) flooding conditions
- iii) The Watershed Management with components of 1) Land Use Zoning, 2)Watershed Rehabilitation, 3) Reforestation, 4) Agro-forestry, 5) WatershedProtection, and 6) Sustainability Plan

In the succeeding Feasibility conducted, earliest possible implementation of the non-structural measures such as CBFEWS and watershed management proposed in the Master Plan was recommended.

The above recommendations were judged reasonable. The recommended measures shall be established/ formulated as immediately as possible. However, consistency for establishment of proposed FFWS with CBFEWS is necessary, since FFWS was already programmed to implement by PAGASA, in which system configuration will be determined soon. PAGASA has been introducing projects on CBFEWS in Bulacan, Pampanga, etc. under "Ready Project", which are considered good examples and reference for the CDO River Basin.

2) Recommendations of the Cagayan de Oro River Basin Management Council (CDORBMC)

In November 2010, the CDORBMC was organized in the Multi Stakeholders Dialogue/Workshop for the Protection, Rehabilitation and Management of the Cagayan de Oro River. It was recommended that the CDORBMC will formulate the Comprehensive Watershed Management Plan for promotion of soil and water conservation of watershed to be attained through activities including monitoring of the conditions of watershed and river course. The above plan will be formulated after 18 months from April 2013.

The recommendations made by the CDORBMC was judged reasonable, however, it will be further studied in detailed after formulation of the said plan.

3) Annual Investment Plan for DRRM in 2013 for the CDO City, and Three (3) Municipalities in Bukidnon

The annual investment plan for DRRM in 2013 for the CDO City and three (3) Municipalities in Bukidnon (Talakag, Libona and Baungon) were collected in this Survey. Various kinds of non-structural measures in the four (4) components in the flood management cycle, such as "Prevention & Mitigation", "Preparedness", "Response", and "Recovery" were planned.

Of these, non-structural measures in "Prevention & Mitigation" and "Preparedness" are those before the disaster. These are related to Community Based Flood Early Warning System (CBFEWS), reforestation, watershed management, etc. in "Prevention & Mitigation", and improvement of DRRMC, contingency plan, etc. in "Preparedness" as shown in the following table:

The NDCC has prepared a manual for local government units on contingency planning for emergencies (3<sup>rd</sup> Edition) in October 2007. Based on the Manual, the disaster preparedness for natural hazards like earthquakes, typhoons, or tropical cyclones, floods/flash floods, volcanic eruptions, storm surges, tsunami, landslides, epidemics, etc., and those for human-induced hazards like fire, influx or refugees,

oil spoil, even power outage, water supply problems, armed conflict, war against terrorism, etc., should be included in the contingency plan for each region, province, city/municipality and barangay.

However, these contingency plans for the CDO City, and municipalities of Talakag, Baungon & Libona in the province of Bukidnon were not well prepared yet due to insufficient information for scenarios for disaster, policies, strategy, future actions, etc. On the other hand, 5-year DRRM plan for the CDO city for the period from 2013 to 2017 was prepared. As of September 2013, all 3 Municipalities have submitted DRRMP. For Baungon, all 16 barangays have submitted DRRMP. For Libona, 6 barangays out of total 14 barangays have submitted DRRMP. For Talakag, 13 barangays out of total 29 barangays have submitted DRRMP. It is expected that non-structural measures proposed in this Survey will be incorporated in their contingency plan.

# Table 2.1.1 Annual Investment Plan for DRRM in 2013 for CDO City

ANNUAL INVESTMENT PROGRAM							
(1) Prevention and Mitigation	Budget (Pesos)	(2) Preparedness	Budget (Pesos)	(3) Response	Budget (Pesos)	(4) Recovery/ Rehabilitation	Budget (Pesos)
1) Purchase of heavy equipments	8,813,000	<ol> <li>Procurement of Rescue Equipments:</li> <li>a.) Rubber Boats</li> <li>b.) Ambulance and Marine Ambulance</li> <li>c.) Rain Guages</li> </ol>	10,169,000	No data		1.) Repair and Maintenance (roads and bridges)	4,068,000
2) Acquisition of Relocation Site	8,813,000					2.) Livelihood Assistance	678,000
3) Disaster Risk Reduction Management for women	2,203,000					3.) Agriculture/ Fishery Assistance	678,000
4) Sanitation and Solid Waste	4,407,000					4.) Shelter Assistance	8,136,000
<ul> <li>5) Infrastructure Projects for the Following:</li> <li>a.) Flood Control</li> <li>b.) Street Lighting</li> <li>c.) Reforestation</li> <li>d.) Climate Change Projects</li> <li>e.) Nursery Development</li> <li>f.) Watershed Rehabilitation</li> </ul>	19,830,000						
Total	44,066,000		10,169,000		29,055,390		13,560,000
					30% of 5%		

Source : Cagayan de Oro City

Table 2.1.2	Annual Investment	Plan for	<b>DRRM</b> in	2013 for	· Municipality	of Talakag	in Bukidnon
-------------	-------------------	----------	----------------	----------	----------------	------------	-------------

		ANNUA	L INVESTMENT	<b>F PROGRAM</b>			
(1) <b>Prevention and Mitigation</b>	Budget (Pesos)	(2) Preparedness	Budget (Pesos)	(3) Response	Budget (Pesos)	(4) Recovery	Budget (Pesos)
1) Approval of Annual Work and Financial Plan recommended by the Council	1) For Funding	<ol> <li>Trainings and Seminars;</li> <li>a.) CCA and Contingency Plan Seminar (2013)</li> <li>b.) DANA Training</li> <li>c.) Basic Life Support (Module 2)</li> <li>d.) Trainings and Seminars for MDRRMC</li> </ol>	1) a.) 300,000 b.) 150,000 c.) 250,000 d.) 100,000	1) Emergency Triage		1) Financial Assistance a.) Shelter Assistance (House Damage) b.) Crop Assistance (Crop Damage)	1) a.) 600,000 b.) 500,000
2) Passage of Regulatory Ordinance that can reduce Disaster Risk of floods, landslide, fire, drought, armed conflict, epidemic	2) For Funding	2) Quarterly MDRRMC meeting	2) 60,000	2) Provision of Medical Care		2) Rental 2 Heavy Equipment	2) 410,264
3) Provide slope protection on eroded areas	3) For Funding	3) Communication and Documentation Equipment and Supplies	3) 53,728 60000 10000	3) Emergency financial assistance (burial, injured, transportation, medicines)		3) Livelihood	3) For Funding
4) Installation ogf Gabules	4) DPWH (no amount)	4) Purchase of Rescue Vehicle	4) 1,300,000	4) Search, rescue and retrieval operation	no data	4) Lot purchase for relocation site	4) For Funding
5) Strict implementation of existing laws of ordinance of no registration no travel policy	5) For Funding	5) Purchase of Motorcycle XR (2)	5) 280,000	5) Security and crowd control		5) Repair of footbridge	5) For Funding
6) Enforcement of Municipal Ordinance on safety travel	6) For Funding	6) Power Generator (Brand New)	6) 510,000	6) Environmental Health Services		6) Rahabilitation of barangay/municipal roads (landslide areas)	6) For Funding
7) Construction of river dikes	7) For Funding	7) Repair/maintenance of vehicle	7) 155,194	7) Management of dead and missing		7) Food/cash for work program	7) For Funding
8) Conduct of quarterly water sampling	8) For Funding	8) Training for Fire Brigade Volunteers	8) For Funding	8) Installation of temporary shelter			
9) Strict enforcement of fire code	9) For Funding	9) Earthquake and Fire Drills	9) For Funding	9) Evacuation center management			
10) Installation of fire hydrants	10) For Funding	10) Psycho Social Training	10) For Funding	10) Supplemental Feeding			
11) Surveillance of dengue, malaria and other vector borne diseases	11) For Funding	11) Updating of Community Based Disaster Risk Reduction Management	11) For Funding	11) Community kitchen			
12) Construction of Over Head Tank	12) 200,000	12) Monitoring and Evaluation	12) For Funding				
13) Installation of signages in high risk areas	13) 50,000	13) Acquisition of life saving and rescue equipment	13) For Funding				
14) Purchase of planting materials for drought resistance crops (cassava, pineapple, crown, and other root crops)	14) 25,000	14) 24 Hour Duty Officer	14) For Funding				
15) Purchase of anti-rabies vaccine	15) 25,000	15) Construction of Operation Center	15) 1,000,000				
16) Construction of perimeter fence for water level monitoring equipment	16) 189,000	16) Rabies Awareness	16) For Funding				1
		17) Advocacy to people living in flooding prone areas or barangay as well as drought prediction	17) For Funding				1
Total	489,000		3,229,922				1,510,264

Note: "For Funding" means under estimation for funding.

Source: Municipality of Talakag in Bukidon

		ANNUAL I	NVESTMENT PROGRAM	M			
(1) Prevention and Mitigation	Budget (Pesos)	(2) Preparedness	Budget (Pesos)	(3) Response	Budget (Pesos)	(4) Recovery	Budget (Pesos)
1) Support to Watershed Management	1) 50,000	1) Trainings/Seminars	1) 561,499			1) Relief Operation	
2) Provide Forage and Pasture	2) 5,000	2) Purchase of Office Supplies	2) 50,000			2) Cash Assistance	
3) Pest/Disease Control	3) 30,000	3) Information and Database Generation	3) 100,000			3) Food for Work	
4) CBMS Program	4) 100,000	4) Purchase of Rescue and Response Equipment	4) 150,000			4) Repair of Roads and Bridges	1
5) Early Warning systems/Materials	5) 75,891	5) Compensatory Benefits to Rescue Volunteers	5) 150,000	none	n/a	5) House Repair/Construction	no data
6) Vulnerability Analysis and Risk Assesment	6) 80,000	6) Completion of MDRRM Office	6) 150,000			6) Restoration of Damaged Communication Lines	
7) Water Treatment	7) 50,000	7) Information Education Campaign	7) 30,000			7) Livestock and Poultry	
		8) Rescue Operation Vehicle	8) 500,000			8) Water System	
		9) Maintenance of Disaster Vehicle	9) 200,000	1		9) Agricultural Crops	-
		10) Support Services for MDRRMO	10) 66,000				
		11) Other Supplies	11) 50,000				
		12) Freight and Handling of 1 unit Firetruck	12) 200,000				
		13) Acquisition of relocation sites	13) 300,000				
Sub-Total	390,891		2,507,499				1
		Tota	l: Php 2,898,390				

# Table 2.1.3 Annual Investment Plan for DRRM in 2013 for Municipality of Baungon in Bukidnon

Source: Municipality of Baungon in Bukidnon

# Table 2.1.4 Annual Investment Plan for DRRM in 2013 for Municipality of Libona in Bukidnon

ANNUAL INVESTMENT PROGRAM							
(1) Prevention and Mitigation	Budget (Pesos)	(2) Preparedness	Budget (Pesos)	(3) Response	Budget (Pesos)	(4) Recovery	Budget (Pesos)
1) Review Municipal Watershed	1) no data	1) Regular meeting of the MDRRMC on DRRM	1) 5,000	<ol> <li>Conduct Rapid DANA Needs and priorities transports vehicle and gasoline, packaged meals and water of the RDANA Team, personal protective equipment *raincoat, umbrella, combat shoes/boots, flashlights, reflectorized life vest, hard hat/helmet, rescue ropes, safety gloves and fast cash funds</li> </ol>	1) 20,000	1) Conduct orientation / seminar on Disaster Rahabilitation and Recovery Team	1) 20,000
2) Review Agriculture Development Plan	2) no data	2) Conduct of earthquake, fire, and evacuation drills in schools and other institutions, and in the communities which are highly vulnerable to disaster	2) 40,000	2) Establishment of Incident Command Center, creation of 3 administrative staff, adm. Cost/equipments table, computer, laptop, motorcycle, generator 12 volts, 17 plate battery, communication equipment (handheld radio, transistor radio, megaphone, radio base, portable TV, water proof camera, water dispenser, disposable cups, chairs and tables, folding beds, blankets, monitoring and evaluation	2) 20,000	<ol> <li>2) 1 purchase of safe relocation site (2 has.) site development including roads and drainages, fecilities, water and electricity</li> </ol>	2) *pending the amount for improvement
3) Adoption of sloping agriculture land technology (SALT)	3) 50,000	3) Hiring of rescuers and fire truck driver making sure that their times are fully maximized for information dissemination, orientation, traffic enforcement	3) 840,000	3) Conduct search and rescue activities, immediate fast cash funds	3) 20,000	3) Conduct post damages on infrastructure and agriculture affected within the municipality	3) 10,000
4) Procurement of propagated planting fruit trees	4) no data	4) Develop information and database generation	4) 5,000	4) Purchase of Chainsaw (3)	4) 225,000	4) Equipment mobilization for infrastructure and rehabilitation	4) *pending the amount for the equipment mobilization for infrastructure and rehabilitation
5) Use of organic farming through multiple cropping system	5) 150,000	5) Gas, fuel, oil, other maintenance, of rescue vehicle	5) 30,000	5) Provide security and safety police line / fire line and immediate whistle and megaphone	5) no data	5) Small scale backyard farming	5) 198,808
6) Tree planting giant bamboos	6) no data	6) Contingency Planning Workshops in the five (5) barangays and Validation of Draft Contingency Plans in all barangays	6) 50,000	6) Conduct medical emergency measures and provide health intervention and medical treatment. Immediate drugs/ medicines, fluids, minor surgical set, splints, slings, bandage, neck collars, lumbar braces, spine board, spider traps, color coded tags, stretchers and wheelchairs, medical oxygen tanks nad gauge, oxygen masks, nasal cannular, collapsible tents (3 sets)	6) *pending the amount for the conduct of medical emergency measures	6) Crops and livestock assistance	6) 200,000
7) Nursery Establishment	7) no data	7) Protocol on cancellation of classes	7) no data	7) Establishment of evacuation center immediate needs; collapsible tents, mats, blankets, mosquito nets, generator, 12 volts-17 plate battery, water tanks for potable drinking water, portable toilets, water drums for bathing/laundry, color coded platic, garbage receptacle, tables and chairs, communication equipments, personal hygiene kits.	7) *pending the amount for the purchase of equipments	7) Emergency shelter Assistance	7) 200,000
8) Tree growing of endemic species	8) 100,000	8) Purchase of handneld radios to midwives	8) 119,000	8) Provide mass feeding, Immediate needs kitchen and feeding utensils, ready to eat food, easy to prepare foods and hire temporary cook.	8) 200,000		
9) Construction of sewerage/ drainage system	9) *pending the amount for construction/ sewerage/ drainage system	9) Purchase of Office Supplies such as; Bond papers, writing materials, computer ink, usb, markers, paper clips, alcohol, detergent soap, rice cooker, etc	9) 82,582	9) Provide immediate integrated relief operation	9) *pending the amount for the integrated relief operation		
10) Clearing, cutting trees down along electric line	10) 50,000	10) Improvement of DRRM office for the equipment	10) *pending the amount for improvement	10) Provide evacuation center	10) no data		
11) Additional construction of small farm reservoir	11) *pending the amount for additional construction of small farm reservoir	11) Contingency Planning Workshop (Municipal Level)	11) 70,000	11) Stress debriefing seminar workshop	11) 55,000		
12) Monitor the small mining operation /quarries	12) 20,000	12) ICS workshop (3 days)	12) 70,000	12) Transport relief supplies, victims and properties to evacuation center	12) 15,000		
13) Planting of root crops commodity	13) 150,000	13) Level II Training of rescuers	13) 250,000	13) Direct and monitor all disaster response and rescue activities	13) 15,000		
14) Installation of overhead tank and fire hydrant (pilot: Barangay Poblacion)	14) *pending the amount for installation of overhead tank	14) Lagalag Uniform (2 pairs)	14) 5,000	14) Conduct search and retrieval	14) no data		
15) Purchase of fire extinguisher	15) no data	15) Enhancement Training of MDRRMC Members	15) 80,000	15) Provision of trainings	15) no data		
16) Reforestation project	16) no data						
17) Perimeter fence of all potable water source	17) *pending the amount for the perimeter fence of all potable water source						
Total	520,000		1,646,582		570,000		628,808
				Total: Php 3,365,390			

Source: Municipality of Libona in Bukidnon

#### 4) Assessment on Flood Hazard Map

The flood inundation map of the CDO city for TS Sendong was prepared by Xavier University in the CDO city as shown in the figures below.



Source: Engineering Resource Center of Xavier University



There are twelve (12) flooded barangays identified in the right side area from the mouth of the Cagayan de Oro River (Barangays Macalaban, Puntod, Consolacion, 17, 18, 15, 13, 10, 7, 6, Nazareth, and Macasandig), and four (4) flooded barangays in the left side area (Barangays Bonbon, Kauswagan, Carmen, and Balulang), accordingly, 16 flooded barangays in total in the CDO city within the CDO River Basin. There are also other barangays affected by Sendong, such as Barangays Bayangan and Dansolihon in the upstream of the CDO River inside the CDO city (Refer to **Figures 2.1.2 and 2.2.2**).

After TY Pablo, similar flood inundation map was prepared by Xavier University for the CDO city, which is also useful for reference.

Flood runoff and inundation models for TS Sendong, TY Pablo and those for each probable flood were prepared by the hydrologist in this Survey, which are useful as flood hazard maps.

In the upstream of the CDO River Basin, Mines and Geosciences Bureau (MGB) under DENR has prepared the geo-hazards (Land Slide and Flooding) Assessment and Mapping (1:10,000 Scale) for the municipalities of Talakag, Baungon & Libona in the province of Bukidnon in August 2012, which was used during the time of TY Pablo.

5) Assessment of Existing Non-Structural Measures on Land Use Management

The Land Use Map in the CDO River Basin, which was prepared by NAMRIA, based on the satellite image taken in 2004, was referred to. Based on the said map, the forest occupies about 26 % of the river basin; grasslands, 25 %; forest protection area, 24 %; agriculture area, 13 %; urban area by 2 %; etc.

The following Comprehensive Land Use Plans (CLUPs) have been formulated or are being formulated for the four (4) LGUs inside the CDO River Basin:

Title	Prepared in (approved in)	Prepared by
Comprehensive Land Use Plan of	Still updating	Cagayan de Oro City
the City of Cagayan de Oro		
2013-2022 (Draft)		
Comprehensive Land Use Plan	2012	Municipality of Talakag, Bukidnon
2009-2018		
Comprehensive Land Use Plan	2012	Municipality of Baungon,
2011-2020		Bukidnon
Comprehensive Land Use Plan	2012	Municipality of Libona, Bukidnon
2010-2019		

Table 2.1.5Comprehensive Land Use Plans (CLUPs) for Cagayan de Oro River Basin

Source: JICA Survey Team

The draft Comprehensive Land Use Plan (CLUP), for the CDO City was referred to as future urban land use. The majority of the areas in the left and right banks along the CDO River, were planned as residential area. Therefore, the plan for these areas should be changed based on the "River Boundary" set in this Survey. In this connection, the CDO City has been working to finalize the CLUP incorporating the disaster related plan.

For the municipality of Talakag, it is expected to maintain its current role in the province as an agro-industrial municipality. On the other hand, the municipality of

Libona is expected to continue agro-industrial activities with mining and manufacturing activities. For the municipality of Baungon, agro-industrial development is still expected to intensify. For the CLUPs of these three (3) municipalities, they started to prepare their CLUPs before TS Sendong, the damage situation by TS Sendong and measures against the disasters are not included in their plans. Therefore, the CLUPs should be updated based on the recent flood damages caused by TS Sendong and TY Pablo. Also, the thematic maps in the CLUPs are drawn by hand or graphic design software for some municipalities. It is difficult for them to update/revise the maps and calculate the land use changes due to the lack of capacity in terms of personnel and equipment.

Resolution on "No Build Zone" was issued, which is effective since no significant damages were reported after TY Pablo. In this connection, ① CDO City will finalize the CLUP taking into account the "River Boundary" set by this Survey, ② DPWH Secretary will declare "Flood Control Area" and promulgate guidelines for governing flood plain management plans in these areas based on the Water Code Article 53, ③Inter-Agency Flood Management Committee will be established by the Secretary of the DPWH based on the Amended Implementing Rules and Regulation Section 38, 39 of the Water Code, and related agencies of the committee will prepare the guidelines for the flood plain management, etc. with LGUs.

As described in the chapter for structural measures, it was planned that the flood plain for Isla de Oro and Cala Cala areas may be used for public park, play ground, etc. as a space friendly to water environment and for conservation of natural environment.

It is recommended to issue necessary regulation for the area within the river boundary and if necessary the vicinity of the boundary including actions to follow the regulation, to prohibit or control activities that may damage or cause deterioration of dike, etc..

6) On-going Projects for Non-structural Measures (Flood Management) in the CDO River Basin

There are six (6 on-going projects for non-structural measures (flood management) as follows:

i) Establishment of FFWS Centers in 13 Major River Basin ("River Centers" Project) by PAGASA in 2013-2014

There are 18 major river basins in the Philippines (more than 1,400km2). Of theses, new FFWS for the 13 major river basins will be established (Abra, Abulug, Panay, Jalaul, Ilog-Hilabanagan, Agusan, Agus-Lake Lanao, Buayan-Malungon, Cagayana De Oro, Mindanano, Davao, Tagoloan, and Tagum-Libuganon river basins), excluding existing FFWS for 5 major river basins (Agno, Bicol, Cagayan, Pampanga and Pasig-Marikina River basins).

According to the information of PAGASA management staff as of December 2013, the bidding procedure for building construction of the four FFWS Centers (so-called as "1<sup>st</sup> Batch") in the Cagayan de Oro, Tagum-Libuganon, Cotabato (Mindanao) and Buayan-Malugon River basins is underway. The River Center for the Cagayan de Oro will be located at San Salvador, approximately 15 km westbound from Cagayan de Oro City. The 2<sup>nd</sup> Batch of three FFWS Centers of

the Davao, Agusan (in Agusan Del Sur) and Agus River (Iligan City) basins will be consecutively proceeded in Year 2014.

 ii) Integrating Disaster Risk Reduction and Climate Change Adaptation (DRR/CCA) in Local Development Planning and Decision-making Process by UNDP/AusAid & NZAP/NEDA in 2012-2013

The Project aims to mainstream integrated concerns of disaster risk reduction and climate change adaption into local decision making and planning process by 1) enhancing local awareness and understanding of climate change and its aggravating effects on existing natural hazards, 2) developing tools to enable formulation of physical framework/land use and development plan that address existing hazards whilst considering climate change risk, 3) demonstrating practical integrated DRR/CCA approaches at the community level, and 4) improving national enabling environment through national and local DRR enhanced climate change plans and multi-stakeholder coordination mechanisms.

Implementing agency is NEDA, EMB of DENR, Housing and Land Use Regulatory Board (HLURB), Office of the Presidential Adviser on Climate Change (OPACC). The Project is scheduled to be implemented by December 2013.

iii) Enabling the Cities of Cagayan de Oro and Illigan to cope with Climate Change ("Project Climate Twin Phoenix") by UNDP/AusAid in 2013-2014

The Project aims to assess the disaster vulnerabilities of the cities of CDO and Iligan and the municipalities surrounding the CDO & Mandulog river basins in Mindanao due to climate change. The results will provide the basis for priority mitigation actions like community based and managed early warning systems and integrated contingency planning. The Project started in 2012 with financial assistance from UNDP and Aus-Aid and will be ended in 2014. There are five (5) components as follows:

Component-1:	Climate Change Vulnerability/ Disaster Risk Assessment								
Component-2:	Development of Priority Climate Change Adaptation and								
	Disaster Risk Mitigation Actions								
Component-3:	Information, Education and Communications (IEC)								
	Campaign and Competency Development of Local Actions								
	on Climate Change Adaptation and Disaster Management								
Component-4:	Socio-economic Resilience Development for the Poor and								
	Most Vulnerable								
Component-5:	Knowledge Management								

iv) Establishment of a Pilot Automatic Warning System (AWS) in CDO River Basin by NDMI/MOPAS in Korea in 2013

According to the information from PAGASA, National Disaster Management Institute (NDMI) of Korea has proposed establishment of a pilot Automatic Warning System (AWS) in the CDO River Basin during the meeting in April 2012. Further, NDMI had two times discussions with PAGASA in October and November 2012 and field inspection in April 2013. Ministry of Public Administration and Security (MOPAS), upper level of the Korean government had also meeting with PAGASA in November 2012. The proposed system will include Automated Rainfall Warning System (ARWS) and Flash Flood Alert System (FFAS). The system will be established for 4-5 areas in the lower CDO River Basin by sirens based on the existing available rainfall and water level data under NOAH.

From the above, CBFEWS is needed for the areas in addition to those with the above system, especially the areas in the upper CDO River Basin. Further, immediate study on additional numbers and locations of the automatic rainfall and water level stations are necessary, since these additional stations will be also important for integration of the system not only for FFWS to be established by PAGASA, but also for future CBFEWS.

v) Data Collection Survey on Situation of Nationwide Flood Forecasting and Warning System by JICA in 2013

In relation to the above item ①, this Project aims to study on needs for capacity development of PAGASA (for aspects on policy, planning, institution, equipment, technology, budget, etc.), which will improve issues on FFWS for the 18 major river basins, and Mandulog river basin in Mindanao seriously damaged by floods in 2011/2012.

The Project started in February 2012, and will end in September 2013.

vi) Project NOAH by DOST

In order to provide a 6 hour lead-time warning to vulnerable communities against floods and to use advanced technology for geo-hazard vulnerability maps, the Project Nationwide Operational Assessment of Hazards (NOAH) was launched by the Department of Science and Technology (DOST).

Presently there are eight(8) component projects under the Project, namely: 1) Hydro-met Sensors Development Project, 2) DREAM-LIDAR 3-D Mapping Project, 3) Flood NET-Flood Modeling Project, 4) Hazards Information Media Project, 5) Enhancing Geo-hazards Mapping through LIDAR Project, 6) Doppler System Development Project, 7) Landslide Sensors Development Project, and 8) Storm Surge Inundation Mapping Project. The members of the Project NOAH are composed of the scientist-leaders of these projects, PAGASA and PHIVOLCS.

The Project shall install 600 automated rain gauges and 400 water level measuring stations for 18 major river basins of the Philippines.

7) Basin Characteristics and Preliminary Assessment on Flood Management

Basin characteristics and preliminary assessment on flood management are mainly considered as follows:

- The Survey area has two (2) distinct characteristics, the upland in the three (3) municipalities of Bukidnon, and the lowland or flood prone area extending into the coast and delta areas in the CDO city. The floods in the upland could be brought about by rapid flow and pose hazard from river bank erosion and landslide. On the other hand, the coastal and delta areas are affected by tides and suffer from flooding.
- The major concerns of flood management in the upland area are considered watershed management probably for river bank erosion and landslide, rehabilitation of bridges, etc, and those in the lowlands or flood prone areas are concerned with issues of dredging, channel excavation, raising of dike/parapet walls, etc.

- The structural measures cannot cover all flood disasters. Accordingly, non-structural measures are important to further reduce flood risk in the Project.
- The contingency plans of the CDO city, three (3) municipalities of Bukidnon, and barangays in the Survey area were not well prepared yet due to insufficient information for scenarios for disaster, policies, strategy, future actions, etc. These plans should be prepared.
- Present barangay DRRMCs were observed in adequate in view of organization, budget and O&M. Accordingly, reinforcement of the BDRRMCs is required.
- The establishment of FFWS in the Survey area is required. Some warning measures can be introduced in close coordination with PAGASA, using rain intensity data, river water levels in the past floods, and computed probable flood water levels, etc.
- The Community Based Flood Early Warning System (CBFEWS), which is a simple system by community (barangay) to minimize flood damage by rain and river water level monitoring, flood advisory, etc can be introduced in close cooperation with PAGASA, etc.
- There are limitations in accuracy in the flood hazard map computed by the hydraulic model, which should be improved by the information of barangay residents.

## 2.2 Formulation of Non-Structural Measures (Flood Management): ICR Task 2-11

2.2.1 Basic Approach

Basically, mitigation, prevention and preparedness, response and recovery compose the four (4) pillars of the flood management cycle as shown in the figure on the right. The annual investment plans of the CDO City and the three (3) municipalities of Bukidnon in the CDO River Basin were prepared based on the same flood management cycle concept. Therefore, current application of the process of the flood management cycle by LGUs in the CDO river basin will be carefully examined to formulate and propose non-structural measures in this Survey.

The core functions of the four (4) pillars of the flood management cycle are considered as follows:



Source: NDRRMC, 2013

## Figure 2.2.1 Flood Management Cycle

<b>Prevention/Mitigation</b>	:	1)	Flood hazard risk assessment and mapping						
		2)	Watershed management and land use planning						
		3)	Enforcement of flood DRR-related laws / orders /						
			regulations						
Preparedness	:	1)	Capacity development through training, orientation,						
			drills and exercises						
	2) Flood early warning system								
		3)	Information Education Campaign (IEC) / Advocacy						
			campaign						

Response	:	1)	Continuous disaster monitoring							
		2)	Emergency	relief	(food,	shelter,	medical	supplies,		
			evacuation camp management, etc.)							
		3)	Rapid damage and needs surveys							
Recovery	:	1)	1) Health program including counseling							
		2)	ses, etc.							

3) Livelihood program

Among these above components, prevention/mitigation and preparedness are mainly measures to be made before flooding, which will be important for non-structural measures in this Survey.

2.2.2 Questionnaire Survey for Barangays in the CDO City Flooded by TS Sendong

It was reported that there were 16 flooded barangays in the CDO city, seriously affected by TS Sendong. Questionnaire surveys for the said 16 barangays were undertaken in September 2012 under this Survey.





Figure 2.2.2 Locations of the Barangays for Questionnaire Survey for Barangays Flooded by TS Sendong, conducted in September, 2012

Based on the results of answers to questionnaires, barangays in the downstream areas near the river mouth such as Barangay Macalaban, Bonbon, and those in the upstream areas such as Barangay Bayanga, Dansolihon, were not so seriously affected compared to others. However, barangays in the middle stream areas such as Barangay 13 in Isla de Oro
area, Cala Cala area in Barangay Macasandig, Balulang, were badly affected. It is also noted that the combined total of affected households in Barangays 7, 10, 13, 15 and 17 (where Isla de Oro is located) is 5,090 comprising 20% of all affected households in CDO.

It is noted that many barangays had established DRRMCs, contingency plans, disaster response team even before TS Sendong, however, these were not functioned well during TS Sendong, due to flash flood in the night time, insufficient warning dissemination, etc. It is further noted that Barangay Macasandig, one of the severely damaged barangays, has already established a new BDRRMC in April 2012 after TS Sendong, and already prepared Barangay hazard and evacuation maps and disaster response team.

Even in the upper watershed of CDO River Basin, some barangays were seriously damaged by TS Sendong (Refer to **Figure 2.2.3**). Barangay seriously damaged in the Municipality of Talakag is Barangay San Isidro due to topographic conditions according to MDRRMC officials. Barangays damaged in the Municipality of Baungon are Pualas, Nicdao, Lingating, Danatag, and Langaon, etc. mostly located along the CDO River. There are several barangays damaged in the Municipality of Libona, such as Barangay Poblacion, Nangka, Pongol, etc. along the Bobonawan River, tributary of CDO River, and Barangay Crossing, etc. along the Agusan River.



Source: JICA Survey Team

Figure 2.2.3 Locations of Barangays seriously damaged by TS Sendong in the Upper Watershed of Cagayan de Oro River Basin

## 2.2.3 Interview and Questionnaire Surveys for DRRMCs in the CDO River Basin

Interview and questionnaire surveys for DRRMC in the CDO River Basin were conducted for the period from March to April in 2013. Target DRRMCs are DRRMC of CDO city, municipalities of Talakag, Libona & Baungon, and barangays seriously affected by TS Sendong in 2011 and TY Pablo in 2012.

Originally, 23 DRRMCs which include CDO city, 16 barangays in the CDO city, 3 municipalities and 1 barangay each in 3 municipalities were selected as target DRRMCs based on the discussions with JICA, however, the number has increased to 3 barangays each in 3 municipalities during the course of the survey. However, due to bad peace and order situation at that time, interview and questionnaire survey for selected Barangay Ligron could not be undertaken. As a result, the survey was conducted for 28 DRRMCs.

Contents of the surveys were: 1) Readiness of DRRMC for organization and preparation of hazard map and situation of DRRM Fund, 2) Awareness for CBFEWS & skill of training, 3) Activities for TS Sendong and TY Pablo, and 4) Existing evacuation centers. The results are shown in the succeeding tables.

First, weather information, incidents, etc. for TS Sendong are shown as follows:

- TS Sendong has appeared in the ocean, about 700km east from the Mindanao Island at 8am on 15th (Thu) Dec., 2011. AT 4pm, warning signal No.1 (30-60 Kph winds) was announced by PAGASA (Lowest out of 4 Public Storm Warning Signals). Rainfall intensity ranging from 10 to 25mm/hr was forecasted within the range of 400km radius.
- In the next day at 8am on 16<sup>th</sup> (Fri) Dec., TS Sendong moved to 200km east from the Mindanao Island. At 11am in the same day, warning signal was changed to No.2 (61-100 Kph winds). Rainfall from 5pm to 12pm at Lumbia PAGASA station at airport in the CDO city was recorded at 180mm. In Macasandig, rainfall started in the morning and its intensity became stronger from 7pm, which resulted in flash flood in the midnight. The flood receded gradually from 4am in the next day, however, it brought about serious damages.
- AT 5am on 17<sup>th</sup> (Sat) Dec., warning signal was changed to No.1 and moved to ocean north-west from the Mindanao Island at 8am.
- Preparatory works, monitoring works, warning to local people, evacuation, relief activities, etc. were not sufficiently undertaken, probably due that 1) PAGASA warning signal was only No.1 (lowest among 4 signals) on 15<sup>th</sup> Dec, 2) Rainfall intensity was strong with short duration, 3) Peak discharge by flash flood occurred in the midnight, after work of the government officials on Friday, etc.

Next, weather information, incidents, etc. for TY Pablo are shown as follows:

- TY Pablo has appeared in the ocean, about 1,000km east from the Mindanao Island at 8am on 2<sup>nd</sup> (Mon) Dec., 2012. AT 10am, rainfall intensity ranging from 20 to 30mm/hr was forecasted by PAGASA, but no warning signal was announced since it was still outside the Philippines territory.
- In the next day at 5pm on 3rd (Tue) Dec., warning signal was changed to No. 3 (101-185 Kph winds).
- TY Pablo moved to east in the Mindanao Island at 8am on 4<sup>th</sup> (Wed) Dec. At 5pm in the same day, warning signal was same as No.3. Rainfall peak at Talakag station in the upstream of the CDO River Basin occurred at 12:15 pm with 19mm in the same day. Flood peak was observed at 1pm at Bubunawan bridge, 3pm at Cabula bridge, and 5pm at Kagay-an bridge. At 2pm, TY Pablo moved to north-west from the Mindanao Island.
- Warning signal was changed to No.1 on 5<sup>th</sup> Dec.
- There were no serious damages, probably due to 1) lessons learnt from TS Sendong,
  2) instructions on preparatory works, evacuation, necessary measures, etc. in the

Association of Barangay Councils (ABC) meetings held on 2-3 Dec., 3) careful monitoring on flood on  $4^{th}$  Dec., 4) relief activities, food provision, etc.





										DRRMC I	Readiness								Fund Sou	irces (Php)			
	Respondent	Information		Estal	blishment of C	ORRMC					Hez	ard Mapping					(	GOP IRA					
			Household						Basis	of Map		Ef	fectiveness	Utiliz	ation	DRRM	to be rele	eased in four (4	+ 30% QRF), ) tranches	Other Sources	Assistance	Amount	
Nai	me of Surveyed DRRMC	Respondent DRRMC/ Designation		Date Organized	Date Re- organized	Organization Chart	Date Prepared	Assistance Received	Field Survey	Computer Analysis	Flood Extent & Depth Info	Mode of Disseminati on	Action Taken by DRRMC	Used for Sendong	Used for Pablo	Plan	2011	2012	2013		Title		
L	CDO CDRRMC	Engr. Armen A. Cuenca/ Asst. DRRM Officer	130,386	June, 2011 ★Executive Order # 050− 2011	-		2012	Yes	Yes	Yes	Yes	Yes	Relocation of people in high risk areas	No	Yes	DRRMP (2013- 2017)	82,377,759	87,019,421	96,851,300	CSWD/City Admin for DRRM Budget	NA	2011: 3,014,994 2012: 3,900,000 2013: 3,800,000	<ol> <li>DRRMC organized in improved for TY Pablo</li> <li>Hazard map prepare was utilized by DRRMC</li> <li>5-year DRRM Plan ( requirement of about F expecting financial assi</li> <li>DRRM Budget is about</li> </ol>
1	Brgy. Balulang BDRRMC	Roy Acebes/ Brgy Kagawad	8,032	July, 2008 (BDCC)	January, 2012 (BDRRMC)	Not Available (NA)	Jan-12	Xavier University	Actual Experience	No	Yes	Not Yet	<ol> <li>Public Consultation with CLENRO &amp; Residents</li> <li>Announcement/ Installation of signage.</li> <li>Resolution to put river dike control, but not yet implemented</li> </ol>	No	Yes	None	682,228	662,966	722,527	None	None	None	<ol> <li>DCC organized in 20 DRRMC could not func guidance for evacuatio</li> <li>Hazard map prepare used for TS Sendong, I</li> <li>No DRRM Plan prep</li> <li>DRRM Budget is abord</li> </ol>
2	Brgy. Bonbon BDRRMC	Admiral A. Avancena∕ Brgy Kagawad	2,500	Nov, 2011	-	NA	Prepared, but still with XU	Red Cross and Xavier University	Yes	Personal Experience	Yes	Not Yet	1) Plan for evacuation: all parts of Bonbon declared flood hazard area, 2) Tree Planting. 3) Flood Drill	No	Yes	None	198,451	187,785	223,608	LGU's	in kind/goods	None	<ol> <li>DRRMC organized ir improved for TY Pablo</li> <li>Hazard map prepare be used for TS Sendor</li> <li>No DRRM Plan prep</li> <li>DRRM Budget is abo</li> </ol>
3	Brgy. Carmen BDRRMC	Antonio Cahayag/Brgy Kagawad	14,780	Nov, 1999 (BDCC)	Mar, 2012 (BDRRMC)	Available	After Sendong, updated in Dec, 2012 after Pablo	Xavier University	Hazard map from Typhoon ONDOY	Yes	Yes	Yes	Tree planting (river side), but lack of financial for structural	No	Yes	None	1,322,615	1,338,762	*no data	None	Maintenance/oth er operating expenses	None	<ol> <li>DCC organized in No DRRMC could not func guidance for evacuatio</li> <li>Hazard map prepare Dec. 2012 after TY Pal</li> <li>No DRRM Plan prep-</li> <li>DRRM Budget is abc</li> </ol>
4	Brgy. Consolacion BDRRMC	Derby T. Pacudan/ Brgy. Kagawad	4,000 - approx.	2007 (BDC)	Mar 2, 2013 BDRRMC (none functional during Sendong and Pablo)	Draft, still to finalize	None	None	No	No	NA	NA	None	No	No	None	NA	NA	270,000	None	in kind/goods	None	<ol> <li>DCC organized in 20 DRRMC could not funce evacuation, meetings, v</li> <li>No Hazard map prep</li> <li>No DRRM Plan prep</li> <li>DRRM Budget is abc</li> </ol>
5	Brgy. Kauswagan BDRRMC	Christine Monforte/ Brgy Kagawad	6800	Jul, 2011	-	NA	16- 17/Oct/2012	Xavier University	Yes	No	Yes	Not Yet	Planning to disseminate the information of Flood Hazard Map	No	Yes	None	745,518	813,456	850,666	Relief operations from different sectors	NA	NA	<ol> <li>DRRMC organized in improved for TY Pablo</li> <li>Hazard map prepare which could not be use</li> <li>No DRRM Plan prep-</li> <li>DRRM Budget is abc</li> </ol>
6	Brgy. Macabalan BDRRMC	Norbel S. Saa/ Punong Barangay	4670	Jun, 2009	Dec, 2010	Available	Jun-12	CDRRMC	Yes	No	Yes	Not yet fully disseminated	Letter to the City Mayor requesting EMD-PCDO listing of residence occupying vulnerable hazard areas at the river banks and coastal areas of the barangay. Tie-up with Philippine Red Cross for barangay wide storm drainage declogging done from October 2012 to February 2013	No	Yes	None	400,000	400,000	450,000	None	None	None	<ol> <li>DRRMC organized ir function well for TS Se evacuation, meetings, v 2) Hazard map prepare for TS Sendong, but us 3) No DRRM Plan prep 4) DRRM Budget is abord</li> </ol>
7	Brgy. Macasandig BDRRMC	Napoleon A. Ramos/ Warning Task Unit	NA	Dec, 2002 (BDCC)	Jan, 2009 (BDRRMC)	Available	Mar-12	CNDR, SMART, Xavier University, CPDO	Yes	No	Yes	Not yet, still with CNDR	Brgy made resolution and delared danger zone areas near the river, tree planting activities in danger zone areass	No	Yes	None	509,346	503,393	556,138	None	None	None	<ol> <li>DCC organized in De function well for TS Se evacuation, meetings, v</li> <li>Hazard map prepare Xavier University, and</li> <li>No DRRM Plan prep 4) DRRM Budget is abc</li> </ol>
8	Brgy. Nazareth BDRRMC	Felipe V. Abrogar/ Brgy Kagawad	20,000 - approx.	Oct, 2009 (BDC), functional	Jan, 2011 (BDRRMC)	Available	Oct-11	Xavier University	Yes	Yes	Yes	No	None	Yes	Yes	None	320,294	311,853	321,555	None	None	None	<ol> <li>DCC organized in Or DRRMC could not func guidance for evacuatio</li> <li>Hazard map prepare could be used for TS S</li> <li>No DRRM Plan prep.</li> <li>DRRM Budget is is a</li> </ol>

# Table 2.2.1 Results of Questionnaire and Interview Surveys (DRRMC Readiness and DRRM Fund)

Assessment on DRRMC Readiness and Fund Sources
June 2011, before TS Sendong, DRRMC could not function well for TS Sendong, but using hazard map, advanced guidance for evacuation, meetings, workshops, etc. d in 2012, which could not be used for TS Sendong, but used for TY Pable. The map for relocation of people in high risk areas. 013-2017) was prepared in May 2013 under UNDP assistance, with a budget 920 ML, which is about 2 times of City DRRM budget for 5 years. The city is tance from outside, such as GOP, NGOs, foreign countries, etc. ut P 97 Mil in 2013.
08 before TS Sendong, and DRRMC re-organized in January 2012, after TS Sendong, ion well for TS Sendong, but improved for TY Pablo using hazard map, advanced , etc. in January 2012 with technical assistance from Xavier University, which could not be ut used for TY Pablo. ured. ut P 0.7 Mil in 2013
Nov. 2011 before TS Sendong, DRRMC could not function well for TS Sendong, but using hazard map, advanced guidance for evacuation, etc. d after TS Sendong with technical assistance from Xavier Univercity, which could not g, but used for TY Pablo. red. ut P 0.2 Mil in 2013.
v. 1999 before TS Sendong, and DRRMC re-organized in Mar. 2012 after TS Sendong, ion well for TS Sendong, but improved for TY Pablo using hazard map, advanced , etc. d after TS Sendong with technical assistance from Xavier Univercity, and updated in lo, which could not be used for TS Sendong, but used for TY Pablo. red. t P 1.3 Mil in 2013.
07 before TS Sendong, and DRRMC re-organized in Mar. 2013 after TY Pablo. ion well for TS Sendong, but improved for TY Pablo using advanced guidance for orkshops, etc. ared. red. ut P 0.3 Mil in 2013
July 2011 before TS Sendong. DRRMC could not function well for TS Sendong, but using hazard map, advanced guidance for evacuation, meetings, workshops, etc. d in Oct 2012 after TS Sendong with technical assistance from Xavier Univercity, for TS Sendong, but used for TY Pablo. ured. ut P 0.9 Mil in 2013.
June 2009, and re-organized in Dec. 2010 before TS Sendong, DRRMC could not ndong, but improved for TY Pablo using hazard map, advanced guidance for orkshops, etc. J after TS Sendong with technical assistance from CDRRMC, which could not be used ad for TY Pablo. ured. ut P 0.45 Mil in 2013.
c 2002, and DRRMC re-organized in Jan. 2009 before TS Sendong. DRRMC could not ndong, but improved for TY Pablo using hazard map, advanced guidance for orkshops, etc. d in March 2012 after TS Sendong with technical assistance from CNDR, SMART, JPDO, which could not be used for TS Sendong, but used for TY Pablo. red. ut P 0.56 Mil in 2013.
t 2009 before TS Sendong, and DRRMC re-organized in Jan. 2011 before TS Sendong, ion well for TS Sendong, but improved for TY Pablo using hazard map, advanced , etc. and thereafter meetings, workshops, etc. d in Oct 2011 before Sendong with technical assistance from Xavier University, which endong and TY Pablo. red. Dout P 0.32 Mil in 2013.

9	Brgy. Puntod BDRRMC	Marvin Beja∕ Brgy Chairman	NA	Jan, 2006 (BDCC)	2009 (BDRRMC)	Available	None	None	No	Yes	Yes	No	None	No	No	None	435,181	445,053	447,976	City Government , NGO's , PO's	in kind , goods, relief operations	None	<ol> <li>DCC organized in Jan 2006 before TS Sendong, and DRRMC re-organized in 2009 before TS Sendong DRRMC could not function well for TS Sendong, but improved for TY Pablo using advanced guidance for evacuation, meetings, workshops, etc.</li> <li>No Hazard map prepared.</li> <li>No DRRM Plan prepared.</li> <li>DRRM Budget is about P 0.45 Mil in 2013.</li> </ol>
10	Brgy. 6 BDRRMC	Edmund A. Labor / BDRRMC Chairman	16	Jan, 2011	Nov. 2012	NA	Yes, but still with XU	Xavier University	Yes	Personal knowledge	Yes	Not yet	None	No	Yes	None	54.558	54,301	55,198	None	in goods/in kind	None	<ol> <li>DRRMC organized in Jan 2011 before TS Sendong, and re-organized in Nov. 2012 after TS Sendong. DRRMC could not function well for TS Sendong but improved for TY Pablo using hazard map, advanced guidance for evacuation, meetings, workshops, etc.</li> <li>Hazard map prepared before Sendong with technical assistance from Xavier University, which could not be used for TS Sendong, but used for TY Pablo.</li> <li>No DRRM Plan prepared.</li> <li>DRRM Budget is about P 0.06 Mil in 2013.</li> </ol>
11	Brgy. 7 BDRRMC	Veluz F. Uman/ Vice Chairman	560	May 12, 2008 (BDCC)	Jan, 2012 (BDRRMC)	Available	Nov-12	Xavier University	Yes	Aerial Survey	Yes	Not well disseminated /understood	None	No	Yes	None	68,315	68,585	70,324	None	in goods/in kind	None	<ol> <li>DCC organized in May 2008 before TS Sendong, and DRRMC re-organized in Jan. 2012 after TS Sendong. DRRMC could not function well for TS Sendong, but improved for TY Pablo using hazard map, advanced guidance for evacuation, meetings, workshops, etc.</li> <li>Hazard map prepared in Nov. 2012 after Sendong with technical assistance from Xavier University, which could not be used for TS Sendong, but used for TY Pablo.</li> <li>No DRRM Plan prepared.</li> <li>DRRM Budget is about P 0.07 Mil in 2013.</li> </ol>
12	Brgy. 10 BDRRM	Christopher Calunod/ Brgy Captain-BDRRMC Chair	806	Jun, 2010	Feb, 2012	NA	13- 14/Dec/2012	Xavier University	Yes	Technical Analysis	yes	Not yet – to be finalized in the coming seminar with CDRRMC	None	No	No	None	63,783	64.076	67,015	Private Sectors/Individu als	in goods/in kind	None	<ol> <li>DRRMC organized in June 2010 before TS Sendong, and re-organized in Feb. 2012 after TS Sendong. DRRMC could not function well for TS Sendong, but improved for TY Pablo using advanced guidance for evacuation, meetings, workshops, etc.</li> <li>Hazard map prepared in Dec. 2012 after Pablo with technical assistance from Xavier University, which could not be used for TS Sendong and TY Pablo.</li> <li>No DRRM Plan prepared.</li> <li>DRRM Budget is about P 0.07 Mil in 2013.</li> </ol>
13	Brgy. 13 BDRRM	Maurino A. Paasa / Brgy Captain	486	March, 2012	_	Available	None	None	NA	No	No	No	None	No	No	None	86,372	87,465	92,612	None	None	None	<ol> <li>DRRMC organized in March 2012 after TS Sendong: DRRMC could not function well for TS Sendong, but improved for TY Pablo using advanced guidance for evacuation, meetings, workshops, etc.</li> <li>No Hazard map prepared.</li> <li>No DRRM Plan prepared.</li> <li>DRRM Budget is about P 0.09 Mil in 2013.</li> </ol>
14	Brgy. 15 BDRRM	Lucilo B. Legaspi/ Brgy Captain-BDRRMC Chair	3556	Dec, 2006 (BDCC)	Jun, 2012 (BDRRMC)	NA	Nov-12	Xavier University, Oro Alert	Yes	Technical Analysis	Yes	No	Confirm information provided by the Hazard Map	No	Yes	None	71,937	74,039	84,889	Private sectors, i relatives	in goods/in kind, relief operations	None	<ol> <li>DCC organized in Dec. 2006 and DRRMC re-organized in June 2012 after TS Sendong, DRRMC could not function well for TS Sendong, but improved for TY Pablo using advanced guidance for evacuation, etc., and thereafter meetings, workshops, etc.</li> <li>Hazard map prepared in Nov. 2012 before Pablo with technical assistance from Xavier University, which could not be used for TS Sendong, but used for TY Pablo.</li> <li>No DRRM Plan prepared.</li> <li>DRRM Budget is about P 0.08 Mil in 2013</li> </ol>
15	Brgy. 17 BDRRM	Cecilia A. Oclarit/ Brgy Kagawad	600	Dec, 2012	-	NA	Before Pablo	City Planning Division Office of CDO	Yes	No	Yes	Yes	Warned the people near the river side	No	Yes	None	82,413	82,773	91,277	None	None	None	<ol> <li>DRRMC organized in Dec. 2012 after TS Sendong, DRRMC could not function well for TS Sendong, but improved for TY Pablo using hazard map, advanced guidance for evacuation, meetings, workshops, etc.</li> <li>Hazard map prepared before Pablo with technical assistance from CPDO, which could not be used for TS Sendong, but used for TY Pablo.</li> <li>No DRRM Plan prepared.</li> <li>DRRM Budget is about P 0.09 Mil in 2013.</li> </ol>
16	Brgy. 18 BDRRM	Mila G. Salico/ Brgy Captain	465	NA	Jan, 2012	NA	None	None	No	No	No	No	None	No	No	None	69,191	70,235	76,729	f Group Foundation	food, educational supply, 1,000 each to 80 persons	with 1,000x80 persons	<ol> <li>DRRMC re-organized in Jan. 2012 after TS Sendong, DRRMC could not function well for TS Sendong, but improved for TY Pablo using advanced guidance for evacuation, meetings, workshops, etc.</li> <li>No Hazard map prepared.</li> <li>No DRRM Plan prepared.</li> <li>DRRM Budget is about P 0.08 Mil in 2013.</li> </ol>

п.	Bukidnon PDRRMC	Aizel Joy O. Cagaanan	1,190,284 *persons as of Nov 2009	8-Sep-10	-	Available	Jul-12	Mines and Geosciences Bureau (MGB) under DENR	Yes	GIS	Yes	Yes	Integrated in the plans made	No	Yes	Jun-08	about 65 Million	about 65 Million	about 74 Million	Yearly allotment by the DRR Provincial Government 300,000.00	None	None	<ol> <li>DRRMC organized in Sep 2010, before TS Sendong, DRRMC could not function well for TS Sendong, but improved for TY Pablo, using hazard map, advanced guidance for evacuation, meetings, workshops, etc.</li> <li>Hazard map prepared by MGB/PPDO in July 2012 after TS Sendong,</li> <li>DRRM Plan prepared in June 2008.</li> <li>DRRM Budget is about P 74 Mil in 2013.</li> </ol>
П.1	Talakag MDRRMC	Janeric L. Manasan/ MLGOO/Chairman Preparedness	12,715	2004 (MDCC)	Oct, 2010 (MDRRMC)	NA	Jul-12	Mines and Geosciences Bureau (MGB) under DENR	Yes	GIS	Yes	Yes	None	No	Yes	None	6,059,000	6,338,206	7,470,266	None	None	None	<ol> <li>DCC organized in 2004 and DRRMC re-organized in Oct 2010, before TS Sendong, DRRMC could not function well for TS Sendong, but improved for TY Pablo, using hazard map, advanced guidance for evacuation, meetings, workshops, etc.</li> <li>Hazard map prepared by MGB in 2012 in July 2012 after TS Sendong.</li> <li>No DRRM Plan prepared.</li> <li>DRRM Budget is about P 7 Mil in 2013.</li> </ol>
1	Brgy. San Isidro BDRRMC	Lilia Lucmayan/ Brgy Secretary	1,338	NA	Oct, 2012 (BDRRMC)	NA	Oct-12	LGU	Yes	No	Yes	Yes	Evacate the areas if adviced by BDRRMC	No	Yes	None	116,558	122,871	144,798	None	None	None	<ol> <li>DRRMC re-organized in Oct 2012, after TS Sendong and before TY Pablo. DRRMC could not function well for TS Sendong, but improved for TY Pablo, using hazard map, advanced guidance for evacuation, meetings, workshops, etc.</li> <li>Hazard map prepared by LGU in Oct. 2012.</li> <li>No DRRM Plan prepared.</li> <li>ORRM Budget is about P 0.14 Mil in 2013.</li> </ol>
2	Brgy. San Antonio	Arlene G. Rangcasajo∕ Brgy Secretary	829	2008	Dec, 2011	Available	Oct-12	LGU	Yes	No	Yes	Yes	Assign persons per area to facilitate incase of incoming flood	No	Yes	None	78,402	NA	NA	None	None	None	<ol> <li>DRRMC organized in 2008 before TS Sendong and re-organized in Dec 2012 after TY Pablo. DRRMC could not function well for TS Sendong, but improved for TY Pablo, using hazard map, advanced guidance for evacuation, meetings, workshops, etc.</li> <li>Hazard map prepared by LGU in Oct. 2012.</li> <li>No DRRM Plan prepared.</li> <li>DRRM Budget is about P 0.08 Mil in 2011.</li> </ol>
п.2	2 Libona MDRRMC	Ursula C. Buta/ MSWDO-LDRRMO	8,856	Jan, 2011	Oct, 2012	Available	Jul-12	MGB	Yes	GIS	Yes	Yes	None	No	No	None	4,013,285	4,209,000	4,807,700	None	None	None	<ol> <li>DRRMC organized in Jan 2011 before TY Sendong, and re-organized in Oct 2012 before Pablo. DRRMC could not function well for TS Sendong, but improved for TY Pablo, using hazard map, advanced guidance for evacuation, meetings, workshops, etc.</li> <li>Hazard map prepared by MGB.</li> <li>No DRRM Plan prepared.</li> <li>DRRM Budget is about P 5 Mil in 2013.</li> </ol>
1	Brgy. Pongol BDRRMC	Alcon U. Calague/ Brgy Kagawad	1049	Apr, 2011	Mar, 2012	Available	26-Dec-12	LGU of Libona	Yes	No	Yes	Yes	None	No	No	None	80,913	83,716	99,180	relief goods from the province	in kind/goods	None	<ol> <li>DRRMC organized in April 2011before TS Sendong and re-organized in Mar 2012 before TY Pablo. DRRMC could not function well for TS Sendong, but improved for TY Pablo, using hazard map, advanced guidance for evacuation, meetings, workshops, etc.</li> <li>Hazard map prepared by LGU in Dec. 2012.</li> <li>No DRRM Plan prepared.</li> <li>DRRM Budget is about P 0.1 Mil in 2013.</li> </ol>
2	Brgy. Nangka BDRRMC	Marlo N. Iman/ Brgy Captain/BDRRMC Chairman	435	Dec, 2009 (BDCC)	Dec 10-13, 2012 (BDRRMC)	NA	10- 12/Dec/2012	LGU of 2 Libona	Yes	Experience	No	No	Tree planting (bamboo trees) in bubunawan river side (2.5 km covered by tree planting)	No	No	None	NA	53,696	62,505	None	None	None	<ol> <li>DCC organized in Dec 2009 before TS Sendong and DRRMC re-organized in Dec 2012 before TY Pablo. DRRMC could not function well for TS Sendong, but improved for TY Pablo, using hazard map, advanced guidance for vexucuation, meetings, workshops, etc.</li> <li>Hazard map prepared by LGU in Dec. 2012.</li> <li>No DRRM Plan prepared.</li> <li>DRRM Budget is about P 0.06 Mil in 2013.</li> </ol>
3	Brgy. Kinawe BDRRMC	Eleazar C. Bacus/ Bgry Captain	827	Dec, 2011	-	Available	10-Dec-12	None	Yes	Experience	Yes	Not Yet	Integrated in the contingency plan like putting signages in the danger zones	No	Yes	None	81,777	81,777	105,465	NGO'S	in kind/goods	None	<ol> <li>DRRMC organized in Dec 2011 before TS Sendong. DRRMC could not function well for TS Sendong, but improved for TY Pablo, using hazard map, advanced guidance for evacuation, meetings, workshops, etc. 2) Hazard map prepared by LGU in Dec. 2012.</li> <li>No DRRM Plan prepared.</li> <li>DRRM Budget is about P 0.11 Mil in 2013.</li> </ol>
п.:	Baungon MDRRMC	Nenita B. Navarez/ MSWDO/MDRRMO	7,365	28-Jun-11	-	Available	None	None	No	No	No	No	None	No	No	None	3,481,786	3,659,537	4,140,557	LGU	in kind/goods	None	<ol> <li>DRRMC organized in Jun 2011 before TY Sendong, DRRMC could not function well for TS Sendong, but improved for TY Pablo, using hazard map, advanced guidance for evacuation, meetings, workshops, etc.</li> <li>Hazard map prepared by MGB.</li> <li>No DRRM Plan prepared.</li> <li>DRRM Budget is about P 4 Mil in 2013.</li> </ol>
1	Brgy. Pualas BDRRMC	Edmund E.Pontilda∕ Brgy Treasurer	561	Jan, 2012	-	Available	Jun-12	LGU of Baungon	Yes	Experience	Yes	Not Yet	Purok 5.6.7 affected families should br relocated in higher grounds	No	Yes	None	NA	78,401	80,741	support from others	in kind/goods	None	<ol> <li>DRRMC Organized in Jan 2012, after TS Sendong and before TY Pablo. DRRMC could not function well for TS Sendong. but improved for TY Pablo, using hazard map, advanced guidance for evacuation, meetings, workshops, etc.</li> <li>Hazard map prepared by LGU in Jun. 2012.</li> <li>No DRRM Plan prepared.</li> <li>DRRM Budget is about P 0.08 Mil in 2013.</li> </ol>
2	Brgy. Lingating BDRRMC	Francis E. Boniao/ Brgy Kagawad	965	Jul, 2007	Jun, 2010	Available	Apr-12	Mucaard	Yes	Experience	Yes	Yes	Forced Evacuation	No	Yes	None	96,856	101,716	132,024	NGO'S	in kind/goods	None	<ol> <li>DCC organized in 2007 before TS Sendong and DRRMC re-organized in June 2010 before TS Sendong. DRRMC could not function well for TS Sendong, but improved for TY Pablo, using hazard map, advanced guidance for versucation, meetings, workshops, etc.</li> <li>Hazard map prepared by Mucaard (NGO) in April 2012.</li> <li>No DRRM Plan prepared.</li> <li>DRRM Budget is about P 0.13 Mil in 2013.</li> </ol>
3	Brgy Imbatug BDRRMC	Felomina C. Labitad/ Brgy Captain	1,172	Feb, 2010	Feb, 2011	Available	Jan-12	LGU	Yes	Experience	Yes	Yes	Put up early warning devices to the flood prone areas	No	Yes	None	115,026	122,862	141,914	NGO, PO	in kind/goods	None	<ol> <li>DRRMC organized in 2010 before TS Sendong and re-organized in Feb 2011 before TS Sendong. DRRMC could not function well for TS Sendong, but improved for TY Pablo, using hazard map, advanced guidance for evacuation, meetings, workshops, etc.</li> <li>Hazard map prepared by LGU in Jan. 2012.</li> <li>No DRRM Plain prepared.</li> <li>DRRME Budget is about P 0.14 Mil in 2013.</li> </ol>

											DRRMC Awareness & Skill				
Name of Surve DRRMC				Community-Based Flood	Early W	arning S	System (CE	BFEWS)				Trainings Received on DRRM			
N	ame of Surveyed				Dura	ation		CBFEWS	Componer	nts			Durat	ion	- 
	DRRMC	Y/N	CBFEWS Project	Sponsor Agency/ Organization	From	То	Rain Gauge	Water Level Staff Gauge	Water Level Auto Gauge	Others (Specify)	Title of Training/ Description	Sponsor Agency/Organization	From	То	
											Water Search & Rescue in CDO City	Philippine Airforce	2010		
											ICS in Cebu City	OCD	Aug-10	Aug-10	1) CBFEWS: Data of 4 Rain gau
											Basic Life Support in CDO City	Red Cross	2010	2012	CBEWS but web based) have be
			Under Preizet NOAH								Climate Change Adaption (CCA) and Local Programming with Emphasis on Meteorological Mitigation Capacity in CDO City	PAGASA-DOST	25-Jul-12	27-Jul-12	constructed by PAGASA in ELS yet, which may take more time of the important issues. Accord
L	CDO CDRRMC	Y	(not a CBEWS but web	DOST	2012	-	Yes	None	Yes	None	Multi-Hazard & Contingency Planning in CDO City	UN-OCHA	17-Sep-12	18-Sep-12	the FEWC by JICA can be cons
			based)								Incidental Command System (ICD) in Cebu City	OCD	8-Oct-12	9-Oct-12	piolt barangays for CBFEWS car
											DRRM Planning in CDO City	UNDP	11-Dec-12	13-Dec-12	2) Trainings: Various trainings h
											Climate Change Adaption Training in Legaspi City	UNDP	18-Dec-12	Dec-12	trainings for planning, implement
											Inception Workshop on Capacity Assessment of DRRMC/DRRMO of CDO & Iligan in CDO City	UNDP	21-Mar-13	Mar-13	be considered as necessary.
1 Brgy. Balulang Y										Seminar on Warning	HAVAS	NA	NA		
1 Brgy. Balulang Y BDRRMC Y			Home Owners Association							DRRM	DSWD	2009	NA	- 1) CBFEWS: Barangay Balulang svsmatic CBFEWS is not existir	
1 Brgy. Balulang Y BDRRMC Y		Siren	of Villa Angela Subdivision (HAVAS/partnership of	-	-	None	None	None	None	DRR	Partners Inc.	2009	NA	the possible JICA assistance. 2) Trainings: Various trainings b	
				OLIMBS/							DRR	Partners Inc.	2010	NA	planning, implementation, etc. fo considered as necessary. -
-											None	None	NA	NA	
2	Brgy. Bonbon	N	None	None	NΔ	NA	None	None	None	None	DRR Training	CDRRMC	3 months before Sendong	NA	_
2	BDRRMC		None	None	TWA		None	None	None	None	Rescue Operation	ORO ALERT	July, 2012	NA	
			Weter Level Staff O								Disaster Trainings	рон	2009	NA	
3	Brgy. Carmen	Y	before Ondoy, Sendong, and	CDRRMC	NA	NA	None	Yes	None	None	Disaster Trainings	PAF	2004	NA	
	BURRING		Pablo								Rescue Operations Trainings	Oro Alert	2000	NA	-
4	Brgy. Consolacion BDRRMC	N	None	None	NA	NA	None	None	None	None	Disaster Risk Reduction Management Training , Community Based	Oro Chamber and Red Cross	2 months after sendong	NA	
5	Brgy. Kauswagan	Ν	None	None	NA	NA	None	None	None	None	NONE	None	NA	NA	
	Dertrano									Undating Early	BRD Training for PWD's	HANDICAP INT'L	Oct , 2012	NA	
6	Brgy. Macabalan	Y	Barangay Weather	NA	NA	NA	None	None	None	Warning System	December 2012 in Grand caprice -1 Day	NA	NA	NA	1
-	BDRRMC		Monitoring Team							through internet	3 Modules DRRM Training	Xavier University and DENR	Nov 2012	NA	-
											1.) MOA signing for the Project 2.) Community Risk Assessment	Series of trainings from: Corporate Network for Disaster Response (CDNR), Smart	NA	NA	
	Brov Macasandio			CLIMBS -*an insurance of							3.) Community-Based Disaster Risk Management Workshop 4.) Contingency Planning Workshop	NA	NA	NA	-
7	BDRRMC	Y	Early Warning System	cooperative	NA	NA	None	None	None	None	5.) Camp Coordination and Camp Management Training/Drill Planning	NA	NA	NA	_
											6.) Table Top Exercise 7.) Final Briefing 8.) Flood Drill	NA	NA	NA	
8	Brgy. Nazareth BDRRMC	Y	Project NOAH	PAGASA, DOST, DAR, DENR, City Government	NA	NA	Yes	Yes	Yes	None	DISASTER RISK REDUCTION (fire fighting drill)	1) Philippine Rescue, 2) Coastguard hired by Brgy. Nazareth to do the trainings to their BDRRMC	2009	NA	
9	Brgy. Puntod BDRRMC	Ν	None	None	NA	NA	None	None	None	None	*no data	NA	NA	NA	
10	Brev. 6 BDRRMC	N	None	None	NA	NA	None	None	None	None	Module 1	Xavier Univesity	Nov, 2012	NA	
											Module 2	Xavier University	Nov, 2012	NA	
11	Brgy. 7 BDRRMC	Ν	None	None	NA	NA	None	None	None	None	Disaster Risk Reduction	LGU	NA	NA NA	1
		1			l		l			1	Disaster Preparedness	Xavier University	13-Dec-13	14-Dec-13	
12	Brgy. 10 BDRRMC	Ν	None	None	NA	NA	None	None	None	None	Disaster Risk Reduction Preparedness	Handicap International	25-Feb-12	NA	-
10	Broy 12 PDPDMO	N	Nerra	Nerra	NA	NIA	Nerre	Nerra	Ness	Neee	Disaster Risk Reduction Preparedness	BLGU Xavier University and DOH speakers	23-Jan-13	NA	
13	Drgy. 13 BDRRMC	IN .	ivone	ivone	NA 	NA	ivone	NUNE	inone	ivone	CBFEWS	ORO ALERT	NA	NA	
14	Brgy. 15 BDRRMC	N	None	None	NA	NA	None	None	None	None	Training on Disaster Peparedness Planning	Xavier University	14-Nov-12	NA	
						<u>.</u>					Disaster Risk Reduction	DILG and XAVIER UNIVERSITY	13-Nov-12	14-Nov-12	
15	Brgy. 17 BDRRMC	N	None	None	NA	NA	None	None	None	None	Disaster Risk Reduction	Congressnam Rutus Rodriguez	16-Nov-12 14-Dec-12	16-Nov-12 15-Dec-12	-
16	Brgy. 18 BDRRMC	N	None	None	NA	NA	None	None	None	None	*no data	NA	NA	NA NA	
		•		·	•							•	•		-

# Table 2.2.2 Results of Questionnaire and Interview Surveys (CBFEWS, Trainings on DRRM)

ssment on DRRMC Awareness & Skill
ges & 3 WLs in the CDO River Basin under Project NOAH (not a en used since 2012. Flood Early Warning Center (FEWG) will be alvador in 2013, however, system configuration has not decided to decide. Arrangement of PAGASA staff for the FEWC is also one ingly, technical assistance for capacity development to the staff in idered as necessary. Further, technical assistance to selected to be also considered as one of the possible JICA assistance, the CDO city. y many donor communities have been made since 2010. However, tation, etc. for CBFEWS and Contingency Plan to be prepared can
has siren and water level staff gauge for warning, however, g. Technical assistance for CBFEWS can be considered as one of y many donor communities have been made. However, trainings for r CBFEWS and Contingency Plan to be prepared can be
Do above

					-										
п.	Bukidnon PDRRMC	Y	18 Automatic Weather Station	Joint Effort of the Provincial Govenrment Bukidhon, Provincial Agriculture Office (PAO), Provincial Agricultural Fishery Council (PAFC), LGU's, and PAGASA Bukidhon PAGASA Bukidhon	2012	-	Yes	None	None	Automatic Weather Station at PAGASA Bukidnon	NA	NA	NA	NA	
											CCA and Contingency Plan Seminar (2013)	ABC, MUN. AD., MTO, CSO, NIPC, PNP, DILG, CEO, MBO, BFP, PIO, DENR	May, 2012	Dec, 2012	
	T I I NODDWO	~		2007	Oct,		×			Automatic Rain	DANA Training	ABC, MUN. AD., MTO, CSO, NIPC, PNP, DILG, CEO, MBO, BFP, PIO, DENR	May, 2012	Dec, 2012	1) CBFEWS: Data of 1 Rain gaug has been used since 2012. It se
ш.1	Talakag MDRRMC	Ŷ	Project NUAH	DOST	2012	-	Yes	None	None	Gauge	Basic Life Support (Module 2)	ABC, MUN. AD., MTO, CSO, NIPC, PNP, DILG, CEO, MBO, BFP, PIO, DENR	May, 2012	Dec, 2012	2) Trainings: Various trainings we etc. for CBFEWS and Continger
											Training and Seminar for MDRRMC	ABC, MUN. AD., MTO, CSO, NIPC, PNP, DILG, CEO, MBO, BFP, PIO, DENR	May, 2012	Dec, 2012	
1	Brgy. San Isidro BDRRMC	Y	EARLY WARNING SYSTEMS	NA	NA	NA	Yes	None	None	1) Traffic signs, 2) Wang-wang, 3) Flood Marker, 4) Continuous heavy rain, 5) Whistle, 6) Kuratong, 7) Bells	NONE	None	NA	NA	<ol> <li>CBFEWS: Own early warning system:</li> <li>Trainings: No trainings were made. Tr</li> <li>prepared can be considered as nece</li> </ol>
2	Brgy. San Antonio	N	None	None	NA	NA	None	None	None	None	Disater Preparedness Handling	DILG/LGU/Talakag	Oct., 2012	Oct, 2012	<ol> <li>CBFEWS: No systems exists.</li> <li>Trainings: Training on preparedness v Contingency Plan to be prepared can b</li> </ol>
											Rescue Training On First Aid/Basic Life Support - CPR And High Angle Rescue	Local Govenrment Unit of Libona	2-Feb-12	6-Feb-12	
				2007	0010		X			Automatic Rain	Barangay Rescuers Training And Planning Workshop On Disaster Preparedness Training Seminar (Batch #1)	Local Government Unit of Libona (70% DRRM)	27-May-12	1-Jun-12	1) CBFEWS: Data of 1 Rain gaug (not a CBEWS but web based) ha
11.2	Libona MDRRMC	Ŷ	Project NUAH	DOST	2012	-	Yes	None	None	Gauge	Barangay Rescuers Training And Planning Workshop On Disaster Preparedness Training Seminar (Batch #2)	Local Government Unit of Libona (70% DRRM)	15-Jun-12	19-Jun-12	2) Trainings: Various trainings we CBFEWS and Contingency Plan
											Barangay Rescuers Training And Planning Workshop On Disaster Preparedness Training Seminar (Batch #3)	Local Government Unit of Libona (70% DRRM)	15-Jun-12	19-Jun-12	
1	Brgy. Pongol	N	None	None	NA	NA	None	None	None	None	Basic Concepts of Disaster and Climate Change	MASS-PECC, LGU Libona	26-Dec-12	28-Dec-12	
<u> </u>	BDRRMC			× · · · · ·							Module 1	Xavier University	Nov, 2012	Nov, 2012	
2	Brgy. Nangka	Y	Early Warning System	in Partnership with	Jan,	NA	Yes	None	None	None	General Rescue	Libona, DILG and LGU	9-Aug-12	NA NA	
-	BDRRMC	·	Lany naming oyocom	PAGASA	2012		100	110110		10000	Disaster Risk Reduction	MASS-PECC, DILG and LGU	10-Dec-12	12-Dec-12	
									1		Disaster Preparedness Module 1	Xavier University, DILG, LGU	Nov, 2012	NA	
2	Brgy. Kinawe	V V	Archia Alacay (Privata)	Archia Alacay (Privata)	since	NA	Vac	Nono	Vac	Nono	Disaster Preparedness Module 2	Xavier University, DILG, LGU	Dec, 2012	NA	]
Ĭ	BDRRMC	l '	A one Alasay (1 Hvate)	A one Alasay (1 Hvate)	2002		103	None	103	None	Rescue	DSWD, FIRE DEPT., PNP, DA	Nov, 2012	NA	
											Rescue DRR and CC Adaptation	LGU	16-Feb-13 16-May-11	NA 17-May-11	
		v	Distant NOALI	DOCT	0010		Yes	News	Xee	Water Level Automatic Gauge	Rapid Damage Assessment and Needs Alaysis	LGU	22-Sep-11	23-Sep-11	1) CBFEWS: Data of 1 Rain gaug (not a CBEWS but web based) ha
11.3			Project NOAH	DOST	2012	-	Tes	None	tes	with Rain Gauge -2012	CBDRRM Training *batch # 1	LGU	13-Jun-12	15-Jun-12	2) Trainings: Various trainings we etc. for CBFEWS and Continger
											CBDRRM Training *batch # 2	LGU	4−Jul−12	5-Jul-12	, , , , , , , , , , , , , , , , , , ,
	Bray Buolog										BDRRMC Training for DRRM	MuCAARD (Muslim-Christian Agency for Advocacy Relief and Development Inc.	12-Feb-12	14-Feb-12	
1	BDRRMC	N	None	None	NA	NA	None	None	None	None	Disaster Risk Reduction	Advocacy Relief and Development Inc.	Nov, 2012	NA	
1					1	1					Disaster Risk Reduction	LGU of Baungon	June, 2012	NA	1
											Climate Change	Loren Legarda	July, 2012	NA	
	Brgy. Lingating				Nov, 2012	NA					CBDRRM	MuCAARD (Muslim-Christian Agency for Advocacy Relief and Development Inc.) and LGU	NA	NA	
2	BDRRMC	Ý	Siren and Megaphone	CFSI			None	None	None	Siren	Disaster Risk Reduction	MuCAARD (Muslim-Christian Agency for Advocacy Relief and Development Inc.) and LGU	NA	NA	
					1						Disaster Risk Reduction Training	DILG, DSWD	2011	NA	
1					2012						Project NOAH	Provincial DRRMC	27-Nov-12	NA	1
1	Brev Imbatue	L .			After	1.					Information Education Communication Campaign	NA	3-Dec-12	NA	1
3	BDRRMC	Y	NOAH	DOST /PAGASA	Sendon	NA	Yes	Yes	Yes	None	Mapping Climate change impacts in the Municipal Barangays covering Cagayan de Oro River basin and iponan watershed	DSWD	21-Feb-13	NA	

ge at Talakag under Project NOAH (not a CBEWS but web based) sems necessary to introduce CBFEWS in selected barangays, and vere made in 2012. However, trainings for planning, implementation, ncy Plan to be prepared can be considered as necessary.
is exists. rainings for planning, implementation, etc. for CBFEWS and Contingency Plan to essary
was made in 2012. Trainings for planning, implementation, etc. for CBFEWS and be considered as necessary
ge at Libona and 1 WL at Bubunawan bridge under Project NOAH as been used since 2012. It seems necessary to introduce and study possible JICA assistance. were made in 2012. Trainings for planning, implementation, etc. for a to be prepared can be considered as necessary.
Do above
Do above
Do above
te at Baungon and 1 WL at Bubunawan bridge under Project NOAH as been used since 2012. It seems necessary to introduce and study possible JICA assistance. rere made in 2011/2012. Trainings for planning, implementation, ncy Plan to be prepared can be considered as necessary
Do above
Do above

<b>Table 2.2.3</b>	<b>Results of Questionnaire and Intervi</b>	iew Surveys	(Activities during TS Sendong and TY Pat	blo)
--------------------	---	-------------	--	------

Name of Surveyed	<b>a</b>		TS Sendong			TY Pablo		
DRRMC	Descriptions	Before	During	After	Before	During	After	Assessment on DRRMC
	1 . Advisories/Updates recieved	Yes, but delayed	No data	No data	Yes	Yes	Yes	1) Advisories/Updateswere w well received and updated.
	2 . Source of Advisories/Updates	TV , Radio	No data	No data	TV , Radio	TV , Radio	TV, Radio	2) Source of Advisories/Upda
	3.Date received	16-Dec-11	No data	No data	1-Dec-12	2-4 Dec 2012	5-Dec-12	3) Date received: before, duri
	4 . Recepient of Advisories/Updates	No data	No data	No data	BDRRMCs	BDRRMCs	BDRRMCs	4) Recepient of Advisories/U
	5 . Action Taken	Very low awareness level since Northern Mindanao is Typhoon free	No right information to LGU	No data	Four (4) days before Pablo, City already prepared	Force evacuation	Conducted Post Evaluation, Debriefing to all stakeholders	5) Action Taken: Very low aw on action: 4 days before for
	1 . Advisories/Updates recieved		No data	No data	YES De die /ee le heere	YES	YES	-
	2 . Source of Advisories/ Opdates	No data	No data	No data	3-Dec-11		5-Dec-12	
	4 Receptent of Advisories/Updates	Barangay Secretary	No data	No data	Barangay Captain/Official	Barangay Captain/Official	Barangay Captain/Official	1
1 Brgy. Balulang BDRRMC	5 . Action Taken	Brgy. Sec. announced that there was a typhoon coming but did not mind it	16 Dec 2011 - called attention of council rescue operation	17 Dec 2011 - retrieval of casualties, damage assessment, relief operation ≉with Phil. Army, Police, Oro Alert Rescue, Mountain Climbers	Meeting (BDRRMC) for preparedness , Hauling of evacuees to SM, Xavier covered court, warning to all residents	Monitoring of evacuees situation, monitoring of typhoon	Hauling back of evacuees from EC to home, Damage assessment	•
	1 . Advisories/Updates recieved	No	No	Yes	YES	YES	YES	
	2. Source of Advisories/Undates	TV. Radio, SMS	TV. Radio, Celohone, SMS	No data	CDRRMC, TV, Radio, Celphone,	Celphone, SMS	TV. Radio Celohone SMS	
					SMS			
2 Brgy. Bonbon	3 . Date received	16-Dec-11	17-Dec-11	17-Dec-11	3-Dec-12	4-Dec-12	Dec 5,2012	4
BDRKMC	<ol> <li>Receptent of Advisories/Updates</li> <li>Action Taken</li> </ol>	Brgy Captain None -it was unexpected	Brgy. Captain Rescue operation, relief operation, Hauling of evacuees	Clean-up, monitoring, assessment of damages, relief operation	Re-echoed the updates from CDRRMC, forced evacuation, constant monitoring	Preparation	Monitoring of affecred area/assessment	
	1 . Advisories/Updates recieved	Yes	Yes	Yes	Yes	Yes	Yes	
	2 . Source of Advisories/Updates	PAGASA , BALAY MINDANAO -	TV, Radio, Celohone	TV, Radio, Celohone	PAGASA, CDRRMC, TV, RADIO,	No data	No data	
	3 Date received	No data	No data	No data	Two (2) days before Pablo	No data	No data	
3 Brgy. Carmen BDRRMC	4. Recepient of Advisories/Updates	Official -Members of BDRRMC	Official -Members of BDRRMC	Brgy Captain/Official and Members	Brgy Captain/Official	Brgy. Captain/Official	Brgy Captain/Official *members of	
	5 . Action Taken	Dissemination of Information	Rescue operation, transportation	Evacuation center/relief operation	Information dissemination, force evacuation, all BRGY. Captains and	Evacuation/Transportation of	Relief Operation/ foods, medicines,	
					Officials meeting at CDRRMC			
	Advisories/Updates recieved     Source of Advisories/Updates	Yes TV	Yes Civilian Volunteers Oro Alert	Yes No data	CDRRMC, ORO ALERT, PAGASA,	Yes No data	Yes No data	-
Brgv.					TV, Radio			
4 Consolacion	3 . Date received	Two (2) days before Sendong	No data	No data	No data	No data	No data	4
BDRRMC	4 . Receptent of Advisories/Updates	CVO's, lanod	No data	Brgy. Official	Brgy. Official	Brgy. Official	Brgy. Official	-
	5 . Action Taken	Information dissemination for incoming Sendong	operation, temporary evacuation at UCCP	damage assessment, relief operation (food)	Force evacuation of the identified areas under No Build Zone	evacuees, preparation incase of rescue operation	Evacuation center management, Assessment of damages	
	1 . Advisories/Updates recieved	No No	No.	Yes	Yes TV Oslahara	Yes Dadia Oalaharaa	Yes Dedie Oelekers	-
Brov Kauswagan	3 Date received	No data	No data	No data	No data	No data	No data	4
5 BDRRMC	4 Receptent of Advisories/Updates	No data	Brey Captain and Brey Officials	Brey Captain and Brey Officials	Brev Captain and Brev Officials	Brev Captain and Brev Officials	Brev Captain and Brev Official	
			Dig captair and big criticial	Relocation of victims, relief	Meeting of all Brgy Captains.	Monitoring, cutting of trees		1
	5. Action Taken	No data	Rescue operation	operations	voluntary evacuation	blocking the road	Relief operation	
	1 . Advisories/Updates recieved	No	No	Yes	Yes	Yes	Yes	
	2 . Source of Advisories/Updates	No data	Radio ,TV, not from concerned	Radio, Celohone	Radio, Celohone, Internet	Radio, Celohone	Radio, Celohone	
	3. Date received	No data	17-Dec-11	17-Dec-11	1-Dec-12	4-Dec-12	5-Dec-12	1
	4 . Recepient of Advisories/Updates	No data	Brgy. Captain and Brgy. Officials	Brgy. Captain and Brgy Kagawads	Brgy. Captain and Brgy Kagawads	Brgy. Captain and Brgy.Kagawads	Brgy. Captain and Brgy. Kagawads	]
6 Brgy. Macabalan BDRRMC	5 . Action Taken	No data	Brgy. Captain alarmed the people to stay awake	Rescue operation, listing of victims, route for evacuation center, relief operation	Weather Monitoring Team access to weather bulletin updates, provide briefings to the local recue team members, ready access to needed vehicles and other emergency supplies and materials, facilitate ready EC's, establishe proper communication and action, prioritize mobility of vulnerable sectors/residents to EC's	Posting of assigned rescue teams at designated strategic area, quick response to needed supplies- materials to EC's, sustained communication between and among BDRRM and CLGU's and NGO's concern	Sustained weather bulletin updates via internet, assessment EC's evacuees situation, alliance work with concern agencies for BDRRM concerns	
	1 . Advisories/Updates recieved	Yes	Yes	Yes	Yes	Yes	Yes	
	2 . Source of Advisories/Updates	OCD/ Region X	TV, Radio	Radio, Celohone	TV, Radio, Celphone	TV, Radio, Celphone	TV, Radio, Celphone	
	3 . Date received	12-Dec-11	16-Dec-11	Dec, 2011	2-Dec-12	4-Dec-12	Dec, 2012	
Brmy Managardia	4 . Recepient of Advisories/Updates	Brgy Captain and Brgy Officials (BDRRMC)	(BDRRMC)	BDRRMC)	BDRRMC)	(BDRRMC)	BDRRMC)	-
7 BDRRMC	5 . Action Taken	Monitoring of Sendong, information dissemination of updates, force evacuation (but many did not follow)	Still force evacuation for those along the river HH's, people were saving their own lives "it happened rapidly"	Retrieval of casualties, helping evacuees, provision of relief goods to EC's	Fiood drill, meeting of BDRRM/spread -call for duty, activated BDRRMC, prepared EC, transportation, warned the people, monitoring of typhoon, forced evacuation, disseminated pick-up area/ways	Force evacuation , monitoring of typhoon, stand by/get ready	Relief operation with CSWD/DSWD, helped the washed- out HH to be relocated	
P				i		i	· · · · · · · · · · · · · · · · · · ·	0

MC Activities, Before, During and After Sendong and Pablo
were received before Sendong, but delayed. Those for Pablo were
ndates for Sendong and Pablo was PAGASA through TV and Radio.
uring and after the incident.
/Updates: No data for Sendong, but BDRRMCs for Pablo
awareness level and no right info. to Sendong, but marked imrovement or preparation, 2 days before for evacuation, etc.
Basically same as above

$(\mathbf{U})$	munucu)								
È	Í Í Í	1 . Advisories/Updates recieved	No	Yes	Yes	Yes	Yes	Yes	
	2	2 . Source of Advisories/Updates	TV , Internet	TV	TV	Internet, PAGASA	Internet, PAGASA	Internet, PAGASA	
	3	3 . Date received	Three (3) days before landfall	No data	Jan, 2012	Three (3) days before landfall	No data	No data	
8	Brgy. Nazareth BDRRMC	4 . Recepient of Advisories/Updates	Brgy Council	Brgy Council	Brgy Council	Brgy Kagawad	Brgy Captain and Brgy Official (BDRRMC)	Brgy Captain and Brgy Official (BDRRMC)	В
	5	5 . Action Taken	None	Evacuated at Brgy Gym	Cleaning, damage assessment, relief operation	Informed the Chairman and the council, moved to evacuation	Moved to evacuation center, rescue operation	Cleaning of the Brgy, damage assessment, relief operation	
		1 Advisories / Indetes vesioned	Ne	Ne dete	Vee	Vee	Vee	Vee	
	ľ	I . Advisories/ Opdates recieved	No	No data	Remy Officials and City	Tes	Tes	Tes	
	2	2 . Source of Advisories/Updates	Research	No data	Government	CDRRMC	Celphone	Celphone	
	Brow Duntod	2 Data reactived	16-Dee-11	17-Dec-11	Ne data	Dec 2-4 2012	Ne data	No data	
9		A Date received	Ite-Dec-II	Pumi Officiale	No data	Dec 2-4, 2012 Rem: Officials	INO data	INO data	В
	DDIVINIO	+ . Receptent of Advisories/ Opdates	Brgy Official		Brgy Captain	Brgy Officials	Menitering all affected areas	Brgy Officials - Tarlou	
	Ę	5 . Action Taken	None	Evacuation and Rescue	Continue research, buy rescue equipments	Information dissemination	updating weather forecast,	Relief operations, food assistance	
	1	Advisories/Undates recieved	No	No	No	Yes	Yes	No data	
		2 Source of Advisories/Updates	TV Radio	No data	TV Radio	TV Radio OCD CDRRMC	TV Radio SMS	No data	
		3 Date received	No data	No data	No data	No data	4-Dec-12	No data	
10	Brgy. 6 BDRRMC	4. Receptent of Advisories/Updates	No data	No data	No data	Brgy Officials . Govt Officials	Brgy Officials	No data	в
				Evacuation Center - Tourism Hall	City Government helped only	Evacuated the people at City			
		5 . Action Taken	None	, then went to ampi	during rescue	Central School	Information dissemination	No data	
	1	1 . Advisories/Updates recieved	No	No	No	Yes	Yes	Yes	
	2	2. Source of Advisories/Updates	TV. Radio	Celphone	Celphone	TV .Radio. Celphone	TV .Radio. Celphone	TV .Radio. Celphone	
		3. Date received	No data	17-Dec-11	Dec 17-30, 2011	Two (2) days before Pablo	4-Dec-12	Dec 4-30, 2012	
11	Brgy. / BDRRMC	4. Recepient of Advisories/Updates	No data	Brgy Captain , Brgy Officials	Brgy Captain , Brgy Officials	Brgy Captain	Brgy Captain , Brgy Officials	Brgy Captain, brgy Officials	В
				Evacuated the affected people,	Clean-up, effected people were	Meeting of BDRRMC at City for	Force evacuation, accomodation of	Clean up, relief operation,	
		. Action Taken	INORE	relief operation	evacuated	Warning	evacuees	coordination to MDRRMC	
	1	1 . Advisories/Updates recieved	No	No	No	Yes	Yes	No data	
	l ľ	2 Source of Advisories (11-d-t	TV	No data	Calabana	Internet, PAGASA, ORO ALERT,	TV, Radio, Celphone, Internet,	RAadio, Celphone, House-to-	
	4	2 . Source of Advisories/ Updates	10	No data	Celphone	CDRRMC	CDRRMC	House, Mega Phone	
10	Brgy. 10	3 . Date received	No data	No data	two (2) days after	No data	No data	No data	
12	BDRRMC	4 . Recepient of Advisories/Updates	None	All the Barangay Officials	All the Barangay Officials	All Barangay Officials	All the Barangay Officials	No data	В
					Ole minus of debuies well of an emotion	Warning dissemination 24 hrs,	E	Hauling back of the evacuees to	
	Ę	5 . Action Taken	None	Rescue operation	Cleaning of debris, relief operation,	standb, meeting with CDRRMC-	Force evacuation to Camaman-an,	Brgyn, all evacuees were given	
					coordinations to other LGO's	week before Pablo	put warning signs near the road	relief, cleaning/ clearing of debris	
	1	1 . Advisories/Updates recieved	Yes	Yes	Yes	Yes	No data	No data	
	2	2. Source of Advisories/Updates	Celphone, CDRRMC, PAGASA	Siren and Mega Phone of the Brgy	No data	OCD, CDRRMC	No data	No data	
12	Brgy. 13	3 . Date received	No data	No data	No data	Nov 30-Dec 2, 2012	No data	No data	
13	BDRRMC	4 . Recepient of Advisories/Updates	Brgy Captain	Brgy Captain, Brgy Officials	No data	Brgy Official	No data	No data	Ь
	ŧ	5 . Action Taken	Information dissemination from CDRRMC to Barangay	Monitor of the rise of water	No data	All the brgy officials were called for meeting	No data	No data	
	1	1 . Advisories/Updates recieved	Yes	No data	No data	Yes	Yes	Yes	
	2	2 . Source of Advisories/Updates	TV, Radio, SMS, Celphone	No data	No data	Radio	Celphone	Celphone	
	3	3 . Date received	15-Dec-11	No data	No data	2 or 3 days before Pablo	4-Dec-12	A day after and so on	
14	Brgy. 15	4 . Recepient of Advisories/Updates	Brgy Captain	No data	No data	Brgy Captain and Brgy Officials (BDRRMC)	Brgy Captain and Brgy Officials	Brgy Captain and Bgry Officials	В
	55111110	5 . Action Taken	Information dissemination to people, rescue preparation	Brgy Officials, Oro Alert, Opol Municipality Suport the rescue operation	Relief operation, accomodation of the victims esp. children, facilitate the shelter of the victims in the	Seminars on preparation for Pablo Storm, color coding of the alert level, monitoring, evacuated the	Monitoring of the safetyness, rouving	Relief operation at the identified EC, hauling of the evacuees going back to brgy	
		· · · · · · · · · ·			relocation sites	people to higher grounds		Y .	
		I . Advisories/Updates recieved	No TV D I	No TV D	No O L L OMO	Yes	Yes	Yes	
	2	2 . Source of Advisories/Updates	IV, Radio	IV, Radio	Celphone, SMS	Celphone, SMS			
	<u> </u>	3 . Date received	16-Dec-12	Den Contain and Dury Officials		Two (2) days before	4-Dec-12	D-Dec-12	
15	Brgy. 17 4	4 . Recepient of Advisories/Updates	Brgy Officials and all the people	and the people	Brgy Captain and Brgy Officials	Brgy Captain and Brgy Officials	Brgy Captain and Brgy Officials	Officials	в
	BDRRMC	5 . Action Taken	Listened to radio for update	Ran away from flood/ saving their lives	Rescue operation, retrieval operation, clean-up, relief operation, assessment of damage, coordination in the other agencies	Meeting of officials by CDRRMC, forced evacuation	Monitoring of the flood and the typhoon	Clean-up, going back to the houses, assessment of damage	
	1	1 . Advisories/Updates recieved	No	Yes	Yes	Yes	Yes	Yes	
	2	2 . Source of Advisories/Updates	TV, Radio	Brgy Tanod	Brgy tanod	TV, Radio, Celphone	TV, Radio, Celphone	TV, Radio, Celphone	
16	Brgy. 18	3 . Date received	1 day before Sendong	No data	No data	3 days before Pablo	No data	No data	_
10	BDRRMC	4 . Recepient of Advisories/Updates	Brgy Official	Brgy Officials	Bgry Official	Brgy Captain	Brgy Captain and Brgy Officials	Brgy Captain and Brgy Officials	В
	F	5 . Action Taken	Disseminated Information	Rescue operation	Relief operation, continue rescue	CDRRMC Meeting -all Brgy	Area Monitoring	Relief operations, cleaning	
			Vee		operation	Captains		Vec	1) Advisories/Updateswere were recei
			PAGASA, RDRRMC, TV, Radio,						well received and updated.
	4	2 . Source of Advisories/ Updates	Celphone	IV, Radio, Celphone, LDRRIVIO	LDRRMO	PAGASA, RDRRMC	i v, Radio, Celphone	IV, Radio, Celphone	2) Source of Advisories/Updates for S
п	Bukidnon	3 . Date received	14-Dec-11	16-Dec-11	Dec, 2011	Dec 1-2, 2012	4-Dec-12	Dec ##, 2012	3) Date received: before, during and at
п.	PDRRMC	A Descript of Advisories / Indates			Burge Contain and Officials	Berry Contain and LDBBMO	Brgy Captain and Officials, Police,	Brgy Captain and Officials,	1) Recontant of Advicentics (Undetex)
	2						army, PDRRMC staff	farmers, victims, LDRRMO	
	Ę	5 . Action Taken	Text brigade, warning, informaiton dissemination	Rescue operation in Baungon, Libona	Relief Operation, program for rehab and recovery, release of shelter assistance from LDRRMF	Warned the LDRRMO, on stand by	Stand by 24/7, rescue operation at valencia	Assesment of damage	5) Action Taken: Very low awareness I on action: 4 days before for preparat
	1	I Advisories/Updates recieved	No	Yes	Yes			Yes	
	2	2 . Source of Advisories/Updates	No dete	IV, Mayor			1 V, Radio, Celphone		
	2	Date received	Neme						
<b>II</b> 4	Talakag	+ . Receptent of Advisories/Updates	Ivoné		MURRMU		MDRRMU	MURRMU	
п. 1	MDRRMC				Accomment of democratic	INLOU meeting, identified flood	Monitoring of event, ready for	RDANA, hire vehicle for additional	В
		Antion Taken	Name	MDRRMO conducted monitoring of	Assessment of damage, evacuation	for every strong identified	rescue by vehicles, pre-emptive	transport services for Rapid	
		D. Action Taken	None	the river	demaged family closering of read	in barangeus for monitoring of	evacuations in Brgy4, Lapok and	Damage Assessment and Needs	
					damaged family, cleaning of road	water level	Lirungan	Analysis (RDANA)	
		1 Advisories/Undatos residuad	Vac	Ves	Vec		Vec	Ves	
		2 Source of Advisories / Indates	TV Radio Celobone	TV Radio Celobone	TV Radio Celobone	TV Radio Celohone	TV Radio Celebone	TV Radio Celobone	
	Brgy, San Isidro	B Date received	Dec 13-14 2011	16-Dec-11	17-Dec-11	Dec 2-3 2012		5-Dec-12	
1	BDRRMC	A Recenient of Advisories/Undetee	Broy Cantain	Broy Cantain and Broy Officials	Broy Cantain and Broy Officials	Broy Cantain and Broy Officials	Broy Cantain	Broy Cantain and Broy Official	В
		T. Receptent of Advisories/ Opdates		Brgy Captain and Drgy Officials	Digy Captain and Drgy Officials	Warned the people pear the river		Digy Capitalitianu Drgy Official	
	5	5 . Action Taken	Warned the people near the river	Monitoring at Ugiaban	Assessment of damage	for a difference of the stress	Monitoring	in the sold buildes ushed	

Basically same as above
Basically same as above
received before Sendong, but delayed. Those for Pablo were
s for Sendong and Pablo was PAGASA through TV and Radio.
and after the incident.
tes: No data for Sendong, but BDRRMCs for Pablo
ness level and no right info. to Sendong, but marked imrovement iparation, 2 days before for evacuation, etc.
Basically same as above
Basically same as above

_									
		1 . Advisories/Updates recieved	No	No	No	No	No	Yes	
		2 Source of Advisories/Undates	No data	No data	No data	TV Badio	TV Radio	Brev Official	
		3 Date received	No data	No data	No data	No data	No data	No data	
	Brgy. San	A December of Advicentics (Updates	No data	No data	No data	No data	No data	Dura Official	_
2	Antonio	4 . Receptent of Advisories/Updates	No data	No data	No data	No data	No data	Brgy Official	E E
								Damage report, evaluation of	
	1	5 . Action Taken	No data	No data	No data	No data	No data	affected/victims, province gave	
								financial assisstance to the victims	
									1) Advisories/Updateswere were rece
		<ol> <li>Advisories/Updates recieved</li> </ol>	No	Yes	Yes	Yes	Yes	Yes	well received and undeted
									well received and updated.
								TV, Radio, Through validation of	
								the victims, from the evacuees and	
		2 Source of Advisories/Undates	Media	Radio PAGASA MEDIA	Handheld radio and letter of	TV Celphone	Barangay Disaster Risk Reduction	Pablo victims themselves who were	2) Source of Advisories/Undates for 5
			Modia		communication		and Management Council		
								validated as to the extent of	
								damages done by the typhoon	
		3 . Date received	No data	16-Dec-11	17-Dec-11	Dec 3 .2012	4-Dec-12	5-Dec-12	3) Date received: before, during and a
11.2	Libona MDRRMC			Brmy Officials, Purok Presidents					
	4	4 . Recepient of Advisories/Updates	No data	Digy Officials, Fullok Fresidencs	Brgy Officials and Brgy Tanod	Schools Heads and Brgy Captains	Brgy Officials	Brgy Officials and Evacuees	<ol><li>Recepient of Advisories/Updates: N</li></ol>
				and Brgy Captain					
					Route from evacuation center to	Through TV, handheld radio and	Through public transportation		
					their respective homes. The team	Office Order to evacuate hazard	services and force evacuation to		
				Boute to covered court as	conducted emergency MDRRMC	prope areas pre-emptive	neonle living in prone areas, force	Return of evacuees from	5) Action Taken: Very low awareness
	5	5 . Action Taken	No data		conducted emergency mortane		people inting in profile droug, force	Evacuation Centers to their	
				evacuation center	meeting to assess damage of	evacuation from their respective	evacuation to covered courts,	respective home	on action: 4 days before for preparat
					typhoon needs through the Brgy	homes to assigned schools as	school buildings and other assigned		
					DRRMC	evacuation buildings	emergency evacuation centers		
	Brey Pongol								
	Digy. I oligoi	<ol> <li>Advisories/Updates recieved</li> </ol>	Yes	Yes	YES	Yes	Yes	Yes	
	DURRING				1				
1	1	2 Source of Advisories/Undates	TV Radio Celphone	Man Power (Tanod and Council),	Radio Celphone	PAGASA, TV, Radio, Celphone,	TV Radio Celphone	TV Radio Celphone	
1	f			Purok Presidents		LGU Libona			1
1		3 Date received	15-Dec-11	16-Dec-11	17-Dec-11	Dec 3 2012	4-Dec-12	Dec 5-6 2012	
		o . Date received				Dec 0,2012		000 0 0, 2012	
1	4	4 . Recepient of Advisories/Updates	Brev Captain and Officials	Brev Captain and Brev Officials	Brev Captain and Brev Officials	Brgy Captain, Brgy Officials, and	Brey Captain and Brey Official	Brev Captain and Brev Officials	E
			Big, captain and criticialo	Big, captain and Big, childle	Big, suptain and big, shiolais	the Community	Big, suptain and Big, stillia	Sig, captain and sig, chickais	-
			Information dissemination by					Assessment, relief operations from	
			Dural Dranaustian of avecuation		Assisting Housing Materials (fund	Information dissemination 1 day		municipal financial accietance and	
		- ··· -··	Purok, Preparation of evacuation		from MDRRMC), Evacuation of	before Pablo, Preparation of EC	Survey, updating of affected area,	municipal, mancial assistance and	
		5 . Action Taken	centers, vehicles and other	Rescue operation	neonle giving of relief goods	and rescue operation -MDRRMC	undating of weather	relief goods, assistance for partially	
			equipments needed for EC and		people, giving of relief goods,		updating of weather	and totally damaged houses from	
			rescue		clothings	and Mayor		province	
		1 Advissuiss / Indetse us sissed	Y	V	V	¥	VEC		
	-	I . Advisories/ Updates recieved	Yes	tes	res	Yes	YES	YES	
	1	2 . Source of Advisories/Updates	TV, Radio	TV, Radio	TV, Radio	TV, Radio	TV, Radio	TV, Radio	
		3 . Date received	16-Dec-11	16-Dec-11	17-Dec-11	Dec 3 ,2012	4-Dec-12	5-Dec-12	
2	Brgy. Nangka	A Receptent of Advisories/Undates	Brmy Cantain and Officials	Brmy Captain and Officials	Brmy Cantain	Brmy Cantain and Officials	Broy Captain and Officials	Brmy Cantain and Officials	P
-	BDRRMC	+ . Receptent of Advisories/ opdates	Digy Captain and Officials			bigy baptain and ornelais			-
					Monitored the Brgy/assessment of	informed/warned the people,	Stand by for emergency activities.	Relief operation to evacuees,	
	5	5 . Action Taken	Warning from MDRRMC	No data	damage reported to MDRPMC	forced evacuation conducted for	food roliof to overview	assessment of damage and	
					damage, reported to MDRRMO	those families in the danger zone	rood relief to evacuees	submitted to MDRRMC	
	1	1 Advisories/Indates recieved	Yes	No data	Yes	Yes	Yes	Yes	
		2 Source of Adviceries (Undetee	Ddia_MDDDMC	Ne data	Padia	Dadia	Padia Calabana	Padia Calabana	
	4	2 . Source of Advisories/ Updates	Raio-MDRRING	INO data	Radio	Radio	Radio, Celphone	Radio, Celphone	
	Brm Kinowo	3 . Date received	16-Dec-11	No data	17-Dec-11	Dec 3 ,2012	4-Dec-12	4-Dec-12	
3	Drgy. Kinawe	4	Council	1 s s				Prov Contain and Officials	_
		4 . Receptent of Advisories/Updates	Council	No data	Brgy Captain and Brgy Officials	All Council of Kinawe	Brgy Captain and Brgy Officials	Drgy Gaptain and Officials	
	BDIVINIO	4 . Receptent of Advisories/Updates	Council	No data	Brgy Captain and Brgy Officials	All Council of Kinawe	Brgy Captain and Brgy Officials		
	BDITTWIC	4 . Receptent of Advisories/Updates		No data	Survey, monitoring of damaged	All Council of Kinawe Meeting called by MDRRMC and	Brgy Captain and Brgy Officials Rescue team spread out near river	Monitoring of damages with	
	BDITTING	4         . Receptent of Advisories/ Updates           5         . Action Taken	information dissemination	No data No data	Brgy Captain and Brgy Officials Survey, monitoring of damaged	All Council of Kinawe Meeting called by MDRRMC and warning	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be	Monitoring of damages with	
	BDRRWC {	Kecepient of Advisories/ Updates     Action Taken	information dissemination	No data No data	Brgy Captain and Brgy Officials Survey, monitoring of damaged areas	All Council of Kinawe Meeting called by MDRRMC and warning	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready	Monitoring of damages with MDRRMC	
	EDITING (	Kecepient of Advisories/ Updates     Action Taken	information dissemination	No data No data	Brgy Captain and Brgy Officials Survey, monitoring of damaged areas	All Council of Kinawe Meeting called by MDRRMC and warning	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready	Monitoring of damages with MDRRMC	T) Advisories/Updateswere were rece
		4 . Receptent of Advisories/Updates     5 . Action Taken     1 . Advisories/Updates recieved	information dissemination	No data No data No	Brgy Captain and Brgy Officials Survey, monitoring of damaged areas Yes	All Council of Kinawe Meeting called by MDRRMC and warning Yes	Brgy Captain and Brgy Othicials Rescue team spread out near river and creeks to monitor and be ready Yes	Monitoring of damages with MDRRMC Yes	T) Advisories/Updateswere were rece
		A . Receptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Communication (Industry)	information dissemination YES	No data No data No	Brgy Captain and Brgy Officials Survey, monitoring of damaged areas Yes	All Council of Kinawe Meeting called by MDRRMC and warning Yes	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes	Monitoring of damages with MDRRMC Yes	1) Advisories/Updateswere were rece well received and updated.
		A . Receptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates	YES TV, RADIO	No data No data No data	Brgy Captain and Brgy Officials Survey, monitoring of damaged areas Yes Radio	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio	Monitoring of damages with MDRRMC Yes Radio	1) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for \$
	Baungen	A . Receptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received	information dissemination YES TV, RADIO 16-Dec-11	No data No data No No data No data	Brgy Captain and Brgy Officials Survey, monitoring of damaged areas Yes Radio 17-Dec-11	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12	Monitoring of damages with MDRRMC Yes Radio 5-Dec-12	1) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a
П.3	Baungon	Acceptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received	YES TV, RADIO 16-Dec-11	No data No data No data No data	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bery Captain with MDRRMC and	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brey Captain and Officials with	Monitoring of damages with MDRRMC Yes Radio 5-Dec-12	1) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a
II.3	Baungon MDRRMC	4 . Recepient of Advisories/Updates     5 . Action Taken     1 . Advisories/Updates recieved     2 . Source of Advisories/Updates     3 . Date received     4 . Recepient of Advisories/Updates	YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC	No data No No data No data No data No data	Brgy Captain and Brgy Officials Survey, monitoring of damaged areas Yes Radio 17-Dec-11 Bgry Captain with MDRRMC and yolunteers	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRPMC	Monitoring of damages with MDRRMC Yes Radio 5-Dec-12 Brgy Captain and Officials	1) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates; N
П.З	Baungon MDRRMC	A Complete of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Recepient of Advisories/Updates	information dissemination YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC	No data No data No data No data No data	Brgy Captain and Brgy Officials Survey, monitoring of damaged areas Yes Radio 17-Dec-11 Bgry Captain with MDRRMC and volunteers	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRRMC	Monitoring of damages with MDRRMC Yes Radio 5-Dec-12 Brgy Captain and Officials	1) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N
П.З	Baungon S MDRRMC 4	4 . Recepient of Advisories/Updates     5 . Action Taken     1 . Advisories/Updates recieved     2 . Source of Advisories/Updates     3 . Date received     4 . Recepient of Advisories/Updates	YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC Monitoring if the typhoon, warned	No data No data No data No data No data No data	Brgy Captain and Brgy Officials Survey, monitoring of damaged areas Yes Radio 17-Dec-11 Bgry Captain with MDRRMC and volunteers Rescue/retrieval of the affected	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRRMC Monitoring of the typhoon ready	Monitoring of damages with MDRRMC Yes Radio 5-Dec-12 Brgy Captain and Officials Relief operation, feeding of	1) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very Iow awarenees
П.З	Baungon MDRRMC	A Complete of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Recepient of Advisories/Updates     Action Taken	information dissemination YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC	No data No data No data No data No data No data	Brgy Captain and Brgy Officials Survey, monitoring of damaged areas Yes Radio 17-Dec-11 Bgry Captain with MDRRMC and volunteers Rescue/retrieval of the affected, relief prestion	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2–3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRRMC Monitoring of the typhoon, ready stand by	Monitoring of damages with MDRRMC Yes Radio 5-Dec-12 Brgy Captain and Officials Relief operation, feeding of evacuees, monitoring of the	1) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 5 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for arcsect
II.3	Baungon S MDRRMC	Acceptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Receptent of Advisories/Updates     Action Taken	YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman	No data No data No data No data No data No data	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRMC Monitoring of the typhoon, ready stand by	Monitoring of damages with MDRRMC Yes Radio 5-Dec-12 Brgy Captain and Officials Relief operation, feeding of evacuees, monitoring of the evacuees	1) Advisories/Updateswere were rece well received and updated.     2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat
П.3	Baungon 4 MDRRMC 4	A . Receptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Receptent of Advisories/Updates     Advisories/Updates     Advisories/Updates	information dissemination YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman	No data	Brgy Captain and Brgy Officials Survey, monitoring of damaged areas Yes Radio 17-Dec-11 Bgry Captain with MDRRMC and volunteers Rescue/retrieval of the affected, relief operation	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yee	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRRMC Monitoring of the typhoon, ready stand by Yee	Monitoring of damages with MDRRMC Yes Radio 5-Dec-12 Brgy Captain and Officials Relief operation, feeding of evacuees, monitoring of the evacuees	1) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 9 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat
п.з	Baungon MDRRMC	Acceptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Acceptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Action Taken	YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman No	No data No data No data No data No data No data No data	Brgy Captain and Brgy Officials       Survey, monitoring of damaged areas       Yes       Radio       17-Dec-11       Bgry Captain with MDRRMC and volunteers       Rescue/retrieval of the affected, relief operation       No       Dudie	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2–3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Dec 5 - Och	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRRMC Monitoring of the typhoon, ready stand by Yes	Monitoring of damages with MDRRMC Yes Radio 5-Dec-12 Brgy Captain and Officials Relief operation, feeding of evacuees, monitoring of the evacues	<ol> <li>Advisories/Updateswere were rece well received and updated.</li> <li>Source of Advisories/Updates for 3</li> <li>Date received: before, during and a</li> <li>Recepient of Advisories/Updates: N</li> <li>Action Taken: Very low awareness on action: 4 days before for preparat</li> </ol>
П.З	Baungon S MDRRMC	Acceptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates	YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman No TV	No data No data No data No data No data No data No data TV	Brgy Captain and Brgy Officials Survey, monitoring of damaged areas Yes Radio 17-Dec-11 Bgry Captain with MDRRMC and volunteers Rescue/retrieval of the affected, relief operation No Radio, Celphone	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2–3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRRMC Monitoring of the typhoon, ready stand by Yes Radio, Celphone	Monitoring of damages with MDRMC Yes Radio 5-Dec-12 Brgy Captain and Officials Relief operation, feeding of evacuees, monitoring of the evacuees Yes Radio, Celphone	1) Advisories/Updateswere were rece well received and updated.     2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat
П.З	Baungon MDRRMC	A comparison of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Advisories/Updates recieved     Source of Advisories/Updates	YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC Monitoring if the typhoon, warned the BDRRMO, called the BDRRMC and warned the chairman No TV 16-Dec-11	No data Ino data Ino Ino Inv	Brgy Captain and Brgy Officials Survey, monitoring of damaged areas Yes Radio 17-Dec-11 Bgry Captain with MDRRMC and volunteers Rescue/retrieval of the affected, relief operation No Radio, Celphone 17-Dec-11	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012	Brgy Captain and Brgy Officials         Rescue team spread out near river         and creeks to monitor and be         ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with MDRTMC         Monitoring of the typhoon, ready stand by         Yes         Radio, Celphone         4-Dec-12	Monitoring of damages with MDRRMC Yes Radio 5-Dec-12 Brgy Captain and Officials Relief operation, feeding of evacuees, monitoring of the evacuees Yes Radio, Celphone 5-Dec-12	1) Advisories/Updateswere were rece well received and updated.     2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat
П.3	Baungon MDRRMC	Acceptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Source of Advisories/Updates     Date received     Descript of Advisories/Updates	YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman No TV 16-Dec-11 No the	No data No TV TV 17-Dec-11 Nure	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Dec 2-3, 2012	Brgy Captain and Brgy Officials         Rescue team spread out near river         and creeks to monitor and be         ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with MDRRMC         Monitoring of the typhoon, ready stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with DRYC	Monitoring of damages with MDRRMC Yes Radio 5-Dec-12 Brgy Captain and Officials Relief operation, feeding of evacuees, monitoring of the evacuees Yes Radio, Celphone 5-Dec-12 Durg Costain and Officials	1) Advisories/Updateswere were rece well received and updated.     2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat
II.3 1	Baungon MDRRMC	Acceptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Source of Advisories/Updates     Source of Advisories/Updates     Date received     Source of Advisories/Updates     Date received     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates	information dissemination YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman No TV 16-Dec-11 No data	No data TV 17-Dec-11 None	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRRMC Monitoring of the typhoon, ready stand by Yes Radio, Celphone 4-Dec-12 Brgy Captain and officials with community volunteers in the Brow	Monitoring of damages with MDRMC Yes Radio 5-Dec-12 Brgy Captain and Officials Relief operation, feeding of evacuees, monitoring of the evacuees Yes Radio, Celphone 5-Dec-12 Brgy Captain and officials	<ol> <li>Advisories/Updateswere were rece well received and updated.</li> <li>Source of Advisories/Updates for 3</li> <li>Date received: before, during and a</li> <li>Recepient of Advisories/Updates: N</li> <li>Action Taken: Very low awareness on action: 4 days before for preparat</li> </ol>
II.3 1	Baungon MDRRMC Brgy. Pualas BDRRMC	Acceptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Source of Advisories/Updates     Date received     Date received     Receptent of Advisories/Updates     Date received     Receptent of Advisories/Updates	YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman No TV 16-Dec-11 No data	No data No data No data No data No data No data No data No data 17-Dec-11 None	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Acaessment of dominant operation	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRRMC Monitoring of the typhoon, ready stand by Yes Radio, Celphone 4-Dec-12 Brgy Captain and officials with community volunteers in the Brgy Deadly weaks	Monitoring of damages with MDRRMC Yes Radio 5-Dec-12 Brgy Captain and Officials Relief operation, feeding of evacuees, monitoring of the evacuees Yes Radio, Celphone 5-Dec-12 Brgy Captain and officials	1) Advisories/Updateswere were rece well received and updated.     2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat
п.з	Baungon MDRRMC Brgy. Pualas BDRRMC	Acceptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Source of Advisories/Updates     Date received     Source of Advisories/Updates     Date received     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates     Action Taken     Advisories/Updates     Action Taken     Advisories/Updates     Action Taken     Action Taken     Advisories/Updates     Action Taken	information dissemination YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman No TV 16-Dec-11 No data	No data TV 17-Dec-11 None	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2–3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRRMC Monitoring of the typhoon, ready stand by Yes Radio, Celphone 4-Dec-12 Brgy Captain and officials with community volunteers in the Brgy Rready -warning system set up,	Monitoring of damages with MDRMC Yes Radio 5-Dec-12 Brgy Captain and Officials Relief operation, feeding of evacuees, monitoring of the evacuees Yes Radio, Celphone 5-Dec-12 Brgy Captain and officials Cleaning of public places.	1) Advisories/Updateswere were rece well received and updated.     2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat E
II.3 1	Baungon MDRRMC Brgy. Pualas BDRRMC	Acceptent of Advisories/Updates     Acceptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Source of Advisories/Updates     Date received     Reception of Advisories/Updates     Action Taken	YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman No TV 16-Dec-11 No data	No data No data No data No data No data No data No data TV 17-Dec-11 None	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods,	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepared	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRRMC Monitoring of the typhoon, ready stand by Yes Radio, Celphone 4-Dec-12 Brgy Captain and officials with community volunteers in the Brgy Rready -warning system set up, standby for emergency, designated	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage	<ol> <li>Advisories/Updateswere were rece well received and updated.</li> <li>Source of Advisories/Updates for 3</li> <li>Date received: before, during and a</li> <li>Recepient of Advisories/Updates: N</li> <li>Action Taken: Very low awareness on action: 4 days before for preparat</li> </ol>
II.3	Baungon MDRRMC Brgy. Pualas BDRRMC	<ol> <li>Receptent of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Source of Advisories/Updates</li> <li>Source of Advisories/Updates</li> <li>Receptent of Advisories/Updates</li> <li>Action Taken</li> <li>Receptent of Advisories/Updates</li> </ol>	information dissemination YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman No TV 16-Dec-11 No data No data	No data No TV 17-Dec-11 None None	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRRMC Monitoring of the typhoon, ready stand by Yes Radio, Celphone 4-Dec-12 Brgy Captain and officials with community volunteers in the Brgy Rready -warning system set up, standby for emergency, designated relocation sites just in case	Monitoring of damages with MDRRMC Yes Radio 5-Dec-12 Brgy Captain and Officials Relief operation, feeding of evacuees, monitoring of the evacuees Yes Radio, Celphone 5-Dec-12 Brgy Captain and officials Cleaning of public places, assessment of damage	1) Advisories/Updateswere were rece well received and updated.     2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat
II.3 1	Baungon MDRRMC Brgy. Pualas BDRRMC	Acception of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Reception of Advisories/Updates     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates recieved	Volateli         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned         the BDRRMC, called the BDRRMC         and warned the chairman         No         TV         16-Dec-11         No data         No data	No data No data No No data No TV 17-Dec-11 None None Yes	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio. Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRRMC Monitoring of the typhoon, ready stand by Yes Radio, Celphone 4-Dec-12 Brgy Captain and officials with community volunteers in the Brgy Rready -warning system set up, standby for emergency, designated relocation sites just in case	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes	<ol> <li>Advisories/Updateswere were rece well received and updated.</li> <li>Source of Advisories/Updates for 3</li> <li>Date received: before, during and a</li> <li>Recepient of Advisories/Updates: N</li> <li>Action Taken: Very low awareness on action: 4 days before for preparat</li> </ol>
II.3 1	Baungon MDRRMC Brgy. Pualas BDRRMC	Acceptent of Advisories/Updates     Acceptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Action Taken     Action Taken     Advisories/Updates recieved     Action Taken     Action Taken     Advisories/Updates recieved     Action Taken	information dissemination YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman No TV 16-Dec-11 No data No data No data DV Badia MEDIA DACACA	No data No TV 17-Dec-11 None None Yes Colobara	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         Duration	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes DL Device	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRRMC Monitoring of the typhoon, ready stand by Yes Radio, Celphone 4-Dec-12 Brgy Captain and officials with community volunteers in the Brgy Rrady -warning system set up, standby for emergency, designated relocation sites just in case Yes	Monitoring of damages with MDRRMC Yes Radio 5-Dec-12 Brgy Captain and Officials Relief operation, feeding of evacuees, monitoring of the evacuees Yes Radio, Celphone 5-Dec-12 Brgy Captain and officials Cleaning of public places, assessment of damage Yes Perior Colonana	1) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat E
II.3 1	Baungon MDRRMC Brgy. Pualas BDRRMC	Acception of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Reception of Advisories/Updates     Advisories/Updates recieved     Advisories/Updates recieved     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Reception of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates	VOULCH         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman         No         TV         16-Dec-11         No         No         TV         16-Dec-11         No data         No data         Yes         TV, Radio, MEDIA, PAGASA	No data No TV 17-Dec-11 None None Yes Celphone	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRRMC Monitoring of the typhoon, ready stand by Yes Radio, Celphone 4-Dec-12 Brgy Captain and officials with community volunteers in the Brgy Rready -warning system set up, standby for emergency, designated relocation sites just in case Yes TV, Radio, Celphone	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone	1) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat E
II.3 1	Baungon MDRRMC Brgy. Pualas BDRRMC	Acception of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates     Action Taken     Advisories/Updates     Action Taken     Action Taken     Action Taken     Action Taken     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Source of Advisories/Updates	Volacia         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman         No         TV         16-Dec-11         No data         Ves         TV, Radio, MEDIA, PAGASA         15-Dec-11	No data No	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012	Brgy Captain and Brgy Officials         Rescue team spread out near river         and creeks to monitor and be         ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with         MDRRMC         Monitoring of the typhoon, ready         stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with         community volunteers in the Brgy         Rready -warning system set up,         standby for emergency, designated         relocation sites just in case         Yes         TV, Radio, Celphone         4-Dec-12	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         evacuees         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12	1) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat E
II.3 1	Baungon MDRRMC Brgy. Pualas BDRRMC	Acceptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates     Action Taken     Actio	YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman No TV 16-Dec-11 No data No data Yes TV, Radio, MEDIA, PAGASA 15-Dec-11	No data No TV 17-Dec-11 None None Yes Celphone 16-Dec-11	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials.	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012	Brgy Captain and Brgy Officials         Rescue team spread out near river         and creeks to monitor and be         ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with MDRRMC         Monitoring of the typhoon, ready stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with community volunteers in the Brgy         Rready -warning system set up, standby for emergency, designated relocation sites just in case         Yes         TV, Radio, Celphone         4-Dec-12	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials	1) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat
II.3 1	Baungon MDRRMC Brgy. Pualas BDRRMC	Acceptent of Advisories/Updates     Acceptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Source of Advisories/Updat	YES TV, RADIO TV TC	No data No TV 17-Dec-11 None None Yes Celphone 16-Dec-11 Bray Cantaja and Officials	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials,         BDRBMC with volunteers	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials	Brgy Captain and Brgy Officials         Rescue team spread out near river         and creeks to monitor and be         ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with         MDRRMC         Monitoring of the typhoon, ready         stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with         community volunteers in the Brgy         Rready -warning system set up,         standby for emergency, designated         relocation sites just in case         Yes         Tv, Radio, Celphone         4-Dec-12	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRPMC	1) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat E
п.з	Baungon MDRRMC Brgy. Pualas BDRRMC	<ol> <li>Acceptent of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Acti</li></ol>	YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman No TV 16-Dec-11 No data No data Yes TV, Radio, MEDIA, PAGASA 15-Dec-11 Brgy Captain and officials	No data No data No data No data No data No data No data No data No data No TV 17-Dec-11 None None Yes Celphone 16-Dec-11 Brgy Captain and Officials	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the month of the volunteers from the month.	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRRMC Monitoring of the typhoon, ready stand by Yes Radio, Celphone 4-Dec-12 Brgy Captain and officials with community volunteers in the Brgy Rready -warning system set up, standby for emergency, designated relocation sites just in case Yes TV, Radio, Celphone 4-Dec-12 Brgy Captain, BDRRMC	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC	1) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat E
II.3 1	Baungon MDRRMC Brgy. Pualas BDRRMC	Acceptent of Advisories/Updates     Acceptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Action Taken     Actio	Volucii         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman         No         TV         16-Dec-11         No         No         TV         16-Dec-11         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials	No data No data Secondaria None Yes Celphone 16-Dec-11 Brgy Captain and Officials	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials	Brgy Captain and Brgy Officials         Rescue team spread out near river         and creeks to monitor and be         Yes         Radio         4-Dec-12         Brgy Captain and Officials with         MDRRMC         Monitoring of the typhoon, ready         stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with         community volunteers in the Brgy         Rready -warning system set up,         standby for emergency, designated         Yes         TV, Radio, Celphone         4-Dec-12         Brgy Captain, and officials with         community volunteers in the Brgy         Reside, Support         Ready -warning system set up,         standby for emergency, designated         Yes         TV, Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of         evacuees, monitoring of the         evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC	1) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat E
II.3	Brgy. Pualas BDRRMC	<ol> <li>Recepient of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Recepient of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Source of Advisories/Updates</li> <li>Source of Advisories/Updates</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Action</li></ol>	information dissemination YES TV, RADIO 16-Dec-11 Brgy Captain/BDRRMC Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman No TV 16-Dec-11 No data No data Yes TV, Radio, MEDIA, PAGASA 15-Dec-11 Brgy Captain and officials	No data No TV 17-Dec-11 None None Yes Celphone 16-Dec-11 Brgy Captain and Officials	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials Flood drill, meeting of	Brgy Captain and Brgy Officials Rescue team spread out near river and creeks to monitor and be ready Yes Radio 4-Dec-12 Brgy Captain and Officials with MDRRMC Monitoring of the typhoon, ready stand by Yes Radio, Celphone 4-Dec-12 Brgy Captain and officials with community volunteers in the Brgy Rready -warning system set up, standby for emergency, designated relocation sites just in case Yes TV, Radio, Celphone 4-Dec-12 Brgy Captain, BDRRMC	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC	1) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat E
1	Baungon MDRRMC Brgy. Pualas BDRRMC BBRRMC	Acceptent of Advisories/Updates     Acceptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates     Action Taken     Advisories/Updates     Action Taken     Action Taken	Volucii         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned         the BDRRMC, called the BDRRMC         and warned the chairman         No         TV         16-Dec-11         No data         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials	No data No data Secondaria None Yes Celphone 16-Dec-11 Brgy Captain and Officials	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread =call for duty.	Brgy Captain and Brgy Officials         Rescue team spread out near river         and creeks to monitor and be         ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with         MDRRMC         Monitoring of the typhoon, ready         stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with         community volunteers in the Brgy         Rready -warning system set up,         Ves         Yready -warning system set up,         Yes         TV, Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC	1) Advisories/Updateswere were recewell received and updated.         2) Source of Advisories/Updates for 3         3) Date received: before, during and a         4) Recepient of Advisories/Updates: N         5) Action Taken: Very low awareness on action: 4 days before for preparat
II.3 1 2	Baungon MDRRMC Brgy. Pualas BDRRMC BDRRMC	<ol> <li>Recepient of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Recepient of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Recepient of Advisories/Updates</li> <li>Date received</li> <li>Recepient of Advisories/Updates</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Recepient of Advisories/Updates</li> <li>Date received</li> <li>Recepient of Advisories/Updates</li> </ol>	Volucii         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman         No         TV         16-Dec-11         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials	No data No TV 17-Dec-11 None None Yes Celphone 16-Dec-11 Brgy Captain and Officials	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread -call for duty, cetingted BDRDPD0	Brgy Captain and Brgy Officials         Rescue team spread out near river         and creeks to monitor and be         ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with         MDRRMC         Monitoring of the typhoon, ready         stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with         community volunteers in the Brgy         Ready -warning system set up,         standby for emergency, designated         relocation sites just in case         Yes         TV, Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         evacuees         S-Dec-12         Brgy Capitalin and Officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC	1) Advisories/Updateswere were recewell received and updated.         2) Source of Advisories/Updates for 3         3) Date received: before, during and a         4) Recepient of Advisories/Updates: N         5) Action Taken: Very low awareness on action: 4 days before for preparat
11.3	Baungon MDRRMC Brgy. Pualas BDRRMC BDRRMC BDRRMC	<ol> <li>Acceptent of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Source of Advisories/Updates</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Action Taken</li> <li>Action Taken</li> <li>Action Taken</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Source of Advisories/Updates</li> </ol>	Volucii         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned         the BDRRMO, called the BDRRMC         and warned the chairman         No         TV         16-Dec-11         No data         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials	No data Second S	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city         Monitoring of flood, assessment of	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare TV, Radio Dec 2-3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread -call for duty, activated BDRRMC, prepared EC,	Brgy Captain and Brgy Officials         Rescue team spread out near river and creeks to monitor and be ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with MDRRMC         Monitoring of the typhoon, ready stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with community volunteers in the Brgy Rready -warning system set up, standby for emergency, designated relocation sites just in case         Yes         TV, Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC	1) Advisories/Updateswere were recewell received and updated.         2) Source of Advisories/Updates for 3         3) Date received: before, during and a         4) Recepient of Advisories/Updates: N         5) Action Taken: Very low awareness on action: 4 days before for preparat
II.3 1 2	Baungon MDRRMC Brgy. Pualas BDRRMC Brgy. Lingating BDRRMC	<ol> <li>Acceptent of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Recepient of Advisories/Updates</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> </ol>	Volucii         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman         No         TV         16-Dec-11         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials         No data	No data No TV TV 17-Dec-11 None None Yes Celphone 16-Dec-11 Brgy Captain and Officials Monitoring of the flood, assessment	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city         Monitoring of flood, assessment of damages, relief operation, feeding	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread -call for duty, activated BDRRMC, prepared EC, transportation, warned the people,	Brgy Captain and Brgy Officials         Rescue team spread out near river         and creeks to monitor and be         ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with         MDRRMC         Monitoring of the typhoon, ready         stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with         community volunteers in the Brgy         Rready -warning system set up,         standby for emergency, designated         relocation sites just in case         Yes         Brgy Captain, BDRRMC         Monitoring of flood	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capital and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capital and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC	1) Advisories/Updateswere were recewell received and updated.         2) Source of Advisories/Updates for 3         3) Date received: before, during and a         4) Recepient of Advisories/Updates: N         5) Action Taken: Very low awareness on action: 4 days before for preparat
II.3 1	Baungon MDRRMC Brgy. Pualas BDRRMC BDRRMC	<ol> <li>Receptent of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Source of Advisories/Updates</li> <li>Receptent of Advisories/Updates</li> <li>Source of Advisories/Updates</li> </ol>	Volucin         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman         No         TV         16-Dec-11         No data         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials         No data	No data No TV 17-Dec-11 None None Yes Celphone 16-Dec-11 Brgy Captain and Officials Monitoring of the flood, assessment	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city         Monitoring of flood, assessment of damages, relief operation, feeding of victims	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2–3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2–3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread –call for duty, activated BDRRMC, prepared EC, transportation, warned the people, monitoring of tvohoon. forced	Brgy Captain and Brgy Officials         Rescue team spread out near river         and creeks to monitor and be         ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with MDRRMC         Monitoring of the typhoon, ready stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with community volunteers in the Brgy         Rready -warning system set up, standby for emergency, designated relocation sites just in case         Yes         TV, Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees, monitoring of the evacuees.         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees	Advisories/Updateswere were rece well received and updated.     Source of Advisories/Updates for 3 Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat E
II.3 1 2	Brgy. Pualas BDRRMC	Action Taken	Volucii         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman         No         TV         16-Dec-11         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials         No data	No data Second S	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city         Monitoring of flood, assessment of damages, relief operation, feeding of victims	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread -call for duty, activated BDRRMC, prepared EC, transportation, warned the people, monitoring of typhoon, forced evacuation disseminated nickernel	Brgy Captain and Brgy Officials         Rescue team spread out near river and oreeks to monitor and be ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with MDRRMC         Monitoring of the typhoon, ready stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with community volunteers in the Brgy Rready -warning system set up, standby for emergency, designated relocation sites just in case         Yes         TV. Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees, monitoring of the evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees	1) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat E
II.3 1	Baungon MDRRMC Brgy. Pualas BDRRMC Brgy. Lingating BDRRMC	<ol> <li>Recepient of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Recepient of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Recepient of Advisories/Updates</li> <li>Action Taken</li> </ol>	Voinclin         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned the BDRRMC called the BDRRMC and warned the chairman         No         TV         16-Dec-11         No data         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials         No data	No data No TV 17-Dec-11 None None Yes Celphone 16-Dec-11 Brgy Captain and Officials Monitoring of the flood, assessment	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city         Monitoring of flood, assessment of damages, relief operation, feeding of victims	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread -call for duty, activated BDRRMC, prepared EC, transportation, warned the people, monitoring of typhoon, forced evacuation, disseminated pick-up	Brgy Captain and Brgy Officials       Rescue team spread out near river and creeks to monitor and be ready       Yes       Radio       4-Dec-12       Brgy Captain and Officials with MDRRMC       Monitoring of the typhoon, ready stand by       Yes       Radio, Celphone       4-Dec-12       Brgy Captain and officials with community volunteers in the Brgy Rready -warning system set up, standby for emergency, designated relocation sites just in case       Yes       TV, Radio, Celphone       4-Dec-12       Brgy Captain, BDRRMC       Monitoring of flood	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capital and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         evacuees, monitoring of the evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capital and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees	1) Advisories/Updateswere were recewell received and updated.         2) Source of Advisories/Updates for 3         3) Date received: before, during and a         4) Recepient of Advisories/Updates: N         5) Action Taken: Very low awareness on action: 4 days before for preparat         E
II.3 1 2	Baungon MDRRMC Brgy. Pualas BDRRMC BDRRMC	<ol> <li>Acceptent of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Action Taken</li> <li>Action Taken</li> <li>Action Taken</li> <li>Action Taken</li> </ol>	Volucii         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman         No         TV         16-Dec-11         No data         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials         No data	No data No TV 17 17-Dec-11 None None Yes Celphone 16-Dec-11 Brgy Captain and Officials Monitoring of the flood, assessment	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city         Monitoring of flood, assessment of damages, relief operation, feeding of victims	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread -call for duty, activated BDRRMC, prepared EC, transportation, warned the people, monitoring of typhoon, forced evacuation, disseminated pick-up area/ways	Brgy Captain and Brgy Officials         Rescue team spread out near river and oreeks to monitor and be ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with MDRRMC         Monitoring of the typhoon, ready stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with community volunteers in the Brgy         Rready -warning system set up, standby for emergency, designated relocation sites just in case         Yes         Brgy Captain, BDRRMC         Monitoring of flood	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees	1) Advisories/Updateswere were recewell received and updated.         2) Source of Advisories/Updates for 3         3) Date received: before, during and a         4) Recepient of Advisories/Updates: N         5) Action Taken: Very low awareness on action: 4 days before for preparat         E
II.3 1 2	Brgy. Pualas BDRRMC	Acception of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Source of Advisories/Updates     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Action Taken     Advisories/Updates	Volucii         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman         No         TV         16-Dec-11         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials         No data         No data	No data No TV 17-Dec-11 None None Yes Celphone 16-Dec-11 Brgy Captain and Officials Monitoring of the flood, assessment Yes	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, our of relief goods, our of relief goods, other the city         TV, Radio         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city         Monitoring of flood, assessment of damages, relief operation, feeding of victims         Yes         Yes	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread -call for duty, activated BDRRMC, prepared the people, monitoring of typhoon, forced evacuation, disseminated pick-up area/ways Yes	Brgy Captain and Brgy Officials         Rescue team spread out near river and oreeks to monitor and be ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with MDRRMC         Monitoring of the typhoon, ready stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with community volunteers in the Brgy         Radio, Celphone         4-Dec-12         Brgy Captain and officials with community volunteers in the Brgy         Radio, Celphone         4-Dec-12         Brgy Captain and officials with community volunteers in the Brgy         Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC         Monitoring of flood         Yes         Monitoring of flood	Brgy Capital and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capital and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capital and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees         Yes	1) Advisories/Updateswere were recewell received and updated.         2) Source of Advisories/Updates for 3         3) Date received: before, during and a         4) Recepient of Advisories/Updates: N         5) Action Taken: Very low awareness on action: 4 days before for preparat         E         E         E         E         E         E         E         E
II.3 1 2	Baungon MDRRMC		Voolnchi         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned         the BDRRMC, called the BDRRMC         and warned the chairman         No         TV         16-Dec-11         No data         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials         No data         No data	No data No TV 17 17 17 17 17 17 17 17 17 17 17 17 17	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials         BSsessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city         Monitoring of flood, assessment of damages, relief operation, feeding of victims         Yes         Yes         Brgy Tanod, Bery Officials	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread -call for duty, activated BDRRMC, prepared EC, transportation, disseminated pick-up area/ways Yes LGU	Brgy Captain and Brgy Officials         Rescue team spread out near river         and creeks to monitor and be         ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with         MDRRMC         Monitoring of the typhoon, ready         stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with community volunteers in the Brgy         Rready -warning system set up,         standby for emergency, designated relocation sites just in case         Yes         Brgy Captain, BDRRMC         Monitoring of flood         Yes         Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees         Yes         Radio, Celphone	1) Advisories/Updateswere were recevell received and updated.         2) Source of Advisories/Updates for 3         3) Date received: before, during and a         4) Recepient of Advisories/Updates: N         5) Action Taken: Very low awareness on action: 4 days before for preparat         E
II.3 1 2	Brgy. Pualas BDRRMC	Acception of Advisories/Updates     Acception Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Accion Taken     Advisories/Updates recieved     Source of Advisories/Updates     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates	Volume         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman         No         TV         16-Dec-11         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials         No data         No data         No data         No data	No data No TV TV 17-Dec-11 None Yes Celphone 16-Dec-11 Brgy Captain and Officials Monitoring of the flood, assessment Yes Brgy Tanod, Brgy Officials 17-Dec-11	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city         Monitoring of flood, assessment of damages, relief operation, feeding of victims         Yes         Brgy Tanod, Bgry Officials	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread -call for duty, activated BDRRMC, prepared EC, transportation, warned the people, monitoring of typhoon, forced evacuation, disseminated pick-up area/ways Yes	Brgy Captain and Brgy Officials         Rescue team spread out near river         and creeks to monitor and be         ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with         MDRRMC         Monitoring of the typhoon, ready         stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with         community volunteers in the Brgy         Rradio, Celphone         4-Dec-12         Brgy Gaptain and officials with         community volunteers in the Brgy         Rradio, Celphone         4-Dec-12         Brgy Captain, and officials is a set up,         standby for emergency, designated         relocation sites just in case         Yes         Brgy Captain, BDRRMC         Monitoring of flood         Yes         Radio, Celphone         4-Dec-12	Brgy Capital and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capital and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         evacuees         S-Dec-12         Brgy Capital and Officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRC         Assessment of damage, relief operation to evacuees         Yes         Radio, Celphone         5-Dec-12	1) Advisories/Updateswere were recewell received and updated.         2) Source of Advisories/Updates for 3) Date received: before, during and a         4) Recepient of Advisories/Updates: N         5) Action Taken: Very low awareness on action: 4 days before for preparat         E         E         E         E         E         E         E         E
II.3 1 2	Baungon MDRRMC		Volucial         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned         the BDRRMC, called the BDRRMC         and warned the chairman         No         TV         16-Dec-11         No data         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials         No data         No data         No data         No data	No data No dat	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city         Monitoring of flood, assessment of damages, relief operation, feeding of victims         Yes         Prey Tanod, Bry Officials         17-Dec-11	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread -call for duty, activated BDRRMC, prepared EC, transportation, disseminated pick-up area/ways Yes LGU A week before Pablo	Brgy Captain and Brgy Officials         Rescue team spread out near river         and creeks to monitor and be         Yes         Radio         4-Dec-12         Brgy Captain and Officials with         MDRRMC         Monitoring of the typhoon, ready         stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with         community volunteers in the Brgy         Readio, Celphone         4-Dec-12         Brgy Captain, and officials with         community volunteers in the Brgy         Ready vorning system set up,         Ves         TV, Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC         Monitoring of flood         Yes         Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC         Monitoring of flood	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         evacuees, monitoring of the evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees         Yes         Radio, Celphone         5-Dec-12	1) Advisories/Updateswere were recevell received and updated.         2) Source of Advisories/Updates for 3) Date received: before, during and a         4) Recepient of Advisories/Updates: N         5) Action Taken: Very low awareness on action: 4 days before for preparat         E
II.3 1 2	Baungon MDRRMC	Acception of Advisories/Updates     Acception Taken     Advisories/Updates recieved     Source of Advisories/Updates     J Date received     Accion Taken     Advisories/Updates recieved     Source of Advisories/Updates	Voidicili         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman         No         TV         16-Dec-11         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials         No data         No         No data         No         No data         No data         No data         No data	No data No	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city         Monitoring of flood, assessment of damages, relief operation, feeding of victims         Yes         Yes         Pyes         Ty-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city         Monitoring of flood, assessment of damages, relief operation, feeding of victims         Yes         Brgy Tanod, Bgry Officials         17-Dec-11         Brgy Captain and Brgy Officials	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2–3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2–3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread –call for duty, activated BDRRMC, prepared EC, transportation, warned the people, monitoring of typhoon, forced evacuation, disseminated pick-up area/ways Yes LGU	Brgy Captain and Brgy Officials         Rescue team spread out near river         and creeks to monitor and be         ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with         MDRRMC         Monitoring of the typhoon, ready         stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with         community volunteers in the Brgy         Rready -warning system set up,         standby for emergency, designated         relocation sites just in case         Yes         Brgy Captain, BDRRMC         Monitoring of flood         Yes         Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC         Monitoring of flood         Yes         Radio, Celphone         4-Dec-12         Brgy Officials	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capital and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capital and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees         Yes         Radio, Celphone         5-Dec-12         BDRRMC	1) Advisories/Updateswere were recevell received and updated.         2) Source of Advisories/Updates for 3) Date received: before, during and a         4) Recepient of Advisories/Updates: N         5) Action Taken: Very low awareness on action: 4 days before for preparat
II.3 1 2 3	Brgy Imbatug BDRRMC	Acceptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     J advisories/Updates recieved     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     A Receptent of Advisories/Updates     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Receptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     A Receptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     A Receptent of Advisories/Updates     Action Taken     Advisories/Updates recieved     A Receptent of Advisories/Updates	Volucin         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned         the BDRRMO, called the BDRRMC         and warned the chairman         No         TV         16-Dec-11         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials         No data	No data No TV TV 17-Dec-11 None None Yes Celphone 16-Dec-11 Brgy Captain and Officials Monitoring of the flood, assessment Yes Brgy Tanod, Brgy Officials 17-Dec-11 Brgy officials	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         Monitoring of flood, assessment of damages, relief operation, feeding of victims         Yees         Brgy Tanod, Bgry Officials         17-Dec-11         Brgy Captain and Brgy Officials         Receile operation, feeding of victims	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread -call for duty, activated BDRRMC, prepared EC, transportation, warned the people, monitoring of typhoon, forced evacuation, disseminated pick-up area/ways Yes LGU A week before Pablo Brgy Officials	Brgy Captain and Brgy Officials         Rescue team spread out near river and creeks to monitor and be ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with MDRRMC         Monitoring of the typhoon, ready stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with community volunteers in the Brgy         Radio, Celphone         4-Dec-12         Brgy Captain and officials with community volunteers in the Brgy         Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC         4-Dec-12         Brgy Captain, BDRRMC         Monitoring of flood         Yes         Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC         Monitoring of flood         Yes         Radio, Celphone         4-Dec-12         Brgy Officials	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees.         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees         Yes         Radio, Celphone         5-Dec-12         BDRRMC	I) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat E
II.3 1 2 3	Baungon MDRRMC Brgy. Pualas BDRRMC BBRRMC BBRRMC	<ol> <li>Acceptent of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Date received</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Receptent of Advisories/Updates</li> <li>Action Taken</li> <li>Action Taken</li> <li>Action Taken</li> <li>Action Taken</li> <li>Action Taken</li> </ol>	Volume         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman         No         TV         16-Dec-11         No data         Vy         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials         No data         No         No data         No data         No data         No data         No data	No data No TV 17-Dec-11 None Yes Celphone 16-Dec-11 Brgy Captain and Officials Monitoring of the flood, assessment Yes Brgy Tanod, Brgy Officials 17-Dec-11 Brgy officials -	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city         Monitoring of flood, assessment of damages, relief operation, feeding of victims         Yes         Yy         Brgy Tanod, Bgry Officials         17-Dec-11         Brgy Captain and Brgy Officials         Regif operation from MDRRMC, continue rescue operation grave	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread -call for duty, activated BDRRMC, prepared EC, transportation, warned the people, monitoring of typhoon, forced evacuation, disseminated pick-up area/ways Yes LGU A week before Pablo Brgy Officials 2 days before information	Brgy Captain and Brgy Officials         Rescue team spread out near river         and creeks to monitor and be         ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with         MDRRMC         Monitoring of the typhoon, ready         stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with         community volunteers in the Brgy         Rready -warning system set up,         standby for emergency, designated         relocation sites just in case         Yes         Brgy Captain, BDRRMC         Monitoring of flood         Yes         Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC         Monitoring of flood         Yes         Radio, Celphone         4-Dec-12         Brgy Officials	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Relief operation and Brgy Officials         Relief operation, goods home	I) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat E E E E E E E E E E E E E
II.3 1 2 3	Brgy. Pualas BDRRMC	Acception of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Date received     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Action Taken     Advisories/Updates recieved     Source of Advisories/Updates     Action Taken     Action	Voideling         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned the BDRRMC called the BDRRMC and warned the chairman         No         TV         16-Dec-11         No data         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials         No data         No data	No data No TV TV 17-Dec-11 None Yes Celphone 16-Dec-11 Brgy Captain and Officials Monitoring of the flood, assessment Yes Brgy Tanod, Brgy Officials 17-Dec-11 Brgy Officials Rescue	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials,         BDRRMC with volunteers from the city         Monitoring of flood, assessment of damages, relief operation, feeding of victims         Yes         Brgy Captain and Dfficials, BDRRMC with volunteers from the city         Monitoring of flood, assessment of damages, relief operation, feeding of victims         Yes         Brgy Tanod, Bgry Officials         Brgy Captain and Brgy Officials         Relief operation from MDRRMC, continue rescue operation, gave         Phen 1500 capt formit (http://dot.mail	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread -call for duty, activated BDRRMC, prepared EC, transportation, warned the people, monitoring of typhoon, forced evacuation, disseminated pick-up area/ways Yes LGU A week before Pablo Brgy Officials Seminars/meeting all barangay officials 2 days before, information	Brgy Captain and Brgy Officials         Rescue team spread out near river         and creeks to monitor and be         ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with MDRRMC         Monitoring of the typhoon, ready stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with community volunteers in the Brgy         Radio, Celphone         4-Dec-12         Brgy Captain and officials with community volunteers in the Brgy         Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC         Wonitoring of flood         Yes         Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC         Monitoring of flood         Yes         Radio, Celphone         4-Dec-12         Brgy Officials         Monitoring of flood	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees, monitoring of the evacuees.         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Relief operation and Brgy Officials         Relief operation, goods, home materials	1) Advisories/Updateswere were recewell received and updated.         2) Source of Advisories/Updates for 3         3) Date received: before, during and a         4) Recepient of Advisories/Updates: N         5) Action Taken: Very low awareness on action: 4 days before for preparat         E
II.3 1 2 3	Baungon MDRRMC Brgy. Pualas BDRRMC BDRRMC BDRRMC BDRRMC	<ol> <li>Receptent of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Receptent of Advisories/Updates</li> <li>Source of Advisories/Updates</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Source of Advisories/Updates</li> <li>Source of Advisories/Updates</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> </ol>	Voidicii         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned         the BDRRMC, called the BDRRMC         and warned the chairman         No         TV         16-Dec-11         No data         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials         No data         No         No data	No data No TV 17 17 17 17 17 17 17 17 17 17 17 17 17	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials         BDRRMC with volunteers from the city         Monitoring of flood, assessment of damages, relief operation, feeding of victims         Yes         Yes         Pres         Yv, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city         Monitoring of flood, assessment of damages, relief operation, feeding of victims         Yes         Pres         Yes         Brgy Tanod, Bgry Officials         Relief operation from MDRRMC, continue rescue operation, gave Php 1,500 each family (totally	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread -call for duty, activated BDRRMC, prepared EC, transportation, warned the people, monitoring of typhoon, forced evacuation, disseminated pick-up area/ways Yes LGU A week before Pablo Brgy Officials Seminars/meeting all barangay officials 2 days before, information dissemination, forced evacuation,	Brgy Captain and Brgy Officials         Rescue team spread out near river and oreeks to monitor and be ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with MDRRMC         Monitoring of the typhoon, ready stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and Officials with community volunteers in the Brgy         Rready -warning system set up, standby for emergency, designated relocation sites just in case         Yes         Brgy Captain, BDRRMC         Monitoring of flood         Yes         Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC         Monitoring of flood         Monitoring of flood         Monitoring	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Captain and Brgy Officials         Relief operation, goods, home materials	I) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat E E E E E E E E E E E E E
II.3 1 2 3	Brgy. Pualas BDRRMC	<ol> <li>Accepient of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Recepient of Advisories/Updates</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Action Taken</li> <li>Advisories/Updates recieved</li> <li>Source of Advisories/Updates</li> <li>Source of Advisories/Updates</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Recepient of Advisories/Updates</li> <li>Source of Advisories/Updates</li> <li>Date received</li> <li>Recepient of Advisories/Updates</li> <li>Action Taken</li> </ol>	Volucial         information dissemination         YES         TV, RADIO         16-Dec-11         Brgy Captain/BDRRMC         Monitoring if the typhoon, warned the BDRRMC, called the BDRRMC and warned the chairman         No         TV         16-Dec-11         No data         Yes         TV, Radio, MEDIA, PAGASA         15-Dec-11         Brgy Captain and officials         No data	No data No TV TV 17-Dec-11 None Yes Celphone 16-Dec-11 Brgy Captain and Officials Monitoring of the flood, assessment Yes Brgy Tanod, Brgy Officials 17-Dec-11 Brgy officials Rescue	Brgy Captain and Brgy Officials         Survey, monitoring of damaged areas         Yes         Radio         17-Dec-11         Bgry Captain with MDRRMC and volunteers         Rescue/retrieval of the affected, relief operation         No         Radio, Celphone         17-Dec-11         Brgy Captain and Officials         Assessment of damaged areas, solicitation of relief goods, purchase goods, coordination         Yes         TV, Radio         17-Dec-11         Brgy Captain and Officials, BDRRMC with volunteers from the city         Monitoring of flood, assessment of damages, relief operation, feeding of victims         Yes         Brgy Tanod, Bgry Officials         17-Dec-11         Brgy Captain and Brgy Officials         Probe-11         Brgy Tanod, Bgry Officials         Probe-11         Brgy Captain and Brgy Officials         Probe-11         Brgy Tanod, Bgry Officials         Probe-11         Brgy Captain and Brgy Officials	All Council of Kinawe Meeting called by MDRRMC and warning Yes Radio Dec 2-3, 2012 Brgy Captain and Officials Meeting with BDRRMC and ABC for preparedness, forced evacuation Yes Radio, Celphone Dec, 2012 Brgy Captain and Officials Warned the people so they can also prepare Yes TV, Radio Dec 2-3, 2012 Brgy Captain and Officials Flood drill, meeting of BDRRM/spread -call for duty, activated BDRRMC, prepared EC, transportation, warned the people, monitoring of typhoon, forced evacuation, disseminated pick-up area/ways Yes LGU A week before Pablo Brgy Officials Seminars/meeting all barangay officials 2 days before, information dissemination, forced evacuation, brgy officials meeting	Brgy Captain and Brgy Officials         Rescue team spread out near river         and creeks to monitor and be         ready         Yes         Radio         4-Dec-12         Brgy Captain and Officials with         MDRRMC         Monitoring of the typhoon, ready         stand by         Yes         Radio, Celphone         4-Dec-12         Brgy Captain and officials with         community volunteers in the Brgy         Rradio, Celphone         4-Dec-12         Brgy Ormergency, designated         relocation sites just in case         Yes         4-Dec-12         Brgy Captain, BDRRMC         Monitoring of flood         Yes         Radio, Celphone         4-Dec-12         Brgy Captain, BDRRMC         Monitoring of flood         Yes         Radio, Celphone         4-Dec-12         Brgy Officials         Monitoring	Brgy Capitalin and Officials         Monitoring of damages with         MDRRMC         Yes         Radio         5-Dec-12         Brgy Capitalin and Officials         Relief operation, feeding of evacuees, monitoring of the evacuees         evacuees         Yes         Radio, Celphone         5-Dec-12         Brgy Capitalin and officials         Cleaning of public places, assessment of damage         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Assessment of damage, relief operation to evacuees         Yes         Radio, Celphone         5-Dec-12         BDRRMC         Radio, Celphone         5-Dec-12         Bray Captain and Brgy Officials         Relief operation, goods, home materials	I) Advisories/Updateswere were rece well received and updated. 2) Source of Advisories/Updates for 3 3) Date received: before, during and a 4) Recepient of Advisories/Updates: N 5) Action Taken: Very low awareness on action: 4 days before for preparat E E E E E E

Basically same as above
ere received before Sendong, but delayed. Those for Pablo were
tes for Sendong and Pablo was PAGASA through TV and Radio.
ng and after the incident.
areness level and no right info. to Sendong, but marked imrovement oreparation, 2 days before for evacuation, etc.
Basically same as above
Basically same as above
Basically same as above
ere received before Sendong, but delayed. Those for Pablo were
tes for Sendong and Pablo was PAGASA through TV and Radio.
ng and after the incident.
reness level and no right info. to Sendong, but marked imrovement preparation, 2 days before for evacuation, etc.
Basically same as above
Basically same as above
Basically same as above

									Po	ower	Wa	ter		Toilet/W	ashrooms		Kit	chen		
t Surve	lame of yed DRRMC		Evacuation Center/Facility	Location	Type of Structure	Size of Area (m2)	Capacity (in families/ persons)	Evacuee (in persons)	CEPALCO	Generator	Water Utility	Outsour ced/ Delivere d by Fire Trucks	wc	Urinal	Shower	Lavatory	Cooking Area	Faucet	Flooding Experien ced by Sendong /Pablo?	Assessment on Existing Evacuation Centers
I. CD	. CDO City																			<ol> <li>School can not be used for evacuation cener according to RA 10121, however, still used, needs to secure another sites for evacuation.</li> <li>Some evacuation centers are subject to flooding, needs to secure another sites.</li> <li>Electricity was not available for about 1 week for Sendong, and only halh day for Pablo</li> <li>Water supply by Water District was stopped during Sendong, but not for Pablo.</li> <li>Some evacuation centers have not enough capacity in size of area and facilities of water faucet, toilet (1 toilet/20 heads), kitchen, etc.</li> </ol>
		1.1	Km 5 Elementary School & Covered Court	Upper Balulang	*Covered court (concrete, standard) *20 classrooms (1storev.	1,740	112 / 560	Sendong: 60 families Pablo: 60 families	Yes	No	Water District	Yes	9	5	9	9	5	9 / 0	No	Cannot be assessed due to no data for size of evacuation area.
1	Balulang	1.2	Xavier hieghts Covered Court	Upper Balulang	*Standard (concrete)	480	32 / 160	Sendong: No data Pablo: 39 families	Yes	No	Water District	Yes	2	2	2	2	1	4 / 0	No	<ol> <li>Capacity in area seems not enough for Pablo</li> <li>Toilet seems not enough.</li> </ol>
		1.3	Manresa Farm	Upper Balulang	*Grounds(tents)	No data	No data	Sendong: 131 families	Yes	No	None	Yes	2	2	2	2	1	None	No	Cannot be assessed due to no data for size of evacuation area.
		1.4	Villa Verde	Lower Balulang	*Grounds(tents)	No data	No data	Sendong: No data Pablo: 40 families	Yes	No	Water District	Yes	No	No	No	No	1	None	No	Do above
		2.1	Bonbon Elementary School & Covered Court	Zone 5, Bonbon	*Covered court(concrete,standard) *2 storey (concrete)	1,929	124 / 620	No data	Yes	No	Water District	Yes	1/room	1/room	1/room	1/room	1	5 / 0	Yes	<ol> <li>Flooding were experienced during Sendong &amp; Pablo with 1-1.5 m with drainage problem.</li> <li>Capacity in area cannot be assessed for Sendong &amp; Pablo due to no data of evacuees.</li> </ol>
2	Bonbon	2.2	Brgy Hall	Zone 4, Bonbon	*2 storey (concrete)	35	2 / 12	Sendong: 100 families Pablo: None	Yes	No	Water District	Yes	5	5	5	5	1	4 / 0	Yes	<ol> <li>Flooding were experienced during Sendong with 0.5-1 m with drainage problem.</li> <li>Capacity in area seems not enough for Sendong, EC was not used for Pablo.</li> <li>Toilet seems enough.</li> </ol>
		3.1	West City Central School & Covered Court	Ilaya, Carmen	*Covered court:standard (concrete) Room:standard (concrete)	1,740	112 / 560	Sendong: 100 families Pablo: 40 families	Yes	No	Water District	Yes	1/room	1/room 2 common	1/room 3 common	1/room	2	4 / 0	No	<ol> <li>Capacity in area seems enough for Sendong &amp; Pablo</li> <li>Toilet seems enough.</li> </ol>
		3.2	Oro Chamber Building	Macapagal Drive, Pueblo de	*Concrete	400	26 / 133	Sendong: None Pablo: 150 families	Yes	No	Water District	Yes	2	2	2	2	1	2	No	<ol> <li>Capacity in area seems not enough for Sendong &amp; Pablo</li> <li>Toilet seems not enough.</li> </ol>
		3.3	Zone 6 Covered Court	Zone 6, Carmen	*Standard (concrete)	480	32 / 160	Sendong: 26 families Pablo: 33 families	Yes	No	Water District	Yes	3	3	3	1	1	1 / 0	No	<ol> <li>Capacity in area seems enough for Sendong &amp; Pablo</li> <li>Toilet seems not enough.</li> <li>33 families are still there due to no houses</li> </ol>
3	Carmen	3.4	Zone 10 Covered Court	Zone 10, Upper Carmen	*Standard (concrete)	480	32 / 160	Sendong: No data Pablo: 135 families	Yes	No	Water District	Yes	2	2	2	2	1	4 / 0	No	<ol> <li>Capacity in area seems not enough for Sendong, but enough for Pablo</li> <li>Toilet seems not enough.</li> </ol>
		3.5	Zone 8 Covered Court	Zone 8, Carmen (Alco)	*Standard (concrete)	480	32 / 160	Sendong: 100+ families Pablo: 14 families	Yes	No	Water District	Yes	4	4	4	4	1	2 / 0	No	<ol> <li>Capacity in area seems not enough for Sendong, but enough for Pablo</li> <li>Toilet seems not enough.</li> </ol>
		3.6	Barangay Hall	Carmen	*2 storey building *Covered court(standard,concrete)	515	34 / 172	Sendong: No data Pablo: 105 families	Yes	No	Water District	Yes	4	4	4	4	1	4 / 0	No	<ol> <li>Capacity in area seems not enough for Sendong, but enough for Pablo</li> <li>Toilet seems not enough.</li> </ol>
		3.7	Macanhan Covered Court	Macanhan, Carmen	*Standard (concrete)	480	32 / 160	No data	Yes	No	Water District	Yes	2	2	2	2	1	4 / 0	No	<ol> <li>Capacity in area cannot be assessed for Sendong &amp; Pablo due to no data of evacuees.</li> <li>Capacity of toilet cannot be assessed for Sendong &amp; Pablo due to no data of evacuees.</li> </ol>
		3.8	SM Mall Parking Building	Pueblo de Oro, Carmen	*Standard (concrete)	No data	No data	Pablo: 1,221 families	Yes	No	Water District	Yes	No data	No data	No data	No data	No data	No data	No	<ol> <li>Capacity in area cannot be assessed due to no data for size of evacuation area</li> <li>Capacity of toilet cannot be assessed due to no data of toilet.</li> </ol>
4	Consolacion	-	Not Existing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1) No existing evacuation center. People were evacuated to EC in the vicinity of barangay.
		5.1	Kauswagan Central School	Kauswagan	*2 storey (concrete) *25 Rooms (standard)	1,575	100 / 500	Sendong: No data Pablo: 41 families individuals	Yes	No	Water District	Yes	1/room	1/room	1/room 1 common	3	1	2 / 0	No	<ol> <li>Capacity in area seems enough for Sendong, but enough for Pablo</li> <li>Toilet seems not enough.</li> </ol>
		5.2	San Isidro ECO Church Paris	Kauswagan	*Convent, Church, Meeting hall (concrete)	9,000	600 / 3000	Sendong: 200–250 families Pablo: 136 families	Yes	No	Water District	Yes	6	6	6	12	1	12 / 0	No	Do above
		5.3	Kauswagan Covered Court	Barangay Hall, Kauswagan	*Covered court	480	32 / 160	Sendong: 400–450 families Pablo: 500+ families	Yes	No	Water District	Yes	2	2	2	5	1	5 / 0	No	<ol> <li>Capacity in area seems not enough for Sendong, but enough for Pablo</li> <li>Toilet seems not enough.</li> </ol>
5	Kauswagan	5.4	NHA Covered Court	Phase 3, Kauswagan	*Standard (concrete)	480	32 / 160	Pablo: 600−700 families	Yes	No	None	Yes	None	None	None	None	None	None	No	<ol> <li>Capacity in area seems not enough for Pablo</li> <li>No toilet available</li> </ol>
		5.5	RER Church	RN Pelaez Boulivard, RER Drive	*Church	480	32 / 160	Sendong: 40 families Pablo: None	Yes	No	Water District	Yes	2	2	2	3	1	3 / 0	No	<ol> <li>Capacity in area seems not enough for Sendong</li> <li>Toilet seems not enough.</li> </ol>
		5.6	Bongbongon Elementary School	NHA Bongbongo n,	*2 storey (concrete) *15 Classrooms (standard)	945	60 / 300	Sendong: No data Pablo: 92 families	Yes	No	Water District	Yes	1/room	1/room 2 common	1/room 2 common	1/room	1	4 / 0	No	<ol> <li>Capacity in area seems not enough for Sendong and Pablo</li> <li>Toilet seems not enough.</li> </ol>
		5.7	IFI Church	Zone 1, Kauswagan	Concrete (9x20 estimated)	180	12 / 60	Sendong: 120 families Pablo: 23 families	Yes	No	Water District	Yes	2	2	1	1	1	2 / 0	No	Do above
		5.8	Barangay Hall	Kauswagan	*2 storey(concrete)	35	2 / 12	Sendong: No data Pablo: 95 families	Yes	No	Water District	Yes	2	2	2	2	1	3 / 0	No	<ol> <li>Gapacity in area seems not enough for Pablo</li> <li>Toilet seems not enough.</li> </ol>

# Table 2.2.4 Results of Questionnaire and Interview Surveys (Existing Evacuation Center)

		6.1	Macabalan Element	ary Ma	acabalan	*10 classrooms (concrete, standard)	630	40 / 200	Sendong: 50+ families Pablo: 65 families	Yes	No	Water District	Yes	1/room	1/room	1/room 2 common	12	1	12 / 0	No	<ol> <li>Capacity in area seems not enough for Sendong and Pablo</li> <li>Toilet seems enough</li> </ol>
		6.2	Macabalan National	High Ma	acabalan	*10 classrooms (concrete, standard)	630	40 / 200	Sendong: No data Pablo :65 families	Yes	No	Water	Yes	1/room	1/room	1/room 2 common	12	1	12 / 0	No	1) Capacity in area seems not enough for Pablo 2) Toilet seems enough
		6.3	Port Side Area	Ma	acabalan	No data	No data	50 / 250	No data	Yes	No	None	No data	None	None	None	None	None	None	No	<ol> <li>Capacity in area cannot be assessed for Sendong &amp; Pablo due to no data of evacuees.</li> <li>No toilet available</li> </ol>
6	Macabalan	6.4	Macabalan Covered Court	Ma	acabalan	*Standard (concrete)	480	32 / 160	Sendong: No data Pablo: 65 families	Yes	No	None	None	None	None	None	None	None	None	No	<ol> <li>Capacity in area seems not enough for Pablo</li> <li>No toilet available.</li> <li>Roof was damage by Sendong and Pablo.</li> <li>People were transfered to Macabalan High School and Elementary.</li> </ol>
		6.5	Barangay Multi Pur Building	oose Ma	acabalan	Concrete	35	2/12	No data	Yes	No	Water District	Yes	No	No	No	None	None	None	No	<ol> <li>Capacity in area cannot be assessed for Sendong &amp; Pablo due to no data of evacuees.</li> <li>No toilet available.</li> </ol>
		7.1	Tibasak Covered C	ourt Ma	ibasak, acasandig	*Standard (concrete)	480	32 / 160	Sendong: 200+ families Pablo: 150+families	Yes	No	Water District	Yes	26	26	7	1	2	5 / 1	Yes	<ol> <li>Flooding were experienced during Sendong (2.5m) &amp; Pablo (0.6m) with drainage problem.</li> <li>Capacity in area seems not enough for Sendong and Pablo</li> </ol>
		7.2	Buena Oro Covere Court	d Bu	uena Oro	*Standard (concrete)	480	32 / 160	Sendong: 26 families Pablo: 37 families	Yes	No	Water District	Yes	None	None	None	None	1	None	No	<ol> <li>Capacity in area seems enough for Sendong, but not enough for Pablo</li> <li>No toilet available, used from houses near the EC.</li> </ol>
7	Macasandig	7.3	Macasandig Elemer School & Covered	<mark>tary</mark> court Ma	acasandig	*Covered court (concrete, standard) *35 classrooms (standard)	2,685	172 / 860	Sendong: 630 families Pablo: 165 families	Yes	No	Water District	Yes	1/room	1/room	1/room	1/room	2	36 / 0	No	<ol> <li>Capacity in area seems not enough for Sendong, but enough for Pablo</li> <li>Toilet seems not enough.</li> </ol>
		7.4	Macasandig Covere Court	d Ma	acasandig	*Standard (concrete)	480	32 / 160	Sendong: No data Pablo: 112 families	Yes	No	Water District	Yes	1	1	1	1	1	1 / 0	No	<ol> <li>Capacity in area seems not enough for Pablo</li> <li>Toilet seems not enough.</li> </ol>
		8.1	Barangay Nazareth	Gym St Na	2th 20th t, azareth	*Standard (concrete)	1,000	67 / 333	Sendong: 250+ families Pablo: 45 families	Yes	No	Water District	Yes	2	2	2	2	1	2 / 0	No	<ol> <li>Capacity in area seems not enough for Sendong, but enough for Pablo</li> <li>Toilet seems not enough.</li> </ol>
8	Nazareth	8.2	South City Central School & Covered	Court Na	th 21th t, azareth	*Covered court:standard (concrete) *15 classrooms: Standard	1,425	92 / 460	Sendong: 56 families Pablo: 36 families	Yes	No	Water District	Yes	1/room	1/room	1/room	1/room	2	17 / 0	No	<ol> <li>Capacity in area seems enough for Sendong and Pablo</li> <li>Toilet seems not enough.</li> </ol>
		9.1	San Nicholas Chur	ch St	endoza t, rossing	*3 storey(concrete)	180	12 / 60	Sendong: 50 families Pablo: 130 families	Yes	No	Water District	Yes	5	5	5	7	1	7 / 0	Yes	<ol> <li>Flooding were experienced during Sendong &amp; Pablo (1-1.5m)</li> <li>Capacity in area seems not enough for Sendong and Pablo</li> </ol>
		8.2	Puntod National Hi School	gh Ca St	abaraban t, Puntod	*2 storey (concrete) *18 classrooms (standard)	1,134	72 / 360	Sendong: 20+ amilies Pablo: 20+ families	Yes	No	Water District	Yes	2 common	2 common	2 common	2	1	21 / 0	Yes	<ol> <li>Flooding were experienced during Sendong (0.5-1m)</li> <li>Capacity in area seems enough for Sendong and Pablo.</li> </ol>
9	Puntod	9.3	SDA Puntod Churc	Ju h pa Pເ	ulio acana St, untod	*3 bulidings: Sda office, church, appartment (2 storey.concrete)	No data	No data	Sendong: 700 families Pablo: 180 families	Yes	No	Water District	Yes	11	11	11	23	3	23 / 0	Yes	<ol> <li>Flooding were experienced during Sendong (1.5m) &amp; Pablo (1m)</li> <li>Capacity in area cannot be assessed due to no data for size of evacuation area</li> <li>Toilet seems not enough.</li> </ol>
		9.4	Puntod Elementary School (North City Central School)	Pu	untod	Standard(concete) 15 class rooms	945	60 / 300	Sendong: No data Pablo: No data	Yes	No	Water District	Yes	1/room	1/room	1/room	1/room	1	21 / 0	No	<ol> <li>Capacity in area cannot be assessed for Sendong &amp; Pablo due to no data of evacuees.</li> <li>Capacity of toilet cannot be assessed for Sendong &amp; Pablo due to no data of evacuees.</li> </ol>
10	Brgy. 6	-	Not Existing		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1) No existing evacuation center. People were evacuated to EC in the vicinity of barangay.
11	Brgy. 7	11	Barangay Hall	Bi Ba	urgos, arangay 7	*3 storey (concrete)	35	2 / 12	Sendong: 10+ families Pablo :25 families	Yes	No	Water District	Yes	3	3	3	3	None	3 / 0	Yes	<ol> <li>Flooding were experienced during Sendong (1.5m) &amp; Pablo (1m)</li> <li>Capacity in area seems not enough for Sendong and Pablo</li> <li>Toilet seems not enough.</li> </ol>
12	Brgy. 10	12	Barangay 10 Hall	Ya Bi	acapin urgos St.	*3 storey (concrete)	35	2 / 12	Sendong: 20−30 families Pablo: None	Yes	No	Water District	Yes	2	2	2	4	1	4 / 0	Yes	Do above
		12	Masonic Temple	Ca Pa	apistrano acana St.	*3 storey (concrete)	35	2 / 12	Pablo: 20 families	Yes	No	Water District	Yes	3	3	3	5	None	5 / 0	No	<ol> <li>Capacity in area seems not enough for Pablo</li> <li>Toilet seems not enough.</li> </ol>
13	Brgy. 13	-	Not Existing		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1) No existing evacuation center. People were evacuated to EC in the vicinity of barangay.
14	Brgy. 15	-	Not Existing		-	_	-	-	_	_	_	-	-	-	-	-	-	-	-	-	1) No existing evacuation center. People were evacuated to EC in the vicinity of barangay.
15	Brgy. 17	-	Not Existing		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1) No existing evacuation center. People were evacuated to EC in the vicinity of barangay.
16	Brgy. 18	18	Barangay 18 Hall	Ab Ma St	bellanosa agsaysay t	*3 storey (concrete)	35	2 / 12	Sendong: 20 families Pablo: 10 families	Yes	No	Water District	Yes	3	3	3	4	None	5 / 0	Yes	<ol> <li>Flooding were experienced during Sendong (2.5-3m).</li> <li>Capacity in area seems not enough for Sendong and Pablo</li> <li>Toilet seems not enough.</li> </ol>
CDO	Total	41																			

II. Prov	<mark>ince of Bukid</mark>	dnon																	
II.1 Mu	nicipality of Ta	alakag																	<ol> <li>Electricity was not availa</li> <li>Water supply by Water D</li> <li>Some evacuation center</li> <li>faucet, toilet, kitchen, etc.</li> </ol>
		1.1 San Isidro Covered Court	Barangay Hall, San Isidro	*Standard (concrete)	480	32 / 160	None	Yes	No	Water District	Yes	None	No	1	1	1	1 / 0	No	<ol> <li>Capacity in area cannot</li> <li>Capacity of toilet cannot</li> </ol>
1	San Isidro	1.2 Barangay Hall	Barangay Hall, San	*3 storey (concrete)	35	2 / 12	None	Yes	No	Water District	Yes	1	1	1	1	1	1 / 0	No	Do above
		1.3 San Isidro Public Mar	ket Hall, San	*Concrete (Covered court size)	480	32 / 160	None	Yes	No	Water District	Yes	None	No	1	1	1	1 / 0	No	Do above
		2.1 Barangay Covered Co	Barangay ourt Hall Compound	*Standard (concrete)	480	32 / 160	None	Yes	No	None	Yes	5 commor	n 5 common	5 common	5	1	None	No	Do above
2	San Antonio	2.2 BNS Building	Barangay Hall Compound	*Concrete	35	2 / 12	None	Yes	No	None	Yes	2	2	2	2	1	None	No	Do above
		2.3 Mini Library	Barangay Hall Compound	*Concrete	35	2 / 12	None	Yes	No	None	Yes	2	2	2	2	1	None	No	Do above
Talaka,	g Total	6																	
II.2 M	unicipality of L	Libona																	<ol> <li>School can not be used needs to secure another si</li> <li>Electricity was not avails</li> <li>Water supply by Water D</li> <li>Some evacuation center faucet, toilet, kitchen, etc.</li> </ol>
1	Pongol	1.1 Pongol Elementary School	Pongol	14 Classrooms	882	56 / 280	None	Yes	No	Water District	No	1/room 2 commor	1/room 2 common	1/room	1/room 2 common	1	16 / 0	No	<ol> <li>Capacity in area cannot</li> <li>Capacity of toilet cannot</li> </ol>
2	Nangka	2.1 Barangay Hall	Nangka	7 Classrooms	441	28 / 140	Sendong: None Pablo: 9 families / 33 persons	Yes	No	Water District	No	1/room	1/room	1/room	1/room	1	7 / 0	No	<ol> <li>Capacity in area seems</li> <li>Toilet seems not enough</li> </ol>
		2.2 Nangka Elementary School	Nangka	10 Classrooms	630	40 / 200	Sendong: None Pablo: 9 families / 23 persons	Yes	No	Water District	No	1/room	1/room	1/room	1/room	1	10 / 0	No	<ol> <li>Capacity in area seems</li> <li>Toilet seems not enough</li> </ol>
		3.1 Kinnawe Elementary School	Kinawe, Libona	17 Classrooms	1,071	68 / 340	None	Yes	No	Water District	No	1/room 6 commor	1/room 6 common	1/room	1/room	1	23 / 0	No	<ol> <li>Capacity in area cannot</li> <li>Capacity of toilet cannot</li> </ol>
3	Kinawe	3.2 Kinawe High School	Kinawe, Libona	14 Classrooms	882	56 / 280	None	Yes	No	Water District	No	1/room	1/room	1/room	1/room	1	14 / 0	No	<ol> <li>Capacity in area cannot</li> <li>Capacity of toilet cannot</li> </ol>
		3.3 IFI Church	Kinawe, Libona	Concrete(standard)	180	12 / 60	Sendong: None Pablo: 5 families / 32 persons	Yes	No	Water District	No	5	5	5	5	1	5 / 0	No	<ol> <li>Capacity in area seems</li> <li>Toilet seems not enough</li> </ol>
Libona	Total	6																	
II.3 Mu	nicipality of B	Saungon																	<ol> <li>School can not be used needs to secure another si</li> <li>Electricity was not availa</li> <li>Water supply by Water D</li> <li>Some evacuation center faucet, toilet, kitchen, etc.</li> </ol>
		1.1 Pualas Covered Cour	t Pualas, Baungon	Concrete (standard)	480	32 / 160	None	Yes	No	Water District	No	2	2	2	2	1	1 / 0	No	<ol> <li>Capacity in area cannot</li> <li>Capacity of toilet cannot</li> </ol>
	Pualas	1.2 Pualas Elementary School	Pualas, Baungon	6 classrooms Concrete (standard)	378	24 / 120	None	Yes	No	Water District	No	1/room	1/room	1/room	1/room	1	6 / 0	No	Do above
		1.3 Pualas Barangay Hall	Pualas, Baungon	Concrete (standards)	35	2 / 12	None	Yes	No	Water District	No	1	1	1	1	1	1 / 0	No	Do above
		2.1 Lingating Elementary School	Lingating, Baungon	Concrete (standard) 16 classrooms	1,008	64 / 320	None	Yes	No	Water District	No	1/room 2 commor	1/room 2 common	1/room 2 common	2	1	18 / 0	No	Do above
2	Lingating	2.2 Lingating Covered Co	burt Lingating, Baungon	Standard(concrete)	480	32 / 160	Sendong: None Pablo: 74 families / 309 persons	Yes	No	Water District	No	None	None	None	None	1	None	No	<ol> <li>Capacity in area seems r</li> <li>No toilet is available.</li> </ol>
3	Imbatug	3.2 Municipal GYM	Baungon	Concrete (standard)	1,000	67 / 333	None	Yes	No	Water District	No	2	2	2	2	1	2 / 0	No	<ol> <li>Capacity in area cannot</li> <li>Capacity of toilet cannot</li> </ol>
		3.3  Purok Center (Session   Hall)	Baungon	Concrete	200	14 / 70	None	Yes	No	water District	No	2	2	2	2	1	2 / 0	No	Do above
Baung	on Total	7																	
Groun	l Total	60																	

ble for about 1 week for Sendong, and only halh day for Pablo strict was stopped during Sendong, but not for Pablo. s have not enough capacity in size of area and facilities of water
be assessed for Sendong & Pablo due to no data of evacuees. be assessed for Sendong & Pablo due to no data of evacuees.
for evacuation cener according to RA 10121, however, still used, tes for evacuation. ble for about 1 week for Sendong, and only halh day for Pablo strict was stopped during Sendong, but not for Pablo. s have not enough capacity in size of area and facilities of water
be assessed for Sendong & Pablo due to no data of evacuees. be assessed for Sendong & Pablo due to no data of evacuees.
enough for Pablo I.
enough for Pablo I.
be assessed for Sendong & Pablo due to no data of evacuees. be assessed for Sendong & Pablo due to no data of evacuees.
be assessed for Sendong & Pablo due to no data of evacuees. be assessed for Sendong & Pablo due to no data of evacuees.
enough for Pablo
for evacuation cener according to RA 10121, however, still used, tes for evacuation. ble for about 1 week for Sendong, and only halh day for Pablo strict was stopped during Sendong, but not for Pablo. s have not enough capacity in size of area and facilities of water
be assessed for Sendong & Pablo due to no data of evacuees. be assessed for Sendong & Pablo due to no data of evacuees.
not enough for Pablo
be assessed for Sendong & Pablo due to no data of evacuees. be assessed for Sendong & Pablo due to no data of evacuees.







Figure 2.2.7 Location of Designated Evacuation Centers in Municipality of Baungon







Figure 2.2.9 Location of Designated Evacuation Centers in Municipality of Talakag

Based on the results of interview and questionnaire surveys, current situation/problems and measures considered as necessary for the four (4) aspects are summarized as follows:

Table 2.2.5	Current Situation/Problems and Measures considered as Necessary for the Four (4)
	Aspects (Flood Management)

No.	Current Situation/Problems	Measures considered as Necessary
Aspe	ct I: Assessment on DRRMC Readiness and Fund S	Sources
I.1	DRRMC : Most of them were established before TS Sendong in December 2011 and some of them were re-organized after TS Sendong. During TS Sendong, many of them could not function well due to various reasons mentioned previously [1] PAGASA warning signal was only No.1 (lowest among 4 signals) on 15 <sup>th</sup> Dec, 2) Rainfall intensity was strong with short duration, 3) Peak discharge by flash flood occurred in the midnight, after work of the government officials on Friday, etc. ] . As a result, serious damages were brought about to the CDO River Basin. On the other hand, during TY Pablo, significant improvement in operational measures by utilization of flood hazard map, ABC meetings, advanced guidance on evacuation, flood monitoring, etc. As a result, no significant damages were reported.	There are about 100 barangays in the CDO River Basin. Of these, more than one half of the barangays were affected by TS Sendong. As explained in the left column, operation of DRRMCs was not well functioned due to (1) initial warning signal was 1 (light), (2) flash flood occurred in the midnight by high intensity rainfall with short duration, (3) response of DRRMCs were delayed due to after work on Friday. Operation of DRRMCs was improved by lessons learnt from TS Sendong. However, <u>Institutional</u> reinforcement of DRRMCs by capacity development measures before, during and after flood disasters is necessary. This reinforcement will improve in operational measures by utilization of flood hazard map, advanced guidance on evacuation, flood monitoring, etc. more effectively based on the DRRMP and contingency plan to be prepared.
I.2	Hazard Map : The maps were prepared for CDO city and some barangays in the city under technical assistance of Xavier university. For some barangays in the 3 municipalities (Talakag, Libona and Baungon) in the Bukidnon province, the maps were prepared by Mines and Geosciences Bureau (MGB) under DENR and/or LGUs/NGOs. However, these were based on the previous floods by TS Sendong, TY Pablo,etc. The maps could not be utilized during TS Sendong, however, used by some DRRMCs during TY Pablo for evacuation. Further, thematic maps in the CLUPs are drawn by hand or graphic design software. It is difficult for them to update/revise the maps and calculate the land use changes due to the lack of capacity in terms of personnel and equipment.	The hazard map is core of the contingency plan. Present maps were prepared based on the inundation areas referring from TS Sendong and TY Pablo. The maps based on the computed inundation areas with return period of 1/2, 1/5, 1/10, 1/25, 1/50 prepared in this Survey, are also good references. However, these maps need to be improved with more accurate elevation and big scale. Accordingly, improvement of hazard map and education to local residents is necessary. Further, preparation and/or improvement of evacuation plan is also necessary. Based on the hazard maps to be developed, land use regulation for flood plain is necessary. In this case, technical assistance for data base applying such as GIS may be considered.

No.	Current Situation/Problems	Measures considered as Necessary
No. I.3	Current Situation/Problems         DRRMP :         5-year DRRM Plan (2013-2017) was prepared         by the CDO DRRMC in March 2013 under         financial assistance by UNDP. Required budget         for the 5-year DRRMP was estimated at P 1.3         Billion, which is 2.6 times of that of DRRMC.         CDRRMC anticipates financial assistance from         the GOP, NGO, foreign countries, etc.         Barangays in the city did not prepare DRRMPs.         PDRRMC of Bukidonon province prepared old         DRRMP in 2008, however, it was not updated.         Barangays in the 3 municipalities in Bukidonon	Based on the RA 10121, all DRRMCs should prepare the DRRMPs. Under this situation, Minutes of Agreement (MOA) was signed by Bukidnon province, 3 municipalities of Bukidnon, (Talakag, Libona and Baungon), CDO city and Iligan city in October 2012, to prepare all BDRRMPs. In this connection, <u>all DRRMCs in the CDO River Basin should prepare the DRRMPs.</u>
I.4	Dataligays in the 5 inducepanties in Duktationprovince did not prepared the DRRMPs.DRRMF 2013 :The fund requirement and proposed works forthe following aspects: (1) Prevention &Mitigation, (2) Preparedness, (3) Response, (4)Recovery, were shown.	Ever year, similar proposal and budget request were made. <u>The fund should be secured based on</u> <u>the DRRMP. Accordingly, DRRMP should be</u> <u>formulated.</u>
II.	Assessment on DRRMC Awareness & Skill	
II.1	<u>CBFEWS</u> : In some barangays, warning by siren, megaphone, etc. based on monitoring river water level, etc. were made, however, most of barangays did not do any warning. So, there are no CBFEWS basically in the CDO River Basin.	<u>CBFEWS shall be established for selected</u> <u>barangays in the CDO River Basin.</u>
П.2	Trainings: Various kinds of trainings were undertaken by GOP, NGOs, donor countries, etc. For CDO city, it was observed there were many trainings related to contingency plan and DRRM under financial assistance by UNDP, especially after TY Pablo in December 2012. For local residents in some barangays in the city, trainings mainly for DRRM were made by GOP, CDO city, Xavier university, etc., however, trainings for structural measures for flood mitigation were not made, which are important for them to understand the necessity, importance, effectiveness, etc. of the project proposed. For 3 municipalities (Talakag, Libona and Baungon), 2-4 trainings for rescue, DRRM, etc. were made by GOP, LGUs, etc.	Trainings on CBFEWS considered to be developed, and formulation and implementation of Contingency Plan is necessary. Further, Information, Education and Communication (IEC) to the local residents is necessary in order for them to understand the necessity, importance, effectiveness, etc. of the project proposed in this Survey and to be implemented.
III.	Assessment on DRRMC Activities, Before, During	g and After Sendong and Pablo
III.1	Advisory & Warning / Updated Information : Information was not timely during TS Sendong. However, it was improved during TY Pablo. More adequate advisory and warning shall be provided, which will be better for self assistance, community assistance and public assistance.	Establishment of FFWS by PAGASA is necessary in order to obtain more adequate advisory and warning in the CDO River Basin. <u>CBFEWS is</u> <u>also necessary</u> , which will be quick and effective system for small area such as barangay area. These systems will be expected to contribute self assistance, community assistance and public assistance in the basin.

No.	Current Situation/Problems	Measures considered as Necessary
III.2	<u>Actions taken :</u> Actions were not properly taken due to less understanding on flood and insufficient information during TS Sending. However, actions were well taken during TY Pablo, by preparedness 4 days before the typhoon attack and evacuation 2 days before the attack.	<u>Capacity development on organizational and</u> <u>operational aspects, etc. for DRRMC is necessary</u> in order to take actions more effectively during floods.
IV.	Assessment on Existing Evacuation Centers	
IV.1	<u>Evacuation Center :</u> Based on the RA 10121, class room cannot be used for evacuation. However, some were seemed to be used due to insufficient number and area of evacuation center.	Additional evacuation centers are necessary.
IV.2	Location of Evacuation Center : Some centers were flooded.	Other sites where safe from habitual inundation are necessary. Based on the information from the CDO City, Improvement (Heightening) of Roads in the left side near the river mouth and those in the right side in barangay Macasandig is necessary as approach to the evacuation centers.
IV.3	<u>Facilities of Evacuation Center :</u> Data on facilities for 64 centers listed by the CDO City were not available. Therefore, site investigation was made. Based on the results of the investigation, facilities of the centers were insufficient in view of area, number of toilet, kitchen, etc during TY Pablo.	Improvement of some facilities is necessary. Required number of toilet, kitchen, etc of the facilities shall be investigated.
IV.4	Electricity : It was cut for about 6 weeks in the CDO City, 2 weeks in Talakag, 3 weeks in Baungon and 1 day in Libona during and after TS Sendong, while 3days to 1 week during and after TY Pablo. <u>Water Supply:</u> It was cut for about 7 weeks in the CDO City, 4 weeks in Talakag, 3 days in Baungon and 0 day in Libona during and after TS Sendong, while 2days to 2 week sduring and after TY Pablo	Hazard maps for electricity and water supply are necessary to anticipate potential damages. Study on arrangement of staff for restoration, priority ranking for rstoration, assistance request of staff from other areas, re-organization of staff for restoration, is also necessary. For these above, preparatory works for restoration of infrastructure and improvement on actions are necessary to be taken immediately after the incident.

## 2.2.4 FFWS in the CDO River Basin

There is no FFWS in the CDO River Basin. However, PAGASA will construct the FFW Center for the basin in 2013 within the compound of existing PAGASA weather center in El Salvador city. Budget arrangement for one each for rainfall and river water level stations was also secured. Besides, staff for the center such as1) Chief FFWC、2) Assistant Chief、3)Hydrologist、4)Hydro Aide、5) Hydro Aide、6) Hydro Aide、7)Telecom Engineer、Hydro Technician, etc., will be arranged and trainings for the staff will be made.

Since March 2012, Data Collection Survey on Situation of Nationwide Flood Forecasting and Warning System in the Philippines has been conducted by JICA. In this Survey to be completed in September 2013, latest situation on nationwide existing meteorological and hydrological observation system has been investigated, and future needs for the priority works on the system for the new FFWS as well as needs for capacity development to the staff for the system and O&M will be confirmed.

As of the middle of September 2013, followings were confirmed for the FFWS in the CDO River Basin:

- 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.
- As a next step, preliminary study on future System to be connected between PAGASA Central Office- Hydro Meteorological Division and PAGASA River Center in El Salvador, is planned.

Currently, there are 3 automatic river water level stations under NOAH project in the CDO River Basin. These are installed after TS Sendong, located at Kagay-an bridge and Cabula bridge in the CDO river, and Bubunawan bridge in the Bubunawan river, one of the tributaries of the CDO river (Refer to **Figure 2.2.10**).

In the upstream of the CDO River Basin, there are three (3) existing bridges, i.e., Ugiaban bridge, Tal-uban bridge, and Tikala-an bridge. These sites will be probably useful for river water level stations for future FFWS due to lead-time, easy access, etc. If warning water levels at these stations will be set, these will be effective information to the residents downstream from the stations (Refer to **Figure 2.2.10**). More detailed study is necessary, together with the study of additional rainfall stations for FFWS, i.e., location, numbers, etc.

The study on number and location of automatic rainfall and river water level stations for the FFWS in the CDO River Basin is being made by PAGASA. Under NOAH project, about 600 rainfall stations and 400 river water level stations will be installed in the Philippines. Of these, about 100 rainfall stations and 50 river water level stations were already installed according to the information form DOST-ASTI. Maintenance of these stations is important.

It is noted that tentative FFWS by conventional rain gauges and river water staff gauges as CBFEWS will be established first since it may take time to establish integrated FFWS in the CDO River Basin.



Figure 2.2.10 Location Map of Existing Rainfall and River Water Level Stations and those preliminary planned additionally for the CDO River Basin.

## 2.2.5 5-Year DRRM Plan (2013-2017) of the CDO City

The CDO City prepared the 5-Year DRRM Plan (2013-2017) in March 2013 with the financial assistance from UNDP. The summary is shown below.

# Table 2.2.6Summary of Budgetary Requirements for 5-Year DRRMP of CDO City<br/>(2013-2017)

							Unit: Pesos
	Activities in Priority Area	2013	2014	2015	2016	2017	Total
For	Disaster Prevention and Mitigation						
1	Lobby and Advocate for DRR/CCA legislation		100.000				100,000
2	Conduct public information and awareness on		100,000				100,000
3	DRR/CCCA	300,000,000					300 000 000
4	Install RCPC pipes to identified strategic locations	30,000,000					30 000 000
5	Construct flood control dikes and structures	30,000,000		600.000.000			600 000 000
6	Construct SALT training to formers	100.000	100.000	100,000	100.000	100.000	500,000
7	Linetall water impounding systems	100,000	100,000	2 000 000	100,000	100,000	2 000,000
8	Eco-Tourism Forest Park Development			2,000,000			2,000,000
0	A Seeding Production		1 000 000				1 000 000
	R. Behabilitata the CdeO rivers		10,000,000				10 000 000
	C Agro-Forestry Intervention		10,000,000	20.000.000			20,000,000
	D. Conduct livelihood activities	3 000 000		20,000,000			3 000 000
0	Expand barangays for organic farming	800,000	800.000	800.000	800.000	800.000	4 000 000
<u> </u>	Construct the Cagayan de Oro Integrated	300,000	300,000	000,000	000,000	500,000	4,000,000
10	Organic Agriculture Demonstration Training Center				2,700,000		2,700,000
11	Plant mangrove propagules in coastal areas	300.000	300.000	300.000	300.000	300.000	1,500,000
<u> </u>	Develop and distribute IEC materials on Solid	200,000	500,000	200,000	200,000	500,000	_,200,000
12	Waste Management		100,000				100,000
13	Embankment of Carmen open dumpsite				5 000 000		5,000,000
	Conduct vulnerability assessment for DRRM				.,,		
14	updating	200,000					200,000
15	Install community EWS		1.000.000	1.000.000	1.000.000	1.000.000	4,000,000
16	Localize Project NOAH		5,000,000	-,,	-,,	-,	5,000,000
17	Construct additional access roads		30,000,000	25.000.000	15.000.000	10.000.000	80,000,000
	Total	334,400,000	48,500,000	649,200,000	24,900,000	12,200,000	1,069,200,000
For	Disaster Preparedness	, ,	- / /	, ,	, ,	, ,	,,
	Conduct workshop on formulation of Manual of		00,000				80.000
1	Operations for LDRRMO and Operation Center		80,000				80,000
2	Provide additional facilities for LDRRMO and OpCen		5,000,000	5,000,000			10,000,000
3	Provide additional facilities for Identified ECs	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000	25,000,000
4	Purchase 4x4pick-up trucks and utility transport vehicles	6,000,000					6,000,000
5	Conduct specialized trainings among CDRRMO personnel	300,000	200,000				500,000
6	Construct warehouse for stock contingencies		10,000,000				10,000,000
7	Construct City Mortuary		10,000,000				10,000,000
8	Purchase of food and non-food items for emergency needs	1,000,000	1,000,000	1,000,000	1,000,000		4,000,000
9	Conduct specialized trainings to identified sectors		300,000				300,000
10	Conduct workshop exemplars on DRR/CCA		,			3,000,000	3,000,000
	Integration in school curricula Conduct workshop/orientation on warning and						
11	forecasting capacities with communities		50,000	50,000	50,000	50,000	200,000
12	to different sectors	100,000					100,000
13	Conduct resources mapping of the city	50,000					50,000
14	Provide hazard maps to all 80 barangays		500,000				500,000
15	Orient accredited response groups on CDRRMC plans and protocols		40,000				40,000
16	Create quick response teams in every barangay/community organizations		200,000	200,000	200,000	200,000	800,000
	Total	12,450,000	32,370,000	11,250,000	6,250,000	8,250,000	70,570,000
For	Disaster Response	· · · ·		· · · ·			
	Total						58,400,000
For	Disaster Recovery and Rehabilitation						
	Total						96,100,000
	Grand Total						1,294,270,000

Source: DRRMC of CDO City

In the above plan, activities by government agencies concerned and other stakeholders for the following four (4) aspects, i.e., 1) disaster prevention and mitigation, 2) disaster preparedness, 3) response, and 4) rehabilitation and reconstruction. 22 outcome, 50 outputs and 153 activity plans are included in the plan. Required budget for 5 years was estimated at P 1.3 Billion, about 2.6 times of the city budget. CDRRMC is anticipating financial assistance from GOP, NGOs, foreign countries, etc.

Of these, the activities for non-structural measures are as follows:

For Disaster Prevention and Mitigation

- i Lobby and Advocate for DRR/CCA legislation
- ii Conduct public information and awareness on DRR/CCCA
- xiv Conduct vulnerability assessment for DRRM updating
- xv Install community EWS
- xvi Localize Project NOAH
- xvii Construct additional access roadsConstruct additional access roads

#### For Disaster Preparedness

- x Conduct workshop on formulation of Manual of Operations for LDRRMO and Operation Center
- xi Provide additional facilities for LDRRMO and OpCen
- xii Provide additional facilities for Identified ECs
- xiii Purchase 4x4pick-up trucks and utility transport vehicles
- xiv Conduct specialized trainings among CDRRMO personnel
- xv Construct warehouse for stock contingencies
- xvi Construct City Mortuary
- xvii Purchase of food and non-food items for emergency needs
- xviii Conduct specialized trainings to identified sectors
- xix Conduct workshop exemplars on DRR/CCA integration in school curricula
- xx Conduct workshop/orientation on warning and forecasting capacities with communities
- xxi Reproduce and distribute IEC primer on DRRM to different sectors
- xxii Conduct resources mapping of the city
- xxiii Provide hazard maps to all 80 barangays
- xxiv Orient accredited response groups on CDRRMC plans and protocols
- xxv Create quick response teams in every barangay/community organizations

Required budget for the above was estimated at P 160 Mil., about 12% of the total budget requirement of P 1.3 Bil. Of these, the followings are considered as possible JICA loan program since the works cannot be implemented only by GOP, which shall be started from 2015. The total cost was estimated at with the cost of P 88 Mil.

#### For Disaster Prevention and Mitigation

- xv Install community EWS
- xvii Construct additional access roads

#### For Disaster Preparedness

- xxvi Conduct workshop exemplars on DRR/CCA integration in school curricula
- xxvii Conduct workshop/orientation on warning and forecasting capacities with communities

2.2.6 MOA signed by Bukidnon province, 3 Municipalities of Bukidnon, (Talakag, Libona and Baungon), CDO City and Iligan City

MOA was signed by Bukidnon province, 3 municipalities of Bukidnon, (Talakag, Libona and Baungon), CDO city and Iligan city in October 2012. They agreed the following 7 issues:

- 1) BDRRM Plan, Contingency Plan, Climate Change Action Plan, and DRRM Structure
- 2) Enhancement of local government staff and communities by establishment of advocacy, monitoring and database.
- 3) Legislative Action, Policy Support
- 4) Financial Assistance by Trust Fund
- 5) Establishment of Implementation Mechanism by Institutional Incident Command System
- 6) Establishment of monitoring System
- 7) Organization of Emergency Response Team/Unit

Based on the information from DRRMC of CDO City, new contingency plan of the CDO city is under preparation, however those for the barangays in the city were not yet prepared. PDRRMC of Bukidnon prepared Contingency Plan for Drought, Flooding & Fire in June 2008, but not updated since then. 3 municipalities and barangays in Bukidnon did not prepare the plans yet. Accordingly, preparation of DRRMP and contingency plan and their implementation are urgently required.

#### 2.2.7 Non-Structural Measures required for Each Area and Agencies concerned

Based on the results of review of the existing non-structural measures in this Survey, questionnaire/ interview surveys for the DRRMCs, 5-Year DRRM Plan (2013-2017) of the CDO City, MOA signed by Bukidnon province, 3 Municipalities of Bukidnon, (Talakag, Libona and Baungon), CDO City and Iligan City, FFWS in the CDO River Basin, current activities of other foreign countries and NGOs, non-structural measures required for each area and agencies concerned were considered as follows:

No.	CDO City	Talakag	Baungon	Libona	PAGASA
(1) Reinforcement of DRRMCs	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	
<ul> <li>(2) Preparation of Contingency Plan and DRRMP, which includes</li> <li>Preparation/Update of Flood Hazard</li> <li>Map, Evacuation Planning, etc.</li> </ul>	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	
(3) FFWS					$\checkmark$
(4) Community Based Flood Early Warning System (CBFEWS)	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
(5) Information, Education and Communication (IEC)	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	
(6) Land Use Regulation for Flood Plain	$\checkmark$				

Table 2.2.7Non-Structural Measures required for Each Area and Agencies Concerned<br/>(Flood Management)

# CHAPTER 3 FORMULATION OF MASTER PLAN (FLOOD MANAGEMENT): ICR TASK 2-12

## 3.1 Non-Structural Measures (Flood Management)

As explained in the previous chapter for the structural measures, safety level of the structures was designed at 25-year flood for river improvement measures (50-year flood for Master Plan with construction of dam) in the CDO River Basin. Since it will normally take several years to attain the design level, and even if the target design level is attained, non-structural measures are necessary before the level is attained and for bigger design flood after the level is attained.

As previously explained, RA 10121 or the Philippine Disaster Risk Reduction & Management Act of 2010 enacted on May 2010, mandating all Local Government Units (LGUs) including the barangays to establish Barangay Disaster Risk Reduction & Management Councils (BDRRMCs), and to formulate a Contingency Plan and Comprehensive Development Plan. RA 10121 acknowledged the need to promote the participation of all sectors, all stakeholders at all levels especially the local community. However, it was judged that there is still necessity to improve on institution, role, coordination, information dissemination, etc. for DRRMCs and related agencies, since it has not been long since RA10121 was enacted.

Further, based on the results of assessment of the existing non-structural measures in the CDO River Basin, questionnaire survey for barangays in the CDO City flooded by TS Sendong, interview and questionnaire surveys for DRRMC's in the CDO River Basin, etc., current situation, problems, measures considered as necessary were identified.

Based on the above, following six (6) major non-structural measures were formulated as a master plan for the CDO River Basin: In each measures, sub-measures are also shown in the following table:

- (1) Reinforcement of DRRMCs
- (2) Preparation of Contingency Plan and DRRMP, which includes Preparation/Update of Flood Hazard Map, Evacuation Planning, etc.
- (3) FFWS
- (4) Community Based Flood Early Warning System (CBFEWS)
- (5) Information, Education and Communication (IEC)
- (6) Land Use Regulation for Flood Plain

Based on the current situation on the budget, human resources, etc., three (3) phases of implementation plan for the CDO River Basin were formulated for the flood management plan as non-structural measures: namely, Urgent Plan for the period from 2013 to 2014, short-mid term plan for the next 5 years from 2015 to 2019, and long term plan for the period from 2020 to 2025 as follows:.

No	Non-Structural Measures	Contents of Measures		Urgent Plan 2013/2014	Short-Mid Term Plan 2015-2019	Long Term Plan 2020-2035	Remarks
			Reinforcement of Selected C/M & BDRRMCs (Role, Function, etc.)	0	0		Being implemented by GOP
1	Reinforcement of DRRMCs	1.2	Reinforcement of Communication/Coordination between C/M DRRMC and BDRRMCs (Network, etc.)	0	0		Do above
		1.3	Reinforcement of Communication/Coordination among BDRRRMCs (Vicinity, Up & Down Stream, etc.)	0	0		Do above
		1.4	Reinforcement of Communication/Coordination w/ PAGASA and Other Agencies Concerned (before, during and after Floods, etc.)	0	0		Do above
		1.5	Reinforcement of Communication/Coordination w/ NGOs (during and after Floods, etc.)	0	0		Do above
		1.6	Reinforcement of Communication/Coordination w/ CDORBMC, BWPDC, BWRBF (General Issues, etc.)	0	0		Do above
	Preparation of Contingency Plan		Preparation/Update of Flood Hazard Map	0	0		Being implemented by GOP, but it seems difficult due to accuracy.
2	includes	2.2	Evacuation Planning (Number, Location, Capacity of Facilities (Area, Water Supply, Toilet, etc.), Route, Transportation, Role, etc.)	0	0		Do above
	of Flood Hazard	2.3	Emergency Relief Planning	0	0		Being implemented by GOP
	Map, Evacuation	2.4	Plan for the Weak	0	0		Do above
	Planning, etc.	2.5	Preparation of Contingency Plan	Õ	õ		Do above
		2.6	Preparation of DRRMP	Ő	, in the second s		Do above
	FFWS	3.1	Reinforcement of Monitoring on Meteorological and Hydrological Data (Selection of Automatic Rainfall and River Water Step I Station (Number, Location, Specification, etc.)	0	0		Technical assistance seems necessary.
		3.2	Establishment of Database (Acquisition of Data, Data Storing/Transmitting System, etc.)	0	0		Do above
3		3.3	Establishment of Flood Warning System, Information Dissemination to LDRRMCs (Rainfall Intensity, River Water Level), IEC to LDRRMCs, etc.	0	0		Do above
		3.4	Reinforcement of Related Agencies (Information Sharing, Flood Fighting, Stakeholder Meetings, etc)	0	0		Do above
		3.5	Procurement Plan of Equipment for FFWS and O&M Plan	0	0		Do above
		3.6	Capacity Development for FFWS PAGASA Staff	0	0		Do above
		3.7	Study on Future Step 2 System	0	0		Do above
		3.8	Study on Future Step 3 System		0	0	Do above
		4.1	Selection of Conventional Rainfall and River Water Level Stations	0	0	0	Technical assistance seems necessary.
4	CBFEWS	4.2	Technical Assistance for Warning by Rainfall, River Water Level, etc.	0	0		Do above
		4.3	Capacity Development for LGUs		0	0	Do above
	Information, Education and Communication (IEC)		Information Campaign and Publicity for Proposed Structural		-	-	Technical assistance
1		5.1	Measures (by Web site, leaflet, etc.)		0		seems necessary.
		5.2	Capacity Development by Seminar, Workshop, etc.	0	0	0	Do above
5		5.3	Disaster Education w/ DepED/PAGASA, etc. (Understanding of Disaster, Evacuation, Illegal Disposal of Garbege to River, etc.)	0	0	0	Being implemented by GOP
1		5.4	Training on Flood Fighting	0	0		Do above
1		5.5	Training on Rescue	ŏ	ŏ		Do above
			Database by GIS for Land Use Regulation of Habitual Inundation	Ŭ	- Ŭ		Technical assistance
6	Land Use Regulation for	6.1	Areas		0		seems necessary.
1	Flood Plain	0.2	Study on Land Use Regulation based on Flood Hazard Map		0		Do above
1	riood rialli		IStudy and Implementation on Heightening of Houses, Buildings, etc.				

Table 3.1.1	Implementation P	lan (Flood Mai	nagement) for th	e CDO River	Basin (Flood I	Management)
Iubic Silii	mpicincincution	1um (1 100u 111u)	ingement, for th			(indiagoniene)

Source: JICA Survey Team (2013)

#### **3.2** Implementation Plan (Flood Management)

Details of six (6) major non-structural measures are presented as follows:

#### 3.2.1 Reinforcement of DRRMCs

#### 1) Background

Communication and coordination of DRRMCs for flood warning, evacuation, etc. were not properly made for TS Sendong. This is due to (1) initial warning signal was 1 (light), (2) flash flood occurred in the midnight by high intensity rainfall with short duration, (3) response of DRRMCs were delayed due to after work on Friday. On the other hands, those for TY Pablo were improved due to utilization of flood hazard map, ABC meetings, advanced guidance on evacuation, flood monitoring, etc.

However, there is still necessity to improve those of DRRMCs. Accordingly, reinforcement of DRRMCs is necessary in operational measures by utilization of flood hazard map, advanced guidance on evacuation, flood monitoring, etc. more effectively based on the DRRMP and contingency plan to be prepared.

The above reinforcement of DRRMCs is being undertaken by the concerned agencies in the GOP.

#### 2) Objective

It will aim at reinforcement of selected DRRMCs in the CDO River Basin.

#### 3) Contents of Measures

Following measures are proposed with cooperation with vicinity DRRMCs of barangays, city, municipalities, etc. As one of the methods to undertake these measures, participation of agencies concerned such as local NGOs, DRRMCs in other areas in the Philippines who has experienced in these reinforcement can be considered.

- Reinforcement of Selected DRRMCs (Role, Function, etc.)
- Reinforcement of Communication/Coordination between C/M DRRMC and BDRRMCs (Network, etc.)
- Reinforcement of Communication/Coordination among BDRRRMCs (Vicinity, Up & Down Stream, etc.)
- Reinforcement of Communication/Coordination w/ PAGASA, OCD and Other Agencies Concerned (before, during and after Floods, etc.)
- Reinforcement of Communication/Coordination w/ NGOs (during and after Floods, etc.)
- Reinforcement of Communication/Coordination w/ CDORBMC, BWPDC, BWRBF (General Issues, etc.)
- 3.2.2 Preparation of Contingency Plan and DRRMP, which includes Preparation/Update of Flood Hazard Map, Evacuation Planning, etc.

1) Background

Flood hazard maps were prepared by NOAH project, Xavier University, MGB, etc. However, these were based on the previous floods by TS Sendong, TY Pablo,etc .and was considered that there were some problems in accuracy, etc. So, in this Survey, maps with return period of 1/2, 1/5, 1/10. 1/25, 1/50, and those for TS Sendong and TY Pablo were prepared. There are necessities to review the maps taking into account the opinions of local residents, and to be useful for evacuation. Evacuation planning is also necessary.

The Contingency Plan and DRRMP, which include the above are being prepared by the agencies concerned in the GOP, however, technical assistance from outside for Preparation/Update of Flood Hazard Map, Evacuation Planning, was judged necessary in view of accuracy in preparation, etc..

2) Objective

It will aim at preparation of Contingency Plan and DRRMP, which include preparation/update of flood hazard map, evacuation planning, etc. for all the barangays in the CDO River Basin.

3) Contents of Measures

Following measures are proposed:

Preparation/Update of Flood Hazard Map with more accurate elevation and big scale

- Evacuation Planning (Number, Location, and Capacity of Facilities (Area, Water Supply, Toilet, etc.) of Evacuation Center, Route & Transportation of Evacuation based on Flood Hazard Map, Role for Evacuation with self assistance, community assistance and public assistance concept, etc.)
- Plan for the people required for assistance of evacuation

## 3.2.3 FFWS

## 1) Background

PAGASA has been planning to establish FFWS for 13 major river basins in the Philippines. Of these, there are 8 basins in Mindanao Island and CDO River basin has a high priority among them. It is expected to construct FFWS Center for the CDO River Basin in 2013. In order to obtain more accurate advisory and warning on flood, it is prerequisite to construct.

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.

2) Objective

It will aim at establishment of FFWS

3) Contents of Measures

Following measures are proposed:

- Reinforcement of Monitoring on Meteorological and Hydrological Data (Selection of Automatic Rainfall and River Water Level Station (Number, Location, Specification, etc.)
- Establishment of Database (Acquisition of Data, Data Storing/Transmitting System, etc.)
- Establishment of Flood Warning System, Information Dissemination to LDRRMCs (Rainfall Intensity, River Water Level), IEC to LDRRMCs, etc.
- Reinforcement of Related Agencies (Information Sharing, Flood Fighting, Stakeholder Meetings, etc)
- Procurement Plan of Equipment for FFWS and O&M Plan
- Capacity Development for FFWS PAGASA Staff
- 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

#### 3.2.4 Community Based Flood Early Warning System (CBFEWS)

#### 1) Background

CBFEWS is also necessary, which will be quick and effective system for small area such as barangay area. The systems will be expected to contribute self assistance, community assistance and public assistance in the basin. CBFEWS will be established in collaboration with PAGASA who is working on this system under READY project. This system will be conventional with simple warning system by rainfall intensity/river water level to be operated by community (barangay).

2) Objective

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

3) Contents of Measures

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

PAGASA has a warning color coding with rainfall intensity category for Metro Manila as follows: PAGASA has a plan to set similar warning color coding for another areas.

- 7.5-15mm (Yellow as "Ready")
- 15-30mm (Orange as "Get set")
- Over 30mm (Red as "Go")

 Table 3.2.1
 Rainfall Intensity Classification

RAINFALL INTENSITY CLASSIFICATION Unit (mm)

	1 hr	3 hr	6 hr	12 hr	24 hr
Light	< 2.5	< 7.5	< 15	< 30	< 60
Moderate	2.5 - 7.5	7.5 - 22.5	15 - 45	30 - 60	60 - 180
Heavy	> 7.5	> 22.5	> 45	> 90	> 180

Source: PAGASA

## 3.2.5 Information, Education and Communication (IEC)

## 1) Background

Information, education and communication for river, river structure, floods, flood mitigation measures, DRRMP, contingency plan, etc., are very important to the local residents. Without the knowledge, residents along the CDO River were seriously affected by TY Sendong.

2) Objective

It will aim to develop capacity of barangay residents in flood plain.

3) Contents of Measures

Following 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, etc. (Understanding of Disaster, Evacuation, Illegal Disposal of Garbage to River, etc.)
- Training on Flood Fighting
- Training on Rescue

## 3.2.6 Land Use Regulation for Flood Plain

#### 1) Background

In the CDO River Basin, there are key issues such as river boundary and CLUP which is not finalized yet. Without land use regulation for the flood plain, flood damages cannot be minimized.

2) Objective

It will aim to inform to residents in the flood plain that the areas are risky for floods, and to minimize flood damages.

3) Contents of Measures

Following measures are proposed:

- Database for Land Use Regulation of Habitual Inundation Areas
- Study on Land Use Regulation based on Flood Hazard Map
- Study on Heightening of Houses, Buildings, etc.

# CHAPTER 4 SELECTION OF PRIORITY PROJECTS (NON-STRUCTURAL MEASURES): ICR TASK 2-13

## 4.1 **Priority Projects**

Priority projects were selected based on the criteria as follows:

- 1) Projects expected to obtain big and effective impacts on flood mitigation
- 2) Projects economically feasible
- 3) Projects which can be implemented quickly without problems in view of natural environment, social environment and political problems, etc.)

As a result, all non-structural measures selected in the master plan, except item 6.3: Study and Implementation of Heightening of Houses, Buildings, etc, were basically selected based on the above selection criteria. As for the new FFWS to be implemented by PAGASA, the projects were identified as national priority projects. Therefore, these non-structural measures were selected as priority projects. However, due to time constrain, number of barangay will be selected, and contents of the project will be prioritized as follows:

#### 4.1.1 Reinforcement of DRRMCs

It will aim at reinforcement of selected DRRMCs in the CDO River Basin. In selection of DRRMCs, results of questionnaire surveys undertaken in September 2012, etc. will be used. Following measures are proposed with cooperation with vicinity DRRMCs of barangays, city, municipalities, etc. As one of the methods to undertake these measures, participation of agencies concerned such as local NGOs, DRRMCs in other areas in the Philippines who has experienced in these reinforcement can be considered.

- Reinforcement of Selected DRRMCs (Role, Function, etc.)
- Reinforcement of Communication/Coordination between C/M DRRMC and BDRRMCs (Network, etc.)
- Reinforcement of Communication/Coordination among BDRRRMCs (Vicinity, Up & Down Stream, etc.)
- Reinforcement of Communication/Coordination w/ PAGASA and Other Agencies Concerned (before, during and after Floods, etc.)
- Reinforcement of Communication/Coordination w/ NGOs (during and after Floods, etc.)
- Reinforcement of Communication/Coordination w/ CDORBMC, BWPDC, BWRBF (General Issues, etc.)
- 4.1.2 Preparation of Contingency Plan and DRRMP, which includes Preparation/Update of Flood Hazard Map, Evacuation Planning, etc.

It will aim at preparation of Contingency Plan and DRRMP, which include preparation/update of flood hazard map, evacuation planning, etc. for the selected barangays. Following measures are proposed:

- Preparation/Update of Flood Hazard Map with more accurate elevation and big scale
- Evacuation Planning (Number, Location, and Capacity of Facilities (Area, Water Supply, Toilet, etc.) of Evacuation Center, Route & Transportation of Evacuation based on Flood Hazard Map, Role for Evacuation with self assistance, community assistance and public assistance concept, etc.)
- Plan for the people required for assistance of evacuation

#### 4.1.3 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
- 4.1.4 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

#### 4.1.5 Information, Education and Communication (IEC)

It will aim to develop capacity of residents in selected barangays. Following measures are proposed:

- 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.)
- Training on Flood Fighting
- Training on Rescue
- 4.1.6 Land Use Regulation for Flood Plain

It will aim to inform the areas 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

#### 4.2 Scoping for the Project (Non-Structural Measures): ICR Task 2-15

Selection criteria for non-structural measures on flood management proposed for JICA Loan were set as follows:

- (1) Projects contribute to transfer of Japanese technology (Flood Hazard Mapping, etc.)
- (2) Projects reinforced and/or supplement to completed or on-going projects assisted by Japanese ODA (FFWS, etc.)
- (3) Projects supplement to the structural measures to be implemented by JICA Loan (CBFEWS, etc.)

(4) Projects to understand importance of the structural and non-structural measures to be implemented by JICA Loan (Information Campaign and Publicity, etc.)

From the above criteria, followings were selected as non-structural measures proposed for JICA Loan.

4.2.1 Preparation/Update of Flood Hazard Map, Evacuation Planning

Following measures are proposed:

- Preparation/Update of Flood Hazard Map with more accurate elevation and big scale
- Evacuation Planning (Number, Location, and Capacity of Facilities (Area, Water Supply, Toilet, etc.) of Evacuation Center, Route & Transportation of Evacuation based on Flood Hazard Map, Role for Evacuation with self assistance, community assistance and public assistance concept, etc.)
- Plan for the people required for assistance of evacuation

## 4.2.2 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
- 4.2.3 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
- 4.2.4 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, etc. (Understanding of Disaster, Evacuation, Illegal Disposal of Garbage to River, etc.)

#### 4.2.5 Technical Assistance for Land Use Regulation for Habitual Inundation Areas

It will aim to inform the areas 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

Target LGU organizations, such as DRRMCs, BENRO/CLENRO/MENRO and related agencies/organizations for the above measures are shown below.

No.	CDO City	Talakag	Baungon	Libona	PAGASA	
(1) Technical Assistance for Flood Hazard Mapping and Evacuation	~	$\checkmark$	$\checkmark$	$\checkmark$		
Planning						
(2) Technical Assistance for FFWS					$\checkmark$	
<ul><li>(3) Technical Assistance for Community Based Flood Early Warning System (CBFEWS)</li></ul>	~	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	
<ul><li>(4) Technical Assistance for Information Campaign and Publicity for the Project (Structural Measures)</li></ul>	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$		
(5) Technical Assistance for Land Use Regulation for Flood Plain	$\checkmark$					

Table 4.2.1 Non-Structural Measures proposed for JICA Loan
# CHAPTER 5 STUDY ON NON-STRUCTURAL MEASURES (WATERSHED MANAGEMENT)

# 5.1 Assessment of Land Classification and Forest Distribution in the CDO River Basin: ICR Task 1-2 & 2-10

#### 5.1.1 Land Classification on Forestlands and Alienable & Disposal (A&D) Lands

Based on the land classification in the Philippines, all the terrestrial lands in the Philippines are delineated into the Forestlands and Alienable & Disposal (A&D) Lands,

based on the Public Land Act in 1930s. By the Constitution enacted in 1987, all the national lands are categorized into four (4) categories; i) Agricultural Lands, ii) Forest or Timber lands, iii) Mineral Lands, and iv) National Parks. In the DENR Administrative Order (DAO) No.15, A&D Lands are defined as the synonymous with the Agricultural Lands.

The forestlands occupy almost the same areas compared as the A&D Lands. Basically, the forestlands are located in the mountainous and upper portions of lands, and the A&D Lands are on the flat and lower portions. In terms of land ownership, the former is the public lands, and the latter is the private lands. It is necessary to be approved by the Congress to re-delineate the boundaries between the public private lands and lands. Nowadays, the forestlands are utilized for the timber harvesting, pasture lands, and agricultural



lands by the immigrants, other than the forests. DENR is the national agency to manage the forestlands, whilst DA is for the A&D Lands. The distribution of the forestlands and A&D Lands inside the CDO River Basin is shown in **Figure 5.1.1 and Table 5.1.1**.

City/Municipality	Forestland		A&D L	and	Total		
Cagayan de Oro City	4,609.4	3.4%	6,520.6	4.8%	11,130.0	8.2%	
Mun. Talakag	50,578.2	37.1%	29,670.5	21.8%	80,248.7	58.8%	
Mun. Baungon	16,495.5	12.1%	13,185.9	9.7%	29,681.5	21.8%	
Mun. Libona	764.9	0.6%	8,898.7	6.5%	9,663.7	7.1%	
Illigan City	5,591.3	4.1%	78.9	0.1%	5,670.2	4.2%	
Total	78,039.3	57.2%	58,354.7	42.8%	136,394.0	100.0%	

Table 5.1.1Distribution of the Forestlands and Alienable & Disposal (A&D) Lands in the<br/>CDO River Basin per LGUs

Source: DENR Region X

#### 5.1.2 Land uses in the CDO River Basin

As described in Chapter 2, the lower portions of the CDO River Basin are mainly used as the residential areas in CDO City, and middle and upper portions of the CDO River Basin in Bukidnon are mainly utilized as the agricultural lands and forests. The existing Master Plan by DPWH (2011) shows the land use classification as of 2010 in the CDO River Basin as shown in **Table 5.1.2 and Figure 5.1.2**.



City/Munic	City/Municipality		Mun.	Mun.	Mun.	Iligan City	Tota	1	Forest
Land Uses	· ·	Oro City	Talakag	Baungon	Libona		(ha)	(%)	(ha/%)
Forest		8.57	30,107.34	7,764.66	0.00	754.18	38,634.76	29.2%	38,634.76
Forest Produc	ction	3,368.11	0.00	17.14	797.03	0.00	4,182.29	3.2%	4,182.29
Forest Protect	tion	4,242.28	1,054.14	188.55	1,311.25	1,679.77	8,475.99	6.4%	8,475.99
Agricultural		231.40	8,064.62	10,884.24	42.85	0.00	19,223.11	14.5%	
Agricultural		0.00	0.00	214.26	1 276 56	0.00	1 100 82	3 /1%	
Production		0.00	0.00	214.20	4,270.30	0.00	4,490.82	5.470	
Agricultural		0.00	1 276 97	9 727 25	2 922 16	0.00	13 976 68	10.5%	
Protection		0.00	1,270.77	,121.25	2,722.40	0.00	15,720.00	10.570	
Grassland		85.70	37,769.16	94.27	0.00	25.71	37,974.85	28.7%	
Built Up area		197.12	299.96	0.00	94.27	0.00	591.35	0.4%	
Urban Landu	se	2,451.10	111.41	471.36	0.00	0.00	3,033.87	2.3%	
Land under CARP		162.84	0.00	0.00	0.00	0.00	162.84	0.1%	
Mining Quarrying		25.71	1,156.99	0.00	0.00	34.28	1,216.98	0.9%	
Inland Water		377.09	0.00	51.42	0.00	0.00	428.51	0.3%	
Total	(ha)	11,149.92	29,413.15	79,840.60	9,444.43	2,493.95	132,342.04	100.0%	51,293.04
	(%)	8.4%	22.2%	60.3%	7.1%	1.9%	100.0%		38.8%

<b>Table 5.1.2</b>	Distribution	of the Land	Use in the	<b>CDO River</b>	Basin
--------------------	--------------	-------------	------------	------------------	-------

Source: Master Plan (2011)

Based on the land use map above, 38.8% of the areas are covered by the forests; i.e. forest, forest production and forest protection, in the CDO River Basin. The vast areas in the forestlands in the CDO River Basin are utilized as other purposes: i.e. agricultural lands, grasslands, residential areas, and so on.

#### 5.1.3 Vegetative Cover in the CDO River Basin

As described in Chapter 2, the lower portions of the CDO River Basin are mainly used as the residential areas in CDO City, and middle and upper portions of the CDO River Basin in Bukidnon are mainly utilized as the agricultural lands and forests. The vegetative distributions in the CDO River Basin as of 2003 are shown in **Table 5.1.3** and **Figure 5.1.3**, based on the data and information from DENR Region X.

City	Cagayan de	Mun.	Mun.	Mun.	Iligan	Tota	1	Forest	
Vegetative C	lass	Oro City	Talakag	Baungon	Libona	City	(ha)	(%)	(ha/%)
Closed Forest	, broad leaved	0.00	12,405.63	5,540.89	175.34	0.00	18,121.87	13.3%	18,121.87
Open Forest,	broad leaved	405.48	13,402.90	4,171.01	21.92	385.76	18,387.07	13.5%	18,387.07
Mangrove Fo	rest	53.25	0.00	0.00	0.00	0.00	53.25	0.0%	53.25
Other wooded	l land, Shrubs	3,730.46	15,671.42	7,228.58	1,069.60	4,280.60	31,980.66	23.4%	
Other wooded Grassland	l land, wooded	0.00	15,838.00	0.00	0.00	464.66	16,302.66	12.0%	
Other land, N Grassland	atural	3,612.10	12,357.41	4.38	0.00	247.67	16,221.57	11.9%	
Other land, cu Annual Crops	iltivated,	1,225.22	10,483.42	12,085.63	8,399.01	291.51	32,484.78	23.8%	
Other land, cu Perennial Cro	ıltivated, ps	859.19	0.00	653.16	0.00	0.00	1,512.35	1.1%	
Other land, B	uilt-up Area	1,297.55	87.67	0.00	0.00	0.00	1,385.22	1.0%	
Total	(ha)	11,183.25	29,683.65	80,246.46	9,665.87	5,670.21	136,449.44	100.0%	36,562.19
	(%)	8.2%	21.8%	58.8%	7.1%	4.2%	100.0%		26.8%

 Table 5.1.3
 Distribution of the Vegetative Cover in the CDO River Basin

Source: DENR Region X (2011), modified by JICA Survey Team



Based on the vegetative cover map above, 26.8% of the areas are covered by the forests; i.e. Closed Forest, Open Forest and Mangrove Forest, in the CDO River Basin. The vast areas categorized as the forests in the CDO River Basin are utilized as other purposes: i.e. agricultural lands, grasslands, residential areas, and so on.

# 5.1.4 Transition of the Forest Cover in the CDO River Basin

The forest cover ratio in 1900s is said to be about 70% in whole of the country. Especially after 1950s, vast areas of the natural forests were harvested and cleared for the large-size agricultural plantation and timber harvesting in the whole of the country. In the response to the forest degradation and decrement of the forest areas in the country, including the CDO River Basin, the Philippine Government declared the logging bans to prohibit the logging in the natural forests at the several times; i.e. in 2004 by the President Aroyo and in 2011 by the President Aquino. Based on the analyses of the several existing documents, the transitions of the forest areas in Mindanao Island and inside the CDO River Basin from 1900s to 1990s are shown in below figures and table.

Table 5.1.4Transition of the forest areas between 1900s and 1990s of the Country,<br/>and in Mindanao Island and inside the CDO River Basin,<br/>based on the Existing Documents Analyses

Area	Whole Country *1		Whole Mindana	o Island *1	CDO River Basin *1		
Period	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	
Total Land Area (ha)	29,534,405	100.0%	10,202,192	100.0%	136,385	100.0%	
1900s	20,674,083	70.0%	8,912,382	87.4%	135,956	99.7%	
1920s	17,720,643	60.0%	8,849,432	86.7%	133,714	98.0%	
1960s	11,813,762	40.0%	5,935,464	58.2%	122,233	89.6%	
1970s	10,041,698	34.0%	4,445,735	43.6%	57,684	42.3%	
1987	6,999,654	23.7%	4,140,292	40.6%	50,944	37.4%	
1999	5,404,796	18.3%	2,752,574	27.0%	32,465	23.8%	
(Reference)							
2003~2010 *2*3	7,974,289	27.0%	2,063,595	20.2%	36,562	26.8%	

Source: Dolom, P. and Dolom, M. (2006), Promoting good ecogovernance through participatory forest land use planning; DENR (2012), 2011 Philippines Forestry Statistics; and DENR Region X (2010), Vegetative Cover Map of the Cagayan de Oro River Basin.

- \*1 Forest loss figures are referred from Dolom, P. and Dolom, M. (2006), modified by JICA Survey Team and areas of whole Mindanao and CDO river basin between 1990s and 1999 are calculated through GIS application by the JICA Survey Team. As the original data of the article cannot be obtained, and the figures in the original article were digitized by the Survey Team by using ArcGIS software, there should include the significant errors in the calculated and estimated figures in the table above and figure below. However, these data can be utilized to recognize the transition of the forest areas in the whole of Mindanao Island and inside the CDO River Basin.
- \*2 Forest areas in 2003-2010 for the whole country and whole Mindanao Island are referred from "2011 Philippines Forestry Statistics" published by DENR in 2012, and calculated by JICA Survey Team.
- \*3 Forest area for CDO River Basin in 2003~2010 is referred from the Vegetative Map prepared by DENR Region X in 2010 (**Table 5.1.3 and Figure 5.1.3**).



(1) Transition of the forest areas between 1900s and 1990s in Mindanao Island



(2) Transition of the forest areas between 1900s and 1990s inside the CDO River Basin

# Figure 5.1.4 Transition of the forest areas between 1900s and 1990s in Mindanao Island and inside the CDO River Basin

Source: Forest loss figures are referred from Dolom, P. and Dolom, M. (2006), modified by JICA Survey Team and areas of whole Mindanao and CDO river basin are calculated through GIS application. As the original data of the article cannot be obtained, and the figures in the original article were digitized by the Survey Team by using ArcGIS software, there should include the significant errors in the calculated and estimated figures in the table above and figure below. However, these data can be utilized to recognize the transition of the forest areas in the whole of Mindanao Island and inside the CDO River Basin. As shown in the figures and table above, the forest areas are decreasing in the CDO River Basin as same as those in the whole of the Philippines. In Mindanao Island, the forest areas decrease significantly in the south and central part of Mindanao, compared to the CDO River Basin.

5.1.3 Transition of the Forest Cover and Floods in the Lower Portion of CDO River Basin

The figure below shows the transition of the forest cover inside the CDO River Basin and destructive tropical cyclones, including tropical storm and typhoons, which hit the CDO River Basin area. It is assumed that decrement of forest covers would cause the floods in the lower portions of CDO River Basin. However, although it was quite rare for Mindanao areas to be hit by the destructive tropical cyclones in the past, as Mindanao areas would become easily suffered by the destructive tropical cyclones since 2000s, the lower portions of the CDO River Basin would be easily suffered by the disastrous floods, maybe because the more tropical cyclones would pass and hit the CDO River Basin area. Therefore, the forest degradation would be one of the causes for the floods in the lower portions, but not the sole reason.



Source: Same sources as Figure 5.1.4 and Table 5.1.4 for "Forest Rates". "Destructive Tropical Cyclones "

# Figure 5.1.5 Transition of the Forest Areas inside CDO River Basin and Period of Destructive Tropical Cyclones which hit the Northern Mindanao

As mentioned in Chapter 9, the fine sand continues to flow down from the upper portions of the CDO River Basin, resulting in the sedimentation and flow away of the fine sand in the river mouth area of the CDO River. It is assumed that the small-scale to large-scale agricultural lands on the middle and upper portions of the river basin would be considered to be one of the sources of those fine sands. Most of those agricultural lands are located inside the A&D Lands on the middle and upper watershed, and some are inside the forestlands. As the riparian areas along the rivers and creeks, and waterways which are dug inside the agricultural lands, are denuded for the development of the agricultural fields, and vegetation covers have not yet been recovered along those riparian areas, the surface water flows and dine sands are easily to be flown into the rivers, creels and waterways upon the rain, and those flown fine sands flow way down to the lower portions of the river. However, as there are no studies and researches on the fine sand sources and sediment analysis for the CDO River Basin, it is quite difficult to specify the sources and sedimentation of the fine sands for the CDO River.

# 5.2 Assessment of Existing Non-Structural Measures (Watershed Management): ICR Task 1-2 & 2-10

- 5.2.1 Organization Structures for the Watershed Management for the CDO River Basin
  - 1) Cagayan de Oro River Basin Management Council (CDORBMC)

The CDORBMC was constituted on November 2010, to act as the governing body for the operation, supervision, and management of the CDO River Basin. The CDORBMC was organized as multi-sectoral coordinative body, headed by Cagayan de Oro Archbishop and co-chaired by DENR Region X and DILG Region X. The legal document to formalize CDORBMC is under preparation by DILG Region X from 2010, but this document has not yet been finalized.

At the start of CDORBMC, it was composed of the authorities, LGUs and organizations in CDO City, however, in the response to the disaster by TS Sendong and in the response from the same kinds of organizations in the upper watershed; BWPDC/BWRBF, the said two (2) River Basin Organizations (RBOs) agreed to follow a unified blue print of actions for the immediate rehabilitation of the CDO River Basin and the joint consultative planning workshop, a Civil Society Organization-led initiative, was conducted in July 2012 in CDO City, by the said two (2) RBOs. The three (3) municipalities in the upper watershed of CDO River Basin in Bukidnon Province were the members for one of the four (4) Technical Working Groups (TWGs) of CDORBMC. Those three (3) municipalities were introduced to become the members of Board of Stakeholders at the 5<sup>th</sup> Executive Committee (ExeCom) in August 2012, and become the member of the Board of Stakeholder officially at the 1<sup>st</sup> Board of Stakeholders Meeting in September 2012. Regarding the relationships and activities with the Bukidnon Provincial Government and CDORBMC, However, even though the cooperation between CDORBMC and BWRBF were agreed to be important for the further disaster prevention, as of February 2013, the workshop held in July 2012 mentioned above is the sole activity which was conducted in cooperation with CDORBMC and BWRBF. Moreover, the new members were introduced to the Board of Stakeholders at the 2<sup>nd</sup> Board of Stakeholders Meeting held in February 2013, and such authorities and organizations as DPWH, COWD, HLURB and MBDA have become into the new members officially.

2) Bukidnon Watershed Protection and Development Council (BWPDC) / Bukidnon Watershed and River Basin Forum (BWRBF)

The BWPDC was constituted by Presidential Memorandum Order No. 270 of His Excellency Fidel V. Ramos, issued on March 22, 1995, in order to "fully protect and preserve the remaining forests in the Bukidnon Watersheds, and rehabilitate open areas within their headwaters". The BWRBF was at first established in 2011 as a Civil Society Organization, chaired by the Bishop of Malaybalay. In January 2012, Bukidnon Governor formalized the BWRBF through an Executive Order (EO)<sup>1</sup>, and named Bishop of Malaybalay as the head of the BWRBF. Although the relationship between two organizations had been unclear, the BWRBF has become one of the members of Technical Advisory Committee (TAC) of BWPDC, and has been positioned as the members of the BWPDC.

<sup>&</sup>lt;sup>1</sup> Minda News, dated on February 5, 2012.

3) Macajalar Bay Development Alliance (MBDA)

MBDA is established for the proper management and development of natural environment and coastal resources of the Macajalar Bay. The MBDA is composed in 14 LGUs along the Macajalar Bay, and Xavier University is working as a secretariat. The MBDA is targeting to formulate the Bay-wide integrated coastal management plan. As mentioned above, the MBDA has become one of the members of CDORBMC, based on the "Ridge to Reef Approach".

- 5.2.2 Watershed Management Plans for the CDO River Basin
  - 1) Watershed-Related Plans by DENR Region X

DENR Region X formulated the Cagayan (de Oro) River Watershed Management Plan in 1999, and the Characterization Study (2007) and Vulnerability Assessment (2009) were conducted only for Bubunawan River, which is one of the tributaries of CDO River, by DENR Region X. The same kinds of studies: i.e. Characterization Study and Vulnerability Assessment, are planned for Picoting River, which is also one of tributaries of CDO River, in 2013.

2) Formulation of the Watershed Management Plan by RBCO-DENR

RBCO-DENR published the tender for formulating the Integrated River Basin Management and Development Master Plans (IRBMDMPs) for four (4) major rivers in the Philippines in August 2013, including CDO River Basin. The objective of this plan will include the concerns on the followings:

- Water Resources Management 1 2. Watershed Management Creation of Institutional Framework and Physical Structure for Management 3. 4. Flood Control / Mitigation and Hazard Management River and River Delta Management 5. Coastal resources Management 6. 7. **Biodiversity Conservation** Climate Change Adaptation and Mitigation 8. Mineral Resources Management 9. 10. Community Participation which will promote a more sustainable management
  - of the basin, and
- 11. Economic Development Plan.

For the CDO River Basin, due to the delay of selection of the consulting firm for the study by the local bidding, the Notice to Proceed (NTP) has just been issued by the Secretary of DENR in May 2013. After the issue of NTP, the selected consulting firm visited at CDO City and DENR Region X to conduct the courtesy visits and preliminary site surveys. The total length of the study is 18 months, thus the IRBMDMP for the CDO River Basin will be formulated by November 2014.

<b>Table 5.2.1</b>	List of Contents in the Terms of Reference (TOR) for the Integrated River
Basin N	Ianagement and Development Master Plan, prepared by RBCO-DENR

No.	Summary of TOR
1. Phas	e I: Review of Water Policy and Basin Development Strategy
(i)	Review and assess the guiding policy principles for the river basin development and management at national, sectoral and project levels that have been enunciated and adopted in the Philippines.
(ii)	Collect relevant statistical data relating to climate, hydrological, geographic, hydrogeological, environmental, and socio-economic conditions in the river basin at least 10 years
(iii)	Identify existing water control structures and water users in the basin and recommend intervention measures relative to impacts as a result of climate change.
(iv)	Assimilate the IRBMDMP and relevant documents for the preparation and adoption of a comprehensive policy on river basin development in the River Basin
(v)	Review existing information and studies on water sector in the Philippines including experiences from international organizations such as JBIC/JICA, World Bank, and ADB in the Philippines.
(vi)	Review and assess the existing Regional/Provincial Development Plan, CLUP, Basin Development Plan, etc. that will substantiate the preparation of master plans.
(vii)	Assess management regimes of various existing and abolished/inacted River Basin Organizations (RBOs), stating merits and demerits for the establishment of RBO in the RB of interest.
(viii)	Study recognized international and local best practices for the river basin/watershed management activities, including resource transfer mechanisms between upstream and downstream and by communities.
(ix)	Identify all stakeholders who may be involved in the development and management of the water sector in the basin and analyze their roles, rights, and responsibilities. Examine and evaluate policies for stakeholders' participation; the absorptive capacity of different stakeholder groups, gender issues; experience in participatory water resources management, and mechanism for client groups' participation (including women) in planning, implementation, and management of all the sectors within the basin.
(x)	Conduct consultation meetings with stakeholders, communities, and business communities in the basin, focusing on how to solve the current problems in the water sector through community participation.
(xi)	Undertake a social analysis for the river basin to identify (i) groups who will benefit from and/or use the proposed works, (ii) groups who may be adversely affected by the works, (iii) indigenous people, and (iv) other major stakeholders to included gender concerns.
(xii)	Conduct discussions with relevant institutions at the national, regional, provincial, municipal levels, including DA, NIA, DENR, DPWH, DoE, NCIP, NEDA, other agencies, NGOs and business communities, etc., to assess current administrative arrangement and strategies for the water sector.
(xiii)	Describe how water and its delivery are priced, including issues such as water price subsidies and indirect pricing or taxation methods, and water license fees.
(xiv)	Assess the effectiveness of existing policies, laws, decrees, etc. pertaining to the water sector that govern allocation of available water resources, water rights and water pricing, project identification and implementation; funding mechanisms; water infrastructure management; environmental protection; payment for environmental services; recognition and incentive policies for communities practicing sustainable watershed management practices; and public health at the national and basin level.
(xv)	Consolidate existing Geographic Information System (GIS) data for the River Basin of interest and develop a data base for river basin Management System.
(xvi)	Formulate development strategy for the CDO River Basin which will be applicable for the next 15 years, considering population growth, economic development, water availability and resources development, flood and climate change hazard, and environmental conservation activities.
2. Phas	e II: Formulation of Master Plan
(i)	Describe current natural and socio-economic condition and the trends in the river basin, highlighting current problems in the water sector.
(ii)	Assess the physical resources, including availability of surface water and groundwater and water quality. Identify sensitive ecosystem, and describe how the issues on water quality affect these ecosystems.

No.	Summary of TOR
(iii)	Describe surface and ground water resources development and use. Assess existing water rights
	including customary water right. Evaluate past/present development of single/multipurpose water
	supply and control infrastructure. Assess past/present programs in water supply and disposal, and
	programs in irrigation and drainage. Evaluate the impact of in-stream uses on the environment.
(iv)	Conduct water balance study and develop mathematical computer model for the basin.
(v)	Assess current land use and existing tenurial instruments (e.g. CBFMA, IFMA, CADT, etc.) in
	the basin. Identify the trend of land use and recommend appropriate land use in the basin for the
	next 15 years.
(vi)	Assess the efficiency and effectiveness of relevant institutions at the macro/micro levels. In
	particular, evaluate the appropriateness of the current planning-by-level philosophy. Identify and
	comment on overlaps and duplication of functions between and within levels of Government.
(vii)	Review and describe the state of water resources in terms of availability and quality. Assess the
	incidence and conditions associated with major water-related diseases, related to water supply
	and sanitation.
(viii)	Review and identify the proposed projects, both structural and non-structural components, in
	connection with (i) watershed conservation and management, (ii) irrigation, (iii) hydropower
	generation, (iv) water supply for domestic and industrial use, (v) disaster risk reduction and
	management, (vi) drainage and flood control, (vii) waste and wastewater management, (viii)
	navigation, (ix) eco-tourism, (x) mining sites rehabilitation and restoration, (xi) coastal and
	marine resources management, (xii) river delta management, (xiii) groundwater and recharge
	zone management, and (xiv) environmental conservation. Develop and recommend as set of
(irr)	Indentify the present and emerging major issues and forecast future trands for each of the
(1X)	indentify the present and emerging major issues and forecast future trends for each of the subsectors. In particular, distinguish the constraints that are now or may in the future hinder the
	subsectors. In particular, distinguish the constraints that are now of may in the future inner the resolution of major issues facing the water sector, and specify the opportunities that may exist to
	facilitate or accelerate their solution
(x)	Indentify and man major infrastructures such as dams flood controls irrigation hydronower
(Л)	facilities hulk water projects ground water pumping stations erosion controls structures
	hydro-meteorological stations and water sources such as springs, fresh water lakes, etc.
(xi)	Prepare a gender action plan to reflect the analysis of the role of women in the decision making
()	process.
(xii)	Ascertain the status of current major project related to the water sector in the basin. Review their
	appropriateness in terms of effectiveness in addressing the major issues identified previously.
(xiii)	Evaluate alternative strategies for managing water resources, including those relating to the
	management of supply, and those relating to the management of demand. Develop clear economic
	and administrative decision criteria to allocate scarce water resources among competing
	subsectors in the basin.
(xiv)	Prepare the public awareness plan for integrated river basin management, such as education
	program, hexamedia program, exchange visits, knowledge sharing symposia and other water
	advocacy program.
(xv)	Develop River Basin-based natural and geo-hazard maps using MGB generated geo-hazard maps
	and conduct interpretation of its impact on socio-economic and environmental conditions of the
	basin.
(xvi)	Assess and identify appropriate flood control and community preparedness / adaptation
	strategies
(xvii)	Formulate a 15-year Master Plan for the CDO River Basin. The Master Plan should include the
	list of recommended priority projects with indicative cost.
(xviii)	With the implementation of the Master Plan, assess the impact on communities living in the basin
	providing emphasis on dwellers living in hazard prone areas (easement, foreshore, etc.).
(xix)	Identify local stakeholders' participation and their roles and responsibilities as part of plan
	Implementation.
(XX)	Identify the constraints to implement the proposed Master Plan and propose mitigation measures.

Source: RBCO-DENR (2013)

In advance to this study, the mapping activities related to the IRBMDMP have been commenced from October 2012 by using the special fund from RBCO-DENR<sup>2</sup>. This mapping activity categorizes the geohazard risks, such as landslides, flood and drought, inside the CDO River Basin. This mapping activity is planned to be completed by the end of May 2013, and the Geohazard Maps being delivered to each LGU. In addition, two other researches; i.e. Research on Analyses of watershed Land Use, sediment Budget and Dynamics to understand Flooding in CDO River and Research on the Assessment of Metal and Organic Geochemical Pollution in the Coastal Area of CDO have been planned for the CDO River Basin, but they have not yet commenced due to the delay of selection of the consultants, as of May 2013. These three (3) research projects are identified and programmed by CDORMBC.

3) Watershed Management Plans by LGUs

Bukidnon Province has formulated the Watershed Management Framework Plan in 1995. Also the Bukidnon Province Environmental Code is planned to be revised in 2013.

Based on this framework plan, all the municipalities in Bukidnon formulated their own watershed management plans in and around 2002 with instructions by and in coordination with BENRO and BWPDC. Those formulations were funded by CIDA. However, as the watershed management was ranking in the low priority in the development plans for each municipality, only some activities planned in those watershed management had been implemented. The BENRO also planned to assist in formulating the Barangay level watershed management plans for all the barangays inside Bukidnon Province, only some 10 barangays had formulated their watershed management plans. In 2013, BENRO plans to assist some barangays to formulate their Barangay-level watershed management plans.

On the contrary, there are no watershed management plans and forest land use plans for the whole of CDO City, because the watershed management has been ranked in the lower priority based on the low forest area ration in CDO City.

4) Management Plans by the Donors

ADB conducted the Technical Assistance on formulating the Pre-Feasibility Study on Wastewater, Watershed Management and Solid Waste Management (TA-7506-REG<sup>3</sup>) for Cagayan de Oro City from June 2012, concluded in November, 2012 by submitting the Final Report to the City Government and CDIA-ADB. Although the watershed management is one of the tasks, CDO River Basin is out of the plan, and the concentration is in the Iponan River, adjacent to CDO River. The contents of the watershed management component are; i) eco-tourism project for the rural watershed, ii) improvement in the flood risk reduction for urban watershed, and iii) reforestation of various zones of the CDO Riverbanks for in the stretch of about 15 km from the river mouth of CDO River.

CTI Engineering International Co., Ltd. / PASCO Corporation

<sup>&</sup>lt;sup>2</sup> Research on Mapping Impact of Climate Change to the Municipalities covering the CDO Watershed

<sup>&</sup>lt;sup>3</sup> Project Preparation Support for Cities Development Initiative for Asia. CDIA: Prefeasibility Study (PFS) on Wastewater, Watershed Management and Solid Waste Management in Cagayan de Oro City, Philippines

5) Management Plans for the Protected Areas

As mentioned in Chapter 2, there exist two (2) Protected Areas (Natural Parks) inside the CDO River Basin. The PAWCZMS-DENR Region X has responsibilities to manage those Protected Areas, and the following management plans are already formulated by DENR Region X.

- Draft Management Plan for Mt. Kalantungan Range Natural Park (2008)
- Management Plan for Mt. Kitanglad Range Natural Park (2001)
- 6) Coastal Management Plans

Based on the "Ridge to Reef Approach <sup>4</sup>" concept, the coastal management has been considered to be integrated into the watershed management. PAWCZM-DENR Region X has responsibilities to manage the coastal areas as the national level authority, whilst Agricultural Productivity Office (APO) / City Agricultural Office (CAO) and MAO have obligations to manage the coastal areas as the LGU level. In case of CDO City, CLENRO has also one part of responsibilities to manage the coastal areas.

According to the Executive Order No. 533 in 2006, CDO City has been formulating the Coastal Resource Management Plan (CRMP) for the coastal areas in CDO City. The CRMP has not yet approved by the City Mayor, because the land use portions in the CRMP has been planned to be integrated into the CLUP of the CDO City. According to the information from APO as of the start of May 2013, the CRMP would be approved by the City Mayor after the election in May 2013.

Along the coastal lines in CDO City, there exist six (6) numbers of the candidate Marine Protected Areas (MPA) sites, and the designated Barangay Councils had prepared management plans for MPAs and/or Fish Sanctuaries in cooperation with PAWCZMS-DENR Region X and APO. Those MPA candidate sites are planned to be approved officially when the CRMP will be approved by the City Mayor. After the approval by the City Mayor, CLENRO will submit the approved CRMP to the MBDA in order to be integrated and utilized into the Bay-wide Coastal Management Plan, which is being formulated by the MBDA. However, as most of the management plans by the Barangay Councils had been prepared in the early 2000s, those plans should be revised and updated based on the drastic changes by the TS Sendong.

7) Activities related to the Watershed Management, planned in the DRRMPs of LGUs

CDO City has just revised and updated their DRRMP 2013-2020 in 2013. The reforestation for the middle watershed of the CDO River and also coastal management are also planned in the CDRRMP. The MDRRMPs have not yet been revised for the three (3) municipalities in Bukidnon in the upper watershed of the CDO River Basin.

As mentioned in the Section 2.2 (5) above, some activities related to the watershed management have been planned in the CDRRMP, as shown in the below table.

<sup>&</sup>lt;sup>4</sup> IUCN advocates a "reef to ridge" approach by which all the attributes of natural ecosystems, from the seas, rivers and wetlands, to the mountains and hill forests above, are protected.

	Planned Activity	Implementers / Budgets		
		(including plans and assumptions)		
	For Disaster Prevention and Mitigation			
(6)	Construct SALT training to farmers	Planned AfD Project?		
(8)	Eco-Tourism Forest Park Development			
	A. Seedling production	DENR budget?		
	B. Rehabilitate the Cagayan de Oro Rivers	DENR budget?		
	C. Agro-forestry Intervention	Planned AfD Project?		
	D. Conduct livelihood activities			
(11)	Plant mangrove propagules in coastal areas	APO budget?		

Table 5.2.2	Activities related to the Watershed Management planned in							
CDRRMP 2013-2020								

Source: CDRRMP 2013-2020 (2013)

Among the planned activities related to the watershed management, items (6) and (8) C may be implemented through the planned project by AfD, whilst activities (8) A, B and C will be implemented by the DENR budget, due to the order by the RA10452 (2013). Activity (11) is being implemented by the APO regular budget.

#### 5.2.3 Watershed Management-related Activities in CDO River Basin

The several national-level authorities; i.e. DENR, local-level authorities: i.e. LGUs, and international donors: i.e. ADB, have been implementing many kinds of activities related to the watershed management inside the CDO River Basin. Among the activities by those organizations, the locations of activities implemented by DENR Region X are indicated in the following figure.



Source: DENR Region X (2013)

Figure 5.2.1 Location Map on the Watershed Management-related Activities by DENR Region X in the CDO River Basin

# 1) Watershed Management Activities by DENR

DENR is implementing the Community-Based Forest Management (CBFM) activities with People's Organizations (POs) inside the forestlands after allocating the land tenures to the POs. Those areas in the following table are allocated as CBFMAs inside the CDO River Basin.

City / Municipality	No. of POs	Areas of CBFMA (ha)	Remarks
Cagayan de Oro City	8	3,592.84	CBFMAs outside of CDORB in Brgy. Dansolihon are included
Talakag	27	14,292.99	
Baungon	19	10,171.49	
Libona	13	3,472.91	
Iligan City	4	1,278.89	
	71	32,809.12	

Table 5.2.3CBFMA areas inside the CDO River Basin as of March 2013

Source: DENR Region X (2013), CLENRO (2012)

Based on the plans on the National Greening Program (NGP), DENR Region X has conducted (or been conducting) the following activities at the CBFMA areas in the CDO River Basin.

Table 5.2.4Target and Accomplishment of National Greening Program (NGP),<br/>inside the Cagayan de Oro River Basin

Province /	PENRO /	Tenure	Accomplishment in 2011 (ha)					
City	CENRO	Instrument	Refo	Agro	ANR	Urban	Mang	Total
Bukidnon	CENRO	CBFM Area	240					240
	Talakag	Urban Area						
	Mt. Kitanglad	Protected Area	55		7			62
	RNM							
CDO City	CENRO	CBFM/ISF	139					139
	Initao	Area						
Total	434		7			441		

Province /	PENRO /	Tenure	Accomplishment in 2012 (ha)					
City	CENRO	Instrument	Refo	Agro	ANR	Urban	Mang	Total
Bukidnon	CENRO	CBFM Area	271	52				323
	Talakag	Urban Area				27		27
	Mt. Kitanglad	Protected Area			40			40
	RNM							
CDO City	CENRO	Urban Area				5		5
	Initao							
Total			271	52	40	32		395

Note: Refo: reforestation, Agro: Agro-forestry, ANR: Assisted Natural Regeneration, Urban: Urban plantation, Mang: Magrove plantation

Source: FMS-DENR Region X

In addition to the regular activities, DENR Region X has conducted the following activities, based on the recommendations by CDORBMC.

Activity	Barangay	Q'ty	Partner	Remarks
Planting	Tignapolan	105km	LGU,	Funded by DENR
Bamboo along	Macasandig		DENR	CY2010-2012, and City
CDO river				Government provided
				technical assistance.
Reforestation		65ha	CDORBMC	Provision of seedling and
along CDO river				technical assistance were
				done through City Urban
				greening Program

Table 5.2.5	Watershed Management Activities conducted by DENR Region X,
	as the Recommendation by CDORBMC

Source: DENR Region X (2013)

At this moment, DENR Region X is recommending to plant bamboos along the river side areas. However, there are issues that uprooted bamboo and palm trees, which are recommended by DA, might cause the clogging of the river flow by accumulating by the bridge beams, resulting in the floods in the lower portions of the river. During the 2<sup>nd</sup> Board of Stakeholder Meeting on February 2013, members of NGO, one of the members of Board of Stakeholders of CDORBMC, raised the same issue, and DENR Region X accepted this issue and pointed that other indigenous tree species, which are suitable for the riparian areas, would be planted and replaced from bamboos along the rivers. Therefore, it is expected that indigenous tree species would be planted along the river side, aside from the bamboos.

2) Protected Area Management Plan and Measures

Inside the CDO River Basin, there are two (2) Protected Areas, namely; i) Mt. Kalantungan Range Natural Park; and ii) Mt. Kitanglad Range Natural Park (MKRNP). The Protected Area Management Boards (PAMBs) are established for each Protected Area, based on the NIPAS law, and PAMBs are conducting the management activities for the Protected Areas.

- Extension and enlightenment on the conservation to the barangays and municipalities inside and around the Protected Areas
- Conservation activities by Indigenous Peoples (IPs), who reside in and around the Protected Areas.

Those two (2) Protected Areas are located in the upper watershed of the CDO River Basin, about 25 to 40 km far from the center of CDO City, for which the river structures will be constructed by the future Project. Therefore, there would be no negative impacts to the Protected Areas by the future Project. Also, the participatory conservation activities are being conducted by the IPs, lead by PAMBs and PAWCZMS-DENR Region X, it is expected for the conservation activities would be implemented continuously.

3) Management Activities by CLENRO/MENRO and BENRO

CLENRO/MENROs are to be the offices to implement and manage the environment and natural resources in each City / Municipality. The management activities conducted by CLENRO inside the CDO River Basin are as follows:

Activity	Barangay	Q'ty	Partner	Remarks
Planting	Tignapulu-an	20.75km	LGU,	Funded by DENR
Bamboo	Macasandig	10km	DENR	CY2010-2012, and City
along CDO				Government provided
river				technical assistance.
	Bitan-ag Creek in Bgy	15km	LGU	Planned in 2013
	Tignapulu-an		DENR	
	Monigue Creek in Bgy	15km		
	Dansolihon.			
Planting	Balulang, Macasandig,	Assisted forest		Provision of seedling and
forest trees	Lumbia, Bayanga	trees: 43.55km		technical assistance were
and giant	Mambuaya,	Giant bamboo:		done through City Urban
bamboo along	Dansolihon, Macahan,	7.075km		greening Program
CDO river	Brgy. 10, 13, 15, 17, 7,			
	Taguanao			

 Table 5.2.6
 Watershed Management Activities conducted by CLENRO inside the CDO River Basin

Source: CLENRO (2013)

For the three (3) municipalities in Bukidnon Province, the following activities are being conducted by the instruction and in cooperation with BENRO. BENRO is one of the provincial offices which manage the environment and natural resources in Bukidnon Province.

Table 5.2.7Watershed Management Activities conducted byBENRO/MENRO in Bukidnon Province inside the CDO River Basin

Activity	Barangay	Q'ty	Partner	Remarks
Barangay	All the barangays in	1ha each	MENRO	Provision of seedling and
Tree Park	Bukidnon			technical assistance were
				done through BENRO

Source: BENRO (2013), MENRO Talakag, Baungon and Libona (2013)

In addition, CLENRO of CDO City is implementing to plant bamboos along the CDO River and its tributaries inside CDO City, in cooperation with DENR Region X. However, as the uprooted bamboos by the flash floods would be the main causes of the floods at the lower portions of the River Basin, it would be necessary to plant the trees another than bamboos, which are suitable for the river side areas, and have longer and straight roots.

For the Municipality of Libona, the MENRO is conducting to establish riparian forests along the small rivers inside the large-scale agricultural lands of Del Monte Philippines, in cooperation with Del Monte Philippines and others. Total lengths of 6 km have been covered by the riparian forest as of May 2013 in Libona, though there are still vast areas not to be covered by vegetations and denuded along the small rivers and creeks in Libona. In addition, the MENRO conducted planting along the upper portions of Bubunawan River inside Libona, in cooperation with CEPALCO, totaling 10 ha at this moment. However, there are still no such activities in other two (2) municipalities; Talakag and Baungon, on the upper watershed. The MENRO of Libona is having the experiences to coordinate with the private companies to establish the riparian forests, however, those two other municipalities do not have yet. Coordination with the private sectors not only to establish riparian forests but also conduct other activities would be effective for the local municipalities to obtain the financial assistances and also extend the importance on the riparian forests to the residents in their areas.

# 4) Management Activities by APO (CAO) / MAO

Agricultural Productivity Office (APO) / City Agricultural Office (CAO) and Municipal Agricultural Office (MAO) have responsibilities to manage the agriculture and fisheries activities, and also the conservation of the coastal areas. APO of CDO City is conducting the mangrove plantation along the coastal areas inside the CDO River Basin, in cooperation with DENR and NGO. The coastal conservation activities conducted by APO of CDO City inside the CDO River Basin are shown in below table.

Activity	Barangay	Q'ty	Partner	Remarks
Mangrove Plantation	Bonbon	19.7ha	DENR	
Planting mangrove	Bonbon	2ha (by 2012)		Provision by City
propagules		1ha (in 2013)		Government

Table 5.2.8Conservation Activities conducted by APO of CDO City<br/>inside the CDO River Basin

Source: APO (2013), CLENRO (2012)

5) Management Activities by International Donors

ADB is conducting the technical assistances in updating the current municipal watershed management plans, and the conduct of capability building activities (TA-7716-PHI<sup>5</sup>) for Bukidnon from July 2011, and will be completed within the year 2013. All of the 22 LGUs (i.e., municipalities and cities), and 44 barangays in Bukidnon, are the target LGUs to be trained. There are three (3) components of the said TA; i) Participatory Watershed Management Planning and GIS, ii) Watershed-based Agroforestry and Livelihood Development, and iii) Rural Infrastructure Planning and O & M. TA-7716-PHI is considered as the start-up program for the up-coming ADB-loan project (i.e., Integrated Natural Resources Management, or INREM). Technically, INREM has been already commenced in 2012, and now it is on its preparation period. The DENR, being the implementing agency, has the responsibility to coordinate with the funding agency, and to oversee the implementation of the project, together with LGU Bukidnon.

The AfD, French Development Agency, is planning to formulate and implement assistances for forest conservation, watershed management, sustainable agriculture and rural livelihood improvement in Bukidnon in Region X and Lanao del Sur in ARMM. Based on the interviews with the person in charge of the project formulation in DENR Central Office, there were two (2) workshops regarding the new project on November 2012 and March 2013, and the concepts of the new planned project by AfD are as follows:

- Target areas: Bukidnon and Lanao del Sur
- Planned Activities: Watershed management, sustainable agriculture, agro-forestry, etc.
- Implementing agencies: DILG as lead executing agency, DENR as the technical supporting agency
- Further schedule: F/S is scheduled in 2013.

Initially, it will focus on priority sites in Bukidnon and Lanao del Sur and is to be implemented in six zones around critical watersheds in Mindanao (six mountain

<sup>&</sup>lt;sup>5</sup> Decentralized framework for Sustainable Natural Resources and Rural Infrastructure Management, Philippines

ranges including Mt. Kitanglad and Mt. Kalatungan) representing a degraded or deforested areas of about 44,000 ha.

Based on the interviews with representative of AfD Philippines Office, they are planning to specify their target areas and target activities after the INREM project will decide them, as there are duplicated in the target areas and activities with INREM.

# 5.3 Formulation of Non-Structural Measures (Watershed Management): ICR Task 2-11

5.3.1 Consideration on the Watershed Management Activities in the CDO River Basin

Based on the reviews of the watershed management activities and natural conditions inside the CDO River Basin, the current status and constraints, necessary measures and present implementation status are summarized in **Table 5.3.1**. Among the necessary measures listed in table below, most the measures are being implemented and scheduled to be implemented by DENR and LGU, and donors; i.e. ADB, AfD. However, a few measures which are highlighted in the gray color are assumed not to be implemented sufficiently. Especially, as the establishment of riparian forests will have potentials to reduce and mitigate the fine sand flow and sedimentation from the agricultural lands on the middle and upper watershed, resulting in reducing the sedimentation on the lower watershed. Also, the establishment of mangrove forest at the river mouth and coastal areas will improve not only the living environment for the villagers but habitat environments for the aquatic plants and animals, resulting in the improving the living and livelihood conditions of the villagers. Therefore, those measures are considered to be implemented through the Project assistances.

 Table 5.3.1
 Current Status and Constraints, Necessary Measures and Present

 Implementation Status on the Watershed Management inside the CDO River Basin

	Location		Status / Constraints	Necessary Measures	Present Implementation
l Forest lands		Forest	<ul> <li>Degradation of the forest in quality</li> <li>Decrease of forest areas</li> </ul>	<ul> <li>Reforestation by indigenous tree species</li> <li>Assist Natural Reforestation (ANR)</li> <li>Adequate utilization of Non-Timber Forest Products (NTFP)</li> </ul>	DENR implements the necessary measures, mainly, together with LGUs
nd Upper Watershed		Agricultural Lands	<ul> <li>Degradation of the forest in quality</li> <li>Decrement of forest areas</li> <li>Increment of fine sand flow and sedimentation</li> </ul>	- Compatible implementation of forestry and agriculture by agro-forestry for sustaining the livelihood	Scheduled by INREM project by ADB. Assumed to be included in the new project planned by AfD.
Mid a		Slope Agricultural Lands	- Increment of soil erosion and fine sand flow and sedimentation	<ul> <li>Introduction of the slope agricultural methods, suitable for the slope areas: SALT, conservation agriculture, etc. to secure productivity and control sand erosion and sedimentation</li> </ul>	Scheduled by INREM project by ADB. Assumed to be included in the new project planned by AfD.

	Locatio	on	Status / Constraints	Necessary Measures	Present Implementation
		Riparian Area	<ul> <li>Degradation of the forest in quality</li> <li>River ridge erosion by floods</li> </ul>	- Enforcement of riparian areas by planting the indigenous tree species and bamboos along the riparian areas	DENR implements the necessary measures, mainly, together with LGUs
		Protected Area	<ul> <li>Conservation and protection activities in participation of the residents</li> </ul>	<ul> <li>Extension and enlightenment activities on protected area conservation to the residents</li> </ul>	DENR implements the necessary measures, mainly, together with LGUs
		Riparian Area	- Increment of fine sand flow and sedimentation	- Establishment of riparian forests along the small rivers to reduce the fine soil flow into the rivers from the agricultural lands	Being implemented by BENRO / MENRO, DENR and private sectors, but only in small scale.
A&D Land		Agricultural Lands	- Increment of fine sand flow and sedimentation	<ul> <li>Establishment of riparian forests along the waterways and irrigations to reduce the fine sand flow into the waterways and irrigations from the agricultural lands</li> </ul>	Tasks of LGU (CAO / MAO) and DA. Assumed to be included in the new project planned by AfD.
		Slope Agricultural Land	- Increment of fine sand flow and sedimentation	- Introduction of the slope agricultural methods, suitable for the slope areas: SALT, conservation agriculture, etc. to secure productivity and control sand erosion and sedimentation	Tasks of LGU (CAO / MAO) and DA. Assumed to be included in the new project planned by AfD.
	Overall		- Un-formulation and un-updates of the watershed management plans	<ul> <li>Formulation of CDO River Watershed Management Plan</li> <li>Formulation and updates of watershed management plans of tributaries of the CDO River</li> <li>Formulation and updates of watershed management plans of each Barangay and municipality</li> </ul>	Being implemented by RBCO-DENR for CDO River, and scheduled to be done by DENR Region X for several tributaries of the CDO River. Scheduled to be done by BENRO and MENRO for the upland LGUs and barangays
tershed	Riparian areas		<ul> <li>Decrement of vegetative covers by establishing the residential areas along the dikes</li> </ul>	<ul> <li>Distribution of seedlings to each Barangay</li> </ul>	Being implemented by CLENRO / BENRO and DENR Region X
Lower Wa	Overall		- Un-formulation of the watershed management plans	<ul> <li>Formulation of the watershed management plan for CDO City</li> <li>Formulation of forest management plan for CDO City</li> </ul>	Not implemented and planned. Tasks of CDO City.

	Location		Status / Constraints	Necessary Measures	Present Implementation
ver Mouth	Riparian Areas and Coastal Area		<ul> <li>Degradation of mangrove forests by immigrants and utilization by the residents</li> <li>Negative impacts by river structures</li> </ul>	- Reforestation and rehabilitation of mangrove forests	Being implemented by APO/CAO and DENR, but only in small scale.
R	Image: Constant of the constant of the constant resource management plans		- Un-formulation and un-updates of the coastal resource management plans	<ul> <li>Formulation of the Coastal Resource Management Plan by CDO City</li> </ul>	Being implemented by APO

Note: BENRO: Bukidnon Environment and Natural Resource Office, MENRO: Municipal Environment and Natural Resource Office, MAO: Municipal Agricultural Office, CLENRO: City Local Environmental and Natural Resource Office, APO/CAO: Agriculture Productivity Office / City Agriculture Office

Source: JICA Survey Team

5.3.2 Composition of the Proposed Plan (Watershed Management)

The priority projects were selected based on the same criteria referred to Section 4.1. The implementation plan (Watershed Management) for the CDO River Basin was organized as shown in the following table.

No. and Location		Activity	Urgent Plan	Short-Mid Term Plan	Long Term Plan	Remarks	
			2013-2014	2015-2019	2020-2035		
A.	Mid an	d Upper Watershed					
A-1.	Forestla	and in Mid and Upper Watershed	1				
1.1	Forests		-				
	1.1.1	Reforestation by Indigenous Tree Species	$\checkmark$	$\checkmark$	$\checkmark$	Assumed to be done by DENR, ADB and LGU, and AfD future Project	
	1.1.2	Implementation of Assisted Natural Reforestation (ANR)	$\checkmark$	$\checkmark$	~	Assumed to be done by DENR, ADB and LGU, and AfD future Project	
	1.1.3	1.3 Adequate Utilization of the Non-Timber Forest Products (NTFP)		~	~	Assumed to be done by DENR, ADB and LGU, and AfD future Project	
1.2	Agricul	ltural Lands					
	1.2.1	Introduction of Agro-Forestry		$\checkmark$	$\checkmark$	Assumed to be done by ADB and AfD future Project	
1.3	Slope A	Agricultural Land	•		•		
	1.3.1	Introduction of Slope Agricultural Methods		$\checkmark$	$\checkmark$	Assumed to be done by AfD future Project	
1.4	Riparia	n Areas					
	1.4.1	Enforcement of Riparian Forests by Indigenous tree Species	$\checkmark$	V	~	Being implemented and planned to be done by DENR, MENRO and BENRO	
A-2	A&D I	and in the Mid and Upper Water	rshed				
2.1	Riparia	arian Areas					
	2.1.1	Establishment of Riparian Forests to Mitigate Soil Flow and Sedimentation	$\checkmark$	~	~	Being implemented by MENRO, BENRO, DENR and private sectors, but only in small scale	

 Table 5.3.2
 Implementation Plan (Watershed Management) for the CDO River Basin

No Loc	and ation	Activity	Urgent Plan	Short-Mid Term Plan	Long Term Plan	Remarks	
			2013-2014	2015-2019	2020-2035		
2.2	Agricu	ltural Areas					
	2.2.1	Establishment of Riparian Forests along the Waterways and Irrigation to mitigate Soil Flow and Sedimentation	$\checkmark$	~	~	Assumed to be done by AfD future Project	
2.3	Slope A	Agricultural Areas		•		·	
	2.3.1	Introduction of Slope Agricultural Methods		$\checkmark$	$\checkmark$	Assumed to be done by AfD future Project	
A-3	Overall	for the Mid and Upper Watersho	ed		-	· · · · ·	
3.1	Overall						
	3.1.1	Formulation of CDO River Watershed Management Plan	$\checkmark$			Being implemented by DENR	
	3.1.2	Formulation of Watershed Management Plans for Tributaries of CDO River	$\checkmark$	$\checkmark$		Planned to be partially implemented by DENR	
	3.1.3	Formulation of the Watershed Management Plans for each Municipality in Bukidnon Province	$\checkmark$	~		Partially implemented by ADB	
	3.1.4	Formulation of the Watershed Management Plans of each Barangays in Bukidnon Province	$\checkmark$	~		Planned to be implemented by BENRO and MENRO	
B.	Lower	Watershed		•			
B-1	Riparia	n Areas of CDO River in the Lo	wer Waters	hed			
1.1	Riparia	n Areas					
	1.1.1	Distribution of Seedlings to each Barangay for Establishment of Riparian Forest and Tree Park	$\checkmark$	~	~	Being implemented by CLENRO	
<b>B-2</b>	Overall	for the Lower Watershed					
2.1	Overall	l					
	2.1.1	Formulation of the Watershed Management Plan for CDO City		~		Not planned yet by CLENRO	
	2.1.2	Formulation of the Forest Management Plan for CDO City		$\checkmark$		Not planned yet by CLENRO	
C.	River N	ver Mouth and Coastal Areas					
C-1	River N	Nouth and Coastal Areas					
1.1	River N	r Mouth and Coastal Areas					
	1.1.1	Reforestation and Rehabilitation of Mangrove Forests	$\checkmark$	$\checkmark$	$\checkmark$	Being implemented by APO and DENR, but in small scale	
C-2	-2 Overall in the River Mouth and Coastal Areas						
2.1	Overall						
	2.1.1	Formulation of the Coastal Resource Management Plans	$\checkmark$			Being implemented by APO, in coordination with DENR and MBDA	

Note: BENRO: Bukidnon Environment and Natural Resource Office, MENRO: Municipal Environment and Natural Resource Office, MAO: Municipal Agricultural Office, CLENRO: City Local Environmental and Natural Resource Office, APO/CAO: Agriculture Productivity Office / City Agriculture Office

Source: JICA Survey Team

# 5.4 Scoping for the Project (Watershed Management): ICR Task 2-15

5.4.1 Proposed Activities as the Japanese Yen Loan Project

The non-structural measures on watershed management proposed for Japanese Yen Loan Project were set through the selection criteria as below:

- 1) Projects contribute to enhance the cooperation and relationship between the downstream and middle / upper stream areas (establishment of riparian forests along the rivers inside the A&D Lands on the middle and upper watershed)
- 2) Projects contribute to enhance the living environments for the residential areas and habitat environment for the aquatic biota along the coast or river mouth (mangrove plantation along the river mouth and coastal areas)

As mentioned in the Section 5.2, the measures and assistances on the watershed management for the forestlands on the middle and upper watershed are being implemented and planned to be implemented by NGAs: i.e. DENR, DA, LGUs: i.e. CLENRO/MENRO, BENRO, and donors: i.e. ADB, AfD. As the DENR is the sole agency to manage the forestlands, it is necessary to coordinate with DENR to formulate and conduct any kinds of activities inside the forestlands. Therefore, the JICA Survey Team will not propose for the watershed management in the forestlands, however, some recommendations will be made, if necessary.

On the contrary, the A&D lands on the middle and upper watershed are being utilized as the small- to large-scale agricultural lands, commercial areas, residential areas, and so on. For some small rivers and creeks in the A&D lands, some activities are being implemented to establish the riparian forests in cooperation with LGUs and the private sectors: i.e. Del Monte Philippines, and so on. However, vast areas along the small rivers and creeks, and also along the waterways and irrigation inside the A&D lands still remain denuded and less vegetation, so that the fine sand flown from the agricultural lands are being directly flowing into the rivers and creeks, resulting in the sedimentation at the lower parts of the watershed. Therefore, as less watershed management measures are conducted especially for the agricultural lands on the middle and upper watershed, it is recommended to establish the riparian forests and vegetation cover along the small rivers and creeks, and also waterways and irrigations in A&D lands in order to reduce and mitigate the fine sand flow from the agricultural fields into the rivers and creeks, resulting in the less flow away of fine sands to the lower portions. Moreover, the coordination with LGUs and residences either in the upper watershed and lower watershed, related organizations; i.e. DPWH, DENR, NGOs, and private sectors, to conduct any activities; such as establishment of riparian forests, will lead to comprehensive understanding of the river structures, which will be constructed in the downstream, and efficient and sustainable management of the river structures. It is also important for the LGUs in the upper watershed to recognize that DPWH would be involving to establish the riparian forests in the upper watershed for facilitating the LGUs in the upper watershed to understand the river structure construction in the downstream. Therefore, the JICA Survey Team will propose to consider establishing the riparian forests inside A&D lands on the middle and upper watershed. For the implementation of the establishment of riparian forests, all the budget are planned to be borne by LGUs, related organizations, and private sectors, whilst the Project will plan to coordinate among the stakeholders, and conduct technical assistances on implementation.

However, as INREM project will be commenced by ADB from 2013 for the upper portions of the CDO River Basin in Bukidnon Province, and AfD is planning to formulate and implement the assistances on integrated land management and conservation agriculture for the similar areas with ADB, the target locations and activities should be coordinated with those of ADB and AfD, in order not to overlap with INREM and AfD.

Also, the mangrove forests, one of the specific natural characteristics along the coastal areas, are being reduced by the immigration and utilization by the villagers and immigrants, and also there will be possibilities for mangrove areas to be suffered any kinds of damages by constructing river structures by the Project. Although APO and DENR conducts to plant mangrove along the river mouth areas and coastal areas, the Project should take the mangrove reforestation and rehabilitation into consideration, especially for the areas which will be and may be damaged by the construction of river structures.

5.4.2 Profiles of the Proposed Activities

# 1) Technical Assistance for Riparian Forest Establishment in the Agricultural Lands

1) Background

Based on the Water Code (RA1067), Revised Forestry Code (PD705), DENR DAO97-05 and DAO99-21, the legal easement areas between the natural water ways, such as the riparian areas, should be maintained and the riparian forests should be established and conserved for preventing from the soil erosion and for the soil conservation.

Inside the CDO River Basin and adjacent river basin, the riparian forests are being established along the small rivers inside the large-scale agricultural lands; i.e. Del Monte Philippines, and so on in cooperation with LGUs and private sectors. However, there still remain the vast riparian areas denuded and with no vegetative covers inside the agricultural lands, so that amounts of fine sands continue to flow into the rivers from the agricultural lands.

The LGUs have responsibilities to protect and establish the riparian forest inside the A&D lands. However, it is difficult for the LGUs, especially for the municipalities, to conduct the protection and conservation activities for the riparian forests, because of shortage of the budgets, and also because lack of experiences and knowledge to coordinate with private sectors and NGAs other than DENR to establish the riparian forests. Inside the CDO River Basin, there is only one municipality; Libona in Bukidnon, to implement the riparian forest establishment along the two to three small rivers/creeks inside the agricultural fields in cooperation with the private sectors. Therefore, there will be possibility for other municipalities to collaborate with private sectors to establish the riparian forests inside their premises. This activity is also consistent with the IRBMDMP for CDO River Basin in terms of watershed conservation and management.

2) Objective

To reduce and mitigate the fine soil inflow into the rivers and creeks directly and indirectly from the forests and agricultural lands in the middle and upper watershed.

Through the enforcement in coordination with related organizations and LGUs both in the upper and lower watersheds, the necessity of the watershed management in the upper watershed will be recognized by the stakeholders in the lower watershed.

#### 3) Contents of Measures

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
- 4) Remarks
- Measurement and monitoring of sources of the fine sands flown into the rivers and sedimentation should be considered.
- Coordination with ADB and AfD should be considered for selecting the target areas.
- Actual cost for producing tree seedlings and planting will be borne by LGUs and private companies.

2) Technical Assistance for Mangrove Forest Establishment along the Coastal Areas

#### 1) Background

Based on the Act incorporating Certain Sections of the National Internal Revenue Code of 1977 (RA7161), Fishery Code (RA8550) and Revised Forestry Code (RD705), it is banned to cut mangrove species / forests and convert to other purposes, and also those legislations stipulate to conserve the mangrove forests and vegetation. Also the PD705 stipulates that the mangrove forests and swamp forests within 20m from the coastal lines and river banks should be conserved and/or established.

There remain small areas of mangrove forests, and DENR and APO are planting the mangrove along the coastal areas of the CDO River. These mangrove forests are supplying the adequate living environments to the villagers, and are improving their livelihood through enriching the aquatic biota.

It is important to establish and maintain the mangrove forests along the river mouth areas and coastal areas of the CDO River for improving the living environment and livelihood of the villagers. This activity is also consistent with the IRBMDMP for CDO River Basin in terms of coastal and marine resource management, and river delta management.

2) Objective

To improve living environments and to secure livelihood for the villagers through improving the biodiversity at the river mouth areas and coastal areas by establishing the mangrove forests

3) Contents of Measures

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

#### 4) Remarks

- Measurement and monitoring of sedimentation at the river mouth areas should be considered in order to mitigate the negative impacts on mangrove forests and aquatic plants and animals.
- Actual cost for producing propagules and planting will be borne by LGUs, private companies and NGOs.

Target LGU organizations, such as DRRMCs, BENRO/CLENRO/MENRO and related agencies/organizations for the above measures are shown below:

Table 5.4.1	Non-Structural Measures proposed for JICA Loan on the Watershed
	Management

No.	CDO City	Talakag	Baungon	Libona	Private Sector /NGO
<ol> <li>Technical Assistance for Riparian Forest Establishment in the Agricultural Lands</li> </ol>	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
<ul><li>(2) Technical Assistance for Mangrove Forest Establishment along the Coastal Areas</li></ul>	$\checkmark$				$\checkmark$

Source: JICA Survey Team

# 5.4.3 Recommendations on the Watershed Management to DPWH, DENR and LGUs from the JICA Survey Team

In addition to the proposed activities for the Japanese Yen loan projects, the following issues are being proposed as the recommendations on the watershed management from the JICA Survey Team to DPWH, DENR and LGUs which have responsibilities to conserve and manage the natural environment.

- · Mitigation of fine sand sedimentation through compliance with the CLUP
  - It is observed that the fine sands flow into the rivers and creeks from the agricultural lands on the middle and upper watershed, and the agricultural lands are considered as one of the sources of fine sands. Therefore, it is recommended that the source areas of the find sands should be restricted by reducing the spread of the large-scale agricultural lands through compliance with the CLUP. Also it is recommended to facilitate with the land owners to consider and establish the measures to reduce flowing the fine sands for the existing agricultural lands and/or for the new agricultural lands if established. Accordingly, it is advisable for DA and LGUs to conduct these activities, in cooperation with DPWH, which manages the river structures in the downstream.
- Confirmation of the sources of fine sands and monitoring
  - Although the fine sands flow down from the agricultural lands through the visual check, no measurement has been conducted to identify the sources and monitor the sand flow and sedimentation. Therefore, in order to formulate and implement the adequate measures to mitigate the fine sand flow, it is recommended to conduct measurement of the fine sand flows and sedimentation. It is advisable for DPWH to conduct these measurements.
- Promotion of planting indigenous tree species along the riparian areas by replacing from the bamboos

Deep-rooted indigenous tree species should be planted along the riparian areas, by replacing from the shallow-rooted bamboos and tree species. Therefore it is necessary for DENR to select the adequate species for the riparian areas, establish the seedling production of selected species, establish and examine the methods of planting and maintenance of the selected species.

• Formulation of the watershed management plan and forest management plan for CDO City

There are no plans on watershed management and forest management for the whole CDO City. Although there are some issues and items planned in CLUP on the tershed management and forest management, those issues and items are not sufficient for the proper management of the watershed and forests in CDO City. Therefore, it is recommended for CDO City to formulate their own adequate plans on watershed management and forest management inside CDO City.

• Early realization of the Coastal Resource Management Plan

Although the CRMP is being formulated by APO of CDO City, the CRMP has not yet been approved by the Mayor of the City. In order for the adequate utilization and management of the coastal areas in CDO City, it is recommended for the CRMP approved and implemented at the early stage. Moreover, the formulation and implementation of the CRMP of CDO City will contribute to establish the Bay-wide Coastal Management Plan, which is promoted by MBDA.

# CHAPTER 6 IMPLEMENTATION SCHEDULE AND CONSULTANT'S TOR FOR JICA LOAN PROJECT (FEASIBILITY STUDY): ICR TASK 3-1

Consultant's TOR on the non-structural measures for JICA Loan Project is shown as follows:

Table 0.1.1 I OK of the Consultant
------------------------------------

Position Assigned	Tack Assigned
Fosition Assigned	Task Assigned           • Device end to a flood beyond magning accounting planning
Plonner/Civil Engineer	Community Deced Flood Forly Warring System (CDEEWS) and
francer/ Civil Engineer	Laformation Comparing and Dublicity for the Desired (Structured Measures)
	Information Campaign and Publicity for the Project (Structural Measures)
(1) Iechnical	• Select barangays for technical assistance for flood hazard mapping,
Assistance for Flood	evacuation planning and CBFEWS
Hazard Mapping and	• Prepare flood hazard maps for the selected barangays upgrading from the
Evacuation Planning,	maps prepared by "The Preparatory Survey for Flood Risk Management
(3) Technical	Project for Cagayan de Oro River (FRIMP-CDOR) in 2013 by JICA", by
Assistance for	verification of topographic information based on interview from residents in
Community Based	barangay, etc.
Flood Early Warning	• Update evacuation data (Number, Location, Capacity of Facilities (Area,
System (CBFEWS)	Water Supply, Toilet, etc.), Route, Transportation, Role, etc.) and formulate
and	the evacuation plan for the selected barangays
(4) Technical	<ul> <li>Prepare plan for CBFEWS for the selected barangays</li> </ul>
Assistance for	• Assistance in installation of rainfall gauges and water level staff gauges or
Information Campaign	devices
and Publicity for the	<ul> <li>Study on warning levels and information dissemination system</li> </ul>
Project (Structural	• Develop, arrange and conduct training or capacity development programs
Measures)	related to flood hazard mapping, evacuation planning and CBFEWS
	• Prepare and implement program for Information Campaign and Publicity for
	the Project (Structural Measures)
	<ul> <li>Prepare necessary reports and documents</li> </ul>
	• Report all outputs of the tasks to Team Leader (TL)
Hydrologist for	• Review hydrological and hydraulic studies for "The Preparatory Survey for
(2) Technical	Flood Risk Management Project for Cagayan de Oro River (FRIMP-CDOR)
Assistance for FFWS	in 2013 by JICA".
	<ul> <li>Investigate existing FFWS in other basins</li> </ul>
	<ul> <li>Review FFWS models (monitoring stations, data</li> </ul>
	transferring/storage/dissemination method, warning criteria, and equipment,
	etc.) in other basins
	• Confirmation on the development plans and on-going projects of FFWS by
	DOST-ASTI, PAGASA and other donors in the CDOR
	• Review and study location, number specification, etc. of proposed rainfall
	and water level stations for FFWS in the CDO River Basin
	• Establish hydrological and hydraulic models as open-ended type for FFWS
	in the CDO River Basin based on the additional information for new stations
	• Transfer technology for hydrological and hydraulic studies, and models for
	the CDO River Basin
	<ul> <li>Preliminary Study for future system</li> </ul>
	• Prepare necessary reports and documents
	• Report all outputs of the tasks to Team Leader (TL)

#### (1) International Expert

Position Assigned	Task Assigned
Watershed	• Review watershed management study for "The Preparatory Survey for Flood
Management Planner	Risk Management Project for Cagayan de Oro River (FRIMP-CDOR) in
for	2013 by JICA".
(6) & (7) Technical	• Assist in the implementation and institutionalization of proposed projects
Assistance for	among DPWH, DENR and LGUs, and private sectors, if necessary
Watershed	• Assist in selecting locations and numbers of proposed projects for riparian
Management	forest establishment and mangrove forest establishment using interview survey and participatory approach
	<ul> <li>Monitor and evaluate progress and quality of proposed projects through field</li> </ul>
	inspections
	• Develop and arrange training programs related to watershed management
	<ul> <li>Prepare necessary reports and documents</li> </ul>
	• Report all outputs of the tasks to Team Leader (TL)

Source: JICA Survey Team

#### (2) Local Expert

Position Assigned	Task Assigned
Flood Management	• Assist Flood Management Planner/ Civil Engineer (foreign) in the pursuit of
Specialist for	his tasks
Items (1), (3) and (4)	• Select barangays for technical assistance for flood hazard mapping and
above	evacuation planning
	• Verify flood hazard maps by topographic information based on interview
	from residents in barangay, etc.
	<ul> <li>Assist in updating evacuation data and plan</li> </ul>
	• Assist in development, arrangement and conduct for training or capacity
	development programs related to flood hazard mapping and evacuation
	planning
	• Assist in preparation and implementation for program for Information
	Campaign and Publicity for the Project (Structural Measures)
Watershed	• Assist Watershed Management Planner (foreign) in the pursuit of his tasks
Management Specialist	• Assist in institutionalization of proposed projects among DPWH, DENR and
for	LGUs, and private sectors, if necessary
Item (6) above	• Assist in implementation of proposed projects
	• Assist in selection for location of proposed project for watershed
	management plan using interview surveys and participatory approach
	• Assist in implementation and institutionalization of proposed projects
	• Assist in monitor and evaluation for progress and quality of proposed
	projects through field inspection
	• Assist in preparation and implementation for program related to watershed management
GIS Expert for	• Assist all experts in the preparation of thematic maps using satellite image
(5) Technical	analysis and GIS
Assistance for Land	• Establish and maintain database
Use Regulation for	• Assist in the report preparation using expertise in satellite image analysis and
Habitual Inundation	GIS
Areas	

Source: JICA Survey Team