オルモック市洪水対策事業

構造物と非構造物対策

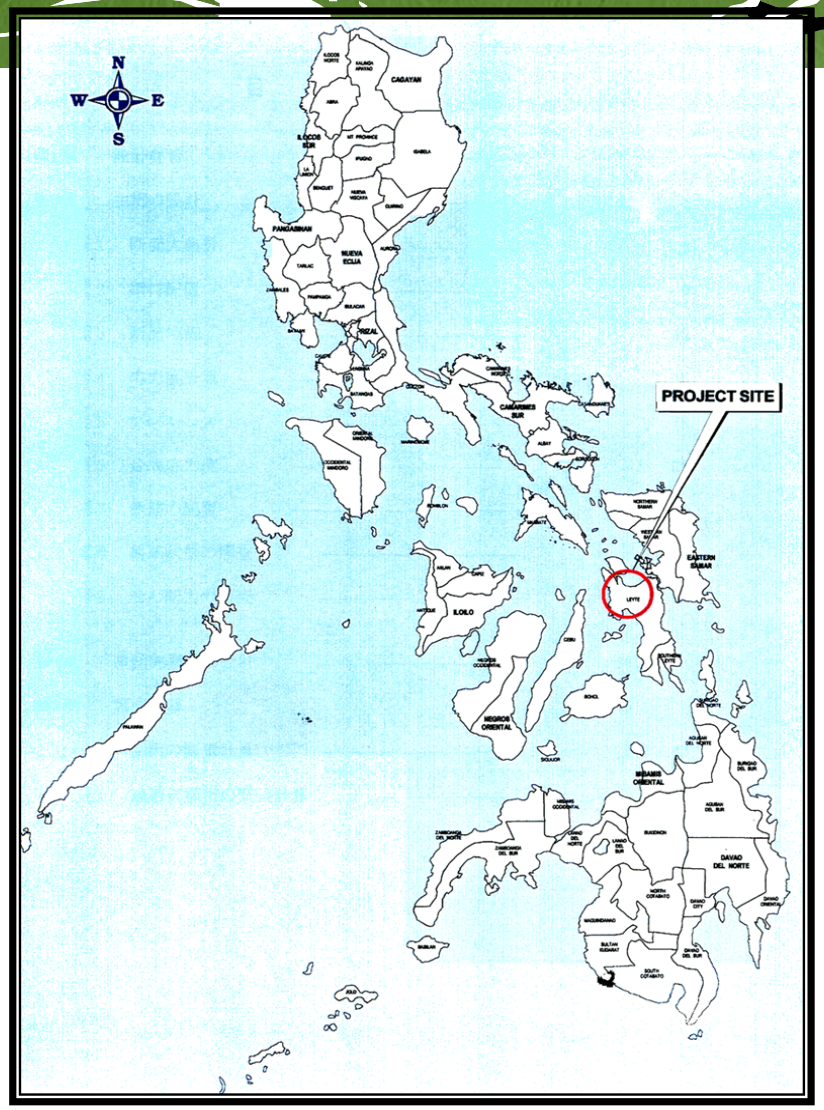
レイテ島、フィリピン共和国

2017年5月

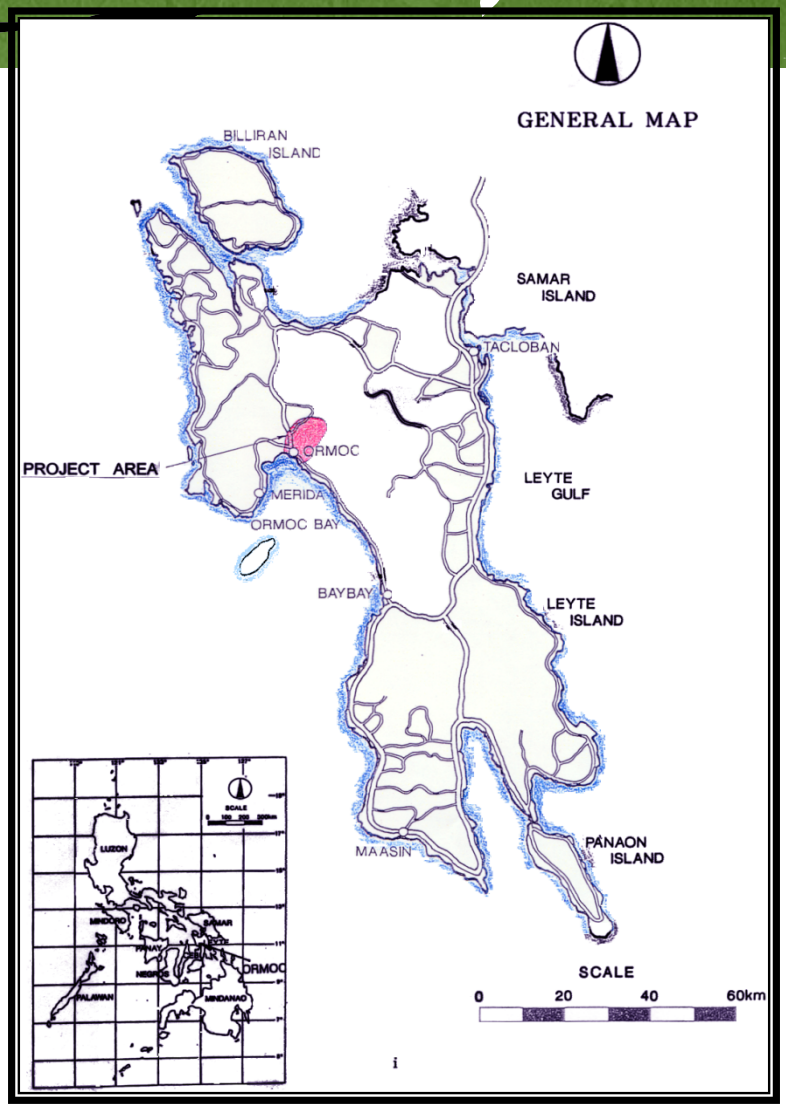
賀来　衆治

建設技研インターナショナル

Location 位置図



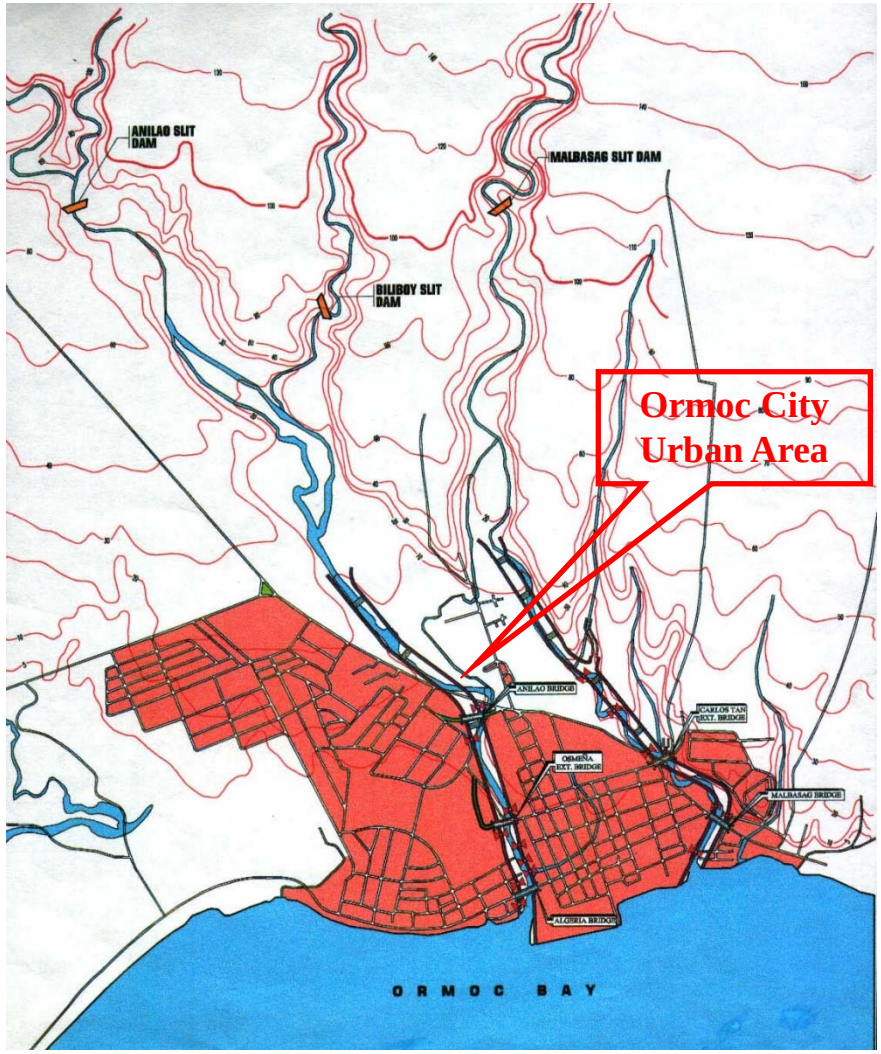
Philippine Islands、フィリピン国



Ormoc City in Leyte, Visayas
オルモック市、レイテ島

Ormoc City was ---on 5 November 1991

- Ormoc City is situated between two rivers: Anilao River and Malbasag River.
- Ormoc City is 464.3 km^2 with its area, while urban area is only 3.8 km^2 .on the deltaic land of the two rivers.
- Ormoc City has populations of 84,600 (1970), 105,000 (1980) and 129,200 (1990）
- The population increase in 1980 to 1990 was attributed by that in urban area. Population density in 1990 is 2.8 heads/ha in the City and 101.3 heads/ha.



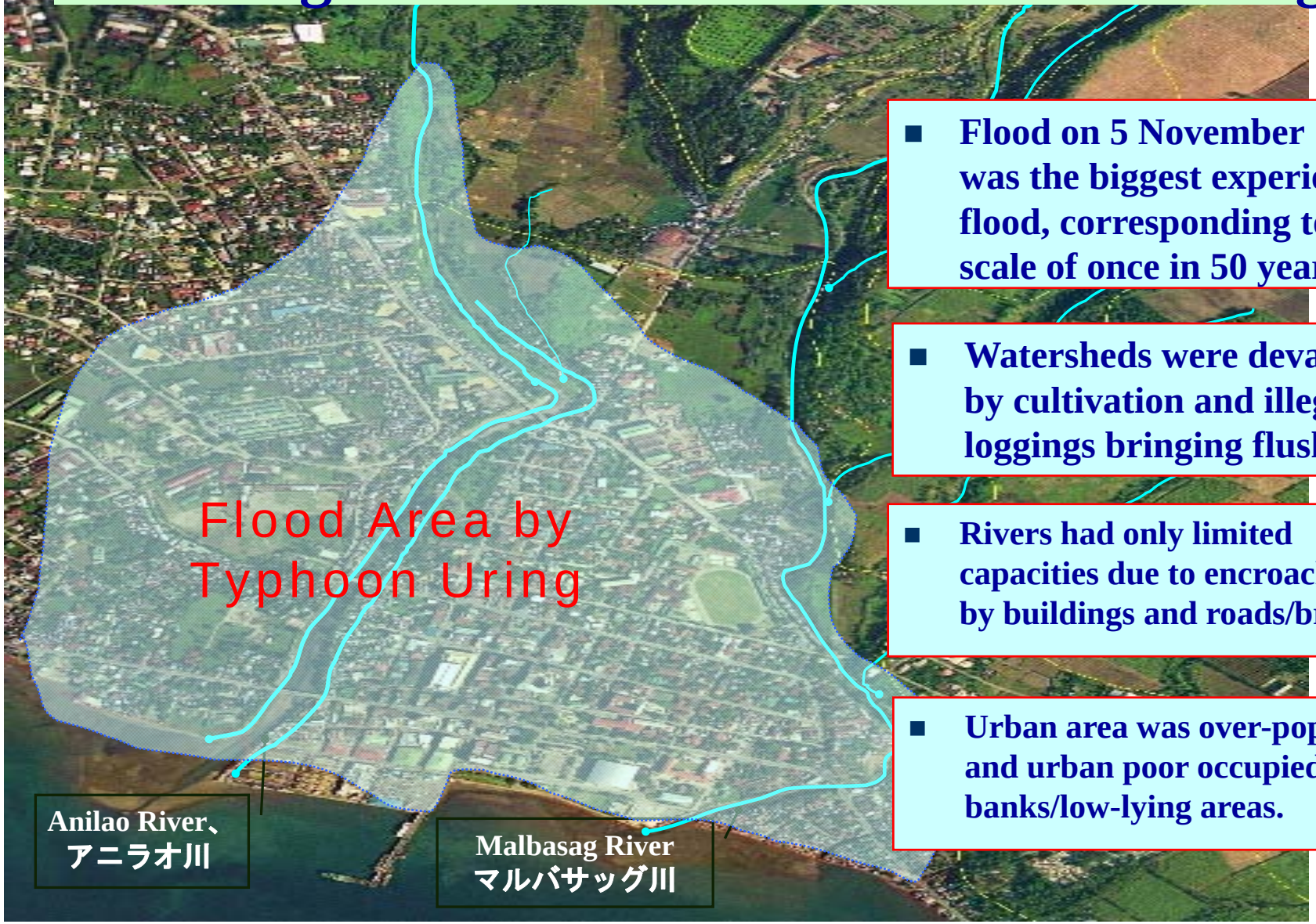
TOPOGRAPHY AND RIVER CHARACTERESTICS

ANILAO **and** ***MALBASAG Rivers*** **flows in parallel at Ormoc City**

Anilao River **– a meandering river with two tributaries** ***Mag-aso and Biliboy Rivers*****,17km approx. length, 31km^2 watershed area, 1/45 – 1/75 gradient, 2-5 year return period discharge capacity.**

Malbasag River **– a meandering river, 12 km approx. length, 14km^2 watershed area, 1/150 gradient, 2-5 year return period flow capacity.**

Typhoon Uring on 5 November 1991 brought the most disastrous flood damage.



- Flood on 5 November 1991 was the biggest experienced flood, corresponding to the scale of once in 50 years.
- Watersheds were devastated by cultivation and illegal loggings bringing flush floods.
- Rivers had only limited capacities due to encroachment by buildings and roads/bridges.
- Urban area was over-populated and urban poor occupied river banks/low-lying areas.

ORMOC CITY METEOROLOGICAL CONDITIONS: BEFORE AND DURING November 5, 1991

Average Annual Precipitation : 2600 mm

Average Monthly Precipitation : 215 mm

Recorded Precipitation during flood : 350-500mm *(maximum concentration noted at 3-4 hrs of rainfall)*

ANILAO PEAK FLOOD DISCHARGE *:* 540 -900 cum/sec

MALBASAG PEAK FLOOD DISCHARGE *:* 240 -400 cum/sec

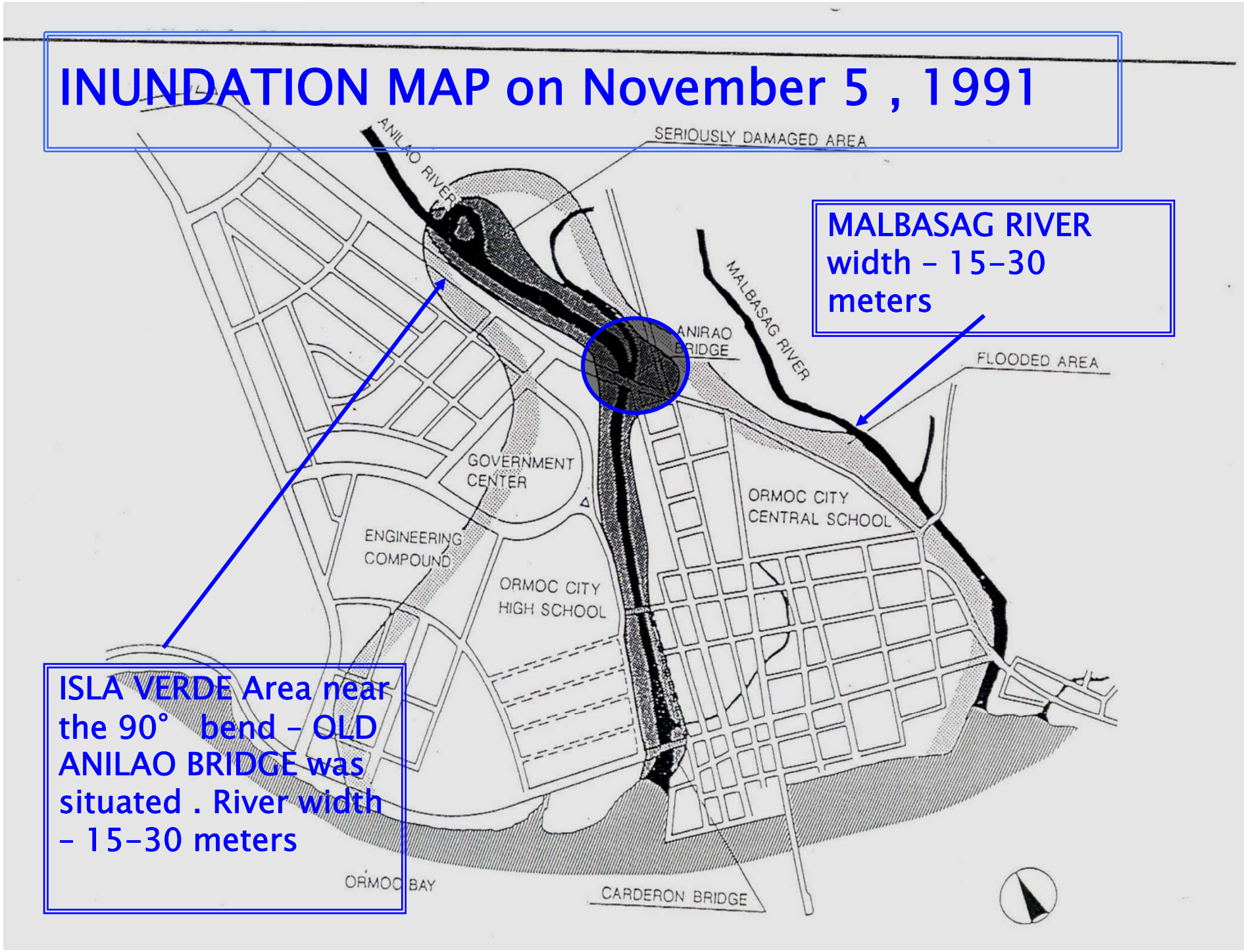
ESTIMATED VOLUME OF FLOATING DEBRIS

ANILAO RIVER : *5,358 shrubs and trees*

MALBASAG RIVER : *3,117 shrubs and trees*

Source: DENR and JICA TECHNICAL ASSESSMENT ON THE CAUSES OF THE FLOOD

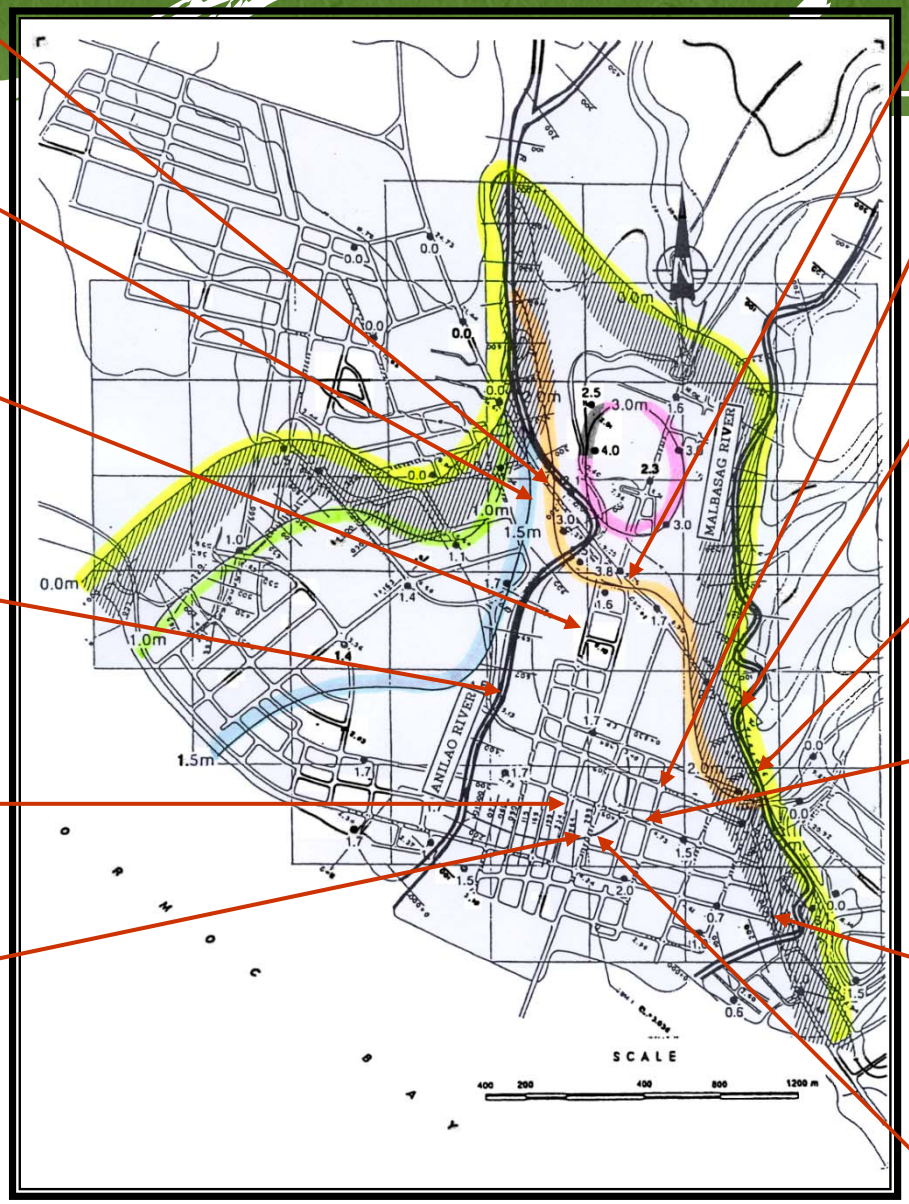
INUNDATION MAP on November 5 , 1991



MALBASAG RIVER width – 15–30 meters

ISLA VERDE Area near the 90° bend – OLD ANILAO BRIDGE was situated . River width – 15–30 meters

Flood Inundation Map



Damage in 1991 Flood 1991年の洪水被害

(caused by Typhoon Uring)

- 7,922 death/missing → Approx. 20% of urban population (38,500) and 6% of city population (129,200)

  死者/行方不明

- 13,760 houses destroyed → Approx. 55% of total houses (24,900)

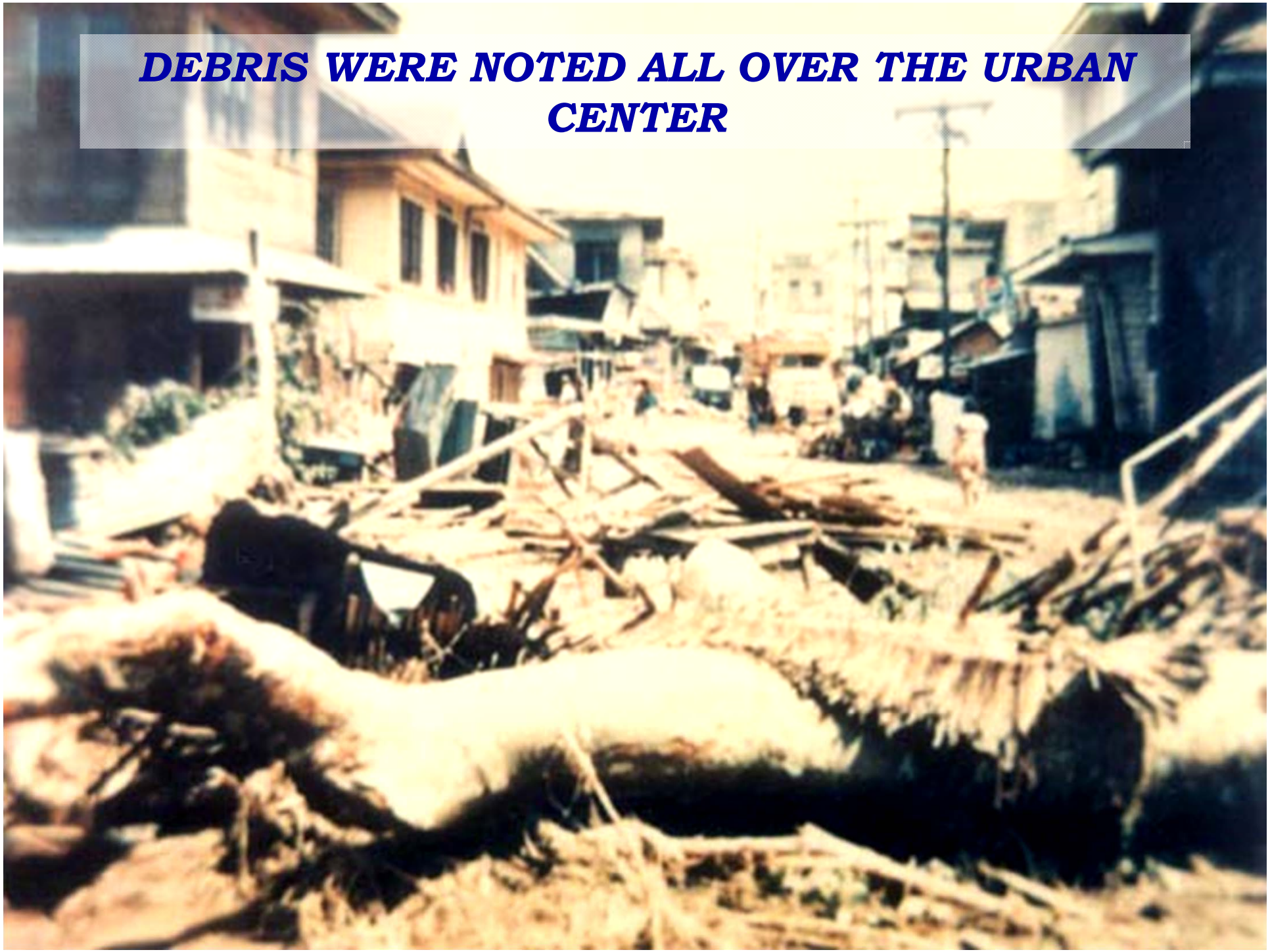
  家屋の破壊

  (2,850 totally & 10,910 partially)

- More than US$23 million(約26.5 億円） worth of damage to properties and infrastructures.

- Most of the victims were the urban poor who had dwelled on river banks and flood-prone area !

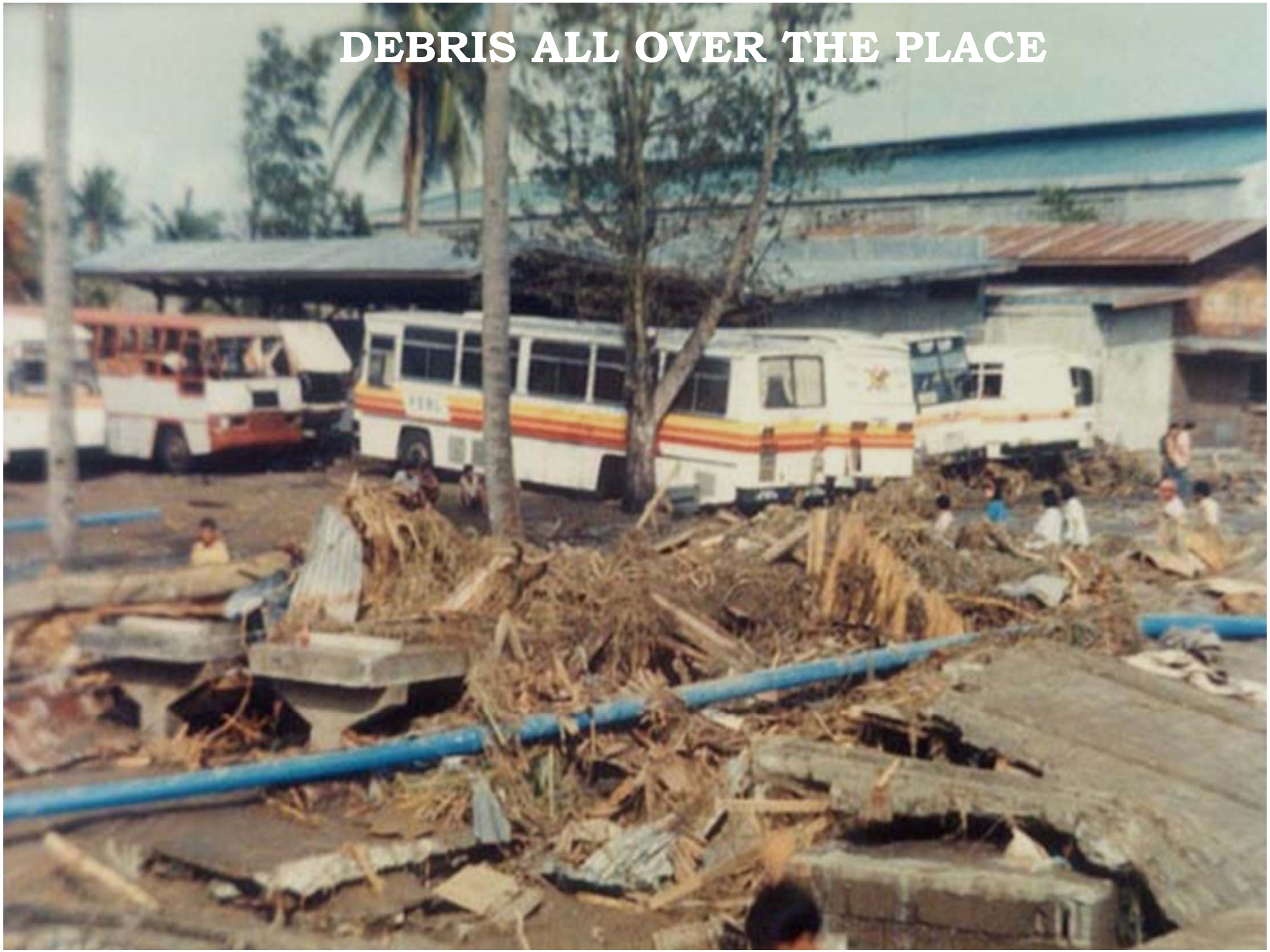

POZOS
HOTEL

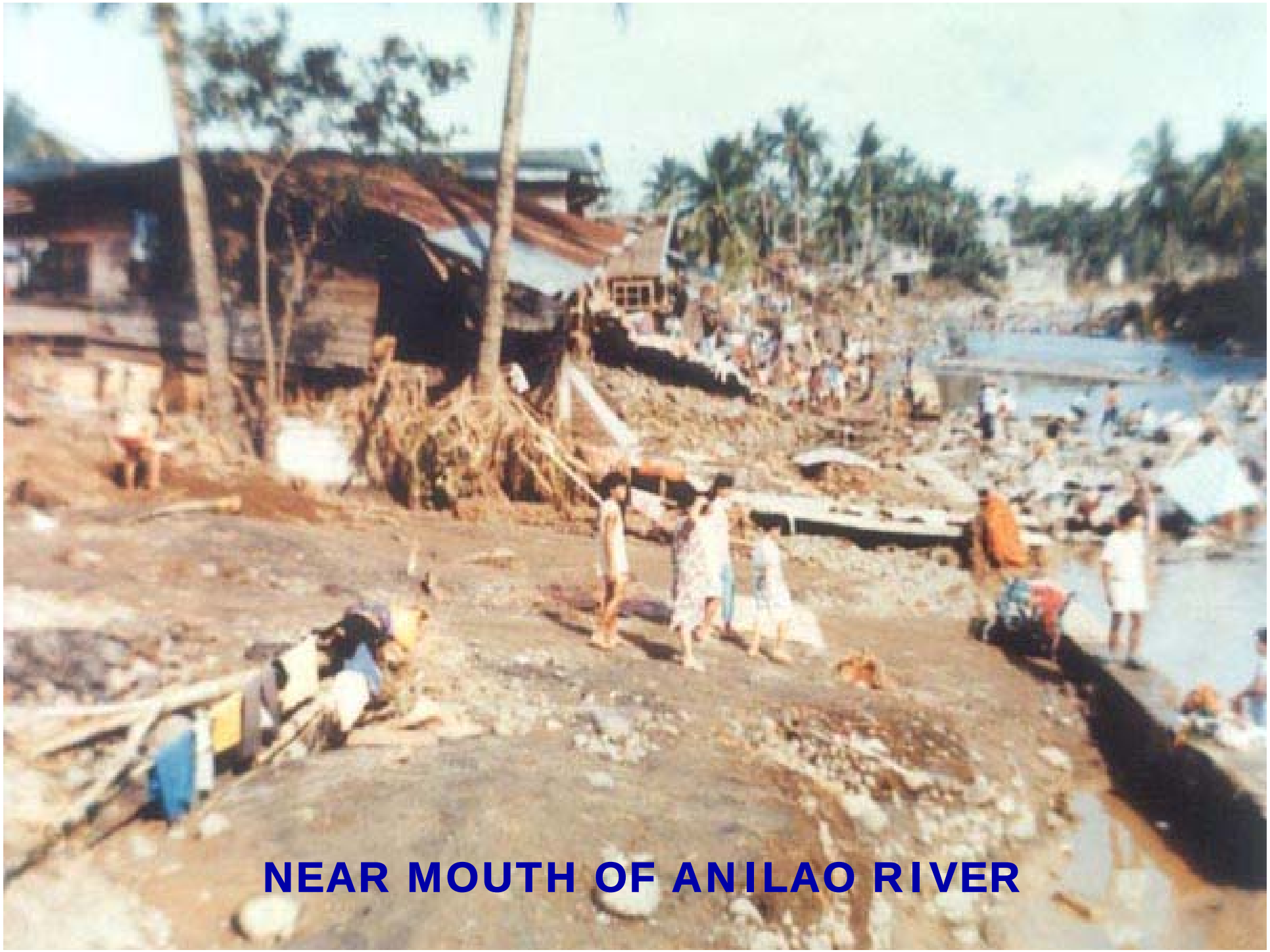

DEBRIS WERE NOTED ALL OVER THE URBAN CENTER

SILTATION ALL OVER THE PLACE
EVEN AT THE HEART OF THE CITY

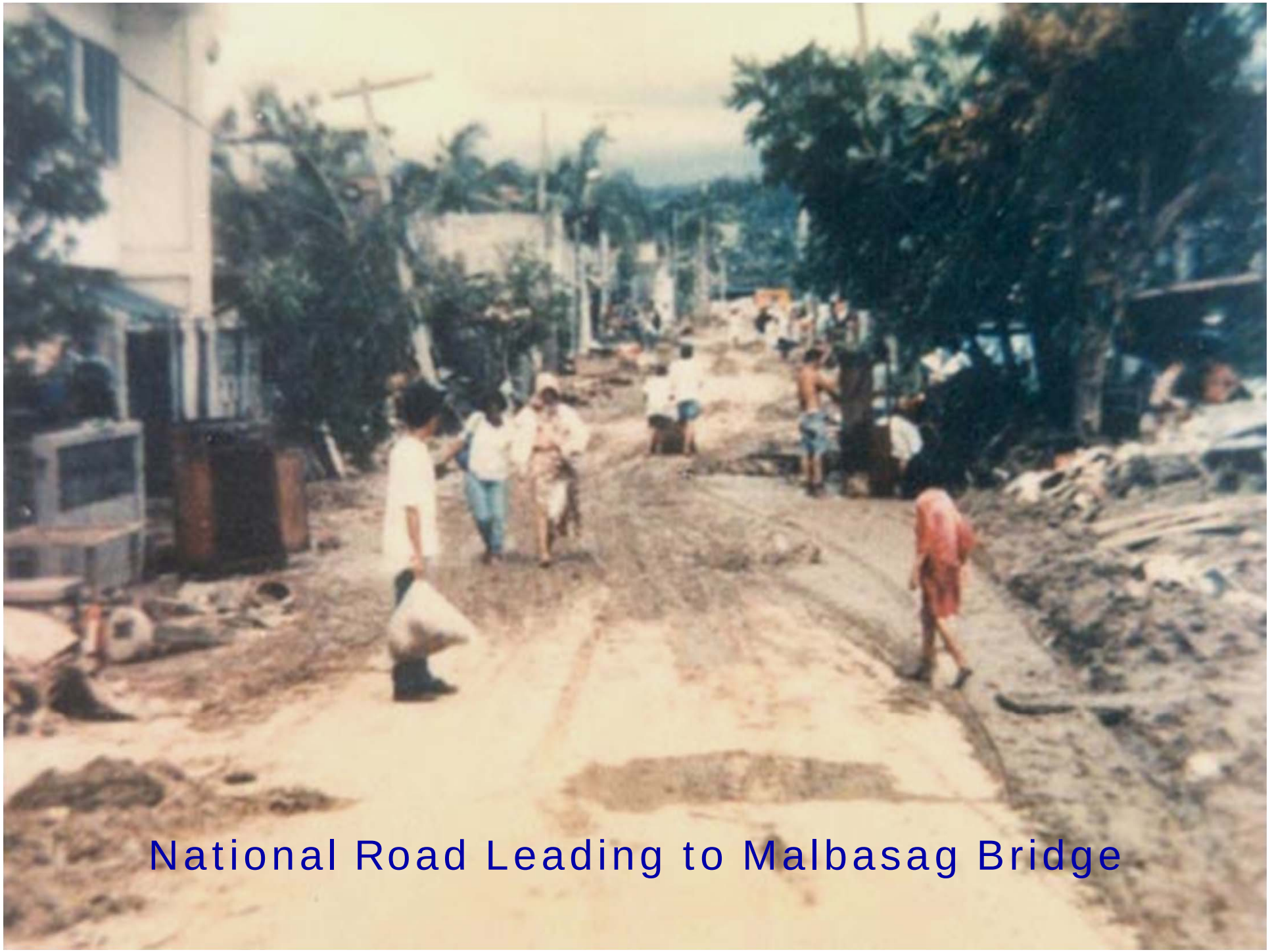
ANILAO BRIDGE – Near the Isla Verde Area

DEBRIS ALL OVER THE PLACE





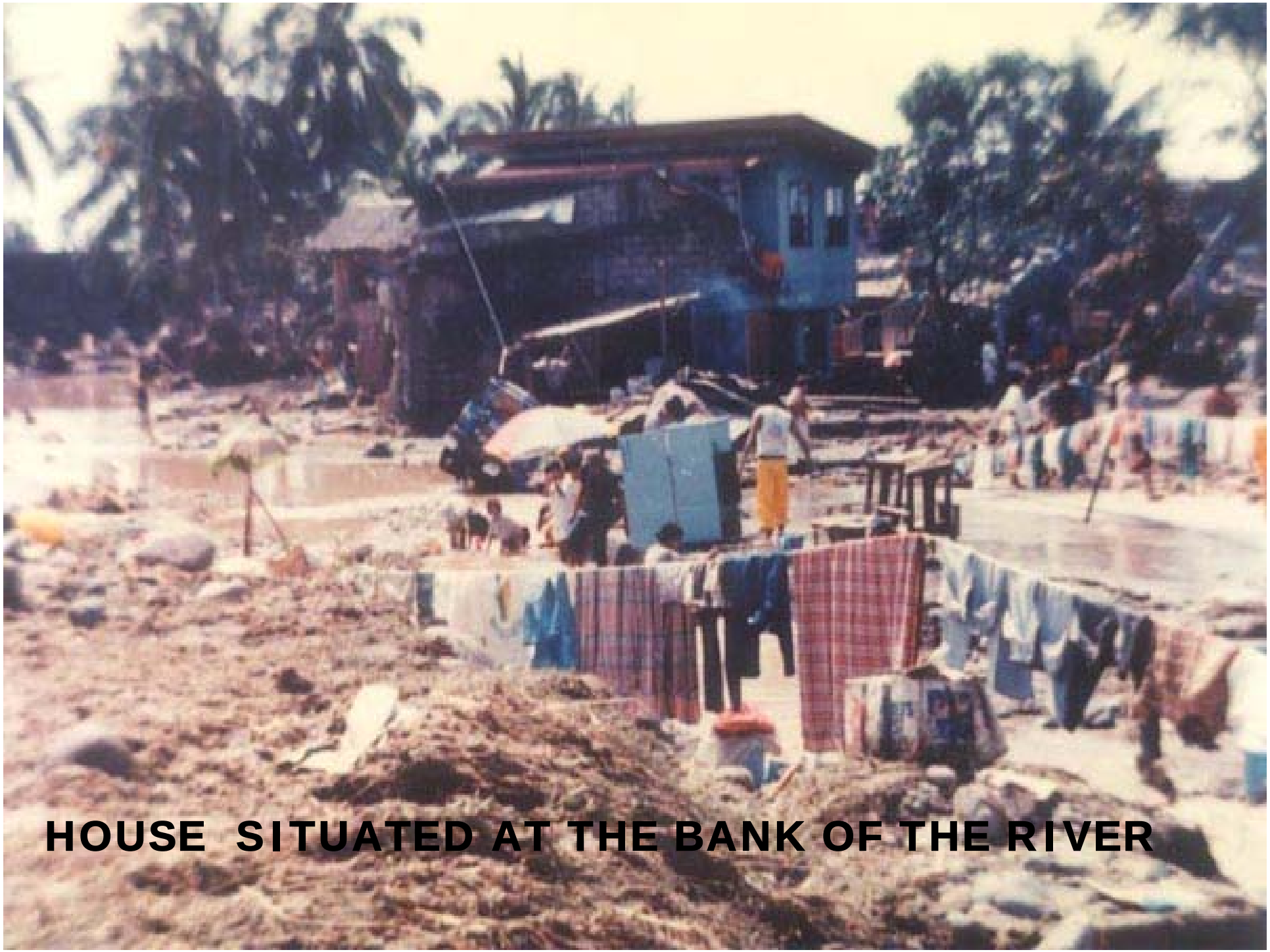
NEAR MOUTH OF ANILAO RIVER



National Road Leading to Malbasag Bridge

DEAD BODIES FOUND UNDER DEBRIS AND DESTROYED HOUSES


ELEVATED AREAS UNDER FLOOD
WATER UPSTREAM OF MALBASAG



HOUSE SITUATED AT THE BANK OF THE RIVER

Project-Related Activities

- 1993-1994

Study on the Flood Control for Rivers in the Selected Urban Centers, conducted by JICA. Ormoc City was identified as area of particular urgency.

- 1996-1997

Basic Design Study on Flood Mitigation Project in Ormoc City, conducted under Japan's Grant-Aid System

- Feb. 1998 – Mar. 1999

Construction of Phase I, under Grant-Aid assistance of the Government of Japan

- Apr. 1999 – Aug. 2001

Construction of Phase II, under Grant-Aid assistance of the Government of Japan

- Mar. 2006 – Jul. 2007

Detailed Design and Construction of Rehabilitation/Enhancement of Ormoc Flood Mitigation Structures, under Non-Project Grand Assistance of Japan Counter-Value Fund and Government of Philippine

Flood Mitigation Project was Launched

- To secure human lives and properties in Ormoc City from floods with magnitude of up to 50-year return period, and

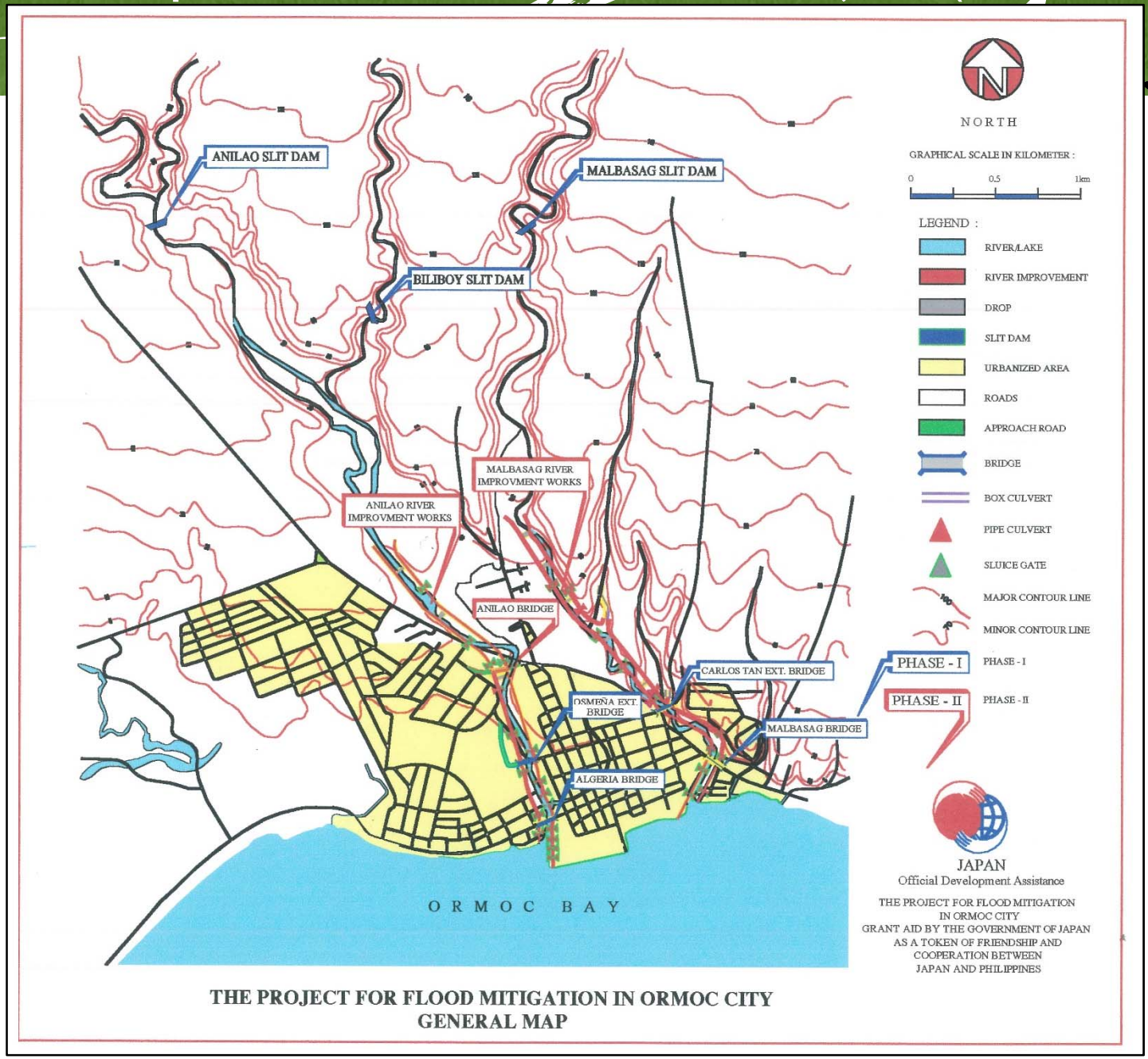
- To conserve and improve the river environment of Anilao and Malbasag Rivers. (親水護岸）

Project Implementation

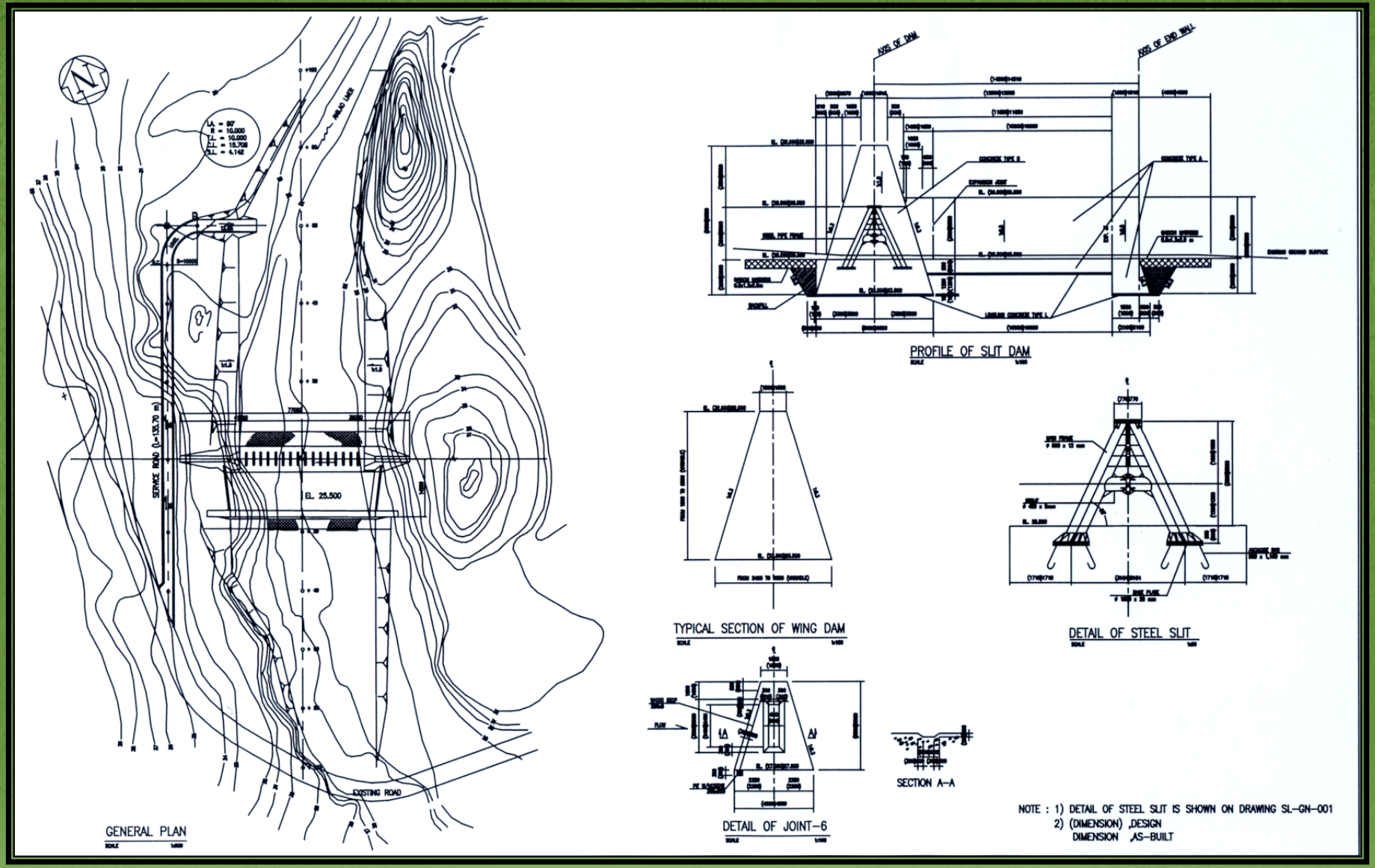
- Project was implemented by the Republic of the Philippines with the Japanese Grant-Aid Assistance executed by JICA.

- DPWH （公共事業道路省）acted as the Executing Agency and its Project Management Office for Major Flood Control Projects (PMO-MFCP) is responsible for actual implementation
  - Design to construction, and
  - Maintenance and operation thereafter.
- DPWH Region VIII Office and the Ormoc City Government assisted the PMO-MFCP as cooperating agencies.

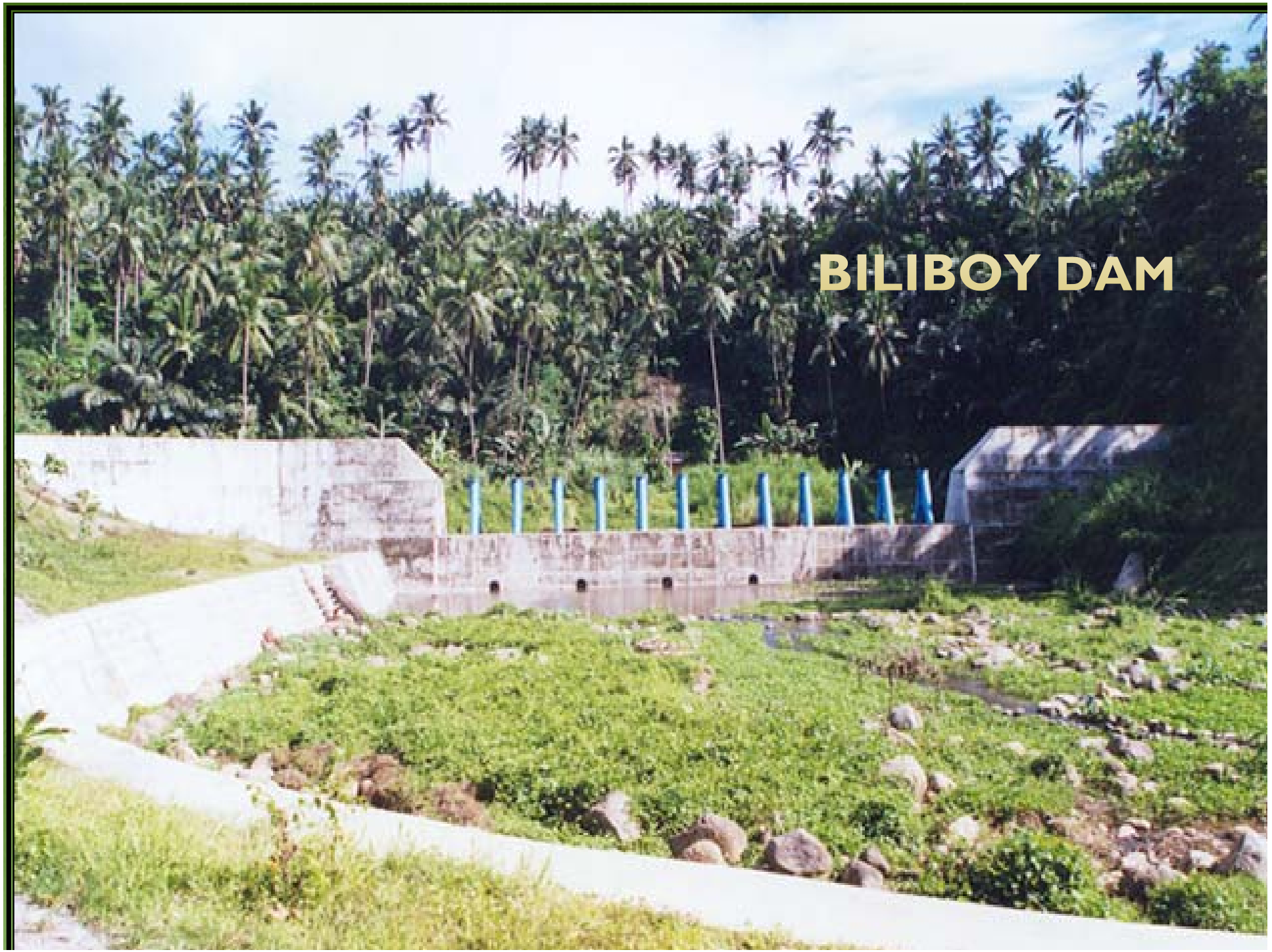
General Map for Ormoc Mitigation Project (施工位置図)



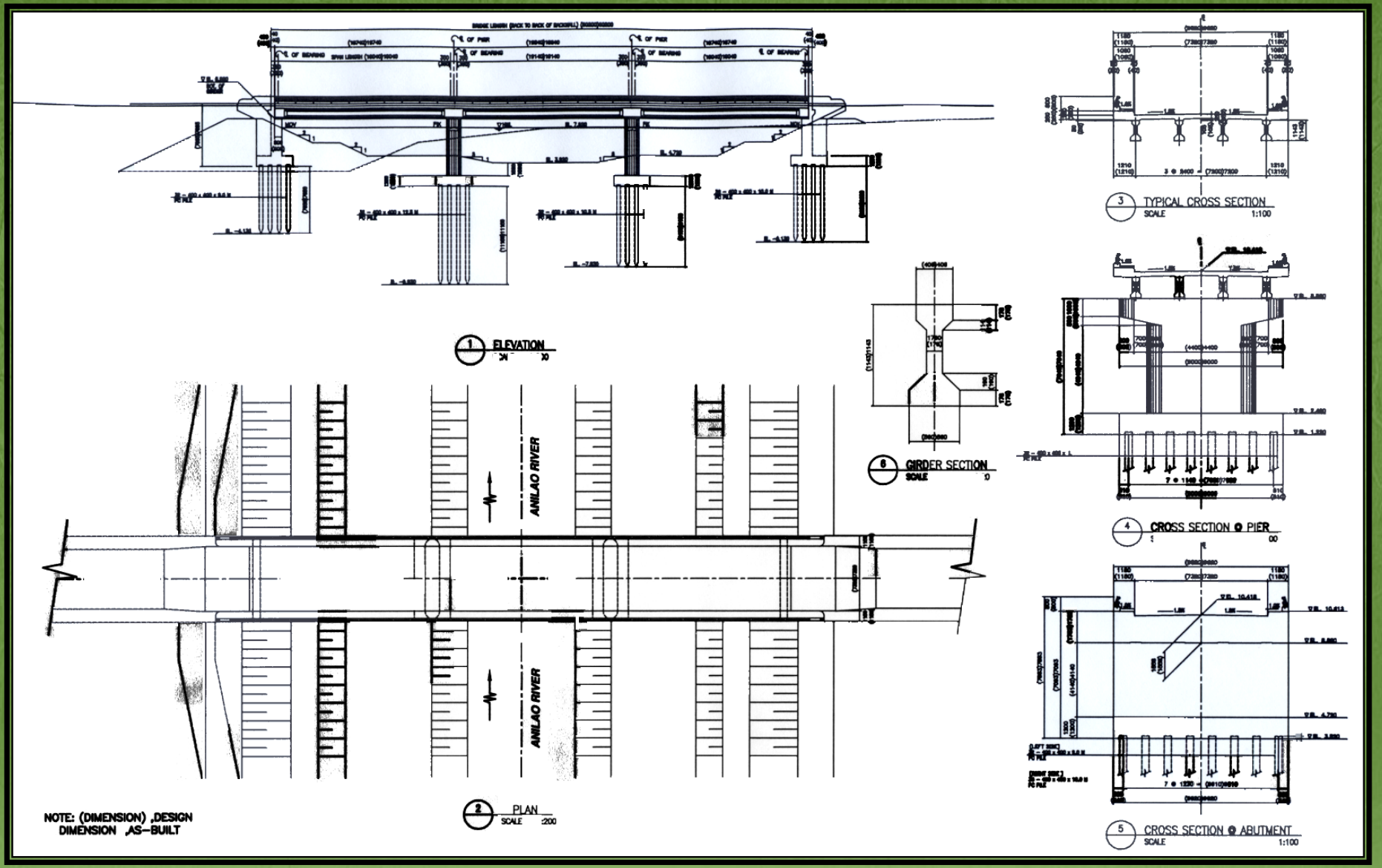
TYPICAL SECTION OF SLIT DAM



TYPICAL type for ANILAO and MALBASAG Slit DAM

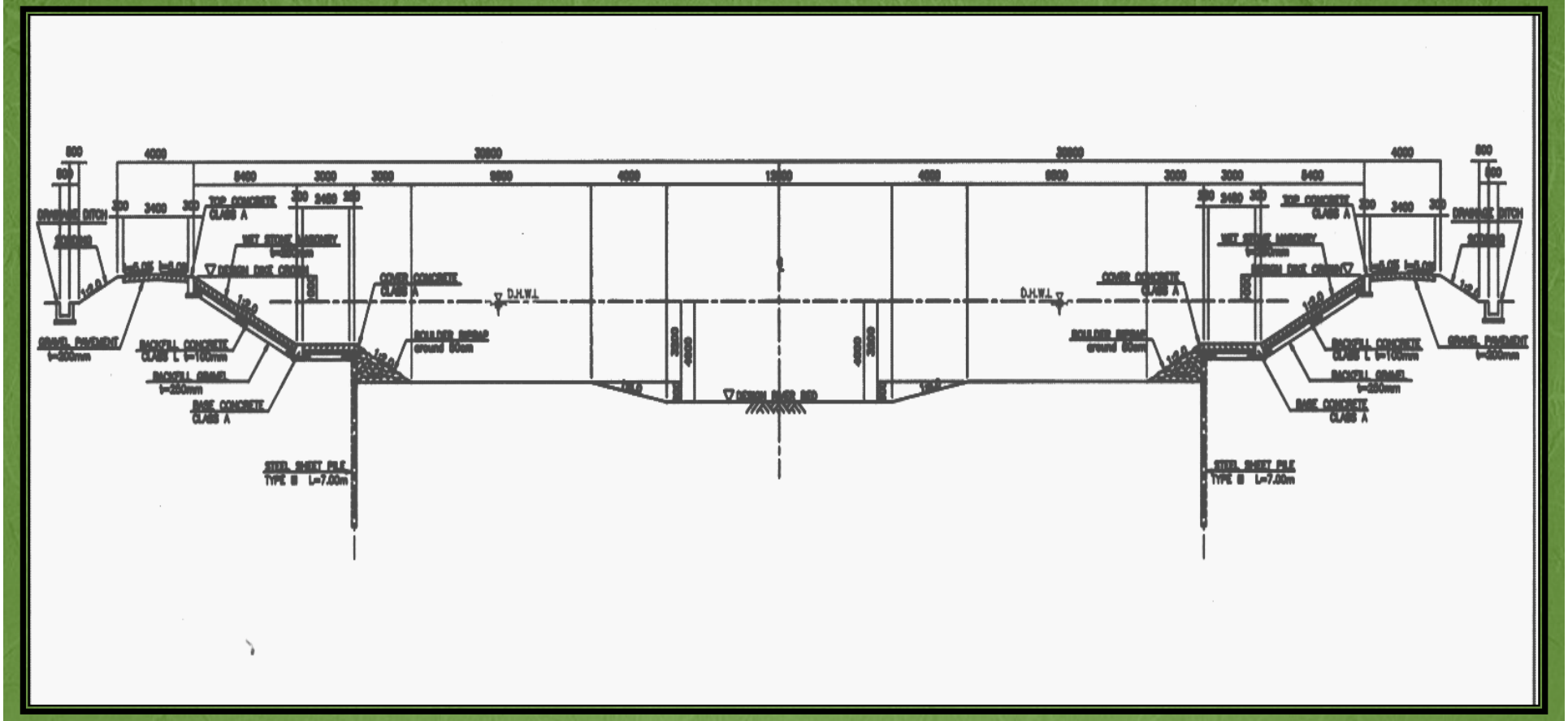

BILIBOY DAM

General Plan for Bridges



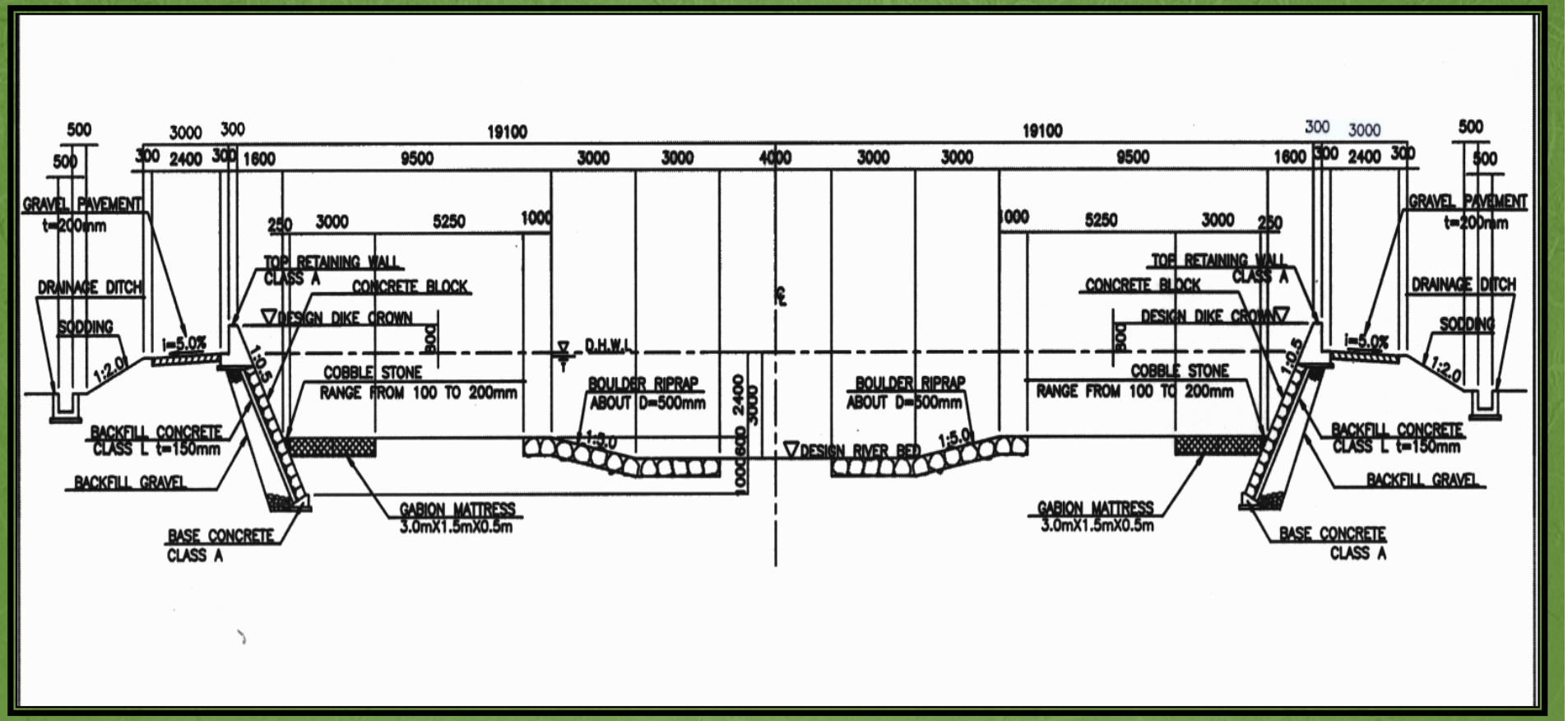
Osmeña Bridge

General Plan for Steel Sheet Pile Type Revetment



Sheet Pile Driving

General Plan for Concrete Block Type Revetment

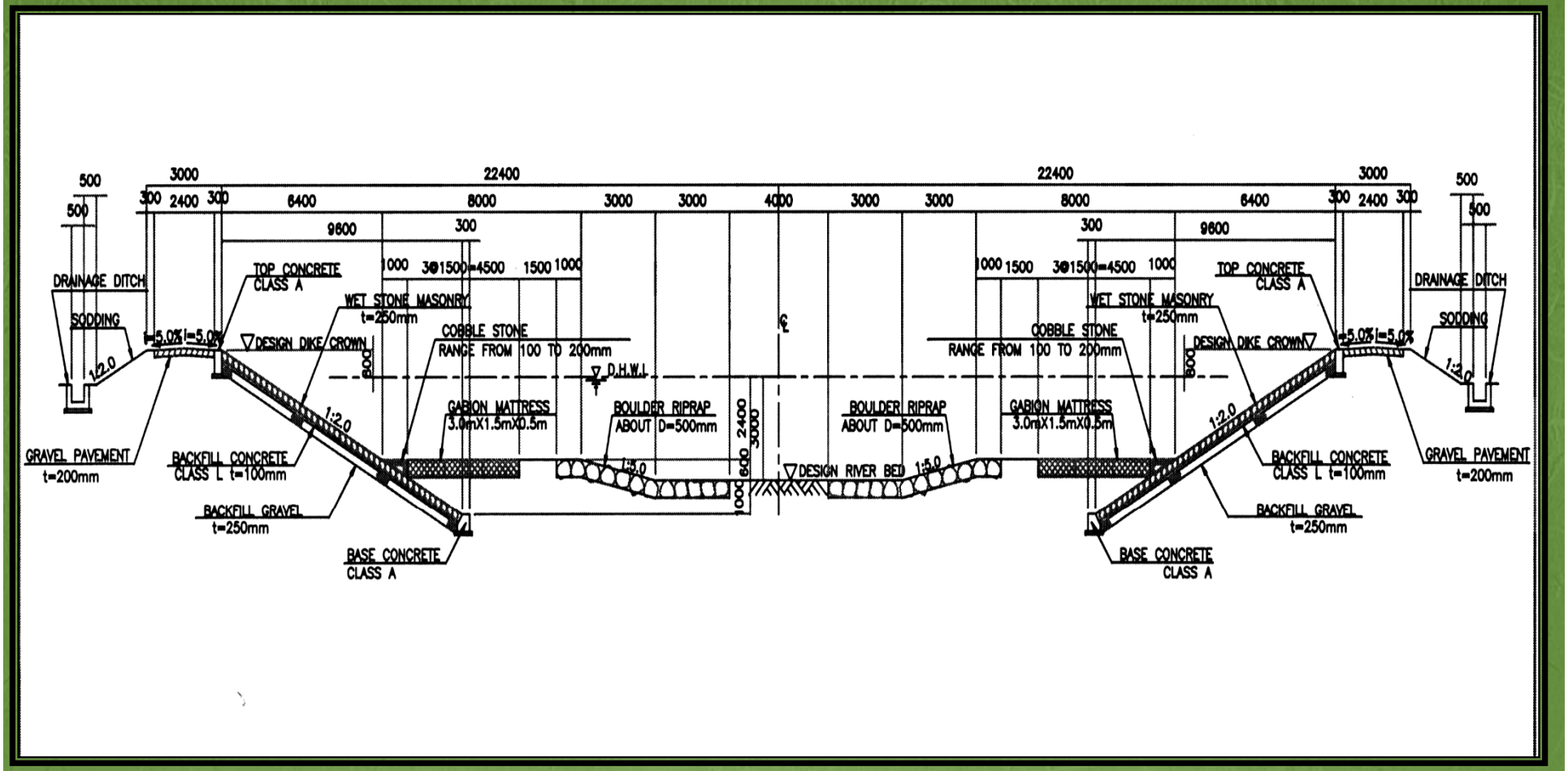


Coco pile driving

(additional foundation-optional)

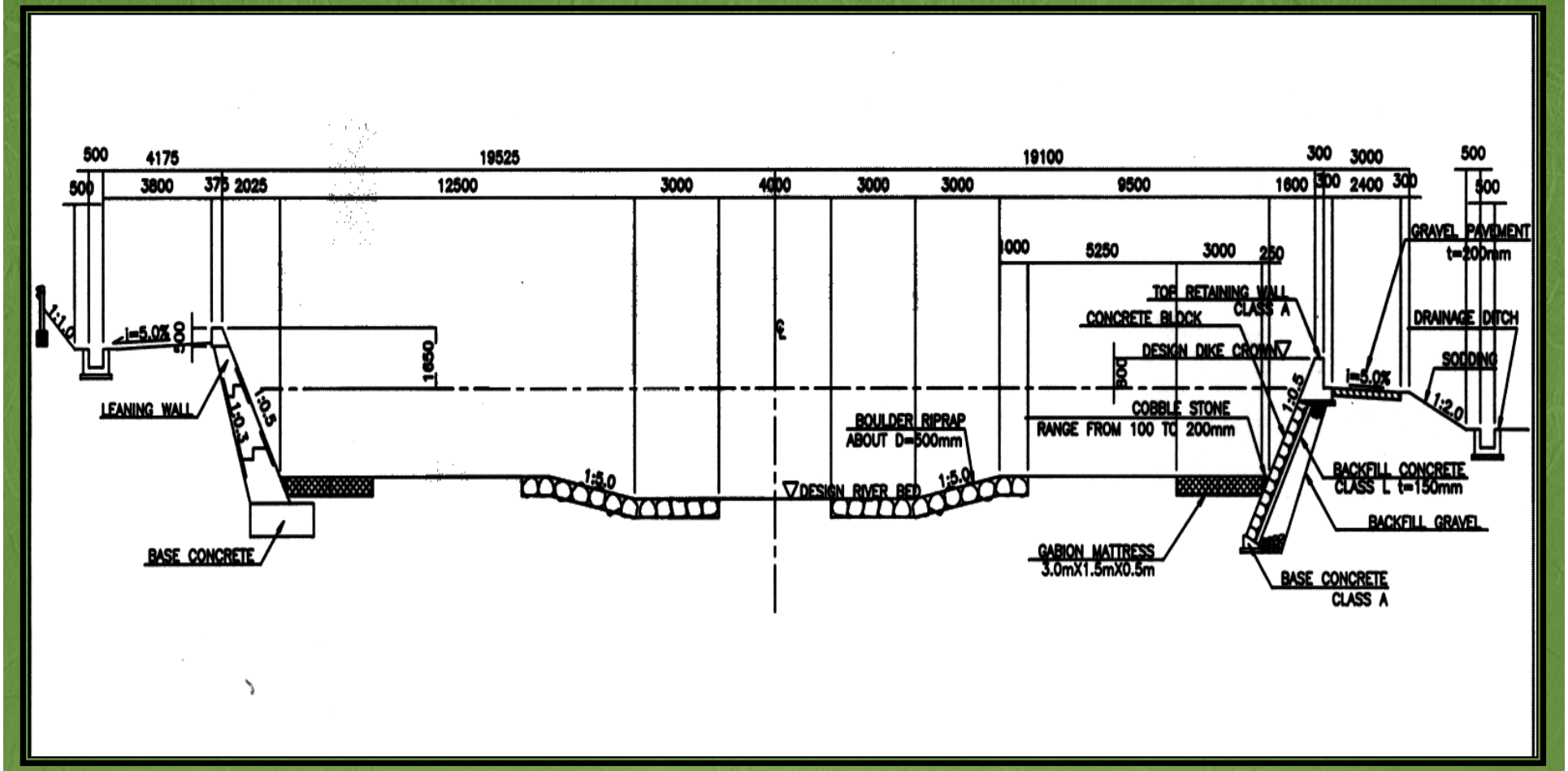
Kenchi Block

General Plan for Wet Stone Masonry Type Revetment



Wet stone masonry (on going)

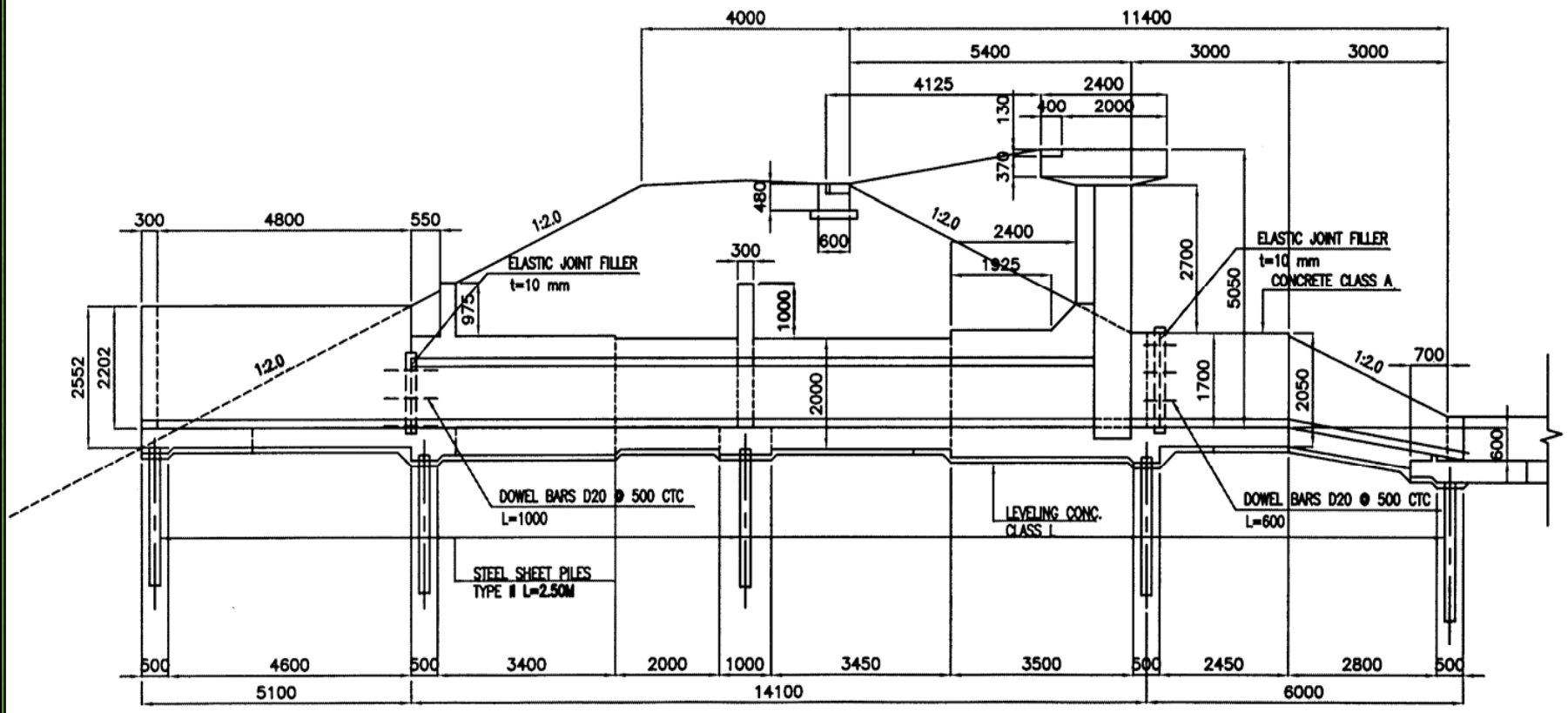
General Plan for Retaining Wall Type Revetment




THE PROJECT FOR FLOOD MITIGATION
IN OMOK CITY PHASE III
INSPECTION FOR SOIL
CONDITION BEFORE CLEANING
AND BASE
4 3'00

Leaning Wall

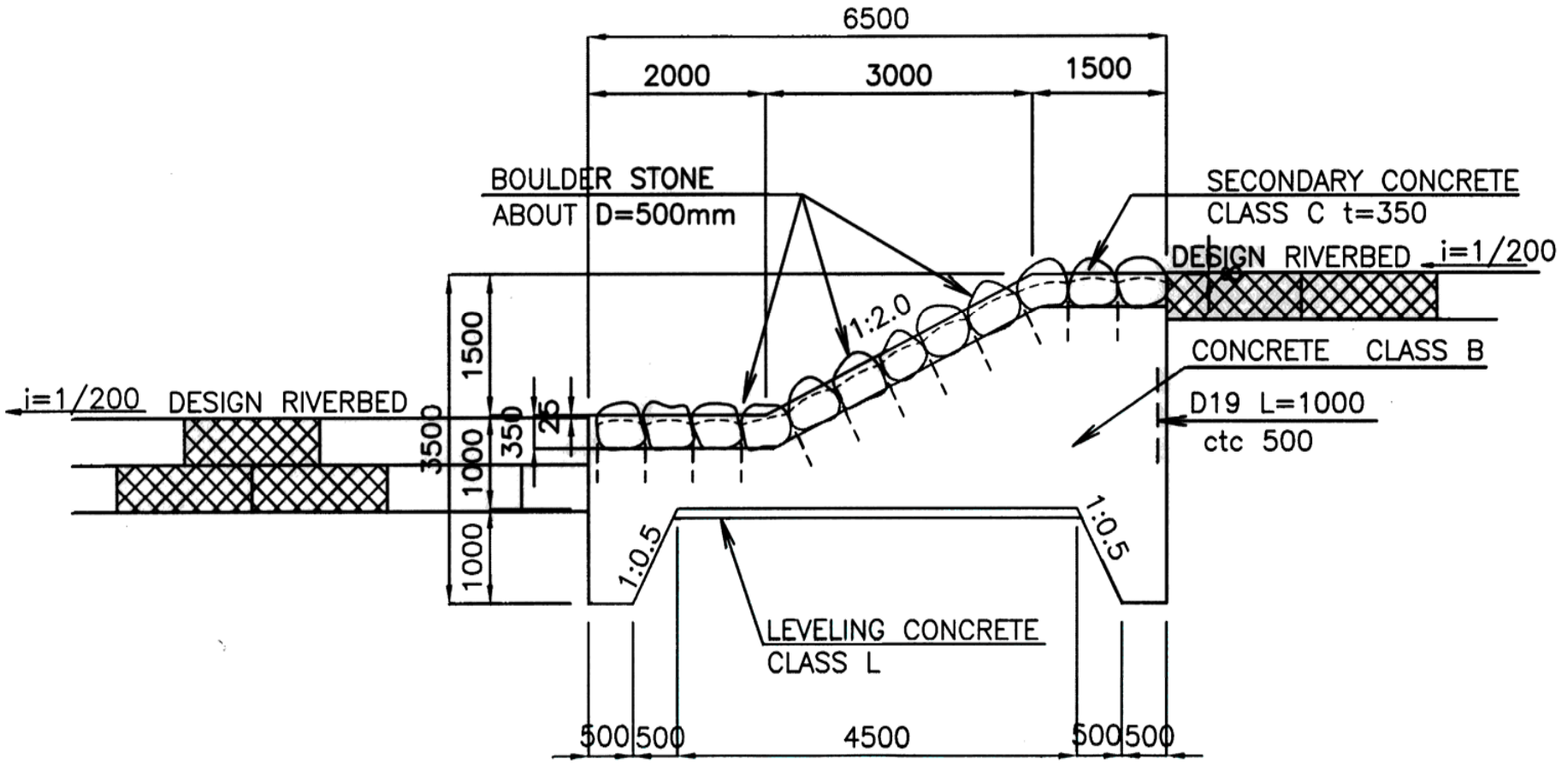
General Plan for Sluice Gate



Alegria Sluice Gate

ANILAO SLUICE GATES

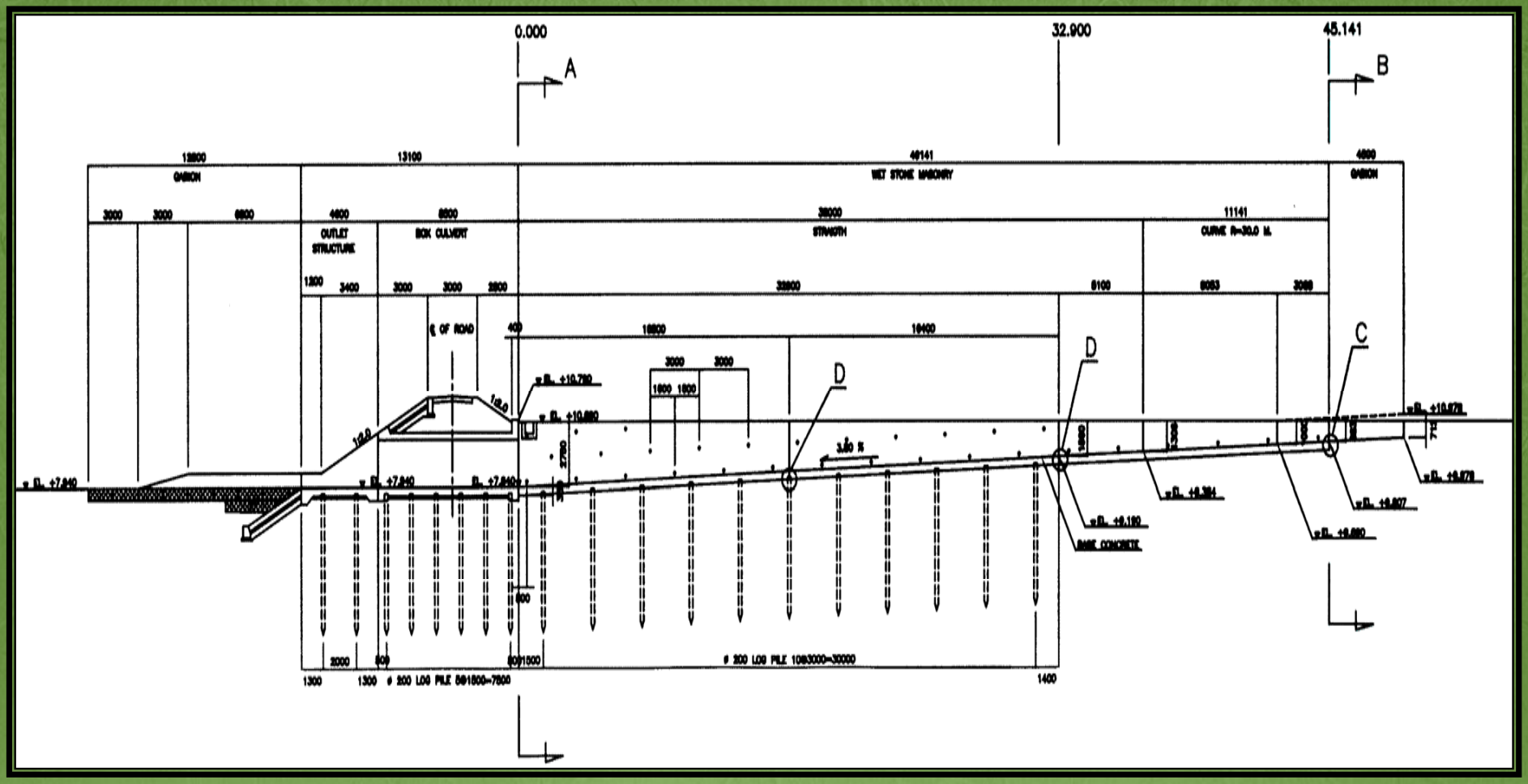
General Plan for Hydraulic Drop



Malbasag Hydraulic Drop


Anilao Hydraulic Drop

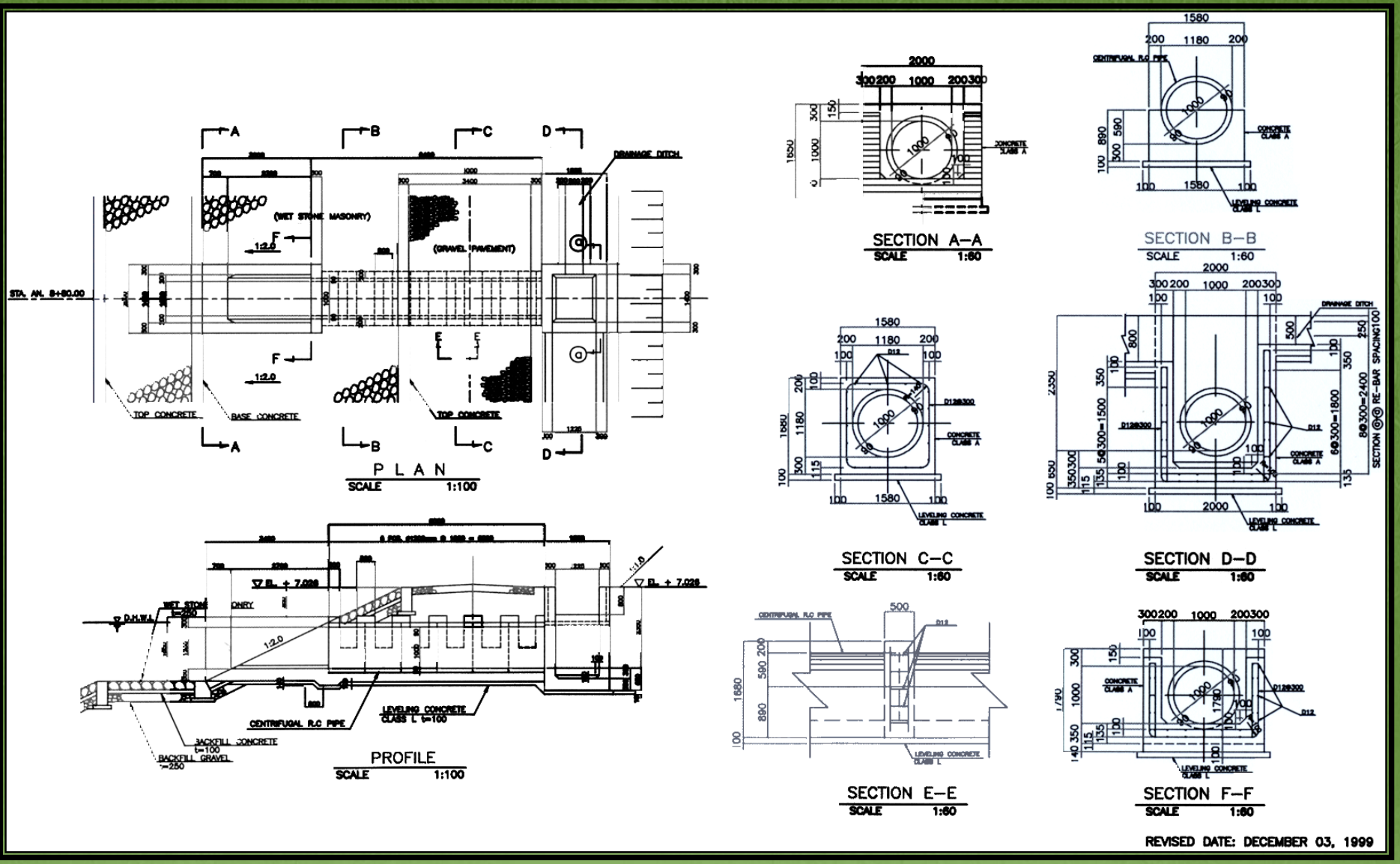
General Plan for Box Culvert




12 9'99


Malbasag Box Culvert

General Plan for Pipe Culvert




THE PROJECT FOR FLOOD MITIGATION
IN ORMOC CITY (PHASEII)
ANILAO RIVER
DATE:
PIPE CULVERT


STAIRS WERE
PROVIDED

MAINTENANCE FLOW

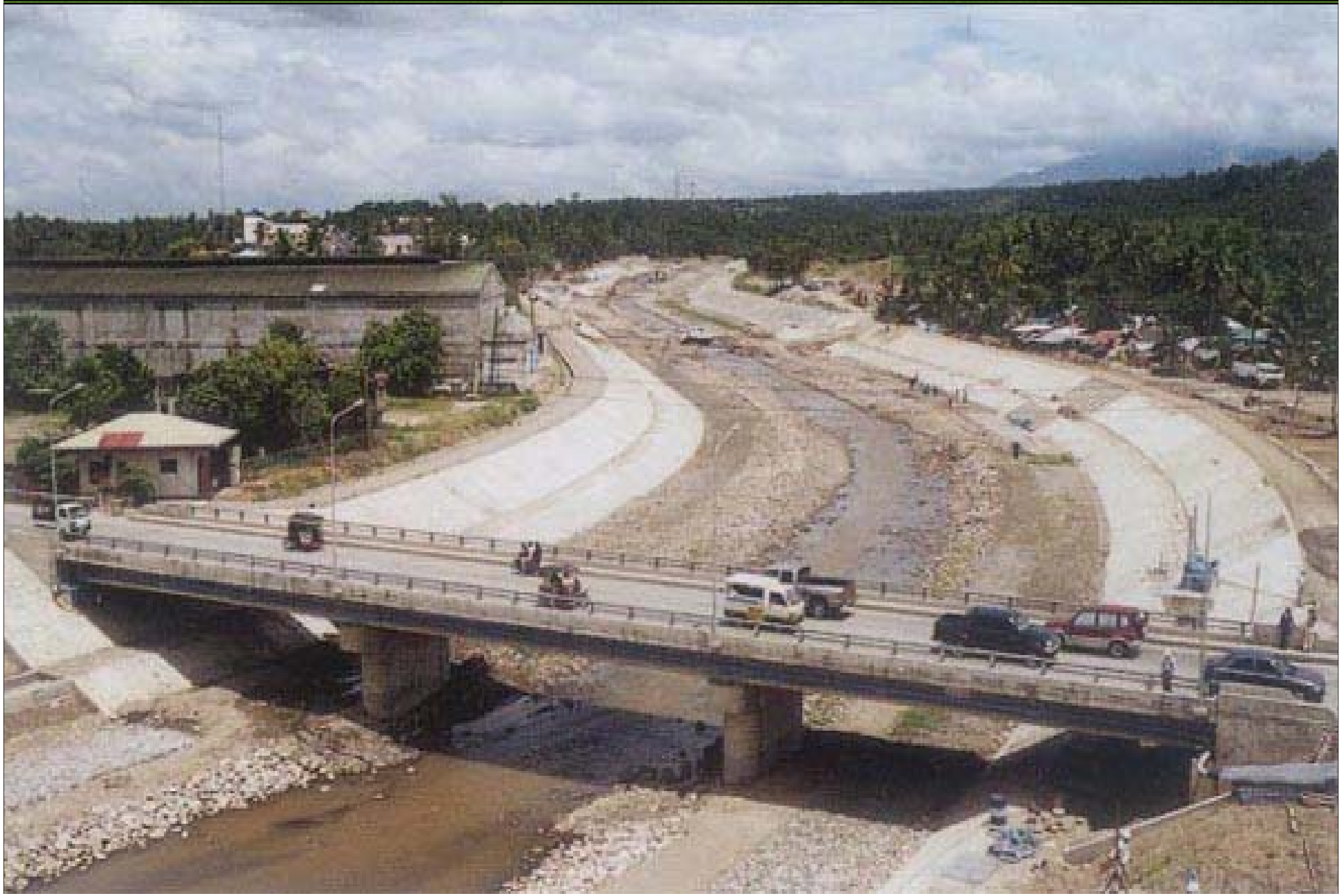

Maintenance Flow
covered with vegetation

Anilao River Mouth (before improvement)

Anilao River Improvement (River Mouth)

ISLA VERDE AREA 1993
(upstream of Anilao Bridge)

Upstream of Anilao River (Isla Verde Section)



Malbasag River Mouth (before improvement)

Malbasag River Improvement (River Mouth)

Malbasag River Improvement (Upstream)

Relocation Site（移転地）

S V

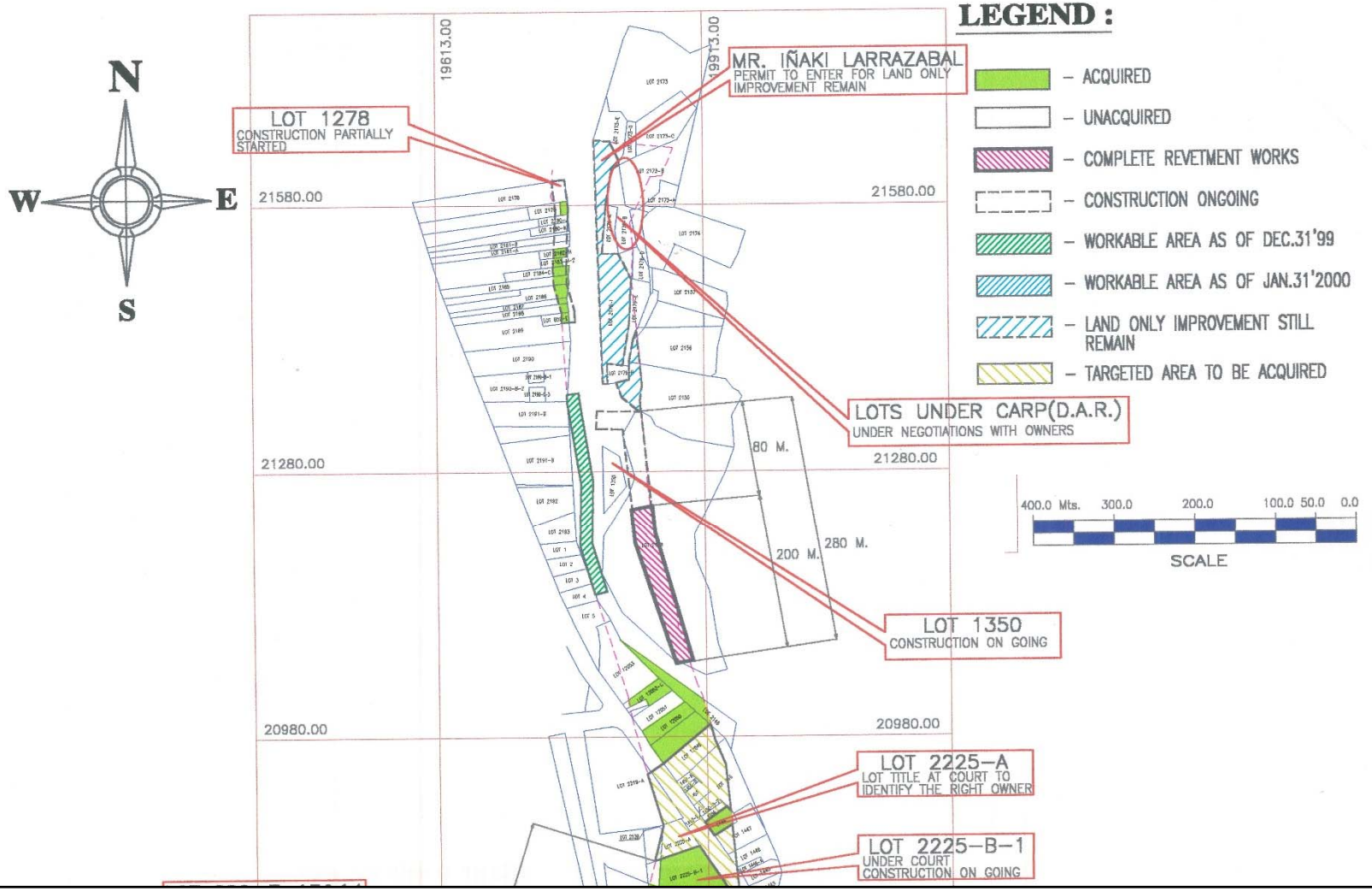
			Lot	Improvement	Tree
1998	Phase I	Dam	11	0	
		Bridge	35	77	
1999	Phase II		239	690	31
		grand total	285	767	

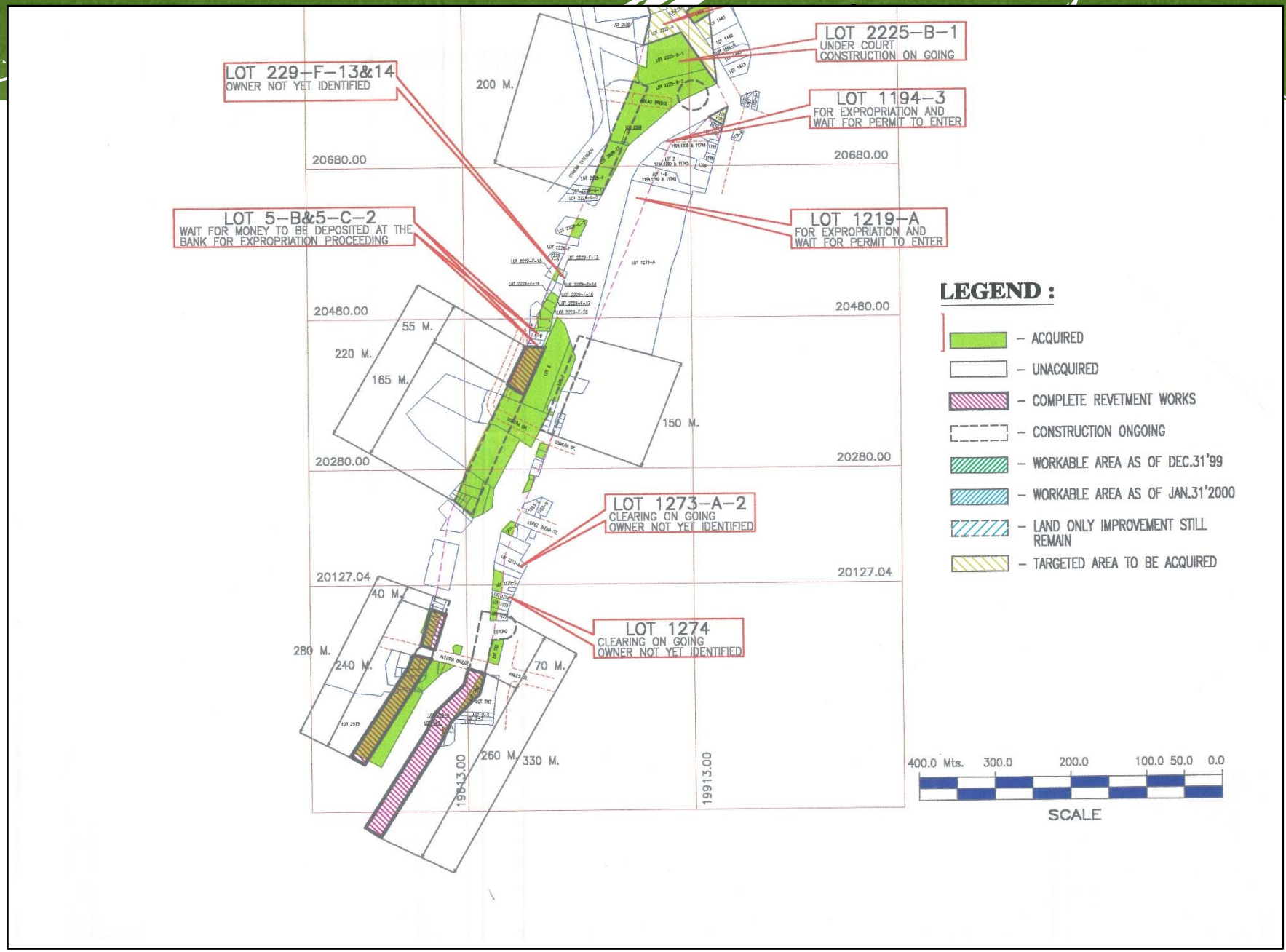
1） 不法住居者の分がImprovementに入っている
2） 一軒の家に複数のHouseholderが入っていたケースが多くあった。
3） LotとImprovementを分別して数えている
（同じ名前にてLotとImprovementに入っている）

ANILAO RIVER IMPROVEMENT WORKS

STATUS OF RIGHT OF WAY ACQUISITION & COMPENSATION

AS OF : JANUARY 31, 2000




LOT 2225–B–1
UNDER COURT
CONSTRUCTION ON GOING
LOT 229–F–13&14
OWNER NOT YET IDENTIFIED
LOT 1194–3
FOR EXPROPRIATION AND
WAIT FOR PERMIT TO ENTER
LOT 5–B&5–C–2
WAIT FOR MONEY TO BE DEPOSITED AT THE
BANK FOR EXPROPRIATION PROCEEDING
LOT 1219–A
FOR EXPROPRIATION AND
WAIT FOR PERMIT TO ENTER
LOT 1273–A–2
CLEARING ON GOING
OWNER NOT YET IDENTIFIED
LOT 1274
CLEARING ON GOING
OWNER NOT YET IDENTIFIED
200 M.
20680.00
20480.00
20280.00
20127.04
19913.00
55 M.
220 M.
165 M.
150 M.
40 M.
280 M.
240 M.
70 M.
260 M.
330 M.
LEGEND :
– ACQUIRED
– UNACQUIRED
– COMPLETE REVETMENT WORKS
– CONSTRUCTION ONGOING
– WORKABLE AREA AS OF DEC.31'99
– WORKABLE AREA AS OF JAN.31'2000
– LAND ONLY IMPROVEMENT STILL REMAIN
– TARGETED AREA TO BE ACQUIRED
400.0 Mts. 300.0 200.0 100.0 50.0 0.0
SCALE

MAKOTO MIGITA STREET

THE TEST . . . .(台風再び)

On July 17 2003 , Ormoc City experienced the onslaught of the rampaging waters due to heavy intermittent rains brought by TYPHOON GILAS.

It was noted through RAINFALL and RIVER GAUGE DATA that the magnitude of TYPHOON GILAS is much higher than as compared to TYPHOON URING which devastated Ormoc City on November 5 , 1991

THE STRUCTURES SAVED ORMOC from another catastrophe.

Anilao River Mouth - July 17-12:54 pm

ANILAO BRIDGE 1:00 PM

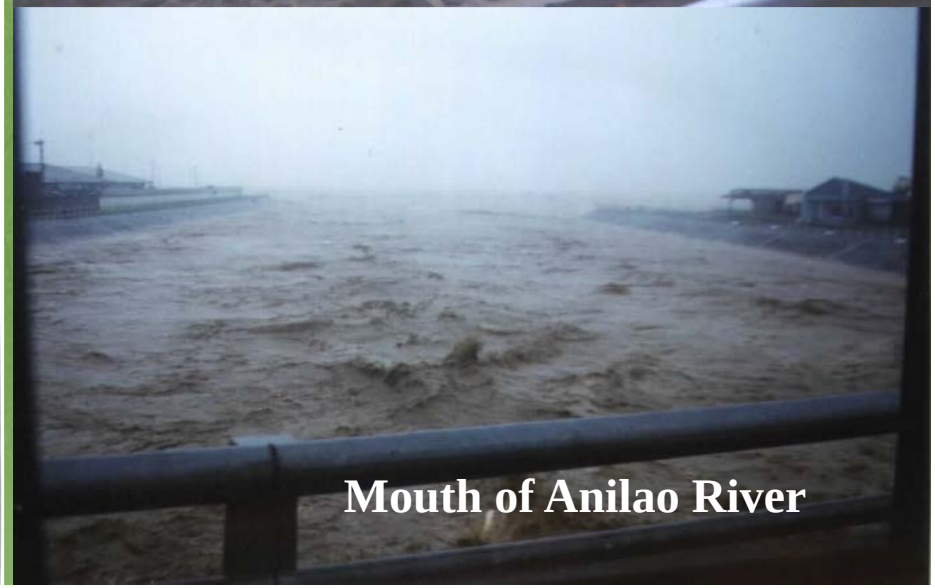
DURING TYPHOON GILAS

ANILAO RIVER

Anilao River @ Water Level Gauge – Upstream Near End of Project

Hydraulic Drop A1

Alegria Bridge

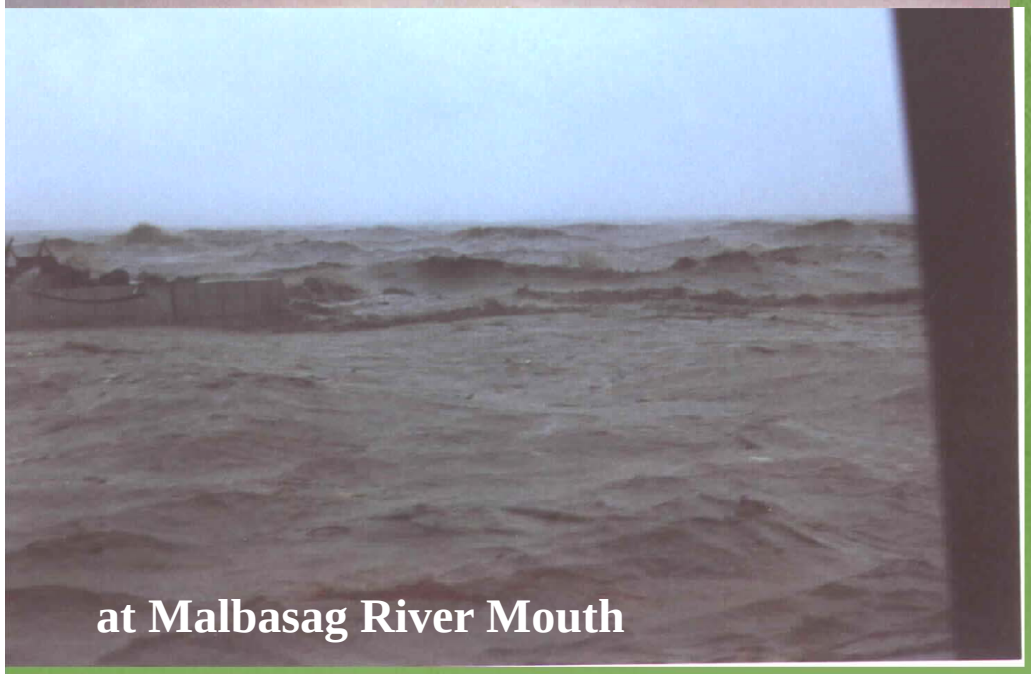


Mouth of Anilao River

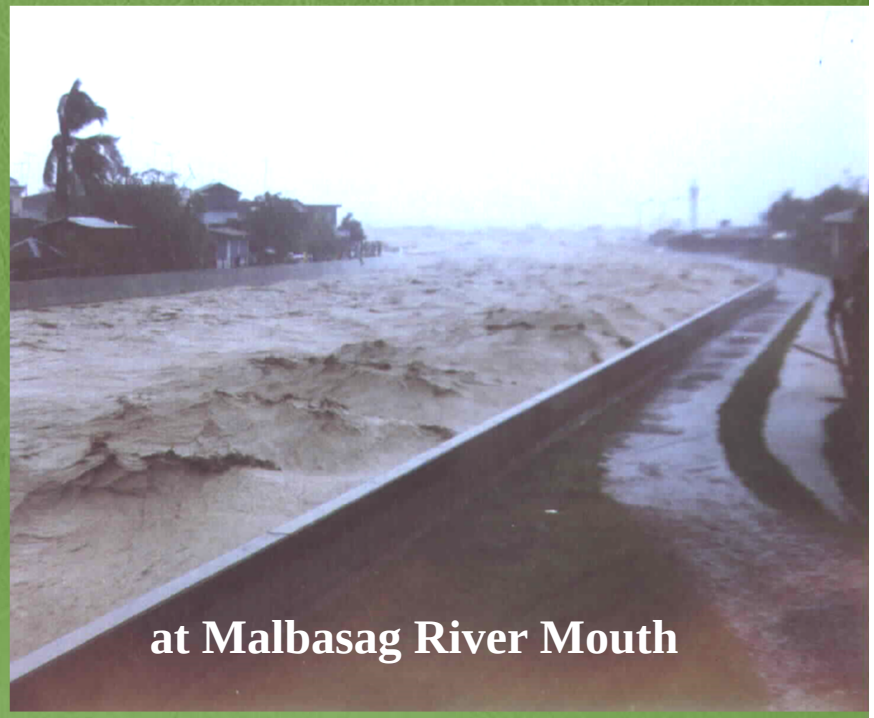
DURING TYPHOON GILAS

MALBASAG RIVER

Upstream of Carlos Tan Ext. Bridge



at Malbasag River Mouth



at Malbasag River Mouth

AFTER TYPHOON GILAS

ANILAO RIVER CHANNEL

Upstream of Osmena Bridge

AFTER TYPHOON GILAS

MALBASAG RIVER CHANNEL

AFTER TYPHOON GILAS

ANILAO SLIT DAM

Anilao Slit DAM

Anilao Slit Dam

AFTER TYPHOON GILAS

BILIBOY SLIT DAM

Downstream Portion of Biliboy Slit Dam

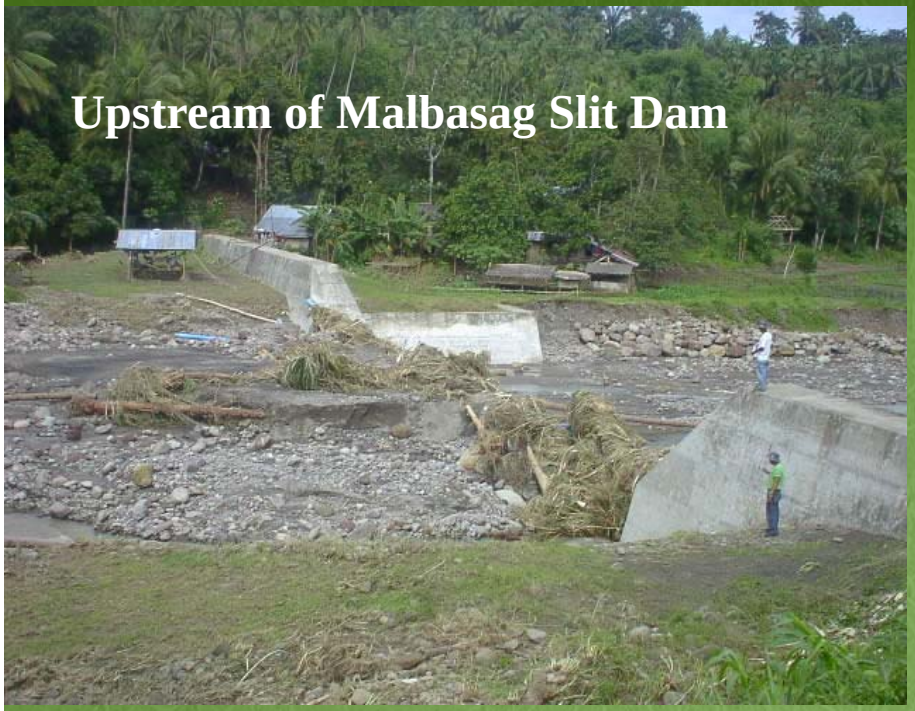
Top View of the Slit Dam

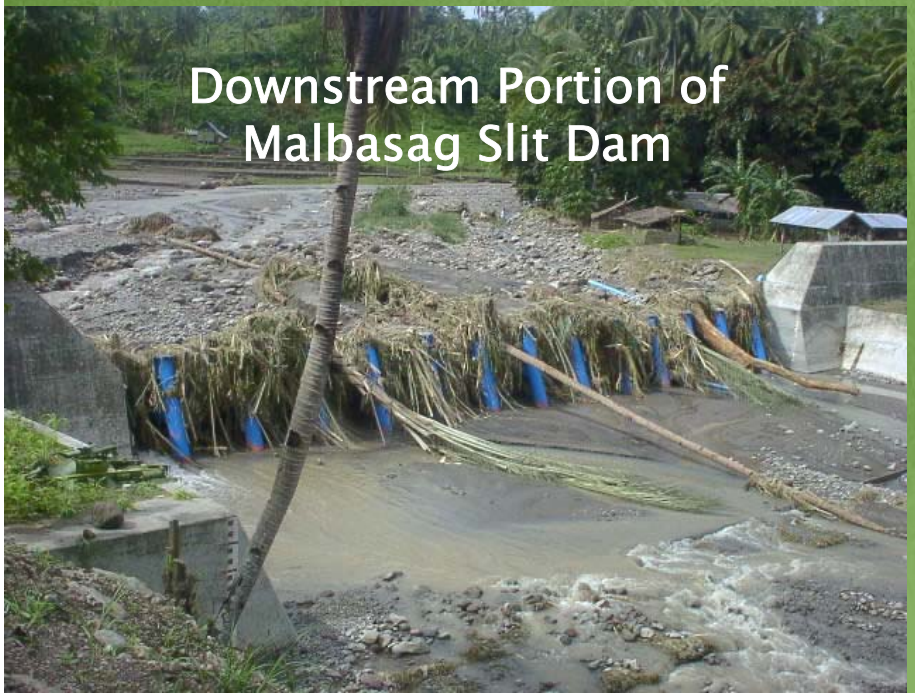
Upstream Portion of the Slit Dam

Biliboy Slit Dam

AFTER TYPHOON GILAS

MALBASAG SLIT DAM





MALBASAG HYDRAULIC DROP

MALBASAG BOX CULVERT

Nadongholan Dike constructed after the flood in 1991 under ADB funding was damaged. The damaged section was outside the JICA Grant Aid assisted project completed in 2001.

NADONGHOLAN DIKE AFTER REPAIR

DAMAGED REVETMENT AT BILIBOY DAM

Malbasag River – End of Project

Sediment deposit at the end of Malbasag River improvement works

DISPOSAL AREA LAND DEVELOPMENT (BEFOR

Disposal Area Land Development (after)

	Unit	1990	1995	1997	2000	2005	2010	2015
Population (in City)	person	129,200	144,033	149,880	154,297	166,144	188,119	215,031
Population (in urban)	person	41,426	46,081	47,962	50,013	53,166	60,198	55,746
Financing Institutions, TAX (income)	Million (PHP)	15	15	15	58	61	61	76
Business license to be issued	No.	2,030	2,296	2,836	2,629	3,455	4,351	5,727
Number of permission of construction	No.	NA	NA	210	150	234	152	208
Expensive in household	PHP	NA	NA	NA	NA	2M	3.5M	NA
Land price (urban area)-business	per/m2	NA	2,430	2,430	2,430	4,950	4,950	16,000
Land price (urban area)-residential	per/m2	NA	1,000	1,000	1,000	2,200	2,200	5,000
Land price (agriculture)	per/m2	NA	12	12	12	20	20	25
Land price (industrial)	per/m2	NA	2,430	2,430	2,430	4,950	4,950	4,950
Educational Institute	No.	88	94	93	104	109	117	126
Source of Data: Ormoc City 2016	NA: not available							

After the Project （工事完成後）

- Improvements in the socio-economic conditions of the area:

1. After 2000, population has increased by 7% (5% for Leyte Province). 21% (urban in 2015)人口増加

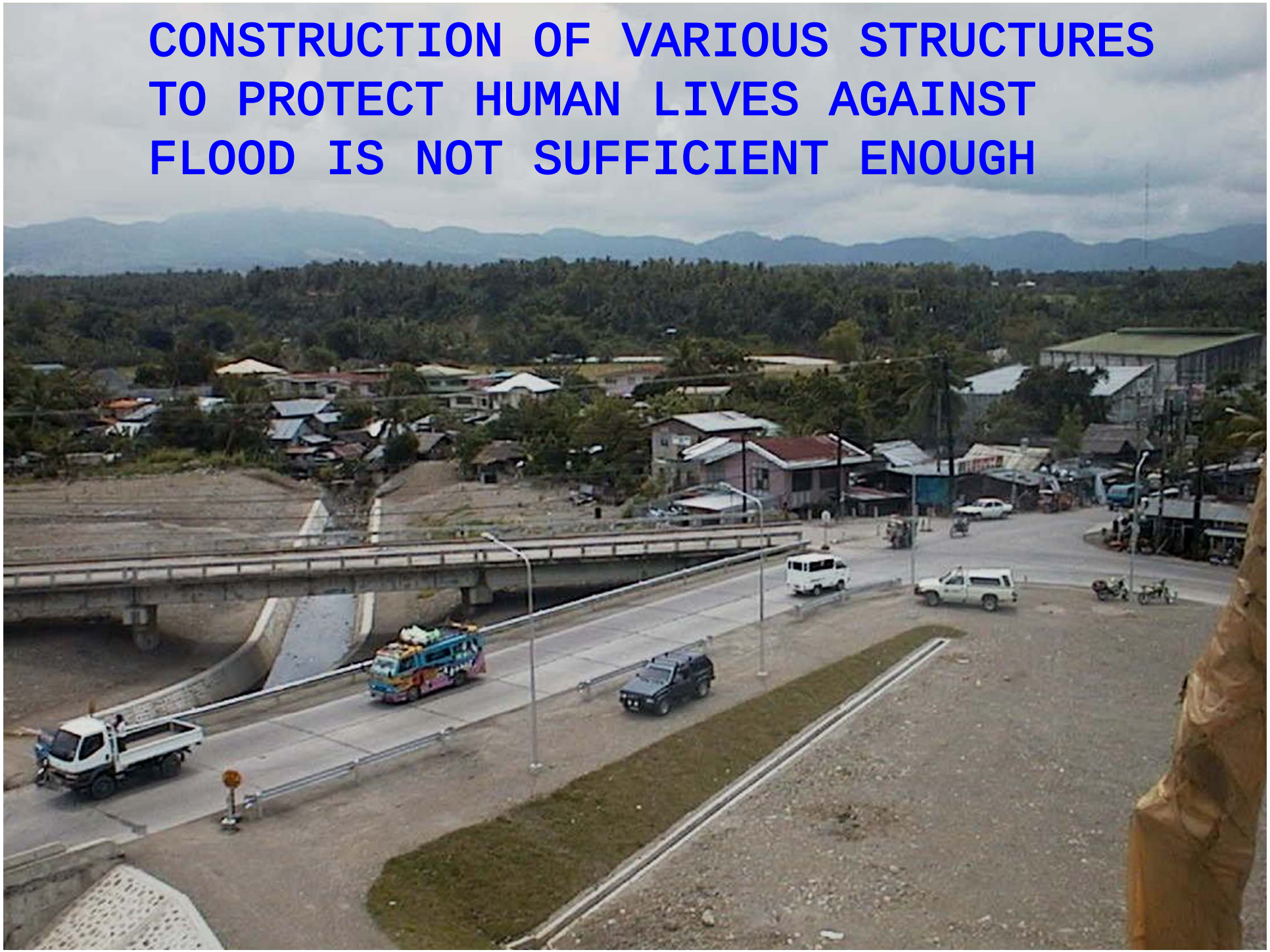
2. Financing institutions increased from 15 (in 1997) to 58 (in 2000). Then 78(in 2015) 税金収入

3. Four major bridges re-constructed under the Project have made the City accessible throughout. 技術移転

4. The land use in the area has been enhanced. 土地再開発

With the completed structures
構造物で十分？

CONSTRUCTION OF VARIOUS STRUCTURES TO PROTECT HUMAN LIVES AGAINST FLOOD IS NOT SUFFICIENT ENOUGH



施設と河道境界の維持管理

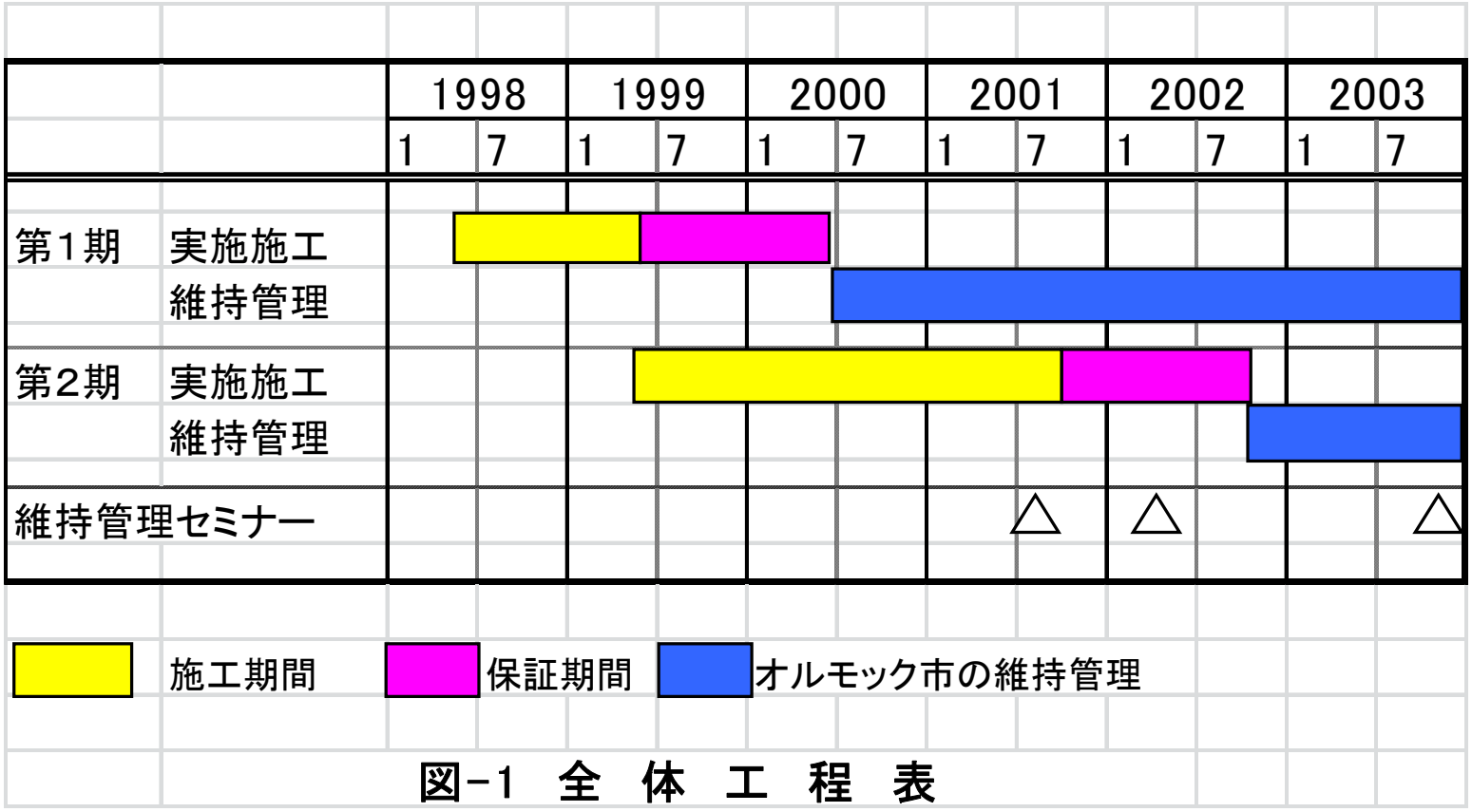


図-1 全 体 工 程 表

Houses above the revetment

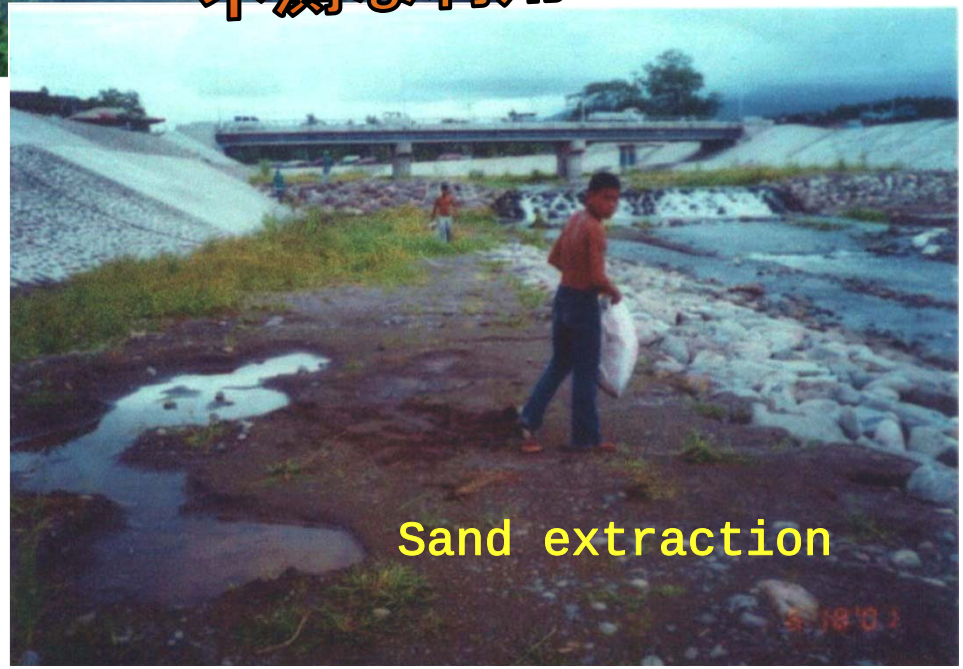
ILLEGAL STRUCTURES
不法構造物

Rest house under the bridge

Blocked drainage due to house extension

INDESCRIMINATE USE and Practices !!!!

不測な利用と行為



違法な占領

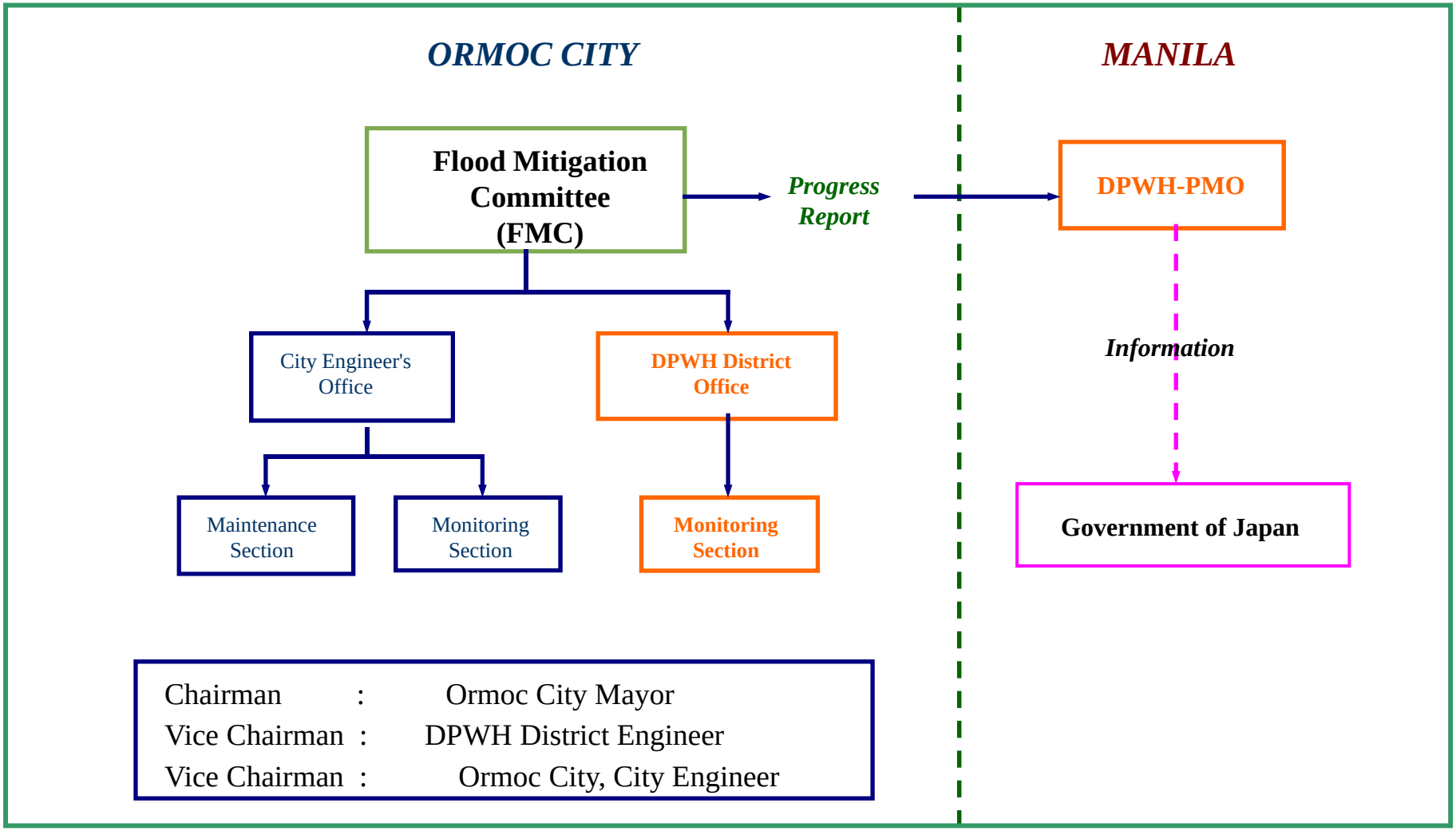
CREATION OF FLOOD MITIGATION COMMITTEE
洪水対策委員会

FMC was created through an Approved Supplemental Memorandum of Agreement between the City Government and DPWH defining the specific roles and responsibilities of both the LGU and DPWH relative to the maintenance, repair and rehabilitation works of the facilities and structures of the project.

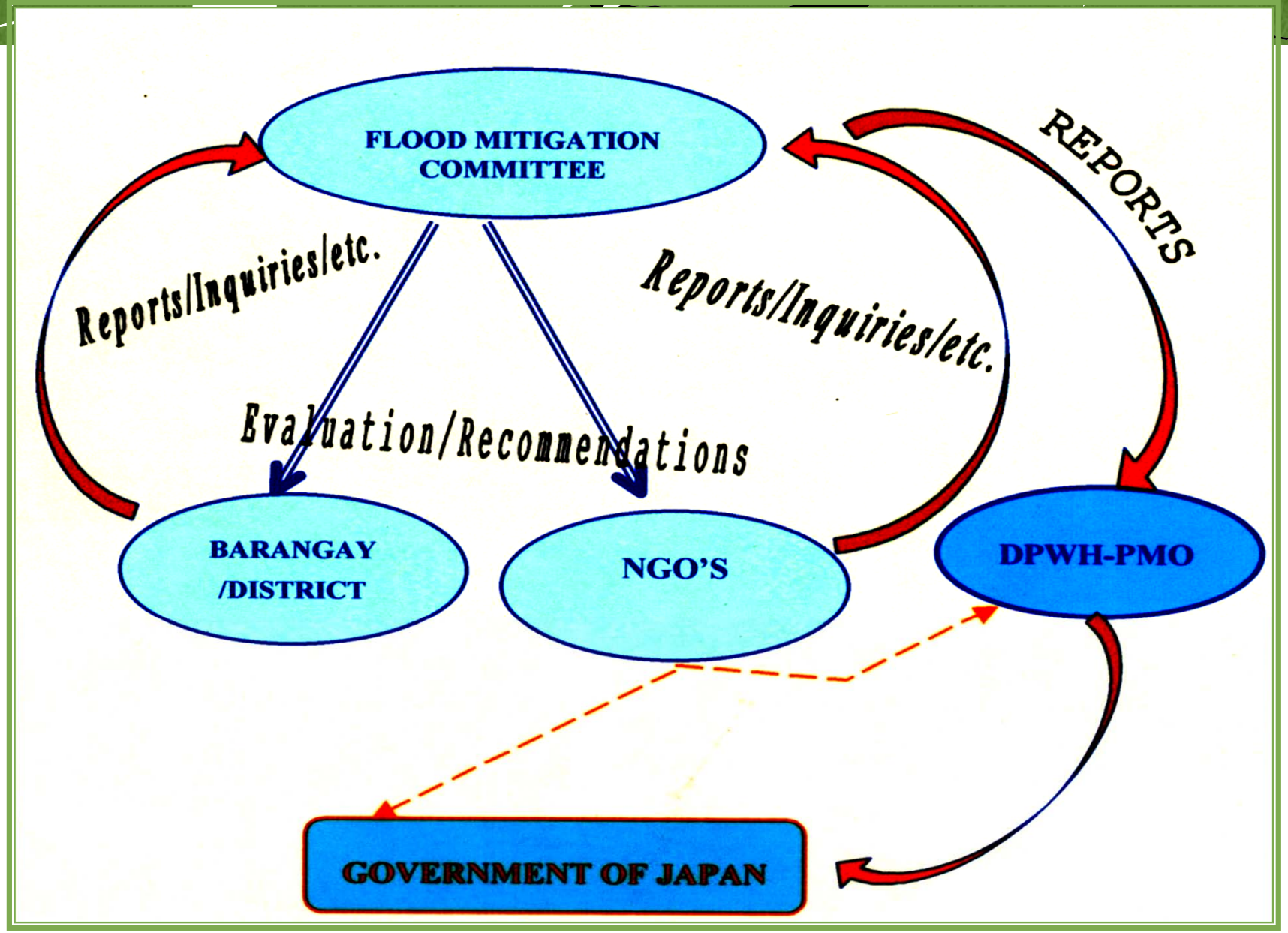
Operations and Maintenance 施設維持管理

- A Flood Mitigation Committee was organized including the City, Barangay (County), NGOs, DPWH-4th LED and DPWH-PMO-MFCP.
- Actual operation and maintenance work is undertaken by the Technical/Monitoring Section of the Office of City Engineers.
  - Vegetation control;
  - Removal and disposal of garbage in the rivers;
  - Declogging of lined canals and culverts;
  - Repair/restoration/replacement of project facilities.
- Budget for 2002 is US$ 45 thousand (2 million PhP).

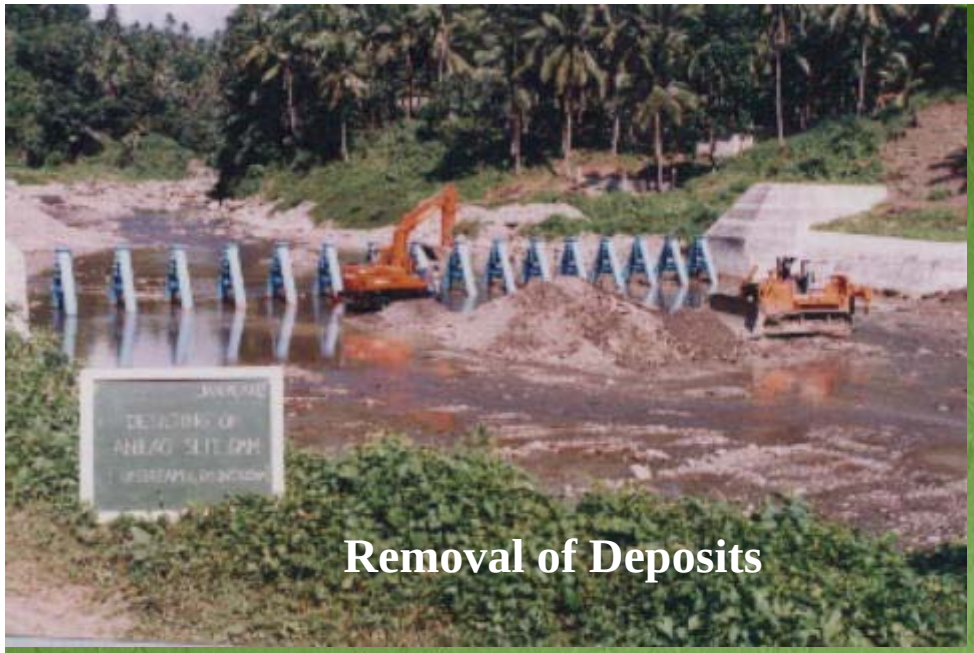
Organization for Operation and Maintenance for Flood Control Facilities



COMMUNICATIONS FLOW



Maintenance Activities @ Slit Dams



Removal of Deposits

Vegetation Control

MONITORING AND REMOVAL OF ILLEGAL STRUCTURES

Installation of Perimeter Fence
河川境界フェンス

CHANNEL EXCAVATION TO RESTORE DESIGNED DISCHARGE CAPACITY

RECHANNELING & REMOVAL OF DEPOSITS @ BILIBOY SLIT DAM

REMOVAL OF DEPOSITS @ MALBASAG SLIT DAM

COMMUNITY INVOLVEMENT　住民参加
お絵かきコンテスト

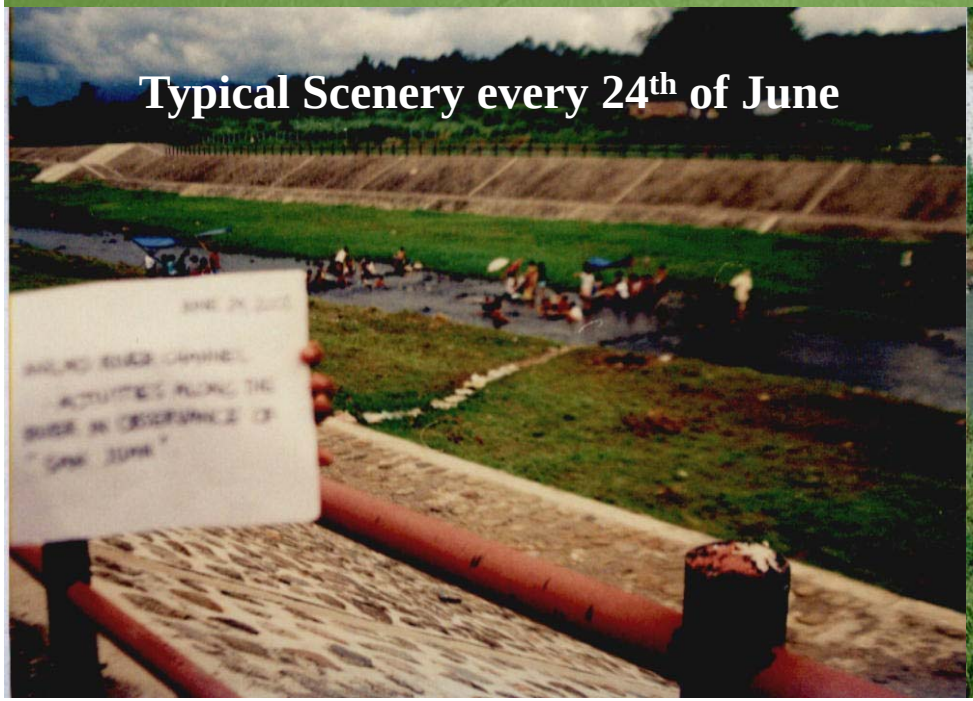
Winning Masterpiece

Painting contest on the river bank in the River Festival on Dec. 4, 2003
お絵かきコンテスト

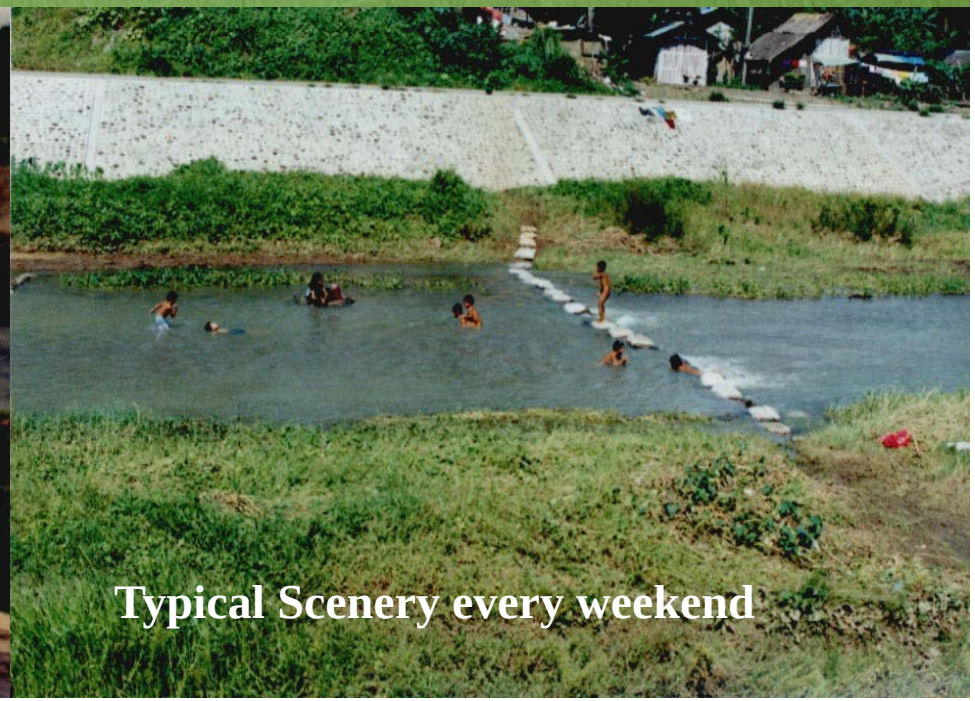
Winning paint in the River Festival on Dec. 4, 2002.

RIVER SCENERIES

During youth convention



Typical Scenery every 24th of June



Typical Scenery every weekend


A smart house wife

River becomes a part of people’s life.

River Walk,　河川散歩道路


THE RIVER WALK AT NIGHT

Flood Fighting Activity, 水防活動

Storage House for Flood Fighting,
水防活動のための機材保管倉庫と展望台

Present Condition at Ormoc City(1/2), Sep 2007
(6 year after the completion)

オルモック工事完成後6年

Anilao River, downstream site
アニラオ川、下流

Anilao River, upstream site
アニラオ川、上流

Present Condition at Ormoc City(2/2), Sep 2007
(6 years later after the completion)
現在のオルモック、工事完成後6年

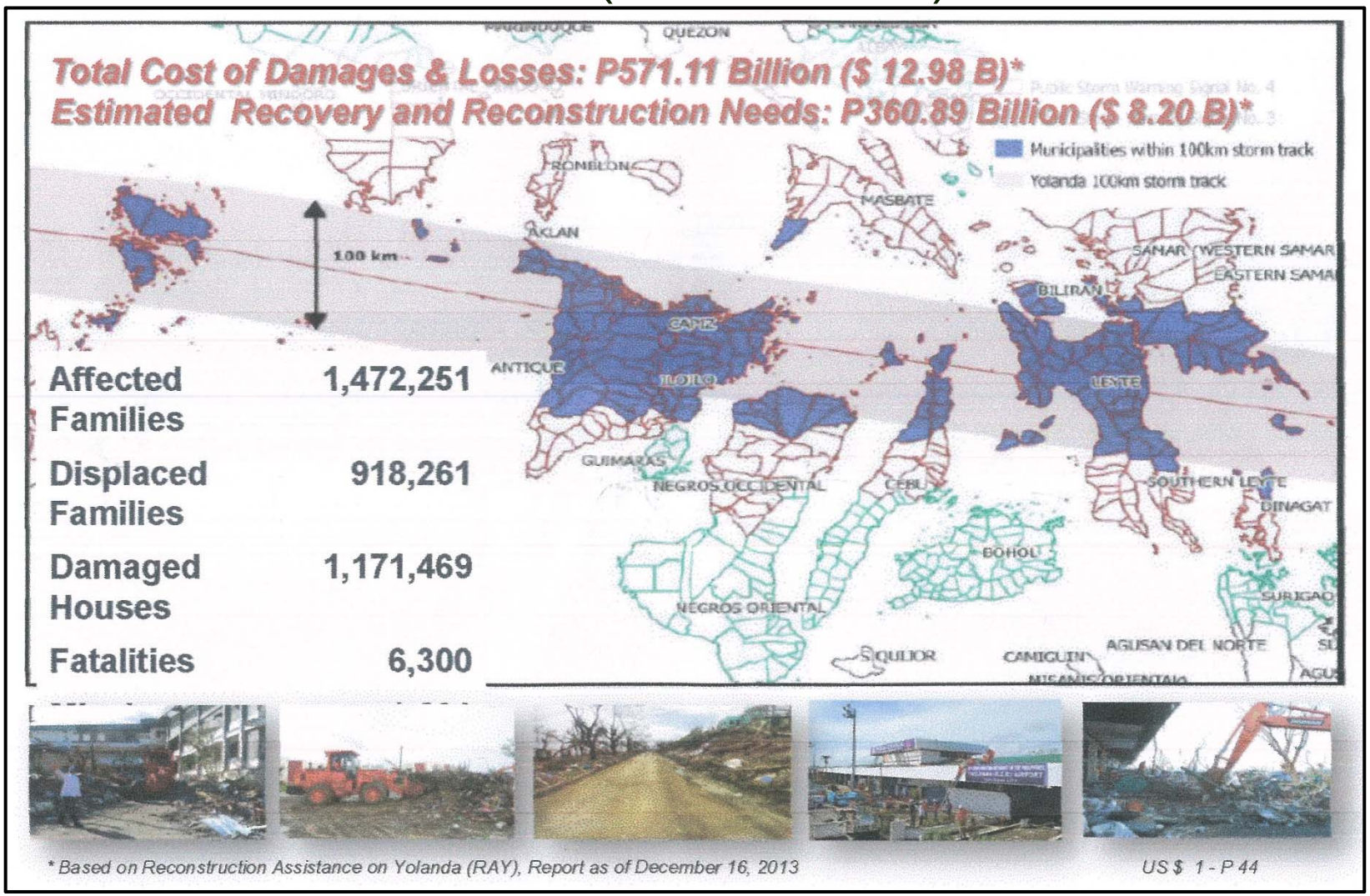
Malbasag River, downstream site
マルバサッグ川、下流

Malbasag River, upstream site
マルバサッグ川、上流

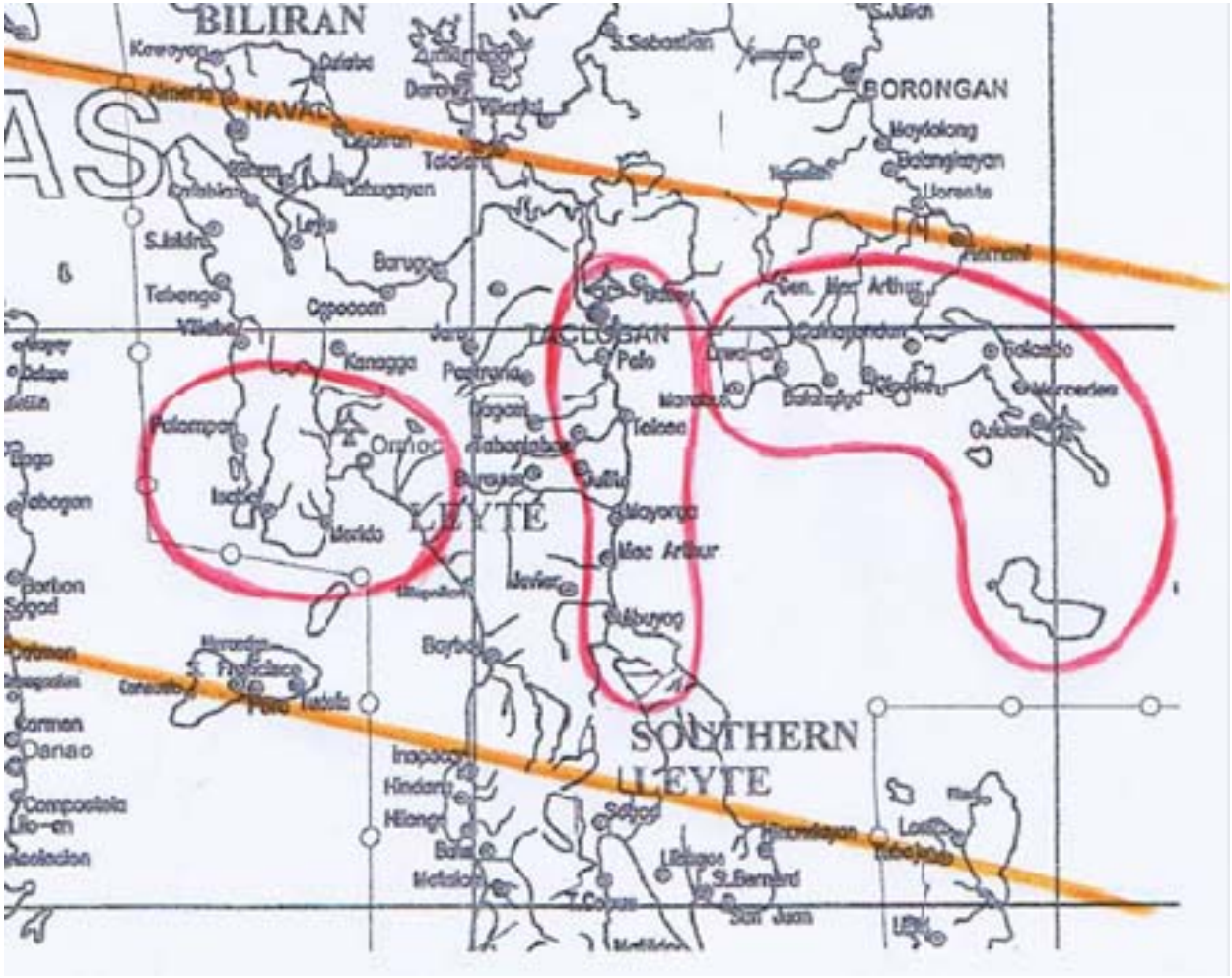
Land Development (1-Hectare Spoil Bank)

TEST AGAIN

TYPHOON HAIYAT (YOLANDA) 2013-11-08



TEST AGAIN



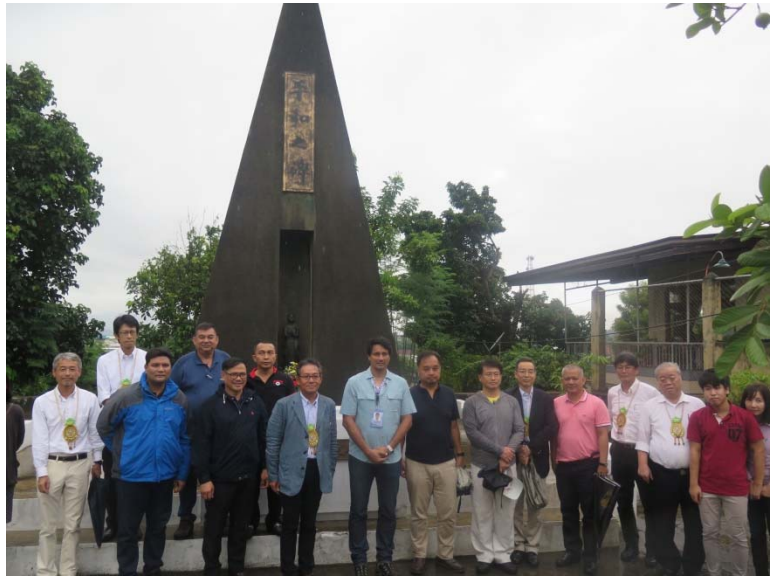

BRGY. DISTRICT 14
MULTI - PURPOSE HALL

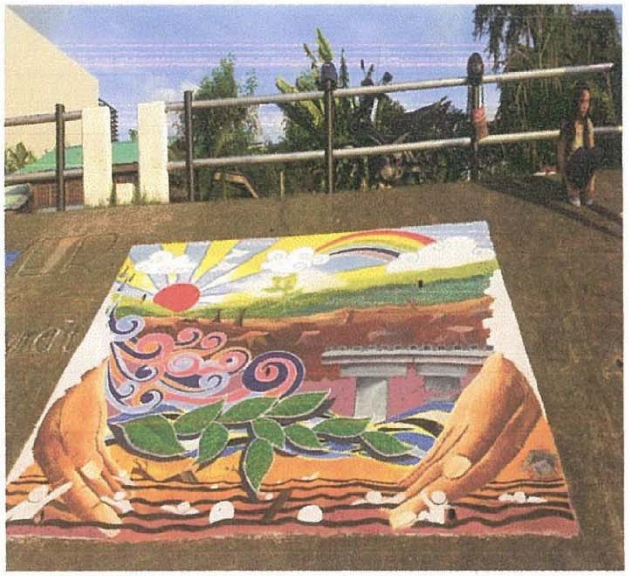

HOPE

Ormoc 2016 Aug (after 15 years)

Remembrance of 25th the Ormoc Tragedy

Opening Museum for Flood Risk Management



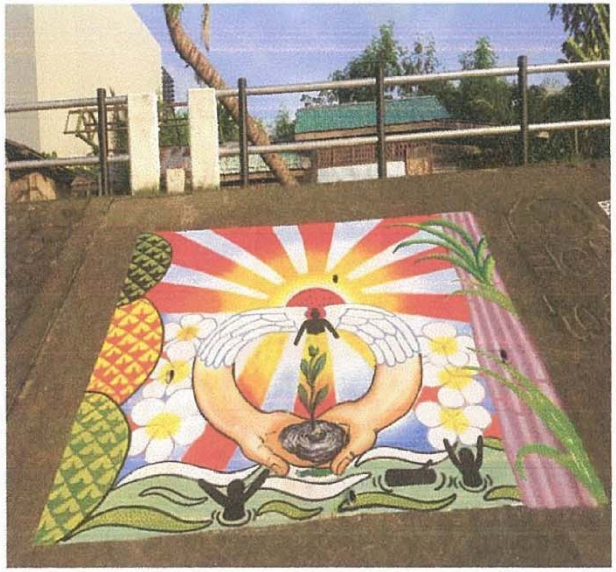


Entry No. 1 " Helping Hands "

Artists : Noe R. Gabisay, Ma. Teresa M. Ablen

Entry No. 2 " The Survivors"

Artists: Hareol N. Tero, Ma. Patria D. Quilantang



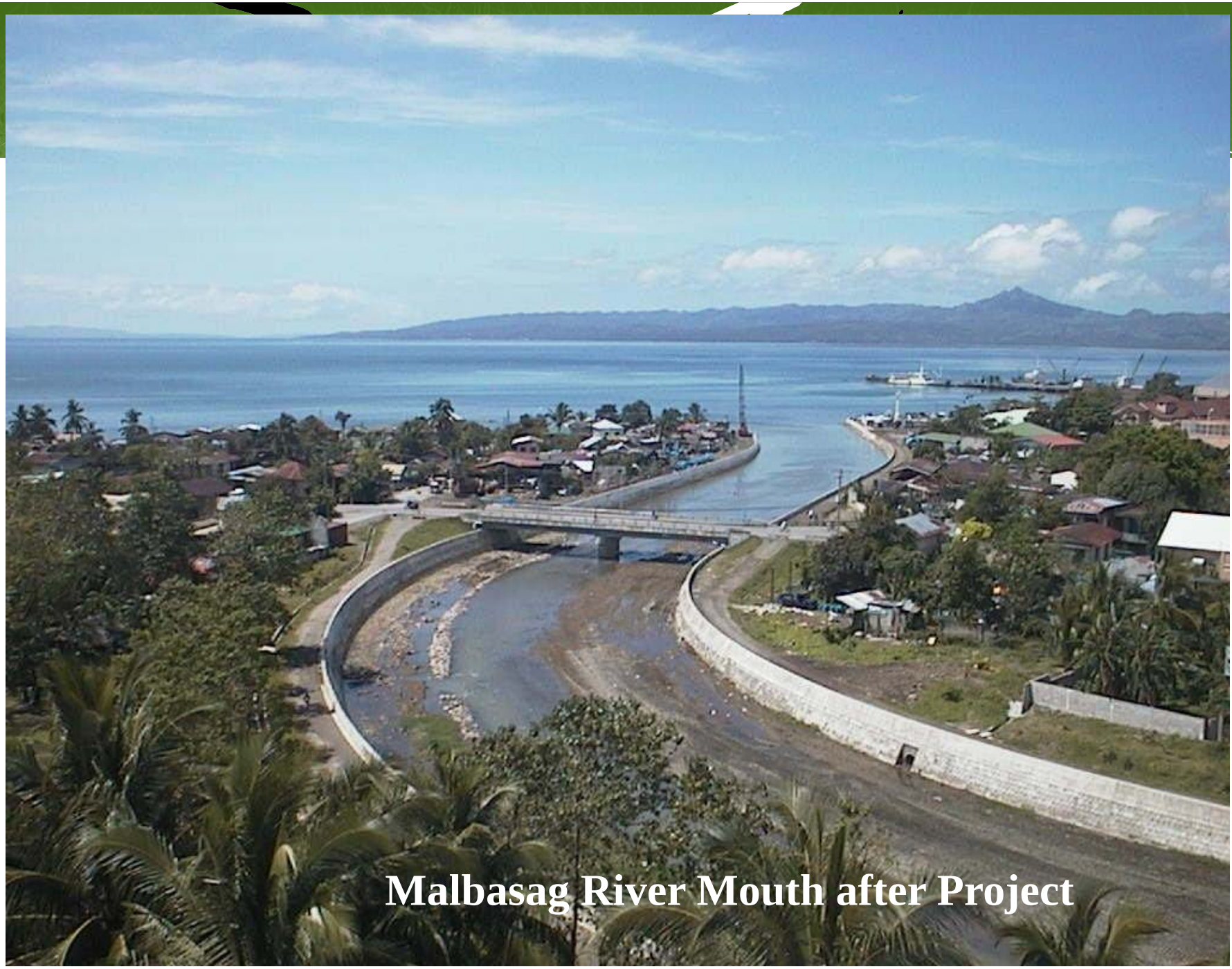
Entry No. 3: " The Growing City "

Artists: Rollie D. Zamora, Raquel Rebecca M. Bragas

Entry No. 4 : T " he Resilient Ormocanons"

Artists : Jesse Bonnie Bazalo, Jella E. Labor


PEOPLE MUST LEARN AND INSTILL ON THEIR MINDS THAT WE MUST LOVE THE RIVERS IN HARMONY WITH THE ENVIRONMENT AS WE LOVE OURSELVES
IRWIN L. ANTONIO
Ormoc City,Philippines



Malbasag River Mouth after Project