



Department of Public Works and Highways Flood Control Management Cluster

GO GROUP ON
EARTH OBSERVATIONS

Global Centre of Excellence for
Water Hazard and Risk Management

ICHARM

International Centre for Water Hazard and Risk
Management under the auspices of UNESCO

Flood Mitigation in Philippines



PATRICK B. GATAN
Project Director

Outline of Presentation

1. Flooding Scenario in the Philippines

- ▶ Why is Metro Manila and Surrounding Areas Perennially Flooded?
- ▶ 2009 Typhoon Ondoy Metro Manila Flooding

2. Policy Direction / Framework

- ▶ World Bank Proposed Projects
- ▶ Mangahan Floodway
- ▶ Paranaque Spillway
- ▶ Laguna Lakeshore Ringdike Project
- ▶ Marikina Dam

3. Actions / Challengers to Mitigate Flooding

- ▶ Completed and On-going Initiatives

The Philippines

Water-Related Disaster Data

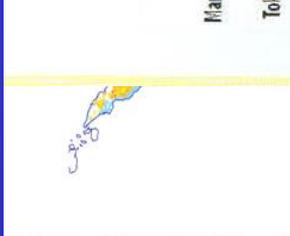
- 7, 107 islands
- Land Area : 298,170 km²
- Population : 105 Million
- Annual rainfall : 2,400 mm
- 92.5% of disasters caused by typhoons
- Ranked 1st in the world: vulnerability to typhoons
- Ranked 3rd in 2012 World Risk Index Report



the Philippines



ta in Key Cities
-Year Average)



Flood Risk Index

Philippine Flood Risk Index Basic Concept

Philippine Flood Risk Index (PFRI_c)

$$PFRI_c = \frac{\text{Hazard} \times \text{Exposure} \times \text{Basic Vulnerability}}{\text{Capacity (Soft Countermeasures + Hard Countermeasures)}}$$

[Five (5) Sub-Indices]

1. Hazard Index (H)
2. Exposure Index (E)
3. Basic Vulnerability (V)
4. Capacity (Soft Countermeasures) (CS)
5. Capacity (Hard Countermeasures) (CH)

PHILIPPINES



River Basins in the Philippines

- 18 Major River Basins
- Catchment Area > 1,400 km²

- 421 Principal River Basins
- Catchment Area > 40 km²
- With intense rainfall:
 - ✓ overflowing of waterways
 - ✓ inundation and deposition of sediment in flood plains
 - ✓ extensive flood damages often result.

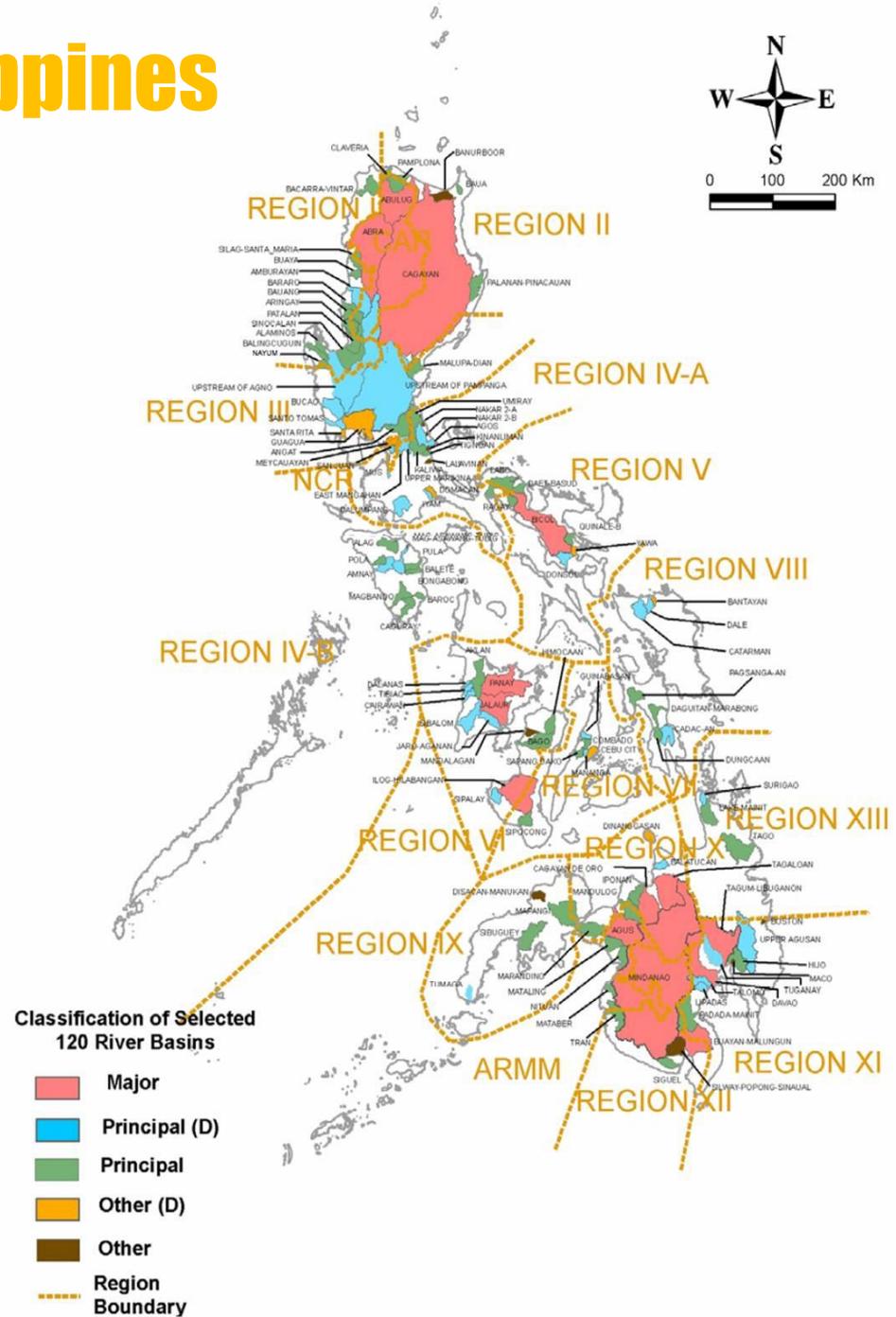


Table Recorded Annual Flood Damages in the Philippines

Year	Population Affected		Causalities			House Damaged		Damage Value* (\$ million)
	Families	Persons	Dead	Missing	Injured	Totally	Partially	
						1,101		30.66
						9,251		26.52
1982	266,476	1,569,017	337	223	347	84,027	97,485	36.54
			126	168	28	29,892	85,072	10.90
			1,979	4,426	732	310,646	313,391	8.67
1985	318,106	1,643,142	211	300	17	8,204	211,151	0.6
			171	43	155	3,162	14,595	38.29
			1,020	213	1,455	180,550	344,416	182.56
1988	1,173,994	6,081,572	429	195	468	134,344	585,732	180.73
			382	89	1,088	56,473	184,584	93.63
			676	262	1,392	223,535	636,742	244.02
1991	150,804	750,335	5,201	4,278	357	15,458	83,664	1.54

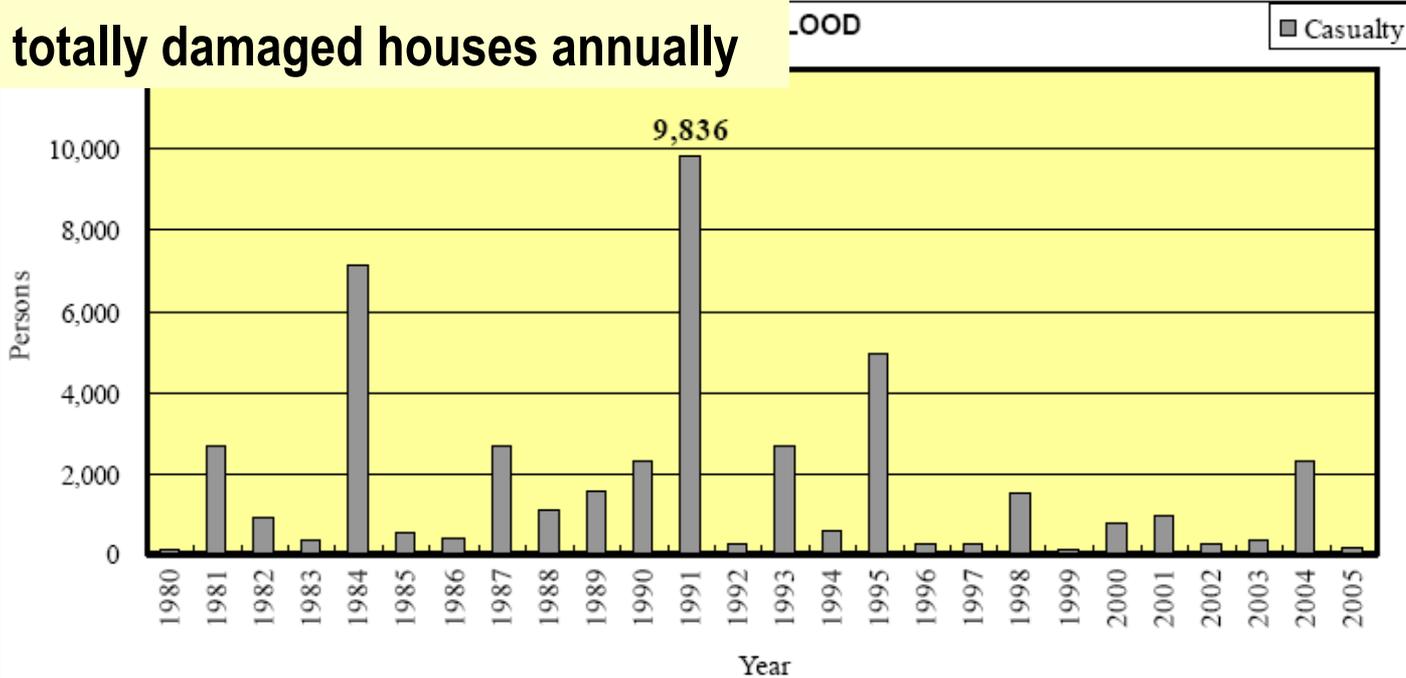
\$ 208 Million (CY 1970-2010 Damage to Economy Data)

\$ 168 Million lost annually

700 persons killed annually

2.8 M people affected annually

77,000 totally damaged houses annually



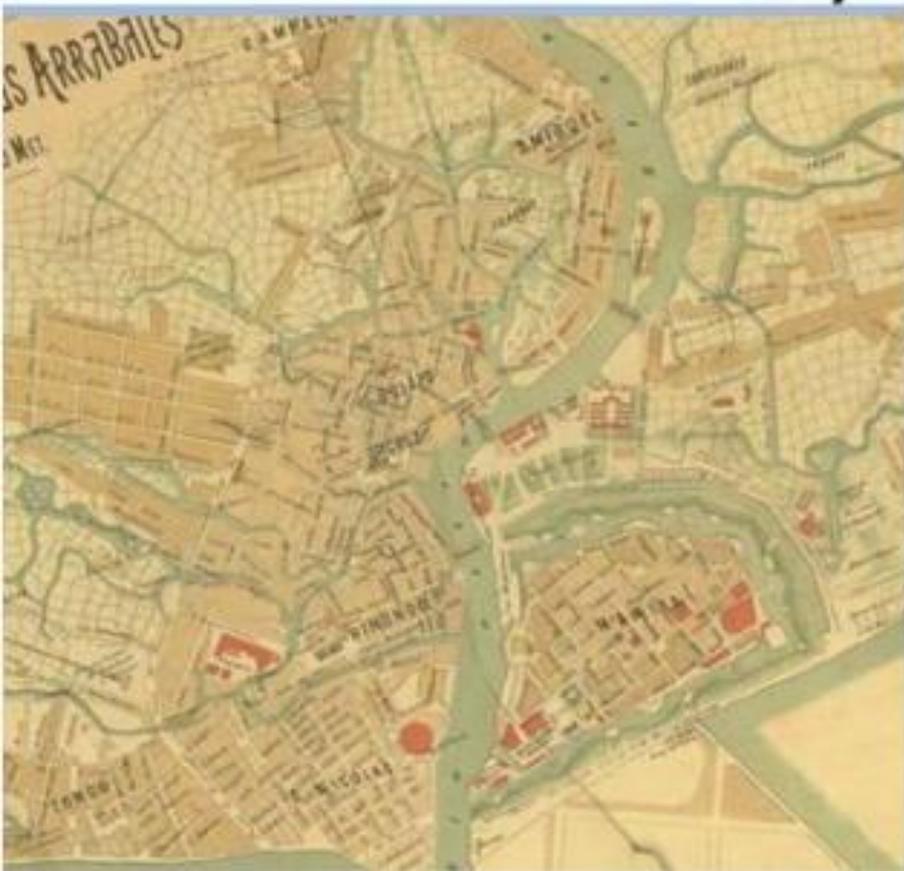
Recent Mega Flood Disasters

Philippine Destructive Typhoons in the last 10 years (2006-2016)

RANK	NAME OF TYPHOON	DATE	DEATHS	COST IN DAMAGE (\$)
1	Typhoon Haiyan	Nov. 6-8, 2013	7,041	\$1.98B
2	Typhoon Pablo	Dec. 2-12, 2012	1,900	\$930M
3	Typhoon Ketsana	Sept. 26-29, 2009	956	\$430M
4	Typhoon Washi	Dec. 16-18, 2011	1,257	\$35M
5	Typhoon Frank	June 18-22, 2008	557	\$296M
6	Typhoon Milenyo	Sept. 25-26, 2006	213	\$147M
7	Typhoon Reming	Nov. 30, 2006	1,479	\$26.66M
8	Typhoon Violeta / Winnie	Nov. 22-Dec. 3, 2004	1,232	\$178M
9	Typhoon Washi	Dec. 16-18, 2011	1,257	\$35M
10	Typhoon Koppu	Oct. 19, 2015	12	\$3.96M



WHY IS THE FLOOD PROBLEM IN MANILA SO HUGE?



LOOK BACK ON FLOOD CAUSE

- **Occurrence of extreme rainfall amount and intensity.**

(According to PAGASA the 24-hr rainfall of 455mm recorded from 8am Saturday to 8am Sunday at the Science Garden in Quezon City is equivalent to a return period of more than 100 years.)

- **Existing river channels do not have the capacity to contain extreme discharge**

(Pasig River has a present flow capacity of $500\text{m}^3/\text{s}$, Marikina River with a $900\text{m}^3/\text{s}$, and in Cainta, Antipolo, Angono & Taytay with $22\text{m}^3/\text{s}$ each)

- **Existing Internal drainage systems in Metro Manila cannot contain the unusual runoff** (*JICA Study on the Drainage Improvement in the Core Area of Metropolitan Manila, March 2005*)

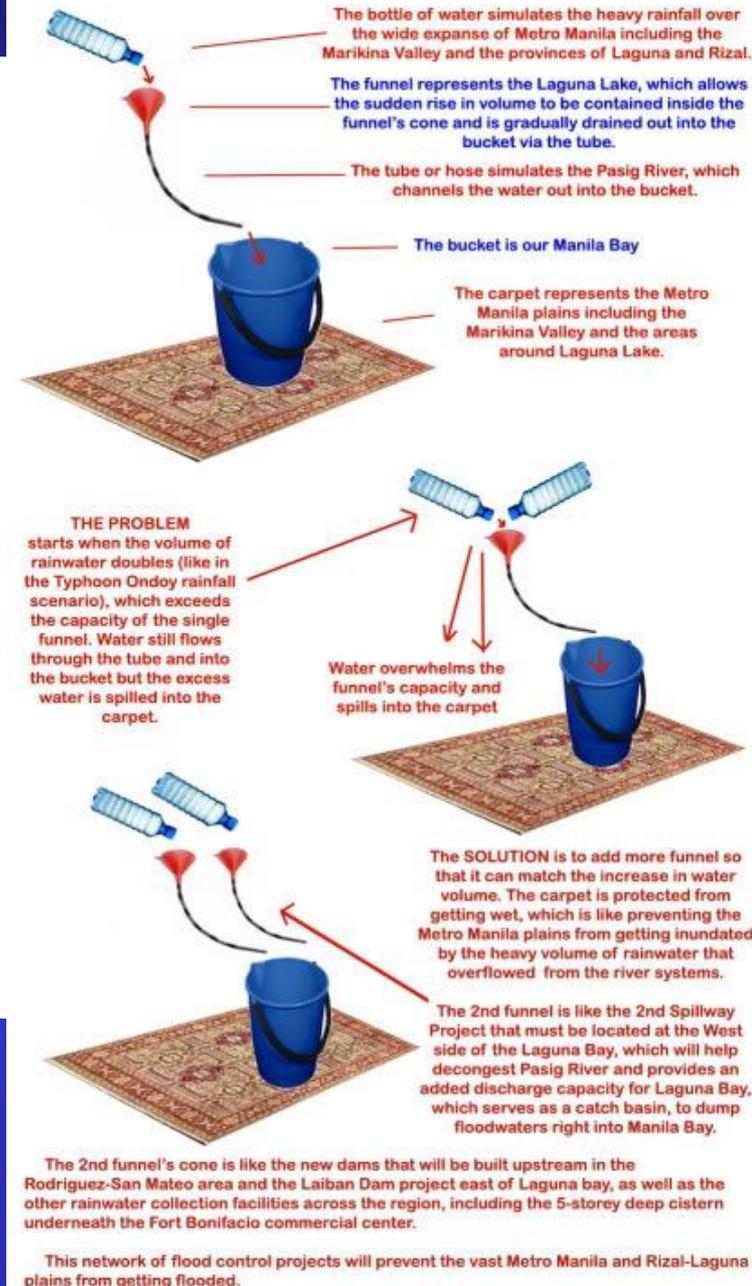
(Old drainage system constructed in 1975 already 70% silted; the runoff coefficient varies from 0.4-0.5. At present, due to rapid urbanization, the runoff coefficient was significantly increased.)

- **Existing internal drainage systems are clogged up by 70% due to indiscriminate throwing of garbage.**

Demonstration on Metro Manila Flooding Scenario

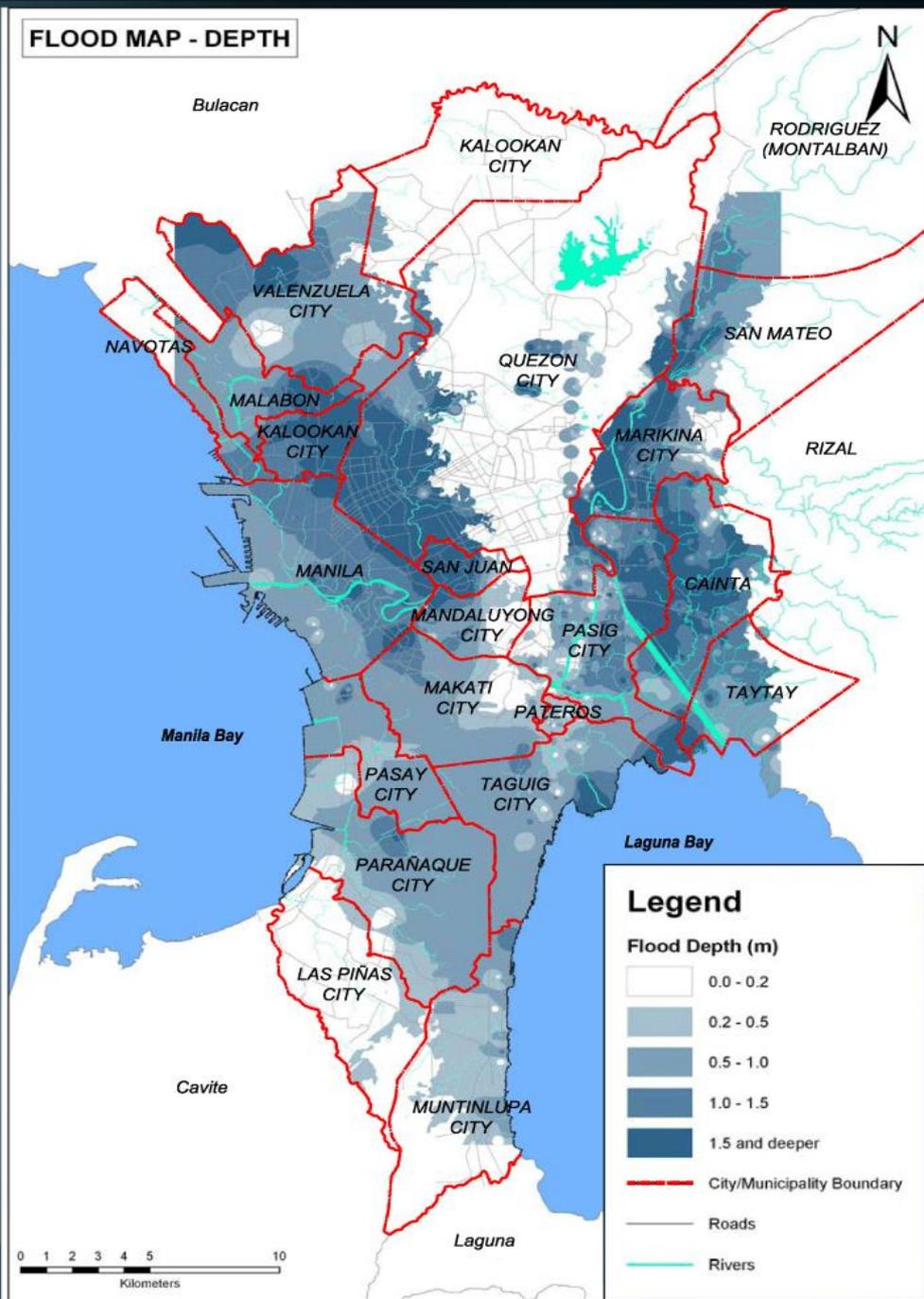
Simulation using a bucket, funnel, hose and a bottle of water

Flipzi's Cove <http://z6.invisionfree.com/flipzi>



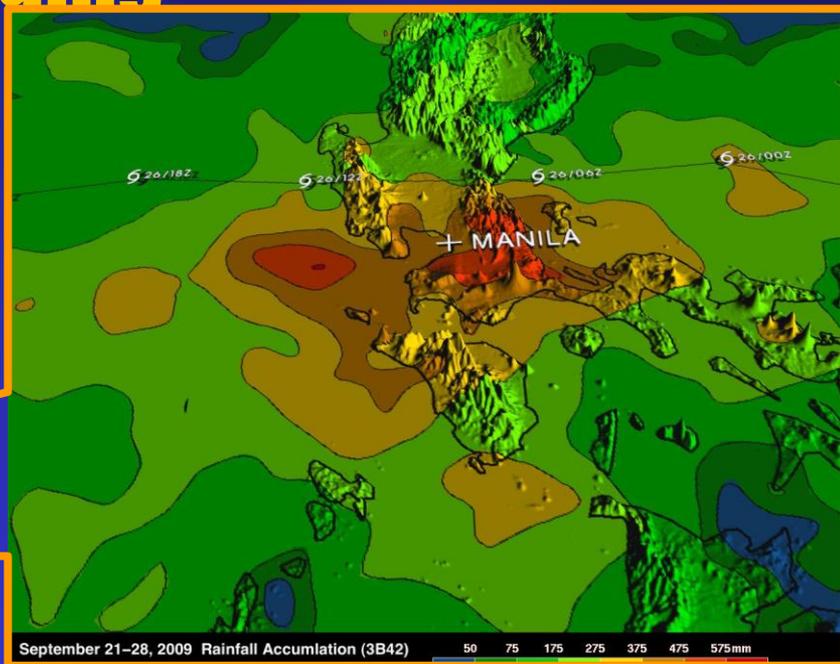
**FLOOD CONDITIONS IN METRO
MANILA DURING TYPHOON KETSANA
IN 2009**

Flood Condition by Ondoy in Pasig Marikina River Area



2009 Metro Manila Flooding

Typhoon Ketsana (26 Sept 2009)



- Tropical Rainfall Measuring Mission (TRMM) / NASA – Multi Satellite Precipitation Analysis (MPA) showed Typhoon ‘Ketsana’ poured **575mm** of rainfall (**6hr Rainfall**)
- Monthly ave. (November) rainfall in manila was poured over in 1 day.



2009 Metro Manila Flooding

Typhoon Ketsana (26 Sept 2009)

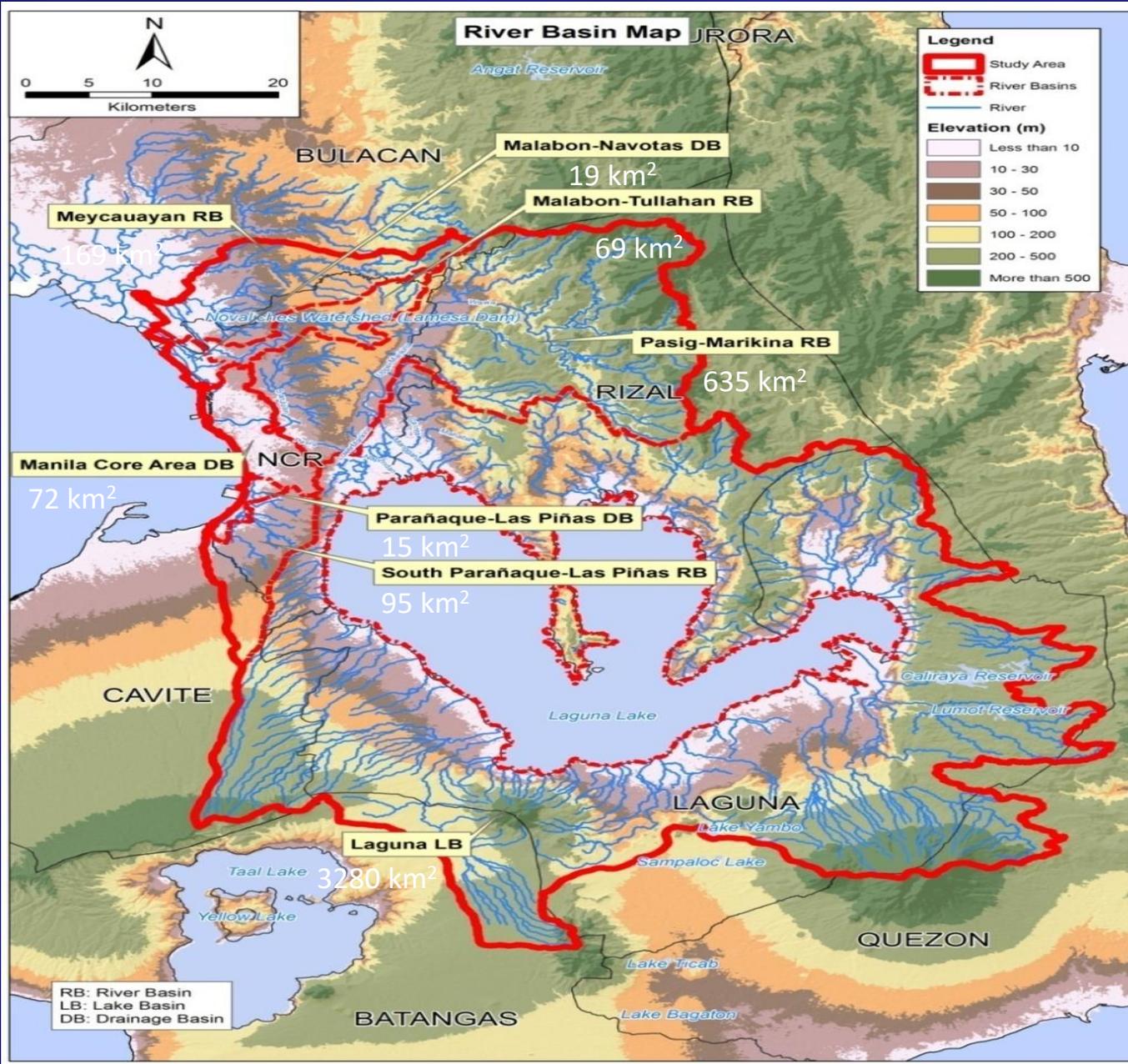


- Affected
- Casualty
- Damage

9.3 million
1,000 people dead
2.7% of GDP

**MASTER PLAN FOR FLOOD
MANAGEMENT IN METRO MANILA AND
SURROUNDING AREAS**

Master Plan for Flood Management in Metro Manila and Surrounding Areas



Based on river basins:
 Pasig-Marikina River Basin and Laguna Lake Basin.

Total area: 4,354 km²

Total Population: 17.1 M

Boundary of Study Area and the River Basins



VOM Flood Control Project

KAMANAVA Flood Control Project

Contract Package 10.1 - River Improvement Works along Upper Marikina River (Left Bank) Marikina Side

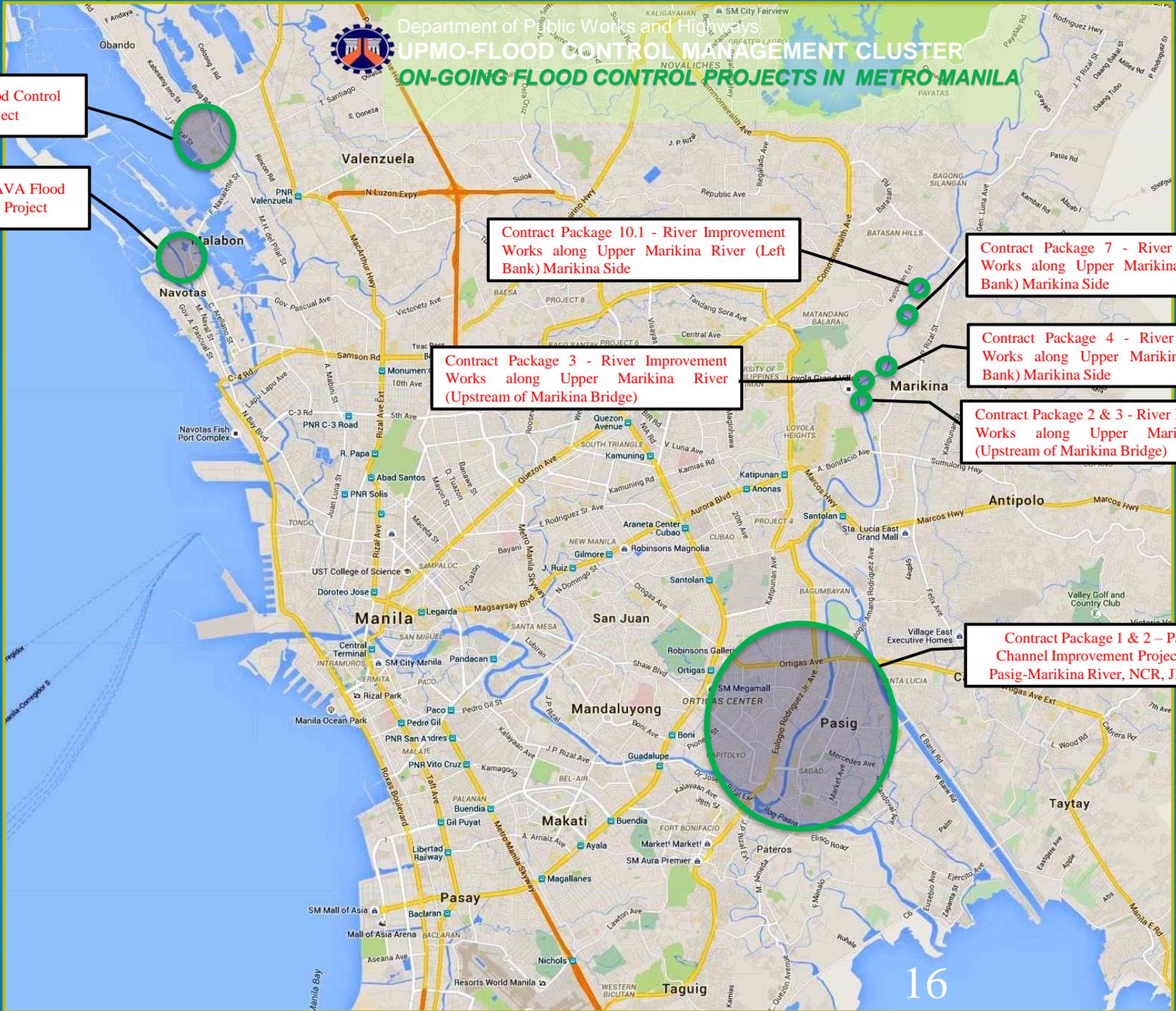
Contract Package 7 - River Improvement Works along Upper Marikina River (Left Bank) Marikina Side

Contract Package 3 - River Improvement Works along Upper Marikina River (Upstream of Marikina Bridge)

Contract Package 4 - River Improvement Works along Upper Marikina River,(Left Bank) Marikina Side

Contract Package 2 & 3 - River Improvement Works along Upper Marikina River (Upstream of Marikina Bridge)

Contract Package 1 & 2 - Pasig River Channel Improvement Project, Phase III, Pasig-Marikina River, NCR, JICA PH-P25



Proposed Marikina Control Gate Structure



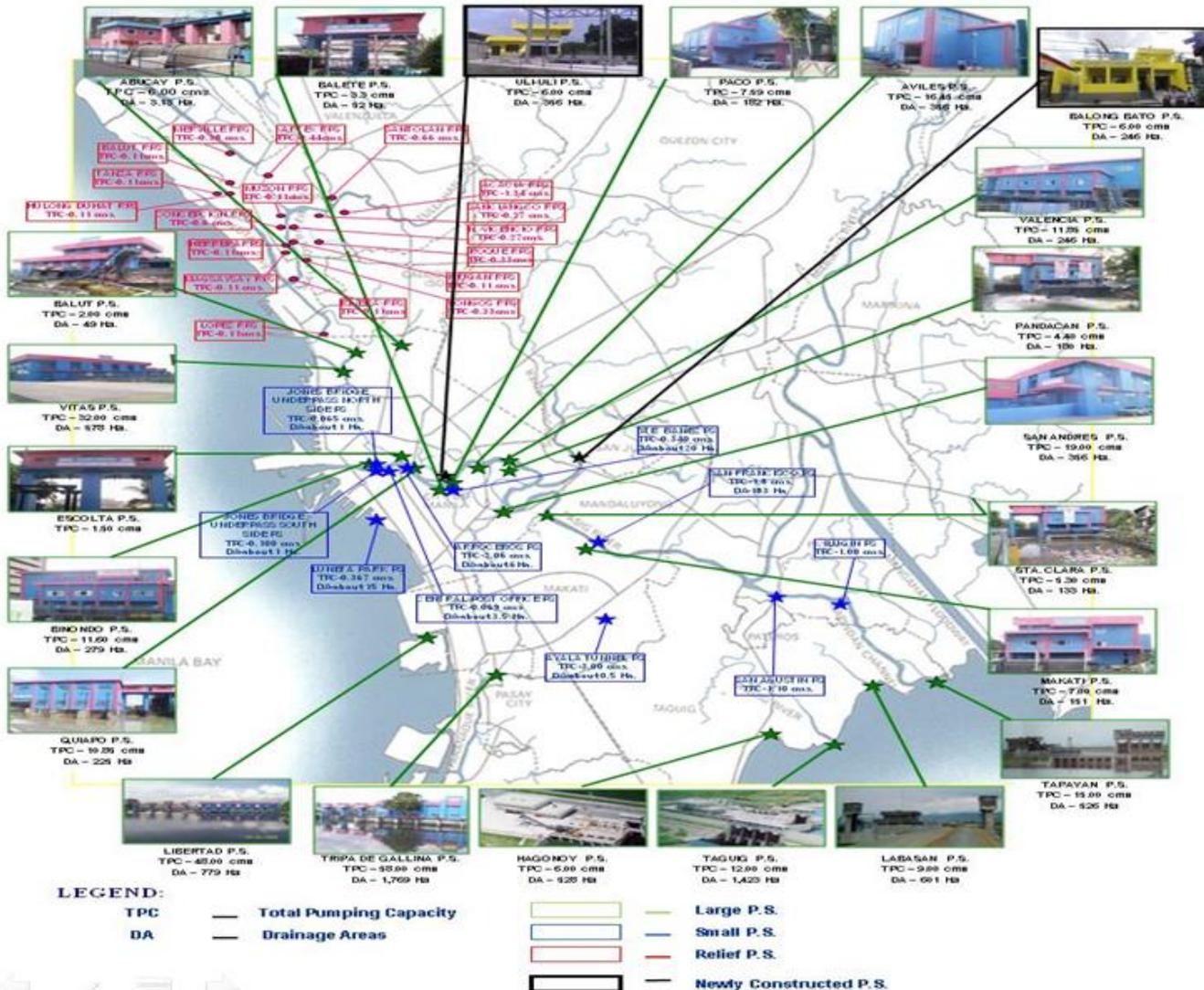
Pasig Marikina Channel Improvement Project



Department of Public Works and Highways

UPMO-FLOOD CONTROL MANAGEMENT CLUSTER

LOCATION MAP OF PUMPING STATIONS IN METRO MANILA



FUNCTIONS:

TO PUMP OUT WATER FROM ESTERO SIDES INTO RIVERS AND BAYS IN ORDER TO CREATE RETARDING RESERVOIR/ STORAGE AREA FOR LOCAL RUNOFF DURING HEAVY RAINFALL.

AREA SERVED: 5,385 hectares

CATEGORIES:

LARGE PS	22
SMALL PS	12
RELIEF PS	18
TOTAL	52

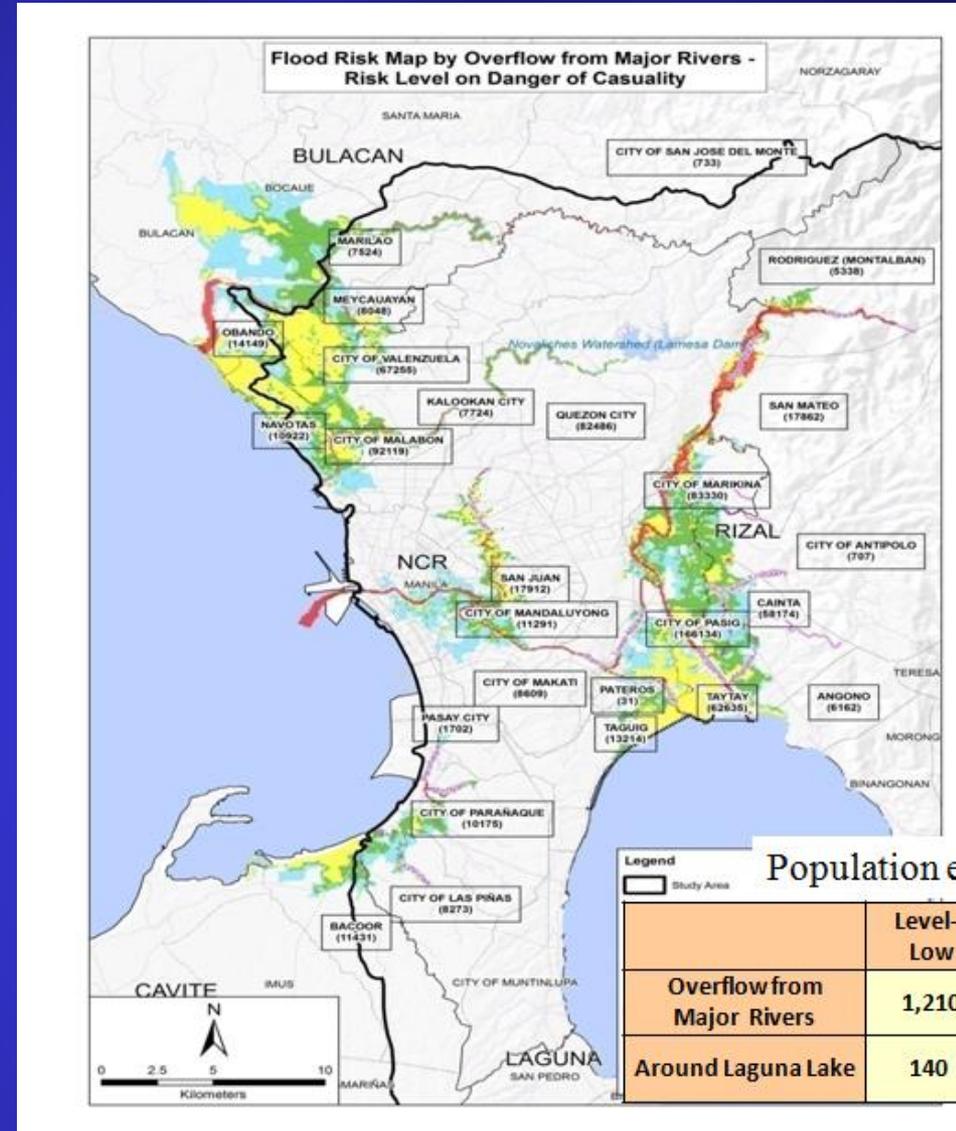


Policy Direction / Framework

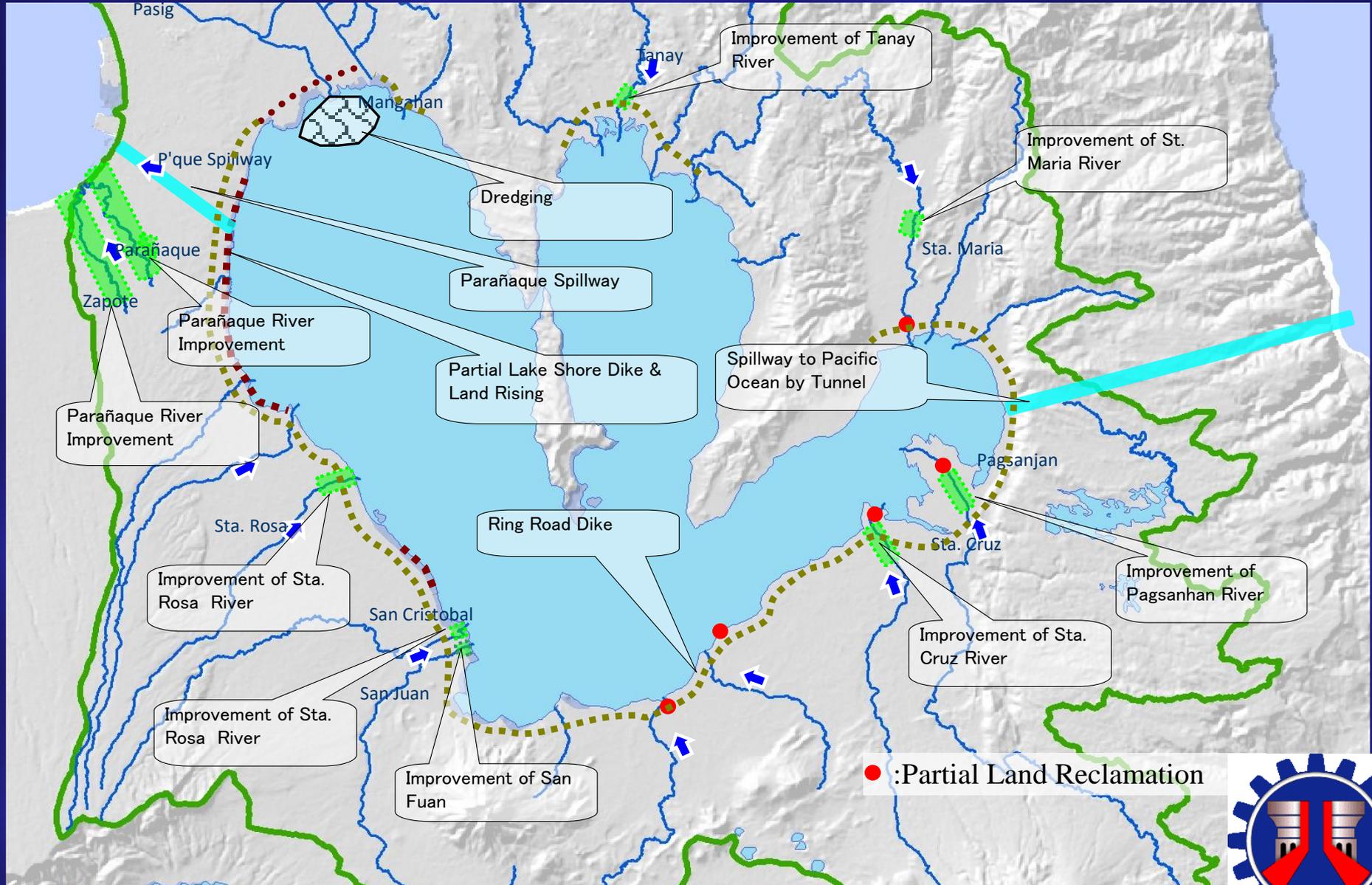
DPWH Efforts to Mitigate Flooding in Metro Manila

1. Flood Management Master Plan for Manila

- Prioritize the construction of flood structures in highly flood prone areas
- Bureau of Design Upgrades on Flood Control and Drainage Standards
 - a) Min. flood return periods of drainage pipes (15 yr flood); esteros/creeks (15 yr flood);
 - b) principal and major rivers (50 yr flood).



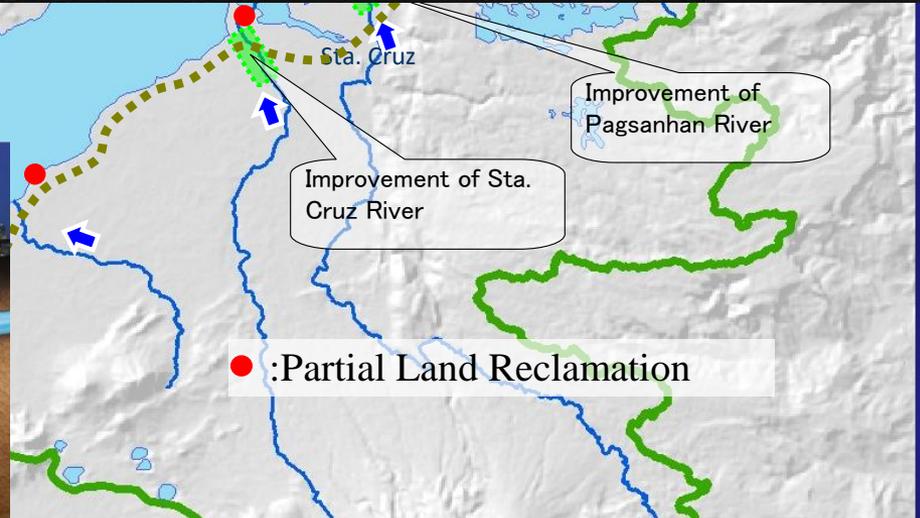
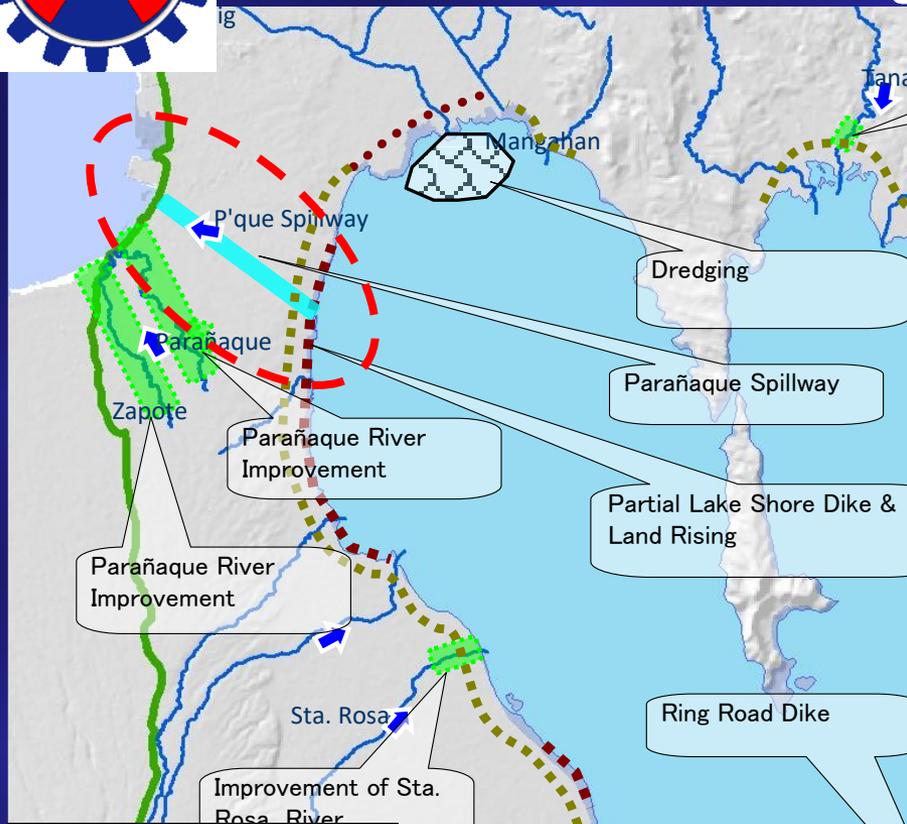
Laguna Lakeshore: Long Flood Control Projects





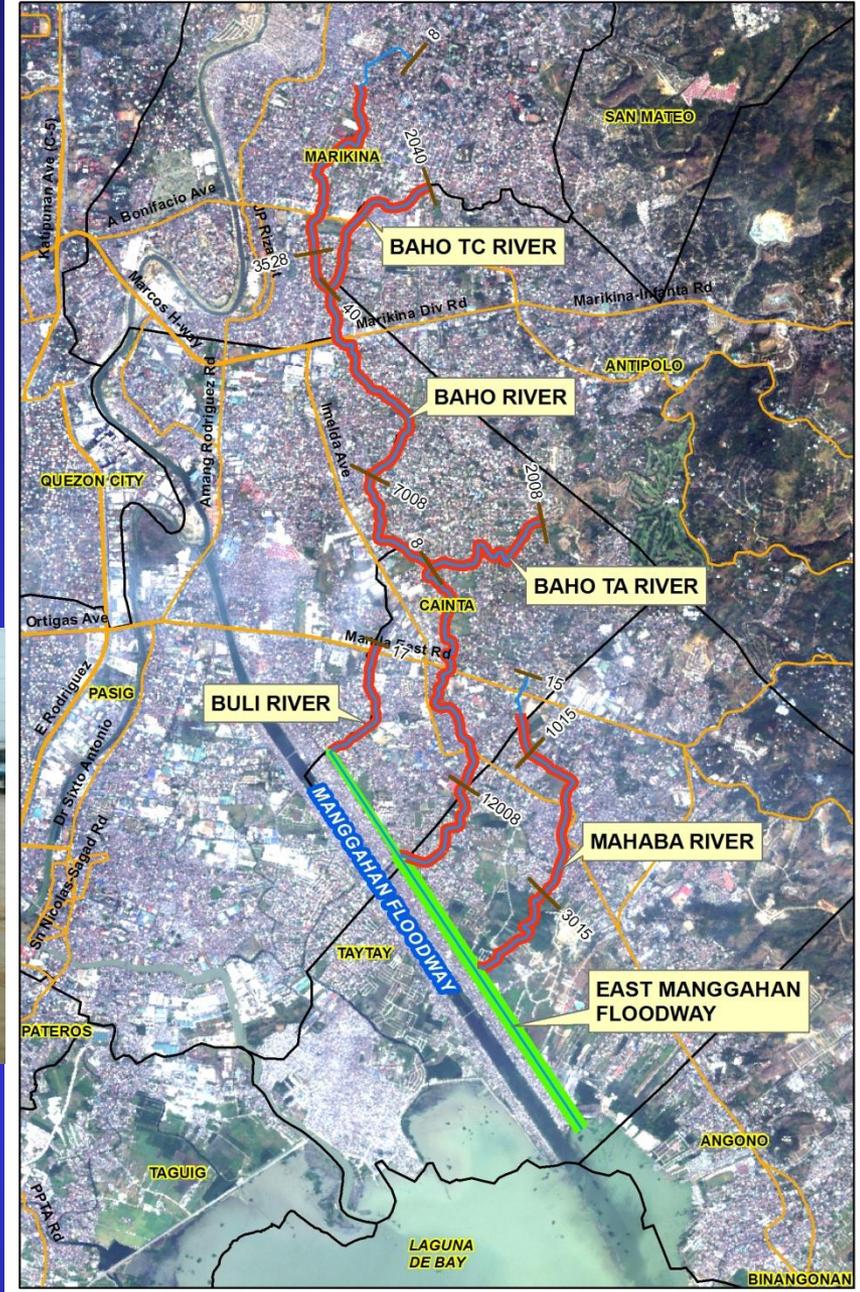
Paranaque Underground Tunnel

DPWH Efforts to Mitigate Flooding in Metro Manila



East Mangahan Floodway

Including Improvement of Inflow Rivers



LEGEND

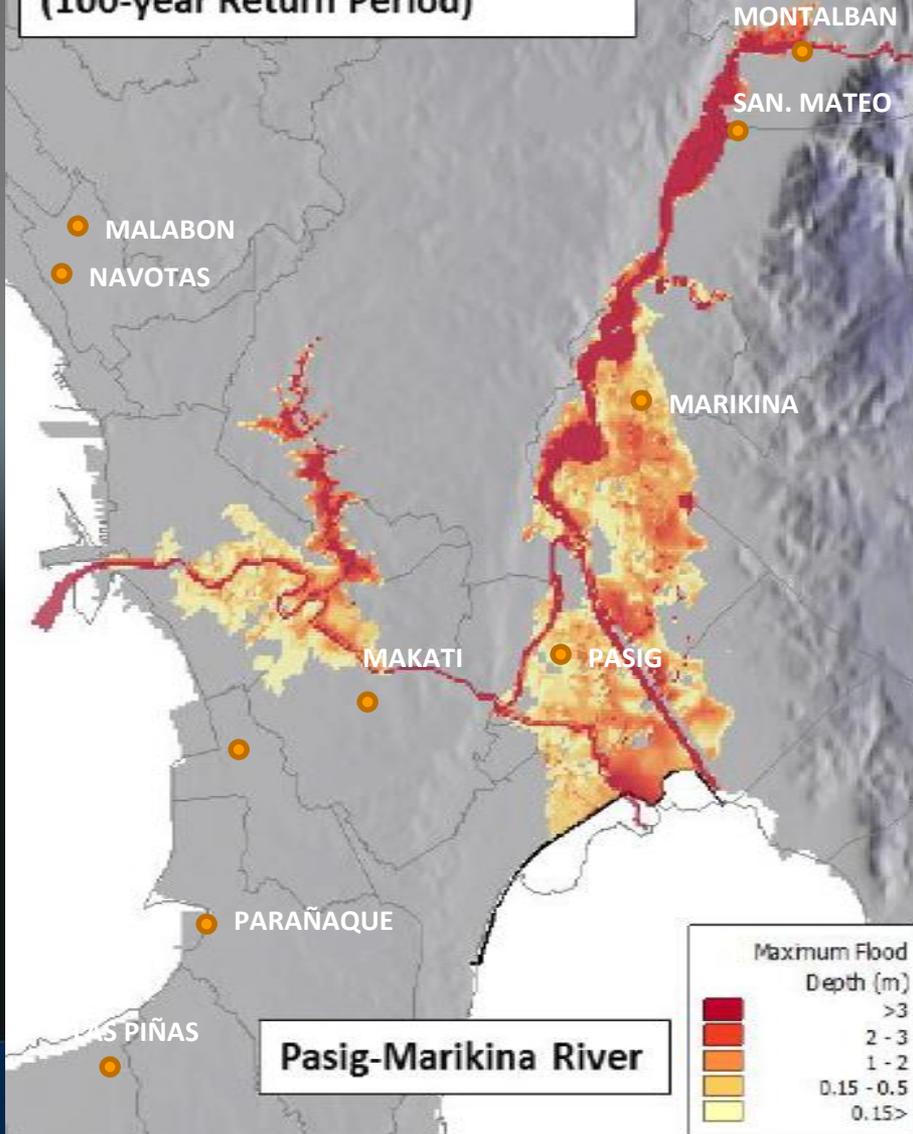
- MAJOR ROADS
- MUN/CITY BDY.
- CONCRETE DIKE
- EARTH DIKE

N

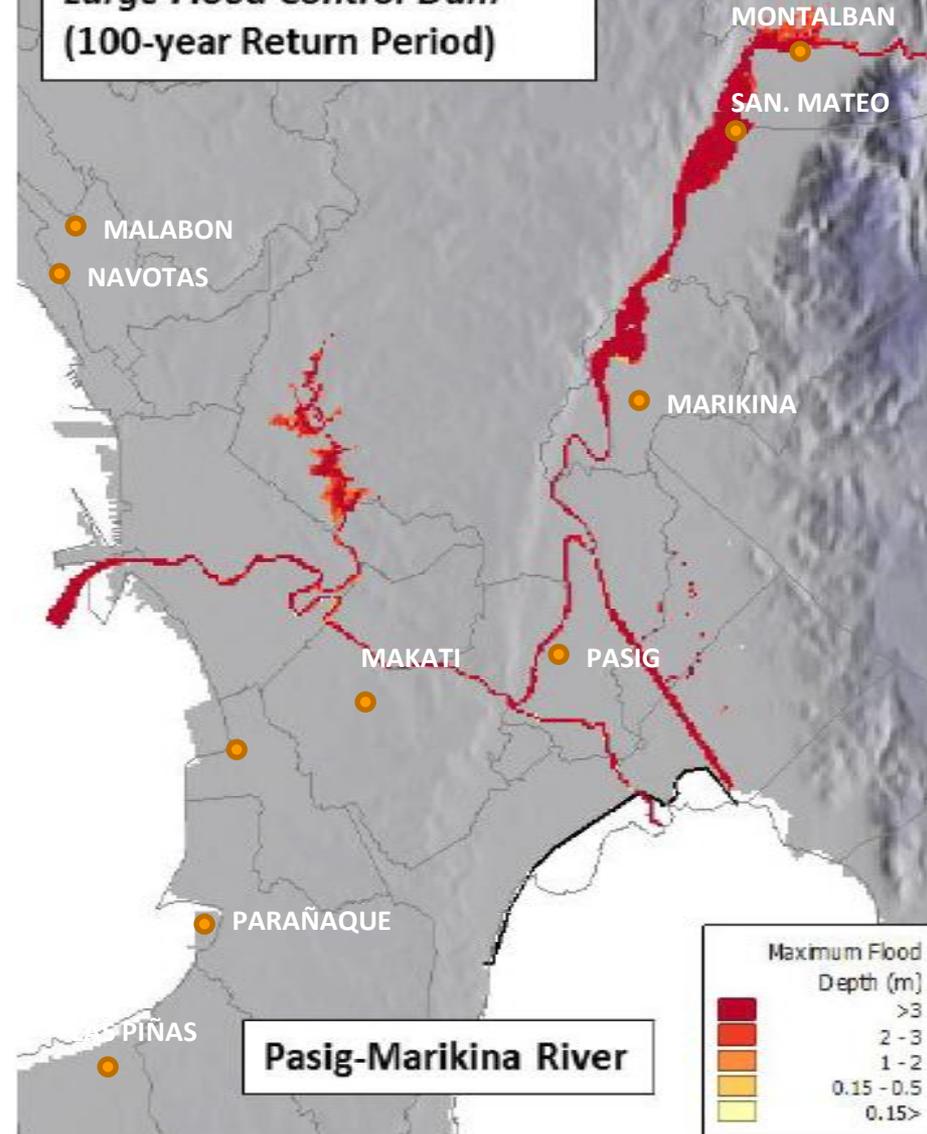
0 0.5 1 2 Kilometers

Comparison of Flood Condition in the Pasig-Marikina River Basin

Flood Condition without Project
Existing Condition
(100-year Return Period)



Flood Condition with Project
River Improvement and
Large Flood Control Dam
(100-year Return Period)

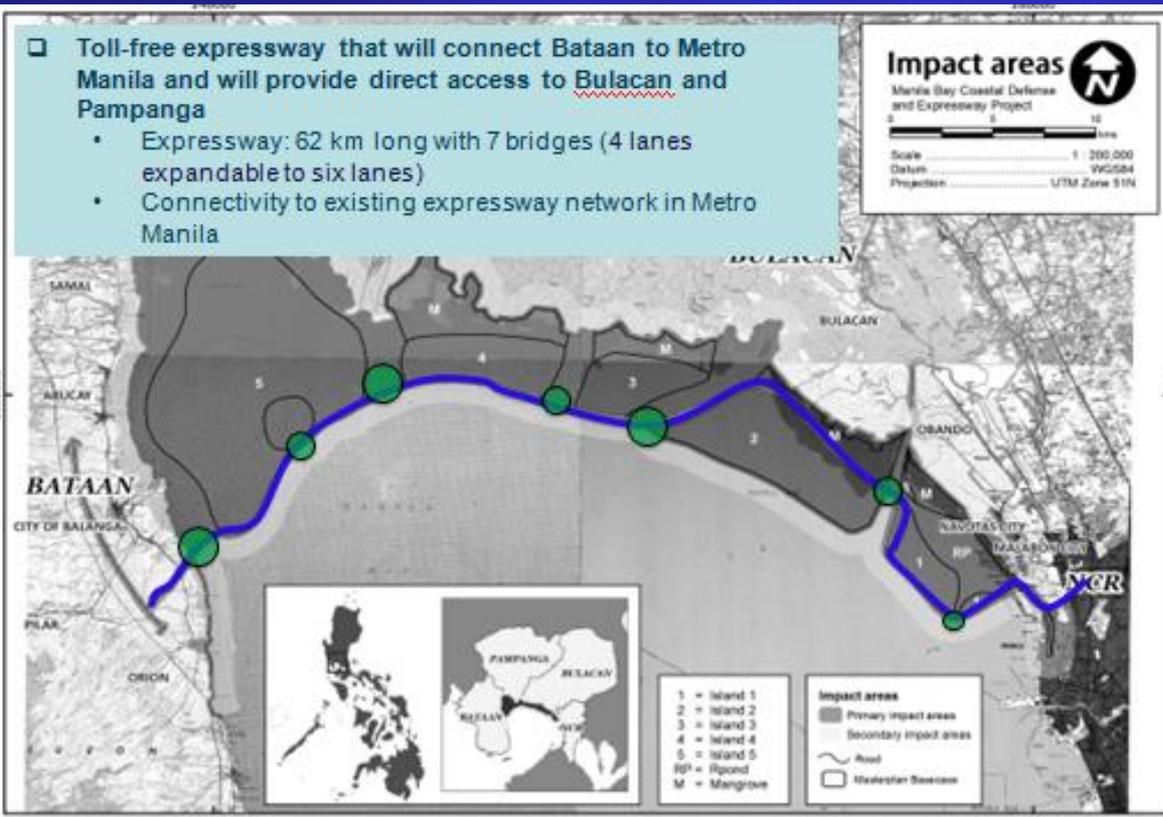


Policy Direction / Framework

DPWH Efforts to Mitigate Flooding in Metro Manila

4. Coastal Flood Defense and Sea Barrier

Metro Manila flood proofing thru flood gates and coastal sea barrier for protection against coastal flooding and storm surge

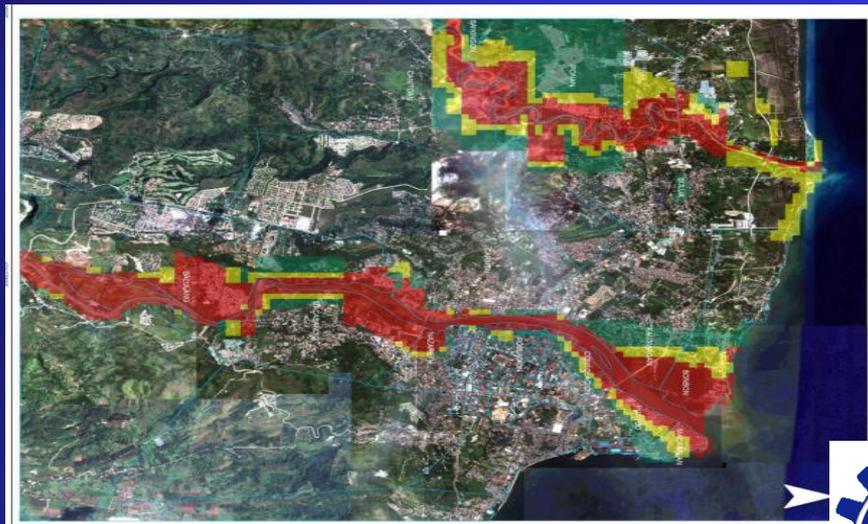


Issues and Challenges

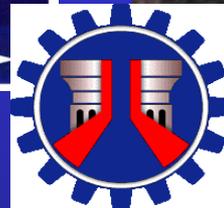
Efforts to Mitigate Flood Disasters

Pursuing Integrated Flood Management

Hazard Map – Development of flood inundation map, pre-and-post flood disaster, that shows flood prone areas, no built-zones (no habitation zones) that reflects the old-cadastral river boundary



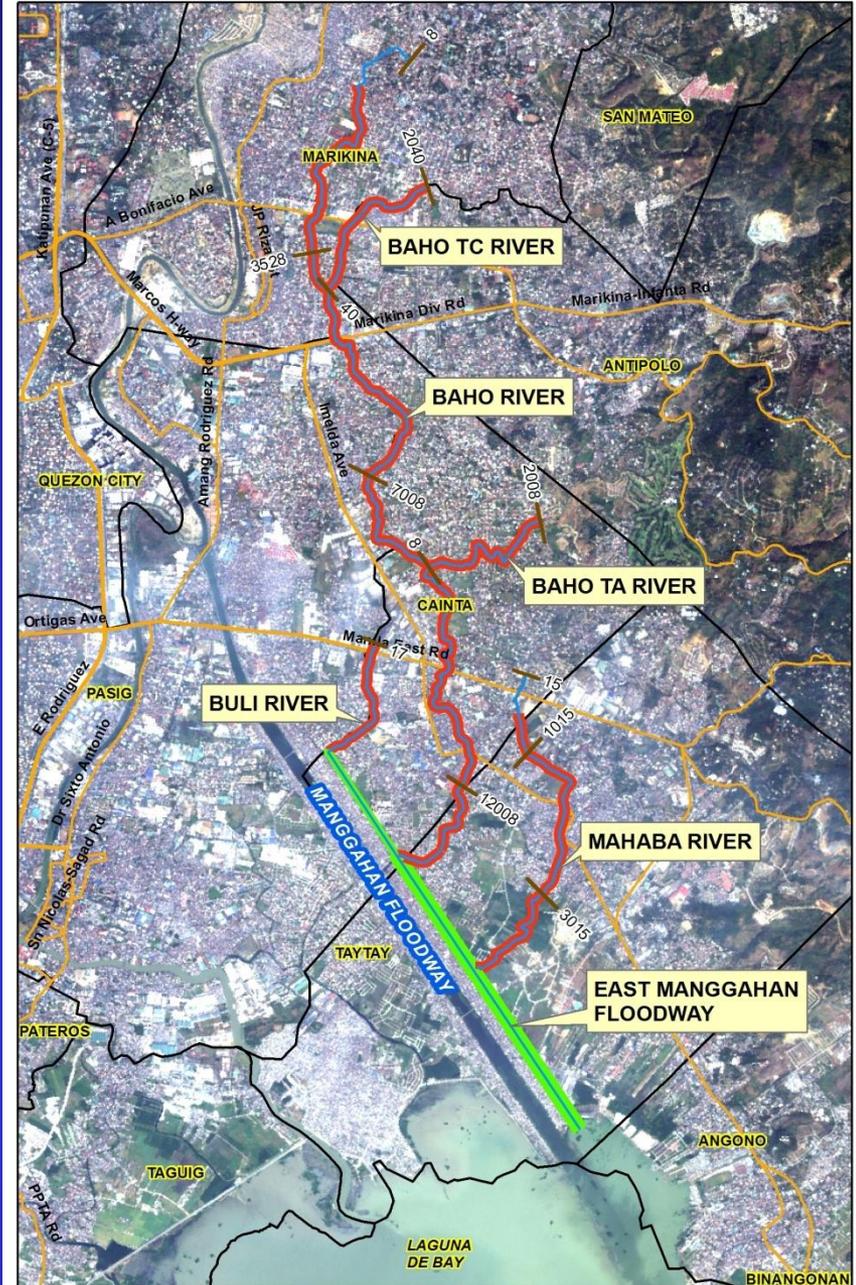
CDO Flood Hazard Map, Post-Sendong, 2012



Bottlenecking of CDO river at Ysalina Bridge

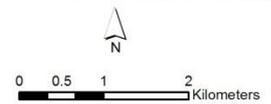
Issues and Challenges

Relocation of Informal Settler Families



LEGEND

- MAJOR ROADS
- MUN/CITY BDY.
- CONCRETE DIKE
- EARTH DIKE



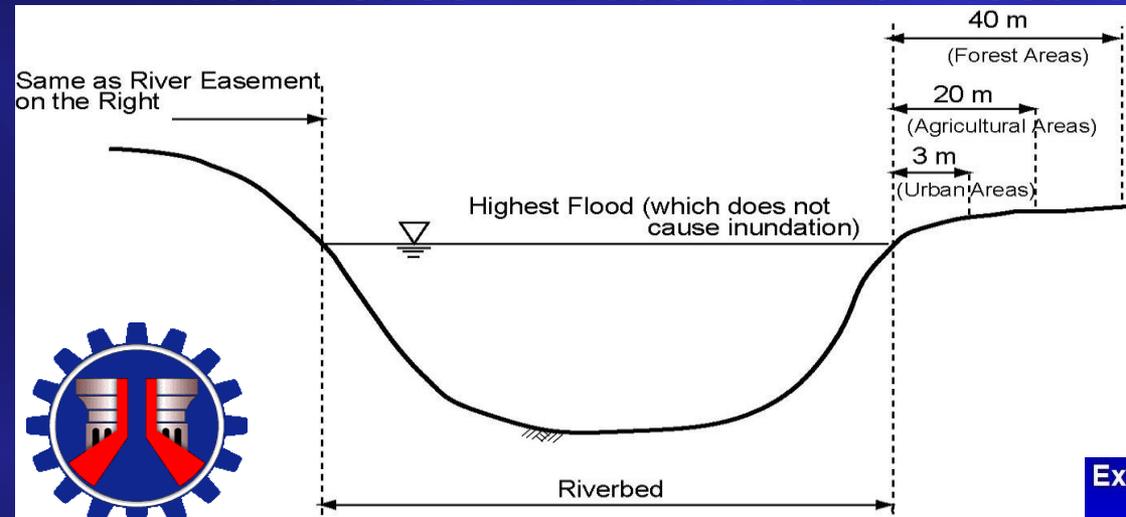
Issues and Challenges

Efforts to Mitigate Flood Disasters

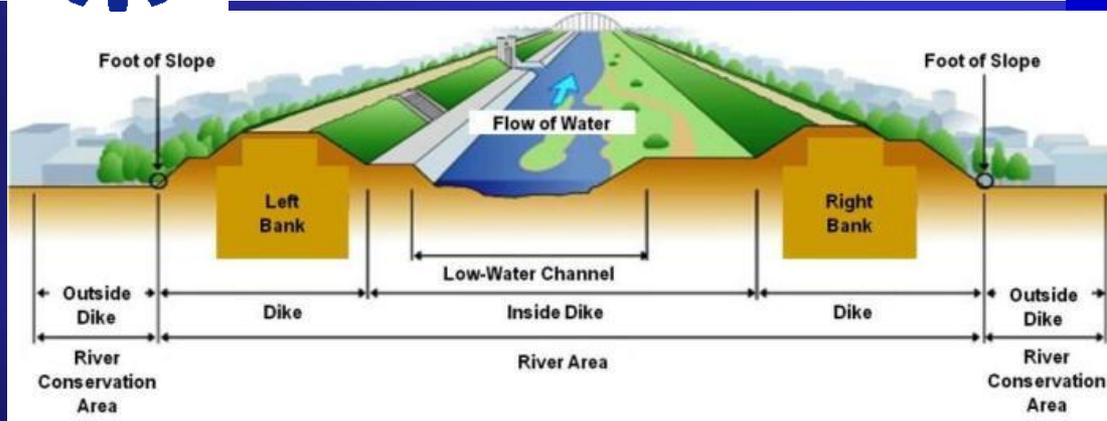
Enforcement of PD 1067 / RA10752

Article No. 51 - Designation of River Easements

Article No. 53 - Declaration of Flood Control Areas (No Build Zones)



Example of Options of River Boundary





Completed and On-going Initiatives

DPWH Efforts to Mitigate Flooding in Metro Manila

Completed and Ongoing Flood Control Projects



Pasig – Marikina River Improvement



Ormoc Flood Mitigation Project



Anilao Slit-Type Sabo Dam



Pinatubo Groundsills



Camiguin Sabo Dam



KAMANAVA Flood Control Project