

Implementation Planning Workshop on International Flood Initiative (IFI) in Asia-Pacific

10 January 2017

Tokyo International Exchange Center

Plaza Heisei, Tokyo, Japan

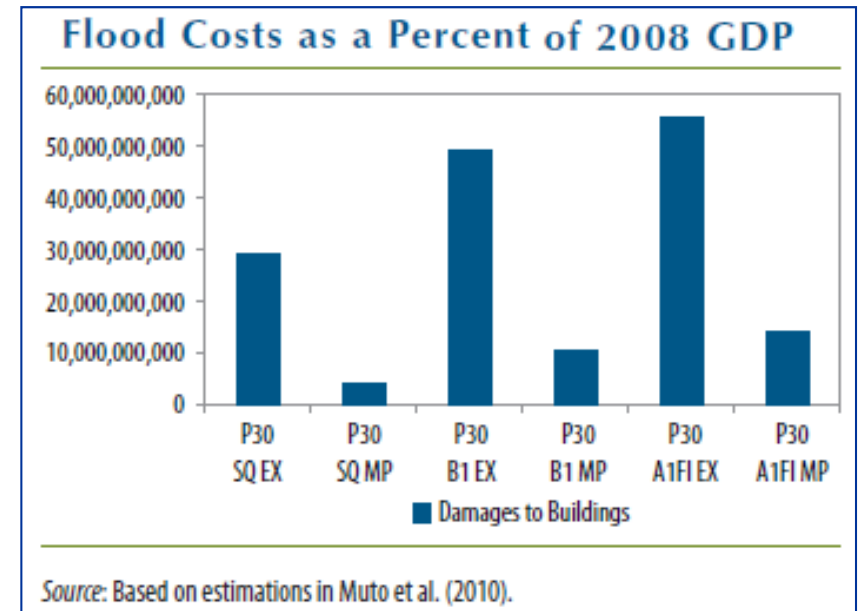
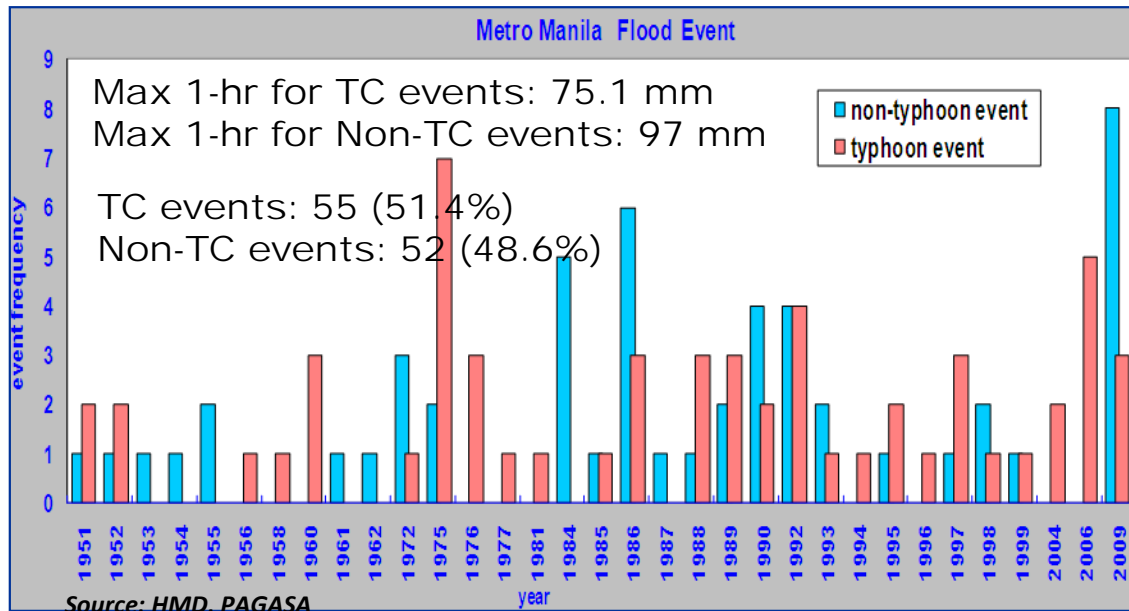
National Report - Philippines

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Deputy Administrator

PAGASA/DOST

Trends & Impacts of Flooding in Metro Manila



Damage Costs from 1-in-10, 1-in-30, and 1-in-100-year Floods in Different Scenarios (2008 PHP)

Flood Intensity	Without CC	With CC	Climate Change Damage Costs (2008 PHP) with an A1FI Scenario with EX
	SQ EX	A1FI-EX	
1/10	15,276,335,523	19,388,093,046	4,111,757,522.59
1/30	40,164,225,177	68,964,812,770	28,800,587,593.15
1/100	64,727,999,688	111,892,101,862	47,164,102,174.61

Source: Muto et al. (2010).

Metro Manila's regional GDP in 2008 was 468 billion PHP (National Statistical Coordination Board). Damage costs range from 3% of GDP (SQ-EX-10) to 24% (A1FI-EX-100).

Climate change costs represent 1% (1-in-10 flood), 6% (1-in-30 flood) & 10% (1-in-100 flood) of GDP.

Source: *Climate Risks and Adaptation in Asian Coastal Megacities: A Synthesis Report, 2010, ADB, JICA, WB*

⇒ **PAGASA: The nation's meteorological and hydrological service (NMHS)**



⇒ To provide weather, flood, climate and astronomical products & services to promote the people's safety and well-being, and contribute to national development



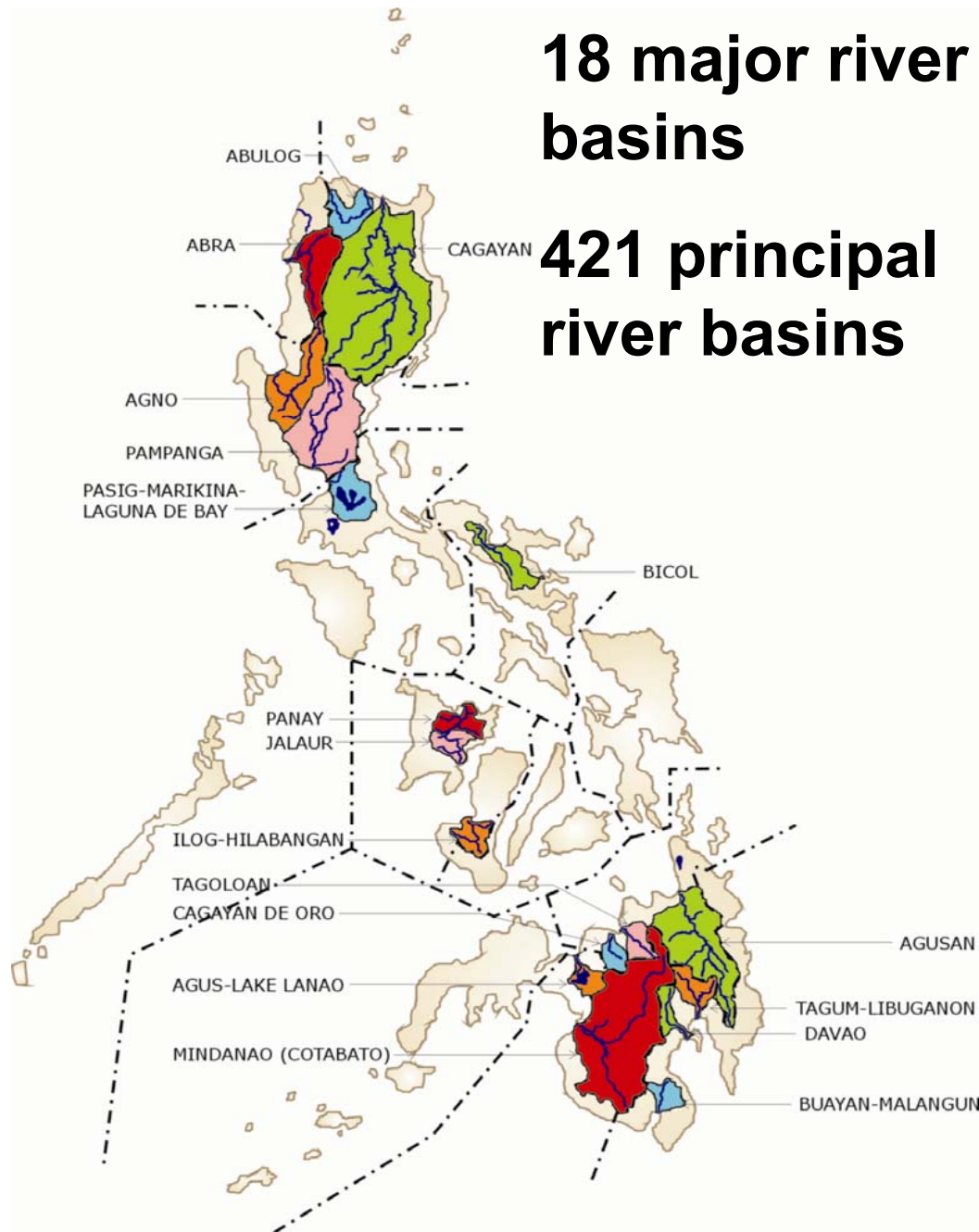
PAGASA – an attached agency of the Department of Science and Technology (DOST).



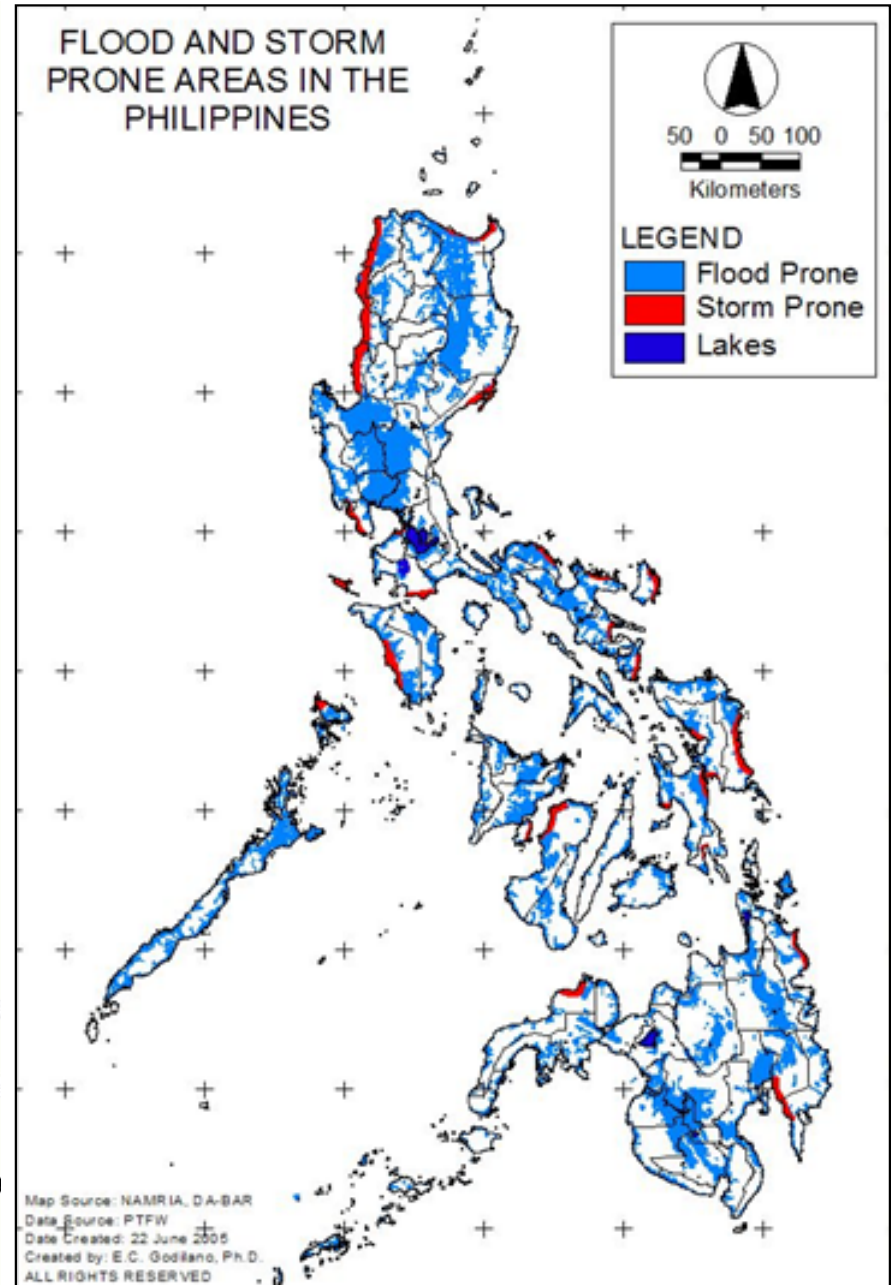
The Philippines, represented by PAGASA, is a Member of the World Meteorological Organization (WMO), a specialized body of the United Nations.

18 major river basins

421 principal river basins



FLOOD AND STORM PRONE AREAS IN THE PHILIPPINES



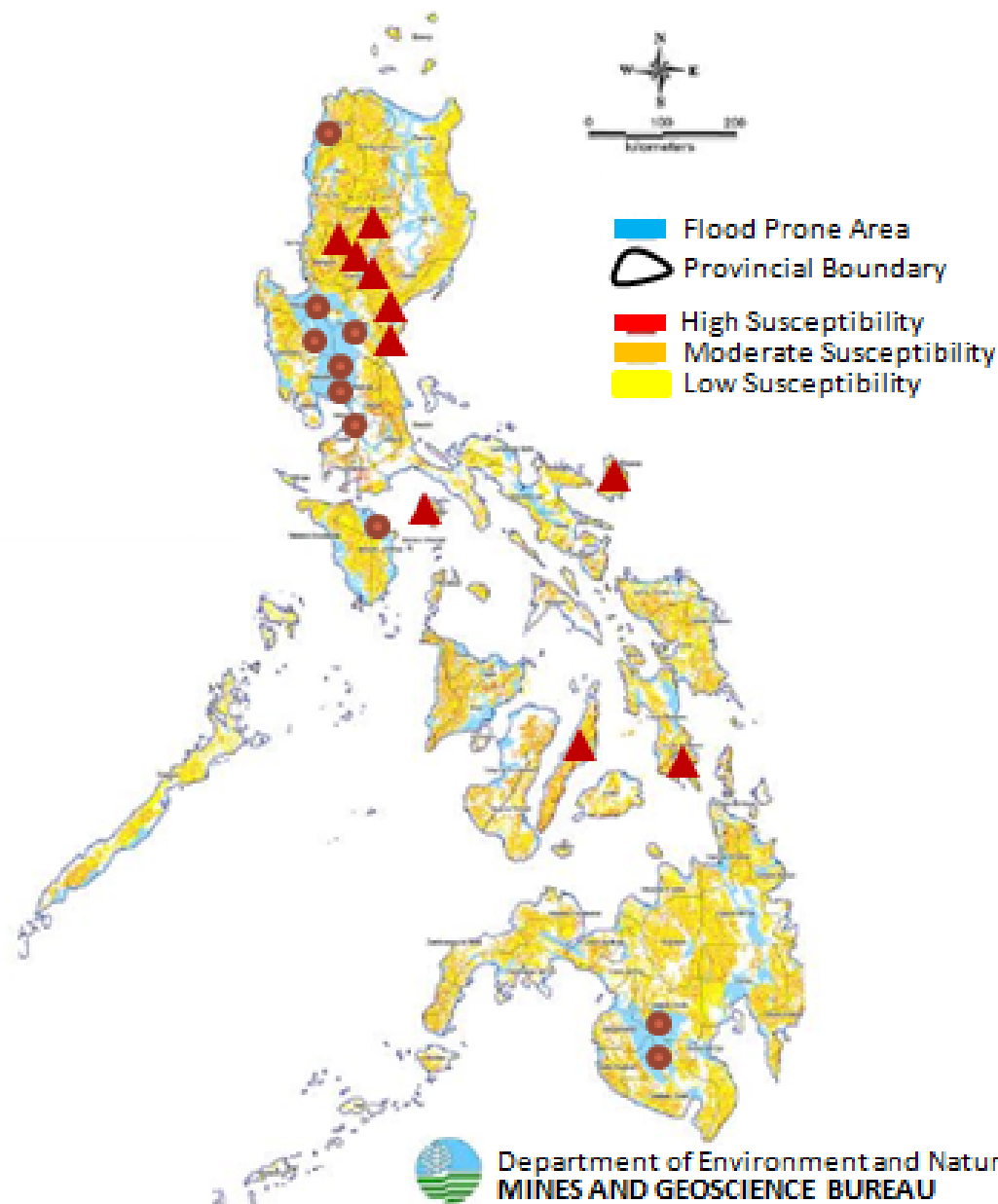
Flood and landslide prone provinces in PH

TOP 10 FLOOD PRONE PROVINCES

1	PAMPANGA	●	79.54%
2	NUEVA ECIJA		51.20%
3	PANGASINAN		48.12%
4	TARLAC		47.11%
5	MAGUINDANAO		42.52%
6	BULACAN		39.85%
7	METRO MANILA		33.16%
8	NORTH COTABATO		30.09%
9	ORIENTAL MINDORO		28.65%
10	ILOCOS NORTE		27.90%

TOP 10 LANDSLIDE PRONE PROVINCES (ALL LEVELS OF SUSCEPTIBILITY)

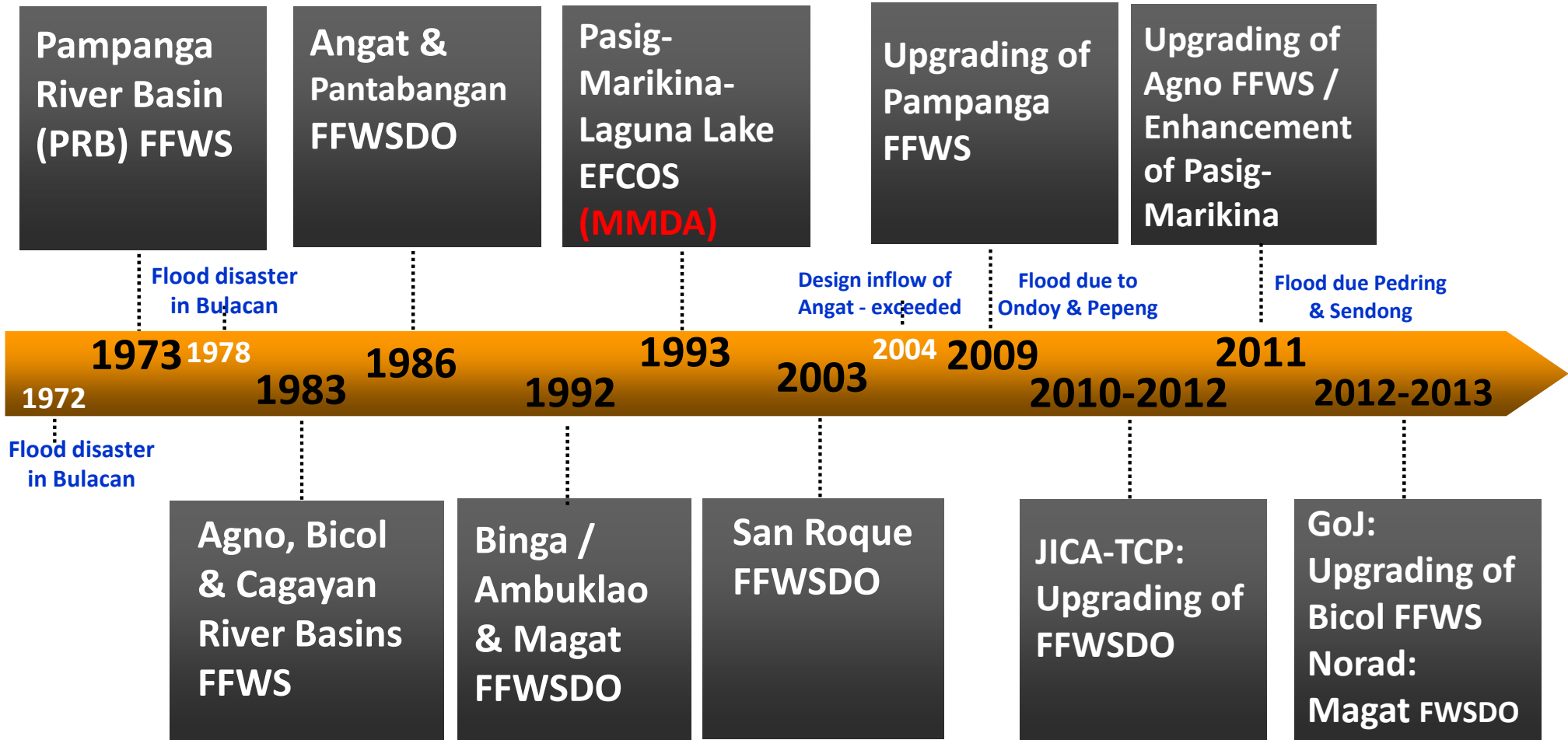
1	BENGUET	▲	90.3%
2	MT. PROVINCE		87.10%
3	NUEVA VISCAYA		86.30%
4	KALINGA APAYAO		84.70%
5	SOUTHERN LEYTE		82.60%
6	ABRA		82.10%
7	MARINDUQUE		78.60%
8	CEBU		77.60%
9	CATANDUANES		77.40%
10	IFUGAO		77.30%



Department of Environment and Natural Resources
MINES AND GEOSCIENCE BUREAU
 LANDS GEOLOGICAL SURVEY DIVISION

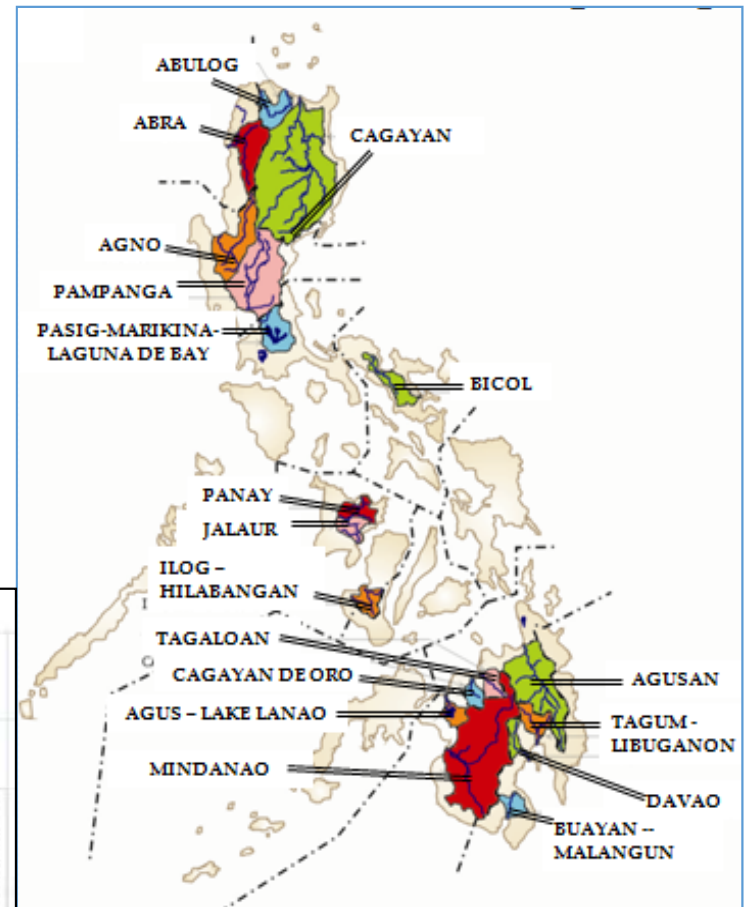
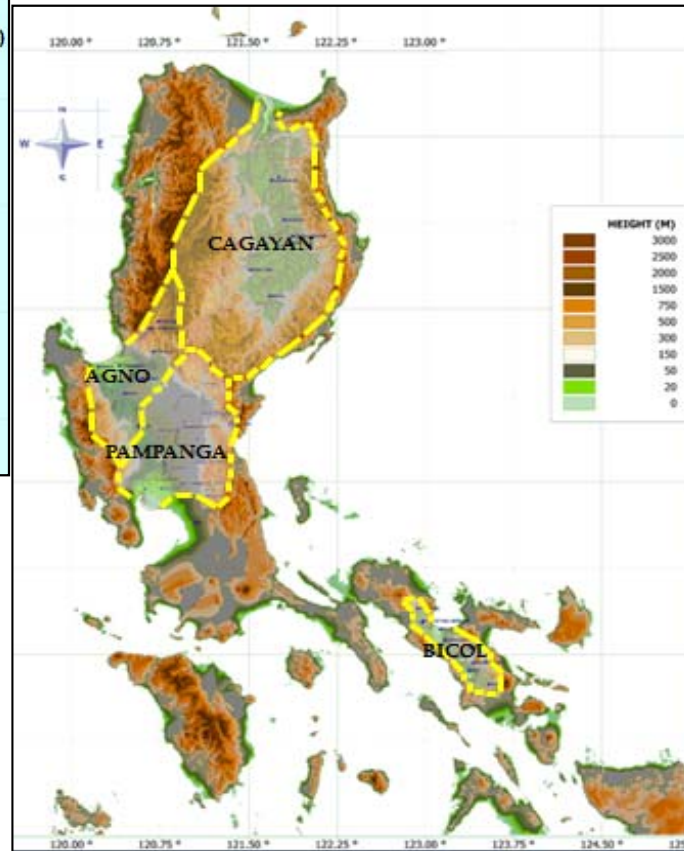
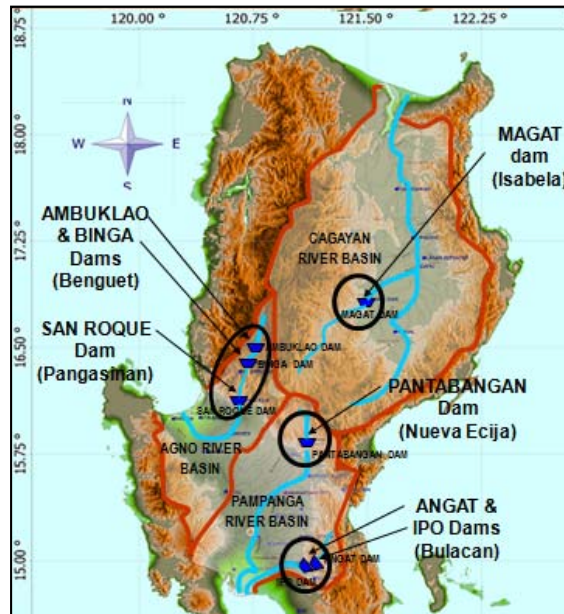
The PAGASA and its Flood Early Warning System

Evolution of FFWS and FFWSDO in the PH

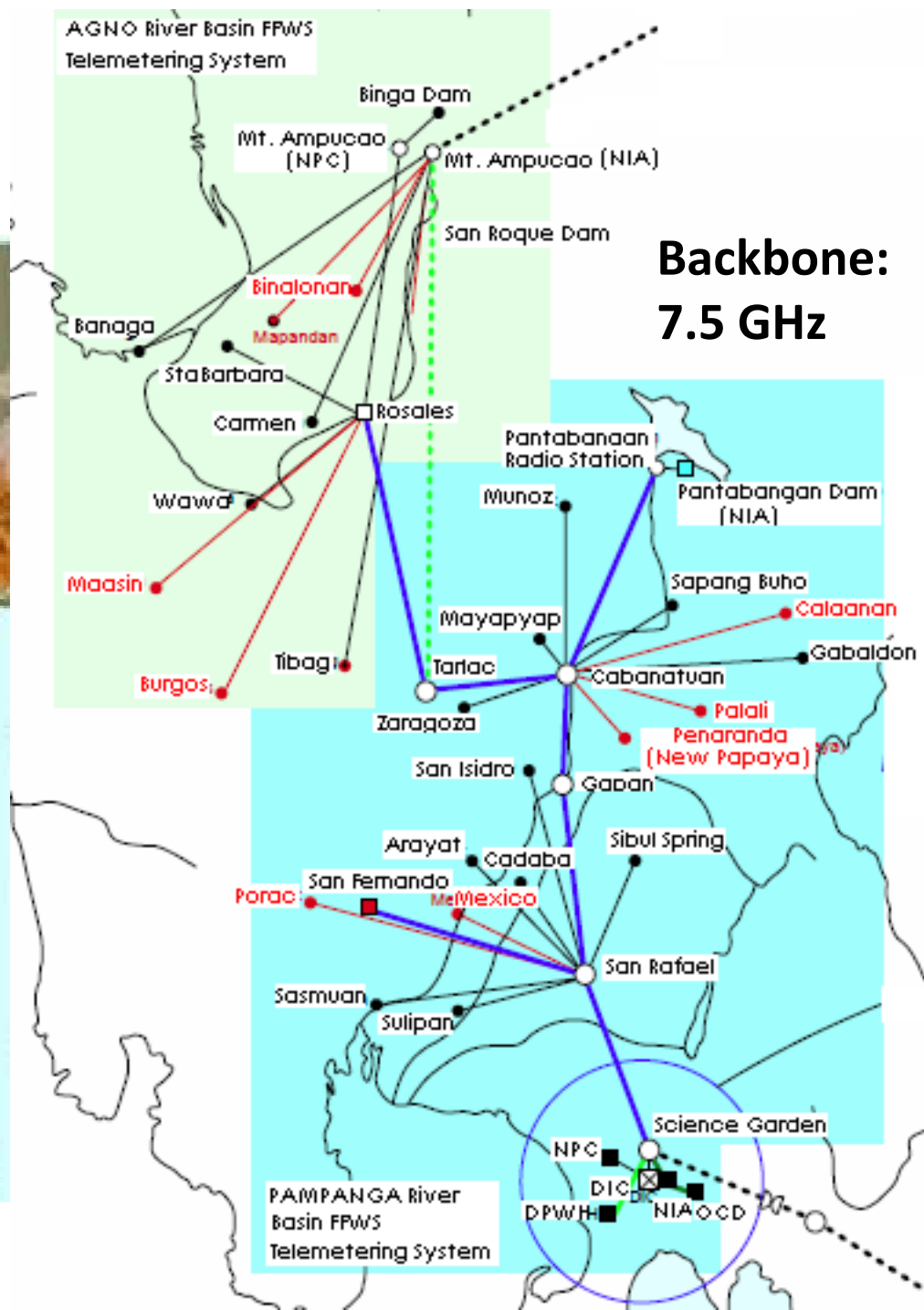
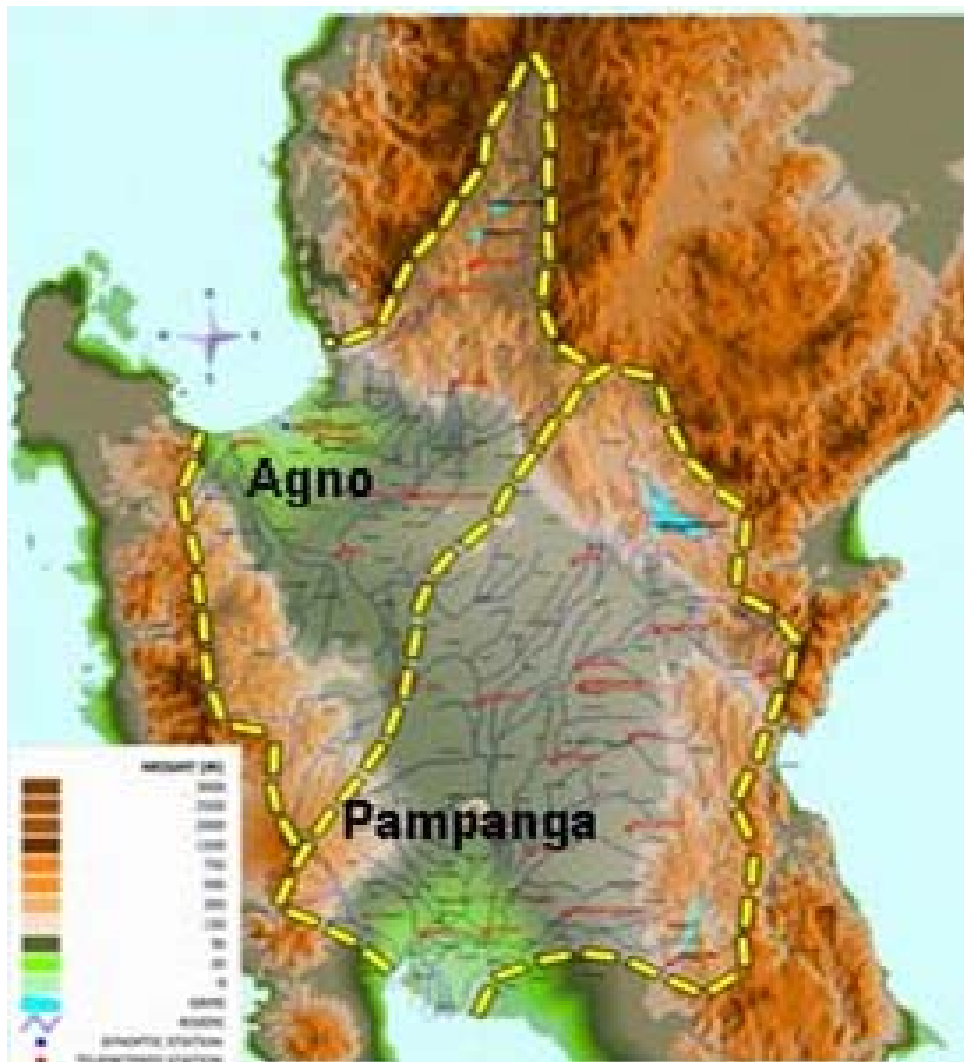


EO 211 – Ipo telemetered FFWSDO - operational
2012 – Caliraya FFWSDO will be operational

NETWORK of Existing PAGASA HYDROLOGICAL Stations (Telemetered major river basins and dams)



Upgraded FFWS: Pampanga & Agno river basins



Hydrological Database

Angat River Basin Hourly Rainfall Menu

Angat River Basin Hourly Rainfall

Rainfall Station	Available Data Period			
	From	To	From	To
<input checked="" type="radio"/> Candaba	1973	2010	Sep 7	Dec 31
<input type="radio"/> Sibul Spring	1973	2010	Aug 28	Dec 31
<input type="radio"/> Sulipan	1973	2010	Aug 1	Dec 31
<input type="radio"/> San Rafael	1973	2010	Aug 1	Dec 31
<input type="radio"/> Ipo Dam	1973	2008	Sep 8	Feb 19

Output Record

Yearly Maximum Hourly Rainfall

Yearly Maximum Daily Rainfall

Daily Rainfall

Hourly Rainfall (1 month data)

Time (0:00-23:00)

Time (9:00-8:00)

Year	Month	Day
From 1973	9	7
To 2010	12	31

Data Retrieve

[Return to Main Menu](#)

Agno River Basin Hydrological Database

The Project for Strengthening of Flood Forecasting and Warning System for Dam Operation

Upper Pampanga River Basin Hydrological Database

The Project for Strengthening of Flood Forecasting and Warning System for Dam Operation

Daily Rainfall (NIA)

River Water Level

Past Flood Data

Hourly Rainfall (PAGASA)

Pantabangan Dam

Masiway Dam

Flood Modeling Working Group

Angat River Basin Monthly Rainfall Menu

Angat River Basin Daily Rainfall

Rainfall Station	Available Data Period			
	From	To	From	To
<input checked="" type="radio"/> Mapiut	1986	2011	May 1	Jul 2
<input checked="" type="radio"/> Talaguo	1986	2011	May 1	Aug 3
<input checked="" type="radio"/> Matulid	1986	2011	May 1	Aug 3
<input checked="" type="radio"/> Angat Dam	1961	2011	Sep 20	Aug 3

Output Record

Yearly Maximum

Monthly and Yearly

Daily

Year	Month	Day
From 1961	9	20
To 2011	8	3

Data Retrieve

Station Name	MONTHLY RAINFALL RECORD												Unit	
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	mm
1961														
1962	8	9	23	39	142	274	1,629	474	612	79			9	
1963	0	8	9	0	1,198	308	290	446	22	13	71		2,992	
1964	15	12	18	20	167	631	333	629	291	181	332	333	2,982	
1965	333	0	0	93	266	436	662	312	409	89	237	83	2,960	
1966	0	65	0	0	687	374	461	479	507					
1967	51	3	0	57	246	751	491	764	378	162	289	5	3,194	
1968	8	0	6	71	130	221		750	323	222	32	2		
1969	19	0	4	27	107	160	991	598	415	289	77	100	2,787	
1970	22	3	24	3	103	347		756	448	356	366	112		
1971	5	5	119	2	486	561	529	218	160	336	442	343	3,344	
1972	32	5	36	31	428	388	2,239	991	389	139	176	10	4,928	
1973	8	5	2	0	121	248	429	521	285	672	277	88	2,656	
1974	0	10	0	137	106	322	441	1,387	54	605	906	210	4,378	
1975	33	7	19	40	83	341	185	762		291	112	339		
1976	14	0	27	25	1,837	421	365	188	652	189	102	83	3,903	
1977	23	14	12	1	156	162	320	375	180	12	106	86	1,479	
1978	0	0	7	6	364	460	872	364	424	461	135	36	3,131	
1979	0	0	0	96	946	463	514	312	210	271	88			
1980	0	0	88	1	109	128	264	98	437	180	227	51	1,586	

Angat River Basin Hydrological Database

The Project for Strengthening of Flood Forecasting and Warning System for Dam Operation

Daily Rainfall

River Water Level/Discharge

Maris Dam

Hourly Rainfall

Magat Dam

Baligatan Outlet Works

Flood Modeling Working Group

Flood Forecasting Model

StorageFunction_rev5 [互換モード] - Microsoft Excel

The Project for Strengthening of Flood Forecasting and Warning System for Dam Operation

Agno River Basin

Flood Forecasting Program

Flood Modeling Working Group

Input Condition

- Basic Data
- Hourly Rainfall
- Sub-Basin Parameter
- River Channel Parameter
- Reservoir H-V
- Flood Operation Rule
- Initial Reservoir Water Level
- Actual Dam Data
- River Flow Capacity (Downstream of San Roque Dam)

Output

- Hydrograph (Ambukiao Dam)
- Hydrograph (Binga Dam)
- Hydrograph (San Roque Dam)
- Hydrograph (All Base Points)
- Peak Discharge
- Basin Mean Rainfall
- Inundation Discharge (Downstream of San Roque Dam)

Calibration Result

- Typhoon Marce (2004)
- Typhoon Pepeng (2009)

Information

- Basin Map
- Basin Diagram

RUN

FloodModel_Angat_rev3 - Microsoft Excel

No.	Year	Month	Day	Hour	Reservoir Water Level (El.m)	Reservoir Volume (mil.m ³)	Inflow (m ³ /sec)	Outflow (m ³ /sec)
1	2011	9	26	1:00	206.38	641.45	42.6	60.4
2	2011	9	26	2:00	206.38	641.39	42.6	60.4
3	2011	9	26	3:00	206.37	641.32	42.6	60.4
4	2011	9	26	4:00	206.37	641.26	42.6	60.4
5	2011	9	26	5:00	206.37	641.20	42.6	60.4
6	2011	9	26	6:00	206.36	641.13	42.6	60.4
7	2011	9	26	7:00	206.36	641.07	42.6	60.4
8	2011	9	26	8:00	206.36	641.00	42.6	60.4
9	2011	9	26	9:00	206.35	640.94	42.9	60.4
10	2011	9	26	10:00	206.35	640.88	43.8	60.4
11	2011	9	26	11:00	206.35	640.82	44.9	60.4
12	2011	9	26	12:00	206.35	640.77	45.6	60.4
13	2011	9	26	13:00	206.34	640.72	46.5	60.4
14	2011	9	26	14:00	206.34	640.67	51.1	65.9
15	2011	9	26	15:00	206.34	640.66	64.0	65.9
16	2011	9	26	16:00	206.35	640.80	85.1	46.2
17	2011	9	26	17:00	206.36	641.06	119.1	46.2
18	2011	9	26	18:00	206.38	641.45	154.4	46.2
19	2011	9	26	19:00	206.40	641.91	173.0	46.2
20	2011	9	26	20:00	206.43	642.50	211.4	46.2
21	2011	9	26	21:00	206.48	643.45	308.2	46.1
22	2011	9	26	22:00	206.55	644.90	449.5	46.1
23	2011	9	26	23:00	206.65	646.43	479.4	46.1
24	2011	9	27	0:00	206.69	647.70	392.5	46.1
25	2011	9	27	1:00	206.75	648.87	355.4	41.6
26	2011	9	27	2:00	206.82	650.11	388.5	41.6
27	2011	9	27	3:00	206.90	651.69	480.4	41.6
28	2011	9	27	4:00	207.00	653.80	625.9	41.5
29	2011	9	27	5:00	207.13	656.34	747.8	41.5
30	2011	9	27	6:00	207.26	658.86	741.5	41.5

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Peak Discharge (m³/sec): 3,782.6 | Inflow: 607.0 | Outflow: 60.4

Maximum Reservoir WL: El. 214.45 m

Dam Crest Elevation: 221.5 El. m | Design Flood Water Level: 219.0 El. m

HWL (Flood Season): 210.0 El. m | HWL (Normal): 212.0 El. m

Reservoir Water Level at Angat Dam

Time (hour)

StorageFunctionMagat_rev1_CalibEmong [互換モード] - Microsoft Excel

The Project for Strengthening of Flood Forecasting and Warning System for Dam Operation

Magat River Basin

Flood Forecasting Program

Flood Modeling Working Group
March 2011

Input Condition

- Basic Data
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- Sub-Basin Parameter
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- River Flow Capacity (Downstream of San Roque Dam)

Output

- Hydrograph (Magat Dam)
- Hydrograph (All Base Points)
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Calibration Result

- Typhoon Emong (2009)

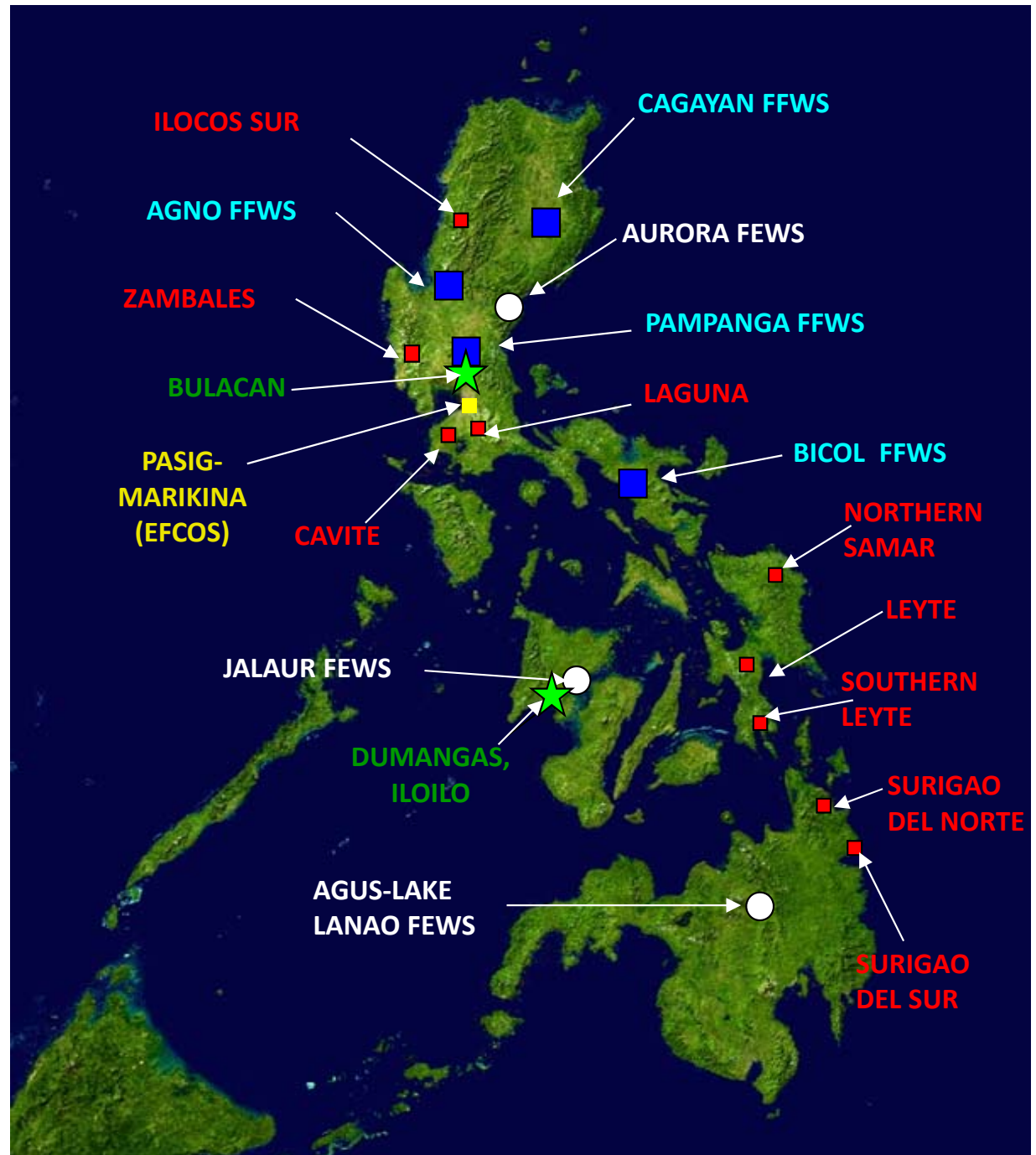
Information

- Basin Map
- Basin Diagram

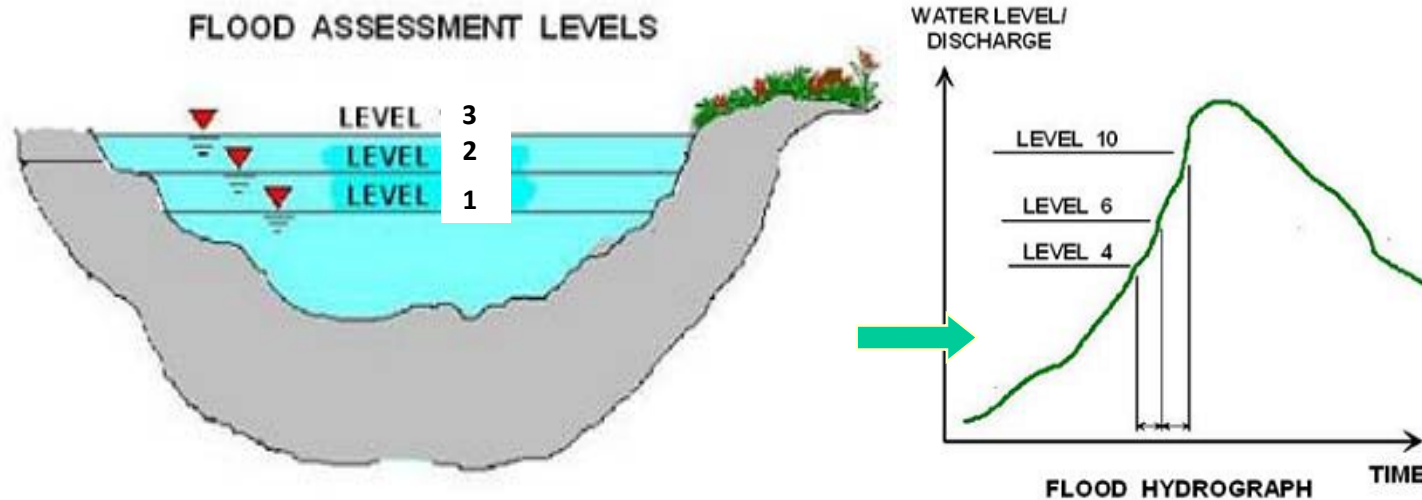
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Community Based Flood Early Warning System (CBFEWS)

Community-based Flood Early Warning System (CBFEWS)



Threshold for Warning: Assessment Water Levels



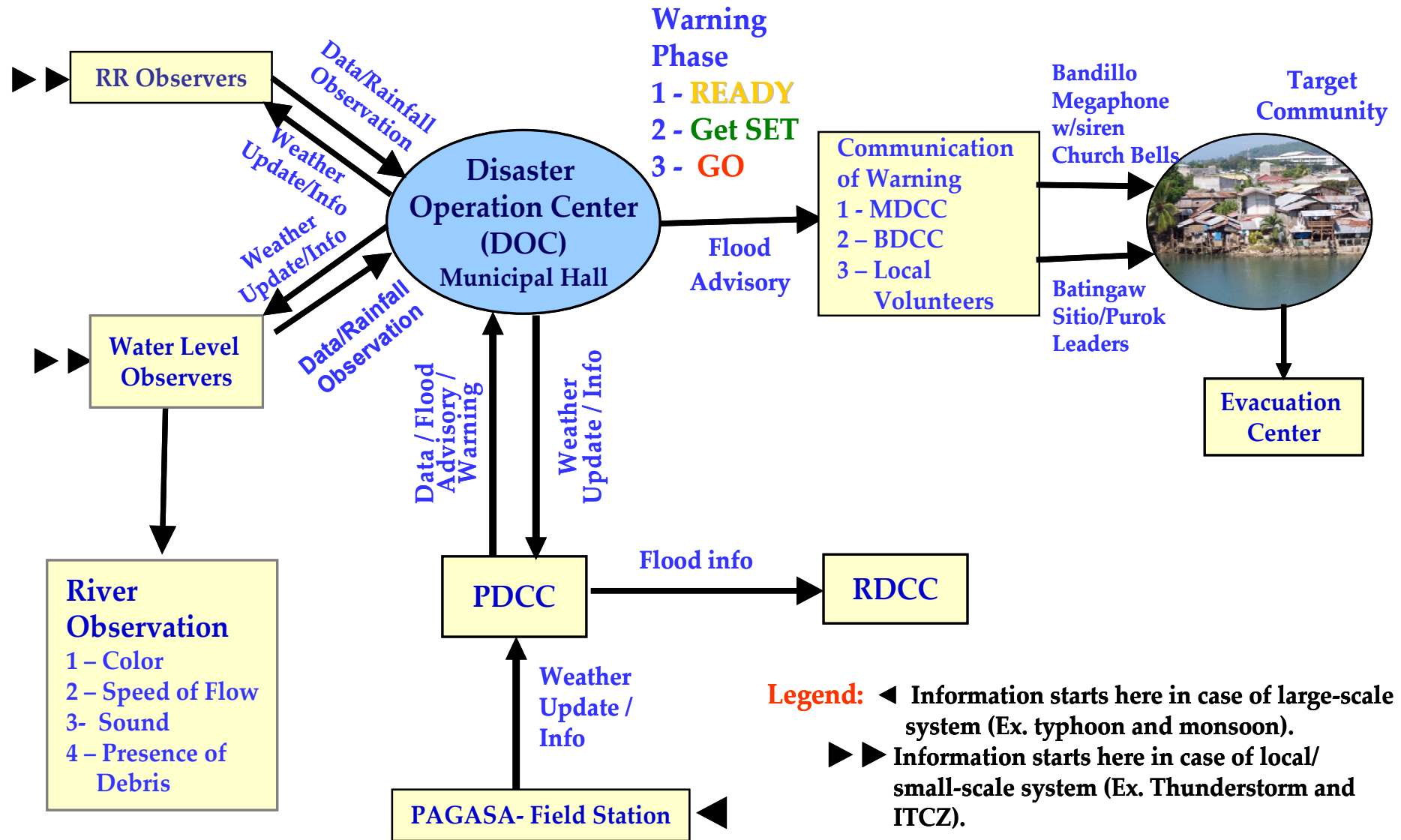
	Actual Water Level (m)	Meaning	Flood Warning
Level 1	1.1 m	Awareness	READY
Level 2	1.5 m	Preparedness	GET SET
Level 3	2.0 m	Response	GO

Values are arbitrary and will be modified when sufficient data becomes available.

Flood Warning Protocol (Batingaw)

Warning Signal/ Info	Water level at the monitoring station	Meaning
1 bell or 1-second of brief siren for every 2 seconds for 30 seconds	Water level has reached <u>Alert Level</u>	<u>READY</u> – People are made <u>aware</u> of an impending flood.
2 bells or two 1-second siren for every 2 seconds for 30 seconds.	The <u>Alert Level</u> reached the <u>Alarm Level</u> in <u>30 minutes or less</u>	<u>GET SET</u> – People are advised to <u>prepare</u> for a possible flood.
Continuous ringing of bells or siren for 20 to 30 seconds.	Water level at the monitoring station reached <u>Critical Level</u>	<u>GO</u> – People are advised to <u>respond/evacuate</u> for an expected flood.

Communication Scheme of a CBFEWS



Provinces where CBFEWSs were installed

Surigao Del Norte



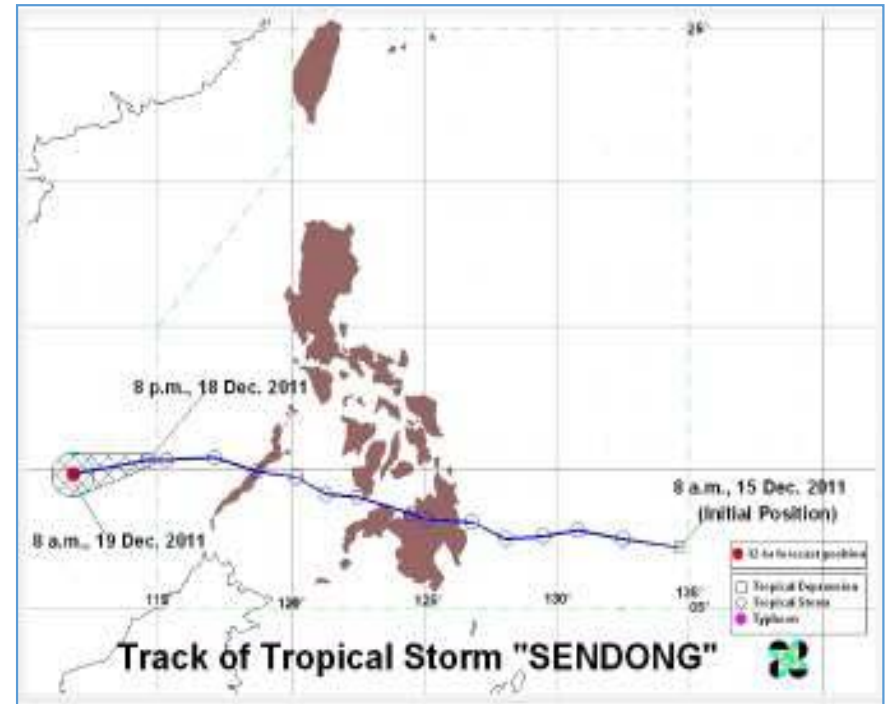
During the Revisit of Ready Team on 6016 May 2008: Success stories were noted in the municipalities of Hinatuan, Barobo & Tagbina in SDS, in Libjo for Dinagat Island & in Mainit & Surigao City.

Observed data were used to forewarn the threatened communities, i.e. before the landslide that occurred in Surigao City in Feb 2008 and in Hinatuan river basin.

Surigao del Sur

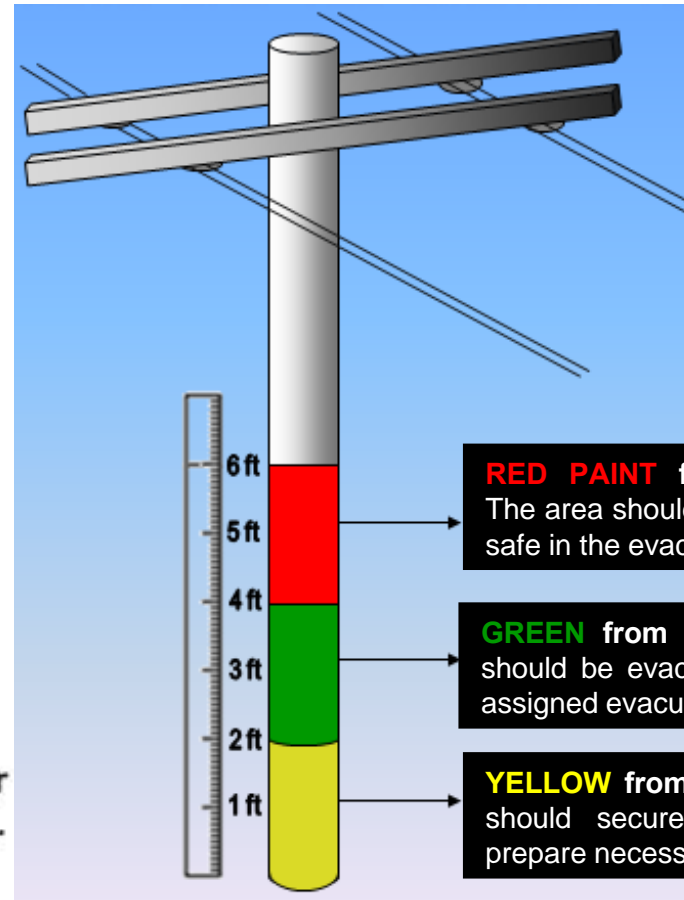
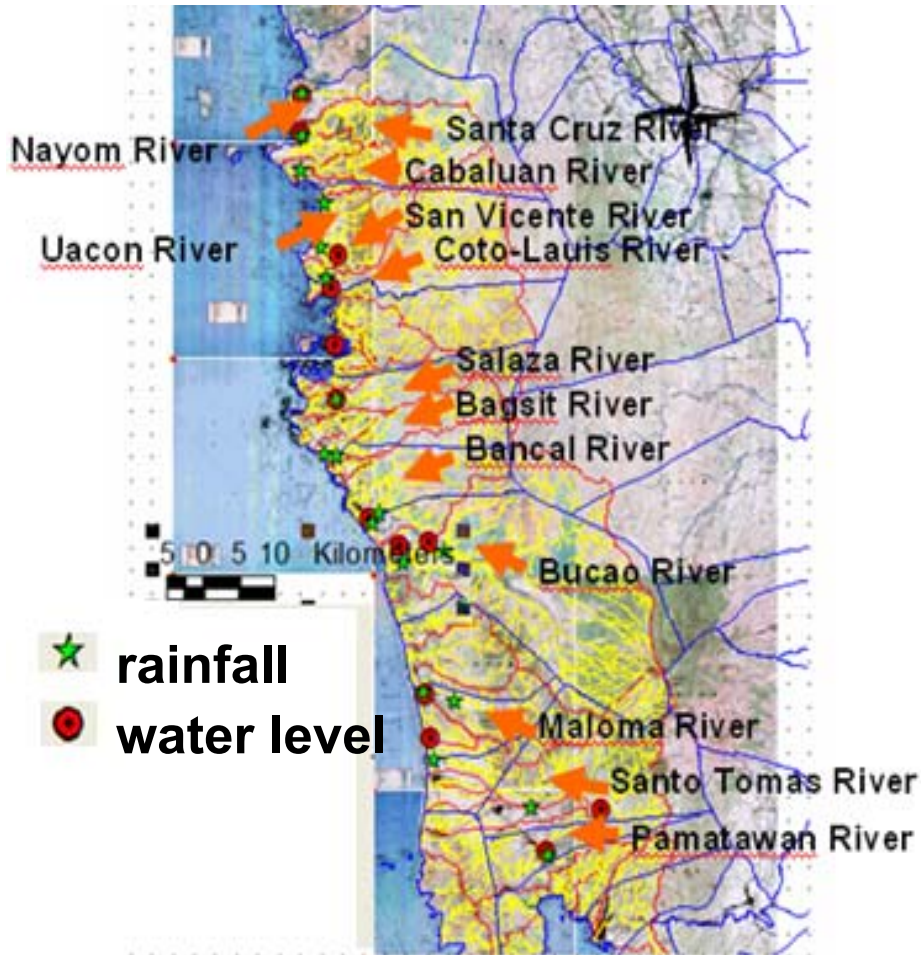
Overall, fewer people are being killed as a direct result of floods, thanks to improvements in warning systems and better preparedness.

- In May 2009, the province of Zambales was devastated by flooding due to passage of a storm but no casualties were recorded. This was mainly attributed to the community based flood early warning system (CBFEWS) in place.



- On 16 Dec 2011, Surigao del Sur recorded 2 casualties compared to Cagayan de Oro and Iligan City (more than 1000) due to the passage of TS Washi. In 2005, CBFEWS was established under the UNDP Ready project. People in the area still remember the lessons during the flood drills conducted. LGUs immediately convened the local DRRMC in anticipation of storm Washi.

Zambales



**Olongapo City:
Colors of Beauty
& Safety**

RED PAINT from 4 to 6 ft. – **high risk.**
The area should be cleared. Everyone should be safe in the evacuation centers.

GREEN from 2 to 4 ft. – **evacuate.** Families should be evacuate their homes and go to their assigned evacuation centers.

YELLOW from 0 to 2 ft. – **get ready** Families should secure all of their possessions and prepare necessary items for evacuation.

**15 digital & 3 manual raingauges (Zambales); 5 digital raingauges - Olongapo City
20 water level gauges (15 in Zambales, 5 in Olongapo City)**

Zero casualty during passage of TY Emong in May 2009

Thank you.