**Philippine Atmospheric, Geophysical & Astronomical Services Administration (PAGASA)**
**Pampanga River Basin Flood Forecasting & Warning Center (PRFFWC)**
**DOST Region 3 Compound, San Fernando, Pampanga 2000**
**Website: prffwc.webs.com**

**PRFFWC Post-Flood Report 2013-1** [1]

# Event: T.S. "Maring" enhanced Southwest Monsoon (Habagat 2013) August 18 to 27, 2013


[1] *PRFFWC Post-Flood Survey team: H.T.Hernando, N.B.Nimes & R.P.Yutuc; Survey date: September 4-6, 2013.*

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**Summary**

Tropical Storm "Maring" (Trami) was the 13th tropical cyclone to enter the Philippine Area of Responsibility (PAR). Maring did not make landfall and neither did it affected the country directly. The presence of the storm, however, induced the Southwest wind flow towards the western sections of the country, particularly over Metro Manila, the Southern Tagalog Provinces and the eastern sections of northern and central Luzon, including the lower sections of Pampanga River Basin (PRB) and the Pasac-Guagua River basin system. "Maring" exited the PAR in the morning of the August 21.

Moderate to occasionally heavy rains brought about by the enhanced southwest wind flow affected the southwest portion of PRB around afternoon of August 18. Main Pampanga River was generally normal except at its lower sections and the allied river basin system of Pasac-Guagua which have river stages already slowly increasing. Monsoon rains continued at the southwest corner of the basin for the next 3 days with intermittent heavy downpour until the afternoon of the 21st while the rest of the basin was unevenly affected by scattered light to moderate rains. Occasional rainshowers continued until the 23rd of August becoming infrequent and lesser in magnitude. However, an unusual brief heavy downpour (thunderstorm type) at upstream of Cabanatuan City around early evening of August 24 caused a passing flash flood that lasted for a few hours within the city proper. There were no casualties reported as a result of this.

Main Pampanga River from its midstream sections in Arayat down to its mouth in Hagonoy started its slow increase starting in the midday of August 19 with portions reaching above alarm levels eventually. Low-lying riverside areas at this stretched were partly inundated with combined effects from the high-tide and from the rains. Candaba swamp water level reached critical level in the morning of August 20. Some areas within the Pasac-Guagua River system, which is an allied river basin of Pampanga River, immediately went underwater even before river levels started to register a rise primarily due to the ponding of continuous rains with intermittent heavy periods on August 19. Similar to Pampanga River, flooded areas within the allied river system was further aggravated by the effects of high-tide. Obviously, the uneven commencement of flooding within the PRB can be attributed primarily to the effects of high tide, the water level status of the rivers, and area saturation condition prior to Habagat. There were some areas within the basin, particularly in the Pasac-Guagua River sub-basin, that still have ponded rainwater from previous rain events preceding August 18.

By comparison, Habagat of 2012 has affected more areas, more families and resulted in relatively much higher flood levels within PRB than the Habagat of this year 2013. However this year, several infrastructures were damaged within the basin mainly both due to the rains and strong river current and the reported limited maintenance to these structures. Among those that were damaged was a portion of the Minalin section of the San Fernando-Sto.Tomas-Minalin tail dike, and the Pasig-Potrero Bridge along SCTEX (Subic-Clark-Tarlac Expressway). The local Disaster Risk Reduction and Management Councils (LDRRMCs) of several areas within the PRB, mainly the Provinces of Pampanga and Bulacan declared their area in a "state of calamity". A total of 5 fatalities, mostly due to drowning, were reported within the PRB area. The Pampanga River Flood Forecasting and Warning Center (PRFFWC) issued a total of 18 flood information, 2 Flood Advisories (FA) and 16 Flood Bulletins (FB), covering the period August 18 to 27.

## 1.0 Hydrological Area Background: Pampanga River Basin (PRB)[2]

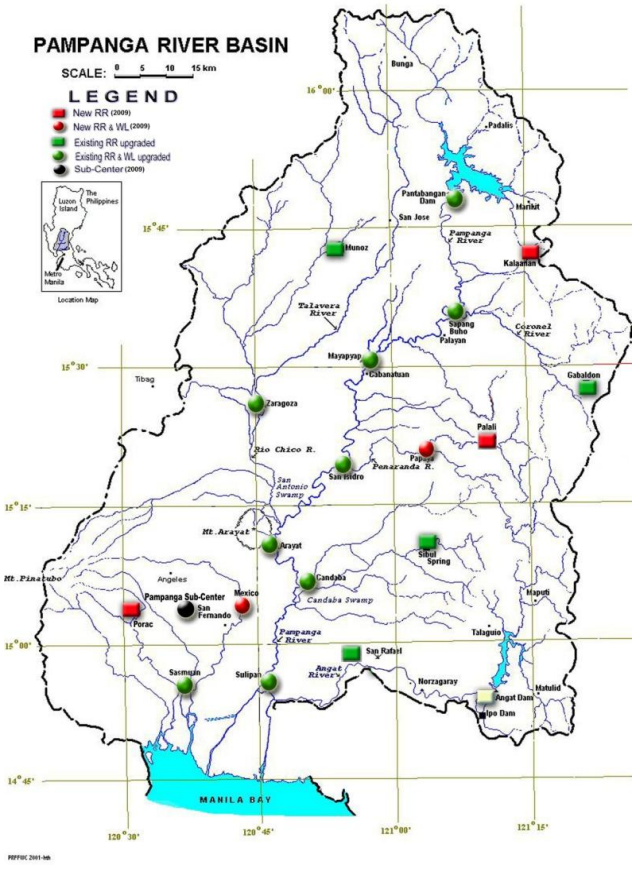
The Pampanga River basin system is the 4th largest basin in the Philippines with an aggregate area of 10,434 km$^2$ (square kilometer). It is broadly divided into three sub-basins: (a) Pampanga main river basin with its catchment area of 7,978 km$^2$, (b) Pasac river basin (or alternatively known as the Pasac-Guagua allied river basin) with 1,371 km$^2$ and (c) Angat River basin with 1,085 km$^2$. These three basins originate from different mountain areas having separate river mouths to the Manila Bay but are interconnected by channels and their water resources management works are mutually and closely related. The basin spreads over the administrative area of eleven (11) provinces covering roughly 90 municipalities/cities. The substantial part of the basin area about 95% is, however, within the bounds of four provinces, namely, Nueva Ecija, Tarlac, Pampanga and Bulacan.

Pampanga River has a channel length of around 265 kms and headwaters originating in the Caraballo Mountains north of the basin. It flows into Pantabangan dam. From the dam it further flows southward meeting with several tributaries until emptying into Manila Bay.

The major tributaries are Coronel, Peñaranda, and Rio Chico Rivers. Rio Chico River has the largest catchment area at 2,895 km$^2$ and it joins the main stream of Pampanga before Mt. Arayat (elevation 1,026 m).

The Angat River system originates in the Sierra Madre Mountains and flows into Angat storage dam. From the dam the river flows westward and finally empties into the Manila Bay through Labangan Floodway. A connecting waterway with Pampanga River, the Bagbag River, is situated in the towns of Pulilan and Calumpit in Bulacan.

The Pampanga River Basin Map (Figure 1.0) on the right showing locations of the present network of telemetered rainfall and water level stations of the PRFFWC.




The Pasac-Guagua River system includes various channels running on the eastern slope of Mt. Pinatubo, such as the Abacan-San Fernando, Pasig-Potrero and Porac-Gumain Rivers which all flow into Manila Bay. In the lower reaches, the river system is connected with Main Pampanga River by the Bebe-San Esteban Cut-off Channel. The morphologies of Pasac River have changed significantly due to mudflow (lahar) movement caused by the Mt. Pinatubo eruption in 1991. Serious sediment

[2] *Major parts taken from the Draft Final Report "The Study on Integrated Water Resources Management for Poverty Alleviation and Economic Development in the Pampanga River Basin". NWRB-JICA Project, December 2010.*

deposition in the river channel is still progressively active. The long-term average annual precipitation in the study area is estimated at about 2,155 mm/year, and about 83% of this is concentrated during the rainy season from May to October.

The basin has two swamp areas, the Candaba and the San Antonio Swamps with an estimated area of about 250 and 120 km$^2$, respectively. There are two major hydraulic structures within the basin, Pantabangan and Angat Dams. The former is located upstream of the upper main Pampanga River and operate as both hydropower and irrigation dam while the latter is located on the eastern portion of the lower main Pampanga River and drains through the Angat River via Ipo and Bustos Dams. Angat operate as hydropower dam and has Ipo and Bustos as water supply reservoir and irrigation dams, respectively.

### 1.1 The Pampanga River Basin Flood Forecasting & Warning Center (PRFFWC)

The PRFFW system is comprise of 17 rainfall (RR) and 10 water level (WL) stations as its monitoring network (refer back to figure 1.0) and is complemented with several local RR and WL observations in Bulacan and Pampanga. There are 2 synoptic and 1 agrometeorological stations within the basin. These stations are not, however, transmitting data on a real-time basis to the center. The PRFFW operations center is located in the DOST Region 3 compound in the city of San Fernando, Province of Pampanga. (For more info: *www.prffwc.webs.com*)

## 2.0 Meteorological Aspect

### 2.1 Tropical Storm "Maring" *(International name "Trami")*

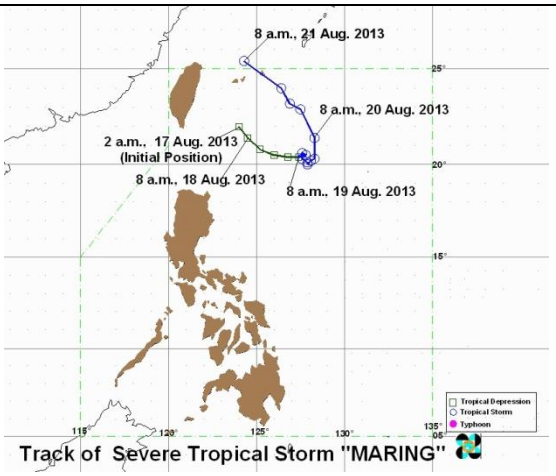



Figure 2.0 Track of Tropical Storm "Maring" during its course within the PAR (August 17 to 21).[3]

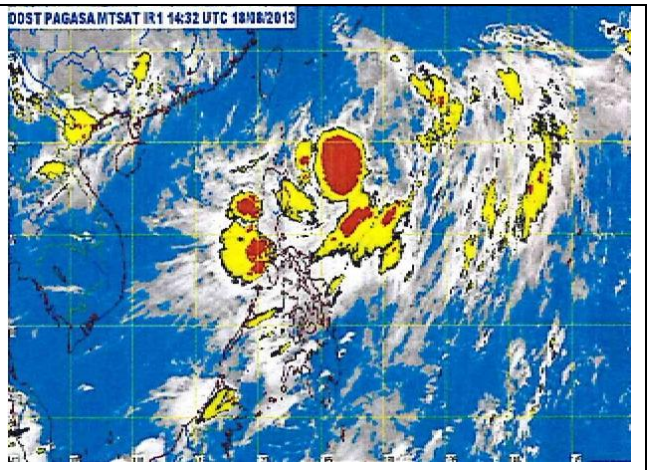



Figure 2.1 An IR satellite image of "Maring" located at northeast of Luzon and a subsequent intense southwest monsoon cloud cover towards the eastern part of central and northern Luzon; image at 2232H (LST), August 18, 2013.

Tropical storm "Maring" (Trami) became the 13th Tropical cyclone to enter the Philippine Area of Responsibility (PAR). It did not make landfall nor did it affected the country directly. It coasted at

[3] *Track of Tropical Cyclone "Pedring" courtesy of "dyuwi@yahoo.com"*

around 300 to about 500 kms northeast of Luzon from August 17 to 21, 2013. It exited the PAR on a northwest direction on the morning of August 21.

### 2.2 Southwest Monsoon (Habagat)

A great portion of our rainfall may be attributed to the southwest (SW) monsoon weather or "Habagat" in Filipino. The SW monsoon is caused by the thermal variations over the Asiatic mainland. During summer in the Northern Hemisphere, the Asiatic continent becomes warmer than the surrounding seas and a low-pressure cell develops over the continent. This causes a flow of moist SW winds over the Philippine area. At times when this SW flow becomes thick in depth, it persists for a long period causing continuous rains that may last for weeks during the months of June to September. Thus aside from typhoons, the SW monsoon is responsible for the great portion of the rainfall during the wet season. At times, however, the SW wind flow is also induced by the presence of a Tropical Cyclone over the Taiwan-Okinawa area. When this happens, the weather characteristic of the SW monsoon, mainly continuous rains, prevails in the Philippines particular at the western seaboards of Luzon including Metro Manila.

Western sections of Central and Northern Luzon, Southern Tagalog Provinces, and Metro Manila were inundated during the Maring-enhanced southwest monsoon (Habagat) of 2013.

## 3.0 Basin Hydrological Aspect

Table 1.0 Rainfall Intensity Classification Table (mm/hr)

| Category | 1 hour | 3 hours | 6 hours | 12 hours | 24 hours |
|---|---|---|---|---|---|
| Light | < 2.5 | < 7.5 | < 15 | < 30 | < 60 |
| Moderate | 2.5 – 7.5 | 7.5 – 22.5 | 15 – 45 | 30 – 90 | 60 – 180 |
| Heavy | > 7.5 | > 22.5 | > 45 | > 90 | > 180 |

### 3.1 Rainfall (Habagat 2013)

Table 2.0 Pampanga River Basin 24-hr rainfall for the period August 18 to 21.

| Stations | August 2013 | | | | Maximum observed 1 hr RR | Time (LST) / Day of maximum 1-hr RR for the period August 18 to 21 |
|---|---|---|---|---|---|---|
| | 18 | 19 | 20 | 21 | | |
| Muñoz | 49 | 26 | 16 | 29 | 13 | 2300H / Aug 18 |
| Sapang Buho | 22 | 15 | 24 | 23 | 9 | 1800H / Aug 19 |
| Gabaldon | 36 | 7 | 13 | 45 | 14 | 1300H / Aug 21 |
| Zaragoza | 44 | 28 | 63 | 36 | 12 | 1400H / Aug 20 |
| Mayapyap | 27 | 11 | 38 | 28 | 9 | 1500H / Aug 20 |
| Peñaranda | 22 | 16 | 45 | 37 | 19 | 1300H / Aug 21 |
| Calaanan | 54 | 17 | 14 | 28 | 31 | 2300H / Aug 18 |
| Palali | 19 | 12 | 32 | 43 | 21 | 1300H / Aug 21 |
| San Isidro | 28 | 33 | 50 | 27 | 10 | 1900H / Aug 19 and 1500H / Aug 20 |
| Arayat | 44 | 54 | 77 | 26 | 14 | 1500H / Aug 20 |
| Candaba | 43 | 53 | 86 | 65 | 13 | 1200H & 1500 / Aug 20 |
| Sibul Springs | 23 | 29 | 58 | 52 | 15 | 2000H / Aug 21 |
| Sulipan | 118 | 120 | 133 | 69 | 28 | 1400H / Aug 20 |
| San Rafael | 58 | 71 | 118 | 85 | 23 | 1100H / Aug 20 |
| **Basin Average** | **41.9** | **35.1** | **54.8** | **42.4** | | |

Table 2.1 Pasac-Guagua River Basin (Allied basin) RR for the same period

| Stations | August 2013 | | | | Maximum observed 1 –hr RR | Time (LST) / Day of maximum 1-hr RR for the period August 18 to 21, 2013 |
|---|---|---|---|---|---|---|
| | 18 | 19 | 20 | 21 | | |
| Sasmuan | 233 | 198 | 139 | 87 | 33 | 1800H / Aug 18 |
| Mexico | 67 | 86 | 109 | 63 | 14 | 1100H / Aug 20 |
| Porac | 227 | 200 | 105 | 63 | 43 | 2300H / Aug 18 |
| San Fernando | 100 | 105 | 89 | 52 | 21.1 | 0900H / Aug 20 (est) |
| **Basin Average** | **156.8** | **147.2** | **110.5** | **67.6** | | |

Average basin rainfall at the Pasac-Guagua River system is relatively much higher than the Pampanga River Basin particularly during the period August 18 to 20.

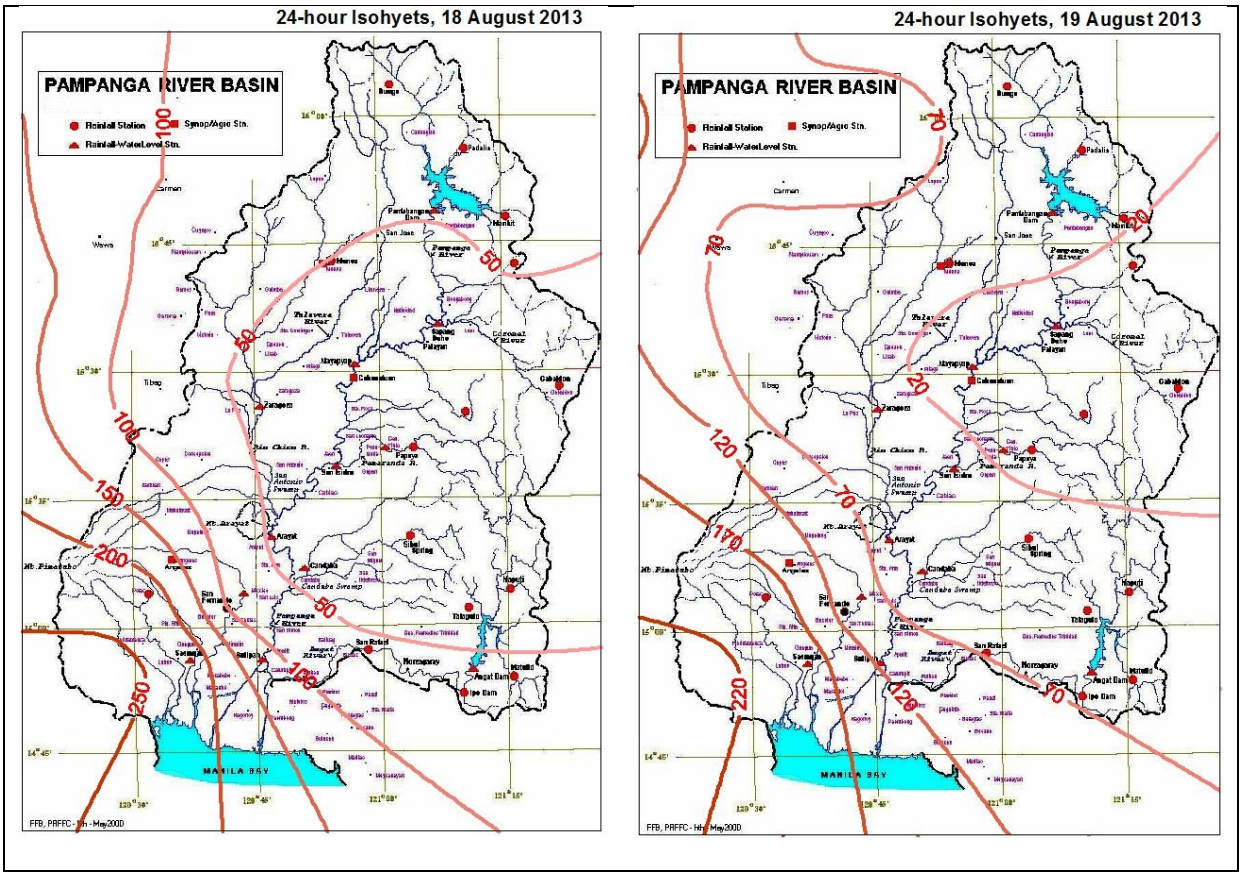



Figure 3.0 The 24-hr isohyets for August 18 (left) and August 19 (right) for Pampanga River Basin

Table 2.2 RR observations from other stations adjacent to and within the PRB

| Stations | | August 2013 | | | |
|---|---|---|---|---|---|
| | Operated by: | 18 | 19 | 20 | 21 |
| Clark Synop, Pampanga | | 95.3 | 109.8 | 125.6 | 72.6 |
| Cabanatuan Synop, Nueva Ecija | | 32.2 | 9.3 | 42.1 | 29.4 |
| Malolos AWS | PDRRMO | 147.1 | 112.5 | 170.7 | 109.7 |
| Baliuag SHINe | Baliuag Uni. | 57.7 | 96.0 | 115.1 | 79.0 |
| Guagua | MDRRMO | 184.1 | 144.6 | 101.1 | 73.9 |
| Tibag, Tarlac | ARBFFWC | 60 | 35 | 68 | 53 |
| Carmen, Pangasinan | ARBFFWC | 99 | 81 | 54 | 55 |
| Sta. Barbara, Pangasinan | ARBFFWC | 125 | 109 | 63 | 71 |

| | | | | | |
|---|---|---|---|---|---|
| Camp O'Donell, Tarlac | ARBFFWC | 115 | 122 | 121 | 56 |
| Maasim, Tarlac | ARBFFWC | 157 | 90 | 74 | 52 |
| San Vicente, Tarlac | ARBFFWC | 106 | 61 | 80 | 53 |
| Sta. Maria, Pangasinan | ARBFFWC | 77 | 95 | 33 | 48 |
| Binalonan, Pangasinan | ARBFFWC | 88 | 52 | 40 | 40 |
| Mapandan, Pangasinan | ARBFFWC | 114 | 77 | 58 | 61 |
| Bugallon, Pangasinan | ARBFFWC | 158 | 204 | 94 | 122 |
| ARBFFWC - Agno River Basin Flood Forecasting & Warning Center (Rosales, Pangasinan) | | | | | |

Rainfall observations from various stations within PRB and partly from stations of the adjacent Agno River Basin were used to produce the 24-hr meteorological day isohyets from August 18 to 21.

Isohyets for both August 18 and 19 show tight and maximum contours at the southwest end of PRB, in particular portions of the allied basin of Pasac-Guagua River system that is at left end corner of the basin. Based on the isohyetal maps, it is quite noticeable that there is a relatively big gap of distribution of observed rainfall between the upper part of the basin and at its lower sections. This plainly indicates that the upstream to almost midstream part of the basin were not significantly affected and not an immediate contributors to the flood episodes downstream of the basin.

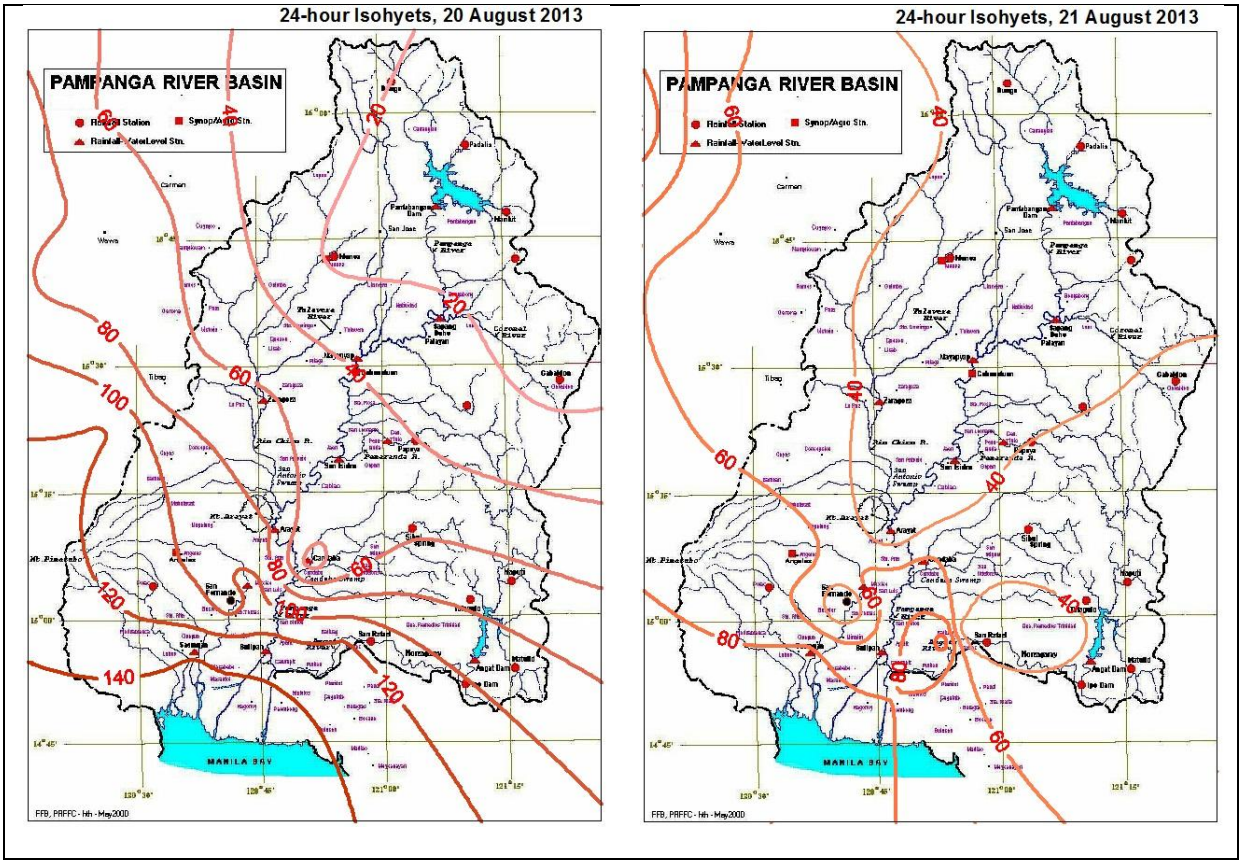



Figure 3.1 The 24-hr isohyets for August 20 (left) and August 21 (right) for Pampanga River Basin

## 4.0 River Status

### 4.1 Station gauge heights

Table 3.0 Time/Date of Station's Flood Assessment Gage Heights were reached

| Station Point | Alert Level | Alarm Level | Critical Level | Remarks |
|---|---|---|---|---|
| Sapang Buho | (3.70 m)<br>Not reached | (4.50 m)<br>Not reached | (6.50 m)<br>Not reached | Peak WL based on telemetry reading was 1.36 m (51.572 m AMSL) attained at about 0100H of Aug. 25 |
| Mayapyap (station was out of order) | (3.00 m)<br>Estimated that the level was not reached | (3.50 m)<br>Estimated that the level was not reached | (4.50 m)<br>Estimated that the level was not reached | Water level sensor was out of order during the period. Maximum water level based on flood marks was estimated to be less than 1.0 m. |
| Zaragoza | (11.00 m)<br>Already above this level prior to the event | (12.50 m)<br>Already above this level prior to the event | (14.50 m)<br>Not reached | WL crested as per telemetry records at 4.31 m (14.523 m AMSL) attained on 2200H of Aug. 22 |
| Peñaranda | No assigned assessment levels at the moment | | | Maximum telemetry reading of 6.01 m (19.376 m TBM based) recorded on 2000H of Aug. 24 |
| San Isidro | (3.20 m)<br>Not reached | (4.50 m)<br>Not reached | (6.00 m)<br>Not reached | Peak WL based on telemetry records was 1.46 m (11.045 m AMSL) attained at around 1000H-1200H of Aug. 25 |
| Arayat | (5.00 m)<br>Around 1400H of Aug. 19 | (6.00 m)<br>Around 2100H of Aug. 19 | (8.50 m)<br>Not reached | WL crested as per records at 8.39 m (8.467 m AMSL) attained around midnight of Aug. 23 |
| Candaba | (3.00 m)<br>Already above this level prior to the event | (4.50 m)<br>Already above this level prior to the event | (5.00 m)<br>Before 1000H of Aug. 20 | Swamp water level crested, as per telemetry records, at 6.30 m (6.143 m AMSL) reached on 1600H, Aug. 23 and remained above the 6.00 m level until 1500H of Aug. 27 |
| Mexico | No assigned assessment levels at the moment | | | Maximum WL based on telemetry readings was 2.61 m (8.543 m based on TBM) and was attained on 1600H of Aug. 20 |
| Sasmuan | No assigned assessment levels at the moment | | | Guagua River at Sasmuan station crested, as per telemetry records, at 3.06 m (1.643 m AMSL) attained on 1000H of Aug. 21 |
| Sulipan | (3.60 m)<br>Not reached | (4.20 m)<br>Not reached | (5.00 m)<br>Not reached | Maximum WL based on telemetry readings was 3.26 m (3.198 m AMSL) attained on 0600H of Aug. 25 |
| *Note: Elevation of "0" of staff gages were based on surveys undertaken on August 2009.*<br>*TBM – Temporary Bench Mark* | | | | |

### 4.2 Tides

Tides were considered to be relatively high during the Habagat 2013 event. The high tides during the period had been one of the main reasons for the flooding in the lower reaches of Pampanga River and in the Pasac-Guagua river systems. High tide also caused the prolonged floodwaters at the downstream sections of the basin in reaching its outlet in Manila Bay.

LDRRMOs reported that riverside and coastal areas in the towns of Hagonoy, Paombong, Calumpit and Malolos in Bulacan, Macabebe, Masantol, Guagua and Sasmuan in Pampanga had already been flooded due to high tide, prior to the August 18 southwest monsoon episode over the basin. High tide effects in the basin can, at times, reached further upstream of Sulipan station until up to Arayat station during low flow conditions in the Pampanga River.

Table 4.0 High Tide (highest for the day)

| Day (2013) | Time | Height (in meters) |
|---|---|---|
| Aug. 17 | 5:27 AM | 1.14 |
| 18 | 6:40 AM | 1.23 |
| 19 | 7:42 AM | 1.30 |
| 20 | 8:40 AM | 1.33 |
| 21 | 9:34 AM | 1.31 |
| 22 | 10:28 AM | 1.22 |
| 23 | 11:21 AM | 1.08 |
| 24 | 12:13 PM | 0.91 |
| 25 | 1:03 PM | 0.72 |

*Note: High Tide from CGSD, NAMRIA, DENR. Based on Navotas port, Latitude 14°41' N, Longitude 120°56' E*

### 4.3 Hydraulic Structures / Dam Releases

Pantabangan and Angat Dams are the two major hydraulic structures within PRB. Pantabangan Dam is located upstream of upper main Pampanga River and operates both as hydropower and as an irrigation reservoir. Conversely, Angat Dam is located on the eastern portion of the lower main Pampanga River. It operates chiefly as a hydropower plant. Ipo Dam, which supports and minimally regulates releases coming from the Angat Dam, is situated about 7 kms downstream of the latter. Ipo serves as an active reservoir for water supply requirements of Metro Manila. It is not an impounding reservoir but more of a diversion dam and very much smaller than Angat Dam. Bustos Dam is located around 38 kms downstream of Ipo and serves mainly as an irrigation reservoir.

A small tributary, the Bayabas River, joins the Angat River in between the river stretch from Ipo Dam to Bustos Dam, about 28 kms downstream of the former. It contributes considerable water to Bustos Dam during rainy season and whenever there are relatively significant flows coming from the mountainous area of DRT (Doña Remedios Trinidad).

Ipo and Bustos dams were the only reservoirs that spilled water at the height of Habagat 2013 over PRB. Both Ipo and Bustos spilled its reservoir water starting in the morning of August 18. Bustos had already spilled through its wash-out gates prior to this, at the height of event “Labuyo” (August 12-14, 2013). Ipo spilling operations lasted until the morning of August 24 while Bustos until the afternoon of August 28. Peak discharge by Ipo was at 199.7 $m^3$ in the afternoon of August 20. Bustos had its peaked discharge at 624.4 $m^3$ in the evening of August 24. The discharges from both reservoirs can be considered as typical channel flows along the Angat River. There were no reported flooding along the Angat River during the “Maring” enhanced southwest monsoon period.

Cong Dadong Dam (google map estimate at 15°11’2.1”N, 120°46’32.7”E), a concrete gravity irrigation dam roughly about 2.5 kilometres upstream of the San Agustin Bridge in Arayat, registered a peak gauge reading of around 9.80 meters at its reservoir side during Habagat 2013. The dam is

being regulated to an elevation of 8.70 meters. The dam is an overflow type dam and is also meant to direct water for irrigation purposes to several towns within Pampanga province.

**5.0 Basin Hydrological Situation**

The main Pampanga River was at a slow recession trend and was below alert level starting on the 18th of August. The Candaba swamp water level was several centimeters below its critical level of 5.0 meters and the Rio Chico River in Zaragoza was still above its alarm level coming from a brief flood segment during the passage of Typhoon "Labuyo" (Utor) at north of the basin on August 12. By midday of the following day, 19 August, almost all river gauging stations were now slowly rising. The slow river rise progress continued until August 25. Main Pampanga River at Arayat stream gauging peaked at 8.39 meters, way above its alarm level of 6.0 meters but several centimeters below critical WL of 8.5 meters in the early morning of August 23; Candaba water level crested at 6.30 meters in the afternoon of that same day. Lower Pampanga observed at Sulipan station similarly registered a slow recession on the following day, 24th of August, after peaking at 3.20 meters in the afternoon of that same day, still way below its assessed alert level of 3.60 meters.

Most areas along the lower main Pampanga River, particularly from Apalit down to Hagonoy, have observed a start of floodwater rise in the morning of August 19 attributed mainly from the rains during that period. Barangay Candating in Arayat, Pampanga, which is a riverside community on the left bank of the Pampanga River started to get flooded in the morning (between 0800H to 1000H LST) of August 22 and peaked at around midnight of that same day. The maximum depth of floodwaters was just above 0.5 meters. Barangay San Agustin in Candaba area, which was one of the worst affected areas in terms of flood depths and duration, has still ponded floodwaters since event "Labuyo" prior to Habagat 2013. However, main flooding brought by the Habagat 2013 started around August 21 to 22 peaking in the afternoon of the 23rd until the morning of the following day. In Hagonoy, Bulacan and Apalit in Pampanga, which are mainly affected by high tide, indicated floodwaters associated with Habagat 2013 started around noontime of August 22. Floodwaters generally subsided in most parts of the basin after more than a week except in Candaba swamp area which took almost 2 weeks before water level subsided below the 5.0 meter critical water level.

Areas within the allied basin of Pasac-Guagua River have areas already flooded due to high tide and ponded floodwaters, remnants of event "Labuyo", prior to the onset of Maring enhanced Habagat 2013. Macabebe, Masantol, Sasmuan and Guagua all in Pampanga were already partly affected by the daily high tide episodes. Estimated start of flooding in most parts of the sub-basin due to Habagat 2013, particularly as reported in Guagua and Macabebe was around morning of August 19. Peak of floodwaters came at around morning of August 21. Floodwaters observed at the city of San Fernando started before noontime of August 20 following the continuous moderate to occasionally heavy rains early that day. Peak floodwaters were observed around afternoon of that same day. Most floodwaters within the sub-basin lasted for a week. Varied rise of floodwaters at the different areas along main Pampanga River and within the Pasac-Guagua sub-basin are attributed mainly to the effects of high tide.

About 2 hours of torrential rains at upstream and adjacent areas of Cabanatuan City starting around night time of August 24 resulted in a localized flash flood within the city. Flood depths reaching waist deep inundated several subdivisions within the city for a few hours. This episode was rather unusual and interviews with the PDRRMO-Nueva Ecija opined that the drainage canal system in the

affected areas were not able to accommodate the rains for that period, citing inadequate capacity and silted canals. This event can be a part basis for establishing possible rainfall warning episodes for the urban area of Cabanatuan City.

## 6.0 Event Casualties and Damages (PRB / Region 3)[4]

The Provinces of Pampanga and Bulacan declared a State of Calamity following the flood event. There were 11 fatalities reported within Region 3 area mostly as a result of drowning. Breakdown of fatalities are as follows: 2 in Bulacan, 1 in NE, 4 in Pampanga, 3 in Zambales, and 1 in Bataan. A national total of 27 persons died as per NDRRMC report and affected a total of 37 cities and 160 municipalities in 18 provinces of 6 regions in the country including the National Capital Region (NCR).

Table 5.0 Breakdown of the population, towns / cities and barangays affected (in Region 3)

| Province | Total Towns & / or Cities affected | Total Barangays affected | Number of Families affected | Number of persons affected |
|---|---|---|---|---|
| Bataan | 12 | 227 | 93,377 | 420,750 |
| Bulacan | 22 | 313 | 190,005 | 821,794 |
| Nueva Ecija | 1 | 5 | 1,680 | 10,075 |
| Pampanga | 21 | 356 | 154,328 | 682,131 |
| Tarlac | 9 | 71 | 10,681 | 48,308 |
| Zambales | 7 | 65 | 6,364 | 24,593 |
| **Total for Region** | **72** | **1,037** | **456,435** | **2,007,561** |
| *Bataan and Zambales are mainly outside the river basin. About 1/3 of Tarlac and 2/3 of Bulacan are within the PRB.* | | | | |

NDRRMC reports that around 456,453 families were affected within the Region, roughly half of which are within the PRB. Damaged houses for the Region totalled 282 of which 195 were totally damaged. Pampanga had the most number of houses damaged within the region mainly those situated along the riverside areas. Partial damage to both infrastructure and agriculture for whole of Region 3 as of August 30 amounted to about ₱ 343,057,403.98.

Major infrastructure damaged within the basin included breaching of the San Fernando-Minalin-Sto. Tomas tail dike between Bgy. Sta. Rita in Minalin and Bgy. San Bartolome in Sto. Tomas, both in the province of Pampanga. MDRRMO-Minalin reported that the tail dike at that portion was overflowed by floodwaters in the afternoon of August 19 following the continuous moderate to occasionally heavy rains that day. The tail dike eventually gave way in the morning of the following day, August 20, aggravating further the depth and extent of inundation to both Barangays, including adjacent barangays of both towns. Floodwaters lasted for almost a week. The Pasig-Potrero Bridge along the SCTEX (Subic-Clark-Tarlac expressway) between Porac and Clark broke around 1500H of August 20 due to strong and diverting river flows of the Pasig-Potrero River as per reports by the management of the expressway. Other than diverting and rerouting of vehicles away from this part of the expressway, there were no reported casualties as a result of this incident.

[4] *NDRRMC Sitrep 20 re Effects of Southwest Monsoon (Habagat) enhanced by Tropical Storm Maring, 30 August 2013, 5:00pm (www.ndrrmc.gov.ph)*

## 7.0 Areas Flooded within the PRB

Available situational reports provided by various LDRRMOs within the basin and from the NDRRMC website were gathered to produce an estimated list of areas (towns) affected during the event and an estimated point flood level map of the basin.

Table 6.0 Areas flooded per Province within PRB with estimated range of flood depth

| Towns | Number of Barangays affected as per reports | Estimated range of flood depths reported / observed (meters) | Situational Remarks |
|---|---|---|---|
| Province of Bulacan | | | |
| Calumpit | 11 | 0.5 – 1.0 | Riverside areas / affected by tides |
| Hagonoy | 28 | 0.3 – 1.0 | Mainly affected by tides |
| Malolos City | 16 | 0.3 – 1.2 | Riverside areas / affected by tides |
| Pulilan | 8 | 0.6 – 1.2 | Riverside and Rice field areas |
| Province of Pampanga | | | |
| Guagua | 31 | 0.3 – 1.2 | Affected by tides |
| Sasmuan | 12 | 0.3 – 0.6 | Affected by tides |
| Candaba | 9 | 0.3 – 2.0 | Riverside and swamp areas |
| Masantol | 26 | 0.4 – 0.6 | Mainly affected by high tide |
| San Luis | 12 | 0.3 – 0.6 | Mostly rice field areas |
| Sta. Ana | 2 | 0.3 – 0.6 | Mostly rice fields (ponded rainwater) |
| Apalit | 12 | 0.3 – 1.0 | Riverside and Rice field areas |
| Mexico | 3 | 0.3 | Mostly rice fields (ponded rainwater) |
| Porac | 2 | 0.6 | Riverside areas |
| San Simon | 2 | 0.4 – 1.2 | Rice field areas |
| Sta. Rita | 1 | 0.3 | |
| Sto. Tomas | 7 | 0.6 – 1.2 | Aggravated by breaching of tail dike |
| Floridablanca | 10 | 0.5 – 1.5 | Riverside areas |
| Bacolor | 9 | 0.3 – 1.2 | Ponded rainwater |
| Macabebe | 22 | 0.8 – 1.2 | Mainly affected by tides |
| Arayat | 3 | 0.3 – 0.5 | Riverside areas |
| Minalin | 7 | 0.6 – 0.9 | Aggravated by breaching of tail dike |
| Lubao | 40 | 0.3 – 1.5 | Affected by tides; rice field areas |
| San Fernando | 14 | 0.3 – 1.5 | Mostly low elevated areas |
| Province of Nueva Ecija | | | |
| Cabanatuan | 2 | 0.3 – 0.5 | Short torrential rains |
| Province of Tarlac (within PRB) | | | |
| La Paz | 9 | 0.3 – 0.5 | |
| Concepcion | 8 | | Rice field areas |
| Capas | 8 | | Rice field areas |
| Bamban | 1 | | Rice field area |
| *Note: There are other areas within the province that have been flooded but are outside the PRB.* | | | |

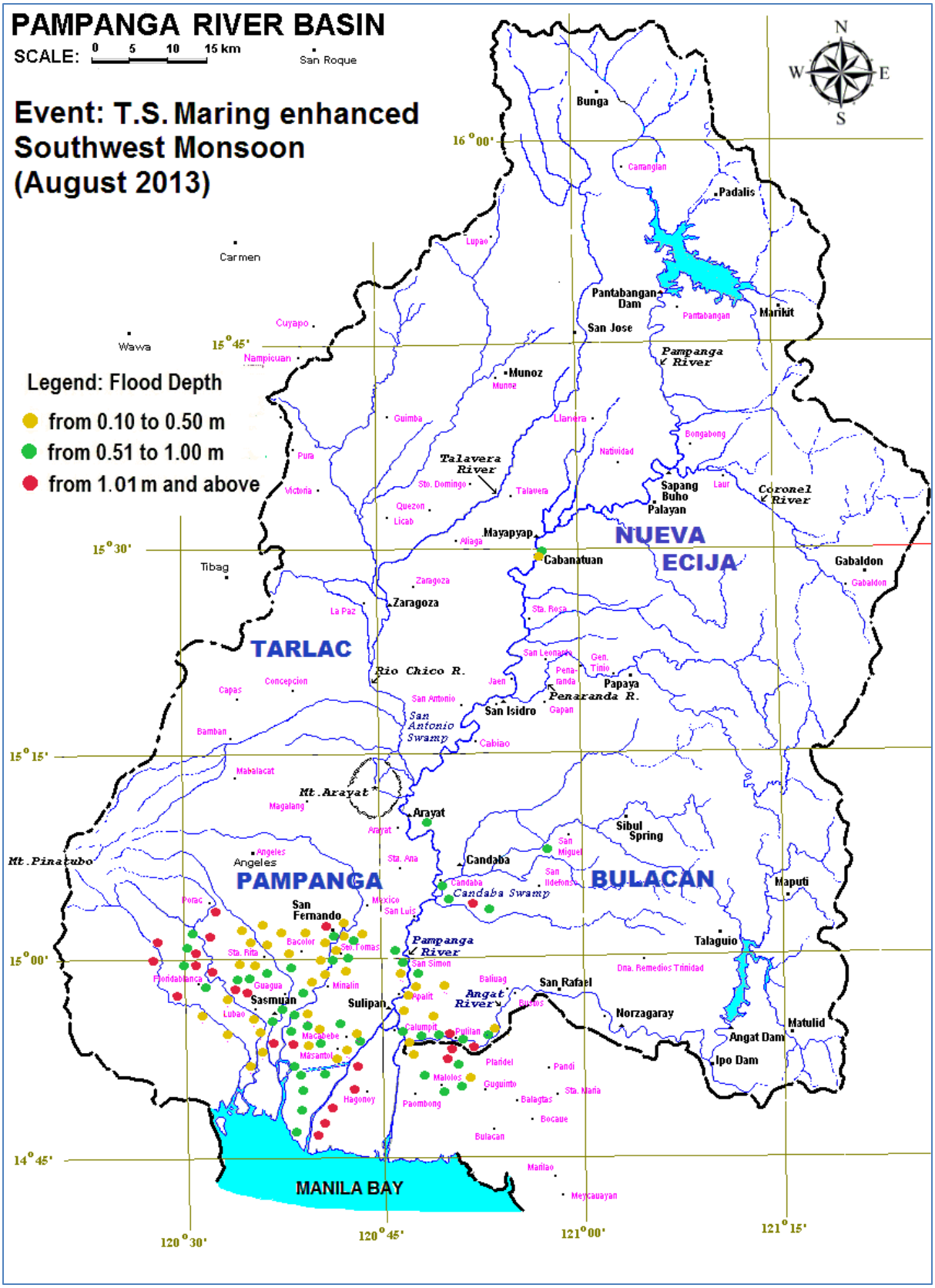


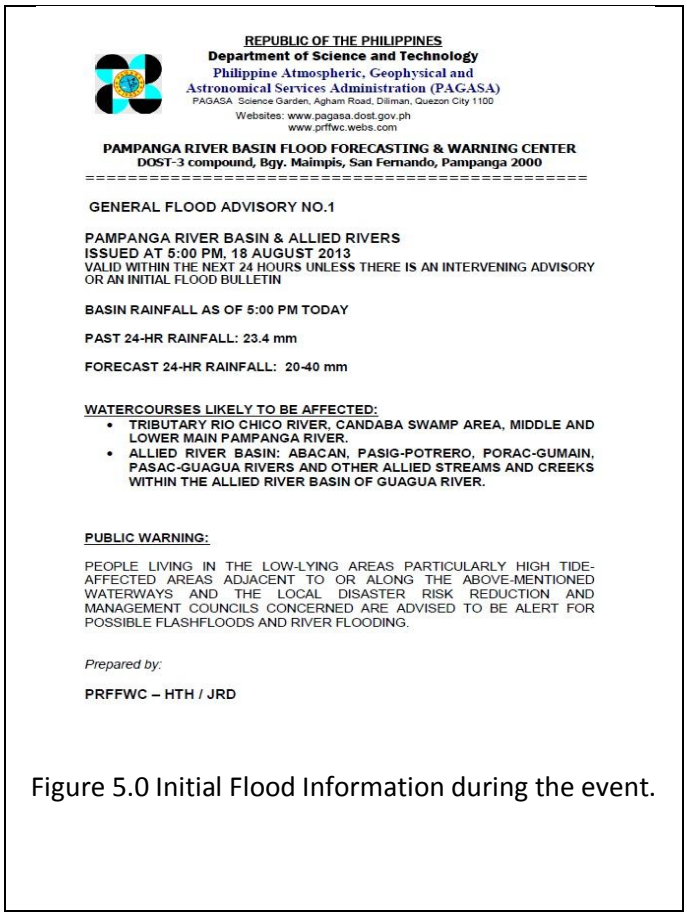

Figure 4.0 Estimated spot flood level map during the event as per available reports from the various DRRMOs within the basin.

## 8.0 Flood Forecasting & Warning Activities

Initial flood information, which is a Flood Advisory, for the event was issued at 1700H of August 18.

Flood Advisory (FA) is hydrological information in general or in its simplest form. It is initialized anytime during flood watch period for awareness and / or preparedness purposes of the flood prone areas within the basins, focusing on rivers and streams that are likely to be affected by heavy intensity rainfall resulting to high streamflow causing possible flooding or flash flooding. [5]

FA no. 2 was issued at 0500H of August 19. By the afternoon of that day, 1700H, the first Flood Bulletin (FB) was issued. All succeeding FBs for the period August 19 to 27 were issued daily at 0500H and 1700H. There were no intermediate bulletins issued during the period.



REPUBLIC OF THE PHILIPPINES
Department of Science and Technology
Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)
PAGASA Science Garden, Agham Road, Diliman, Quezon City 1100
Websites: www.pagasa.dost.gov.ph
www.prffwc.webs.com

PAMPANGA RIVER BASIN FLOOD FORECASTING & WARNING CENTER
DOST-3 compound, Bgy. Maimpis, San Fernando, Pampanga 2000

GENERAL FLOOD ADVISORY NO.1

PAMPANGA RIVER BASIN & ALLIED RIVERS
ISSUED AT 5:00 PM, 18 AUGUST 2013
VALID WITHIN THE NEXT 24 HOURS UNLESS THERE IS AN INTERVENING ADVISORY OR AN INITIAL FLOOD BULLETIN

BASIN RAINFALL AS OF 5:00 PM TODAY

PAST 24-HR RAINFALL: 23.4 mm

FORECAST 24-HR RAINFALL: 20-40 mm

WATERCOURSES LIKELY TO BE AFFECTED:
- TRIBUTARY RIO CHICO RIVER, CANDABA SWAMP AREA, MIDDLE AND LOWER MAIN PAMPANGA RIVER.
- ALLIED RIVER BASIN: ABACAN, PASIG-POTRERO, PORAC-GUMAIN, PASAC-GUAGUA RIVERS AND OTHER ALLIED STREAMS AND CREEKS WITHIN THE ALLIED RIVER BASIN OF GUAGUA RIVER.

PUBLIC WARNING:

PEOPLE LIVING IN THE LOW-LYING AREAS PARTICULARLY HIGH TIDE-AFFECTED AREAS ADJACENT TO OR ALONG THE ABOVE-MENTIONED WATERWAYS AND THE LOCAL DISASTER RISK REDUCTION AND MANAGEMENT COUNCILS CONCERNED ARE ADVISED TO BE ALERT FOR POSSIBLE FLASHFLOODS AND RIVER FLOODING.

*Prepared by:*

PRFFWC – HTH / JRD

Figure 5.0 Initial Flood Information during the event.

Flood Bulletins (FB) are more specific flood information issued whether or not it is being preceded by a basin general flood advisory (depending on the situation) during flood watch monitoring. It can be initialized anytime and issued regularly by FFWCs thereafter until being finalized when floodwaters have generally subsided or no significant increases in the present situation is expected further. FB is more near specific as to river level changes, in terms of its rising and falling trends including possible areas (towns/cities) to be affected. FBs are issued by the PRFFWC at 5am and 5pm daily during flood watch operations unless when situations warrants that an intermediate FB needs to be issued at any time between those two issuance stages to cover for unfavorable situations within the basin.

Total flood information issued during Habagat 2013 event was 18 (2 FAs and 16 FBs). FAs and FBs are forwarded directly to DRRM offices at the national level (NDRRMC), the regional and the local levels within the basin (RDRRMO and basin PDRRMOs), including the FFWS operations center of PAGASA. All issued flood information are also uploaded to the center's website; e-mailed directly to various local DRRM entities, individuals, etc; also shared in various social networks – "facebook" and "twitter".

[5] *Provision of Hydro (Flood) Information Protocol (as of July 2011) by H.M. Borja, AWSC, HMD*

Department of Science and Technology
PHILIPPINE ATMOSPHERIC, GEOPHYSICAL AND ASTRONOMICAL SERVICES ADMINISTRATION (PAGASA)
Pampanga River Flood Forecasting and Warning Center, Hydro-Meteorology Division/NCR-PRSD
Brgy.Maimpis, San Fernando, Pampanga (D.M. Government Center) http://www.prffwc.webs.com

**FLOOD BULLETIN NO. SIXTEEN (16) FINAL – PAMPANGA RIVER BASIN AND ALLIED RIVERS**
ISSUED AT: **5:00 AM, 27 AUGUST 2013**
**VALID FOR THE NEXT 24 HOURS**

**BASIN RAINFALL AS OF 4:00 AM TODAY:**
PAST 24-HR = 5.3 MM FORECAST 24-HR = LESS THAN 10 MM

**BASIN EXPECTED RESPONSE:**

| WATER LEVEL STATION (STN) | RIVER/ SWAMP WATER LEVEL (WL) TREND AT STATION | FLOOD SITUATION MESSAGE | PARTICULAR LOW-LYING AREAS |
|---|---|---|---|
| ARAYAT STN. PAMPANGA RIVER | NOW AT 7.20 M / STEADY RECESSION TO CONTINUE; EXPECTED TO REACH BELOW THE 6.0 M ALERT WL BY LATE TODAY | FLOODING HAS GENERALLY SUBSIDED BUT STILL PERSISTS IN SEVERAL LOW-LYING AREAS FOR A FEW DAYS | RIVERSIDE AREAS OF ARAYAT, SAN LUIS, SAN SIMON |
| CANDABA STN. CANDABA SWAMP | NOW AT 6.07 M / A VERY SLOW RECESSION TO CONTINUE TO REACH 5.0 M CRITICAL WL IN 2 TO 3 DAYS | FLOODING TO PERSIST FOR SEVERAL DAYS | CANDABA SWAMP AREA, PORTIONS OF SAN LUIS, SAN SIMON, APALIT |
| SULIPAN STN. PAMPANGA RIVER | NOW AT 3.07 M / SLOW RECESSION TO REACH BELOW 3.0 M WL BEFORE NOON TODAY (ALERT WL IS 3.6) | FLOODING HAS GENERALLY SUBSIDED BUT STILL PERSISTS IN SEVERAL LOW-LYING AREAS | RIVERSIDE AREAS OF APALIT, CALUMPIT, HAGONOY |
| ANGAT RIVER | | BACK TO NORMAL RIVER CONDITION; FLOODING IS NOT LIKELY TO HAPPEN | RIVERSIDE AREAS OF BUSTOS, BALIUAG, PLARIDEL, PULILAN, CALUMPIT |
| **COASTAL FLOODING IN THE LOW-LYING AREAS (TIDE INFLUENCED AREAS)** | | | HAGONOY, PAOMBONG, MACABEBE, MASANTOL |

THE RESIDENTS AND THE LOCAL DISASTER RISK REDUCTION & MANAGEMENT COUNCILS (LDRRMCs) CONCERNED ARE STILL ADVISED TO CONTINUE TO TAKE APPROPRIATE ACTIONS.

HTH / JRD

EXPECTED FLOOD SITUATION: P=POSSIBLE T=THREATENING O=OCCUR F=PERSIST

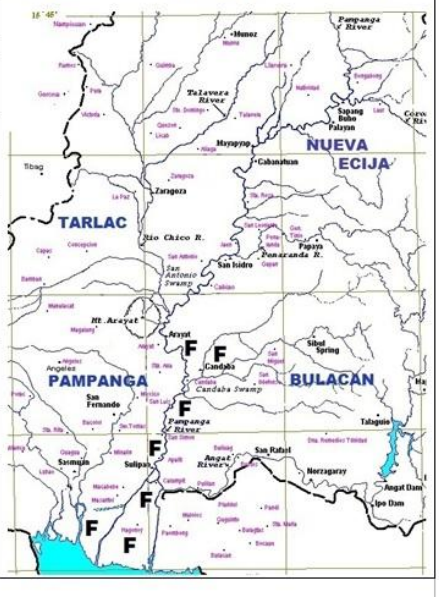



Figure 5.1 Final FB, number 16 (above) issued 0500H of August 27, still maintaining floods to remain or persist (symbol "F") at several areas along the main river. Floods at these areas remained for several days due to area characteristics, tide influenced and ponding of floodwaters due to relatively low elevation characteristics.

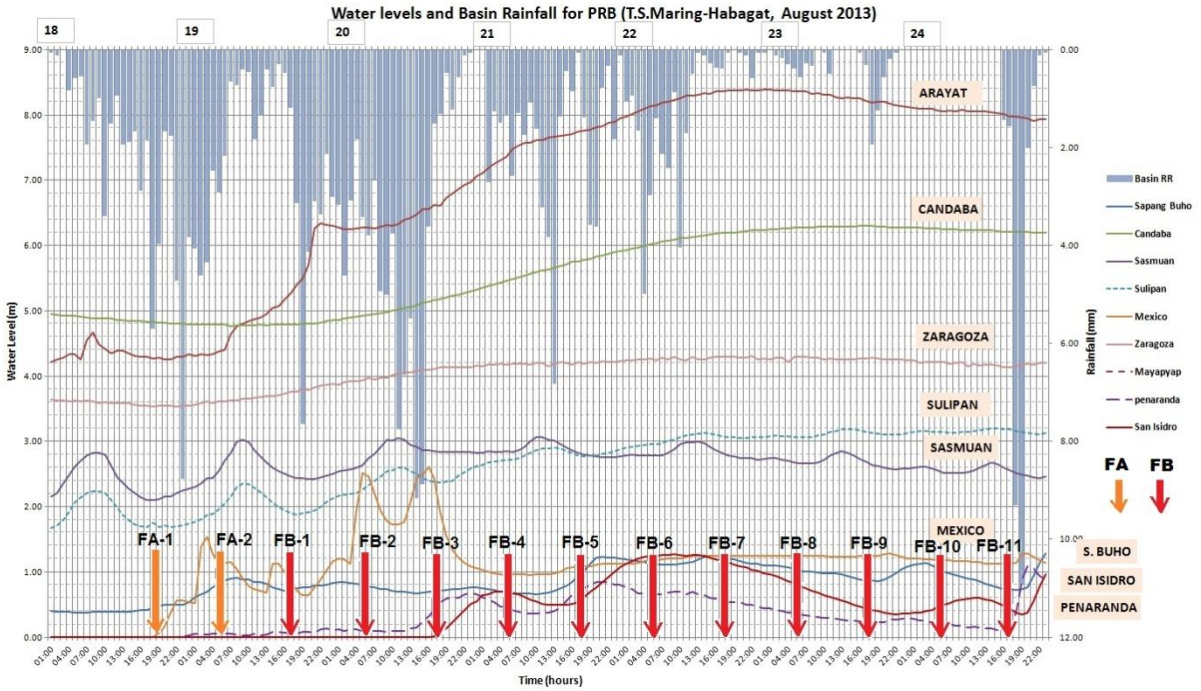



Figure 5.2 Event basin hyetograph and hydrographs (above) for the period August 18 to 24 with the corresponding time issuance of FAs and FBs relative to the basin's hydrological flood event.

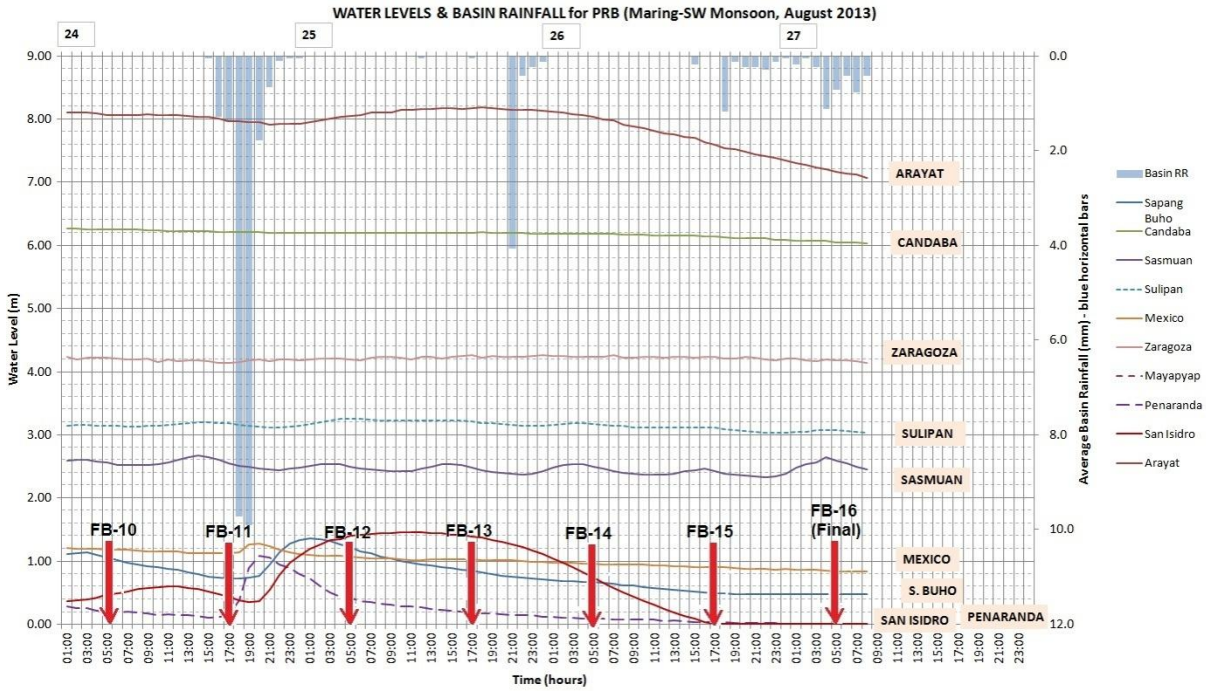



Figure 5.3 Event basin hyetograph and hydrographs (above) for the period October 01 to 04 with the corresponding time issuance of FBs relative to the basin's hydrological flood event.

## 9.0 Event Highlights (in Pictures)


Cong Dadong Dam, gravity irrigation dam about 2.5 kms upstream of Arayat telemetry station, registered a peak gauge reading of around 9.80 meters at its reservoir side during the Habagat 2013. The dam can limit its outflow during relatively low flow river conditions but does not have the capacity to regulate its outflow during river flood stages.



(Top) The Abacan River at Mexico station crested at 2.61 meters during Habagat 2013. (Right) A resident of Bgy. San Agustin, Candaba points to the peak floodwaters reached in the area's flood marker in their barangay during Habagat 2013**.**



Top left shows Barangay San Agustin in Candaba on August 24 and the same area location, top right, 10 days later on September 04, 2013 (note the "Happy Fiesta" bamboo arc)



Top left shows Bgy. San Agustin plaza in Candaba on August 24 and the same area location, top right, on September 04, 2013. Note that the plaza ground is still about 1 meter above the road level.


Waist deep floodwaters at St.Jude Phase 2 in Bgy. San Agustin, San Fernando City, August 20.


Floodwaters at around knee deep level in Bgy. Sto.Niño, San Fernando City on August 21.


Floodwaters along the Jose Abad Santos Avenue, San Fernando City on August 20.


McArthur Hi-way at Sa Nicolas, San Fernando City on August 20.

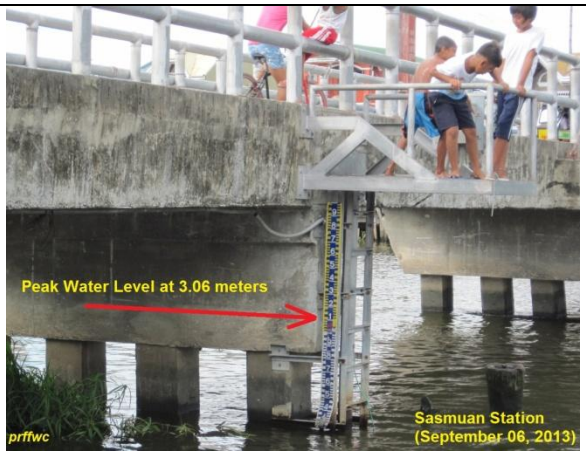


Floodwaters along the McArthur hi-way in Malolos City in Bulacan during Habagat 2013.



Mabini Homes Subdivision in Cabanatuan City (above) was affected by an unusual flashflood late afternoon of August 24. No casualties were reported during the event.


The Candaba Municipal Building with less than a foot deep of floodwaters surrounding it on August 24, 2013.




River stage recorded at Sasmuan water level telemetry station crested at 3.06 meter on August 21, 2013.


A resident of Bgy. Candating in Arayat points to a thigh deep flood mark at the wall of a house in the area.


Knee-deep of floodwaters affected Barangay Remedios in Lubao, Pampanga (August 2013).


Bgy. San Isidro, Lubao was also affected by thigh to waist deep of floodwaters during Habagat 2013.


about a foot deep of floodwaters (top left) along the road going to Bgy. Sto. Nino, Hagonoy on August 22. The town is mainly affected by high tide, and by the overflowing of Pampanga River during flood season.


Peak river stage of Bagbag River as seen on the flood marks left at the staff gauge on Caniogan bridge is around 1.90 meters. Bagbag River joins Angat River with Pampanga River at Calumpit, Bulacan.


The breached tail dike in Bgy. Sta. Rita, Minalin is shown above (top left) taken on August 21.


A gap on the Pasig-Potrero Bridge along SCTEX between Porac and Clark occurred in the afternoon of August 20.

## 10.0 Event Comparison

The peak river stages recorded at various water level telemetry stations of the PRFFWC during T.S. "Maring" enhanced southwest monsoon (Habagat 2013) are definitely far lesser than the recorded levels during Habagat 2012 and 2004. It is also quite way below the levels recorded during T. "Pedring" (September 2011) event.

Table 7.0 Peak stages attained at each WL station as per various flood events for PRB.

| Water Level stations | **T.S. Maring enhanced SW monsoon (Aug 2013)** | **Habagat (Aug 2012)** | **T. Pedring (Sept - Oct 2011)** | **T. Marce enhanced SW monsoon (Aug 2004)** |
|---|---|---|---|---|
| Sapang Buho | **1.36** | **1.63** | **7.17** | **5.45** |
| Mayapyap | (out of order) | **0.60** | **6.86** | **5.06** |
| Zaragoza | **4.31** | **4.64** | **15.40** | **15.39** |
| Peñaranda | **1.08** | **1.68** | **6.01** | (not yet operational) |
| San Isidro | **1.46** | **3.29** | **7.75** | **6.70** |
| Arayat | **8.39** | **9.24** | **10.6 (est.)** | **10.03** |
| Candaba | **6.30** | **6.93** | **7.62** | **7.38** |
| Mexico | **2.61** | **3.46** | **3.30** | (not yet operational) |
| Sasmuan | **3.06** | **3.17** | **3.09** | **2.06 (est.)** |
| Sulipan | **3.26** | **3.95** | **4.85** | **4.39** |
| *Note: "(est.)" means value was estimated based on flood marks; Values in red are highest for the four events. Peñaranda and Mexico stations started operations in 2009 only.* | | | | |

**References:**

Reports:
PRFFWC Initial Post-Flood Report: Southwest Monsoon (Habagat 2012), (August 06 to 17, 2012); PRFFWC, PAGASA, DOST. 2012

PRFFWC Post-Flood Report 2011-2; Pampanga River Basin Flood Events: Typhoons "Pedring" and "Quiel", Sept. 26 to Oct. 04, 2011; PRFFWC, PAGASA, DOST. 2011

PRFFWC Post-Flood Report. Pampanga River Basin: Flood of August 2004 (Southwest Monsoon as enhanced by Typhoon Marce). PRFFWC, PAGASA. October 2004

Resource Entities:

1. National Disaster Risk Reduction & Management Council (www.ndrrmc.gov.ph)
2. Office of Civil Defense Reg. 3 / Regional Disaster Risk Reduction & Management Council 3
3. Department of Agriculture Reg. 3
4. Department of Social Welfare & Development Reg. 3
5. Pampanga Provincial Disaster Risk Reduction & Management Office
6. Bulacan Provincial Disaster Risk Reduction & Management Office
7. Nueva Ecija Provincial Disaster Risk Reduction & Management Office
8. Tarlac Provincial Disaster Risk Reduction & Management Office
9. Guagua Municipal Disaster Risk Reduction & Management Office
10. Hagonoy Municipal Disaster Risk Reduction & Management Office
11. City Disaster Risk Reduction & Management office of San Fernando City
12. Baliuag University SHINe program
13. PAGASA Cabanatuan Synoptic Station
14. PAGASA Clark Synoptic Station
15. CLTV-36

Resource Persons:

1. Mayor Emmanuel Alejandrino, Arayat, Pampanga
2. Engr. Nemensio Benoza, MDRRMO-Macabebe
3. Hejohn Gabriel, Sr., Cong Dadong Dam, Arayat, Pampanga
4. Ana Pineda, resident of Bgy. Candating, Arayat, Pampanga
5. Helen Bagasao, CSWDO-CDRRMO, Cabanatuan City
6. Geia Santiago, MDRRMO, Hagonoy, Bulacan
7. Rico Yumul, MDRRMO, Minalin, Pampanga
8. Edgar A. Dabu, MDRRMO, Lubao, Pampanga
9. Engr. Allan Odchigue, MPDO/MDAO, Municipality of Apalit, Pampanga
10. Cesar Jornadal, resident of Bgy. San Mateo, Arayat, Pampanga
11. Bryan Cyro Velasco, PDRRMO-Bulacan
12. Raul Agustin, PDRRMO-Bulacan
13. Liz L. Mungcal, Executive Officer, PDRRMO-Bulacan
14. Jojo Tomas, MDRRMO, Calumpit, Bulacan
15. Liza A. Quiambao, MPDC, Sto. Tomas, Pampanga
16. Aldwin Mallari, MDRRMO, Guagua, Pampanga
17. Engr. Josephine Legaspi, PDRRMO-Nueva Ecija
18. Marvin Guiang, PDRRMO-Tarlac
19. Neth Jiao, PDRRMO-Pampanga
20. Engr. Alejandro Pangan, DPWH-3