

## PRFFWC Post-Flood Report 2023 <sup>1</sup>

### PAMPANGA RIVER BASIN Flood Event

**Southwest Monsoon enhanced by Tropical Cyclones “EGAY”  
(DOKSURI) and “FALCON” (KHANUN)  
July 24 to August 06, 2023**



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**Southwest Monsoon enhanced by  
Tropical Cyclone “EGAY” (*International Name: DOKSURI*) &  
Tropical Cyclone “FALCON” (*International Name: KHANUN*)  
July 24 to August 06, 2023**

**PRBFFWC, October 2023**

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### Acronyms & Abbreviations

Bul	Bulacan
CL	Central Luzon
CSFP	City of San Fernando, Pampanga
cms / cumecs	Cubic meters per second
DMGC	Diosdado Macapagal Government Center
DRRM	Disaster Risk Reduction & Management
D/S	Downstream

D/T	Downtime
FA	Flood Advisory
FB	Flood Bulletin
HMD	Hydro-Meteorology Division
HMDAS	Hydro-Meteorological Data Applications Section
kph or km/h	kilometers per hour
km <sup>2</sup>	square kilometers
kts	Knots
LB	left bank
LDRRMO	Local Disaster Risk Reduction & Management Office
LGU	Local government Unit
LPA	Low Pressure Area
LST	Local Standard Time
met	Meteorological
MMSS	Marine Meteorological Services Section
mps	meters per second
NCR-PRSD	National Capital Region – PAGASA Regional Services Division
NE	Nueva Ecija
NIA-UPRIIS	National Irrigation Administration – Upper Pampanga River Integrated Irrigation System
NLEX	North Luzon Expressway
OCD	Office of Civil Defense
PAR	Philippine Area of Responsibility
Pamp	Pampanga
pic	picture
PRB	Pampanga River Basin
PRBFFWC	Pampanga River Basin Flood Forecasting & Warning Center
PAGASA	Philippine Atmospheric, Geophysical & Astronomical Services Administration
Q	Discharge
RB	right Bank
RR	Rainfall
SG or S.G.	Staff Gauge or staff gage
SW monsoon	Southwest monsoon (or Habagat)
STS	Severe Tropical Storm
Tar	Tarlac
TCB	Tropical Cyclone Bulletin
TC / TCWS	Tropical Cyclone / Tropical Cyclone Wind Signal
TD	Tropical Depression
TS	Tropical Storm



T or Ty	Typhoon
STy	Super Typhoon
UTC	Universal Time Coordinated
U/S	Upstream
WD	Weather Division
WL	Water Level
WMO	World Meteorological Organization
Wx or wx	Weather
N/R/P/C/M	National / Regional / Provincial / City / Municipal
DRRM O/C	Disaster Risk Reduction & Management Office / Council

## **Preface**

This report gives a view of the hydrological condition of the Pampanga River Basin from the effects of the Southwest Monsoon as enhanced by Tropical Cyclones “EGAY” and “FALCON” during the period July 24 to August 06, 2023. This is presented through the available observed rainfall, water level data, the collated flood information from various sources and the resulting assessed flood episode in the PRB. This report will not provide specifics as to what caused the flooding in the PRB but mainly, the focus is to relate the operational flood forecasting & warning activities of the PRBFFWC as the flood episode unfolded during the event. It also provides a brief evaluation and assessment of the center’s performance which may give basis in the enhancement of future operational hydrological information / warning issuances and other related activities during imminent flood situations within the PRB.

The information and other resulting outputs presented herein have been managed and validated through the best possible means available to the PRBFFWC at its time of processing. However, it is still possible that contents here may have inadvertent results and / or errors. Some of the data, information and pictures included in this report are credited to the respective sources with no intentions of copyright infringement; all materials were mainly used for research and reporting purposes only. The views expressed herein do not necessarily have the endorsement of PAGASA or any office / divisions of the agency. Further, as a caveat, users may freely use the information / data contained herein at their own risk.

An initial post-event survey was first conducted by the PRBFFWC on August 16 to 18 together with the HMDAS survey team of the HMD. The center’s post-flood survey was actually carried-out on August 22 to 27, 2023.

## Summary

**The SW monsoon's occasional and at times incessant rains** over Pampanga River Basin between the period July 25 to August 01 as enhanced by Tropical Cyclones "EGAY" and "FALCON" resulted in the prolonged inundation of the Candaba swamp area and in many areas in the Pampanga Delta. This flood episode affected an aggregate total of more than 414,000 families in some 441 barangays within the PRB. The reported total damage to agriculture and infrastructure for Region 3 was assessed at ₱ 2.2 B and ₱ 2.5 B, respectively. <sup>2</sup>

About a week prior to this flooding episode from the period July 14 to 17, however, occasional to frequent monsoon rains enhanced by Tropical Cyclone "DODONG" had already drenched the PRB resulting in Pampanga River WL at Arayat to reach Alert status and the Candaba swamp WL surpassing Alarm status. It also brought the Zaragoza WL to be above its assessed Alert WL and it remained above the said status until the TCs Egay-Falcon enhanced SW monsoon affected the basin. Except for reported pluvial floods in several areas within the basin, no fluvial or river overflowing occurred during TC DODONG event.

The PRBFFWC issued a total of 4 flood advisories (FA) and 23 flood bulletins (FB) for the PRB as per the SW monsoon effects generated by TCs EGAY & FALCON that is from July 24 to August 06. The final FB was issued with several WL stations still above their respective assessment levels, i.e., Candaba swamp WL was still above Critical, Pampanga River in Arayat was above Alarm, and 2 other WL stations, Zaragoza and Sulipan stations were both above Alert status. The final flood bulletin was initiated as soon as a definite recession of WL had already been manifested in all stations and with the likelihood of improving hydrological condition expected in the PRB for the next several days. This event has had the greatest number of flood information / warnings issued by the PRBFFWC ever since it relocated to the CSFP in 2009. It should also be noted though that all upstream stations of PRBFFWC during this event were down and this was the situation since mid-March of the year, that is 9 out of the 17 and 4 out of the 9 rainfall and water level stations operational, respectively.

The prolonged and persistent flooding in several parts of the Pampanga Delta area lasted for almost a month as it was somewhat sustained by relatively higher tide levels occurring during that period. In fact, several areas in the Pampanga Delta have already been regularly affected by standing floodwaters due to effects of tides even before this event. The perennial and the now "controversial" prolonged flooding of these areas became a highlight of national interest and steps to address the issues are now presently being resolve. <sup>3</sup>

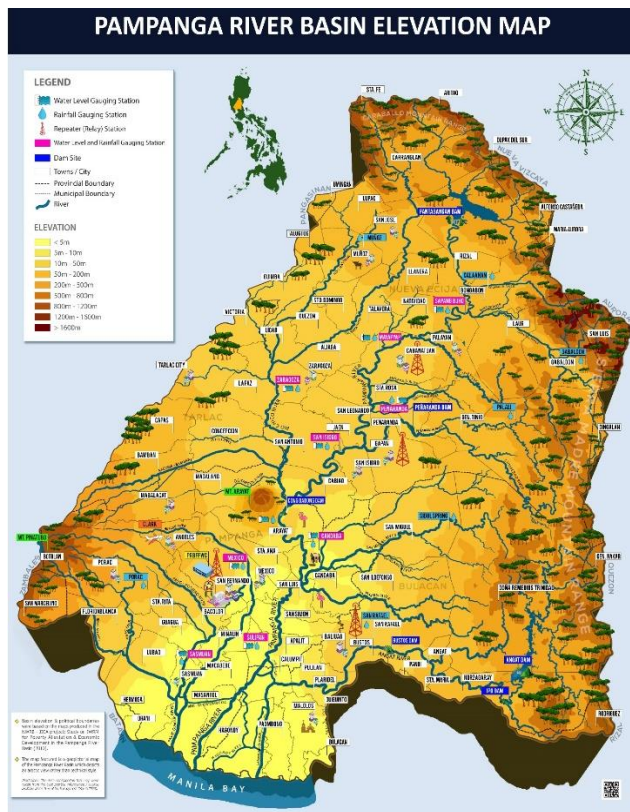
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<sup>2</sup> NDRRMC SitRep No. 36 for SW Monsoon enhanced by TCs EGAY and FALCON (2023) as of 0800H, 24 Aug 2023

<sup>3</sup> <https://www.youtube.com/watch?v=2ZWmxYuGxnA>

## 1.0 Hydrological area background of Pampanga River Basin (PRB) <sup>4</sup>

Pampanga River Basin (PRB) is the 4<sup>th</sup> largest river basin in the Philippines. It drains an aggregate area of 10,434 km<sup>2</sup>. It is generally divided into three sub-basins, namely: (a) Main Pampanga River Basin with its catchment area of 7,978 km<sup>2</sup>, (b) Pasiac River sub-basin (also known as the allied sub-basin of Pasiac-Guagua River system) with 1,371 km<sup>2</sup> and (c) Angat River sub-basin with 1,085 km<sup>2</sup>. Roughly 95% of the basin transcends 4 provinces of Region 3, i.e., nearly the whole of Nueva Ecija, about a third of Tarlac, around two-thirds of Bulacan, and almost whole of Pampanga.



**Figure 1.0** Above shows a “geopictorial” map representation of the elevation changes in the Pampanga River Basin. The elevation color-code is given in the legend box.

Main Pampanga River has a river length of about 265 kilometers with its headwaters situated in the Caraballo Mountains at north of the basin. It flows down into the Pantabangan storage dam and generally move southward joining with several tributaries until it finally drains into Manila Bay. The major tributaries are the Digma, Coronel, Peñaranda, and Rio Chico Rivers. Rio Chico has the largest catchment area at 2,895 km<sup>2</sup> and joins the main stream of Pampanga just before the Mt. Arayat (about 1,026 m in elevation).

Another tributary, the Angat River system originating in the Sierra Madre Mountains flows into the Angat storage dam. From the dam, the river flows generally westward and it mainly empties into the Manila Bay through the Labangan channel. The Bagbag River connects Angat with Pampanga River and is situated between the towns of Pulilan and Calumpit in the Province of Bulacan.

The PRB has two swamp areas, the Candaba and the San Antonio swamps with an area of about 250 and 100 km<sup>2</sup>, respectively. Candaba Swamp covers a maximum inundation area of around 330 km<sup>2</sup> during rainy season.

The Pantabangan and Angat Dams are the two major hydraulic structures within the basin. Pantabangan is situated at the upper main Pampanga River northeast part of the basin and operates both as hydropower and as an irrigation dam. On the other hand, Angat dam is located on the southeastern portion of the basin and drains through the Angat River via the Ipo and Bustos Dams.

<sup>4</sup> Parts were 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. PRBFFWC was a member of the TWG in the said project

Angat mainly operates as a hydropower plant while Ipo and Bustos are as water supply reservoir and irrigation dams, correspondingly.

The Pasiac-Guagua River system is an allied sub-basin of PRB which includes various channels running on the eastern slope of Mt. Pinatubo. These are the Abacan-San Fernando, Pasig-Potrero and Porac-Gumain Rivers. All of these originates in Mt. Pinatubo and flow towards Manila Bay. The lower reach of the main river system is connected with Main Pampanga River thru the Bebe-San Esteban Cut-off Channel. The Rivers in this sub-basin were largely affected by the eruption of Mt. Pinatubo in 1991 such that river alignments have changed significantly due to the mudflows (lahar). Substantial sediment deposition in the river channel is still active.

Long-term average annual precipitation in the PRB is estimated at about 2,155 mm/year, and about 83% of this is concentrated during the rainy season from May to October.

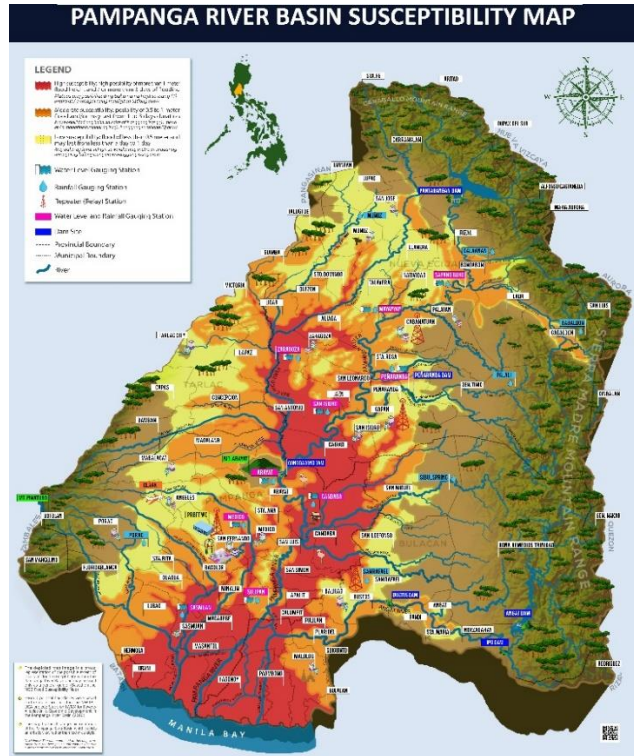


Figure 1.1 Above is a “geopictorial” map representation of the flood susceptibility within the PRB. The red colored areas are designated as highly susceptible, orange as moderately susceptible, and yellow colored as low susceptibility.

## 2.0 The Pampanga River Basin Flood Forecasting & Warning Center (PRBFFWC)

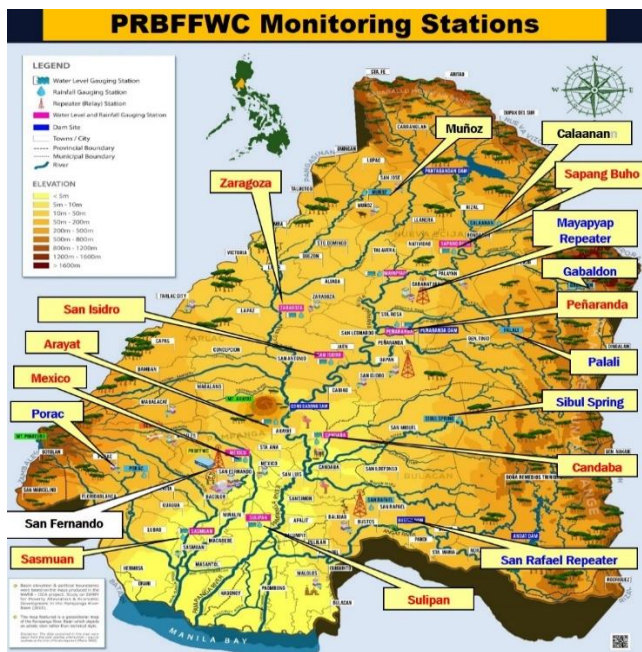


Figure 2.0 Map showing the location of monitoring stations of the PRBFFWC in the Pampanga River Basin.

The PRBFFWC is the main operations center of PAGASA that is responsible in providing hydrological information and / or flood warnings whenever necessary to the flood-prone communities in the PRB. The center issues flood warnings in the form of Flood Advisories (FAs) and Flood Bulletins (FBs) during imminent flood situations or floods that are likely to affect areas within the PRB. The hydrological monitoring system is composed of 17 rain and 10 water level (WL) telemetry stations. It is complemented with 2 synoptic station & an agrometeorological station within the basin. These latter stations, however, are not automatically transmitting data on a real-time basis to the center.

The PRBFFWC started operational flood forecasting & warning in 1973 in its location in Diliman, Quezon City and later transferred its center in the City of San Fernando, Pampanga in 2009. Additional information about PRBFFWC can be access through the website <http://prffwc.synthasite.com/>

### 3.0 Meteorological aspect

#### 3.1 The Southwest Monsoon

The Southwest (SW) Monsoon or “Habagat” in Filipino is a wind system that is characterized by warm moist air coming from the southwest towards the Philippines. The system is oftentimes associated with humid weather coupled with frequent heavy rainfall. It usually affects the country from May to October but occurrence period may also vary each year.

Some of the notable SW monsoon events that affected the PRB during the past 2 decades were the SW of August 2004 as enhanced by TC “MARCE”, SW of June 2011 as enhanced by TC “FALCON”, the SW of August 2012 which was considered as one unforgettable flood event in PRB (refer to cover picture for stage attained in Candaba station), and the SW of August 2013 as enhanced by TC “MARING”.

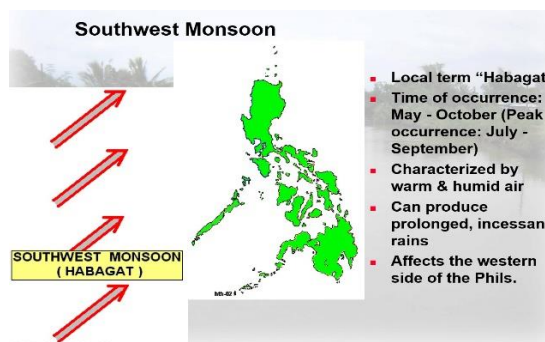


Figure 3.0 A simple descriptive representation of the SW Monsoon and how it affects the Philippines

The SW Monsoon of this year 2023 as enhanced by TC “EGAY” and “FALCON” had frequent monsoon rains mostly over the middle and lower sections of the PRB which lasted for about 2 weeks. This may have been one of the reasons in the prolonged flooding of the Candaba and Pampanga Delta areas.

#### 3.2 Tropical Cyclone “EGAY”<sup>5</sup>

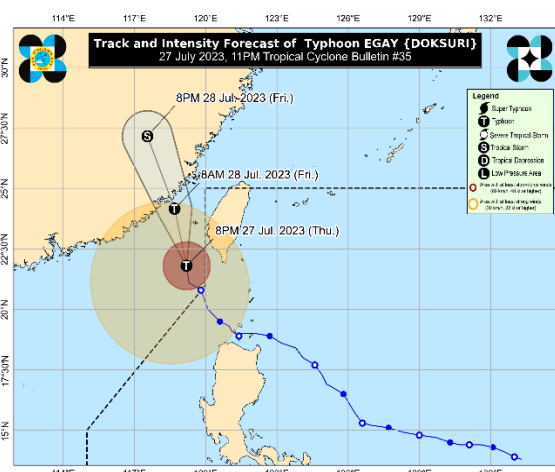


Figure 3.1 Track of TC Egay within the PAR (taken from the WD issued TCB No. 35F for TC Egay)

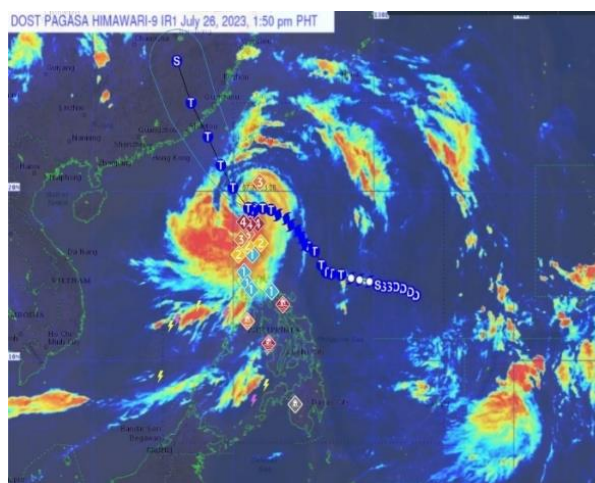


Figure 3.2 Satellite image (1350H LST, 28 July 2023) showing the extent coverage of TC Egay and the SW monsoon over the island of Luzon.

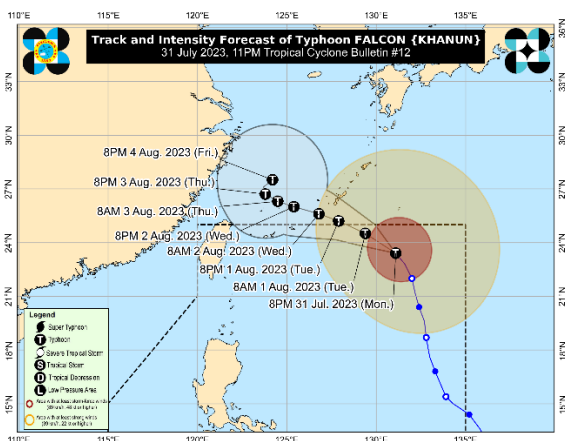
<sup>5</sup> [https://pubfiles.pagasa.dost.gov.ph/pagasaweb/files/tamss/weather/tcprelimsummary/PAGASA\\_Prelim\\_2023\\_EGAY\\_Updated%20\(1\).pdf](https://pubfiles.pagasa.dost.gov.ph/pagasaweb/files/tamss/weather/tcprelimsummary/PAGASA_Prelim_2023_EGAY_Updated%20(1).pdf)

“EGAY” developed into a Tropical Cyclone over the Philippine Sea at far east of southeastern Luzon on 1800 UTC, July 20, 2023. It reached Super Typhoon Category with peak intensity of 185 kph at around 1800 UTC on July 24, 2023. “EGAY” exited the PAR at around 0000 UTC, July 27, 2023. The tropical cyclone trekked way too far from the PRB. It did, however, enhanced the SW Monsoon over the basin starting around afternoon of July 25 until about August 3.

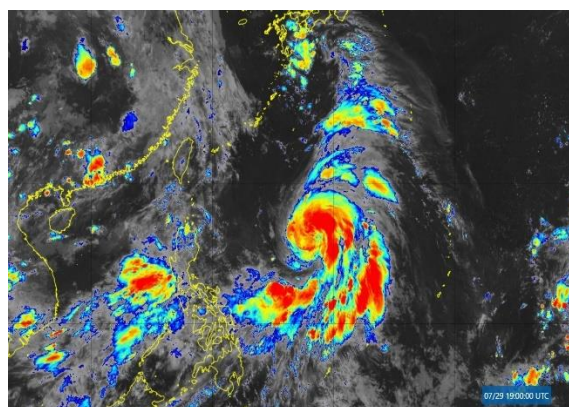
During TC EGAY’s passage within the PAR, the major provinces transcended by the PRB, that is Nueva Ecija, Tarlac, Bulacan and Pampanga, were all placed under TCWS 1 from the period July 24 until the 27. “DOKSURI” is the international name reference of “EGAY” which means eagle in Korean.

### 3.3 Tropical Cyclone “FALCON” <sup>6</sup>

“FALCON” entered the PAR as a Tropical Storm on the ENE side of the country at 1500 UTC, July 28, 2023. It then trekked into a NW to WNW direction away from landmass until it exited at around 0730 UTC, August 01, 2023 as a Typhoon Category TC. Its peak intensity reached 175 kph. Significant hydrometeorological hazard ramification it created was to further enhance the SW monsoon towards the western sections of Luzon including the PRB area. The international name “KHANUN” (meaning Jackfruit) was contributed by the Kingdom of Thailand. No TCWS were raised in any part of the country during TC FALCON.



**Figure 3.3** Track of TC Falcon prior to its exit within the PAR (taken from the WD issued TCB No. 12 for TC Falcon)



**Figure 3.4** JMA satellite image (1900 UTC; 27 July 2023) showing the extent of TC Falcon (Right cloud cluster) upon entry to the PAR and the SW monsoon coverage (Left cloud cluster) west of the island of Luzon.

<sup>6</sup> [https://pubfiles.pagasa.dost.gov.ph/pagasaweb/files/tamss/weather/tcprelimsummary/PAGASA\\_Prelim\\_2023\\_FALCON.pdf](https://pubfiles.pagasa.dost.gov.ph/pagasaweb/files/tamss/weather/tcprelimsummary/PAGASA_Prelim_2023_FALCON.pdf)

#### 4.0 Basin hydrological aspects during the event (July 24 to Aug 04)

##### 4.1 Event basin rainfall

The event rains associated with the SW monsoon enhanced by TCs EGAY & FALCON over the PRB can be collectively presumed to be between July 24 until August 04, 2023.

**Table 1.0** Rainfall Intensity Classification Table (mm/specific time period)

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 – 15	22.5 - 45	> 45	> 90	> 180
Intense	15 – 30	45 - 90			
Torrential	> 30	> 90			

**Table 2.0** Observed 24-hr (met day) rainfall in millimeters from various stations of PRBFFWC for the period July 24 to 31, 2023

Stations	July 24	July 25	July 26	July 27	July 28	July 29	July 30	July 31
Muñoz	1	13	3	72	14	45	3	1
Sapang Buho	12	21	0	43	29	16	11	9
Gabaldon								
Zaragoza	51	31	15	37	33	28	2	4
Mayapyap (NIA-UPRIIS)								
Peñaranda	41	43	30	81	59	52	7	1
Calaanan	2	19	6	58	32	5	32	18
Palali	19	34	42	78	58	32	10	1
San Isidro	16	31	35	78	42	48	5	1
Arayat	11	47	37	78	74	61	7	5
Candaba	5	39	36	72	75	53	8	12
Sibul Spring	43	50	44	109	72	76	17	8
Sulipan	2	29	33	143	87	62	17	27
San Rafael	0	31	14	85	87	80	12	15
Sasmuan	0	38	40	144	112	93	13	39
Mexico	2	33	42	73	70	71	12	15
Porac	3	22	48	144	107	61	3	13
PRBFFWC	1.3	35	46.8	87	102	81.3	10.8	13

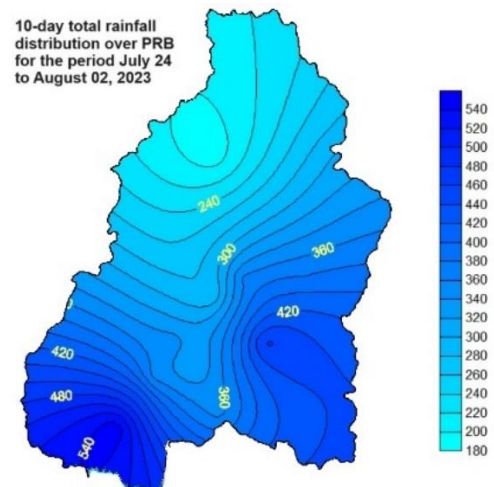
**Table 3.0** Observed 24-hr (met day) rainfall in millimeters from various stations of PRBFFWC for the period August 01 to 04, 2023

Stations	August 01	August 02	August 03	August 04
Muñoz	12	24	4	20
Sapang Buho	39	107	11	4
Gabaldon				

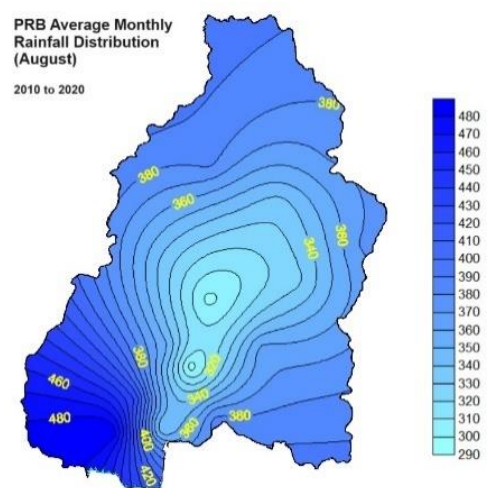
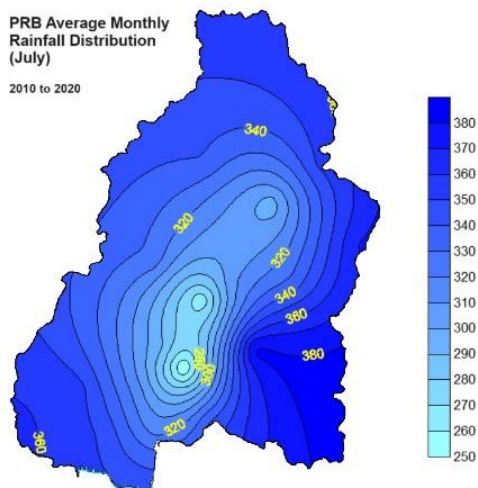


Zaragoza	23	43	2	0
Mayapyap (NIA-UPRIIS)				
Peñaranda	31	14	4	24
Calaanan	39	88	8	1
Palali	71	35	8	8
San Isidro	9	17	3	12
Arayat	6	25	16	0
Candaba	6	14	8	0
Sibul Spring	17	28	8	0
Sulipan	8	19	6	17
San Rafael	10	19	3	1
Sasmuan	22	52	3	1
Mexico	14	24	1	0
Porac	27	27	29	1
PRBFFWC	18.5	32.8	11	0.5

**Figure 4.0** On the right is the isohyet map showing the estimated 10-day total rainfall distribution over the PRB during the SW monsoon enhanced by TCs EGAY-FALCON



**Figure 4.1** (Bottom left) & **Figure 4.2** (Bottom Right) as a comparison to Fig 4.0, are the isohyet maps (average monthly rainfall distribution) of the PRB for the months of July and August (average for the years 2010-2020)

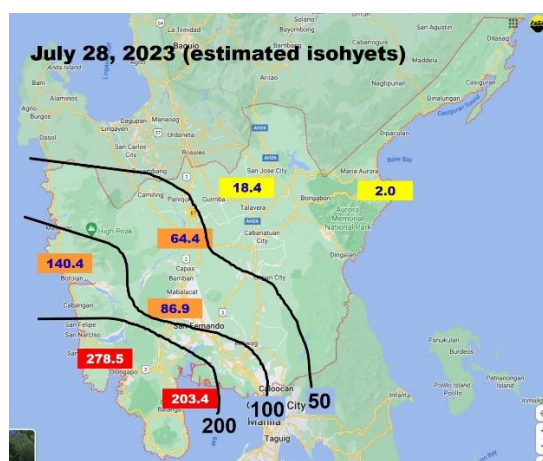
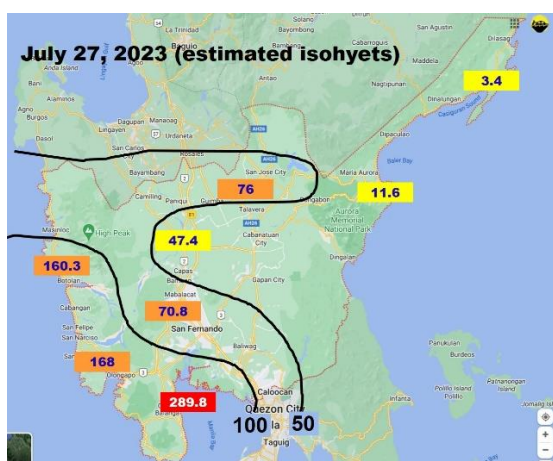


**Table 4.0** Daily rainfall (met day) from other PAGASA stations in Region 3 that are within and adjacent to the PRB from July 24 to August 04, 2023.

Region 3 PAGASA stations (Daily Rainfall in mm)								
	24-Jul	25-Jul	26-Jul	27-Jul	28-Jul	29-Jul	30-Jul	31-Jul
Iba	52.3	159.5	21.8	160.3	140.4	273.1	89.8	51.2
Clark	4.6	42	84.8	70.8	86.9	43.6	4.3	8
Subic	19	56.7	59	168	278.5	170.5	52.7	152.5
Abucay	0	109.5	100.2	289.8	203.4	139.1	48.4	43.3
Hd. Luisita	60.8	36	22.3	47.4	64.4	22	1.5	9
Munoz	1.1	21	2.6	76	18.4	27.8	5.4	3
Baler	4.6	1	0.8	11.6	2	0.2	0.2	0.6
Casiguran	15	6.5	0.9	3.4	0	0	0	0

Rainfall Intensity (mm)	24-hrs.
LIGHT	< 60
MODERATE	60 - 180
HEAVY	> 180

Region 3 PAGASA stations (Daily Rainfall in mm)				
	01-Aug	02-Aug	03-Aug	04-Aug
Iba	54.2	40.4	18.6	20.8
Clark	12.9	30.9	3.3	0.2
Subic	79.6	114.3	51.1	18
Abucay	87	107.8	107.2	12.6
Munoz	13.9	29	4	32
Baler	1.2	3.4	0	0
Casiguran	3	0	0	0



**Fig. 4.3** (Top L) The estimated 24-hr rainfall isohyets for July 27 and **Fig. 4.4** (Top R) for July 28 from the various PAGASA stations within Region 3. Both figures clearly show the SW monsoon effects in Region 3.

#### 4.2 River stages at PRBFFWC forecasting points during the event

PAMPANGA RIVER BASIN ASSESSMENT LEVELS (meters) (as of October 2021)			
COLOR CODE	YELLOW	ORANGE	RED
STATION	ALERT	ALARM	CRITICAL
Sapang Buho	3.70	4.50	6.50
Mayapyap			
Zaragoza	3.00	4.00	5.00
Penaranda	2.50 **	3.50 **	4.50 **
San Isidro	5.00	6.00	8.00
Arayat	5.00	6.00	8.50
Candaba	3.50	4.50	5.00
Mexico	2.00 **	2.50 **	3.50 **
Sasmuan			3.50
Sulipan	2.60	3.20	3.80

\*\* Initial value (for validation)

RIVER RATE (AVERAGE) in meters			
PERIOD	SLOW	GRADUAL	RAPID
1-hour	< 0.3	0.3 - 1.0	> 1.0
3-hour	< 0.6	0.6 - 1.4	> 1.4
6-hour	< 0.9	0.9 - 1.9	> 1.9
12-hour	< 1.6	1.6 - 2.9	> 2.9
24-hour	< 3.0	3.0 - 5.0	> 5.0

**Table 5.0** (Above) A qualitative description for river rates in meters per specific time period

**Table 5.1** (Left) The PRBFFWC assessment levels (as of Oct 2021) that were used during the event

**Table 6.0** Time / Day when the WL Station's Flood Assessment Levels were reached

Station Point	Alert Level	Alarm Level	Critical Level	Remarks
Sapang Buho	(3.70 m) Not reached	(4.50 m) Not reached	(6.50 m) Not reached	The maximum WL recorded from the retrieved logger data was at 1.87 m (51.629 m AMSL) which was reached at around 1000H (LST) of July 28; a lower second rise of 1.45 m (51.209 m AMSL) was recorded at around 1100H (LST) on August 03; it is highly likely that a relatively higher WL may have occurred at the station during the event
Zaragoza	(3.00 m) Was already above this level prior to event	(4.00 m) At around 0800H (LST) of July 28	(5.00 m) Not reached	WL crested, as per retrieved telemetry logger data, at 4.59 m (15.908 m AMSL) attained at 1100H (LST), July 30
Peñaranda	(2.50 m) Not reached	(3.50 m) Not reached	(4.50 m) Not reached	Estimated peak as per logger data reading was 0.76 m (23.448 m based on TBM) attained at 0300H (LST), July 28
San Isidro	(5.00 m) Just before 0000H (LST) of July 29	(6.00 m) Not reached	(8.00 m) Not reached	Peak WL was at 5.34 m (12.104 m AMSL based on the updated "0" gage setting of the WL radar sensor) attained at around 0500H to 0600H (LST) of July 29
Arayat	(5.00 m) 1 <sup>st</sup> , before 2100H (LST) of July 25; 2 <sup>nd</sup> was before 1500H (LST) of July 26	(6.00 m) Before 1800H (LST) of July 27	(8.50 m) Not reached	WL crested, as per telemetry records, at 8.43 m (8.507 m AMSL) attained at 1000H of July 30
Candaba	(3.50 m) Swamp WL was already above Alert prior to the start of the event	(4.50 m) Just before 1400H (LST) of July 27	(5.00 m) Just before 0500H (LST) of July 28	Swamp water level crested at 6.66 m (6.503 m AMSL) on 1100H (LST), July 31 and remained above the critical level until 0900H (LST) of August 09
Mexico	not functioning during the event			There were no definite flood marks identified in the area
Sasmuan	not functioning during the event			About 0.3 m to almost 0.5 m of flooding in some parts of the town of Sasmuan were reported and this was mainly due to pluvial flooding and the effects of tides
Sulipan	(2.60 m) Before 2100H (LST) of July 27	(3.20 m) Just before 0000H (LST) of July 29	(3.80 m) Around 2200H (LST) of July 30	Maximum WL based on telemetry observation was 3.95 m (3.888 m AMSL) attained around 1000H (LST) of July 31

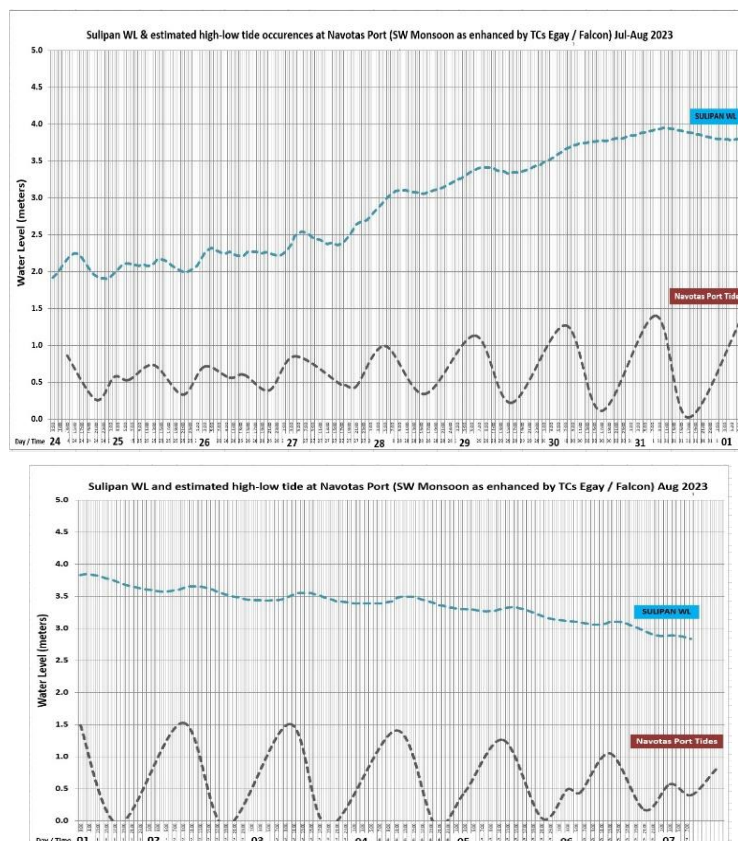
Note: Elevation of "0" of staff gages were mainly based on surveys carried-out on August 2022.

TBM – Temporary Bench Mark

### 4.3 Tides

**Table 7.0** High Tide (highest for the day) from July 26 to August 05, 2023 are shown below (Based on Navotas port, Latitude 14° 41' N, Longitude 120° 56' E)

Day	Time	Height (m)
July 26	2:58 AM	0.71
July 27	3:49 AM	0.85
July 28	4:57 AM	0.99
July 29	6:03 AM	1.13
July 30	7:00 AM	1.27
July 31	7:49 AM	1.40
Aug 01	8:36 AM	1.49
Aug 02	9:24 AM	1.53
Aug 03	10:14 AM	1.51
Aug 04	11:07 AM	1.41
Aug 05	12:04 PM	1.26



**Figure 4.5** (topmost graph) The water level registered at Sulipan Telemetry and the corresponding estimated high and low tides at Navotas Port during the period July 24 to August 01 and (lower graph) from August 01 to 07

Tides during the event were relatively higher. In fact, the tides were the highest during that period of days in the year 2023. It has been observed since several years back that a lot of areas and roads in Masantol, Macabebe, Hagonoy and Calumpit get easily submerged in floodwaters during high tide periods. The standing floodwaters generated by the tides often last for several days to weeks.



Remnants of floodwaters left by the enhanced SW monsoon and the recurring high tides are very much evident along the flooded streets of areas in the Pampanga Delta even after almost 2 weeks have already passed since the event SW monsoon enhanced by TCs EGAY & FALCON. **Pic 01** (left) in the main streets of Hagonoy; **Pic 02** (middle) in Masantol Poblacion area, and **Pic 03** (right) in Bgy. San Gabriel in Macabebe (all photos were taken on August 18, 2023)

### 4.4 Dam structures / releases

Pantabangan and Angat Dams are the two major hydraulic dam structures within the PRB located in Nueva Ecija and Bulacan, respectively. Both of these dams did not release reservoir water during the enhanced SW monsoon by TCs EGAY-FALCON. Two relatively smaller reservoir downstream of Angat Dam along the Angat River, the Ipo and Bustos dams did, however, spill its reservoir water.

The Ipo Dam started releasing reservoir water at 1100H (LST) of July 27 with an initial discharge of 76.11 cumecs. It reached a peak discharge of 112.33 cumecs as reservoir elevation topped at 101.37 m on 1600H LST of July 27. Ipo's Normal High Water Level (NHWL) elevation is set at 101.0 m AMSL. Reservoir discharge eventually subsided at a gradual rate for the next 3 days coming to a constant outflow of 34.7 cumecs on July 31 until closing fully at 0600H LST on August 04. On the other hand, some 37 kilometers downstream of Ipo Dam, the Bustos Dam, an irrigation dam managed by the NIA, had already started spilling its reservoir water at a rate of 39.0 cumecs since 0400H LST of July 23; this was even before the SW monsoon enhanced by TCs EGAY & FALCON affected the PRB. A series of variable reservoir releases with intermittent gate closings ensued for the next 15 days and totally closing its gates at around 0800H LST of August 07. Dam discharge spill peaked at 722.0 cumecs in the evening (2000H LST) of July 28. Information provided by Bulacan-PDRMO indicated that the Bayabas River coming from town of DRT area was a major source of inflow to the Bustos Dam at that time.<sup>7</sup>

A survey analyses of specific 5 river crossings along the Angat river carried-out by the PRBFFWC early this year determined the maximum channel capacity that can be accommodated along the river stretch to be roughly just below 800 cumecs. This is at the section adjacent to the Alejo Santos Bridge which connects the towns of Bustos and Baliuag.<sup>8</sup>

In the UPRIIS area, as per info provided by NIA-UPRIIS, the Atate (PBRIS) Dam in Palayan City had already started reservoir spill on July 23 with a minimal discharge of 3.0 cumecs. Peaked discharge reached 634.53 cumecs on July 29. Another irrigation reservoir dam, the Peñaranda (PENRIS) Dam likewise already started a spill of reservoir on July 23 with a discharge of 18.0 cumecs. It reached a peak spill discharge of 215.0 cumecs on July 29.<sup>9</sup> Discharges from these 2 irrigation dams can be accommodated readily by the channel capacities of the rivers immediately downstream of it, particularly the Pampanga River for Atate Dam and Peñaranda River for Peñaranda Dam.



**Pic 04** (Top L) A view of Atate Dam which is along the Pampanga River in Palayan, NE taken almost 2 weeks after the enhanced SW Monsoon event (photo date: August 16, 2023); **Pic 05** (Top R) Peñaranda Dam along the Peñaranda River in NE with an ongoing reservoir spill when photo was taken on July 30, 2023

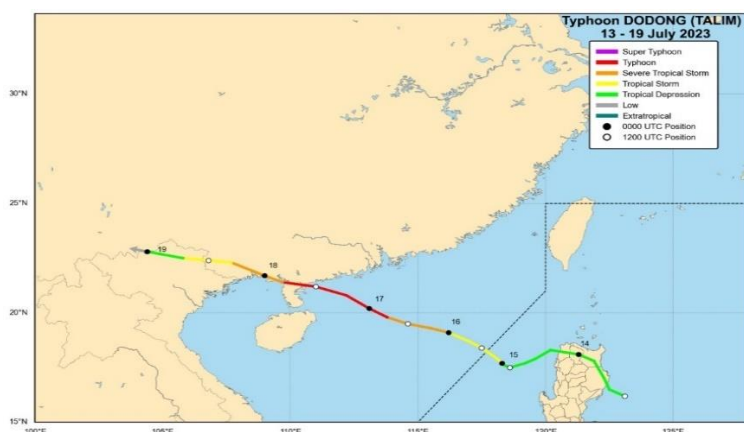
<sup>7</sup> Dam discharge info for Ipo and Bustos Dams provided by Bulacan-PDRMO

<sup>8</sup> <http://prffwc.synthasite.com/resources/angat-assessment-prop-feb2023.pdf>

<sup>9</sup> Dam discharge info provided by NIA-UPRIIS

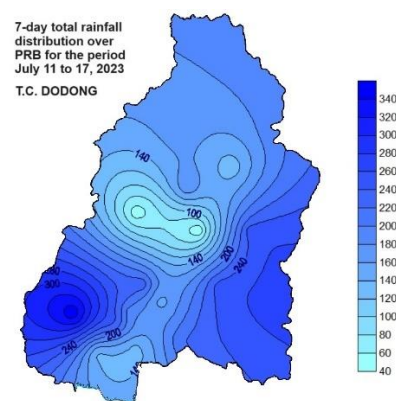
## 5.0 Basin hydrological situation during the event

Apparently, prior to the SW monsoon as enhanced by TCs EGAY-FALCON, Tropical Cyclone “DODONG” (TALIM) already spawned considerable amount of precipitation over most parts of the PRB for the period July 11 to 17, 2023 (refer to Figure 5.1). TC DODONG reached Tropical Storm category before exiting the PAR on July 15.



**Figure 5.0** The best track of TC DODONG as it traverses within the PAR from July 13 to 15, 2023 (PAGASA, WD, MMSS Preliminary Report on TC DODONG)

([https://pubfiles.pagasa.dost.gov.ph/pagasaweb/files/tamss/weather/tcprelimsummary/PAGASA\\_Prelim\\_2023\\_DODONG.pdf](https://pubfiles.pagasa.dost.gov.ph/pagasaweb/files/tamss/weather/tcprelimsummary/PAGASA_Prelim_2023_DODONG.pdf))



**Figure 5.1** The estimated isohyet map for the 7-day total rainfall distribution for the period July 11 to 17, 2023 over the PRB during the passage of TC DODONG

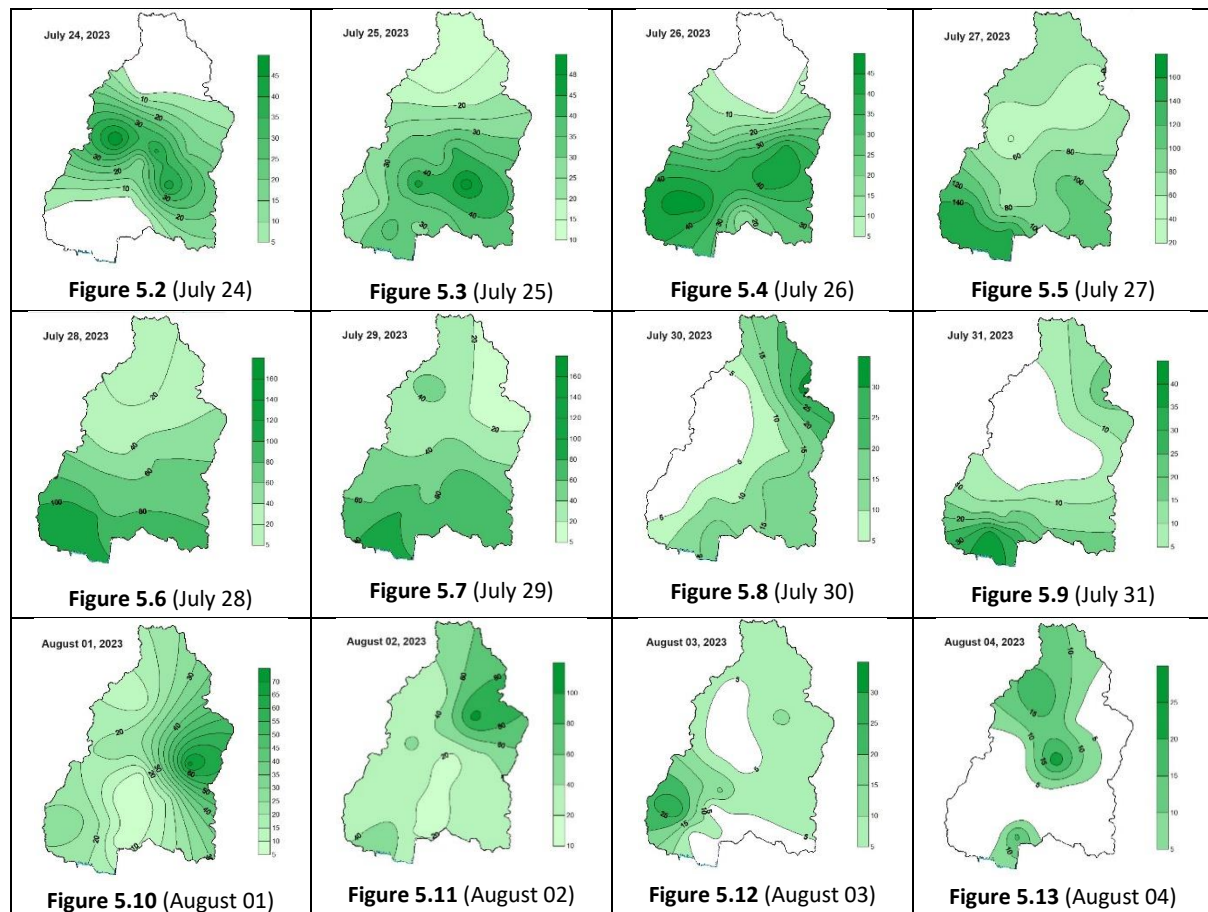
Significant river levels were already reached at several forecasting points within PRB during and after the passage of TC DODONG. Rio Chico River at Zaragoza and Candaba swamp WL remained above their respective Alert WL after TC DODONG left the PAR. Despite a break in the basin’s hydrological rainfall episode for almost a week, WL at these 2 forecasting points were still at significant levels until the start of the SW Monsoon enhanced by TCs EGAY-FALCON event. There were no reported fluvial floods or river overflowing during TC DODONG. However, remnants of pluvial floods or ponded rainwater remained in several areas within the PRB after the event.

A brief timeline of some notable happenings during the SW monsoon enhanced by TCs EGAY-FALCON in the PRB are presented below as follows:

### July 25 to 26

The onset of rains associated with the SW monsoon enhanced by TCs EGAY-FALCON generally started sometime between July 25 to 26, 2023. TC EGAY had already exited the PAR at 0200H of July 25. Almost basin-wide light to moderate rains were observed beginning in the afternoon of the 25<sup>th</sup> until the following day. Pampanga River at Arayat fluctuated within and close to its Alert WL lower limits at the start until it maintained a definite rise above Alert by afternoon of July 26; some towns in Pampanga (e.g., Masantol, Macabebe) and Bulacan (e.g., Calumpit, Hagonoy) have already standing floodwaters even prior to the start of this event.

Figures 5.2 to 5.13 (below) are the 24-hr (met day) isohyet maps showing the estimated basin rainfall distribution over the PRB for the period July 24 to August 04, 2023. A definite pattern of monsoon rain effects at the south and southwest portions of the PRB are clearly manifested in the isohyet maps from July 26 to 29 (refer to Figures 5.4 to 5.7)



### July 27

- 1400H, Candaba swamp WL exceeded its 4.5 m Alarm WL
- 1500H, Ipo Dam started releasing reservoir water
- 1600H onwards of July 27, floods, which are somewhat flashy in nature, were reported and had affected the towns of San Ildefonso, San Rafael and San Miguel (see pics 06, 07 & 08) in Bulacan. This was the initial flood occurrence within the PRB with regards to this event. Later that day, floods which are more pluvial in nature, were also reported mostly in the western part of the PRB such as in the Provinces of Tarlac (in the towns of Bamban, Capas, Concepcion, and La Paz) and in Nueva Ecija (in the towns of Guimba, Talugtug, Licab, Zaragoza and San Antonio)
- 1800H & 2100H, Pampanga River at Arayat and Sulipan exceeded their assessed Alarm WLs, 6.0 m and 2.60 m, respectively



Flooded areas in San Miguel, San Ildefonso and San Rafael in the Province of Bulacan: **Pic 06** (uppermost L) along Maharlika Hi-way in Bgy. Salacot, San Miguel and **Pic 07** (uppermost R) at Bgy. Mandile, San Miguel (photos taken on July 27 and shared by the San Miguel MDRRMO); **Pic 08** (Above L) Flooded roads and residential areas in Bgy. Anyatam, San Ildefonso (photos provided by San Ildefonso MDRRMO); **Pic 09** (Above R) A flooded residential area in Bgy. Pansumaloc, San Rafael, Bulacan (photo courtesy of Mr. L. Rodriguez).

July 28

- 0500H, Candaba swamp WL breached its 5.0 m Critical WL; a continued spread of floodwater over the swamp area
- 0800H, Tributary Rio Chico River at Zaragoza surpassed its 4.0 m Alarm WL



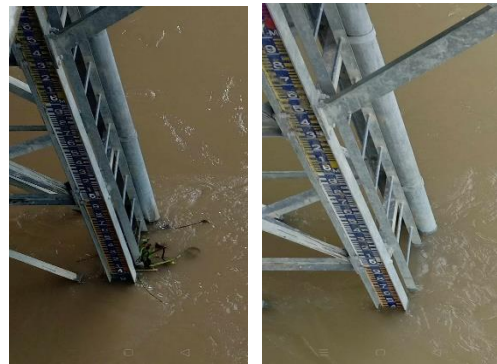
**Pic 10** (Above L) Pluvial flood effects along a portion of McArthur Hi-way in Bgy. Maimpis, City of San Fernando; **Pic 11** (Above middle) Floodwaters in Bgy. Iba-O-Este, Calumpit on July 28 due to pluvial floods coupled with the high tide (photo courtesy of Sarge de Belen); **Pic 12** (Above R) Inundation of Bgy. San Juan in San Luis town due to the overflowing of Pampanga River and from the occasional monsoon rains in the area (photo shared by San Luis MDRRMO)



- Early morning of the day, further pluvial flood occurrences were reported in several towns of Nueva Ecija (San Isidro, Quezon), Bulacan (Malolos City, Paombong, Pulilan, Calumpit, and Hagonoy), and in Pampanga (City of San Fernando, Minalin, Sto. Tomas, Mexico, Sasmuan, Guagua, Lubao, Sta. Ana, San Simon)
- 0900H, portions of the riverside areas of the town of San Luis (i.e., Bgy. San Juan) started to get inundated by the overflowing of the Pampanga River
- 1000H, Pampanga River at Sapang Buho peaked at 1.87 m which is still quite way below its 3.70 m Alert WL



**Pic 13** Based on flood marks, the peak staff gage reading at Sapang Buho telemetry station reached around 1.80 meters



**Pic 14 (L)** Rio Chico River at Zaragoza with SG reading of 3.88 m (1300H, Jul 27; Zaragoza MDRRMO) and **Pic 14.1 (R)** same SG at 4.06 m WL reading (1330H, Aug 04)



**Pic 15 (Top L)** A view of the extent of flooding in Bgy. San Agustin in Candaba (August 04); **Pic 16 (Top R)** The Candaba public market with floodwaters reaching 0.5 m (photo taken in the afternoon of July 29); **Pic 17 (left)** Bgy. Pasig, Candaba with about 0.5 m of floodwaters (July 29); **Pic 18 (Below L)** A view of the Bustos Dam showing spilling of reservoir waters over its ogee spillway and sluice gates (photo courtesy of Bulacan PDRRMO); **Pic 19 (below)** A flooded Crisostomo Park in Hagonoy, Bulacan (photo courtesy of Steph Velasco)



- Before noontime (July 28), the Candaba – Baliuag Road in Bgy. San Agustin in the town of Candaba was no longer passable to all types of vehicles (road was closed); Candaba public market was also underwater from between 0.3 m to 0.5 meters of floodwaters
- 2000H, Peaked reservoir spill of around 722 cumecs was attained at Bustos Dam
- 2300H, TC FALCON entered PAR
- Before midnight, Pampanga River at Sulipan reached its 3.2 m Alarm WL

## July 29

- Just past the midnight to July 29, Pampanga River at San Isidro reached its 5.0 m Alert WL and several hours later peaked at 5.34 m at around 0500H
- Early morning, the Candaba – San Miguel Road (Dukma) in Candaba was no longer passable to almost all types of vehicles



**Pic 20** (Top L) The Candaba – San Miguel Road at Dukma at the height of flooding within the swamp (photo courtesy of Candaba MDRRMO); **Pic 21** (Top R) A comparison of the same area after floods had subsided significantly; **Pic 22** (below) Another aerial shot of the Candaba – San Miguel Road showing the NE approach (San Miguel side) of the bridge still submerged by floodwaters (photos courtesy of Candaba MDRRMO)



- 0400H, Overflowing of Pampanga River at Bgy. Candating in the town of Arayat
- Afternoon, Pampanga River was believed to have overflowed at the Cabiao floodway between Bgys. San Vicente and Concepcion in the town of Cabiao, NE



**Pic 23** (Top L) Bgy. Candating is usually the first area affected by the overflowing of Pampanga River in the town of Arayat; **Pic 23.1** (Top middle) another area within the said barangay with about 0.40 m of floodwaters (photos provided by Arayat MDRRMO); **Pic 23.2** (Top R) A resident of Bgy. Candating, Mr. Warren Mariano, points to the maximum flood level attained in their area



**Pic 24** (Top L) Flowing floodwaters within the Cabiao floodway as seen from the Cabiao viaduct in the afternoon of July 30; **Pic 25** (Top R) the same floodway but this time photo was taken on the following day, July 31; **Pic 26** (L) view of the flooded portion of the NLEX at Tulaoc Bridge in San Simon (from RTVM report); (Below L to R)) flood depth measurements at various areas in San Simon which were carried-out in the morning of August 03: **Pic 27** along McArthur Hi-way in San Agustin; **Pic 27.1** at the CDCP area; **Pic 27.2** in Bgy. Sto Niño; **Pic 27.3** in Bgy. Sta. Monica (photos provided by San Simon MDRRMO)



### July 30

- Afternoon, a small stretch along the NLEX at Tulaoc Overpass in San Simon, Pampanga was submerged by an estimated 0.6 m of flowing floodwaters coming from the Tulaoc River
- 1000H, Pampanga River at Arayat peaked at 8.43 m which is just below its 8.5 m Critical WL
- 2100H, Pampanga River at Sulipan breached the 3.8 m Critical WL; peaked WL was attained some 12 hours later at 3.95 m of July 31
- Widespread inundation continued over the Candaba swamp areas in the portions of San Luis, San Simon, and Apalit; and in the Delta areas of Masantol, Macabebe, Malolos City, Hagonoy and Paombong



Flooded areas in Malolos City: **Pic 28** (Top L) a portion stretch along the MacArthur Hi-way below the overhead by-pass bridge in the Poblacion area; **Pic 28.1** (Top R) submerged road in Bgy. Balite (photos shared by Malolos CDRRMO); **Pic 29** (L) Areas flooded in the town of Paombong (photos courtesy of Paombong MDRRMO)



### July 31

- Around midday, Candaba swamp WL peaked at 6.66 m
- Widespread flooding in the Candaba swamp area and at the Pampanga Delta areas continue



**Pic 30** (Top L) A flooded portion in Bgy. Sta. Monica in San Luis affected by the overflowing of Pampanga River (photo taken on Aug 01); **Pic 30.1** (Top R) the same spot in Bgy. Sta. Monica taken about 10 days later (Aug 10);



**Pic 31** (Left and Right) Various scenes of a still flooded Candaba – San Miguel Road taken on Aug 04 (photo provided by Candaba MDRRMO)

### August 01 and onwards

- In the afternoon of August 01, brief intense to torrential rains were recorded at Calanaan station resulting in floods which were flashy in nature particularly at Bgy. Labi, and along Bgy Olivete-Bantug road in Bongabon, NE; likewise, pluvial floods affected other adjacent barangays in the said town; the said flood episode in the town lasted for about 2 days
- 1500H of August 01, Pampanga River at Sulipan receded below its 3.8 m Critical WL
- Candaba swamp WL registered a very slow recession and continued for more than 2 weeks until the swamp WL receded below the 3.5 m Alert WL at around midday of August 16
- Relatively higher tide levels starting July 30 until August 05 with the highest level, which is actually the highest for year 2023, occurring between 0900H-1000H of August 02; the slow recession of the Pampanga River and the prolonged flooding in the Candaba and Pampanga Delta areas may be attributed to the higher tide levels at that time
- Pampanga River at Arayat reached below 6.0 m Alarm WL at around 1900H of August 06; and below 5.0 m Alert WL by 0400H of August 08
- Rio Chico River at Zaragoza was estimated to have receded below 3.0 m Alert WL by 2<sup>nd</sup> week of August; Station's WL monitoring was not functioning during the event



**Pic 32** (Top L) A view of the front of Hagonoy Municipal Hall compound with almost a meter of floodwaters; **Pic 33** (Top R) The road leading to the Hagonoy Municipal Hall in Bgy. Sto Niño with more than a meter of floodwaters (photos taken on Aug 02 & shared by Mr. Rodolfo Santos);



**Pic 34 (L)** The Sulipan RR-WL telemetry station which was already surrounded by floodwaters at around 1300H of July 31 (photo taken by Ms. W. Flores); **Pic 35 (Bottom L)** A 0.5 m floodwaters in Sta. Monica, San Luis (Aug 03, courtesy of San Luis MDRRMO); **Pic 36 (Below)** PRBFFWC stream gaging team doing river velocity measurements at NLEX Apalit Bridge on Aug 01



**Table 8.0** Spot flooded areas during the event (taken mostly during the post-flood fieldwork)

Location	Estimated Latitude; Longitude	Estimated maximum flood level (m)	Estimated Date of occurrence	Notes / remarks (as per survey, info from reports, interviews, etc.)
Cabiao Floodway (between Bgys. San Vicente & Concepcion in Cabiao, NE)	N 15.21807; E 120.82777	1.0 to 1.2	July 29 (estimated)	Overflowing of the Pampanga River
Maharlika Hi-way at Bgy. Salacot, San Miguel, Bulacan	N 15.186859; E 120.959609	0.6	July 27	Pluvial floods; overflowing of creeks
Bgy. Anyatam, San Idefonso, Bulacan	15.10378°N; 120.93861°E	0.6	July 27	Pluvial floods; overflowing of creeks
Bgy. San Agustin, Hagonoy, Bulacan	N 14.84256; E 120.73779	1.0	July 28 (estimated)	Pluvial, overflowing of river; effects of tides
Bgy. San Miguel, Hagonoy, Bulacan	N 14.85304; E 120.73489	0.6 to 0.9	July 28 (estimated)	Pluvial, overflowing of river; effects of tides
Hagonoy Municipal Hall	N 14.99875; E 120.70383	0.6	July 28 (estimated)	Pluvial, overflowing of river; effects of tides
Sucol St., San Sebastian, Hagonoy, Bulacan	N 14.831968; E 120.737443	0.4	July 28 (estimated)	Pluvial, overflowing of river; effects of tides
Mabini I, Hagonoy, Bulacan	N 14.832524; E 120.735056	0.4	July 28 (estimated)	Pluvial, overflowing of river; effects of tides
Crisostomo Park, Hagonoy, Bulacan	N 14.835537; E 120.733517	0.5	July 28 (estimated)	Pluvial, overflowing of river; effects of tides
San Juan, Hagonoy, Bulacan	N 14.859538; E 120.743760	0.65	July 28 (estimated)	Peaked on the morning of August 01; fluvial and tides
Wawa Uno, Villa Clara Homes, Vgy. San Sebastian, Hagonoy, Bulacan	N 14.828450; E 120.735038	0.55	July 28 (estimated)	Peaked on August 02; fluvial and tides
Bgy. Sta. Monica, San Luis, Pampanga	N 15.03714; E 120.78770	0.8	July 28 (estimated)	Pluvial, overflowing of river
Caduang Tete, Macabebe, Pampanga	N 14.93732; E 120.73311	0.5 to 0.6	July 27 (estimated)	Pluvial, overflowing of river; effects of tides
Colgante, Apalit, Pampanga	N 14.83803; E 120.73855	0.5 to 0.6	July 27 (estimated)	Pluvial, overflowing of river; effects of tides

Bgy. San Gabriel, Macabebe, Pampanga	N 14.91936; E 120.71801	0.6	July 27 (estimated)	Pluvial, overflowing of river; effects of tides
Bgy. San Gabriel, Macabebe, Pampanga	N 14.91737; E 120.71867	1.0	July 27 (estimated)	Pluvial, overflowing of river; effects of tides
Masantol, Pampanga	N 14.89214; E 120.70486	0.6	July 27 (estimated)	Pluvial, overflowing of river; effects of tides
Masantol, Pampanga	N 14.89202; E 120.70482	0.4	July 27 (estimated)	Pluvial, overflowing of river; effects of tides
Bgy. Sta. Lucia Matua, Masantol, Pampanga	N 14.88889; E 120.70370	0.5	July 27 (estimated)	Pluvial, overflowing of river; effects of tides
Masantol, Pampanga	N 14.59137; E 120.70459	0.4	July 27 (estimated)	Pluvial, overflowing of river; effects of tides
San Simon Municipal Hall	N 14.98497; E 120.75101	0.4	July 27 (estimated)	Pluvial flood inside Municipal grounds
Minalin, Pampanga	N 14.94255; E 120.71676	0.3	July 27 (estimated)	Pluvial floods; overflowing of creeks
Bgy. San Vicente, Sto. Tomas, Pampanga	N 14.99875; E 120.70383	0.6	July 27 (estimated)	Pluvial floods; overflowing of creeks
Bgy. Candating, Arayat, Pampanga	N 15.14424; E 120.80099	0.4	Evening of July 28	Overflowing of Pampanga River
Bgy. Sampaloc, Apalit, Pampanga	N 14.95904; E 120.75752	0.5	July 28 (estimated)	Pluvial floods; overflowing of creeks
San Agustin, San Simon going to Apalit / CSFP	N 14.984564; E 120.751366	0.5	July 30	Pluvial floods; overflowing of creeks
Bgy. Sto. Niño, San Simon, Pampanga	N 14.98464; E 120.781366	0.6	July 30	Pluvial floods; overflowing of creeks
CDCP going to NLEX, San Simon, Pampanga	N 14.984564; E 120.781366	0.8	July 29 (estimated)	Pluvial floods; overflowing of creeks
Sta. Monica, San Simon, Pampanga	N 14.995415; E 120.753940	0.6	July 30	Pluvial floods; overflowing of creeks
Candaba – Baliuag Road (Bgy. San Agustin)	15°05'02"N; 120°50'20"E	> 1.0	Started July 28	Not passable from July 28 until August 09 or even after at some portions of the road
Dukma (Candaba – San Miguel Road)	15°06'52"N; 120°51'19"E	> 1.0	Started July 28	Not passable from July 29 until August 08 or even after at some portions of the road
Bgy. San Juan, San Luis, Pampanga	15°03'44"N; 120°48'34"E	0.6 to > 1.0	Started on July 28	Overflowing of Pampanga River

**Table 8.1** Areas (Towns) flooded within PRB as per LDRRMO reports

Province	Towns (within PRB)	
Nueva Ecija	Guimba, Licab, Talugtug (portions w/in PRB), Zaragoza, Quezon, San Antonio, San Isidro, Bongabon	Mostly pluvial floods over roads and agricultural field areas; the towns are mostly situated at the western part of NE
Tarlac	Tarlac City (within PRB), Bamban, Concepcion, La Paz, Capas, Victoria (portions w/in PRB)	Mostly pluvial floods over roads and agricultural field areas; towns are situated at the western part of the PRB
Bulacan	Calumpit, Hagonoy, Paombong, Malolos City, Pulilan, San Miguel, San Ildefonso, San Rafael	Flooding was mainly due to the combination of Pluvial & Fluvial floods and coupled with tide effects in the Delta areas
Pampanga	Candaba, San Luis, San Simon, Macabebe, Masantol, Apalit, Bacolor, Sta. Ana, Arayat, Porac, Lubao, Guagua, Sasmuan, Mexico, Sto Tomas, Minalin, CSFP	Around 208 barangays in 17 towns were reportedly affected by floods at its peak of inundation

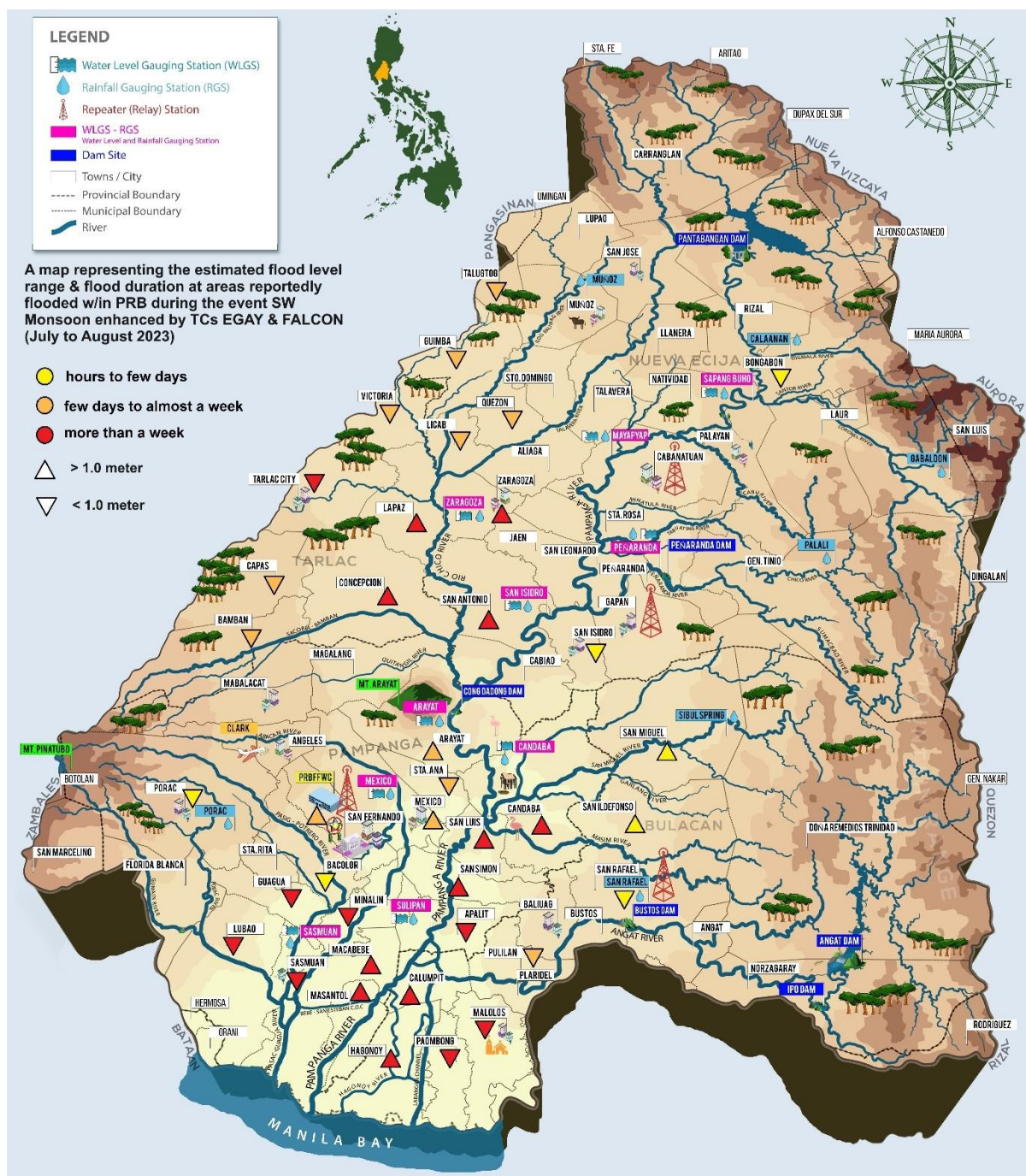


Fig 5.14 The Pampanga River Basin map showing the estimated maximum flood level range and flood duration at areas reportedly flooded during event SW Monsoon enhanced by TCs EGAY & FALCON.

## 6.0 Flood Forecasting & Warning activities during Event SW Monsoon enhanced by TCs EGAY & FALCON

An aggregate total of 27 flood information / warnings were issued by the PRBFFWC during the event from the period July 24 to August 06, 2023.

Initial information, Flood Advisory (FA) No. 1, for the Pampanga River Basin was issued at 1000H of July 24. This was disseminated with a lead time of more than 24 hours (see figure 6.2) prior to the start of the rains that can be technically associated with the SW monsoon enhanced by TCs EGAY-FALCON



over the PRB. Zaragoza and Candaba WLs were already above their respective Alert assessment levels prior to the onset of the event.

Flood Bulletin No. 1 for the basin was issued (1730H, July 26) a few hours after WL of Pampanga River at Arayat rose above its Alert WL (1500H, July 26). Succeeding FBs were issued on a regular dissemination time of 0530H and 1730H except until the final issuance for the flood event at 1700H of August 04, about 30 minutes earlier than the regular dissemination time. There were no intermediate flood bulletin issuances during the course of the center's flood watch status.

Some critical bulletin issuances forwarded by the PRBFFWC were that of FB No. 3 (1730H, July 27) for Candaba swamp WL which failed to forecast swamp WL to exceed critical on the following time of issuance; and FB No. 8 (0530H, July 30) for Sulipan in which the bulletin stated that critical WL will be reached by the next bulletin issuance but, however, still fell a bit short of that projection.

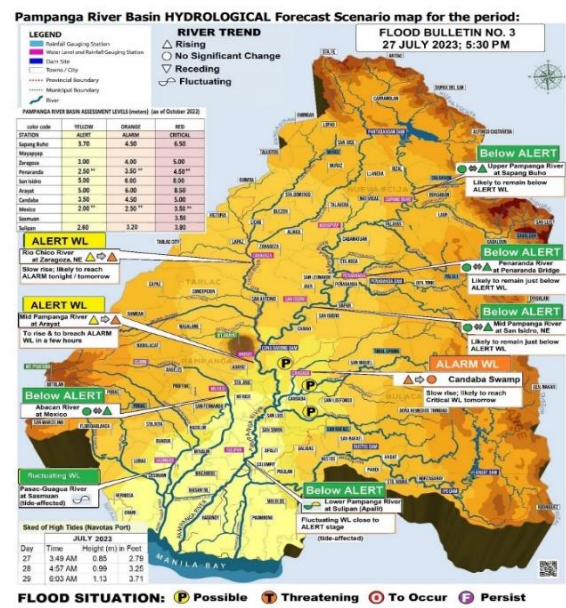


**PAMPANGA RIVER BASIN FLOOD FORECASTING & WARNING CENTER (PRFFWC)**  
DMGC, Bgy. Maimpis, City of San Fernando, Pampanga 2000, Tel. (045) 652-5175; CP: 0999 336 6416  
websites: [bagong.pagasa.dost.gov.ph/prffwc.synhasite.com](http://bagong.pagasa.dost.gov.ph/prffwc.synhasite.com)

FLOOD BULLETIN NO. 3		
PAMPANGA RIVER BASIN & ALLIED RIVERS		
ISSUED AT 5:30 PM, 27 JULY 2023		
(VALID UNTIL THE NEXT BULLETIN AT 5:30 AM TOMORROW)		
Average Basin Rainfall as of 5:00 PM today	Past 24-hr observed	Forecast 24-hr basin rainfall
	40 millimeters	Between 20 to 35 millimeters
BASIN'S LIKELY RESPONSE / RELATED IMPACTS		
WATER LEVEL STATION	RIVER / SWAMP WATER LEVEL (WL) TREND AT STATION	POSSIBLE FLOOD SITUATION MESSAGE (POSSIBLE IMPACTS) & AREAS LIKELY TO BE AFFECTED
Rio Chico River at Zaragoza station (Nueva Ecija)	Now estimated at 3.90 m, above 3.00 m Alert WL; likely to reach 4.00 m Alarm WL tonight / tomorrow morning	Likelihood of Pluvial floods (ponding of rainwater causing several inches of floodwater along roadways & croplands)
Pampanga River at Arayat Station (Pampanga)	Now at 5.91 m, above 5.00 m Alert WL; slow rise to continue to breach the 6.00 m Alarm WL in a few hours; to remain above Alarm WL until tomorrow morning	Pluvial floods (submerged roads, croplands) to persist - Arayat, San Simon, San Luis
Candaba Swamp Area at Candaba (Pampanga)	Now at 4.57 m, above 4.50 m Alarm WL; Slow filling-up of swamp WL to continue but likely to remain below 5.00 m Critical WL until tomorrow morning	Pluvial floods (several partly submerged roads, croplands) to persist within the swamp area; flood is possible in the low lying areas - San Miguel, San Ildefonso, San Rafael, Candaba, Apalit
Pampanga River at Sulipan Station; Pampanga Delta areas (Pasac-Guagua Sub-Basin)	Now at 2.38 m, still below 2.60 m Alert WL; very slow fluctuating rise within & close to Alert WL (tide-influenced)	Pluvial floods (partly submerged roads, croplands) to persist - Plaridel, Pullian, Bakiuag; and the lower sections of Main Pampanga River at riverside areas of Apalit, Macabebe, Masantol, Calumpit, Paombong and Hagonoy; Towns along Angat River - Bustos, Angat, Norzagaray

The public and the Local Disaster Risk Reduction and Management Councils (LDRMOs) of the said provinces within the Pampanga River Basin are advised to continue their preparedness and response activities to mitigate the adverse immediate impacts of the possible hazards associated with the enhanced SW Monsoon, which is likely to persist for 2-3 days, in their area of concern; to remain monitoring for rainfall warnings, updates on T.C. EGAY, and other products issued by PAGASA.

Prepared by: GHH / RFD / JRD Checked by: HTH



**Figure 6.0** (Top L) Flood Bulletin No. 3 issued at 1730H, July 27 showing the Candaba statement to still remain below Critical WL until the next issuance which actually did not hold; Candaba WL actually breached Critical WL in the morning of July 28 almost coinciding with issuance of FB No. 4

**Figure 6.1** (Top R) The accompanying forecast scenario map for FB No. 3 which shows Zaragoza and Arayat at Alert WL and likely to reach Alarm m WL in the next FB; also, Candaba WL at Alarm WL status.

There were some lapses in the bulletin statements made by the center during the event. However, it should be noted that operational monitoring capabilities of the center were also limited at that time. Even prior to the event, all upstream stations and some lower forecasting points of the center were down; operating only with 4 out of 9 WL stations and 9 out of the 17 RR stations during the center's flood watch status. To adjust to the dire situation at that time, the center dispatched validation team at random during the event period just to check and validate river stages at some of the forecasting points particularly at the upstream stations of the center.

The Final FB No. 23 (1700H, August 06) was issued with the following forecasting points still above their respective flood assessment levels as such: Tributary Rio Chico at Zaragoza was above Alert WL, PRBFFWC-hth-Oct2023

Pampanga River at Arayat and Sulipan were both above their respective Alert WLs, and Candaba swamp WL still above Critical WL. The PRBFFWC opted to terminate flood watch status even as the said WLs were still within their flood assessment levels. This was decided by the center upon considering that there was no longer a threat of widespread monsoon rains over the PRB and it has been relatively dry in the basin for the past 2 days prior to the issuance of the final FB. All monitored rivers / tributaries were likewise receding steadily since August 01.



**Pic 37** Upstream view of a receding but still swelled -up Pampanga River with a staff gage reading of 7.63 m (around 1400H of August 03) as seen from the San Agustin Bridge in Arayat, Pampanga. It is still way above the 6.0 m Alarm WL. This photo was taken as part of the center’s random field validation activities during the event.

**Table 9.0** Random assessment of some of the FB forecast statements during the event

FB No.; Time & date of issuance	Forecasting Point	FB forecast statements	Actual river response	Notes / Remarks
FB No. 3; 1730H, July 27	Candaba	<i>“Now at 4.57 m, above 4.50 m Alarm WL; Slow filling-up of swamp WL to continue but likely to remain below 5.00 m Critical WL until tomorrow morning”</i>	At 0500H, July 28, about 8 hours later, Candaba swamp breached the 5.0 m Critical WL at the station	The statement failed to forecast, in both time and magnitude, the breaching of Critical WL at the forecasting point
	Arayat	<i>“Now at 5.91 m, above 5.00 m Alert WL; slow rise to continue to breach the 6.00 m Alarm WL in a few hours; to remain above Alarm WL until tomorrow morning”</i>	Instead of a few hours, just an hour later after the issuance of the FB, WL at Arayat already breached the 6.0 m Alarm WL	The statement may have been just off by a few hours but can be considered close to the time and magnitude accuracy aspects
FB No. 7; 1730H, July 29	Arayat	<i>“Now at 8.34 m, above 6.00 m Alarm WL; slow rise to continue further; to likely breach the 8.50 m Critical WL between tonight till tomorrow morning”</i>	River did not reach the 8.5 m Critical WL; the peak stage was 8.43 m attained at 1000H, July 30	The statement may have been a bit short of the magnitude; however, since Critical WL was stated here, it may give a false additional response / reaction on the part of the LGUs / target communities
FB No. 9; 1730H, July 30	Sulipan	<i>“Now at 3.59 m, above 3.20 m Alarm WL; very slow fluctuating rise to continue to likely reach 3.80 m Critical WL”</i>	Critical WL was breached at 2100H, July 30, about 4 hours later	FB statement was able to forecast the WL. However, the statement “tonight / tomorrow morning” may

		<i>(tide-influenced) tonight / tomorrow morning; Pluvial &amp; Fluvial floods persists along riverside areas of lower main Pampanga River . . . .”</i>		show some time aspect uncertainty in the forecast as to actual time of attainment; this is fine considering that the river at this point was affected by tides
FB No. 10; 0530H, July 31	Candaba	<i>“Now at 6.45 m, above 5.00 m Critical WL; likely to level-off until noon today; to eventually recede starting this afternoon; both pluvial &amp; fluvial floods will continue to remain over the swamp area for several days”</i>	Before midday of July 31, Candaba WL peaked at 6.66 m but coming from an almost steady WL (level-off) for almost a day; eventual slow recession of swamp WL ensued afterwards	The FB statement was able to forecast the WL recession; this is a bit predictable for Candaba swamp especially when there are no longer rains from the eastside area of the swamp and WL have levelled-off for quite some time already
FB No. 16; 0530H, August 03	Arayat	<i>“Now at 7.39 m, still above 6.00 m Alarm WL; a generally slow receding trend to continue &amp; likely to reach below Alarm WL by weekend”</i>	In the actual scenario, a renewed rise of WL at the station was manifested as a result of basin-wide rains in the evening of Aug 02 until the following morning	Both time and magnitude aspects of forecasting was not met in the forecast statement. The good thing was the renewed rise was short-lived and magnitude rise was less than 0.5 meter only

**Table 9.1** Table for validating percentage accuracy of flood forecast information as a set of standard levels used in Flood Forecasting and as basis for forecast efficiency

Time		Magnitude (River Flood Stage)	
For peak / critical WL difference	% Accuracy	For peak / critical WL difference	% Accuracy
0	100 %	0	100 %
+ / - 3 hours	95 %	+ / - (1 to 10 cm)	95 %
+ / - 6 hours	90 %	+ / - (11 to 20 cm)	90 %
+ / - 9 hours	85 %	+ / - (21 to 30 cm)	85 %
+ / - 12 hours	80 %	+ / - (31 to 40 cm)	80 %
		+ / - (41 to 50 cm)	75 %

*This table was taken from a presentation entitled “Flood Warning Information: Formulation of Flood Advisory / Flood Bulletin (a suggestion)” by PRBFFWC during the 1<sup>st</sup> PAGASA RBFFWCs’ Conference / Workshop, Davao City, May 2017.*

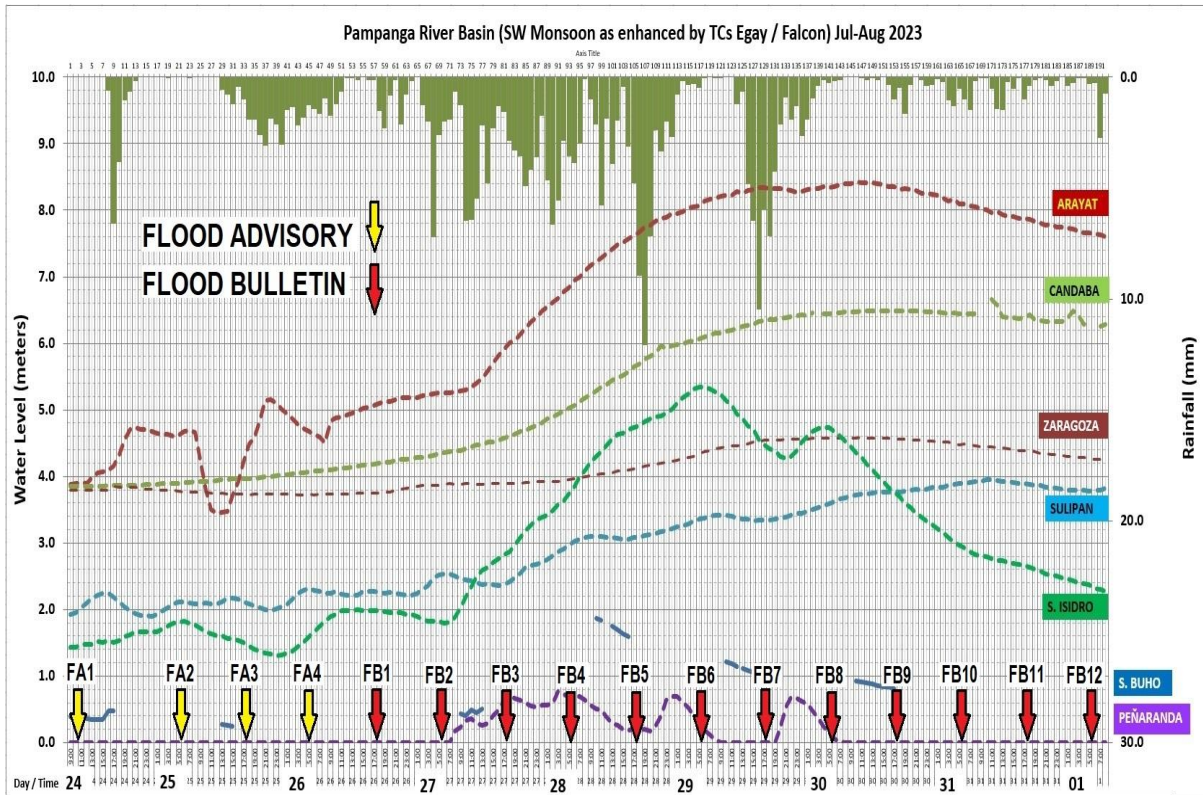


Figure 6.2 The basin hyetograph and the hydrographs of respective monitoring stations during the event with the corresponding flood information (FAs & FBs) issuances by PRBFFWC from July 24 to August 01, 2023

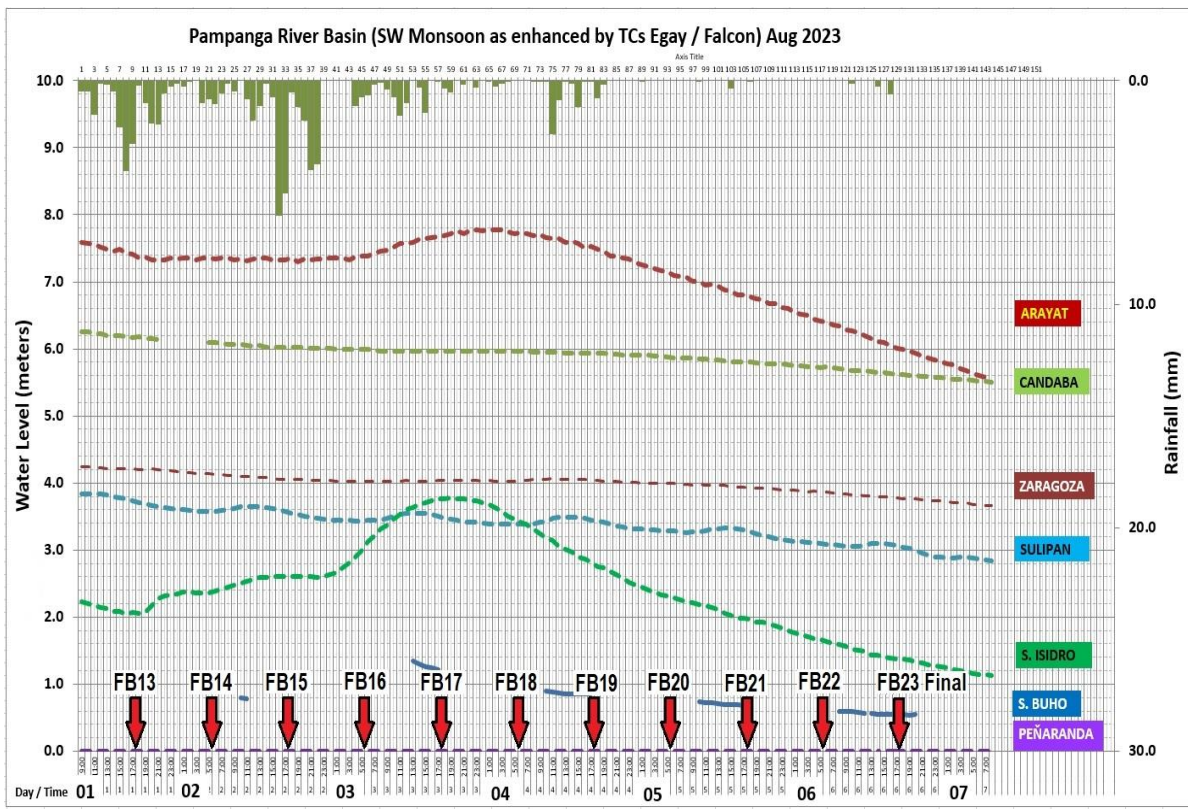


Figure 6.3 The basin hyetograph and the hydrographs of respective monitoring stations during the event with the corresponding flood information (FBs) issuances by PRBFFWC from August 01 to August 06, 2023

## **ANNEX**

## Event comparison

**Table A1** Peak WL registered in the respective telemetry station points of the PRBFFWC for various flood events that affected the PRB

Event	Sapang Buho	Mayapyap	Zaragoza	Peñaranda	San Isidro	Arayat	Candaba	Sulipan	Mexico	Sasmuan	Remarks (maximum period basin RR)
Ty Kadiang (Sept-Oct 1993)	6.30 (SG)	6.18 (SG)	15.9 (SG)		7.65 (SG)	9.81 (SG)	7.6 (SG)	4.91 (SG)			
Ty Loleng (Oct 1998)	7.15 (est)	6.50 (est)	15.76		7.38	9.47	6.62	4.87			2-day event basin RR: 131 mm
TD Winnie-Ty Yoyong (Nov-Dec 2004)	7.60 (est)	7.18	13.63		7.16 (est)	9.42 (est)	6.96	3.97			1-day event basin RR: 77 mm
Ty Marce-SW (Aug 2004)	5.45	5.06	15.39		6.70	10.03	7.38	4.39		2.06 (est)	2-day event basin RR: 114 mm
TS Ondoy (Sept 2009)	3.38	1.72	14.14	3.93	3.89	8.35	6.40	3.29	2.81	3.03	2-day event basin RR: 72 mm
Ty Pepeng (Oct 2009)	6.29	5.46	15.68	2.79	6.46	9.66	7.02	4.03	4.03	2.73	2-day event basin RR: 53 mm
TS Falcon-SW (June 2011)	3.47	2.57	14.88	2.56	4.08	8.37	6.24	2.80	2.72	3.22	
Ty Pedring (Sept-Oct 2011)	7.17	6.86	15.40	6.01	7.75	10.6 (FM)	7.62	4.85	3.30	3.09	2-day event basin RR: 146 mm
SW of August 2012	1.67	0.6	4.64	1.68	3.29	9.24	6.93	3.17	3.46	3.17	2-day event basin RR: 97 mm
TS Maring-SW (Aug 2013)	1.36		4.31	1.08	1.46	8.39	6.30	3.26	2.61	3.06	
Ty Lando** (Oct 2015)	8.08	7.30 (FM)	4.19	7.72	8.23	10.03	7.13	4.29	1.57	2.00	2-day event basin RR: 112 mm
Ty Nona / Frontal System (Dec 2015)	6.84		5.22	5.72	7.80	9.98	6.94	4.13	1.62	2.13	2-day event basin RR: 142 mm
Ty Ulysses (Nov 2020)	5.89		3.67	4.02		8.81	6.34	3.99	2.27	2.83	2-day event basin RR: 70 mm
Ty Karding (Sept 2022)	4.94		3.67	5.30	8.32	8.26	6.03	3.52		3.48	2-day event basin RR: 52 mm
SW Monsoon – TCs Egay-Falcon (Jul-Aug 2023)	1.87		4.59	0.76	5.34	8.43	6.66	3.95			2-day event basin RR: 152 mm

Notes: \*\* - based on a 10-minute telemetry observation (logger);

blue shaded events are associated with enhanced SW monsoon;

blanks indicate station either did not yet exist or station's telemetry system was down during the event;

light orange shaded values +10.213 for MSL;

light green shaded values – adjusted telemetry reading due to a change of type of WL sensor;

(FM) – levels were based on available flood marks only;

(SG) – as per staff gage reading.

Basin		Pampanga River Basin & Allied River Systems																
Event		SW as enhanced by TCs Egay & Falcon																
Year:		2023																
Month:		July - August																
		RAINFALL (RR) STATIONS																
Day	Time	Munoz	Sapang Buho	Gabalton	Zaragoza	Mayapyap	Penaranda	Calaanan	Palali	San Isidro	Arayat	Candaba	Sibul Spring	Sasmuan	Sulipan	Mexico	Porac	San Rafael
25	9:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0
25	10:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0
25	11:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0
25	12:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0
25	13:00	0	0		0		0	1	0	0	0	1	0	0	0	5	0	1
25	14:00	0	0		0		0	0	0	0	0	4	1	0	6	1	0	0
25	15:00	0	0		0		1	0	0	0	11	7	0	0	0	0	0	0
25	16:00	0	0		0		3	0	2	0	0	2	0	0	0	0	0	0
25	17:00	0	1		1		2	1	3	0	0	0	8	0	0	0	0	0
25	18:00	2	3		6		10	3	3	4	0	0	0	0	0	0	0	0
25	19:00	0	2		2		1	3	4	0	2	1	15	0	0	0	0	0
25	20:00	0	5		2		4	2	2	4	6	4	3	0	1	1	0	3
25	21:00	3	2		3		7	1	6	3	3	3	3	2	1	2	7	1
25	22:00	1	4		3		2	3	4	3	1	0	1	3	1	1	1	1
25	23:00	1	3		3		4	1	1	6	3	0	8	0	1	1	1	0
26	0:00	0	0		0		2	0	2	2	2	4	4	13	5	4	5	3
26	1:00	0	1		1		0	1	0	0	3	1	1	4	1	4	3	2
26	2:00	0	0		1		0	0	0	0	2	3	0	5	2	3	1	3
26	3:00	0	0		2		0	0	1	1	1	0	1	7	8	4	0	8
26	4:00	1	0		0		0	0	0	0	3	2	0	2	0	1	0	4
26	5:00	3	0		1		1	2	0	1	1	4	1	1	1	1	1	1
26	6:00	2	0		2		1	1	1	1	2	1	1	1	2	2	1	3
26	7:00	0	0		3		4	0	3	4	3	1	1	0	0	2	2	1
26	8:00	0	0		1		1	0	2	2	4	1	2	0	0	1	0	0

Fig A1 Hourly rainfall recorded at telemetry stations of PRBFFWC during event SW Monsoon enhanced by TCs EGAY & FALCON from the period 0900H, July 25 to 0800H, July 26, 2023.

		WATER LEVEL (WL) STATIONS									
Day	Time	Sapang Buho	Zaragoza	Mayapyap	Penaranda	San Isidro	Arayat	Candaba	Sasmuan	Sulipan	Mexico
25	9:00		3.76		0.00	1.72	4.26	3.92		2.08	
25	10:00		3.76		0.00	1.66	3.79	3.93		2.10	
25	11:00	0.28	3.75		0.00	1.63	3.51	3.93		2.08	
25	12:00		3.74		0.00	1.61	3.44	3.94		2.08	
25	13:00	0.27	3.75		0.00	1.61	3.46	3.95		2.11	
25	14:00	0.26	3.74		0.00	1.56	3.47	3.95		2.17	
25	15:00	0.25	3.73		0.00	1.56	3.72	3.96		2.17	
25	16:00		3.73		0.00	1.54	3.92	3.97		2.15	
25	17:00		3.73		0.00	1.51	4.21	3.97		2.12	
25	18:00		3.72		0.00	1.45	4.49	3.97		2.08	
25	19:00		3.73		0.00	1.40	4.57	3.97		2.05	
25	20:00		3.73		0.00	1.37	4.85	3.98		2.02	
25	21:00		3.73		0.00	1.35	5.14	3.99		2.00	
25	22:00		3.73		0.00	1.33	5.16	4.00		1.99	
25	23:00		3.73		0.00	1.30	5.09	4.01		2.01	
26	0:00		3.73		0.00	1.32	5.01	4.02		2.04	
26	1:00		3.73		0.00	1.34	4.94	4.03		2.08	
26	2:00		3.73		0.00	1.37	4.87	4.04		2.16	
26	3:00		3.72		0.00	1.45	4.78	4.05		2.25	
26	4:00		3.72		0.00	1.50	4.72	4.06		2.29	
26	5:00		3.73		0.00	1.59	4.68	4.07		2.32	
26	6:00		3.72		0.00	1.67	4.64	4.08		2.29	
26	7:00		3.73		0.00	1.75	4.59	4.08		2.27	
26	8:00		3.74		0.00	1.82	4.50	4.09		2.25	

Fig A2 Hourly WL recorded at telemetry stations of PRBFFWC during event SW Monsoon enhanced by TCs EGAY & FALCON from the period 0900H, July 25 to 0800H, July 26, 2023.

Basin		Pampanga River Basin & Allied River System:																
Event		SW as enhanced by TCs Egay & Falcon																
Year:		2023																
Month:		July - August																
		RAINFALL (RR) STATIONS																
Day	Time	Munoz	Sapang Buho	Gabaldon	Zaragoza	Mayapyap	Penaranda	Calaanan	Palali	San Isidro	Arayat	Candaba	Sibul Spring	Sasmuan	Sulipan	Mexico	Porac	San Rafael
26	9:00	1	0		1		1	1	1	2	2	5	2	0	0	2	8	0
26	10:00	0	0		1		0	0	0	0	3	2	2	0	0	3	2	0
26	11:00	0	0		0		0	0	1	0	2	1	1	0	0	3	0	0
26	12:00	0	0		0		0	0	0	0	0	0	0	0	1	0	0	0
26	13:00	0	0		0		0	0	0	0	0	0	0	0	0	0	1	0
26	14:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0
26	15:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0
26	16:00	0	0		0		0	0	0	0	0	0	0	0	0	1	1	0
26	17:00	0	0		0		0	0	0	0	0	0	0	0	0	2	0	0
26	18:00	0	0		0		0	0	0	0	2	0	0	0	0	5	9	0
26	19:00	0	0		0		0	0	0	1	2	4	4	10	5	2	4	0
26	20:00	0	0		0		0	0	0	0	1	1	0	2	1	2	0	3
26	21:00	0	0		0		1	0	0	0	0	0	0	0	0	1	1	0
26	22:00	0	0		1		0	0	0	0	0	0	0	7	14	0	5	5
26	23:00	1	0		0		0	0	0	0	3	0	1	2	2	3	0	0
27	0:00	0	0		1		0	0	0	0	0	0	0	0	0	0	1	1
27	1:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0
27	2:00	0	0		0		2	0	0	6	5	2	2	0	0	2	0	0
27	3:00	0	0		2		3	0	5	4	1	0	1	1	0	0	3	0
27	4:00	0	0		2		11	2	17	12	10	15	21	3	6	12	1	2
27	5:00	0	0		0		6	1	11	4	0	1	5	11	1	0	0	2
27	6:00	0	0		2		1	0	3	2	2	4	4	3	0	2	8	0
27	7:00	1	0		5		5	1	3	3	3	1	1	1	1	2	4	0
27	8:00	0	0		0		1	1	1	1	1	0	0	0	2	1	0	1

Fig A3 Hourly rainfall recorded at telemetry stations of PRBFFWC during event SW Monsoon enhanced by TCs EGAY & FALCON from the period 0900H, July 26 to 0800H, July 27, 2023.

		WATER LEVEL (WL) STATIONS									
Day	Time	Sapang Buho	Zaragoza	Mayapyap	Penaranda	San Isidro	Arayat	Candaba	Sasmuan	Sulipan	Mexico
26	9:00		3.73		0.00	1.89	4.84	4.10		2.25	
26	10:00		3.74		0.00	1.93	4.88	4.11		2.27	
26	11:00		3.74		0.00	1.98	4.90	4.12		2.23	
26	12:00		3.74		0.00	1.99	4.92	4.13		2.22	
26	13:00		3.74		0.00	1.99	4.95	4.14		2.21	
26	14:00		3.75		0.00	2.00	4.98	4.15		2.22	
26	15:00		3.75		0.00	1.99	5.02	4.17		2.27	
26	16:00		3.75		0.00	1.99	5.04	4.17		2.27	
26	17:00		3.75		0.00	1.99	5.07	4.18		2.27	
26	18:00		3.75		0.00	1.99	5.09	4.20		2.26	
26	19:00		3.76		0.00	1.97	5.12	4.21		2.25	
26	20:00		3.77		0.00	1.95	5.13	4.22		2.26	
26	21:00		3.79		0.00	1.96	5.15	4.24		2.25	
26	22:00		3.81		0.00	1.95	5.18	4.25		2.23	
26	23:00		3.82		0.00	1.93	5.18	4.26		2.22	
27	0:00		3.84		0.00	1.92	5.18	4.27		2.22	
27	1:00		3.85		0.00	1.90	5.19	4.28		2.25	
27	2:00		3.86		0.00	1.86	5.21	4.29		2.30	
27	3:00		3.86		0.00	1.83	5.23	4.30		2.36	
27	4:00		3.86		0.00	1.83	5.24	4.32		2.48	
27	5:00		3.87		0.00	1.82	5.26	4.34		2.52	
27	6:00		3.88		0.00	1.80	5.26	4.36		2.54	
27	7:00		3.89		0.00	1.81	5.26	4.37		2.53	
27	8:00		3.88		0.18	1.88	5.27	4.38		2.50	

Fig A4. Hourly WL recorded at PRBFFWC telemetry stations during event SW Monsoon enhanced by TCs EGAY & FALCON from the period 0900H, July 26 to 0800H, July 27, 2023.



Basin		Pampanga River Basin & Allied River System:																
Event		SW as enhanced by TCs Egay & Falcon																
Year:		2023																
Month:		July - August																
		RAINFALL (RR) STATIONS																
Day	Time	Munoz	Sapang Buho	Gabaldon	Zaragoza	Mayayayap	Penaranda	Calaanan	Palali	San Isidro	Arayat	Candaba	Sibul Spring	Sasmuan	Sulipan	Mexico	Porac	San Rafael
27	9:00	0	0		1		0	0	0	0	1	0	0	0	0	2	13	0
27	10:00	0	0		0		10	0	5	5	7	4	3	31	9	15	1	0
27	11:00	0	1		0		0	1	6	1	0	6	18	34	18	5	0	11
27	12:00	0	0		0		2	0	2	1	1	5	13	20	19	8	1	10
27	13:00	0	1		0		3	0	3	1	1	0	3	4	4	2	3	3
27	14:00	2	1		2		3	1	1	4	6	4	7	6	11	5	3	17
27	15:00	4	2		2		5	1	4	3	2	1	4	2	1	1	2	2
27	16:00	2	2		2		1	2	2	2	1	1	1	1	0	0	1	3
27	17:00	0	0		0		1	1	1	1	0	0	1	5	4	1	8	1
27	18:00	0	0		0		3	0	2	1	5	4	1	1	6	1	18	0
27	19:00	10	1		1		6	0	8	3	0	0	3	0	0	0	20	1
27	20:00	6	2		3		4	5	0	3	4	1	0	3	4	2	15	0
27	21:00	4	12		2		4	12	9	6	0	2	6	5	9	3	1	2
27	22:00	2	1		5		7	3	12	7	3	4	7	1	1	2	1	11
27	23:00	4	11		4		2	15	4	2	0	0	4	3	1	1	2	0
28	0:00	6	2		1		0	3	0	1	1	4	4	0	3	1	1	1
28	1:00	2	0		1		1	0	0	0	4	9	0	10	14	5	17	4
28	2:00	0	1		3		5	0	3	7	5	8	9	10	20	8	11	12
28	3:00	14	5		4		4	5	6	4	5	3	15	0	5	4	6	4
28	4:00	2	1		3		6	6	2	10	5	0	1	0	0	1	2	1
28	5:00	13	0		0		2	2	3	5	12	1	2	5	5	1	1	1
28	6:00	0	0		2		9	0	2	8	13	6	2	0	9	2	8	1
28	7:00	1	0		1		3	1	2	3	2	9	5	3	0	3	9	0
28	8:00	0	0		0		0	0	1	0	0	0	0	0	0	0	0	0

Fig A5 Hourly RR recorded at PRBFFWC telemetry stations during event SW Monsoon enhanced by TCs EGAY & FALCON from the period 0900H, July 27 to 0800H, July 28, 2023.

		WATER LEVEL (WL) STATIONS									
Day	Time	Sapang Buho	Zaragoza	Mayayayap	Penaranda	San Isidro	Arayat	Candaba	Sasmuan	Sulipan	Mexico
27	9:00	0.44	3.88		0.23	2.03	5.28	4.39		2.46	
27	10:00	0.41	3.89		0.33	2.18	5.30	4.42		2.44	
27	11:00	0.49	3.89		0.36	2.34	5.34	4.45		2.43	
27	12:00	0.45	3.88		0.29	2.49	5.40	4.48		2.40	
27	13:00	0.50	3.88		0.26	2.59	5.48	4.48		2.37	
27	14:00		3.89		0.29	2.64	5.59	4.51		2.39	
27	15:00		3.89		0.40	2.71	5.71	4.52		2.37	
27	16:00		3.89		0.49	2.76	5.82	4.55		2.36	
27	17:00		3.90		0.63	2.82	5.91	4.57		2.38	
27	18:00		3.90		0.70	2.87	6.01	4.60		2.42	
27	19:00		3.90		0.67	2.97	6.04	4.63		2.48	
27	20:00		3.90		0.64	3.08	6.14	4.68		2.55	
27	21:00		3.91		0.59	3.18	6.22	4.69		2.64	
27	22:00		3.91		0.55	3.27	6.33	4.73		2.67	
27	23:00		3.92		0.54	3.35	6.38	4.76		2.68	
28	0:00		3.93		0.57	3.39	6.48	4.81		2.70	
28	1:00		3.92		0.57	3.42	6.54	4.87		2.75	
28	2:00		3.92		0.60	3.49	6.61	4.90		2.81	
28	3:00		3.93		0.76	3.57	6.68	4.94		2.86	
28	4:00		3.94		0.72	3.63	6.78	4.98		2.91	
28	5:00		3.95		0.69	3.74	6.83	5.02		2.97	
28	6:00		3.96		0.69	3.85	6.95	5.07		3.02	
28	7:00		3.98		0.70	3.99	7.00	5.13		3.06	
28	8:00		4.00		0.63	4.10	7.10	5.18		3.09	

Fig A6 Hourly WL recorded at PRBFFWC telemetry stations during event SW Monsoon enhanced by TCs EGAY & FALCON from the period 0900H, July 27 to 0800H, July 28, 2023.

Basin		Pampanga River Basin & Allied River Systems																
Event		SW as enhanced by TCs Egay & Falcon																
Year:		2023																
Month:		July - August																
		RAINFALL (RR) STATIONS																
Day	Time	Munoz	Sapang Buho	Gabalton	Zaragoza	Mayapyap	Penaranda	Calaanan	Palali	San Isidro	Arayat	Candaba	Sibul Spring	Sasmuan	Sulipan	Mexico	Porac	San Rafael
28	9:00	0	0		0		0	0	0	0	0	0	0	1	1	1	4	9
28	10:00	0	1		0		3	0	0	1	0	0	1	14	5	0	6	0
28	11:00	0	0		0		23	0	2	9	11	10	4	4	5	8	3	8
28	12:00	0	8		0		1	13	3	0	0	0	3	1	0	0	0	1
28	13:00	0	0		0		0	0	1	0	10	13	0	6	2	14	2	4
28	14:00	0	0		0		1	0	8	1	1	1	4	2	2	1	9	1
28	15:00	0	0		0		0	0	2	1	1	1	1	0	0	0	1	0
28	16:00	0	0		0		0	0	0	0	3	1	0	16	4	3	13	1
28	17:00	0	0		4		4	0	0	7	10	15	1	2	14	3	10	4
28	18:00	6	1		15		3	0	3	9	14	7	10	15	12	9	20	7
28	19:00	5	9		4		16	6	10	5	10	15	36	10	14	6	7	28
28	20:00	1	7		5		6	9	25	6	5	5	9	9	2	8	6	0
28	21:00	1	2		3		2	3	3	1	1	0	1	8	5	1	3	2
28	22:00	1	1		0		0	0	0	1	4	3	0	8	10	6	6	7
28	23:00	0	0		0		0	0	0	0	1	1	0	6	6	4	4	6
29	0:00	0	0		0		0	0	0	0	1	1	1	5	3	3	4	7
29	1:00	0	0		1		0	0	0	0	1	2	0	2	2	2	1	1
29	2:00	0	0		0		0	1	0	1	0	0	0	0	0	0	1	0
29	3:00	0	0		0		0	0	0	0	1	0	0	1	0	0	3	0
29	4:00	0	0		1		0	0	0	0	0	0	0	0	0	0	0	1
29	5:00	0	0		0		0	0	0	0	0	0	1	1	0	1	4	0
29	6:00	0	0		0		0	0	1	0	0	0	0	0	0	0	0	0
29	7:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0
29	8:00	0	0		0		0	0	0	0	0	0	0	1	0	0	0	0

Fig A7 Hourly RR recorded at PRBFFWC telemetry stations during event SW Monsoon enhanced by TCs EGAY & FALCON from the period 0900H, July 28 to 0800H, July 29, 2023.

		WATER LEVEL (WL) STATIONS									
Day	Time	Sapang Buho	Zaragoza	Mayapyap	Penaranda	San Isidro	Arayat	Candaba	Sasmuan	Sulipan	Mexico
28	9:00		4.01		0.56	4.21	7.16	5.23		3.10	
28	10:00	1.87	4.03		0.51	4.30	7.22	5.28		3.10	
28	11:00	1.84	4.04		0.49	4.37	7.28	5.34		3.10	
28	12:00		4.04		0.38	4.48	7.36	5.38		3.08	
28	13:00	1.75	4.06		0.29	4.56	7.41	5.45		3.08	
28	14:00	1.69	4.08		0.26	4.63	7.49	5.49		3.07	
28	15:00	1.63	4.08		0.20	4.65	7.52	5.52		3.06	
28	16:00	1.59	4.09		0.19	4.70	7.57	5.57		3.06	
28	17:00		4.11		0.20	4.73	7.62	5.64		3.08	
28	18:00		4.13		0.19	4.77	7.68	5.69		3.09	
28	19:00		4.16		0.20	4.82	7.75	5.76		3.11	
28	20:00		4.17		0.18	4.86	7.78	5.80		3.12	
28	21:00		4.19		0.24	4.90	7.84	5.85		3.14	
28	22:00		4.20		0.40	4.91	7.87	5.97		3.17	
28	23:00		4.22		0.64	4.95	7.89	5.92		3.19	
29	0:00		4.23		0.70	5.01	7.95	5.96		3.22	
29	1:00		4.24		0.69	5.09	7.95	5.98		3.25	
29	2:00		4.27		0.61	5.18	7.98	6.00		3.26	
29	3:00		4.28		0.52	5.24	8.03	6.02		3.29	
29	4:00		4.30		0.41	5.31	8.05	6.04		3.33	
29	5:00		4.35		0.31	5.34	8.07	6.07		3.36	
29	6:00		4.37		0.19	5.34	8.14	6.10		3.38	
29	7:00		4.39		0.12	5.32	8.16	6.12		3.40	
29	8:00		4.41		0.05	5.27	8.18	6.15		3.42	

Fig A8 Hourly WL recorded at PRBFFWC telemetry stations during event SW Monsoon enhanced by TCs EGAY & FALCON from the period 0900H, July 28 to 0800H, July 29, 2023.

Basin		Pampanga River Basin & Allied River Systems																
Event		SW as enhanced by TCs Egay & Falcon																
Year:		2023																
Month:		July - August																
		RAINFALL (RR) STATIONS																
Day	Time	Munoz	Sapang Buho	Gabaldon	Zaragoza	Mayayyap	Penaranda	Calaanan	Palali	San Isidro	Arayat	Candaba	Sibul Spring	Sasmuan	Sulipan	Mexico	Porac	San Rafael
29	9:00	0	0		0		0	0	0	0	0	0	0	0	0	0	1	0
29	10:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0
29	11:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0
29	12:00	0	0		0		0	0	0	0	0	0	0	14	0	2	1	0
29	13:00	0	0		0		1	0	0	0	2	1	0	4	0	0	0	0
29	14:00	0	1		1		0	0	2	1	1	0	18	1	15	2	4	26
29	15:00	0	0		13		14	0	2	0	5	10	14	5	3	11	7	13
29	16:00	3	1		8		4	0	1	6	23	13	11	14	10	18	2	6
29	17:00	14	8		1		3	3	6	5	4	3	11	9	7	7	3	7
29	18:00	1	2		3		16	1	8	14	13	10	8	3	4	8	8	5
29	19:00	0	3		1		10	1	10	14	4	5	5	6	1	3	3	1
29	20:00	0	0		1		2	0	1	1	0	1	2	10	4	2	3	5
29	21:00	0	1		0		0	0	0	0	0	1	2	2	4	2	0	2
29	22:00	0	0		0		0	0	1	0	0	0	1	4	11	0	0	12
29	23:00	0	0		0		0	0	0	0	1	1	1	3	1	6	2	1
30	0:00	0	0		0		0	0	0	0	1	4	0	7	0	6	15	0
30	1:00	0	0		0		1	0	0	3	5	1	1	4	1	2	7	1
30	2:00	0	0		0		1	0	0	3	1	0	0	1	1	2	3	0
30	3:00	0	0		0		0	0	0	1	1	2	0	1	0	0	1	0
30	4:00	0	0		0		0	0	0	0	0	1	1	0	0	0	0	0
30	5:00	0	0		0		0	0	1	0	0	0	1	2	0	0	0	0
30	6:00	0	0		0		0	0	0	0	0	0	0	2	0	0	0	1
30	7:00	0	0		0		0	0	0	0	0	0	0	1	0	0	1	0
30	8:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0

Fig A9 Hourly RR recorded at PRBFFWC telemetry stations during event SW Monsoon enhanced by TCs EGAY & FALCON from the period 0900H, July 29 to 0800H, July 30, 2023.

		WATER LEVEL (WL) STATIONS									
Day	Time	Sapang Buho	Zaragoza	Mayayyap	Penaranda	San Isidro	Arayat	Candaba	Sasmuan	Sulipan	Mexico
29	9:00		4.43		0.00	5.23	8.21	6.16		3.41	
29	10:00	1.22	4.44		0.00	5.14	8.22	6.18		3.41	
29	11:00	1.18	4.46		0.00	5.07	8.23	6.20		3.40	
29	12:00	1.15	4.46		0.00	4.93	8.28	6.22		3.37	
29	13:00	1.12	4.47		0.00	4.87	8.26	6.25		3.36	
29	14:00	1.09	4.49		0.00	4.77	8.30	6.27		3.36	
29	15:00	1.05	4.52		0.00	4.70	8.31	6.29		3.33	
29	16:00	1.03	4.52		0.00	4.56	8.34	6.32		3.34	
29	17:00	1.01	4.54		0.00	4.47	8.34	6.34		3.34	
29	18:00		4.54		0.00	4.41	8.32	6.35		3.34	
29	19:00		4.54		0.00	4.38	8.33	6.36		3.36	
29	20:00		4.55		0.22	4.30	8.32	6.37		3.37	
29	21:00		4.56		0.53	4.27	8.31	6.39		3.39	
29	22:00		4.56		0.68	4.30	8.30	6.40		3.42	
29	23:00		4.56		0.66	4.38	8.27	6.41		3.44	
30	0:00		4.56		0.62	4.51	8.28	6.43		3.45	
30	1:00		4.56		0.58	4.60	8.31	6.42		3.48	
30	2:00		4.57		0.48	4.67	8.32	6.46		3.50	
30	3:00		4.57		0.36	4.72	8.33			3.53	
30	4:00		4.58		0.25	4.74	8.35	6.44		3.56	
30	5:00		4.57		0.15	4.73	8.34	6.45		3.59	
30	6:00		4.58		0.06	4.68	8.36	6.46		3.62	
30	7:00		4.58		0.02	4.61	8.38	6.46		3.66	
30	8:00		4.58		0.00	4.53	8.40	6.47		3.68	

Fig A10 Hourly WL recorded at PRBFFWC telemetry stations during event SW Monsoon enhanced by TCs EGAY & FALCON from the period 0900H, July 29 to 0800H, July 30, 2023.

Basin		Pampanga River Basin & Allied River System:																
Event		SW as enhanced by TCs Egay & Falcon																
Year:		2023																
Month:		July - August																
		RAINFALL (RR) STATIONS																
Day	Time	Munoz	Sapang Buho	Gabaldon	Zaragoza	Mayayyap	Penaranda	Calaanan	Palali	San Isidro	Arayat	Candaba	Sibul Spring	Sasmuan	Sulipan	Mexico	Porac	San Rafael
30	9:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0
30	10:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0
30	11:00	0	0		1		0	0	0	0	0	0	0	0	0	0	0	0
30	12:00	0	0		0		0	0	0	0	2	0	0	0	0	0	0	0
30	13:00	0	0		0		0	0	0	0	1	0	0	0	0	0	0	0
30	14:00	0	0		0		0	0	0	0	2	0	0	0	0	0	0	0
30	15:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0
30	16:00	0	1		0		1	0	2	2	0	0	0	0	0	0	0	0
30	17:00	0	0		0		2	9	4	1	0	0	0	0	0	0	0	0
30	18:00	2	0		0		0	5	0	0	0	0	0	0	0	0	0	0
30	19:00	0	8		0		0	17	0	0	0	0	0	0	0	0	0	0
30	20:00	0	1		0		3	0	1	0	0	0	0	0	0	0	0	0
30	21:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0
30	22:00	0	0		0		0	0	0	0	0	0	0	0	2	0	0	0
30	23:00	0	0		0		0	0	0	0	0	1	0	0	0	2	0	3
31	0:00	0	0		0		0	0	0	0	0	0	5	0	0	0	0	0
31	1:00	0	0		0		0	0	0	0	0	0	0	1	0	0	0	0
31	2:00	0	0		0		0	0	0	0	1	0	0	0	0	0	0	0
31	3:00	0	0		0		0	0	0	0	0	1	0	4	6	3	0	0
31	4:00	0	0		0		0	0	0	1	1	0	3	7	2	2	3	3
31	5:00	0	0		0		0	0	0	0	1	3	0	1	1	1	1	1
31	6:00	0	0		0		0	3	0	0	1	0	5	1	3	0	0	0
31	7:00	1	0		1		1	0	0	1	0	3	9	0	0	1	0	5
31	8:00	0	1		0		0	1	0	1	0	0	0	0	0	0	0	0

Fig A11 Hourly RR recorded at PRBFFWC telemetry stations during event SW Monsoon enhanced by TCs EGAY & FALCON from the period 0900H, July 30 to 0800H, July 31, 2023.

		WATER LEVEL (WL) STATIONS									
Day	Time	Sapang Buho	Zaragoza	Mayayyap	Penaranda	San Isidro	Arayat	Candaba	Sasmuan	Sulipan	Mexico
30	9:00		4.58		0.00	4.44	8.40	6.47		3.71	
30	10:00	0.93	4.58		0.00	4.36	8.43	6.47		3.72	
30	11:00	0.91	4.59		0.00	4.28	8.41	6.48		3.74	
30	12:00	0.89	4.58		0.00	4.19	8.41	6.48		3.74	
30	13:00	0.88	4.58		0.00	4.09	8.41	6.48		3.75	
30	14:00	0.86	4.58		0.00	4.01	8.40	6.49		3.76	
30	15:00	0.84	4.58		0.00	3.93	8.39	6.49		3.76	
30	16:00	0.84	4.57		0.00	3.83	8.35	6.49		3.77	
30	17:00	0.81	4.56		0.00	3.76	8.35	6.49		3.78	
30	18:00		4.56		0.00	3.69	8.31	6.48		3.77	
30	19:00		4.56		0.00	3.59	8.33	6.48		3.78	
30	20:00		4.55		0.00	3.53	8.31	6.48		3.79	
30	21:00		4.55		0.00	3.45	8.30	6.48		3.81	
30	22:00		4.54		0.00	3.39	8.25	6.48		3.80	
30	23:00		4.53		0.00	3.33	8.25	6.47		3.81	
31	0:00		4.53		0.00	3.27	8.24	6.47		3.83	
31	1:00		4.52		0.00	3.21	8.22	6.47		3.84	
31	2:00		4.51		0.00	3.15	8.18	6.46		3.84	
31	3:00		4.51		0.00	3.08	8.13	6.45		3.86	
31	4:00		4.49		0.00	3.01	8.16	6.46		3.88	
31	5:00		4.48		0.00	2.97	8.10	6.45		3.89	
31	6:00		4.49		0.00	2.93	8.09	6.44		3.90	
31	7:00		4.47		0.00	2.86	8.07	6.45		3.91	
31	8:00		4.46		0.00	2.82	8.05	6.45		3.93	

Fig A12 Hourly WL recorded at PRBFFWC telemetry stations during event SW Monsoon enhanced by TCs EGAY & FALCON from the period 0900H, July 30 to 0800H, July 31, 2023.

Basin		Pampanga River Basin & Allied River Systems																
Event		SW as enhanced by TCs Egay & Falcon																
Year:		2023																
Month:		July - August																
		RAINFALL (RR) STATIONS																
Day	Time	Munoz	Sapang Buho	Gabalton	Zaragoza	Mayapyap	Penaranda	Calaanan	Palali	San Isidro	Arayat	Candaba	Sibul Spring	Sasmuan	Sulipan	Mexico	Porac	San Rafael
31	9:00	0	0		0		0	0	1	0	0	0	0	0	0	0	0	0
31	10:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0
31	11:00	0	0		0		0	0	0	0	1	0	0	0	0	7	0	0
31	12:00	0	0		0		0	0	0	0	0	3	0	9	1	1	5	1
31	13:00	0	1		0		0	14	0	0	0	1	0	4	0	1	0	2
31	14:00	0	0		0		0	3	0	0	0	0	0	0	0	0	0	0
31	15:00	1	0		3		0	0	0	0	0	0	0	4	0	0	0	0
31	16:00	0	0		0		0	0	0	0	0	0	1	0	0	0	0	0
31	17:00	0	8		0		0	0	0	0	0	0	0	1	6	0	0	1
31	18:00	0	0		0		0	1	0	0	0	0	0	1	2	0	0	2
31	19:00	0	0		1		0	0	0	0	0	0	1	0	0	0	0	0
31	20:00	0	0		0		0	0	0	0	0	0	0	0	0	0	1	0
31	21:00	0	0		0		0	0	0	0	1	0	0	0	0	0	1	0
31	22:00	0	0		0		0	0	0	0	0	0	0	1	0	1	1	0
31	23:00	0	0		0		0	0	0	0	0	0	0	1	0	0	1	0
1	0:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0
1	1:00	0	0		0		0	0	0	0	1	1	0	1	2	0	1	0
1	2:00	0	0		0		0	0	0	0	0	1	0	0	0	0	0	3
1	3:00	0	0		0		0	0	0	0	0	0	1	0	0	0	0	0
1	4:00	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0
1	5:00	0	0		0		0	0	0	0	0	0	0	2	2	1	0	0
1	6:00	0	0		0		0	0	0	0	0	0	0	1	1	0	0	2
1	7:00	0	0		0		0	0	0	1	1	4	1	14	11	3	3	3
1	8:00	0	0		0		1	0	0	0	1	2	4	0	2	1	0	1

Fig A13 Hourly RR recorded at PRBFFWC telemetry stations during event SW Monsoon enhanced by TCs EGAY & FALCON from the period 0900H, July 31 to 0800H, Aug 01, 2023.

		WATER LEVEL (WL) STATIONS									
Day	Time	Sapang Buho	Zaragoza	Mayapyap	Penaranda	San Isidro	Arayat	Candaba	Sasmuan	Sulipan	Mexico
31	9:00		4.45		0.00	2.81	8.02	6.46		3.93	
31	10:00		4.45		0.00	2.79	8.00			3.95	
31	11:00	0.72	4.44		0.00	2.76	7.97	6.66		3.95	
31	12:00		4.43		0.00	2.74	7.98	6.57		3.94	
31	13:00		4.43		0.00	2.73	7.94	6.40		3.93	
31	14:00		4.41		0.00	2.70	7.90	6.39		3.92	
31	15:00		4.40		0.00	2.69	7.91	6.39		3.91	
31	16:00		4.39		0.00	2.68	7.87	6.37		3.90	
31	17:00		4.39		0.00	2.67	7.88	6.38		3.89	
31	18:00		4.38		0.00	2.63	7.86	6.43		3.88	
31	19:00		4.37		0.00	2.61	7.84	6.35		3.86	
31	20:00		4.35		0.00	2.58	7.81	6.34		3.86	
31	21:00		4.35		0.00	2.54	7.78	6.33		3.84	
31	22:00		4.33		0.00	2.52	7.79	6.33		3.83	
31	23:00		4.33		0.00	2.50	7.74	6.33		3.82	
1	0:00		4.32		0.00	2.47	7.75	6.32		3.81	
1	1:00		4.30		0.00	2.46	7.73	6.37		3.80	
1	2:00		4.30		0.00	2.43	7.71	6.48		3.80	
1	3:00		4.29		0.00	2.41	7.69	6.43		3.79	
1	4:00		4.28		0.00	2.39	7.66	6.29		3.79	
1	5:00		4.27		0.00	2.37	7.66	6.33		3.78	
1	6:00		4.26		0.00	2.32	7.65			3.79	
1	7:00		4.25		0.00	2.30	7.63	6.26		3.80	
1	8:00		4.25		0.00	2.27	7.60	6.28		3.82	

Fig A14 Hourly WL recorded at PRBFFWC telemetry stations during event SW Monsoon enhanced by TCs EGAY & FALCON from the period 0900H, July 31 to 0800H, Aug 01, 2023.

## Sources of Information

### 1. References:

- *NDRRMC SitRep No. 31 (0800H, Aug 18) and No. 36 (0800H, Aug 24) for SW monsoon enhanced by TCs EGAY & FALCON (2023)*
- *RDRRMC-3 SitRep No. 17 re: Effects of SW Monsoon enhanced by TCs EGAY & FALCON in Central Luzon (1800H, Aug 21)*
- *RDRRMC-3 Final Matrix re: Effects of SW Monsoon enhanced by TCs EGAY & FALCON in Central Luzon (1800H, Aug 09)*
- *Pampanga PDRRMC Sit Rep No. 72 Subject: Effects of SW Monsoon enhanced by Typhoon “KHANUN” (Formerly “FALCON”) (1200H, Aug 04)*
- *Bulacan PDRRMO Sit Rep No. 22 re: SW Monsoon (Habagat) (1600H, Aug 05)*
- *Tarlac PDRRMO Terminal Report re: Combined Effects of TC EGAY / Enhanced SW Monsoon (Aug 22)*
- *Nueva Ecija PDRRMO Sit Rep No. 4 Subject: Situational Report on the Effects of SW Monsoon enhanced by Ty DOKSURI (Formerly “EGAY”) (1200H, July 29)*
- *Nueva Ecija PDRRMO “Photo Compilation of Flooded Areas brought by TCs EGAY & FALCON”*
- *DOST, PAGASA, WD, MMSS TC Preliminary Report on Super Typhoon EGAY (DOKSURI). Date Published: 22 August 2023. Updated 03 October 2023*
- *DOST, PAGASA, WD, MMSS TC Preliminary Report on Typhoon FALCON (KHANUN). Date Published: 22 August 2023.*
- *DOST, PAGASA, WD, MMSS TC Preliminary Report on Typhoon DODONG (TALIM). Date Published: 22 August 2023.*
- *Tropical Cyclone Bulletins issued by Weather Division of PAGASA during TC EGAY (TCB #1 to #35F)*
- *Tropical Cyclone Bulletins issued by Weather Division of PAGASA during TC FALCON (TCB #1 to #15F)*
- *“The Study on Integrated Water Resources Management for Poverty Alleviation and Economic Development in the Pampanga River Basin”. NWRB-JICA Project, December 2010.*
- *NIA-UPRIIS Dam Discharge Report for July 2023*
- *Candaba MDRRMO Situational Reports on TCs EGAY (#1 to #8) & FALCON (#1 to #16) (from July 25 to August 12)*
- *Aliaga MDRRMO Report on “Effects of SW Monsoon-TC EGAY-TC FALCON”*
- *Arayat MDRRMO Sit Reps No. 1, 6 & 7 (July 29, 30, Aug 05)*
- *Bongabon MDRRMO Re: TC EGAY, FALCON and SW Monsoon Report*
- *Calumpit MDRRMO Re: TC EGAY Flood Report*
- *Gabalton MDRRMO shared Rainfall and WL graphs from <https://philsensors.asti.dost.gov.ph/site/data>*
- *Hagonoy MDRRMO Situation Report: Effects of Southwest Monsoon enhanced by TCs / Backflooding; 10 August 2023, 12:00pm final*
- *Mary Stephanie Velasco Flood Info - Hagonoy, Bulacan*
- *Macabebe MDRRMO Sit Reps from August 06 to 15*
- *Malolos CDRRMO Flooding Report ICOW SW Monsoon enhanced by TCs EGAY & FALCON (July 27 to August 10)*
- *Masantol MDRRMO Sit Rep re: Flooding as of July 29 and August 01*
- *Paombong MDRRMO Sit Reps re: TC EGAY, Habagat, Dam Release, & High Tide from the period July 28 to August 08*
- *San Ildefonso MDRRMO Report on TC EGAY & Habagat flood incident in San Ildefonso, Bulacan*
- *San Miguel MDRRMO Re: Areas reported flooded during TC EGAY*
- *San Luis MDRRMO Sit Reps No. 1 to No. 43 (July 24 to August 08)*
- *Louie Rodriguez Report on flooded areas in San Rafael, Bulacan*
- *San Simon MDRRMO flood report*

- *FFWS, HMD re: provision of Region 3 PAGASA station synoptic data*
- *Video coverage of flooded areas in Hagonoy (Aug 02, 2023) courtesy of Mr. Jebot Tayson: <https://youtube/watch?v=Gn4EeAjxanY>*

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