

PRFFWC Post-Flood Report 2022 ¹

PAMPANGA RIVER BASIN Flood Events:

- Tropical Cyclone “KARDING” (*International Name: NORU*)
Flood watch coverage: September 24 to October 01, 2022
- Tropical Cyclone “PAENG” (*International Name: NALGAE*)
Flood watch coverage: October 28 to November 01, 2022



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PAMPANGA RIVER BASIN Flood Events 2022

Part I.

**Tropical Cyclone “KARDING” (*International Name: NORU*)
September 24 to October 01, 2022**

Part II.

**Tropical Cyclone “PAENG” (*International Name: NALGAE*)
October 28 to November 01, 2022**

PRBFFWC, April 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
kph or km/h	kilometers per hour
km ²	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

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
OCD	Office of Civil Defense
PAR	Philippine Area of Responsibility
Pamp	Pampanga
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 DRRM O/C	National / Regional / Provincial / City / Municipal Disaster Risk Reduction & Management Office / Council

Preface

This report is composed of two parts. It covers the 2 tropical cyclone (TC) events that particularly passed over the Pampanga River Basin (PRB) in the year 2022. Part I covers TC “KARDING” and Part II for TC “PAENG”. It generally presents the hydrometeorological data, in particular, the rainfall and the water levels attained during the events and in a way shows how its effects unfolded in the Pampanga River Basin. The PRB hydrological data are the validated dataset of the PRBFFWC while other information related to the events were based from the post-event surveys carried out by the PRBFFWC field team that included interviews with public officials from the various LGUs, mainly the LDRRMOs, private individuals, from situational reports and other materials that were lifted from the internet. Information and pictures taken from the internet are credited to the owner with no copyright infringement intended; these were mainly used for research - reporting purposes only. The information and other resulting outputs presented here have been managed and validated through the best possible means available to the PRBFFWC at its time of processing. However, still it is possible that contents herein may have inadvertent errors. Users noting any errors that they may have encountered in this report are requested to inform the PRBFFWC. As a caveat, users may freely use the information contained herein at their own risk.

The post-event surveys conducted by the PRBFFWC field team for TC Karding was carried-out from October 05 to 10, 2022 while for TC Paeng it was from November 09 to 15, 2022.

PART I:
Tropical Cyclone “KARDING” (International Name: NORU)
September 24 to October 01, 2022

Summary

Tropical Cyclone “KARDING” crossed through the Pampanga River Basin as a Typhoon category from about past 2100H of September 25 and until before 0200H of September 26. Its main immediate destructive effects were on its sustained winds rather than the rains it poured in the general PRB area. Unfortunately, flashfloods in the eastern part of the basin during Karding’s passage resulted in several fatalities. The upstream monitoring portion of some 8 stations of the PRBFFWC system went down starting 2200H of September 25 until the rest of the event due to the strong winds generated by Karding. The center of the tropical cyclone was likely to have entered the PRB through the town of Gen. Tinio, Province of Nueva Ecija and exited somewhere in the La Paz-Tarlac City area in the province of Tarlac. The eastern and central towns of Nueva Ecija mostly bore the brunt of destruction from the strong winds. On the other hand, floods inundated the Candaba swamp area and down to several towns in the Pampanga Delta area. Flashfloods, likewise, flowed down from the western slopes of Sierra Madre mountains towards northeastern Bulacan, particularly in the town of San Miguel, which resulted in the tragic death of 5 Bulacan-PDRRMO rescuers. TC Karding left a trail of destruction to the country affecting 8 regions including Metro Manila with a total damage to infrastructure and agriculture amounting to ₱304M and almost ₱2.9B, respectively; an overall reported casualties that included 12 dead, 68 injured, and 5 missing persons.² The PRBFFWC issued the first flood awareness information, a Flood Advisory (No. 1), on 1400H, September 24 and the final flood information, Final Flood Bulletin (No. 13), on 0800H of October 01. The center issued 14 flood information, i.e., 1 Flood Advisory (FA) and 13 Flood Bulletins (FB). The flood associated with Karding was less in magnitude and impact compared with a lot of other previous events and this is described clearly in this report’s cover photo.

² NDRRMC SitRep No. 15 for STY. KARDING (2022), 0800H, Oct 12, 2022

1.0 Hydrological area background of Pampanga River Basin (PRB)³

The Pampanga River Basin is the 4th largest river basin in the Philippines. It drains an aggregate area of 10,434 km². It is generally divided into three sub-basins, namely: (a) Main Pampanga River Basin with its catchment area of 7,978 km², (b) Pasiac River sub-basin (also known as the allied sub-basin of Pasiac-Guagua River system) with 1,371 km² and (c) Angat River sub-basin with 1,085 km². Roughly 95% of the basin transcends 4 provinces of Region 3 which are: nearly the whole of Nueva Ecija, about a third of Tarlac, around two-thirds of Bulacan, and almost whole of Pampanga.

Main Pampanga River has a river length of roughly 265 kilometers with headwaters coming from the Caraballo Mountains at north of the basin. It flows into the Pantabangan storage dam and after the dam, it generally flows southward joining with several tributaries until it finally discharges into Manila Bay. The major tributaries are the Digmala, Coronel, Peñaranda, and Rio Chico Rivers. Rio Chico has the largest catchment area at 2,895 km² and joins the main stream of Pampanga just before Mt. Arayat (estimated elevation of 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 the Labangan Floodway. There is a connecting channel with Pampanga River, the Bagbag River, situated between the towns of Pulilan and Calumpit in the Province of Bulacan.



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

The basin has two swamp areas, the Candaba and the San Antonio swamps with an area of about 250 and 100 km², respectively. Candaba Swamp covers a maximum inundation area of around 330 km² during rainy season.

There are two major hydraulic structures within the basin, the Pantabangan and Angat Dams. Pantabangan is located at the upper main Pampanga River northeast part of the basin and operates both as hydropower and as an irrigation dam. Angat is located on the eastern portion of the basin and drains through the Angat River via Ipo and Bustos Dams. Angat mainly operates as a hydropower plant while Ipo and Bustos as water supply reservoir and irrigation dams, respectively.

³ Some 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.

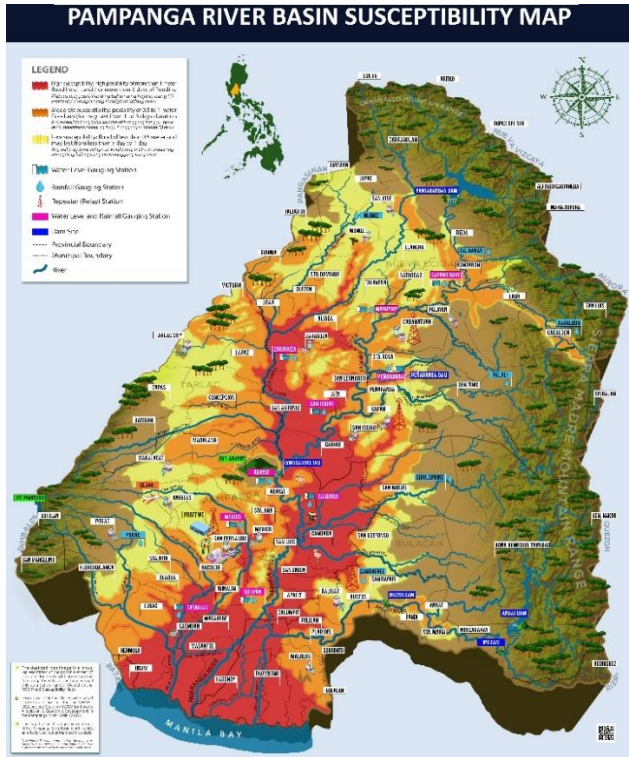


Figure 1.1 Above is “geopictorial” map representation of the flood susceptibility within the PRB. The red colored area are designated as highly susceptible; orange as moderate susceptibility; and yellow colored as low susceptibility.

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

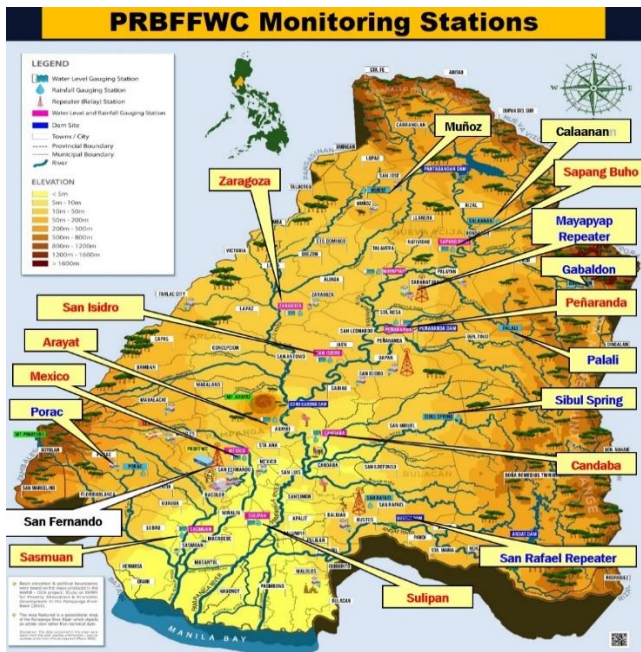


Figure 2.0 Map showing the location of monitoring stations of the PRBFFWC in the Pampanga River Basin.

The Pasac-Guagua River system is an allied sub-basin 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 them originates in Mt. Pinatubo and flow towards Manila Bay. The lower reaches of the river system is connected with Main Pampanga River by the Bebe-San Esteban Cut-off Channel. The Pasac River was affected by the eruption of Mt. Pinatubo in 1991 such that river alignments changed significantly due to mudflow (lahar). Substantial sediment deposition in the river channel is still active.

The 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.

The PRBFFWC is the office 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 18 rain and 10 water level (WL) stations. It is complemented with 2 synoptic station & an agrometeorological station within the basin. These stations, however, are not automatically transmitting data on a real-time basis to the center.

The PRBFFWC operations is located in the DMGC in the City of San Fernando, Pampanga. Additional information about PRBFFWC are available in the following website: <http://prffwc.synthasite.com/>

3.0 Meteorological aspect: Tropical Cyclone Karding (*International name: Noru*)⁴

“KARDING” was the 11th tropical cyclone to enter the PAR for the year 2022 and the 3rd to make landfall during that year. It developed within the PAR in the morning of September 22 and exited in the evening of September 26, see Fig 3.0. It is one of the few tropical cyclones that experienced a rapid to an ‘explosive’ intensification as it reached a Super Typhoon Category in the morning of September 25. Karding underwent rapid intensification, change of 45 knots (kts), from 60 kts to 105 kts, in 24 hours. Noru is the Japanese verb for ‘to ride’, ‘to take’, or such (from Google).



Fig. 3.0. Track of TC “KARDING” within the Philippine Area of Responsibility.

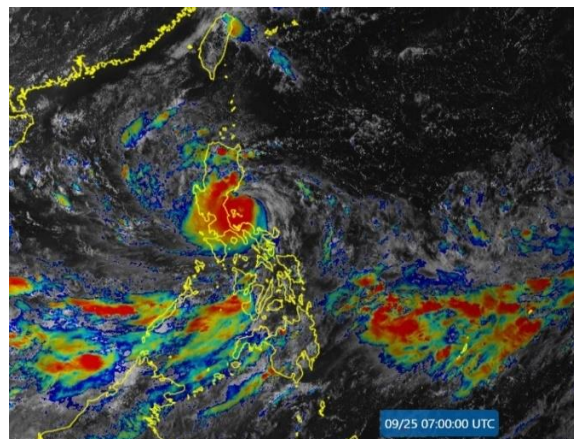
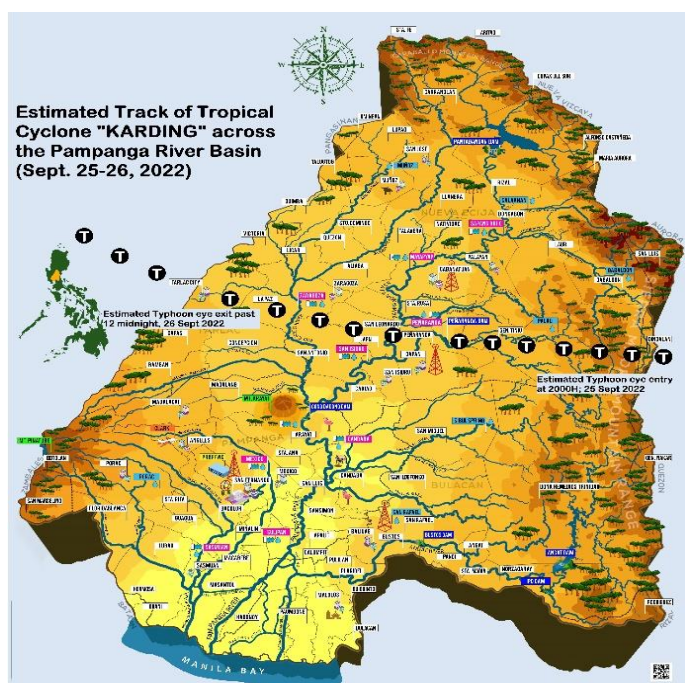


Fig. 3.1. JMA Satellite Image (color enhanced) of TC Karding at 0700H (UTC), Sept. 25, 2022 prior to its approach towards the PRB



Karding trekked across the PRB for roughly 4 hours coming from the eastside of the basin (2000H, 25 September 2022), most likely through the town of Gen. Tiñio and passed (the TC eye) through the towns of Peñaranda, San Leonardo, San Antonio and Zaragoza all in the province of Nueva Ecija, then through the town of La Paz, province of Tarlac and exited at the western side of the basin somewhere in Tarlac City (past 12 midnight of 26 September 2022).

Fig 3.2 (left). Figure on the left is the estimated track of TC Karding over the PRB.

⁴ Taken from Tropical Cyclone Bulletins issued by the WD of PAGASA

Table 1.0. Summary of the TC Karding during the course of its movement within Region 3, specifically through the Pampanga River Basin:

Time & Date	Synopsis (lifted from TC Bulletins)	Location (position of TC)	Lat. & Long.	Cat	Intensity (sustained / gusts)	Pressure (hPa)	Direction & speed	Extent of winds
1900H; Sept 25	“Karding slightly weakens as it is about to make landfall in the vicinity of Gen. Nakar-Dingalan area”	over the coastal waters of Gen. Nakar	15.1 N; 121.7 E	STy	185 / 255	925	W @ 20 kph	290 km
2200H; Sept 25	“Karding makes landfall in Dingalan, Aurora as a typhoon & is now in the vicinity of Nueva Ecija (NE)”	vicinity of San Leonardo, NE	15.4 N; 121.0 E	Ty	175 / 290	935	WNW @ 20 kph	270 km
0100H; Sept 26	“Karding continues to weaken as it crosses Tarlac towards Zambales & to the West Philippine Sea”	vicinity of Mayantoc, Tarlac	15.5 N; 120.3 E	Ty	140 / 230	935	WNW @ 20 kph	270 km
0400H; Sept 26	“Karding emerges over coastal waters of Northern Zambales”	coastal waters of Sta. Cruz, Zambales	15.7 N; 119.5 E	Ty	140 / 170	970	WNW @ 30 kph	270 km

Listed below are the highest Tropical Cyclone Wind Signals raised over areas in Region 3 during TC Karding’s passage over Region 3:

TCWS #5 – extreme southern portion of Aurora, extreme southern portion of Nueva Ecija, eastern portion of Pampanga, eastern and central portions of Bulacan

TCWS #4 – southern portion of Aurora, central and southern portions of Nueva Ecija, Tarlac, rest of Pampanga, rest of Bulacan, Zambales, northern portion of Bataan

TCWS #3 – central portion of Aurora, southeastern portion of Nueva Vizcaya, rest of Nueva Ecija, rest of Bataan

4.0 Basin hydrological aspects during TC Karding

4.1 Event basin rainfall

The event rains associated with TC Karding over the PRB were mainly those that occurred from the evening of September 25 up to the early morning of 26, or more specifically the 24-hr meteorological day of September 25, that is from 8:01 am to 8:00 am of the following day.

Table 2.0 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 2.1 Pampanga River Basin observed 24-hr (met day) rainfall in millimeters for the period September 25 to 26, 2022.

Stations	September 25	September 26	Maximum 1-hr observed RR	Time (LST) / Day of maximum 1-hr RR for the September 25 (meteorological day)
Muñoz	28	13	5	1500H / 25
Sapang Buho	55	9	9	1700H / 25
Gabalton	210	20	44	2100H / 25
Zaragoza	24	1	7	2200H / 25
Mayapyap (NIA-UPRIIS)	109	7	33	0000H / 26
Peñaranda	145	5	64	2300H / 25
Calaanan	83	17	14	1700H & 2100H / 25
Palali	107	22	33	2200H / 25
San Isidro	112	8	36	2300H / 25
Arayat	134	1	47	2300H / 25
Candaba	70	1	25	2300H / 25
Sibul Spring	166	22	65	2200H / 25
Sulipan	65	3	14	2300H / 25
San Rafael	87	2	24	1900H / 25

Table 2.2 Allied sub-basin of Pasac-Guagua River system 24-hr (met day) RR in millimeters for the period September 25 and 26, 2022.

Stations	September 25	September 26	Maximum one hour observed rainfall	Time (LST) / Day of maximum 1-hr RR for the September 25 (meteorological day)
Sasmuan	75	0	17	0000H / 26
Mexico	96	1	28	2300H / 25
Porac	71	1	18	0100H / 26
PRFFWC	91.7	0.5	27.9	2300H / 25

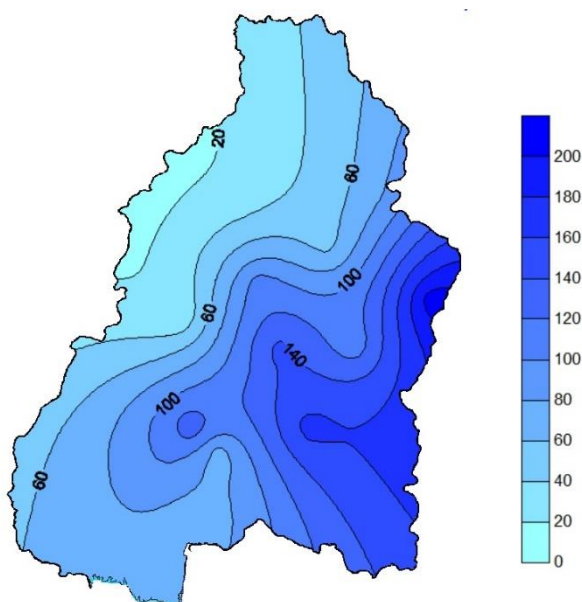


Table 2.3. Observed rainfall from other stations within and adjacent to the PRB on September 25, 2022 are given below as follows:

Station	Rainfall (mm)
Clark Synop	125.2
Muñoz Synop	55.8
Ha. Luisita Agromet	76.2
Bataan Synop *	119.9

* This station is outside PRB & situated on the SW side of the basin

Figure 4.0 (left). The 24-hour (met day) isohyets for Sept 25 during the passage of TC Karding over the PRB.

4.2 River stages at PRBFFWC forecasting points during Karding

PAMPANGA RIVER BASIN ASSESSMENT LEVELS (meters)

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			3.00
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

Figure 4.1 (top L) The PRB assessment levels that were used during event Karding.

Figure 4.2 (above) A qualitative description for river rates in meters per specific time period.

Table 3.0 Time / Day when the Station's Flood Assessment Gauge Heights were reached

Station Point	Alert Level	Alarm Level	Critical Level	Remarks
Sapang Buho	(3.70 m) Before 0100H of Sept 26	(4.50 m) around 0200H of Sept 26	(6.50 m) Not reached	Peak WL was 4.94 m (54.699 m AMSL) attained at around 0400H-0500H of Sept 26
Zaragoza	(3.00 m) Was already above 3.0 m prior to event	(4.00 m) Not reached	(5.00 m) Not reached	WL crested, as per telemetry records, at 3.67 m (14.986 m AMSL) attained at 1500H, Sept 27
Peñaranda	(2.50 m) Just past 2300H, Sept 25	(3.50 m) Between 2300H, Sept 25 to 0000H, Sept 26	(4.50 m) Just past 0000H, Sept 26	Estimated peak as per telemetry reading was 5.30 m (27.988 m based on TBM) attained at 0100H, Sept 26
San Isidro	(5.00 m) Between 0200H to 0300H of Sept. 26	(6.00 m) Before 0300H of Sept 26	(8.00 m) Before 0500H of Sept 26	Peak WL was at 8.32 m (17.657 m AMSL) attained at around 0600H of Sept 26; rapid rise of river stage from 0000H to 0600H of Sept 26

Arayat	(5.00 m) Before 0400H of Sept 26	(6.00 m) Before 0500H of Sept 26	(8.50 m) Not reached	WL crested, as per telemetry records, at 8.26 m (8.337 m AMSL) attained from 1900H-2000H of Sept 26
Candaba	(3.50 m) 1900H of Sept 25	(4.50 m) Just after 1600H of Sept 26	(5.00 m) Just before 2000H of Sept 26	Swamp water level crested at 6.03 m (5.873 m AMSL) on 0700H, Sept 28 and remained above critical level until the 1000H of Oct 03
Mexico	WL sensor at the site was not functioning during the event			There were no definite flood marks identified in the area
Sasmuan	WL at the site was already fluctuating above the assigned critical WL of 3.0 m prior to the event. Critical WL was recommended to be raised to 3.5 m since the riverside area has already been used to the effects of tides which is above the previous assigned critical WL.			No significant floods were observed at the site. The peak WL at the site during the event was 3.48 m (1.642 m AMSL) and was attained 0900H of Sept 26
Sulipan	(2.60 m) Before 2300H of Sept 25	(3.20 m) Before 0800H of Sept 26	(3.80 m) Was not reached	Maximum WL based on telemetry observation was 3.52 m (3.458 m AMSL) attained around 1300H of Sept 27.
<i>Note: Elevation of "0" of staff gages were based on surveys carried-out on August 2022. TBM – Temporary Bench Mark</i>				

4.3 Tides

Table 4.0. High Tide (highest for the day) from Sept 25 to 30, 2022 (Based on Navotas port, Latitude 14° 41' N, Longitude 120° 56' E)

Day	Time	Height (m)
Sept 25	9:22 am	1.16
Sept 26	10:00 pm	1.09
Sept 27	10:40 pm	0.99
Sept 28	10:43 pm	0.94
Sept 29	11:15 pm	1.02
Sept 30	11:51 am	1.09



(Pic 01 above) Bgy. Carillo in Hagonoy, Bulacan was still with standing water due to the remains of the pluvial flood (accumulated rainwater) from Karding and the combined effects of tides in the area. (Photo taken 1100H of Sept 29)

Tides during the event were not that high and were receding after Sept 25. However, some riverside areas of Macabebe, Masantol, Apalit, Hagonoy and Calumpit have already been affected by lingering floods even before Karding’s passage over PRB due to effects of tides. The standing floodwaters often last for weeks.

4.4 Dam structures / releases

The two major hydraulic dam structures within the PRB are the Pantabangan and Angat Dams in the province of Nueva Ecija and Bulacan, respectively. Both dams did not open their gates during Karding. Two relatively smaller reservoir downstream of Angat Dam, the Ipo and Bustos dams did, however, released reservoir water. The Ipo Dam reservoir recorded a peak total discharge of 677.91 cumecs at 2130H of Sept 25 but was eventually reduced by more than 100 cumecs by 2300H of the same day. At noon time of the following day all of its gates were already closed. On the other hand, Bustos dam which is about 37 kms downstream of Ipo Dam had a peak discharge of 1,256 cumecs at around 0100H

of Sept 26. By 0800H of the same day, flows were now down to almost 1/3 of the peak discharge. Around 0600H, Sept 30, all of its gates were close with a prior closing flow of only 26 cumecs.⁵



Recorded peak discharges from the NIA-UPRIIS area dams, Peñaranda and Atate Dams, were estimated at 520 and 1000 cumecs, respectively, and these were attained at around 0600H of Sept 26. Atate Dam is situated a few kilometers downstream of the Sapang Buho Telemetry station while Peñaranda Dam is situated about a kilometer upstream of the Peñaranda Bridge where the Peñaranda telemetry station is situated.⁶



(Pic 02, Top L) Peñaranda Dam a day after the passage of Karding which shows storage water still spilling over the dam's ogee.

(Pic 03, Bottom L) A same view of Peñaranda Dam as mentioned above taken during a relatively low flow condition.



(Pic 04, top L) A view of an overflowing Atate Dam in Palayan City, NE just after the passage of Karding (photo taken 1737H, Sept 26), and (Pic 05, top R) the same dam during a relatively dry state period.

5.0 Basin hydrological situation during TC Karding

TC Karding's center was estimated to have entered the PRB coming from the east, at about 2200H, 25 September 2022, through the towns of Gen. Tinio and then along Peñaranda, San Leonardo, then passing through San Antonio and Zaragoza all in the province of Nueva Ecija; it then coursed through La Paz in province of Tarlac and exited via Tarlac City at past 12 midnight of 26 September 2022.

⁵ Dam discharge info are as per SITREP No. 14 of Bulacan PDRRMO as of 1800H, 01 Oct 2022

⁶ NIA-UPRIIS data report



(Pic 06, Top L) A steel post fell over the Mayapyap station structure, which is already defunct, during the onslaught of Karding in Cabanatuan City, province of Nueva Ecija (photo taken Sept 26).

(Pic 07, Top R) The steel support of this gasoline station in the town of Cabiao, Nueva Ecija, gave way at the height of Karding's passage in the area (photo taken Sept 26)

(Pic 08, Left) Leaning & almost fallen concrete electric posts along the Cabanatuan City to Baler Road in Nueva Ecija a day after Karding struck the province (photo taken Sept 26)

A brief timeline of events during the passage of Karding in the PRB is bulleted below:

- September 25
 - 1400H-1500H: Light to moderate rains associated with Karding already started on the eastern sections of the basin as reflected in the observed rains of the following stations – Gabaldon, Sapang Buho, Calaanan, Palali and Peñaranda;
 - 1600H: Heavy to intense and at times torrential category rains were manifested at the eastern section stations of the basin until midnight of the day

Karding's rainfall affected the PRB starting in the afternoon of September 25 with peak of event rains occurring in the evening until early morning of the next day, September 26. There were 3 stations that registered heavy to intense rainfall in about 7 hours in the evening of Sept 25, Gabaldon station from 1500H – 2200H which totaled more than 186mm; Peñaranda station from 1700H to 0000H of the next day totaling 125 mm; and Sibul Spring station from 1600H to 2300H with a total of 149 mm. The rest of the stations from the east of the basin registered heavy to at times intense rains for about 3 to 5 hours mostly between the period 1700H to 2300H while the rest of the stations at the central to west portions of the basin recorded similar intensities for 5 to 6 hours from the period 2100H until 0300H of the next day.

- 1800H-0000H: Relatively strong winds associated with Karding were felt mostly in the eastern sections of the basin as early as 1800H until 2200H as reported in the town of Gen. Tiño and Gabaldon; around 2000H to 0000H in the town of San Leonardo and Cabiao; and 2100H to 0000H in the town of Jaen;

- 2100H: Karding's eye was estimated to have entered the east of the PRB at Gen. Tiño in Nueva Ecija;
- 2200H: Immediate rise of waterways were observed in the towns of Laur, Gabaldon, Peñaranda and Gen. Tiño in Nueva Ecija (eastern sections of PRB) almost simultaneous with the heavy downpour;
- September 26
 - 0000H: Karding's eye left the PRB sometime past midnight / early morning of Sept 26 somewhere in the vicinity of Tarlac City;
 - 0000H-0400H: Light to moderate and at times intense rains spread over the basin, particularly at the middle to downstream sections of the basin which eventually begun late evening of the previous day;
 - 0000H-0400H: Gradual to rapid rise of river stages were recorded in Sapang Buho and Peñaranda; a few hours later, 0200H-0300H, the same rapid rise was observed in San Isidro which is already at the midstream section of Pampanga River;



Sapang Buho WL station registered a maximum river rise of 1.30 meters in an hour from 2300H to 0000H, Sept 25; Peñaranda WL station had a 1-hour rise of more than 2 meters during the same period; and 3-hrs later, a similar rise of more than 2 meters in an hour was registered at San Isidro WL station. These river rises are characteristics of a flashy flows. There were few river overflowing or fluvial floods reported in the Nueva Ecija area. On the other hand, some of the towns in the province experienced generally pluvial floods in several of their low-lying barangays.



(Pic 09, Top L) Pampanga River at Mayapyap a day after Karding's passage (1516H, Sept 27); (Pic 10, L) Measuring surface river velocity of the Pampanga River at San Isidro with a telemetry reading at that time of 7.10 m using a radar profiler (1145H, Sept 26)

- 0000H – 0100H: Flashfloods were reported in the towns of San Miguel, San Ildefonso and partly in San Rafael all in Bulacan province which came from the western slopes of the Sierra Madre Mountain range at the eastside of the PRB; the rapid flows coursed through the tributaries of Bulo, Garlang & Madlum into the San Miguel River and Biak-na-Bato into the Maasim River.

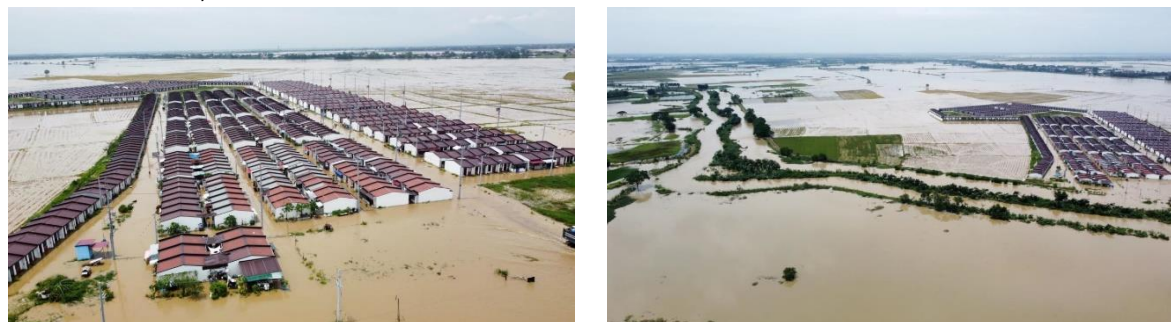


(Pic 11, Top L) The hanging bridge walk over Madlum River in San Miguel, Bulacan was washed out as floodwaters spawned by Karding rose to more than 4 to 5 meters in the area. (Pic 12, Top R) A monitoring station of the Bulacan-PDRRMO was also damaged during the event as floodwaters swept through the said station as high as to the station's utility box. (Photos shared by Bulacan-PDRRMO)

Flashfloods were reported to have occurred just after midnight of Sept 25. In Barangay Camias, Municipality of San Miguel, five Bulacan-PDRRMO responder / rescuers perished at around 0130H to 0200H of Sept 26 when their rescue boat was swept away by a high swift 2-meter floodwaters. Their bodies were later recovered at different locations several tens of meters away from where they were reported to have been last seen. The San Miguel and Maasim Rivers, which flows towards Candaba swamp, rose significantly at the height of Karding's passage over the PRB.



(Pic 13 & 14, L to R) A drone shot of the Maasim River in San Ildefonso, Bulacan showing its overflowed river banks; Bgy. Maasim, San Ildefonso, Bulacan with still flooded areas a day after the passage of Karding (Photos courtesy of San Ildefonso MDRRMO)



(Pic 15 & 16, L to R) Another drone shot of areas in the town of San Ildefonso, Bulacan showing the extent of flooding particularly a flooded housing area in Bgy. Anyatam (photos courtesy of San Ildefonso MDRRMO)



(Pic 17 & 18, L to R) Flooded areas in Bgy. Garland, San Ildefonso, Bulacan taken on Sept 26 (photos courtesy of San Ildefonso MDRRMO)



(Pic 19, grouped photos) Various flooded areas within the Bgy. Pansumaloc, San Rafael, Bulacan; (Pic 20, Below L) A view of an overflowing Maasim River in Bgy. Diliman 2, San Rafael, Bulacan; (Pic 21, Below R) Another flooded area in Bgy. Pulung Bayabas, San Rafael, Bulacan (all photos courtesy of Mr. L. Rodriguez)



- 0600H: Main Pampanga River at San Isidro peaked above its 8.0 m critical WL.
- 1900H-2000H: Pampanga River at Arayat peaked just below its critical WL. An hour later, Candaba swamp WL breached its 5.0 m critical WL and a slow filling-up of the swamp continued for 2 days.



(Pic 22 & 23, L to R) A flooded Cabiao Floodway, between Bgys. San Vicente & Concepcion, a day after Karding and, on the right side, the same spot almost 2 weeks after the event.



(Pic 24 & 25, Top L to R) Another view of the Cabiao floodway taken from the viaduct (Sept 26) with floodwaters still within the waterway and, on the right side, the same location taken almost 2 weeks after Karding (Oct 07)

- 2000H: Floodwaters coming from the overflowed San Miguel and Maasim Rivers started engulfing Candaba swamp area;



(Pic 26 & 27, L to R) Bgy. San Agustin Hall in Candaba almost 2 days after Karding and the same Barangay Hall almost 2 weeks after Karding event. (Left photo taken from Internet as aired by TV Patrol; no copyright infringement intended; for report-research purposes only)



(Pic 28 & 29, Top L to R) The still flooded main road of Bgy San Agustin in Candaba almost 2 days after Karding and, on the right, the same road almost 2 weeks after the event.



(Pic 30, L) The San Agustin Plaza in Candaba still underwater after 2 days since Karding's passed over the PRB. (Photos 28 & 30 were taken from internet as aired by TV Patrol; No copyright infringement intended. For report-research purposes only)

- The town of Candaba had some 27 barangays reportedly inundated ranging from depths of 0.3 to 3.0 meters of floodwaters during Karding.
 - September 27
 - The relatively high flows from the upstream of main Pampanga River, those from Nueva Ecija, ultimately reached the middle and lower sections of the basin which eventually affected the riverside downstream areas of the said river. These are in the towns of San Luis, San Simon, Apalit, Macabebe, and Masantol in Pampanga province and the towns of Calumpit and Hagonoy in the province of Bulacan.

- 0400H, Pampanga River at San Isidro receded below the 6.0 m Alarm WL and between 1000H – 1100H had receded further below its 5.0 m Alert WL
- 1400H-1500H, Pampanga River at Sulipan peaked at 3.52 m just below the established 3.80 m critical WL
- September 28 and onwards
 - 0700H: Candaba swamp WL peaked at 6.03 m; WL remained above 5.0 m critical WL until 1100H of Oct 03



(Pic 31, Top) The Candaba – San Miguel Road, which is just adjacent to the Candaba Telemetry station at Dukma in Candaba, remains flooded on the San Miguel side of the bridge as of Oct 01 and lasted until about 3 more days; (Pic 32, L) the Candaba Telemetry station at telemetry reading of 5.50 m, still above the established 5.0 m critical WL (both photos were taken at around 1000H, Oct 01)

- Arayat WL receded below 6.0 m alarm WL on 1300H, Sept 29; receded below 5.0 alert WL on 0500H, Oct 01
- Sulipan WL receded below 2.60 m alert WL on 1200H, Oct 03
- Recession of floodwaters lasted until the 1st week of October



(Pic 33, L) River velocity measurements of the Pampanga River were carried-out at the San Luis Bridge in the town of San Luis in Pampanga as of 1235H, Sept 29.

Table 5.0: Report of flooded areas during the event as per collated info from various LDRRMOs and from the post-flood survey conducted by PRBFFWC.

Location	Estimated Latitude; Longitude	Estimated maximum flood level (m)	Estimated Date of occurrence	Notes / remarks (as per info from reports, interviews, etc.)
Bgy. San Antonio, Laur, Nueva Ecija	15°36'08"N; 121°12'05"E	0.7	0030H to 1000H, Sept 26	Pluvial floods & overflow of creeks
Gen Tinio, Nueva Ecija (Población East)	15°21'10"N; 121°03'53"E	0.5 to 1.0	Before midnight of Sept 25	Pluvial floods & partly overflow of Chico River
Pan-Philippine Hi-way at San Leonardo, NE	15.31476°N; 120.93694°E	0.5 to 1.0	Early morning of Sept 26	Overflowing of the RB of Peñaranda River
Cabiao Floodway (between Bgys. San Vicente & Concepcion in Cabiao, NE)	15.21807°N; 120.82777°E	1.0 to almost 2.0	Morning of Sept 26	Floods possibly coming from the eastside of the town & partly overflow of Pampanga River
Pan-Philippine Hi-way at Bgy. Camias, San Miguel, Bulacan	15.16192°N; 120.97205°E	1.0 to 1.5	Midnight of Sept 25 until 0400H, Sept 26	Flashy effect from the overflowing of San Miguel River
Bgy. Bantog, San Miguel, Bulacan	15.21183°N; 120.95550°E	1.2	Midnight of Sept 25 until 0400H, Sept 26	From eastern portion of the area (possibly from Bulo River)
Poblacion, San Miguel, Bulacan	15.13954°N; 120.97697°E	1.5	Midnight of Sept 25 until 0400H, Sept 26	Flashy effect from the overflowing of San Miguel River
Bgy. San Jose, San Miguel, Bulacan	15.14727°N; 120.98219°E	1.5 to 2.0	Midnight of Sept 25 until 0400H, Sept 26	Flashy effect from the overflowing of San Miguel River
Bgy. Akle, San Ildefonso, Bulacan	15.04883°N; 121.07183°E	0.5 to 0.9	2200H, Sept 25 to 0100H, Sept 26	Pluvial floods; overflowing of creeks
Bgy. Calawitan, San Ildefonso, Bulacan	15.07421°N; 120.91769°E	1.22	2000H, Sept 25 to 1700H, Sept 26	Pluvial & overflowing of creeks
Bgy. Maasim, San Ildefonso, Bulacan	15.04104°N; 120.93737°E	1.22	2000H, Sept 25 to 1700H, Sept 26	Pluvial plus overflowing of Maasim River
Bgy. Anyatam, San Ildefonso, Bulacan	15.10378°N; 120.93861°E	1.22	2000H, Sept 25 to 1700H, Sept 26	Pluvial floods; overflowing of creeks
Bgy. Garlang, San Ildefonso, Bulacan	15.11142°N; 120.94669°E	1.22	2000H, Sept 25 to 1700H, Sept 26	Pluvial floods; overflowing of creeks
Bgy. Maasim, San Rafael, Bulacan	15.04013°N; 120.93999°E	0.3 to 0.5	2300H, Sept 25 to 0300H, Sept 26	Pluvial plus overflowing of Maasim River
Bgy. Pansumaloc, San Rafael, Bulacan	15.01842°N; 120.89596°E	0.5	2100H, Sept 25 to 1000H, Sept 26	Pluvial floods; overflowing of creeks
Bgy. Diliman 2, San Rafael, Bulacan	15.03743°N; 120.95605°E	0.3 to 0.5	0030H to 0300H, Sept 26	Pluvial plus overflowing of Maasim River
Bgy. Pulong Bayabas, San Rafael, Bulacan	15.01724°N; 120.90401°E	0.3	0300H to 0700H, Sept 26	Pluvial floods; overflowing of creeks
Bgy. Calizon, Calumpit, Bulacan	14.912715°N; 120.753606°E	0.9	initial: Sept 25 peak: Sept 27 receded: Oct 06	Combination of pluvial, fluvial floods & tides
Bgy. Frances, Calumpit, Bulacan	14.920777°N; 120.762633°E	0.9	initial: Sept 25 peak: Sept 27 receded: Oct 06	Combination of pluvial, fluvial floods & tides
Bgy. Meysulao, Calumpit, Bulacan	14.907948°N; 120.739467°E	1.8	initial: Sept 25 peak: Sept 27 receded: Oct 07	Combination of pluvial, fluvial floods & partly effects of tides
Bgy. San Miguel, Calumpit, Bulacan	14.916735°N; 120.742838°E	1.22	initial: Sept 25 peak: Sept 27 receded: Oct 07	Combination of pluvial, fluvial floods & partly effects of tides

Purok 1, Bgy. San Isidro, Hagonoy, Bulacan	14.85607°N; 120.73180°E	0.5 to 0.9	Sept 27	Combination of pluvial, fluvial floods & tides
Bgy. Carillo, Hagonoy, Bulacan	14°51'28"N; 120°45'36"E	0.3 to 0.4	Sept 28 at around 1500H	Combination of pluvial, fluvial floods & tides
Bgy. San Juan, Hagonoy, Bulacan	14°52'03"N; 120°44'31"E	0.3 to 0.4	Sept 27	Combination of pluvial, fluvial floods & tides
Bgy. San Agustin, Candaba, Pampanga	15.09086°N; 120.83177°E	2.0 to 2.5	Started Sept 26	Runoff & pluvial floods; overflowing of rivers & creeks w/in the swamp
Bgy. Mapaniqui, Candaba, Pampanga	15°06'05"N; 120°55'11"E	0.9	Started Sept 26	Runoff & pluvial floods; overflowing of rivers & creeks w/in the swamp
Bgy. Pescadores, Candaba, Pampanga	15°05'25"N; 120°49'31"E	0.3 to 0.9	Started Sept 26	One of the 27 Barangays reported affected in the town
Mapaniqui – Anyatam Road (Bgy. Mapaniqui)	15°06'37"N; 120°56'01"E	1.0	Started Sept 26	Not passable from Sept 26 to 28
Candaba – Baliuag Road (Bgy. San Agustin)	15°05'02"N; 120°50'20"E	2.0 to 3.0	Started Sept 26	Not passable from Sept 26 until Oct 05 or even after at some portions of the road
Dukma (Candaba – San Miguel Road)	15°06'52"N; 120°51'19"E	1.5 to 3.0	Started Sept 26	Not passable from Sept 26 until Oct 05 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	Started on Sept 26 until Sept 30	Exact area is Purok 6 of Bgy. San Juan; Overflowing of Pampanga River
Bgy. Sta. cruz, San Simon, Pampanga	15°00'56"N; 120°46'46"E	0.6	Started on Sept 26 until Sept 30	Pluvial & overflowing of Pampanga River
Bgy. San Pedro, San Simon, Pampanga	15°01'01"N; 120°46'35"E	0.9	Started on Sept 26 until Sept 30	Pluvial & overflowing of Pampanga River
San Gabriel, Macabebe, Pampanga	14°54'40"N; 120°43'09"E	0.9	Sept 26 onwards	Standing flood from pluvial and tides
Masantol Civic Center, Masantol, Pampanga	14°53'48"N; 120°42'36"E	0.5 to 0.9	Sept 26 onwards	Standing flood from pluvial and tides

Table 5.1. Other areas flooded as reported by various LDRRMOs:

Towns	Barangays	
Jaen, Nueva Ecija	Mostly rice field areas – Calabasa, Dampulan, Hilera, Imbunia, Lambakin, Magsalisi, Malabon-Kaingin, Marawa, Niyugan, Pacol, Pamacpacan, Pinanggaan, Ulanin-Pitak, Putlod, San Jose, San Pablo, San Vicente, Sta. rita, sto Tomas N & S	
San Miguel, Bulacan	Bagong Pag-asa, Bagong Silang, Balaong, Balite, Bantog, Bardias, Baritan, Batasan Bata, Batasan Matanda, Biak na Bato, Biclat, Buga, Buliran, Bulualto, Calumpang, cambio, Camias, Ilog-Bulog, King Kabayo, Labne, Lambakin, Magmarale, Malibay, Maligaya, Mandile, Masalipit, Paliwasan, Partida, Pinambaran, Poblacion, Pulong Bayabas, Pulong Duhat, Saccdalan, Salacot, Salangan, san Agustin, San Jose, San Juan, San Vicente, Sapang, Sibul, Sta. Ines, Sta. Lucia, Sta. Rita Bata, Sta. rita Matanda, Tartaro, Tigpalas	
San Ildefonso, Bulacan	Akle, Calawitan, Maasim, Anyatam, Garland	

Calumpit, Bulacan	Balungao, Bulusan, Calizon, Caniogan, Frances, Gatbuca, Gugo, Iba O' Este, Meysulao, Longos, Meyto, Palimbang, Panducot, Pio Cruzcosa, Poblacion, San Jose, San Marcos, San Miguel, Sapang Bayan, Sta. Lucia, Sto. Niño	Flooding is due to the combination of Pluvial, Fluvial, and effects of tides
Hagonoy, Bulacan	San Juan (Purok 3-6), San Isidro (Purok 1-4), Palapat (Riverside), Iba (Iba Sandoval), Tampok, Sto. Niño, San Agustin	
Paombong, Bulacan	Pinalagdan (Sapang Gemo), Kapitangan (Sitio Pukyot), Sto. Rosario	
San Simon, Pampanga	Sta. Cruz, San Pedro, san Nicolas, San Miguel, De la Paz, San Agustin, San Jose, San Juan	Pluvial, Fluvial floods along riverside areas
Macabebe, Pampanga	Saplad David, San Gabriel, Tacasan, San Juan, Sta. Lutgarda, San Esteban, Sta. Maria, San Francisco, San Vicente, San Jose, Candelaria, Caduang Tete	Mostly tides & fluvial effects
Masantol, Pampanga	Sto. Niño, Sta. Lucia Matua, San Isidro Anac, San Isidro Matua, Sta. Lucia Paguiba, Sta. Lucia Wakas, Bebe Anac, Sua, Palimpe, San Agustin, Sta. Monica, Alauli, Balibago, Bagang, Sagrada, Nigui, Sapang Kawayan	Mostly tides & fluvial effects
Minalin, Pampanga	Sta. Catalina, Dawe, Bulac, Maniango, Sta. Rita, Sto. Rosario, San Francisco I & II, Sta. Maria, San Isidro	Pluvial, Tides
Apalit, Pampanga	Paligui, Colgante, San Vicente, Capalangan, Tabuyuc	Pluvial
Candaba, Pampanga	Pasig, Pescadores, Sto. Rosario, San Agustin, Bahay Pare, Dulong Ilog, Vizal Sto. Cristo, Pulung Gubat, Vizal San Pablo, Baranca, Kawayang Bugtung, Lourdes, Magumbali, Mandili, Mapaniqui, Salapungan, Tagulud	Pluvial & Fluvial effects
Sto. Tomas, Pampanga	San Matias	Pluvial
Guagua, Pampanga	Magsaysay, Sto. Cristo, Sta. Ines, Bancal, San Juan Bautista, San Pedro, Magsaysay, San Miguel, San Rafael	Pluvial
Bacolor, Pampanga	Cabetican, Tinajero	Pluvial
San Luis, Pampanga	San Juan, San Nicolas, Sta Cruz Poblacion, San Agustin, Sta Cruz Pambilog, Sta Monica, Sta. Catalina, San Sebastian, Sto Tomas	Mostly fluvial flood on the riverside areas
Arayat, Pampanga	San Mateo, Candating, Gatiawin, Mapalad, Batasan, San Agustin Norte, Guemasan, Palinlang, Cacutud, Poblacion	Mostly pluvial flood
City of San Fernando	Pandaras	Pluvial flood
Mexico	Parian, Sto. Cristo, Sto. Domingo, San Jose Matulid	Pluvial flood

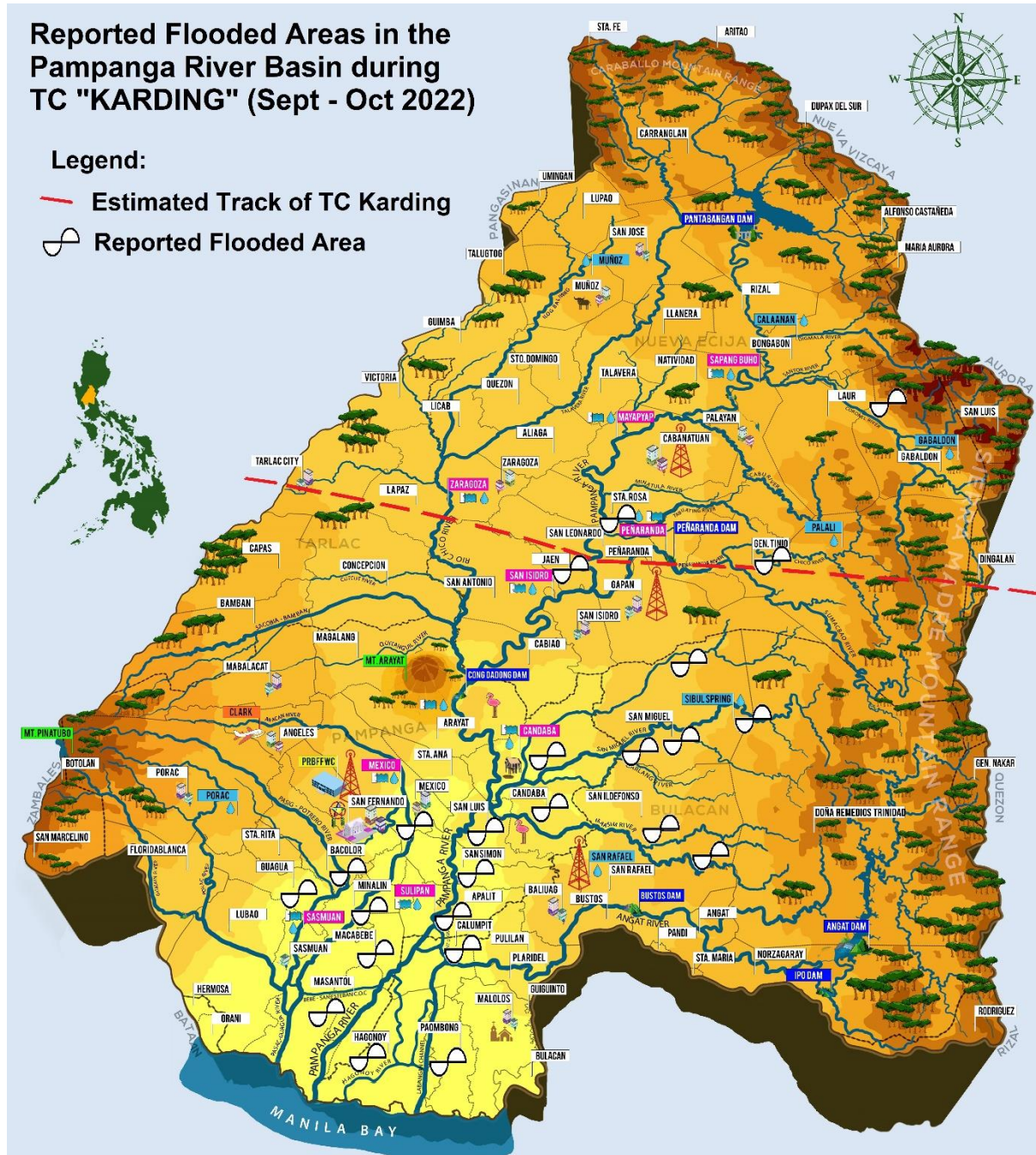


Fig 5.0. The Pampanga River Basin map showing the estimated locations of the reported flooded areas during event Karding.

6.0 Flood Forecasting & Warning activities during TC Karding

Flood Advisory (FA) No. 1 for Pampanga River Basin was issued at 1400H of Sept 24. The information was more than 24 hours prior to Karding’s effect in the PRB (see figure 7.0). FA No. 1 scenario map showed Zaragoza WL and Sulipan WL were already above their respective Alert WL coming from previous rain episodes brought about by the SW monsoon and tide effects, respectively. FA No. 1 was generally issued to make localities be aware and be prepared of an impending flood event in the basin. The next flood information, Flood Bulletin (FB) No. 1, was issued 20 hours later at 1000H of Sept 25. The issuance of FB immediately after coming from just an issuance of a single FA was mainly to emphasize the imminent dangers, e.g., strong winds and floods, that were now posed to affect the PRB as Karding’s threat to the basin became more certain.



PAMPANGA RIVER BASIN FLOOD FORECASTING & WARNING CENTER (PRFFWC)
DMGC, Bgy. Mainipig, City of San Fernando, Pampanga 2000, CP: 0999 236 6416; prffwc@gmail.com
websites: bagong.pagasa.dost.gov.ph / prffwc.synthesia.com

FLOOD ADVISORY No. 1

PAMPANGA RIVER BASIN & ALLIED RIVERS
ISSUED AT 2:00 PM, 24 SEPTEMBER 2022
(VALID FOR THE NEXT 24-HOURS UNTIL THE NEXT ISSUANCE TOMORROW AT 2PM OR UNLESS THERE IS AN INTERVENING ADVISORY OR AN INITIAL FLOOD BULLETIN TO BE ISSUED)

PRESENT & 24-HR FORECAST BASIN HYDROLOGICAL SITUATION:

AS OF 1:00 PM TODAY:

- THE STRETCH OF MAIN PAMPANGA RIVER STILL REMAIN BELOW ALERT WL STATUS; IT WILL REMAIN BELOW ALERT WL UNTIL TOMORROW NOON;
- TRIBUTARY RIO CHICO RIVER AT ZARAGOZA IS NOW ABOVE ALERT WL AND WILL REMAIN WITHIN ALERT WL LIMITS;
- CANDABA SWAMP IS JUST BELOW ALERT WL; SLOW FLUCTUATING RISE TO REACH ALERT WL IS LIKELY WITHIN THE NEXT 24HRS
- AND THE ALLIED RIVERS / TRIBUTARIES WITHIN THE PASAC-GUAGUA SUB-BASIN ARE STILL AND TO REMAIN GENERALLY BELOW ALERT WL THROUGHOUT THE FORECAST PERIOD.

BASIN SITUATIONAL OUTLOOK ON HYDROMET HAZARDS (AND ITS POSSIBLE IMPACTS):

- Light to moderate to at times heavy rains as enhanced by S.T.S. KARDING are likely to occur at the north and east side portions, particularly in the province of Nueva Ecija, of the PRB beginning tomorrow morning;
- Possible Flash floods and Landslides (Large debris and floodwaters can cause structural damage to bridges and roadways, and even houses situated just adjacent to mountain slopes) likely possible at the following areas beginning tomorrow noon: North and East side of Nueva Ecija Province (Carranglan, Laur, Bongabon, Gabaldon, Rizal)
- Pluvial flooding (ponding / accumulation of rainwater at low-elevated areas which can result to impassable streets / roadways, croplands submerged) likely possible at the following areas especially those with poor drainage system beginning tomorrow noon: other areas of Nueva Ecija (Within PRB: San Jose City, Llanera, Gen. Natividad, Palayan City, Cabanatuan City, Gen. Tinio, Guimba, Quezon, Alilaga, Licab, Zaragoza, other adjacent areas) and Tarlac (Within PRB: La Paz)

For awareness, preparedness and mitigation purposes, the public and the Local Disaster Risk Reduction and Management Councils (LDRMCs) within the Pampanga River Basin are advised to start to take precautionary measures to mitigate the adverse immediate impacts of the possible hazards associated with moderate to heavy rains particularly at the above mentioned areas; to continue monitoring for heavy rainfall warnings, thunderstorm / rainfall advisories, and other severe weather information specific to your area, other related products issued by local PAGASA Regional Services Division.

Prepared by: RPY / GHH Checked by: HTH



Pampanga River Basin HYDROLOGICAL SCENARIO MAP

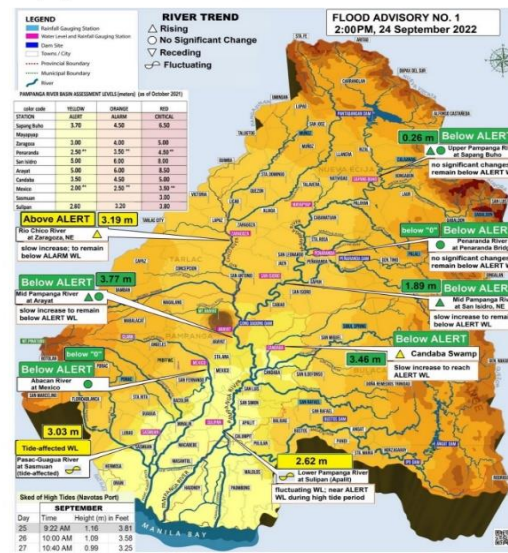


Figure 6.0 (top L) Flood Advisory No. 1 issued at 1400H, Sept 24; Figure 6.1 (top R) The accompanying map for FA No. 1 which shows Zaragoza WL and Sulipan WL already above their respective Alert WL prior to Karding's pass over the PRB.

At around 2200H of Sept 25, about half of the telemetry stations of the PRBFFWC, 8 upstream monitoring stations, went down about 2 hours after the estimated entry of Karding in the PRB. The system was restored only on Oct 05. The downtime was a result of a misaligned repeater antenna as a result of the strong winds brought by Karding.



(Pic 34, Above) Upstream view of a still swelled -up Pampanga River as seen from the San Agustin Bridge in Arayat, Pampanga with a staff gage reading of 6.90 m, still above 6.0 m Alarm WL, taken at around 1300H of Sept 28.

A total of 14 flood information, 1 FA and 13 FB, were issued during event Karding. The final Flood Bulletin (No. 13) was given out at 0500H of Oct 01. The final FB was issued with the Candaba swamp WL still above critical and Zaragoza WL, which responded only a day after Karding's passage over the PRB, was also above its 3.0 m Alert WL.

Table 6.0. Assessment of some of the FB forecast statements during event Karding:

FB No.; Time & date of issuance	Forecasting Point	FB statement	Actual river response	Notes / Remarks
FB No. 2; 5:00 PM (1700H), Sept 25	Sapang Buho	<i>"Now at 0.39 m, still below 3.70 m Alert WL; slow to gradual rise to occur starting tonight and likely to remain below Alert WL until early tomorrow morning"</i>	By 0100H, 26 Sept, about 8 hours later, river stage surpassed Alert WL, and 2 hours later breached Alarm WL & peaked by 0500H, Sept 26	FB was not able to forecast the rapid rise of WL (> 1.0 m / hr) from 2200H, Sept 25 to 0200H, Sept 26
	San Isidro	<i>"Now at 1.26 m still below 5.0 m Alert WL. Slow rise to continue and to remain below Alert WL until tomorrow morning"</i>	Rapid rise of river stage starting from 2300H, Sept 25 to 0400H, Sept 26 such that assessment levels from Alert to Alarm to Critical were all breached in just 4 hours	FB statement underestimated the flashy rise of river stage
	Candaba	<i>"Now at 3.49 m which is now close to 3.5 m Alert WL. Slow filling-up of swamp WL & to exceed Alert WL in a few hours. To remain w/in Alert WL limits until early tomorrow morning"</i>	Alert WL was surpassed 2 hours later at 1900H and remained within Alert WL limits until the next FB was issued	FB statement was able to forecast the actual swamp response during the event
	Arayat	<i>"Now at 4.97 m (still below 5.0 m Alert WL) very slow rise to continue & likely to reach Alert WL w/in the next several hours. To remain w/in Alert WL limits until early tomorrow morning"</i>	Alert WL was reached just before 0400H, Sept 26; however, 2 hours later (0600H, Sept 26) stage reached Alarm WL already	FB statement on stage maintaining w/in Alert WL limits came a bit short as Alarm WL was already reached before end of the forecast period
FB No. 3; 5:00 AM (0500H), Sept 26	San Isidro	<i>"Now at 7.87 m is now close to 8.00 m Critical WL. Gradual rise to continue and will breach Critical WL. Fluvial Flooding is now likely to occur"</i>	Critical WL was reached just after issuance of FB No. 3, at 0500H, and immediately peaking at 0600H, Sept 26	The forecast statement may have been more useful to the end-user if it was stated in the previous FB; it also failed to forecast the stage peak and time
	Candaba	<i>"Now at 3.60 m (above 3.50 m Alert WL). Continued slow filling-up of swamp WL. 4.50 m Alarm WL is likely to be reached later today"</i>	4.50 m Alarm WL was breached just after 1600H, Sept 26	FB statement can be taken as reasonable enough as to actual stage response
	Arayat	<i>"Now at 5.30 m (above 5.00 m Alert WL) very slow rise to continue & breach 6.00m Alarm WL. Flooding is threatening and will occur later today"</i>	6.0 m Alarm WL was reached at 0500H, just after the issuance of FB No. 3	FB statement came a bit short as a rise of more than 0.80 m in an hour was registered at the telemetry station just after issuance of FB no. 3
FB No. 4; 5:00 PM (1700H), Sept 26	Candaba	<i>"Now at 4.48m (above 3.50 m Alert WL). Continued slow filling-up of swamp WL to reach 4.50 m Alarm WL in a few hours. Further rise to continue until tomorrow morning"</i>	Actual 4.50 m Alarm WL was immediately reached just after issuance of FB No. 4 and 3 hours later breached 5.0 m Critical WL at 2000H, Sept 26	FB statement came a bit short as the Alarm WL was reached just after issuance of FB No. 4; Critical WL was also reached within the forecast period
	Arayat	<i>"Now at 8.17 m (above 6.00m Alarm WL) very slow rise to</i>	The peak WL came at around 1900H, Sept 26	FB statement may not be specific as to time of peak

		<i>reach just below 8.50 m Critical WL. Slow recession to start between tonight or early tomorrow morning</i>	and was 0.24 m short of Critical WL; recession generally started at 2300H	but was able to forecast peak to reach just below the Critical WL which can be amply reasonable
FB No. 6; 5:00 PM (1700H), Sept 27	Candaba	<i>“Now at 5.91 m (above 5.00 m Critical WL); further slow filling-up of swamp WL to level-off starting tonight. Slow recession to start by tomorrow morning”</i>	Swamp WL continued a slow fill-up until it practically levelled-off at around 0100H, Sept 28; slow recession generally started at 0800H, Sept 28	FB statement did not specify the peak but since it is already way above Critical WL this can be seen as reasonable enough including the recession trend time.
	Arayat	<i>“Now at 7.83 m (still above 6.00 m Alarm WL) is in a slow recession to reach below Alarm WL by tonight or early tomorrow morning”</i>	River stage reached below 6.0 m Alarm WL before 1300H of Sept 29	FB statement on recession was far way-off by more than a day

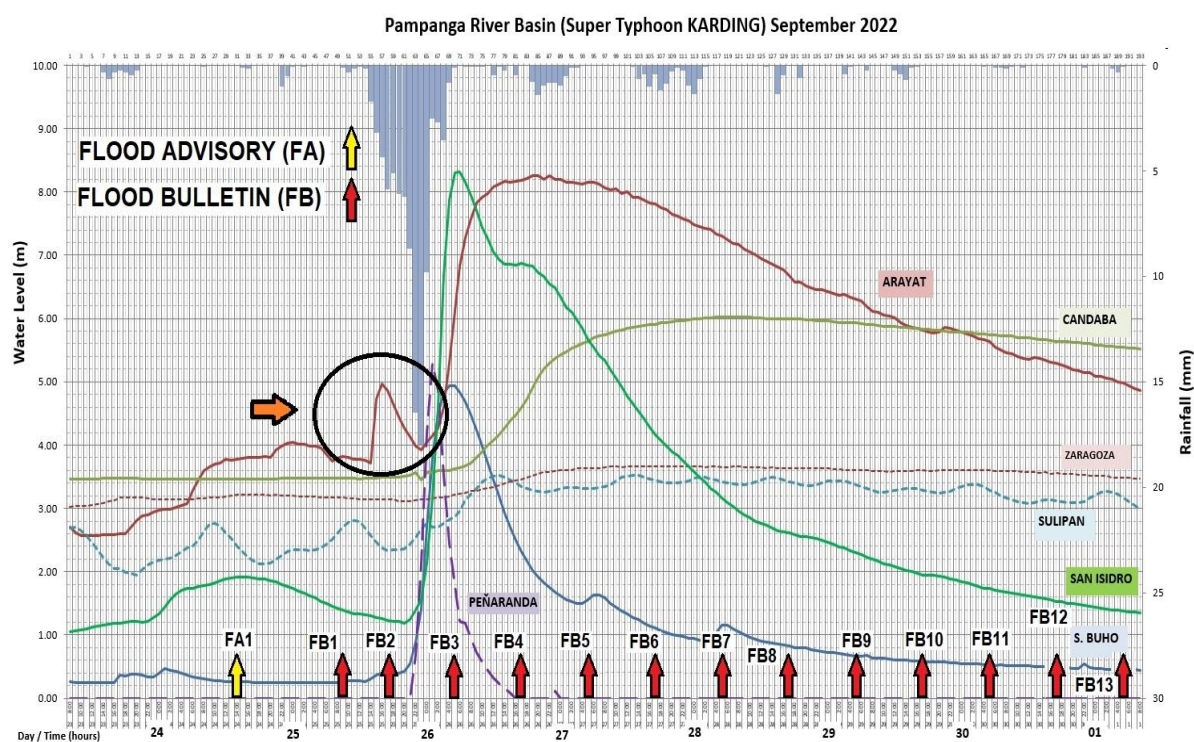


Fig. 7.0. The average basin hyetograph and the hydrographs of respective monitoring stations during Karding with the distribution of flood information (FA & FBs) issued by PRBFFWC from Sept 24 to Oct 01, 2022.

The above figure represents the river basin hyetograph and respective hydrographs of monitoring stations of the PRBFFWC during the event Karding. All hydrographs show a definite gradual to rapid rise just after the observed average rainfall over the basin. It can be seen, however, that Arayat hydrograph had a short temporary rise (black encircled part), almost a meter rise, just several hours before the peak of the average basin rainfall. This rather unusual and uninvestigated brief temporary rise was also manifested during the events Tropical Cyclones Jolina (2021), Quinta, Pepito and Ulysses (2020), and Ompong (2018).

7.0 Highlights of TC Karding in pictures



(Pic 35, Above) Pampanga River at San Agustin Bridge in Arayat just a few hours before cresting at 8.26 m at 1900H, Sept 26 (photo taken at 1100H, Sept 26 at a telemetry reading of 7.98 m)
 (Pic 36, Far L) Coronel River at Bangkerohan Bridge in Palayan City at an estimated gage of 3.40 m (1646H, Sept 26); (Pic 37, L) Staff gage at Peñaranda Bridge with debris still clinging at just below the 6.0 m mark (1628H, Oct 06)



(Pic 38, Top) A view of the Pampanga River passing through the open gates of Cong Dadong Dam (photo was taken on 1357H, Sept 28)

(Pic 39, Top) Event Karding's maximum river mark of Pampanga River (shown with arrows) as seen from upstream side of the Jaen-San Leonardo Bridge.



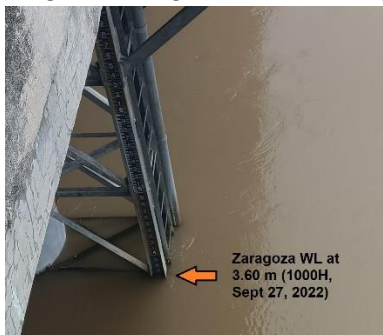
(Pic 40 & 41, L to R) A view of the San Miguel River about 4 hours later after it had swept thru the town of San Miguel (0645H, Sept 26); The arrow pointing to the encircled area in a gasoline station's wall that gave way during the flash flood in Bgy. Camias, San Miguel is where the Bulacan PDRRMO rescuers were reportedly to have been sucked through the said opening by floodwaters towards the fields at the back of the station (photos & event report courtesy of Bulacan PDRRMO)



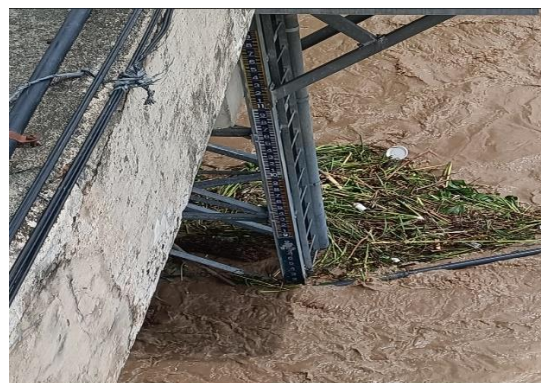
(Pic 42, L) The picture shows a destroyed monitoring system (CCTV and WLMS) of the Bulacan PDRRMO along Biak na Bato River in San Miguel that went underwater early morning of Sept 26. (Photos courtesy of Bulacan PDRRMO)



(Pic 43 & 44, L to R) Remains of washed-out houses on the right bank of Peñaranda River along the San Leonardo-Gapan Bridge; and taking surface river velocity of Pampanga River at Vergara Bridge in Cabanatuan City (1312H, Sept 27)



(Pic 45, 46, 47, L to R) Zaragoza staff gage at around 3.60 m, above the 3.0 m Alert WL (photo taken at 1018H, Sept 27); (middle) a view of Rio Chico River at Zaragoza at above alert WL (1018H, Sept 27); (Top R) the town of Zaragoza was never spared of its fallen electric posts by Karding's wind.



(Pic 48 & 49, L to R) Taking surface river velocity measurements of Pampanga River at Apo Esquivel along the Jaen – San Leonardo Bridge, (1737H, Sept 27); Arayat station's staff gage at 7.98 m, above 6.0 m alarm WL (1100H, Sept 26)



(Pic 50, Left picture) Abacan River as seen downstream from the Mexico Bridge II in Sto. Rosario, Mexico, Pampanga a day after Karding's passage (1011H, Sept 26) showing no definite signs of a relatively high flow (grasses within the channel are still standing).



(Pic 51 & 52, top L-R) Dupinga River in Gabaldon, NE was reported to have rapidly increased in the evening of Sept 25 until early morning of Sept 26; similarly, Coronel River at Bato Ferry Bridge in Laur, Nueva Ecija swelled at the height of Karding's passage over the eastern part of PRB (both pictures were already taken almost 2 weeks past Karding's passage, Oct 06)



(Pic 53 & 51, top L to R) Pampanga River at Sapang Buho station in Palayan City at telemetry reading of 2.31 m with the staff gage steel post covered by debris (1702H, Sept 26); the same view of the area at a relatively low flow regime (photo taken Jul 2021)



(Pic 52, 53, & 54, Top L to R) Barangays Calizon, Frances, and Meysulao in Calumpit, Bulacan were some of the barangays that were flooded during Karding; these barangays are some of the flood-prone areas in Calumpit (photos courtesy of Calumpit MDRMO)



(Pic 55, L) Bgy. San Miguel in Calumpit, Bulacan was likewise affected by floodwaters during Karding (photo courtesy of Calumpit MDRRMO)

(Pic 56, grouped pics below) Various scenes of flooded areas in Puroks 1 & 2 of Bgy. San Isidro, Hagonoy, Bulacan affected by Karding and the recurring high tide (photos courtesy of Hagonoy MDRRMO).



(Pic 57 & 58, Top L & R) Flooded streets in Bgy. San Juan in the town of San Simon, Pampanga; photo taken 0900H, Sept 27 (photos courtesy of San Simon MDRRMO)

(Pic 59, L) Relief goods being distributed to residents in a flooded street of Bgy. Sta. Cruz in San Simon, Pampanga; photo taken at around 0900H of Sept 28 (photo courtesy of San Simon MDRRMO)

Part II.

Tropical Cyclone “PAENG” (*International Name: NALGAE*) October 28 to November 01, 2022

Summary

A little over a month just after TC Karding lashed out the PRB with its strong winds and flood, Tropical Cyclone “PAENG” similarly crossed the basin as a Severe Tropical Storm on 2100H of October 29 and exited as a Tropical Storm at around 0100H of October 30. It entered somewhere from the South-southeast end of the basin between the towns of Plaridel and Bustos in the province of Bulacan. The tropical cyclone exited at the western part of the basin somewhere at the town of Capas in Tarlac province. The howler eventually left the Philippine Area of Responsibility (PAR) in the evening of October 31, 2022. Paeng was a relatively weaker TC in sustained winds compared to Karding when it crossed the PRB but much wider in coverage for the entire country as it affected 17 Regions including Metro Manila as it inflicted damage to infrastructure and agriculture at ₱5.86B and ₱7.2B, respectively. Total casualties included 164 dead, 270 injured, and 28 missing persons.⁷ The effects of Paeng over Region 3 were more on the sustained winds resulting to 489 and 143 houses that were partially damaged and totally damaged, respectively.⁸ Candaba swamp was again flooded but much less in magnitude as compared to Karding.

⁷ *NDRRMC SitRep No. 30 for STS PAENG (2022) as of 1800H, 19 Nov 2022*

⁸ *RDRRMC-3 Matrix SitRep No. 17 on the effects of STS PAENG (2022) as of 1900H, 08 Nov 2022*

1.0 Meteorological aspect: Tropical Cyclone Paeng (*International name: Nalgae*)

More than a month after TC Karding (Sept 25 to 26) crossed the Pampanga River Basin, another tropical disturbance, TC Paeng, entered the PRB at the south end the basin at around 2100H-2200H of Oct 29. About 3-4 hours later, between midnight and 0100H of Oct 30, the TC exited at the west end of the basin. Paeng entered the PRB as a Severe Tropical Storm (STS) Category for about an hour before eventually leaving the area as a Tropical Storm. Compared to Karding, TC Paeng was relatively larger in diameter than the former at almost double in breadth but less in terms of wind strength.

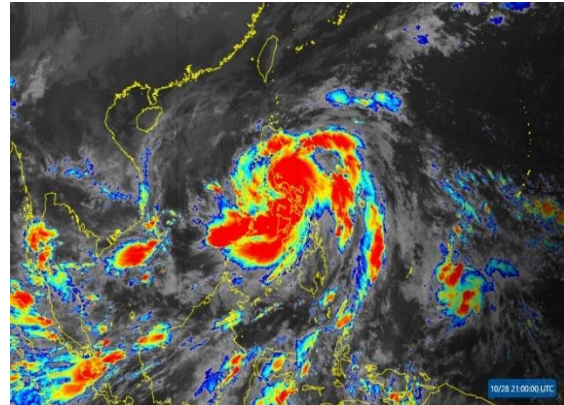
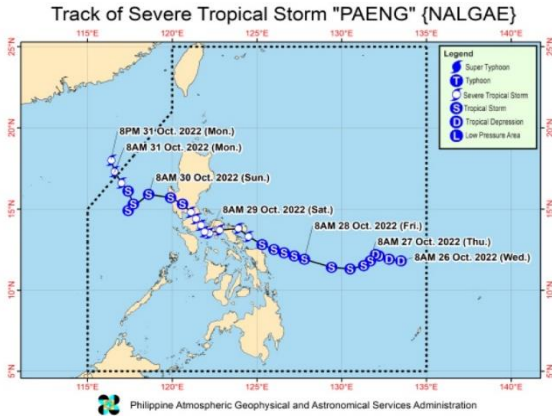


Fig. P1.0. Track of Tropical Cyclone “PAENG” within the Philippine Area of Responsibility and as it crossed the southern portion of Central Luzon.

Fig. P1.1. JMA Satellite Image (color enhanced) of TC Paeng at 2100H (UTC), Oct 28, 2022 over the eastern portions of Luzon area.

Prior to its crossing through the PRB, Paeng already left a trail of destruction in the southern areas of Calabarzon, Mimaropa and Bicol Regions. The eye of the TC was estimated to have entered the PRB between the towns of Plaridel and Bustos, trekked through the town of Baliuag in Bulacan, then through San Simon, San Luis, Sta. Ana, and Mabalacat in Pampanga province before exiting somewhere in the vicinity of Bamban – Capas area in province of Tarlac.



Below listed are the highest Tropical Cyclone Wind Signals raised over areas in Region 3:
TCWS #3 – Bataan, Central and Southern portions of Zambales, Bulacan, Pampanga, and southern portion of Tarlac
TCWS #2 – rest of Tarlac, rest of Zambales, southern portion of Aurora, Nueva Ecija

Fig. P1.2. (Left) The estimated track of the eye of TC Paeng within the Pampanga River Basin from the period 2100H, Oct 29 to 0100H, Oct 30.

Table P1.0. Below is a table summary of TC Paeng during the course of its traverse within Region 3, specifically through the Pampanga River Basin:

Time & Date	Synopsis (lifted from TC Bulletins)	Location (position of TC)	Lat. & Long.	Cat	Intensity (sustained / gusts)	Pressure (hPa)	Direction & speed	Extent of winds
1900H; Oct 29	"Paeng maintains its strength while traversing the northern portion of Cavite"	vicinity of Gen. Mariano Alvarez, Cavite	14.3 N; 121.0 E	STS	95 / 160	985	NW @ 20 kph	560 km
2200H; Oct 29	"Paeng has passed Laguna de bay and the MM-Rizal-Bulacan area"	vicinity of Baliuag, Bulacan	15.0 N; 120.9 E	STS	95 / 160	985	NW @ 15 kph	560 km
0100H; Oct 30	"Paeng weakens into a TS and is about to exit landmass of Luzon"	vicinity of Candelaria, Zambales	15.7 N; 120.1 E	TS	85 / 140	990	NW @ 25 kph	560 km
0400H; Oct 30	"TS Paeng is now over the West Phil Sea"	85km WNW of Iba, Zambales	15.7N; 119.3E	TS	85 / 105	990	WNW @ 30 kph	650 km

2.0 Basin hydrological aspects during TC Paeng

2.1 Event basin rainfall

Rains during the event are shown in the table below covering the period from October 29 to 31 and presented in 24-hr meteorological day format.

Table P2.0. Pampanga River Basin observed 24-hr (met day) RR in millimeters for the period October 29 to 31, 2022.

Stations	October 29	October 30	October 31	Maximum 1-hr observed RR	Time (LST) / Day of maximum 1-hr RR
Muñoz	46	11	1	9	1900H / 29
Sapang Buho	38	1	4	6	2000H / 29
Gabaldon	218	5	3	35	2000H / 29
Zaragoza	25	2	2	10	1400H / 29
Mayapyap (NIA-UPRIIS)	50	8	3	7	0100H / 30
Peñaranda	45	4	3	6	0100H / 30
Calaanan	78	3	1	11	1800H / 29
Palali	65	2	7	7	1900H / 29
San Isidro	51	4	5	8	1800H / 29
Arayat	66	7	3	7	2200H / 29
Candaba	66	3	10	7	1800H / 29
Sibul Spring	67	1	8	9	1300H / 29
Sulipan	86	10	16	12	2200H / 29
San Rafael	101	2	11	13	1400H / 29

Table P2.1. Allied sub-basin of Pasac-Guagua River system 24-hr (met day) RR in millimeters for the period October 29 and 31, 2022.

Stations	October 29	October 30	October 31	Maximum 1-hr observed RR	Time (LST) / Day of maximum 1-hr RR
Sasmuan	104	17	16	30	2200H / 29
Mexico	52	13	5	10	2300H / 29
Porac	79	53	31	17	2300H / 29
PRFFWC	84	11	26	15.5	2200H / 29

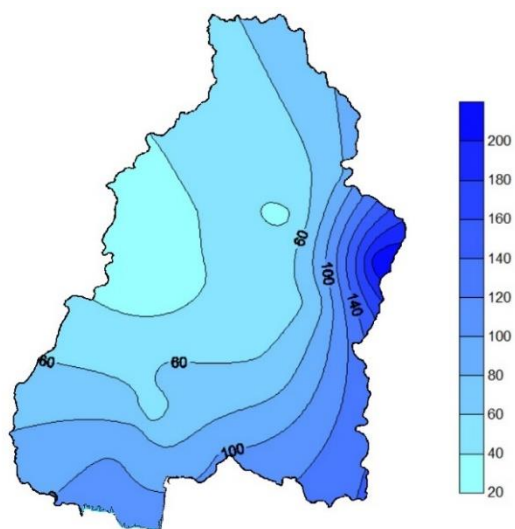


Table P2.2. Recorded rainfall at other stations within & adjacent to the PRB on October 29, 2022 are given below as follows:

Station	Rainfall (mm)
Clark Synop	109.2
Muñoz Synop	98.5
Ha. Luisita Agromet	80.4
Subic Synop*	98.5

*Station is located outside of the basin at the SW side

Figure P2.0. The 24-hour (met day) isohyets for Oct 29, 2022 during the passage of TC Paeng over the PRB.

2.2 River stages at PRBFFWC forecasting points during Paeng

Table P3.0. Time / Day when the Station’s Flood Assessment Gauge Heights were reached during Paeng

Station Point	Alert Level	Alarm Level	Critical Level	Remarks
Sapang Buho	(3.70 m) Before 2300H of Oct 29	(4.50 m) Not reached	(6.50 m) Not reached	Peak WL was 4.40 m (54.159 m AMSL) attained at around 0400H of Oct 30
Zaragoza	(3.00 m) Before 0200H of Oct 31	(4.00 m) Not reached	(5.00 m) Not reached	WL crested, as per telemetry records, at 3.28 m (14.596 m AMSL) on 1500H, Nov 02
Peñaranda	(2.50 m) Not reached	(3.50 m) Not reached	(4.50 m) Not reached	Peaked as per telemetry reading was 2.03 m (24.718 m based on TBM) attained at 2200H, Oct 29
San Isidro	(5.00 m) Before 0400H of Oct 30	(6.00 m) Not reached	(8.00 m) Not reached	Peak WL was at 5.55 m (14.887 m AMSL) attained at around 1800H of Oct 30
Arayat	(5.00 m) Before 0300H of Oct 30	(6.00 m) Just after 0600H of Oct 30	(8.50 m) Not reached	WL crested, as per telemetry records, at 7.39 m (7.467 m AMSL) attained at 0200H of Oct 31
Candaba	(3.50 m) Before 0800H of Oct 30	(4.50 m) Before 0100H of Oct 31	(5.00 m) Not reached	Swamp water level crested at 4.96 m (4.803 m AMSL) on 0000H, Nov 01 and remained

			above Alarm WL until 0700H, Nov 03
Mexico	WL sensor at the site was not functioning during the event		There were no definite flood marks identified in the area
Sasmuan	WL at the site was already fluctuating above the assigned critical WL of 3.0 m prior to the event. Critical WL was recommended to be raised to 3.5 m since the riverside area has already been used to the effects of tides which is above the previous assigned critical WL.		No significant floods were observed at the site. The peak WL at the site during the event was 3.63 m (1.792 m AMSL) and was attained 0500H of Oct 30
Sulipan	WL sensor at the site was not functioning properly during the event; erroneous readings were being transmitted		Maximum WL reported by manual observations was 2.80 m (2.738 m AMSL) on Oct 30; a possible higher WL may have occurred during the event.
<p><i>Note: Elevation of "0" of staff gages were based on surveys undertaken on August 2022.</i> <i>TBM – Temporary Bench Mark</i></p>			

2.3 Tides

Table P4.0. High Tide (highest for the day) from Oct 28 to Nov 01, 2022 (Based on Navotas port, Latitude 14° 41' N, Longitude 120° 56' E)

Day	Time	Height (m)
Oct 28	10:48 pm	1.22
Oct 29	11:28 pm	1.24
Oct 30	-	-
Oct 31	12:13 am	1.24
Nov 01	1:06 am	1.21



(Pic 60, Above) Floodwaters due to tides and remnants of Paeng’s pluvial effects remained along the Macabebe-Masantol road several days even after Paeng’s exit from the PAR (taken 1042H of Nov 09).

Tides during the event were a bit higher than the usual normal tides and the higher tide levels coincided with the time when Paeng had entered the PRB, from Oct 29 until early morning of Oct 31. This resulted in some standing floodwaters in several areas of Macabebe and Masantol in Pampanga even after Paeng already exited the PAR several days after.

2.4 Dam releases

Prior to Paeng’s entry to PRB, Pantabangan Dam was already more than 20 meters below its spilling level of 221.0 meters (198.23 m at around 0745H of Oct 29). Likewise, Angat Dam was more than 10 meters below its flood season high WL elevation of 210.0 meters. It was only Ipo and Bustos Dams which released its reservoir water during event Paeng. Both dams are quite relatively small in reservoir capacity compared to the Angat and Pantabangan Dams, and are only used mainly for domestic and irrigation purposes, respectively. Maximum water released by Ipo Dam was 137.55 cumecs that started at 1500H of Oct 29 and eventually reduced to 40.40 cumecs by 0500H, Oct 30, while for Bustos Dam it was 236 cumecs between the period 0600H to 1400H of Oct 30. Ipo Dam had its gates closed by 1500H of Oct 30 and for Bustos Dam it was at 0600H, Nov 1. By flow standards, both releases were

relatively small to significantly cause inundation at the target areas along Angat river during Paeng's passage over the PRB. UPRIS Dams, Peñaranda and Atate Dams, similarly had maximum discharges at 180 cumecs (0800H, Oct 30), 550 cumecs (0800H, Oct 30), respectively.



(Pic 61, L) Upper Tabuating Dam, somewhere in Gen Tiño in NE and still under NIA-UPRIIS, had a maximum dam overflow spillage of only 1.80 cumecs on 1200H of Oct 30. This dam is a relatively quite small water impounding and overflow reservoir and mainly for irrigation purpose only with just having a drainage area of 18.38 km².

3.0 Basin Hydrological Situation during Paeng

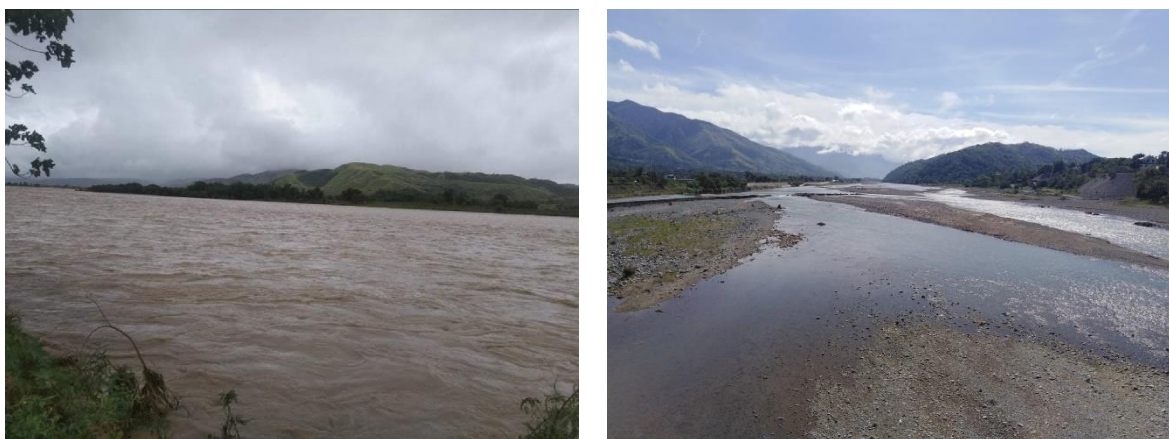
Paeng effects on the PRB generally started in the early morning of October 29 and basically lasted until around November 01 in terms of the pluvial floods that still remained in some parts of the basin. In total, Paeng's impact to the PRB was far less than what had been felt during event Karding. Below is a brief timeline of hydrological features during the passage of Paeng over the PRB:

- October 29
 - 0200H: generally light to occasionally moderate rains started over at the eastern and southeastern portions of the basin and about an hour later almost whole basin was experiencing intermittent light to moderate rains; Gabaldon station, on the other hand, started out with an almost continuous moderate rains until before noontime with a total of about 59 mm in 10 hours;



(Pic 62 & 63, above L to R) A view of Dupinga River at Gabaldon, NE taken at around 1620H, Oct 29 (photo courtesy of Gabaldon MDRRMO) and the same river almost 2 weeks after Paeng (1026H, Nov 10). Dupinga River peaked just above 4 meters at around past midnight of Oct 30 as per WL sensor observation report of Gabaldon MDRRMO.

- 1200H until midnight (0000H): Rains were now almost widespread over the basin at light to mostly moderate with at times heavy rains; Gabaldon station, from 1200H to 2300H, totaled 193 mm in about 12 hours.



(Pic 64 & 65, Above L-R) A view of the swollen Coronel River at Gabaldon-Laur area right after the passage of Paeng taken in the morning of Oct 30 (Internet post by NE-TV48; No copyright infringement intended; for research-reporting purposes only); and the same river on the top right more than a week after Paeng’s passage (1000H, Nov 09)

- 0500H: Sapang Buho WL showed a gradual increase in stage from an initial low of 0.50 m at around 1500H to breaching 3.70 m Alert WL before 2300H of that day, a gradual increase of about 0.4 m/hour;
- 1700H: Similar gradual increases of stages were registered at Peñaranda and San Isidro WL stations starting around 1700H; On the other hand, Peñaranda WL already peaked at 2.03 m at around 2200H and eventually receded below “0” gage by afternoon of the following day;
- 2100H to 2200H: Estimated entry of Paeng’s eye in the PRB somewhere in the vicinity of Plaridel-Bustos in province of Bulacan
- 2200H: Heavy to intense and at times torrential rains were registered at the west and southwest stations of the basin; Pluvial floods occurred in the low-lying areas of Candaba
- October 30
 - 0000H-0001H: Estimated exit of Paeng’s eye in the PRB between Bamban-Capas area in Tarlac province; light to moderate rains becoming intermittent by several hours later still continued over the PRB until around 0600H;



(Pic 66, above) A scoured slope dike protection along Lucung River in Concepcion, Tarlac which gave way at the height of Paeng’s generated river flow of the said river.



(Pic 67, above) Debris still clinging to the staff gage at Arayat station showing a reading at around 7.40m.

- 0300H: Arayat WL breached its 5.0 m Alert WL; slow increase of Candaba swamp WL
- 0400H: San Isidro WL overtopped its 5.0 m Alert WL as well; on the other hand, Sapang Buho WL peaked at 4.40 m just below its 4.50 m Alarm WL and an ensuing gradual to slow recession followed;
- 0700H: Arayat WL overtopped its 6.0 m Alarm WL;
- 0800H onwards: Rains have almost ceased over the PRB & later with mostly isolated light rains until the rest of the day; Candaba WL reached above its 3.5 m Alert WL;
- 1500H: Candaba WL breached the 4.0 m Alarm WL;
- 1800H: San Isidro WL crested at 5.55 m;
- October 31:
 - Isolated intermittent light to moderate rains over the PRB;
 - 0200H: Arayat WL peaked at 7.39 m;
 - 0300H: San Isidro WL reached below its 5.0 m Alert WL;
- November 01 and onwards:
 - 0000H: Candaba swamp WL peaked at 4.96 m just below its 5.0 m Critical WL;
 - 0600H: Arayat WL subsided below 6.0 m Alarm WL and further subsided below 5.0 Alert WL by 2000H;
 - Several towns in the lower reaches of Pampanga delta, e.g., Macabebe, Masantol, Hagonoy, Calumpit and Paombong, had areas that remained flooded for several days as a result of the remnants of the receding floodwaters and effects of tides.



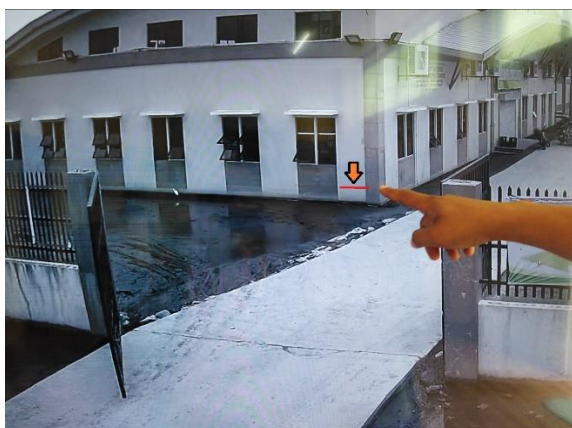
(Pic 68, above) A still flooded street at Bgy. Bebe Anac, Purok Ipil-Ipil in Masantol, Pampanga due to remnants of pluvial effects of Paeng and high tide (courtesy of Masantol MDRRMO)



(Pic 69, above) A similar scene at Bgy. Paguiba in Masantol, Pampanga, again which is due to remnants of pluvial effects of Paeng and the high tide (courtesy of Masantol MDRRMO)



(Pic 70 & 71, L to R) Another flooded street in Bgy. Sta Lucia Matua in and in the Metro Plaza san Nicolas in Masantol, Pampanga several days after Paeng's passage (courtesy of Masantol MDRRMO)



(Pic 72, L) The peak of floodwaters, which was about 0.50 meter high, in the Masantol Community Center is registered by flood marks at the area (photo was taken 1130H, Nov 09)

(Pic 73 & 74, below L-R) Floods of depths of 0.30 to almost 0.50 meters due to remnants of previous flood left by Paeng and due to tides still remain in the roads in the town of Macabebe in Pampanga; the floodwaters have not yet receded at per photo date which was taken on Nov 09.



Table P5.0. Areas flooded as reported by various LDRRMOs during Paeng:

Towns	Barangays	Notes / Remarks
San Ildefonso, Bulacan	Garlang, Maasim	
Calumpit, Bulacan	Balungao, Bulusan, Caniogan, Gugo, Iba O Este, Meyto, Meysulao, Panducot, Pio Cruzcosa, Sapang Bayan	Flooding causes ranges from Pluvial, Fluvial, and effects of tides
Hagonoy, Bulacan	San Sebastian, Sagrada, Sto Niño, San Agustin, Sto. Rosario, Tampok, San Miguel, San Isidro, Abulalas, Sta, Monica, Iba-Ibayo, Palapat, San Juan	
Paombong, Bulacan	San isidro II, Kapitangan, Sto Niño, Binakod, Sta Cruz, Masukol, San Jose, Poblacion, San isidro I, Sto. Rosario, Malumot, San Vicente, San Roque, Pinalagdan	
San Simon, Pampanga	Sta. Cruz, San Pedro, san Nicolas, San Miguel, De la Paz, San Agustin, San Jose, San Juan	Fluvial floods along riverside areas
Macabebe, Pampanga	Saplad David, San Gabriel, Tacasan, San Juan, Sta. Lutgarda, Castuli, San Esteban, Sta. Maria, San Francisco, San Vicente, San Jose, Candelaria, Caduang Tete, Sto Niño	
Masantol, Pampanga	San Isidro Matua, San Nicolas, Sta Lucia Paguiba, Sta Monica, Sto. Niño, Sta Lucia Matua, Sta Lucia Anac, San Isidro Anac, Sta Lucia Wakas, Bebe Anac, San Pedro, Balucus, San Agustin, Malauli, Palimpe, Bebe Matua, Sua, Cambasi, Sta Cruz, Balibago, Bagang, Alauli, Sagrada, Nigui, Sapang Kawayan	Mostly pluvial & tides
City of San Fernando	Pandaras, Maimpis, Del Rosario, Sta Lucia, Sta Teresita	Pluvial
Apalit, Pampanga	Capalangan, Colgante, Paligue, San Vicente, Sulipan, Calantipe, Tabuyuc, Balucuc	Tides, fluvial, & remnants of pluvial flood from Karding
Candaba, Pampanga	Pasig, San Agustin, Bahay Pare, Dulong Ilog, Vizal Sto. Cristo, Pulung Gubat, Vizal San Pablo, Baranca, Kawayang Bugtung,	Mostly Pluvial floods

	Lourdes, Magumbali, Mandili, Mapaniqui, Salapungan, Tagulud	
Guagua, Pampanga	Sta Ines, San Miguel, San Nicolas 1 st , Bancal, San Pablo, San Agustin, San Isidro, San Rafael, San Juan 1 st , San Pedro, Sta Ursula, San Antonio, Sto Niño	Mostly Pluvial floods
Bacolor, Pampanga	Cabetican, Tinajero	Mostly Pluvial floods

4.0 Flood Forecasting & Warning activities during TC Paeng

A total of 11 flood related information, 4 Flood Advisories and 7 Flood Bulletins, were issued during the event. Flood Advisory (FA) No. 1 was issued at 1000H of Oct 28 which was a day before Paeng’s crossing of the PRB. The succeeding 3 FAs were issued at 1730H of the same day, 0530H and 1730H of Oct 29. Flood Bulletin No. 1, however, was issued at 2300H of Oct 29 immediately after an average of 60 mm of rainfall was registered over the PRB. The highest assessment levels attained during the event reached only up to Alarm WL for Arayat and Candaba stations. Candaba peak stage was barely short of its Critical WL. The town of Candaba experienced flooding as usual but its impact was much lesser compared to the flood it experienced during Karding. Final FB, No. 7, was issued at 1730H of Nov 01 with Candaba stage still above the 4.50 Alert WL. Swamp WL subsided below the 3.50 m Alert WL only on 2200H of Nov 06, more than a week later.

During Paeng event, Mexico WL was down and Sulipan WL was transmitting erroneous observations. The Mexico WL has been down for several months already even before Karding. On the other hand, Sulipan WL system was not functioning properly during the Paeng event.

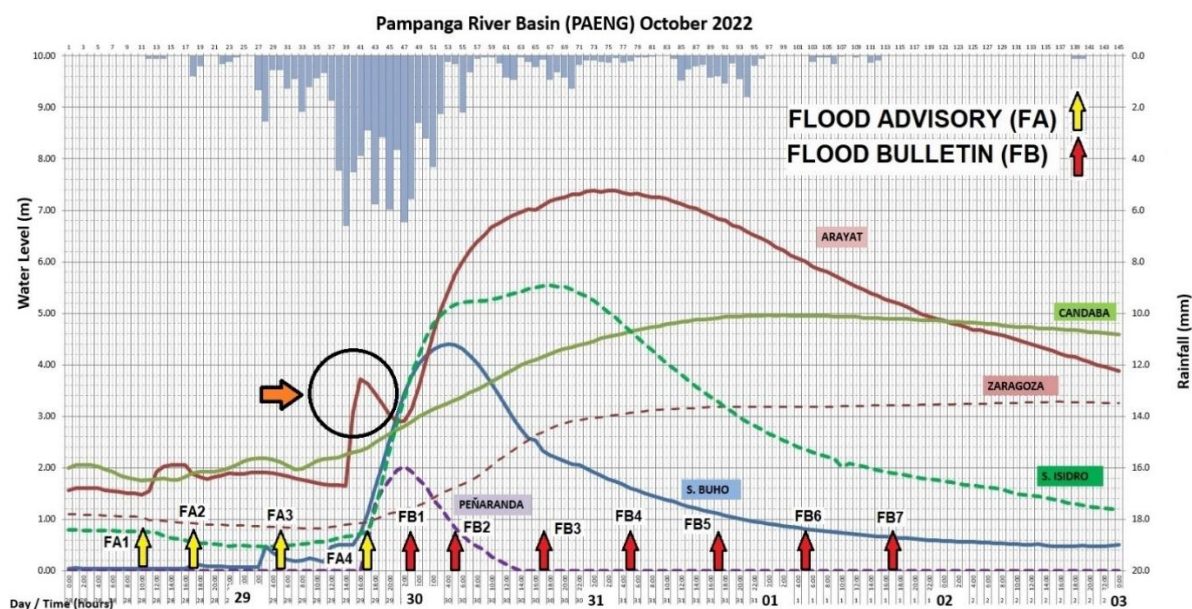


Figure P3.0. The average basin hyetograph and the respective hydrographs of telemetry stations within PRB during Paeng and distribution of issuances of flood warning information (FAs & FBs) by the PRBFFWC from Oct 28 to Nov 01, 2022.

Above figure represents the average basin hyetograph and respective hydrographs of monitoring stations during the event Paeng. Similar to event Karding, the Arayat hydrograph once again manifested a brief temporary rapid rise prior to the event’s full rise as shown by the encircled portion.

ANNEX

Event comparison

Table A1. Below is a table the peak WL registered in respective telemetry station points of the PRBFFWC for some of the events that affected the PRB:

Event	Sapang Buho	Mayapyap	Zaragoza	Peñaranda	San Isidro	Arayat	Candaba	Sulipan	Mexico	Sasmuan	Remarks
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 ave. 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 ave. 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 ave. 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 ave. 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 ave. 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 ave. 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 ave. 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 ave. 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 ave. 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 ave. 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 ave. basin RR: 52 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 that time;

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.

Table A2. Table for validating flood forecast information

A set of standard levels used in Flood Forecasting 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 %

Note: This table was taken from a presentation entitled “Flood Warning Information: Formulation of Flood Advisory / Flood Bulletin (a suggestion)” during the 1st PAGASA RBFFWCs’ Conference / Workshop, May 2017.

Basin		Pampanga River Basin & Allied River Systems																	
Event		Sty KARDING																	
Year:		2022																	
Month:		September																	
		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	
25	9:00	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	10:00	1	1	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0
25	11:00	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
25	12:00	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	13:00	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
25	14:00	1	4	7	0	3	3	4	3	1	0	0	2	0	0	0	0	0	1
25	15:00	5	4	5	4	3	3	8	2	4	3	2	3	1	1	3	1	2	2
25	16:00	2	5	14	4	10	4	7	6	5	2	3	6	0	1	1	1	3	3
25	17:00	1	9	14	4	4	7	14	7	5	3	4	8	5	5	4	2	4	4
25	18:00	0	2	19	0	1	9	6	12	1	0	1	24	1	1	0	1	9	9
25	19:00	1	5	23	0	2	9	7	6	7	3	5	10	0	1	1	0	24	24
25	20:00	5	3	31	1	7	8	7	5	4	1	3	12	1	6	1	0	11	11
25	21:00	3	6	44	4	6	10	14	14	8	5	3	16	3	3	3	2	4	4
25	22:00	1	8	41	7	17	10	8	33	15	24	13	65	6	12	7	1	12	12
25	23:00	3	6	5	0	21	64	4	11	36	47	25	14	9	14	28	10	9	9
26	0:00	3	0	0	0	33	15	1	0	23	26	5	3	17	6	17	15	3	3
26	1:00	0	0	1	0	1	0	0	0	0	6	1	1	8	1	6	18	0	0
26	2:00	0	0	2	0	0	1	0	5	1	4	0	0	10	4	8	10	1	1
26	3:00	1	2	0	0	1	1	1	1	0	9	3	0	12	9	13	4	3	3
26	4:00	0	0	0	0	0	0	0	0	1	1	1	1	1	1	4	3	1	1
26	5:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0

Figure A1. Hourly rainfall recorded at telemetry stations of PRBFFWC during event Karding from the period 0900H, Sept 25 to 0500H, Sept 26, 2022.

		WATER LEVEL (WL) STATIONS									
Day	Time	Sapang Buho	Zaragoza	Mayapyap	Penaranda	San Isidro	Arayat	Candaba	Sasmuan	Sulipan	Mexico
25	22:00	0.88	3.13		0.68	1.39	3.99	3.56	3.19	2.54	
25	23:00	1.41	3.14		2.12	1.55	3.92	3.45	3.25	2.68	
26	0:00	2.71	3.15		4.20	2.14	4.04	3.56	3.30	2.76	
26	1:00	3.81	3.16		5.30	3.17	4.15	3.57	3.33	2.71	
26	2:00	4.49	3.18		4.86	4.60	4.27	3.59	3.32	2.71	
26	3:00	4.82	3.18		3.52	6.68	4.60	3.59	3.46	2.76	
26	4:00	4.94	3.19		2.45	7.87	5.30	3.60	3.46	2.83	
26	5:00	4.94	3.21		1.78	8.31	6.11	3.62	3.45	2.86	
26	6:00	4.84	3.23		1.22	8.32	6.83	3.64	3.44	2.95	
26	7:00	4.68	3.25		1.19	8.15	7.27	3.67	3.46	3.13	
26	8:00	4.47	3.27		0.94	7.94	7.58	3.72	3.46	3.22	
26	9:00	4.24	3.28		0.72	7.70	7.83	3.80	3.48	3.32	
26	10:00	3.98	3.30		0.57	7.44	7.91	3.89	3.25	3.42	
26	11:00	3.72	3.32		0.44	7.26	7.98	4.00	3.18	3.48	
26	12:00	3.45	3.34		0.32	7.05	8.08	4.08	3.23	3.51	
26	13:00	3.19	3.37		0.23	6.94	8.13	4.17	3.08	3.52	
26	14:00	2.93	3.40		0.15	6.86	8.17	4.26	3.06	3.49	
26	15:00	2.70	3.42		0.09	6.86	8.16	4.38	3.34	3.45	
26	16:00	2.49	3.44		0.00	6.85	8.17	4.48	3.38	3.40	
26	17:00	2.31	3.46		0.00	6.88	8.19	4.59	3.41	3.35	
26	18:00	2.16	3.49		0.00	6.85	8.22	4.73	3.39	3.31	
26	19:00	2.02	3.52		0.00	6.83	8.26	4.91	3.41	3.28	
26	20:00	1.91	3.55		0.00	6.73	8.26	5.07	3.39	3.27	
26	21:00	1.82	3.57		0.00	6.67	8.20	5.21	3.39	3.25	

Fig A2. Hourly WL recorded at PRBFFWC telemetry stations during event Karding from the period 2200H, Sept 25 to 2100H, Sept 26, 2022.

Basin		Pampanga River Basin & Allied River Systems																	
Event		STS "PAENG"																	
Year:		2022																	
Month:		October																	
		RAINFALL (RR) STATIONS																	
		Munoz	Sapang Buho	Gabalidon	Zaragoza	Mayayrap	Penaranda	Calaanan	Palali	San Isidro	Arayat	Candaba	Sibul Spring	Sasmuan	Sulipan	Mexico	Porac	San Rafael	SFDO
Day	Time																		
29	4:00	1	1	2	0	1	1	0	1	1	0	0	1	0	0	0	1	0	0
29	5:00	1	0	4	0	0	0	1	0	0	0	1	1	0	1	0	0	1	0
29	6:00	0	0	6	0	0	1	1	2	1	1	2	3	0	1	1	0	0	1
29	7:00	1	0	6	0	0	0	1	1	0	1	1	2	2	1	0	0	0	0
29	8:00	0	1	6	0	1	1	3	2	2	2	4	6	1	2	3	1	2	2.25
29	9:00	0	0	5	0	0	1	0	1	1	3	2	1	2	1	2	1	2	0
29	10:00	0	0	7	1	0	0	0	2	0	0	0	3	0	1	0	0	0	1.5
29	11:00	1	0	6	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0
29	12:00	0	2	9	0	2	1	5	2	1	0	1	4	0	1	0	0	3	0.25
29	13:00	1	4	18	2	4	2	11	7	2	4	3	9	2	4	1	0	6	0.25
29	14:00	4	4	6	10	6	5	7	5	7	6	7	9	6	8	4	7	13	4.75
29	15:00	2	2	15	4	3	3	5	5	2	3	2	7	4	8	1	3	8	4.5
29	16:00	0	2	11	5	4	5	8	7	4	4	5	5	1	1	0	2	4	2
29	17:00	0	1	19	2	1	1	6	6	0	1	1	6	1	2	1	0	4	0
29	18:00	2	3	26	1	3	4	11	6	8	6	7	5	3	4	2	2	6	5
29	19:00	9	0	20	0	0	2	2	7	2	2	4	6	0	0	0	1	0	2
29	20:00	3	6	35	0	6	2	9	6	3	3	1	1	2	6	3	3	11	7.5
29	21:00	2	2	15	0	1	1	1	3	4	2	4	0	9	6	1	1	5	9
29	22:00	0	1	16	0	0	0	2	1	3	7	4	2	30	12	6	10	7	15.5
29	23:00	4	0	3	0	1	2	3	0	2	7	5	0	15	12	10	17	9	10.25
30	0:00	2	2	2	0	1	0	1	1	2	3	3	1	5	4	4	6	6	3.75
30	1:00	5	2	3	0	7	6	2	4	1	2	3	4	2	3	2	3	9	0
30	2:00	6	3	0	0	5	5	1	1	4	6	7	2	8	8	7	4	4	6.75
30	3:00	3	3	1	0	2	0	1	1	1	4	4	0	5	0	4	7	0	4.75

Fig A3. Hourly rainfall recorded at telemetry stations of PRBFFWC during event Paeng from the period 0400H, Oct 29 to 0300H, Oct 30, 2022.

		WATER LEVEL (WL) STATIONS									
		Sapang Buho	Zaragoza	Mayayrap	Penaranda	San Isidro	Arayat	Candaba	Sasmuan	Sulipan	Mexico
Day	Time										
29	16:00	0.72	0.92		0.00	0.72	3.72	2.33	3.31		
29	17:00	1.11	0.94		0.59	0.75	3.64	2.39	3.30		
29	18:00	1.61	1.00		1.29	1.17	3.45	2.49	3.30		
29	19:00	2.05	1.05		1.58	1.75	3.24	2.57	3.31		
29	20:00	2.55	1.11		1.76	2.34	3.02	2.66	3.34		
29	21:00	3.02	1.15		1.95	2.87	2.89	2.73	3.40		
29	22:00	3.44	1.20		2.03	3.34	2.91	2.81	3.46		
29	23:00	3.78	1.22		1.92	3.84	3.14	2.90	3.49		
30	0:00	4.02	1.28		1.77	4.19	3.58	2.99	3.53		
30	1:00	4.18	1.33		1.63	4.55	4.09	3.07	3.55		
30	2:00	4.30	1.42		1.37	4.80	4.64	3.14	3.56		
30	3:00	4.37	1.50		1.21	4.97	5.08	3.20	3.56		
30	4:00	4.40	1.56		1.02	5.09	5.43	3.26	3.54		
30	5:00	4.38	1.62		0.84	5.17	5.75	3.32	3.63		
30	6:00	4.31	1.67		0.70	5.21	5.99	3.38	3.61		
30	7:00	4.19	1.73		0.57	5.22	6.21	3.46	3.49		
30	8:00	4.04	1.82		0.48	5.24	6.39	3.52	3.51		
30	9:00	3.85	1.93		0.41	5.24	6.51	3.59	3.51		
30	10:00	3.63	2.04		0.27	5.27	6.67	3.68	3.05		
30	11:00	3.41	2.15		0.20	5.30	6.75	3.75	3.32		
30	12:00	3.18	2.25		0.13	5.34	6.83	3.83	3.25		
30	13:00	2.95	2.35		0.06	5.39	6.91	3.91	2.95		
30	14:00	2.75	2.45		0.00	5.42	6.97	3.99	3.41		
30	15:00	2.57	2.54		0.00	5.48	7.02	4.05	3.28		
30	16:00	2.53	2.63		0.00	5.50	7.01	4.10	3.42		
30	17:00	2.33	2.69		0.00	5.53	7.10	4.15	3.41		
30	18:00	2.25	2.76		0.00	5.55	7.18	4.21	3.43		
30	19:00	2.19	2.82		0.00	5.52	7.22	4.27	3.44		
30	20:00	2.13	2.86		0.00	5.51	7.25	4.31	3.46		
30	21:00	2.07	2.91		0.00	5.46	7.31	4.35	3.48		

Fig A4. Hourly WL recorded at PRBFFWC telemetry stations during event Paeng from the period 1600H, Oct 29 to 2100H, Oct 30, 2022.

References:

Part I: TC Karding

- *NDRRMC SitRep No. 15 for STy KARDING as of 0800H, 12 Oct 2022*
- *RDRRMC-3 SitRep No. 18 re: Effects of TC KARDING as of 0600H, 07 Oct 2022*
- *RDRRMC-3 Matrix on the effects of TC KARDING in CL as of 0600H, 04 Oct 2022*
- *Pampanga PDRRMC Final Report (No. 117) re: Effects of TC KARDING, 1000H, 11 Oct 2022*
- *Bulacan PDRRMO SitRep No. 14 re: TC KARDING as of 0600H, 01 Oct 2022*
- *Tropical Cyclone Bulletins issued by Weather Division of PAGASA (TCB #1 to #26F)*
- *“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 from 0550H, 25 Sept to 1700H, Sept 26*
- *Candaba MDRRMO Situational Reports for TC KARDING #1 to #12 (1100H, 25 Sept to 1500H, 02 Oct 2022)*
- *Picture Report shared by Hagonoy MDRRMO: TC Karding Flooded Area @San Isidro, Hagonoy, Bulacan; Sept 26, 2022*
- *Jaen MDRRMO SitRep re: TC Karding as of 1400H, 30 Sept 2022*
- *San Ildefonso MDRRMO Report dated 27 Sept 2022*
- *Tarlac PDRRMO Terminal Report re: TC Karding dated 05 Oct 2022*

Part II: TC Paeng

- *NDRRMC SitRep No. 30 for STS PAENG as of 1800H, 19 Nov 2022*
- *RDRRMC-3 Matrix SitRep No. 17 on the effects of the STS Paeng in CL as of 1900H, 08 Nov 2022*
- *RDRRMC-3 SitRep No. 07 re: Effects of TC PAENG in CL as of 0200H, 01 Nov 2022*
- *Pampanga PDRRMC Final Report (No. 34) re: Effects of STS PAENG as of 12NN, 31 Oct 2022*
- *Bulacan PDRRMO SitRep No. 9 re: TC PAENG as of 1700H, 01 Nov 2022*
- *Tarlac PDRRMO SitRep & Advisory Update #11, re: Effects of STS PAENG as of 1700H, 07 Nov 2022*
- *RR & WL observation pics during TC Paeng courtesy of Gabaldon MDRRMO*
- *NIA-UPRIIS Report of Discharges from 0745H, 29 Oct to 1700H, 30 Oct 2022*
- *Tropical Cyclone Bulletins issued by Weather Division of PAGASA (TCB #1 to #30F)*
- *Candaba MDRRMO Situational Reports for TC PAENG #1 to #5 (0900H, 30 Oct to 1500H, 02 Nov 2022)*

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