National Water Resources Board

Use & Relevance of PAGASA Climate Information Services in NWRB

PAGASA 100th National Climate Outlook Forum

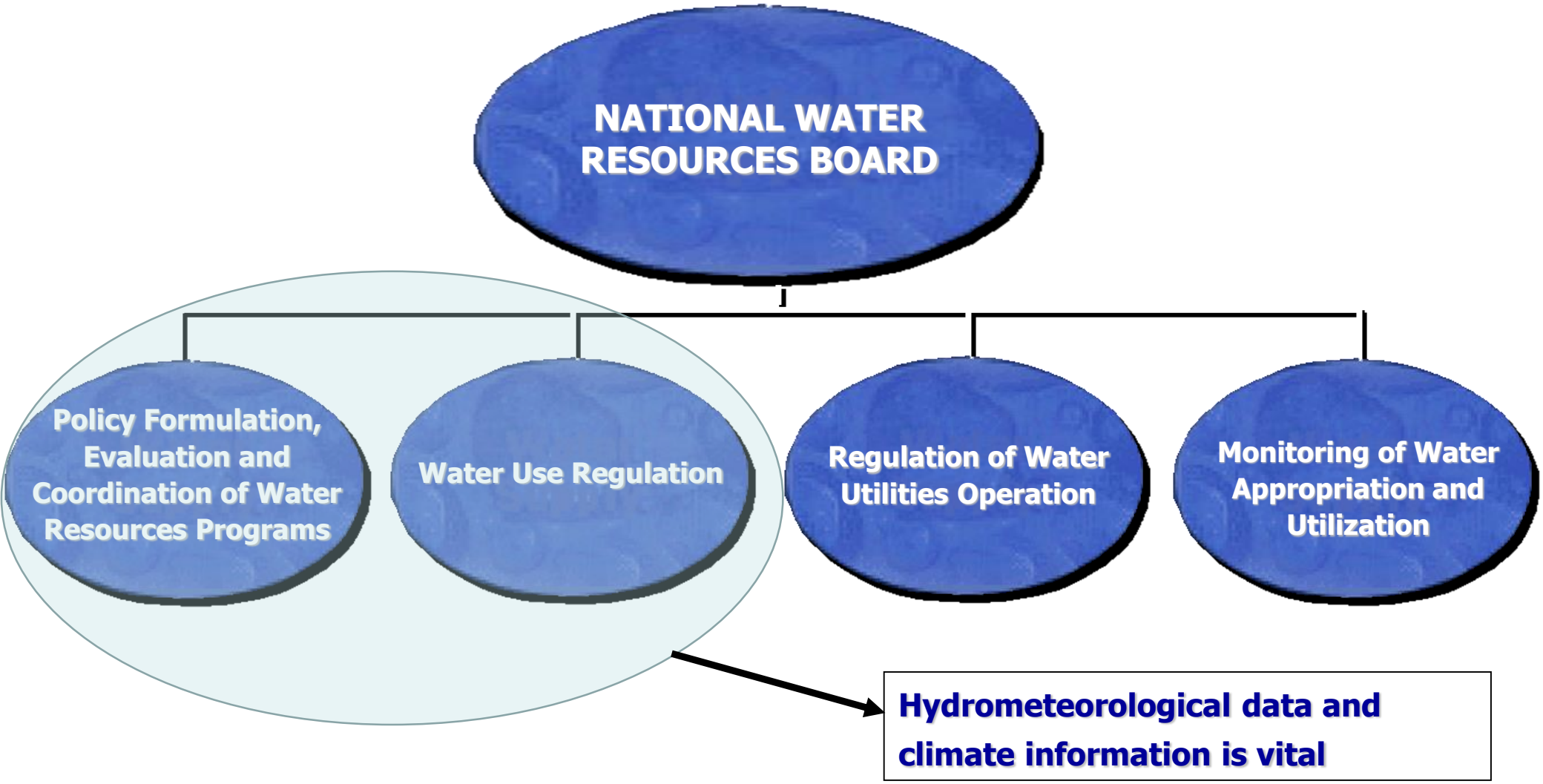
(March 22, 2018)

NATIONAL WATER RESOURCES BOARD

LEGAL MANDATES

The NWRB is the body responsible for coordinating and regulating all activities related to **water resources management** (PD 424, PD 1067) including water utilities operation (PD 1206).

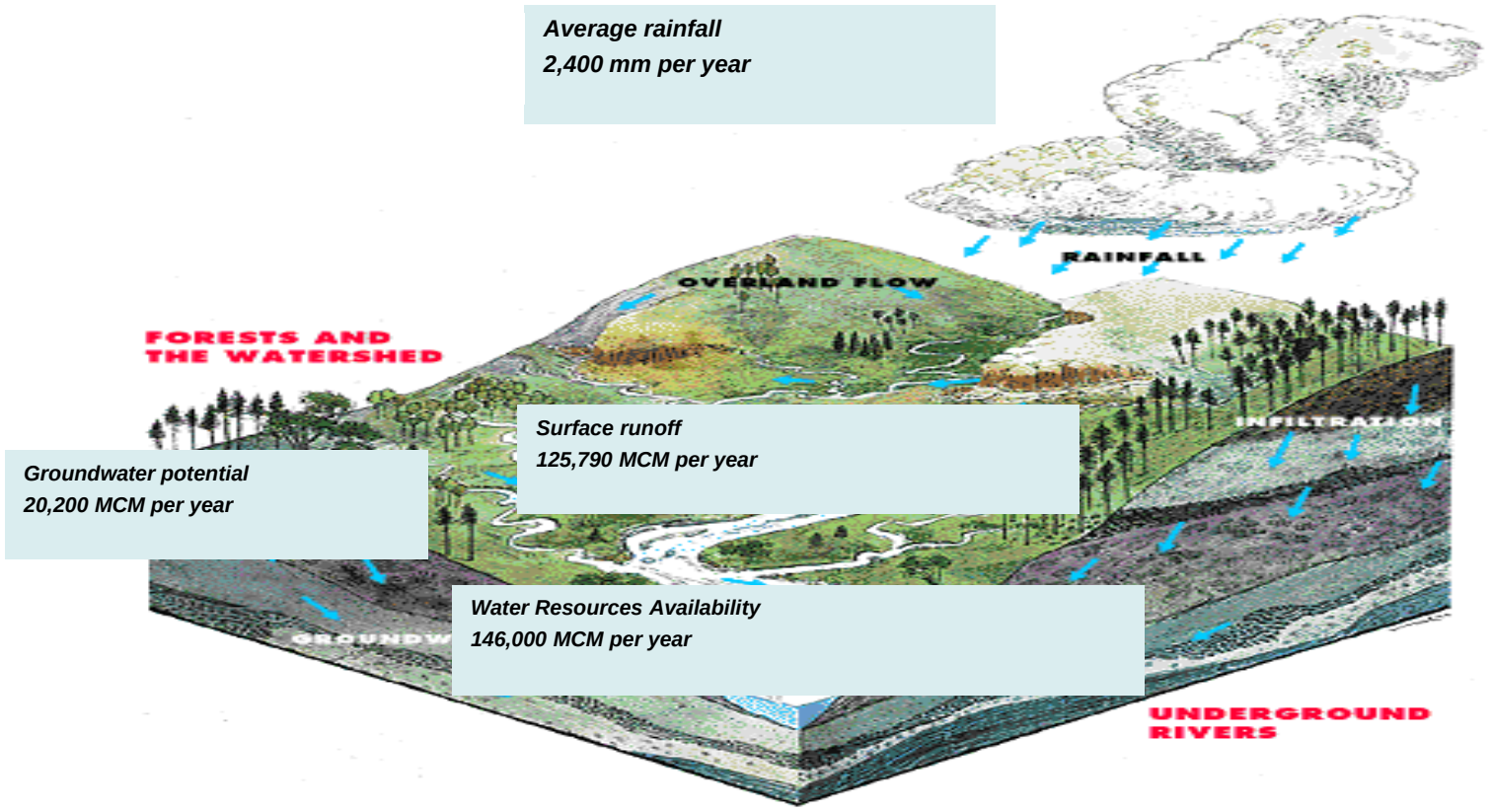
SERVICES/FUNCTIONS



Policy Formulation, Evaluation and Coordination of Water Resources Programs

- **Assessment of Water Resources (i.e. Water potential/ availability) as basis for Policy Formulation and Program Evaluation**

Various Water Resources Assessment Studies/Projects were conducted by NWRB wherein climate and hydrometeorological information were utilized

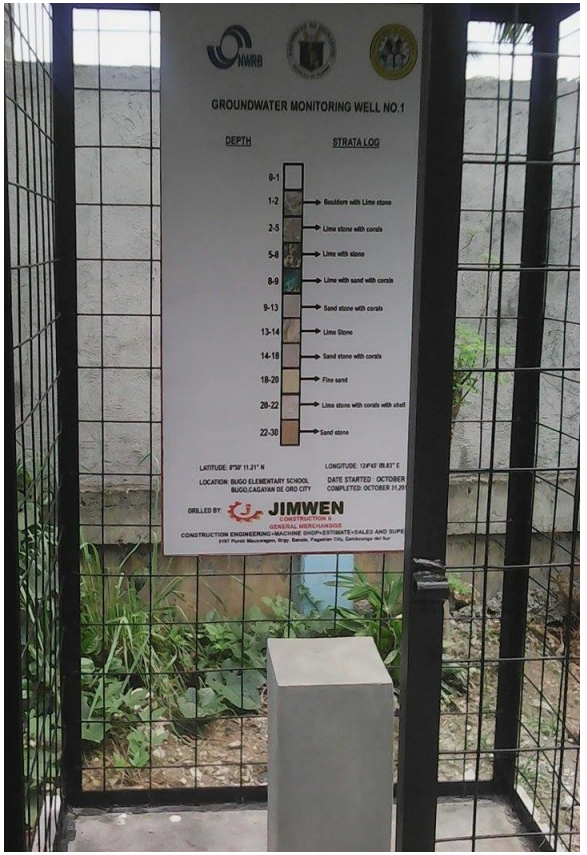


Development of Groundwater Management Plan which includes the Installation of Groundwater Monitoring Wells in Highly Urbanized Areas or Groundwater Constraint Areas

- NWRB conducts the project from 2014-onwards in nine groundwater constraint cities identified in 1998 JICA Masterplan

- The study will effectively and equitably manage groundwater resources and provide guidance document for groundwater development in the study area considering current situation as well as future impact of climate change to ensure long-term sustainability of the resource.

- The Groundwater Management plan will be used as a guide for formulating policies and for regulation of available water resources.



Water Use/Resource Regulation

Reservoir Monitoring

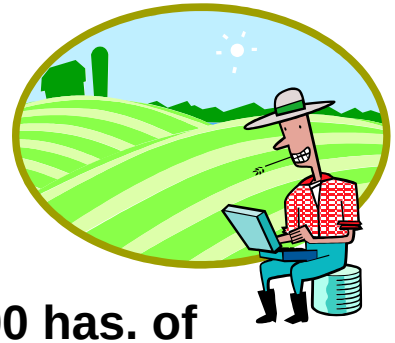
- Reservoirs are subject to regulation by the NWRB in accordance with Article 62 of the Water Code of the Philippines (PD 1067), which provides that:

"All reservoir operations shall be subject to rules and regulations issued by NWRB ..."

Allocation of water from Angat Reservoir

Water supply to Metro Manila,

Flood control to Bulacan Province



Irrigation to 27,000 has. of farm lands in Bulacan and Pampanga Provinces

Power generation for Luzon Power Grid with maximum output of 246 MW

Angat Reservoir Monthly Allocation

1. TWG Meeting (PAGASA, NIA, NAPOCOR, AHC, MWSS, NWRB)

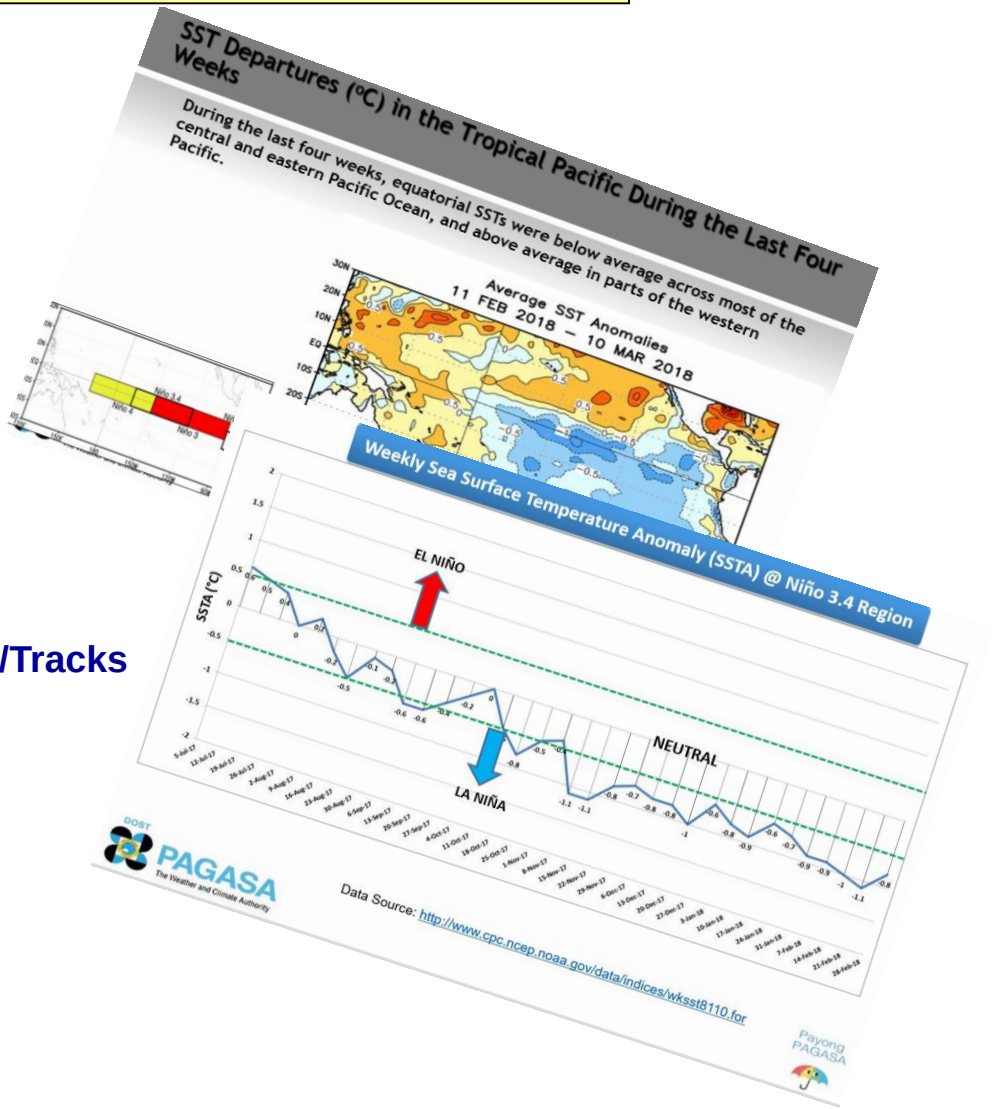
2. Reservoirs Operation and Simulation Study

- ***Irrigation requirement (NIA)***
- ***Water Supply Requirements (MWSS)***
- ***Inflows (Historical Inflows)***
- ***Forecasted Watershed Rainfall – Translated to reservoir inflows***

Angat Reservoir Monthly Allocation

3. Climate Information (PAGASA)

- ***ENSO Update / Outlook***
- ***Climate***
  - **Rainfall**
  - **Temperature**
  - **Dry Day Forecast**
  - **Tropical Cyclone Frequency/Tracks**
  - **Temperature**
- ***Probabilistic Enso Outlook***
  - ***El Niño***
  - ***La Niña***
  - ***Neutral Condition***



Simulation of Angat Water Allocation

$S(t) = S(t-1) + I - O$

Where:

S(t) = present storage in MCM

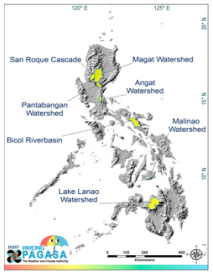
S(t-1) = previous storage in MCM

I = Inflow to the reservoir in MCM

O = Outflow in MCM (Releases for irrigation and water supply)

Forecast Watershed Rainfall (mm) Translated to Inflow (mcm) in Angat Reservoir

MONTH	RAINFALL		INFLOW	
February	(mm)	88.5	(mcm)	40.21
	%Normal	106.4	% Hist.	51
March	(mm)	57.3	(mcm)	25.9
	%Normal	74.7	% Hist.	51
April	(mm)	72.5	(mcm)	32.94
	%Normal	74	% Hist.	86
May	(mm)	236.6	(mcm)	107.51
	%Normal	68	% Hist.	202
June	(mm)	507.1	(mcm)	230.43
	%Normal	167.2	% Hist.	229
July	(mm)	1007.52	(mcm)	457.42
	%Normal	218.8	% Hist.	272



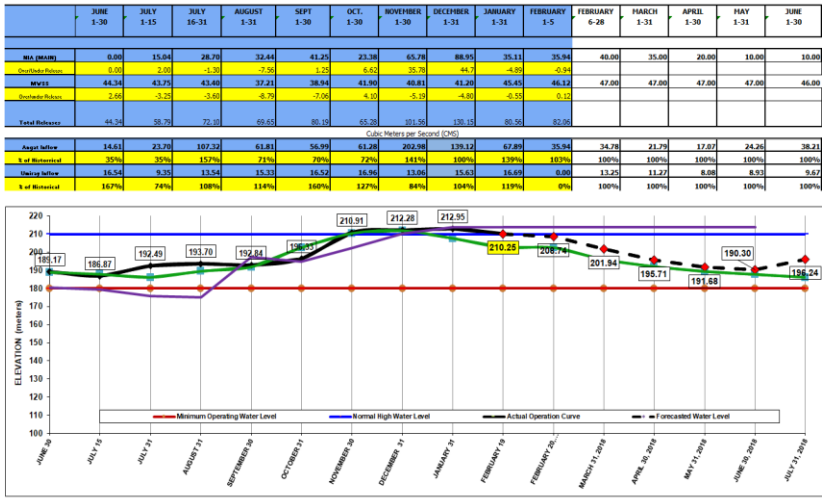
FORECAST WATERSHED RAINFALL for selected Dams and Lakes in (mm) and (%N)

FORECAST WATERSHED RAINFALL (FEBRUARY - JULY 2017)

	NAME	Angat Watershed	Lake Buhi	Lake Lanao	Magat Watershed	Malinao Watershed	Pantabangan Watershed	San Roque Cascade WS
FEBRUARY	MIN	14.1	199.9	75.6	0.0	89.1	30.6	6.1
	MAX	95.0	308.3	109.4	51.0	95.1	100.0	16.1
	MEAN	48.5	256.0	86.2	14.9	92.2	58.8	12.8
	%NORMAL	158.6	125.6	123.0	98.0	127.0	111.1	77.4
MARCH	MIN	14.9	144.9	47.3	14.1	74.1	44.3	31.9
	MAX	68.1	205.4	97.0	65.9	75.3	98.1	42.1
	MEAN	35.9	175.5	72.8	37.3	74.8	66.4	39.4
	%NORMAL	90.5	106.8	99.1	135.0	111.6	123.4	107.5
APRIL	MIN	26.7	59.6	34.5	42.3	45.8	56.8	54.3
	MAX	85.1	111.3	102.8	100.3	58.6	129.6	77.2
	MEAN	49.1	86.8	68.9	70.5	51.1	88.8	72.8
	%NORMAL	61.4	56.2	71.6	75.1	99.2	65.0	72.1
MAY	MIN	231.9	169.2	125.4	221.7	110.5	199.8	312.2
	MAX	258.4	220.6	259.8	356.2	125.8	264.9	403.4
	MEAN	246.2	200.0	195.9	290.5	117.7	234.4	369.5
	%NORMAL	117.9	118.0	102.9	175.1	161.3	132.9	119.6
JUNE	MIN	245.1	235.1	196.5	168.9	145.4	192.9	335.5
	MAX	335.1	264.1	295.8	347.1	151.7	276.4	413.6
	MEAN	286.4	253.3	256.1	261.5	148.2	222.5	375.0
	%NORMAL	107.3	139.1	93.9	98.2	120.3	83.9	85.8
JULY	MIN	256.4	247.6	212.2	343.3	139.8	307.6	754.0
	MAX	425.8	262.1	284.4	815.2	129.2	608.7	961.5
	MEAN	339.4	256.5	252.7	594.8	124.1	448.3	868.0
	%NORMAL	87.5	101.5	87.3	213.6	99.8	116.4	123.9

LEGEND:

< or =40%	way below normal
41-80	below normal
81 - 120	near normal
>120	above normal



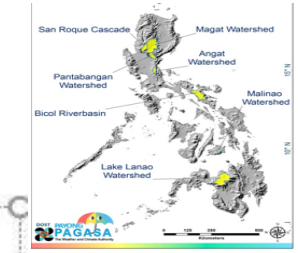
	JUNE 1-30	JULY 1-15	JULY 16-31	AUGUST 1-31	SEPT 1-30	OCT. 1-30	NOVEMBER 1-30	DECEMBER 1-31	JANUARY 1-31	FEBRUARY 1-5	FEBRUARY 6-28	MARCH 1-31	APRIL 1-30	MAY 1-31	JUNE 1-30
NIA (MAIN)	0.00	15.04	28.70	32.44	41.25	23.38	65.78	88.95	35.11	35.94	40.00	35.00	20.00	10.00	10.00
Overbank Release	0.00	2.00	-1.30	-7.56	1.25	6.62	35.78	44.7	-4.89	-0.94					
MWSS	44.34	43.75	43.40	37.21	38.94	41.90	40.81	41.20	45.45	46.12	47.00	47.00	47.00	47.00	46.00
Drawdown Release	2.66	-3.25	-3.60	-8.79	-7.06	4.10	-5.19	-4.80	-9.55	0.12					
Total Release	44.34	58.79	72.10	69.65	80.19	65.28	101.56	138.15	80.56	82.06					
Cubic Meters per Second (CMS)															
Angat Inflow	14.63	23.70	107.32	61.81	56.99	61.28	202.98	139.12	67.89	35.94	34.78	21.79	17.87	24.26	38.21
% of Historical	35%	35%	157%	71%	70%	72%	141%	100%	139%	103%	100%	100%	100%	100%	100%
Umiray Inflow	16.54	9.35	13.54	15.33	16.52	16.96	13.06	15.63	16.69	0.00	13.25	11.27	8.08	8.93	9.67
% of Historical	167%	74%	108%	114%	160%	127%	84%	104%	119%	0%	100%	100%	100%	100%	100%

DOST PAGASA The Weather and Climate Authority

Payong PAGASA

Tropical Cyclone Forecast

MONTH	NUMBER OF TC
FEBRUARY 2018	0 OR 1
MARCH 2018	0 OR 1
APRIL 2018	0 OR 1
MAY 2018	1 OR 2
JUNE 2018	1 OR 2
JULY 2018	2 TO 4



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Dams and Lakes in (mm) and (%N)

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	MEAN	48.5	256.0	86.2	14.9	92.2	58.8	12.8
	%NORMAL	150.6	153.5	123.0	98.0	127.0	111.1	77.4
MARCH	MIN	14.9	144.9	47.3	14.1	74.1	44.3	31.9
	MAX	68.1	205.4	97.0	65.9	75.3	98.1	42.1
	MEAN	35.9	175.5	72.8	37.3	74.8	66.4	39.4
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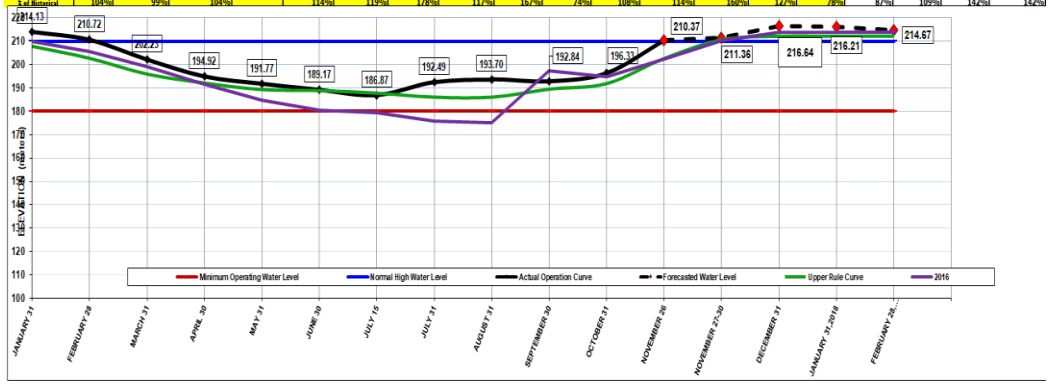
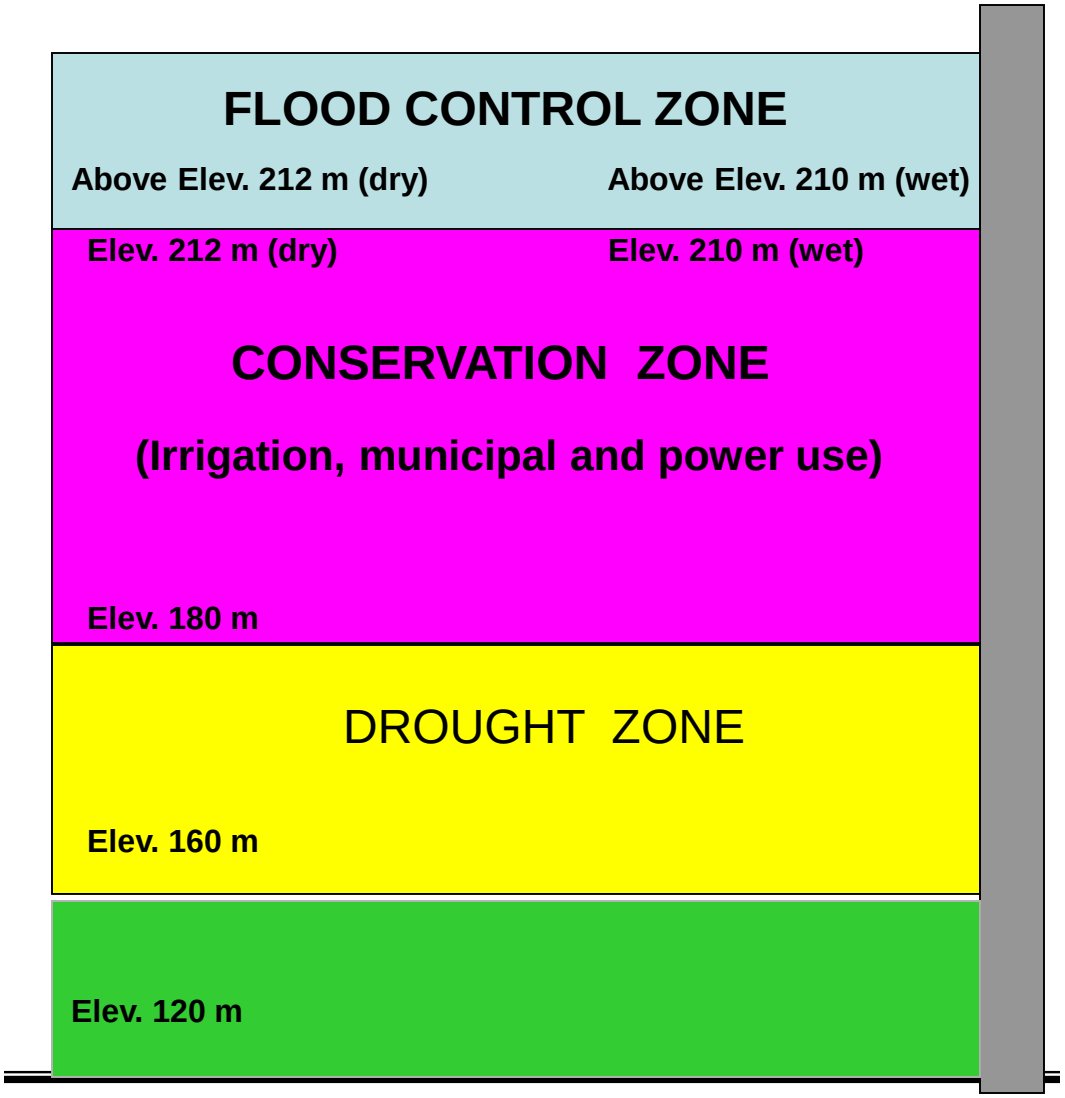
	OCT 1-31	NOV 1-30	DEC 1-31	JAN 1-31	FEB 1-28	MARCH 1-31	APRIL 1-30	MAY 1-31	JUNE 1-30	JULY 1-15	JULY 16-31	AUGUST 1-31	SEPT 1-30	OCT. 1-30	NOVEMBER 1-19	NOVEMBER 20-30	DECEMBER 1-31	JANUARY 1-31	FEBRUARY 1-28
NIA (MAIN)	19.62	34.36	19.62	77.82	69.57	41.57	29.67	0.00	0.00	15.04	28.70	32.44	41.25	23.38	76.53	30.00	35.00	40.00	40.00
Over/Under Release	10.38	9.36	10.38	37.82	3.86	6.57	14.67	0.00	0.00	2.00	-1.30	-7.56	1.25	6.62	46.53				
MWSS	30.39	41.38	30.39	45.10	45.48	45.54	45.59	45.96	44.34	43.75	43.40	37.21	38.94	41.90	39.45	46.00	46.00	46.00	46.00
Over/under Release	15.61	-4.62	15.61	-0.90	-0.52	-0.46	-0.41	-1.04	2.66	-3.25	-3.60	-8.79	-7.06	4.10	6.55				
Total Releases	50.01	75.74	50.01	122.92	115.05	87.11	75.26	45.96	44.34	58.79	72.10	69.65	80.19	65.28					
Cubic Meters per Second (CMS)																			
Angat Inflow	77.07	114.44	77.07	125.60	57.04	20.59	13.55	21.77	14.61	23.70	107.32	61.81	56.99	61.28	235.33	122.68	110.15	62.40	57.73
% of Historical	78%	79%	78%	265%	97%	60%	79%	90%	35%	35%	157%	71%	70%	72%	164%	85%	108%	127%	166%
Ipo Inflow	13.96	15.36	13.96		15.34	14.30	13.87	10.34	16.54	9.35	13.54	15.33	16.52	16.96	12.23	13.63	14.08	19.99	18.81
% of Historical	104%	99%	104%		114%	119%	178%	117%	167%	74%	108%	114%	160%	127%	78%	87%	109%	142%	142%



Angat Reservoir Operation Rule (2009)



Flood Operation and Management

Releases:

- **Irrigation thru main turbines**
- **Water supply thru auxiliary turbines**

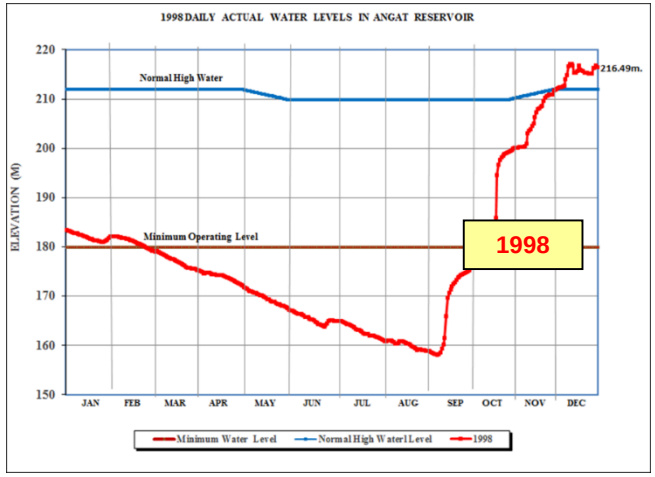
Releases:

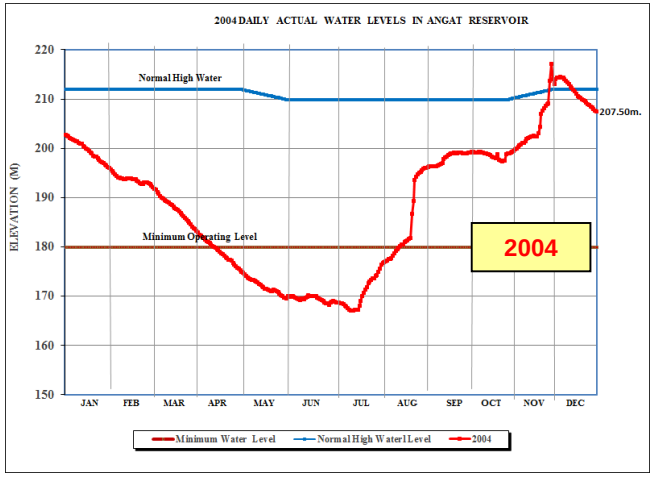
- **Water supply thru auxiliary turbines**

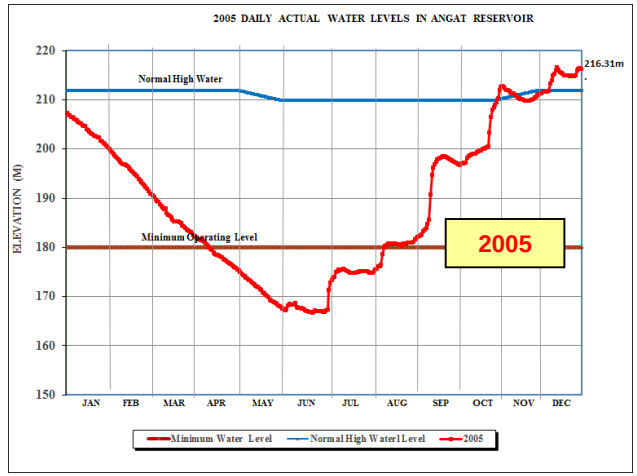
Releases:

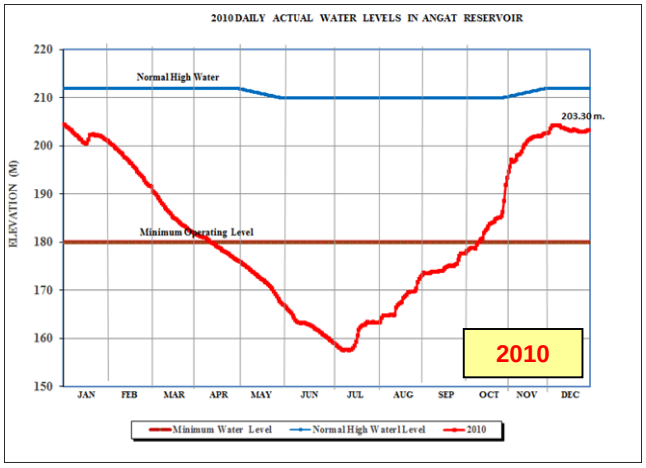
- **Water supply thru low level outlet**

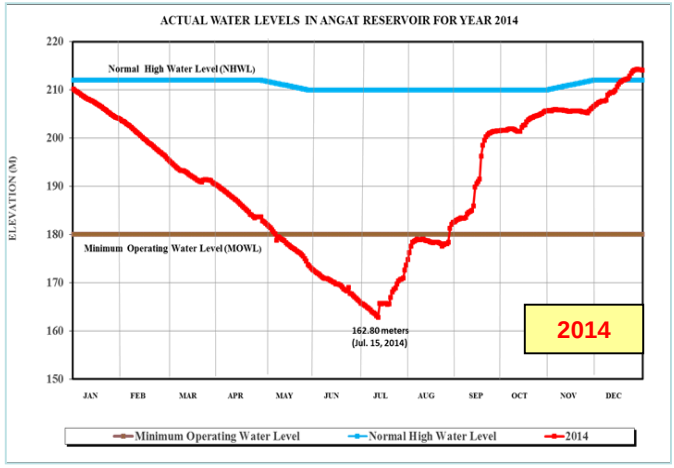
Angat Operation Curves (El Nino Years)

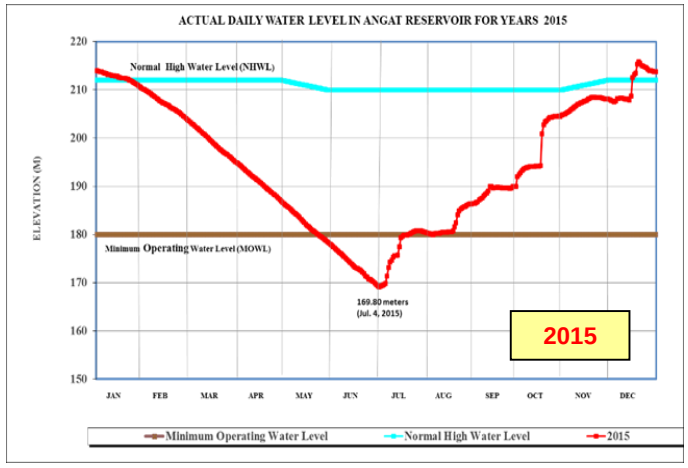












ECOLOGICAL STUDY / SUSTAINABILITY PLAN

- **Environmental / Ecological Study of possible effect or impact of the hydropower project on the river basin system.**
- **Run-off-the- River type hydropower projects**
- **Water Quality Parameters**
  - **Hydrological Simulations (HECRAS)**
  - **Meteorological data (available daily annual from NASA Satellite Data, Air Temperature, relative humidity, Solar Radiation, Atmospheric Pressure, and Wind Speed)**
  - **Dissolved Oxygen (prescribed limit in the policy guidelines)**
  - **Temperature (simulated temperature rise)**

National Water Resources Board

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