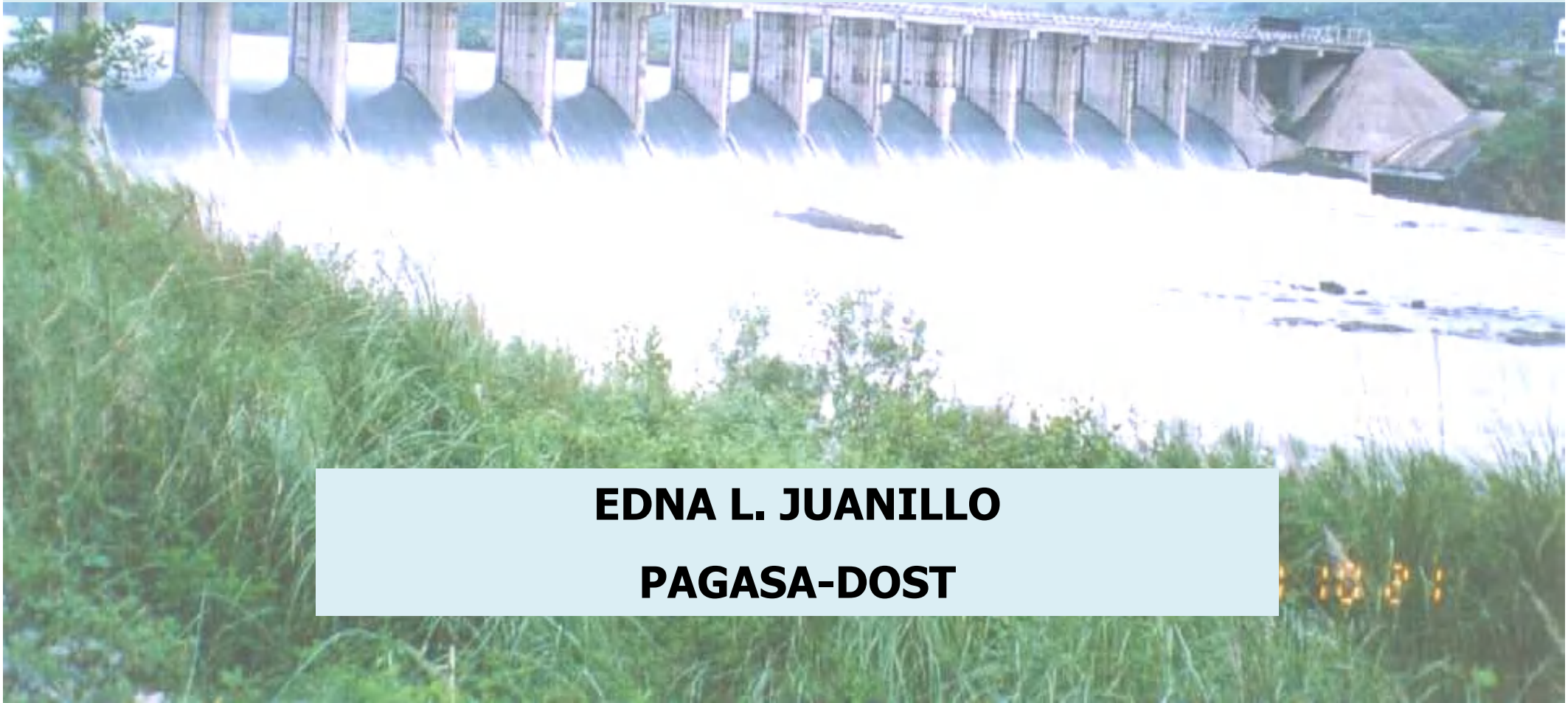
7th Meeting of the Asian Water Cycle Initiative (AWCI) International Coordination Group (ICG)

Tokyo, Japan

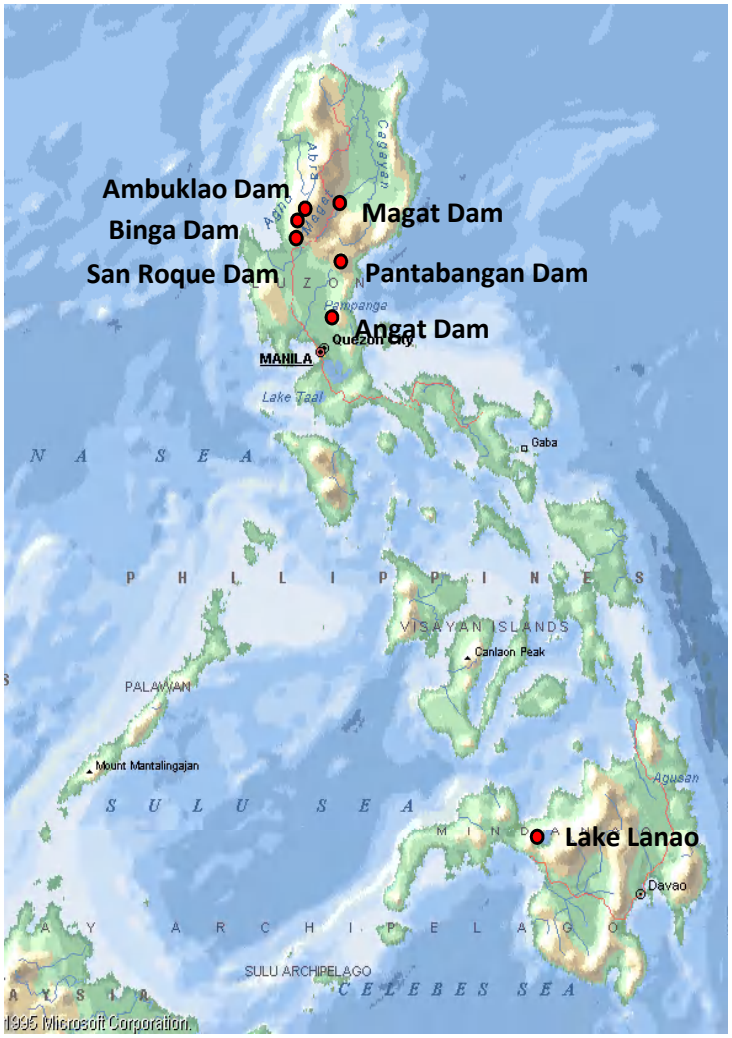
October 5, 2010

THE RECENT EL NINO IMPACTS TO THE PHILIPPINE WATER RESOURCES : FOCUS ON ANGAT DAM

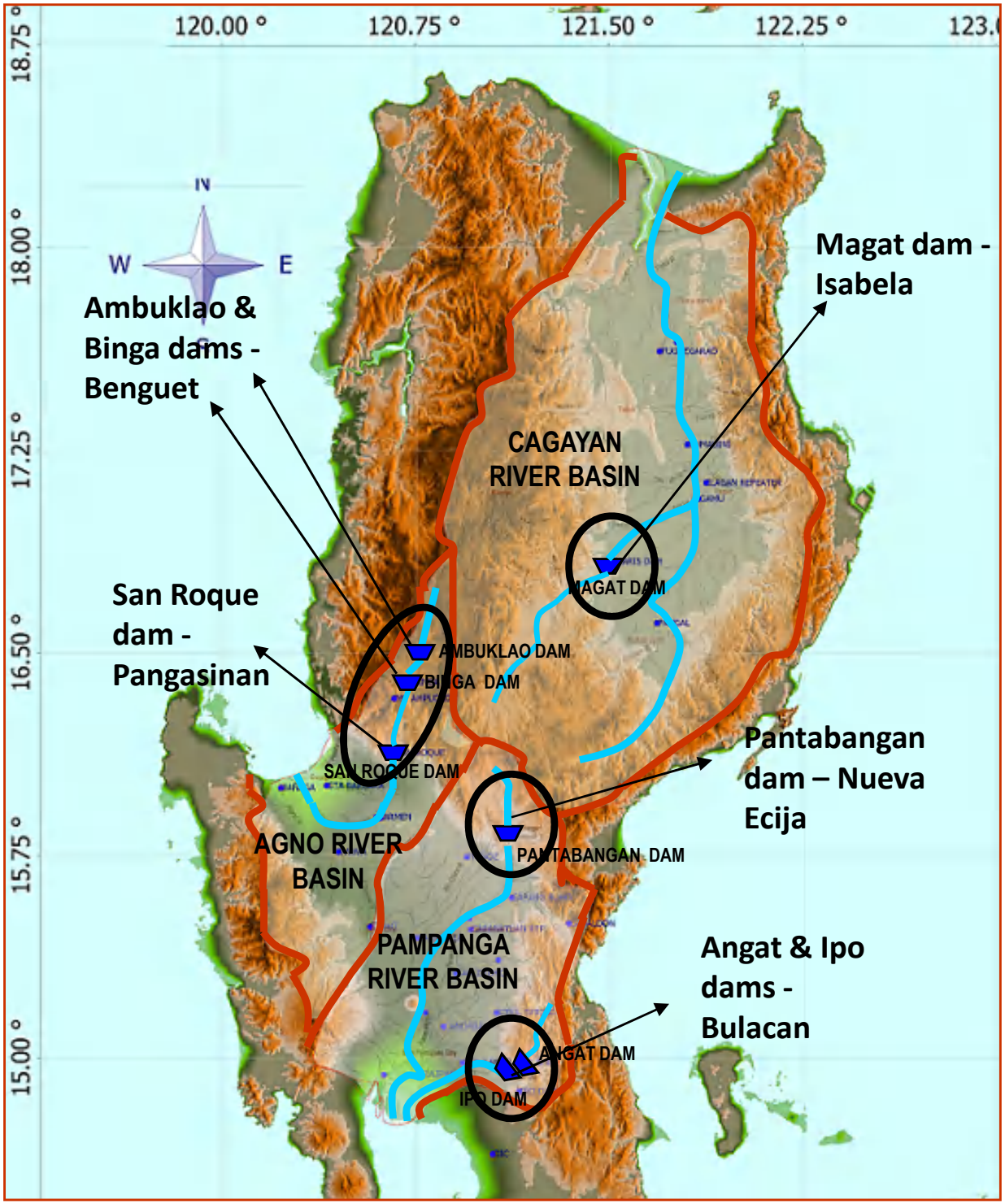


EDNA L. JUANILLO

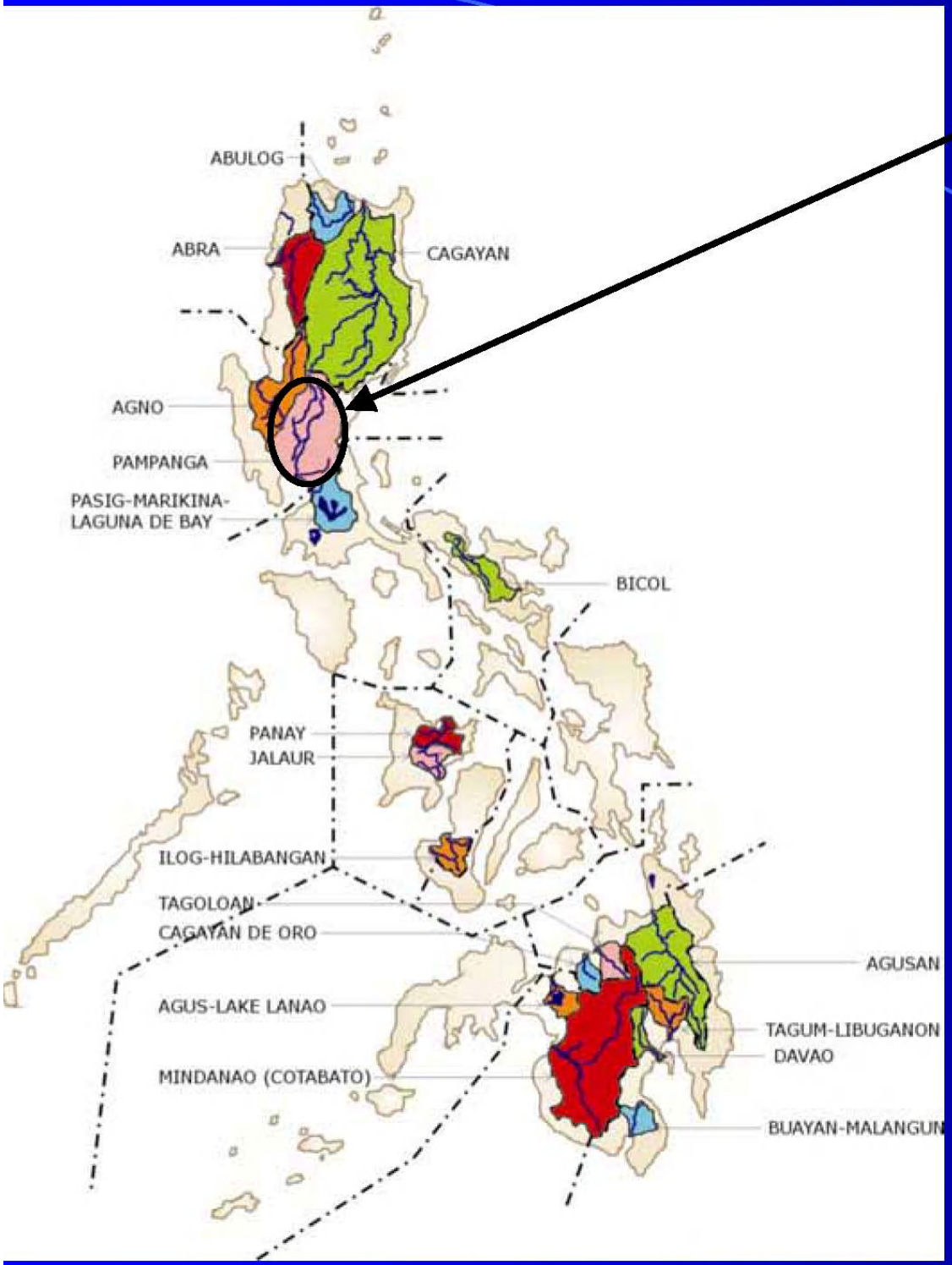
PAGASA-DOST



Location of Major Hydroelectric Dams in the Philippines



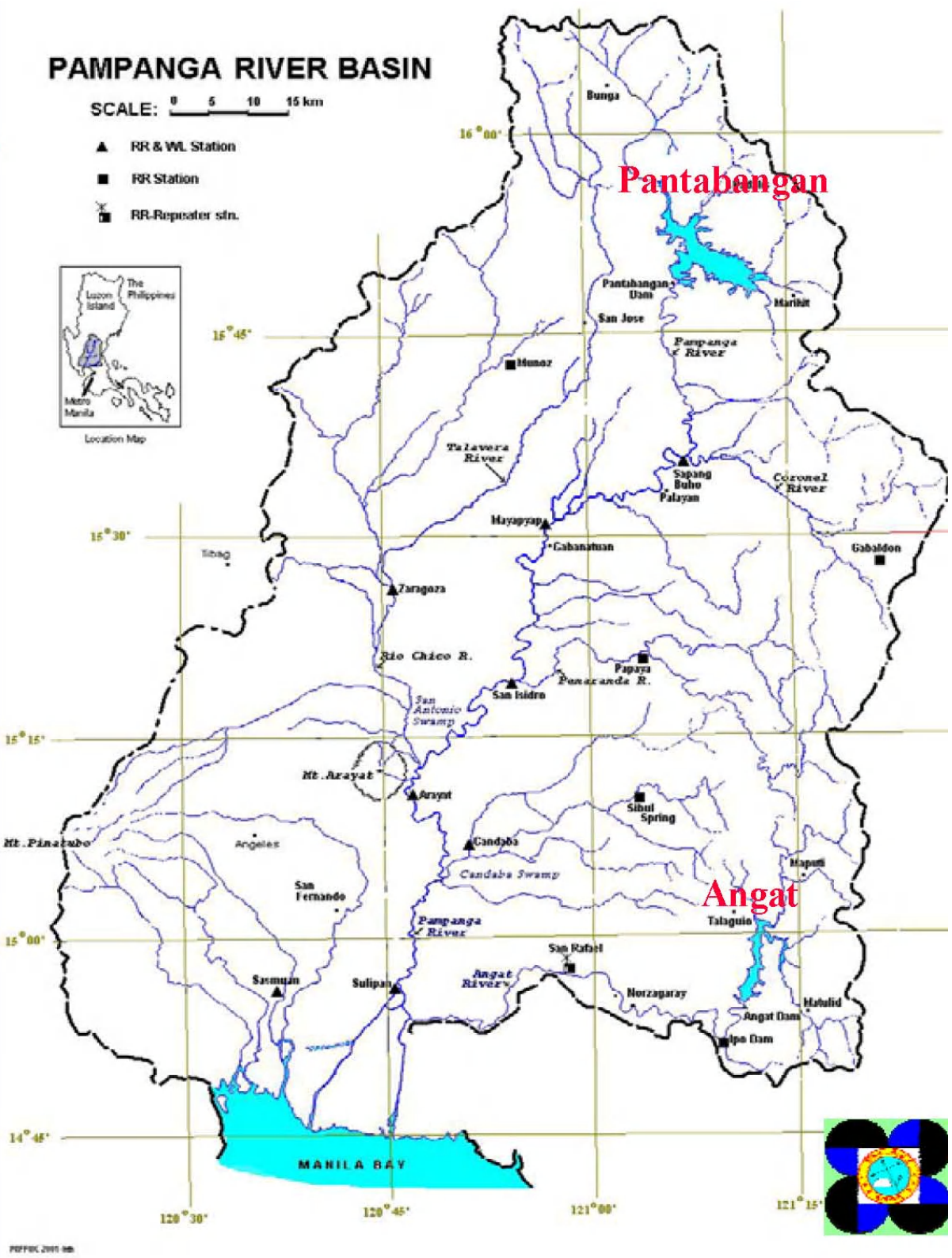
Pampanga River Basin



- Fourth largest basin in the Phil.
- Covers an approximate aggregate area of 10,540 sq.km
- The basin experiences, on an average, at least one flooding in a year.
- It is also affected by El Nino resulting in rainfall deficiency.

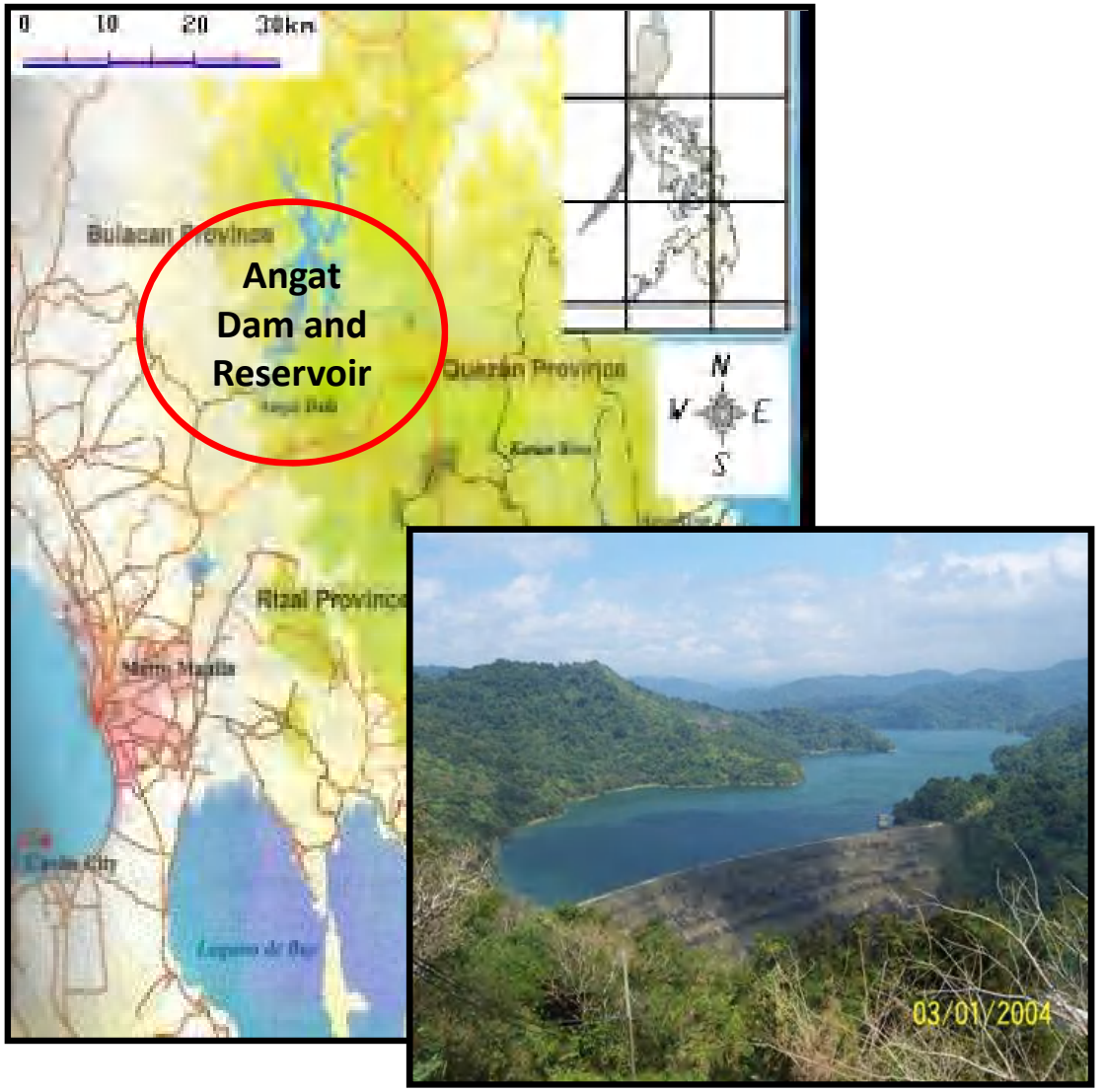
- There are two dams within the basin: Angat and Pantabangan dams.

- Both dams have multi-purpose uses: irrigation, power generation, domestic and industrial water supply

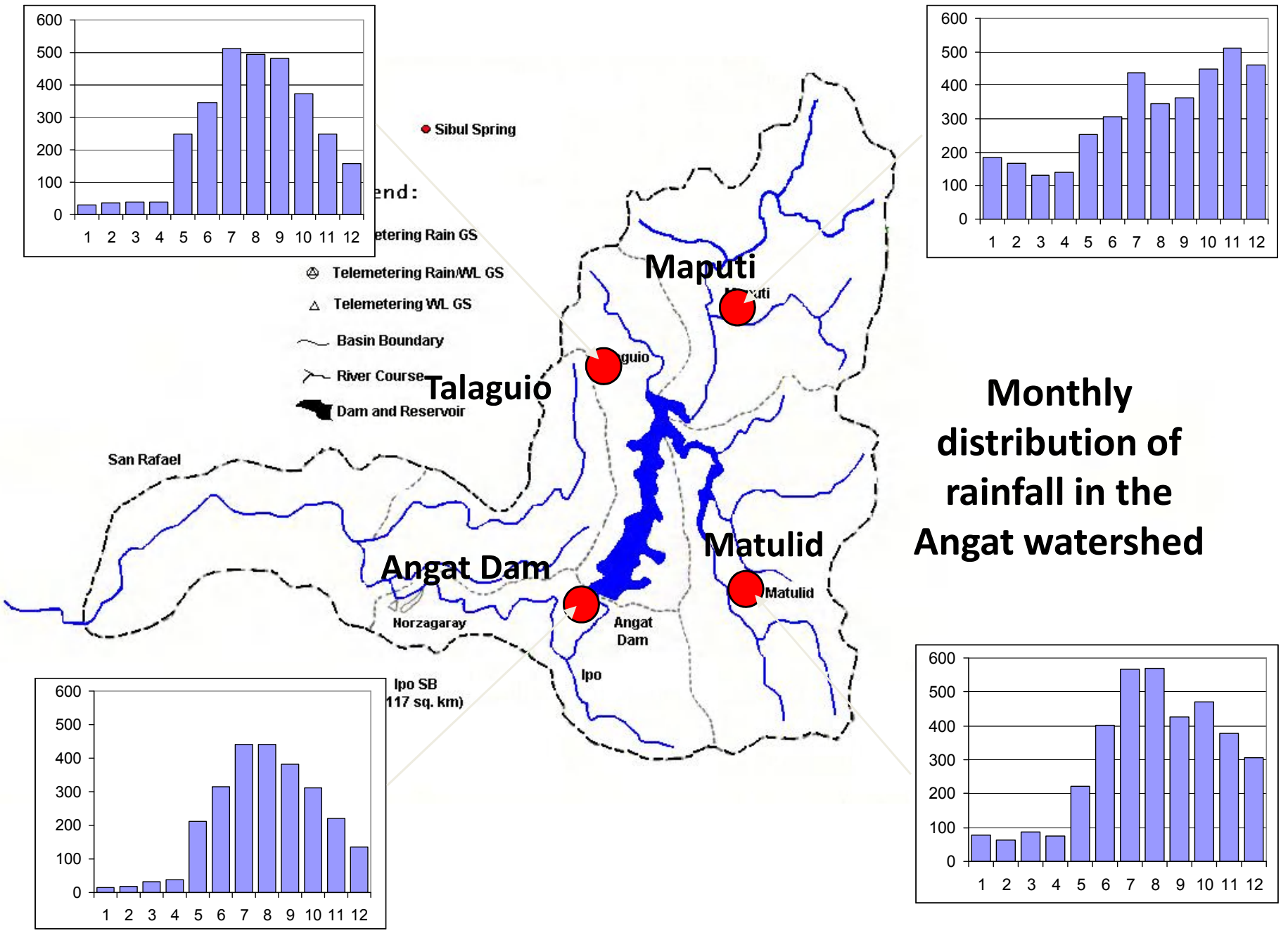


Angat Dam and Reservoir

- Effective Capacity, 640 x 10^6 Cubic Meters
- Annual inflow, 1,894 x 10^6 Cubic Meters
- Drainage Area, 568 Sq. Km.
- Generates 246 MW for Luzon grid
- Irrigates 30,000 hectares of farmlands of Bulacan and parts of Pampanga
- Flood control facility

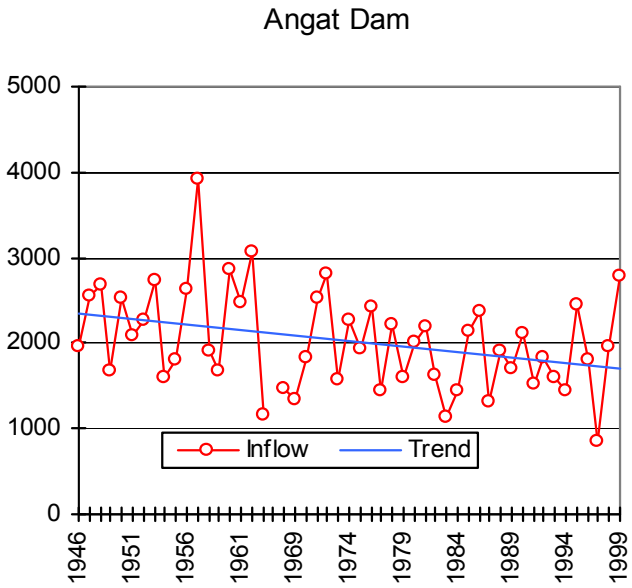


- **Major water supply source for 12 Million people of Metro Manila**

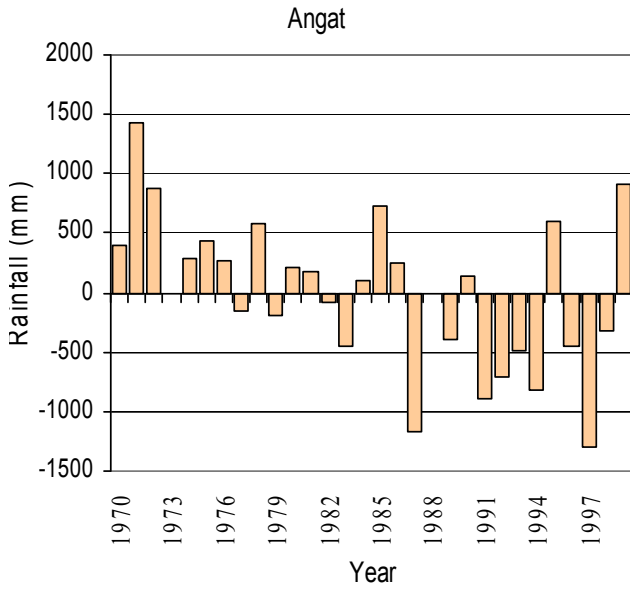


Monthly distribution of rainfall in the Angat watershed

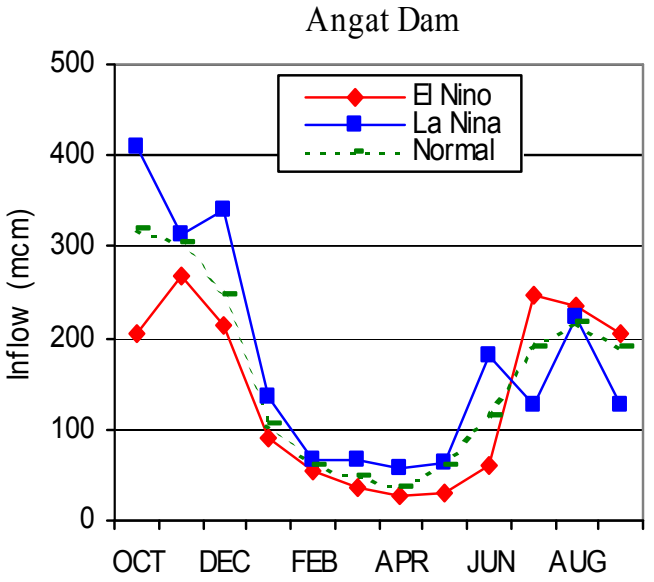
ENSO Impacts on surface and groundwater resources in previous years



Annual Inflow Series for Angat Dam



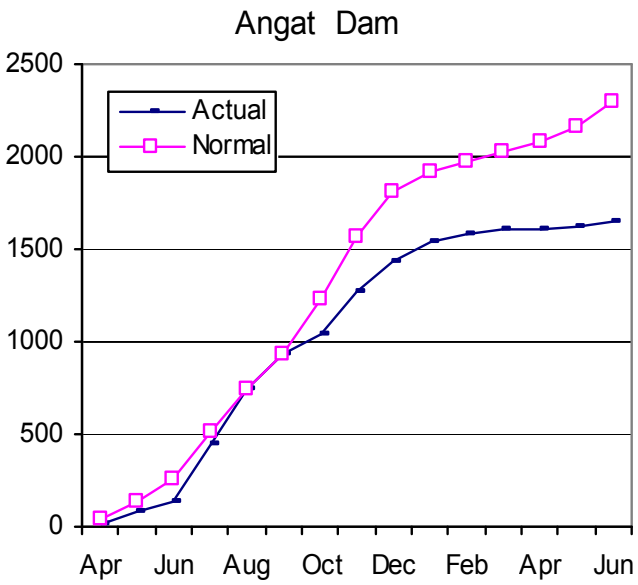
Annual Rainfall Anomaly of Angat Dam



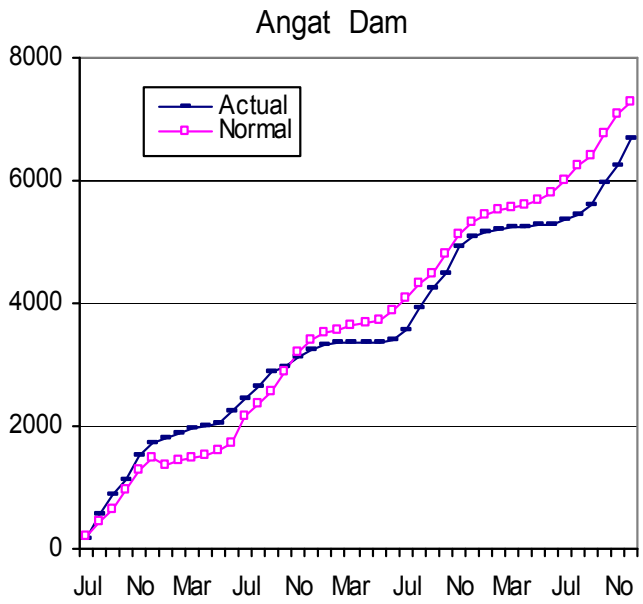
Average Monthly Inflow of Angat Dam(1970-1999)

ENSO Impacts on Angat Dam in previous years

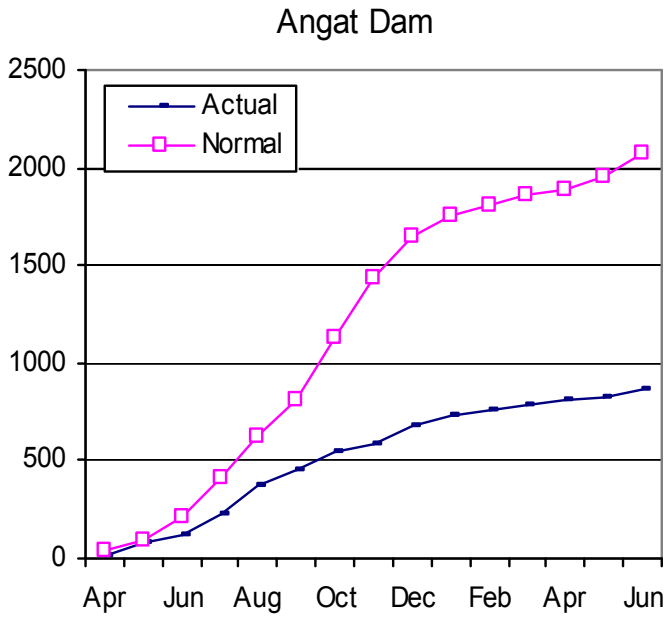
Cumulative Monthly Inflow



1982-83 El Nino



1990-93 El Nino



1997-98 El Nino

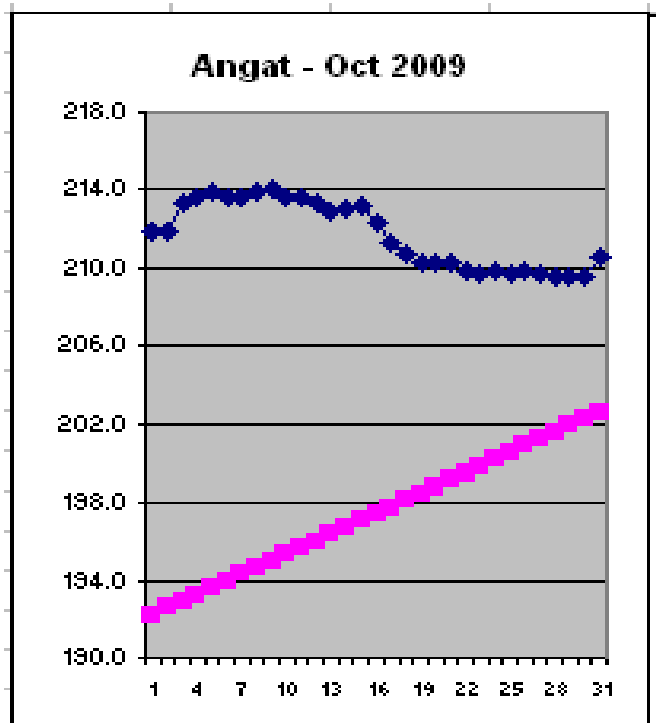
In July 2009, the International Climate Centers issued the following statement

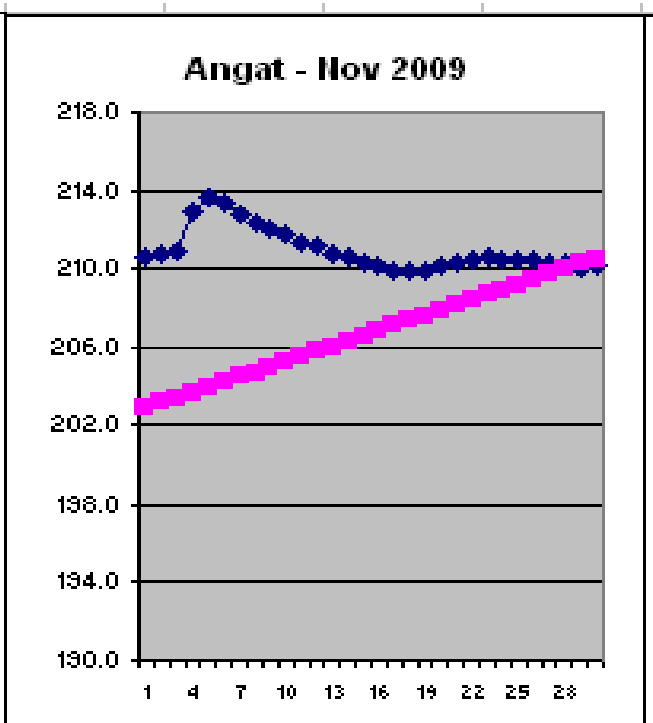
Recent Conditions:

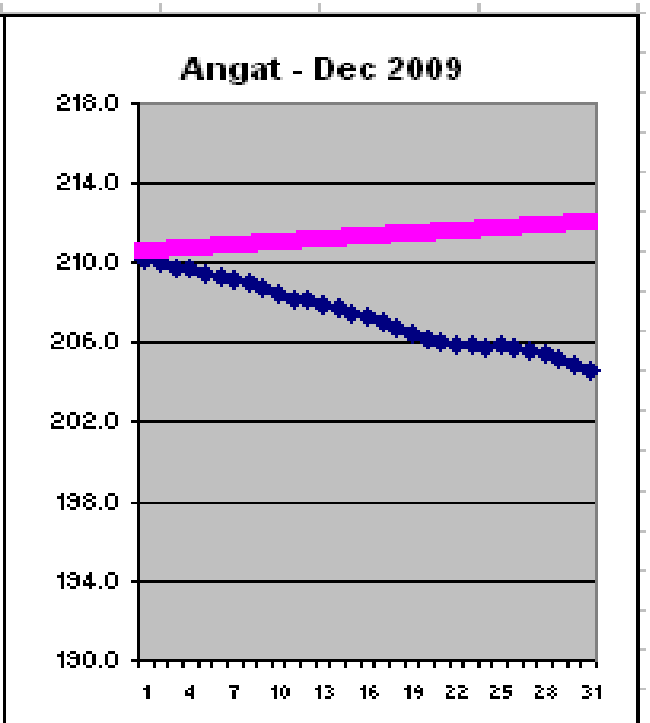
- **El Niño conditions are present across the equatorial Pacific Ocean. Positive Sea Surface T departures continue to increase across much of the equatorial Pacific Ocean**

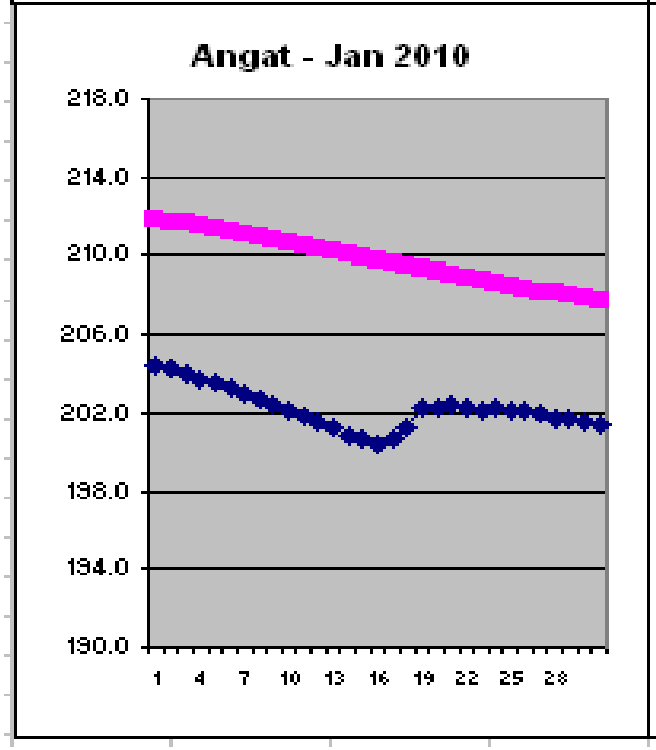
Expected Conditions:

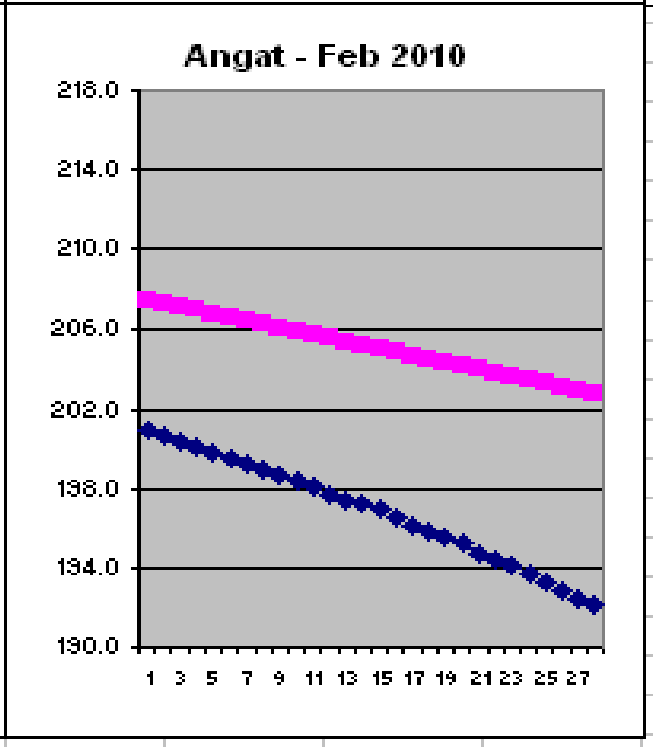
- **Current observations and dynamical model forecasts indicate El Niño conditions will continue to intensify and are expected to last through Northern Hemisphere winter (DJF) 2009-10.**

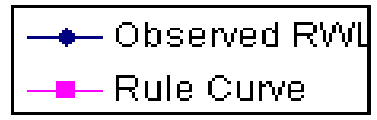






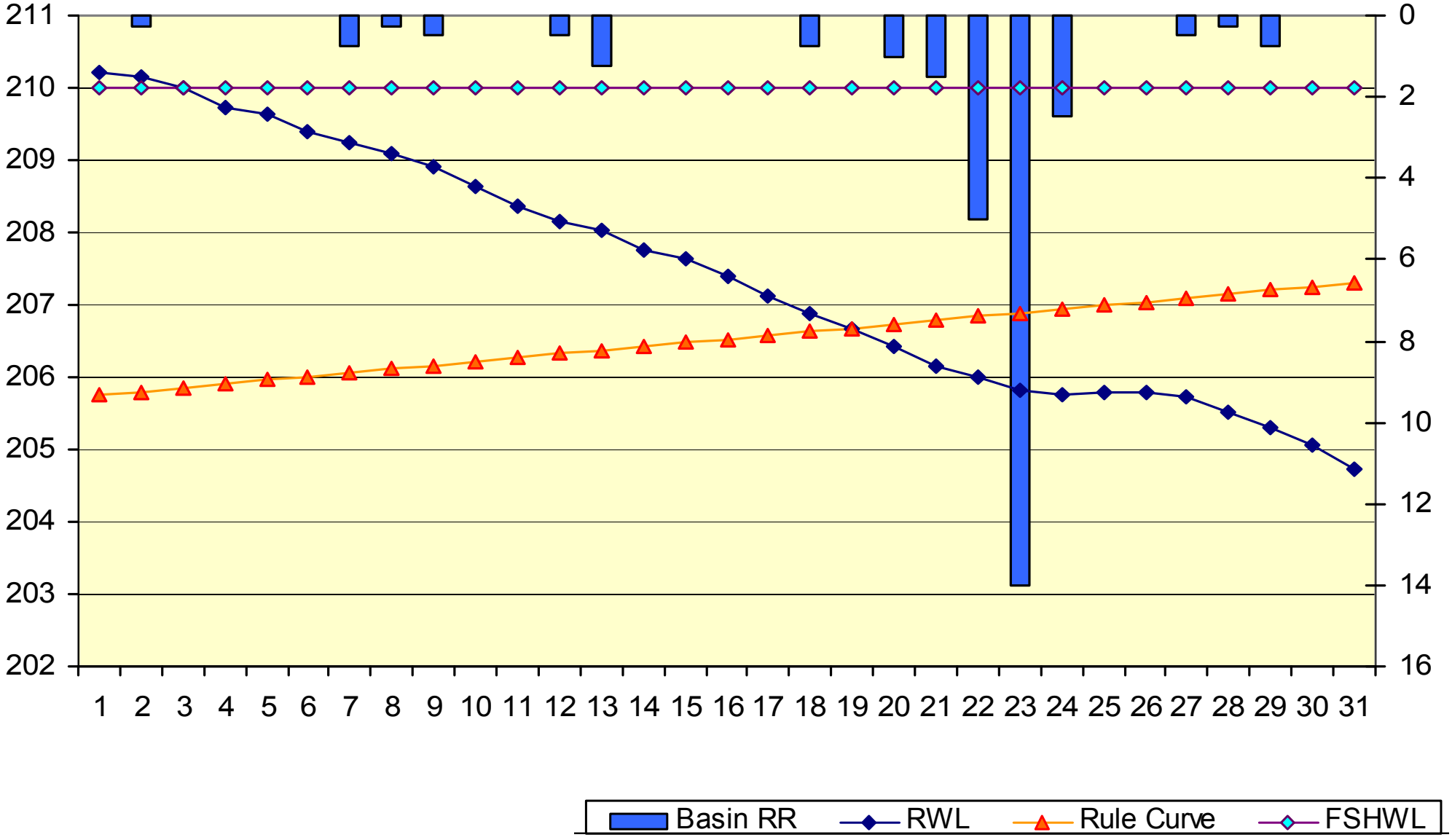






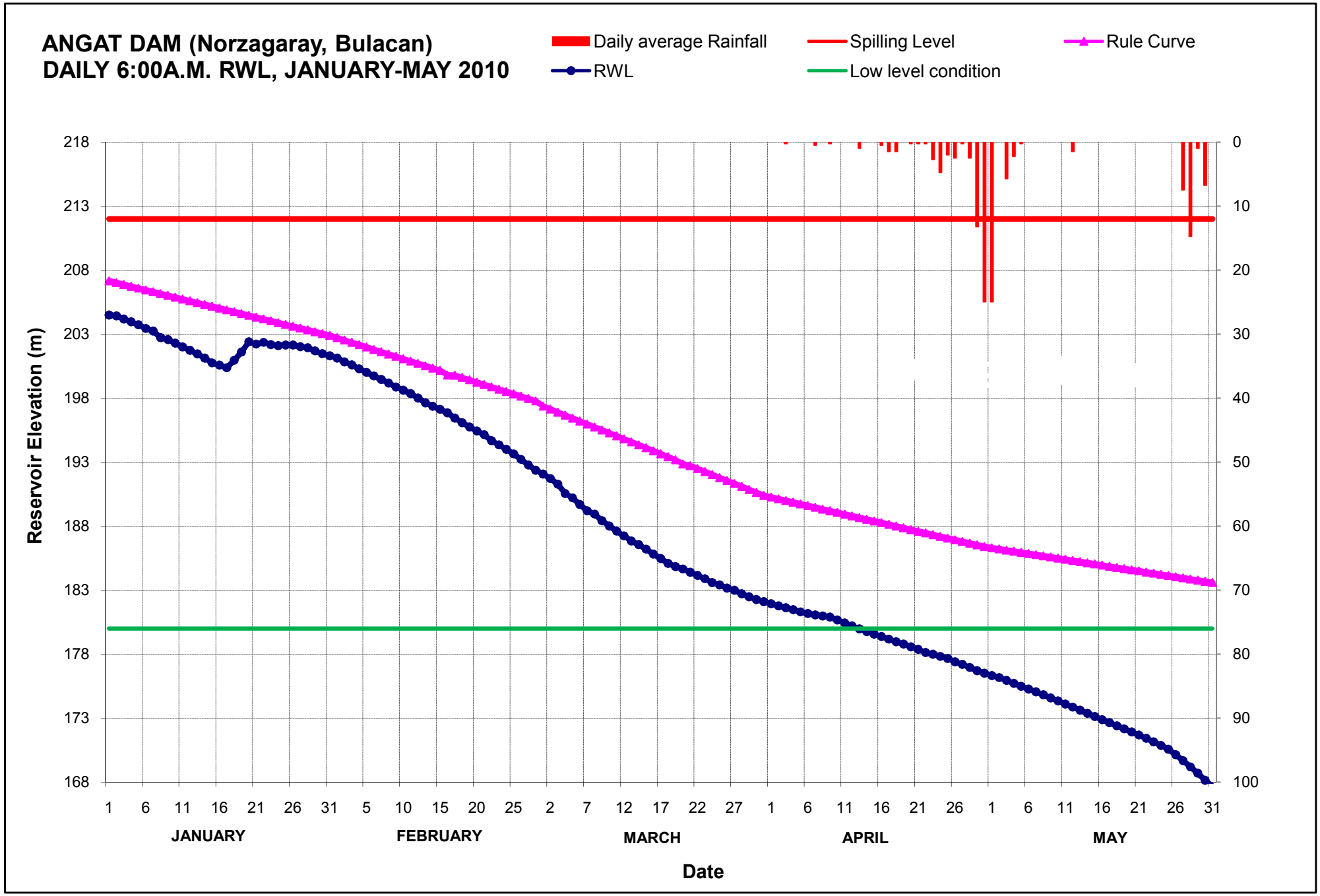
RWL of Angat Dam from October 2009 to February 2010

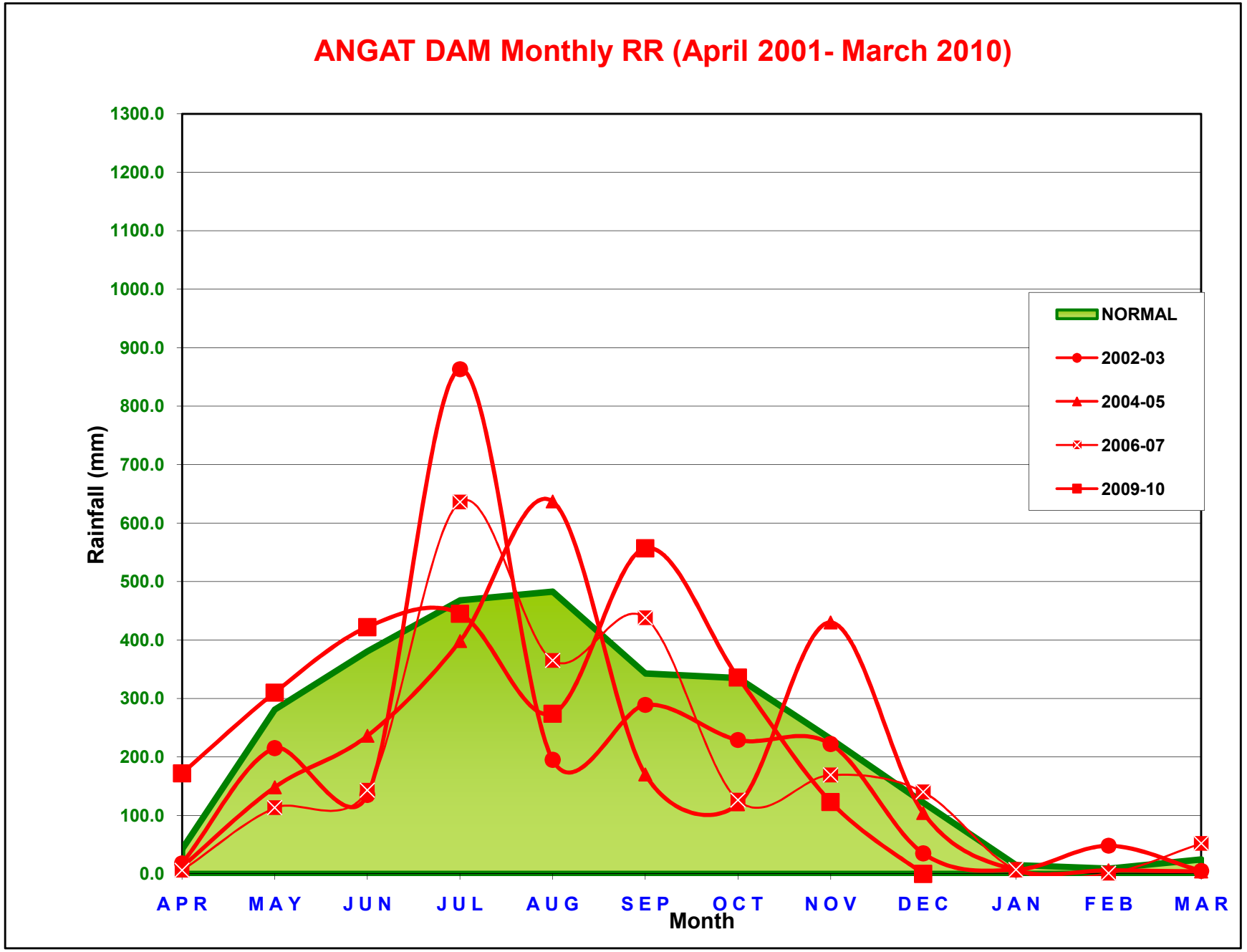
Angat Dam
December 2009



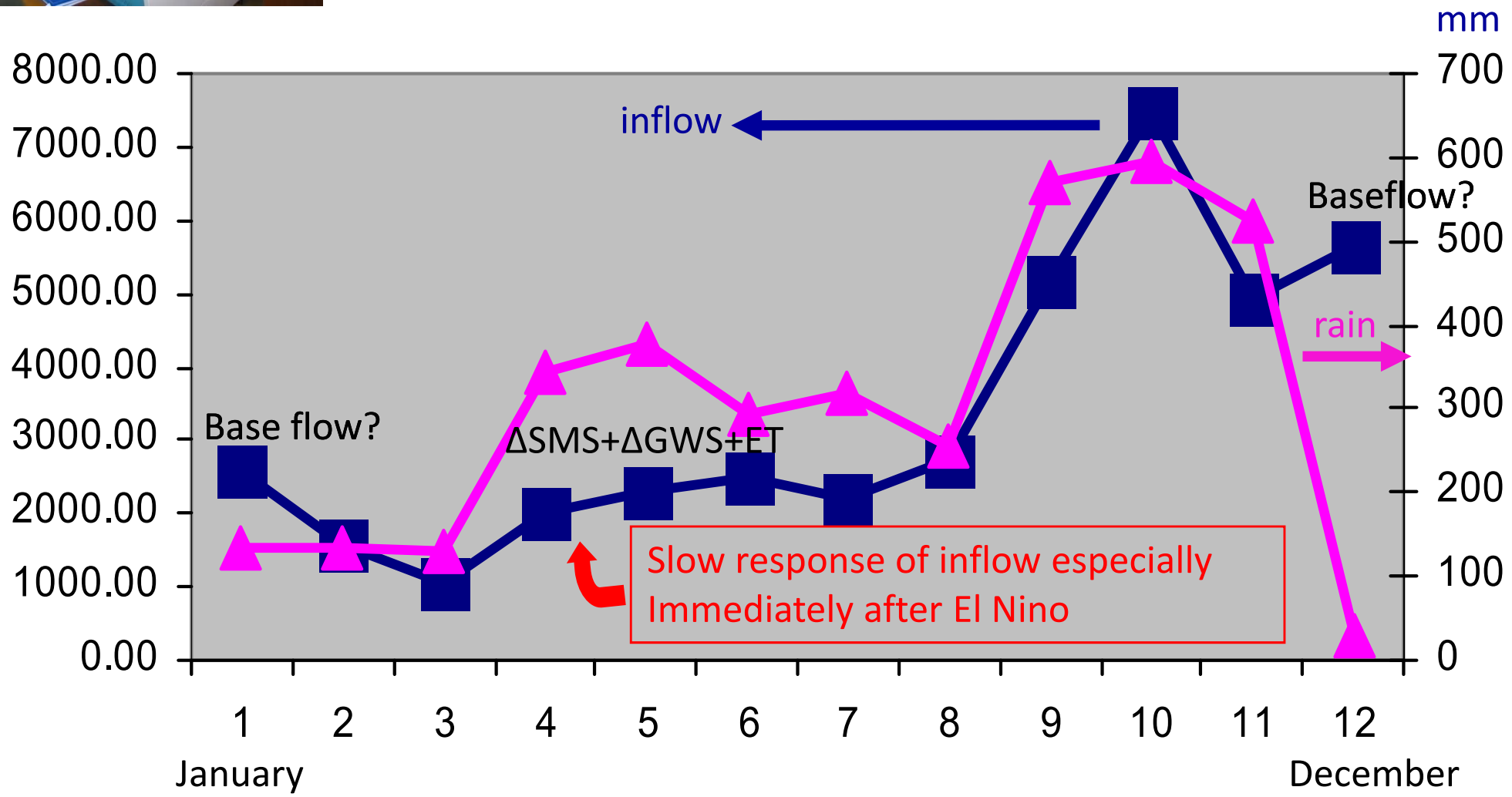
STATUS OF MAJOR MULTI-PURPOSE DAMS IN LUZON-PHILIPPINES
05 March 2010, 0600H

Dam	Reservoir Water Level (masl)	Rule Curve (Normal WL)	Deviation from Normal WL	Rem
Angat	190.21	196.44	-6.23	⇓
Pantabangan	201.58	207.45	-5.87	⇓
Ambuklao	740.28	752.00	-11.72	⇓
Binga	560.40	574.00	-13.60	⇓
San Roque	246.32	249.06	-2.74	⇓
Magat	155.39	182.78	-27.37	⇓

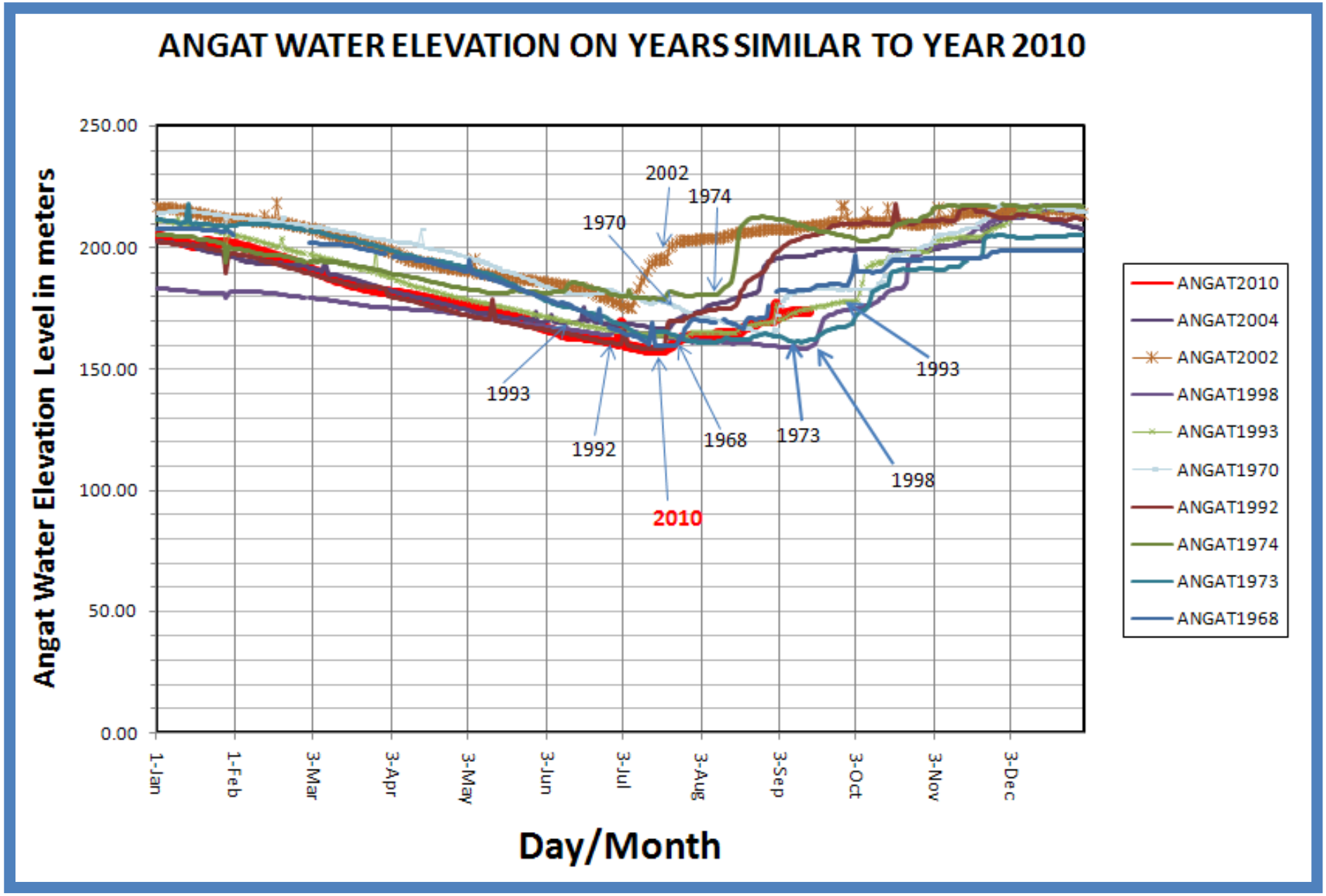

ANGAT DAM (Norzagaray, Bulacan)
DAILY 6:00A.M. RWL, JANUARY-MAY 2010
Daily average Rainfall
Spilling Level
Rule Curve
RWL
Low level condition
Reservoir Elevation (m)
218
213
208
203
198
193
188
183
178
173
168
0
10
20
30
40
50
60
70
80
90
100
1 6 11 16 21 26 31 5 10 15 20 25 2 7 12 17 22 27 1 6 11 16 21 26 1 6 11 16 21 26 31
JANUARY
FEBRUARY
MARCH
APRIL
MAY
Date


ANGAT DAM Monthly RR (April 2001- March 2010)
1300.0
1200.0
1100.0
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
Rainfall (mm)
NORMAL
2002-03
2004-05
2006-07
2009-10
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
Month

Annual Water Balance Angat (2009)



$$P = ET + RO + GWR + \Delta SMS + \Delta SWS + \Delta GWS$$

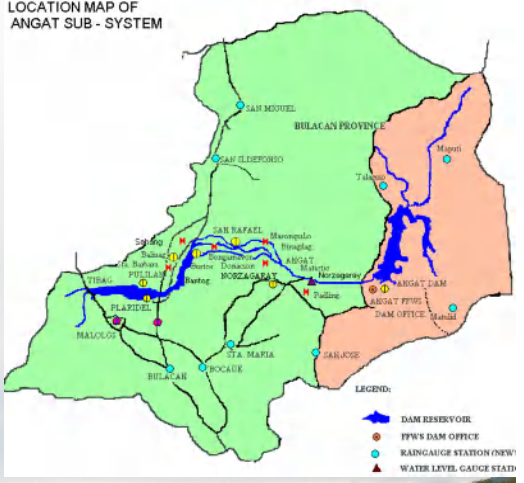

ANGAT WATER ELEVATION ON YEARS SIMILAR TO YEAR 2010
Angat Water Elevation Level in meters
250.00
200.00
150.00
100.00
50.00
0.00
1-Jan
1-Feb
3-Mar
3-Apr
3-May
3-Jun
3-Jul
3-Aug
3-Sep
3-Oct
3-Nov
3-Dec
Day/Month
2002
1974
1970
1993
1992
1968
1973
1998
2010
1993
ANGAT2010
ANGAT2004
ANGAT2002
ANGAT1998
ANGAT1993
ANGAT1970
ANGAT1992
ANGAT1974
ANGAT1973
ANGAT1968

1997-1998 EL NINO EVENT

Angat Reservoir Normal
Water Level

Angat Reservoir 1998
Water Level

Angat Dam in July 2010



SOME IMPACTS OF THE EL NINO PHENOMENON ON ANGAT DAM

- **During the 1997-98 El Nino there was a reduction of water supply to Metro Manila (from Angat dam) from 37 cms to 22 cms resulting to water rationing as the available water was reduced to 4 hours per day. About 30% of the population of Metro Manila who have no access to water coming from MWSS relied on private operators which offered water at a higher cost.**

- **Cloud seeding activities conducted nationwide by the Bureau of Soils and Water Management amounted to about P36.7M during the 1997-98 El Nino;**

- **For the first time since Angat dam was commissioned in 1968, the NWRB Board approved zero allocation for irrigation in the service area of Angat dam starting November 1997 until October 1998;**

- **During the occurrence of an El Nino, the onset of the southwest monsoon is usually delayed for about a month or two;**

- **Annual rainfall trends are either constant or increasing but the inflow trend is decreasing implying that the capacity of the watershed to absorb moisture has significantly decreased due to land use and cover changes.**

- ✓ **For the 1997-98 El Nino, Angat recorded its lowest level of 158.15 m AMSL in September 15, 1998.**

- ✓ **Zero allocation for irrigation from November 1, 1997 to Oct1998.**

- ✓ **During the 2009-10 El Nino event, Angat Dam recorded an elevation lower than that during the 1997-98 El Nino, maybe because of any or all of the following reasons:**

  Increasing ET flux and decreased recharge due to general LULC change?

  A decreasing baseflow because of groundwater drawdown?

  Surface water utilization reducing inflow (agricultural intensification → ET)?

Recommendations

- Improved knowledge on the relationship of the climate and hydrologic variables is crucial in better planning and management of the systems.
- In depth assessment of the lag correlation between rainfall and inflow or streamflow and the indicators of ENSO for forecasting these impacts of these hydroclimate variables;
- Modeling the rainfall-runoff phenomenon to identify or differentiate the factors (climatic or anthropogenic) effecting the changes in the watersheds;
- Identify methodologies to assess potential impacts of Extreme Climate Events through the use of climate information

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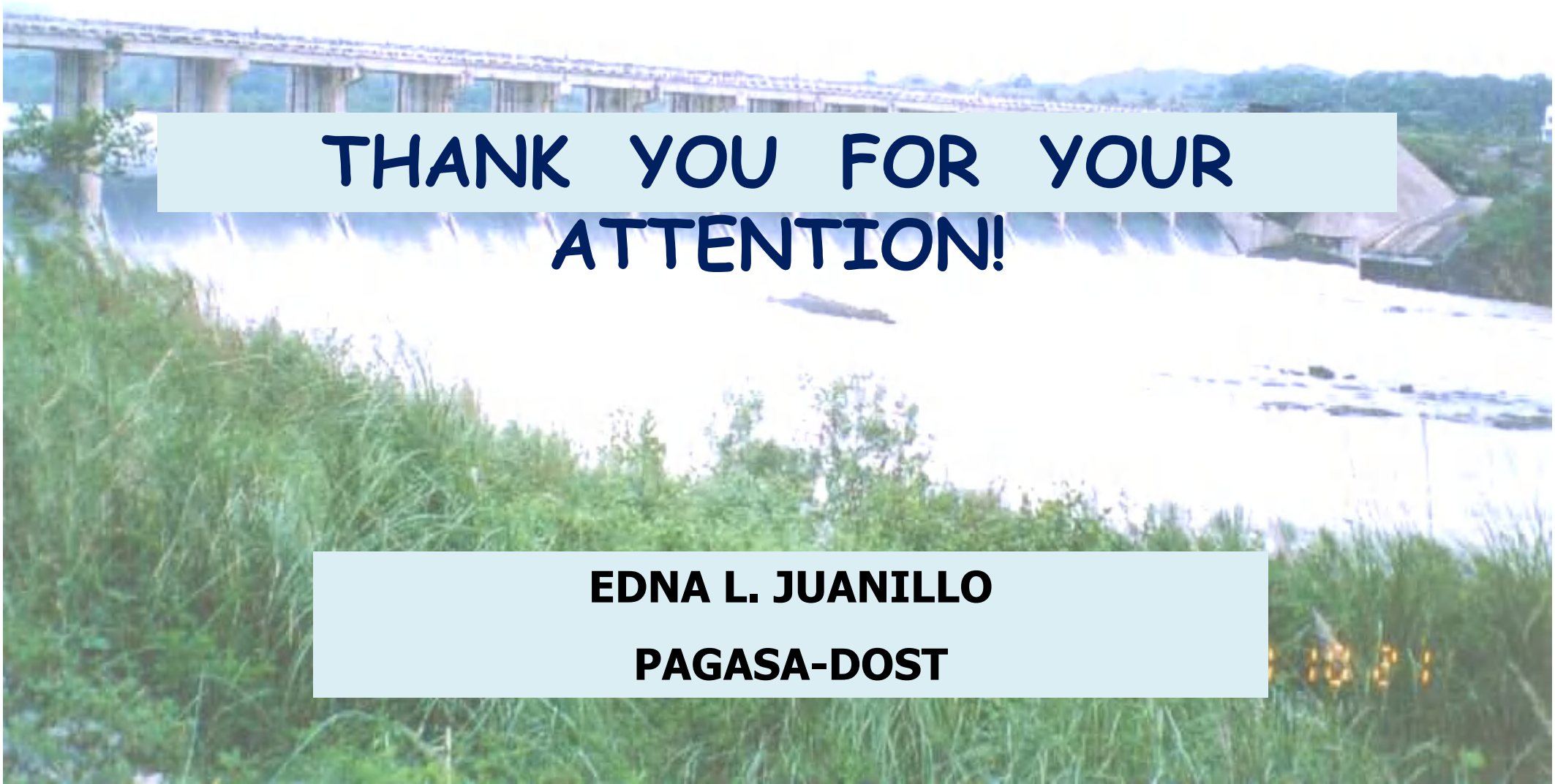

THANK YOU FOR YOUR ATTENTION!

EDNA L. JUANILLO

PAGASA-DOST