Delaware River Basin Commission

The Salt Front

CDRW Forum
October 16, 2019

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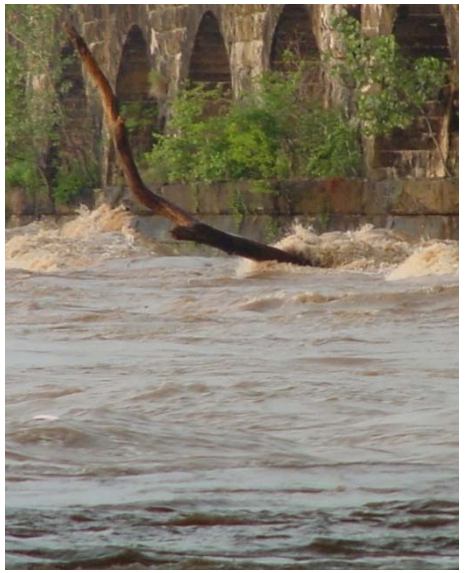
Manager, Water Resource Operations



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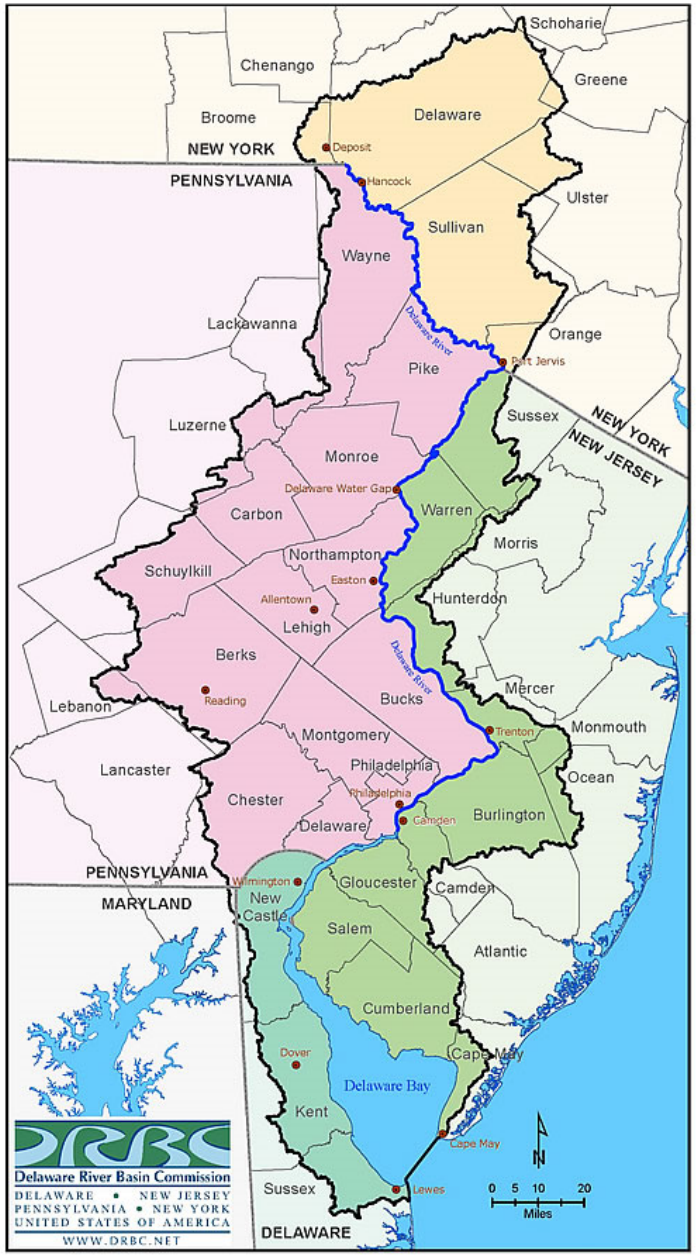

Delaware River Basin

* Length: 330 miles
* Drainage Area: 13,539 square miles
* Interstate boundaries for its entire length (NY-PA, PA-NJ, NJ-DE)
* Water supply for 13 Million people (5 percent of US population)
* Contributes 21 BG in economic value to the region

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Outline

* What is the salt front?
* Why do we care?
* How is it located?
* What is the Vernier?
* How was the Vernier developed?
* How will climate change impact the salt front?

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What is the salt front?

* Defined as the 7-day average 250 mg/l isochlor
* Freshwater-Saltwater interface in the estuary – *where water from the ocean meets water from the river*
* Based on Public Water Supply criteria for taste and consumer preference
* Used for reservoir operations

Management Goal: below River Mile 98

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Why do we care?

* Impacts to Oysters
* Corrosive effects on industrial and municipal facilities located in the estuary
* Effect on the P-R-M aquifer (RM 98)
* Effect on the Torresdale intake of the City of Philadelphia.

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1960s: Delaware River Basin Drought of Record

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Impacts

DRBC Public Hearing, July 7, 1965

* Camden, Philadelphia
* Scott Paper Company (Chester, PA) – 1964 caused the company $500,000 in damages - **$4.1 M in 2019 dollars**
* Atlas Paper Co – Numerous repairs and replayments, alloy failures leading to stress fractures
* Small businesses impacts of a drought emergency harm a $25 M economy **$204 M in 2019 dollars**

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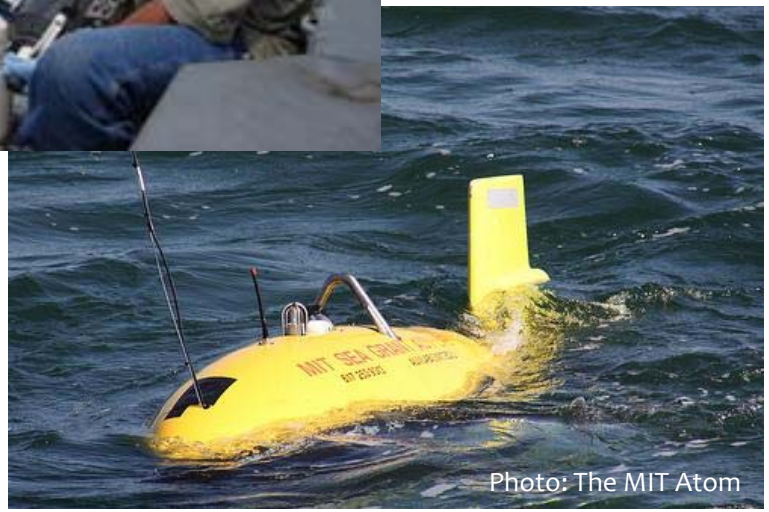
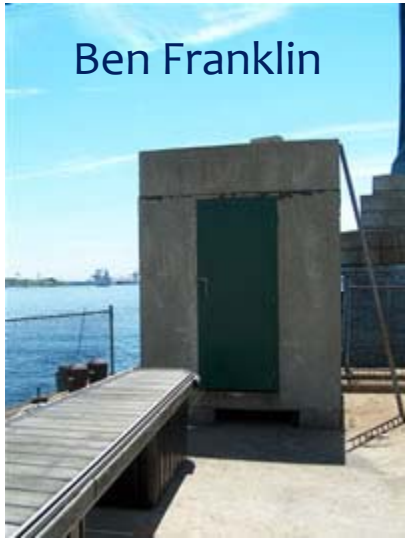
How do we find the salt front?



Not these methods

How is it Calculated?



Photos: USGS

* USGS Gages (Daily average specific conductance)
  * Reedy Island
  * Chester
  * Fort Mifflin
  * Ben Franklin Bridge
* Kimberly Clark (grab from high and low tides)
* USGS Relationship: Specific Conductance => Chlorides
* Logarithmic Interpolation (essentially – nomographs)

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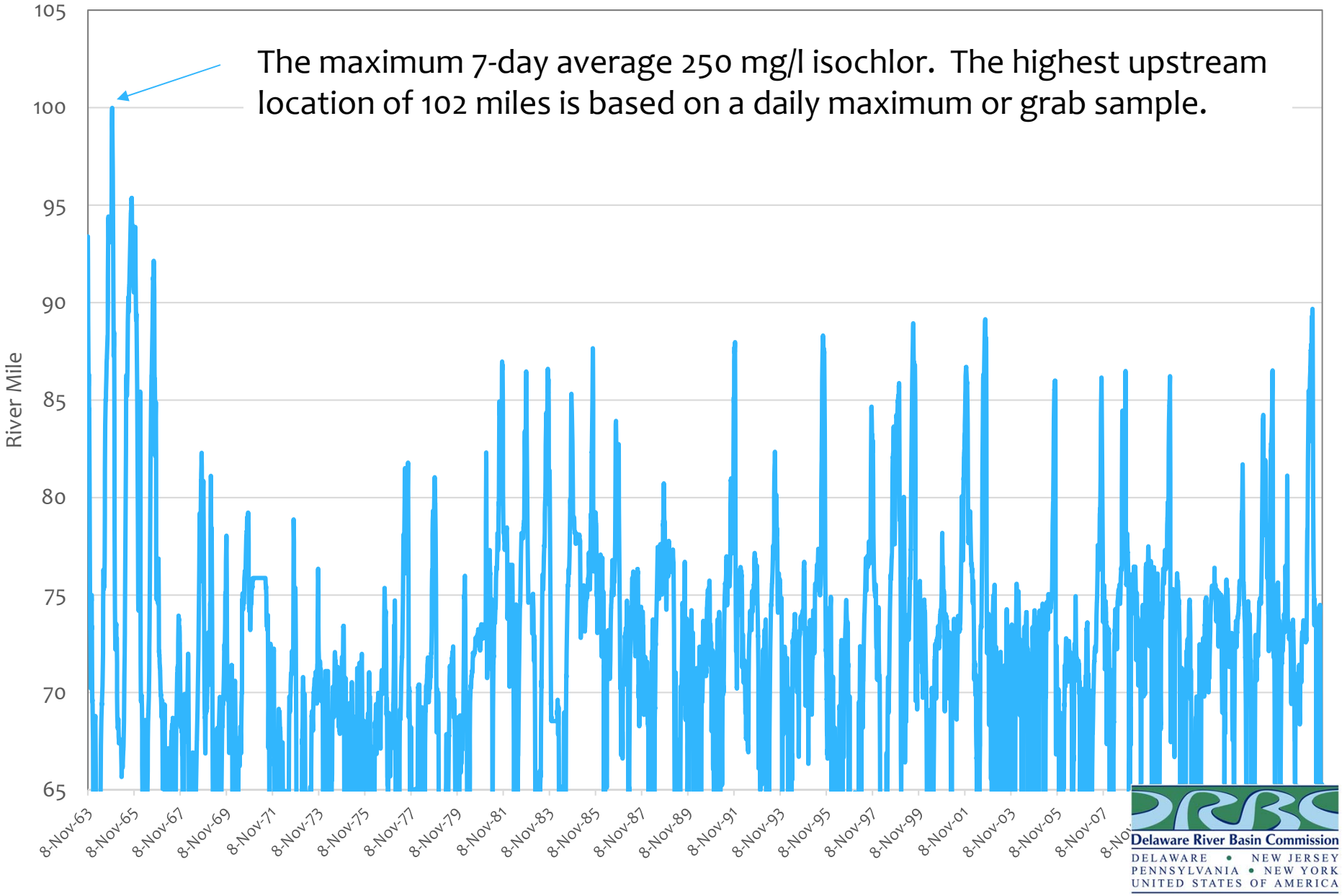
Salt Front River Mile Location 1963 - 2016
7-day average 250 mg/l isochlor



Vernier

* Component of DRBC's Drought Management Plan and Water Code (2.5.3)
* Flow Objectives Based on the Salt Front Location
* Freshwater inflows to the estuary for salinity repulsion
* Good Faith Agreement (Recommendation 3)
* Extensive Modeling – DRBC, Level B (Res. 67-4 Task Force)
* Montague Vernier is **only** in effect during basinwide **drought emergency**

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How does the Vernier Work?

FFMP Figure 1: Basinwide Conditions Defined by NYC Combined Storage

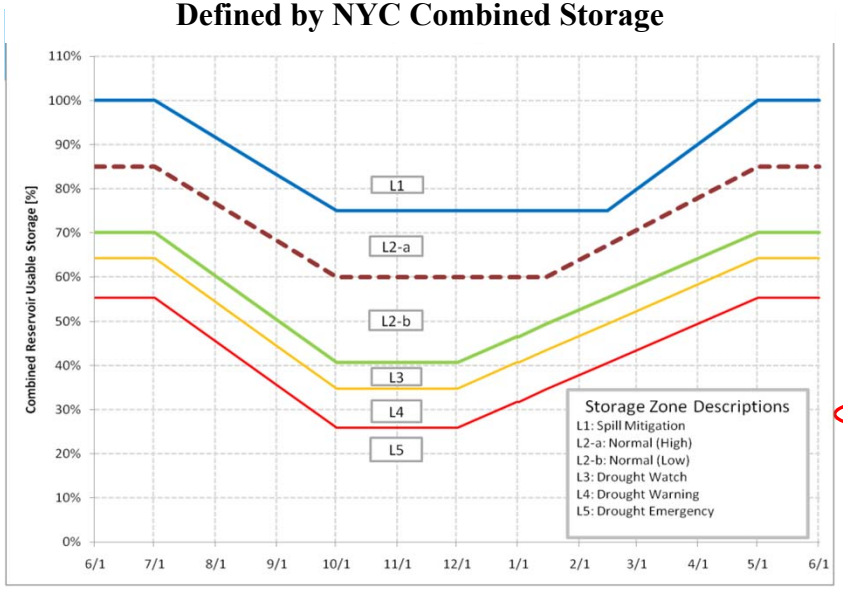

Table 1
Interstate Operation Formula for Diversions and Flow Objectives

NYC Storage Condition	*NYC Diversion (mgd)*	*NJ Diversion (mgd)*	*Montague Flow Objective (cfs)*	*Trenton Flow Objective (cfs)*
Normal (L1, L2)	800	100	1,750	3,000
Drought Watch (L3)	680	100	1,650	2,700
Drought Warning (L4)	560	100	1,550	2,700
Drought Emergency (L5)	520	85	1,100-1,650*	2,500-2,900*
Severe Drought	(to be negotiated depending upon conditions)			

* Varies with time of year and location of salt front, in accordance with Table 2.

Table 2
Interstate Operation Formula for Adjusting Montague and Trenton Flow Objectives during Drought Emergency (L5) Operations

	Flow objective, cubic feet per second at:					
	Montague, NJ			Trenton, NJ***		
7-day average location of Salt Front*, River Mile**	Dec-Apr.	May-Aug.	Sept-Nov.	Dec-Apr.	May-Aug.	Sept-Nov.
Upstream of R.M. 92.5	1,600	1,650	1,650	2,700	2,900	2,900
Between R.M. 87.0 and R.M. 92.5	1,350	1,600	1,500	2,700	2,700	2,700
Between R.M. 82.9 and R.M. 87.0	1,350	1,600	1,500	2,500	2,500	2,500
Downstream of R.M. 82.9	1,100	1,100	1,100	2,500	2,500	2,500

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Triggers

RM 92.5
Mouth of Schuylkill

RM 87
Little Tinicum Island

RM 82.9
Mouth of Chester Creek

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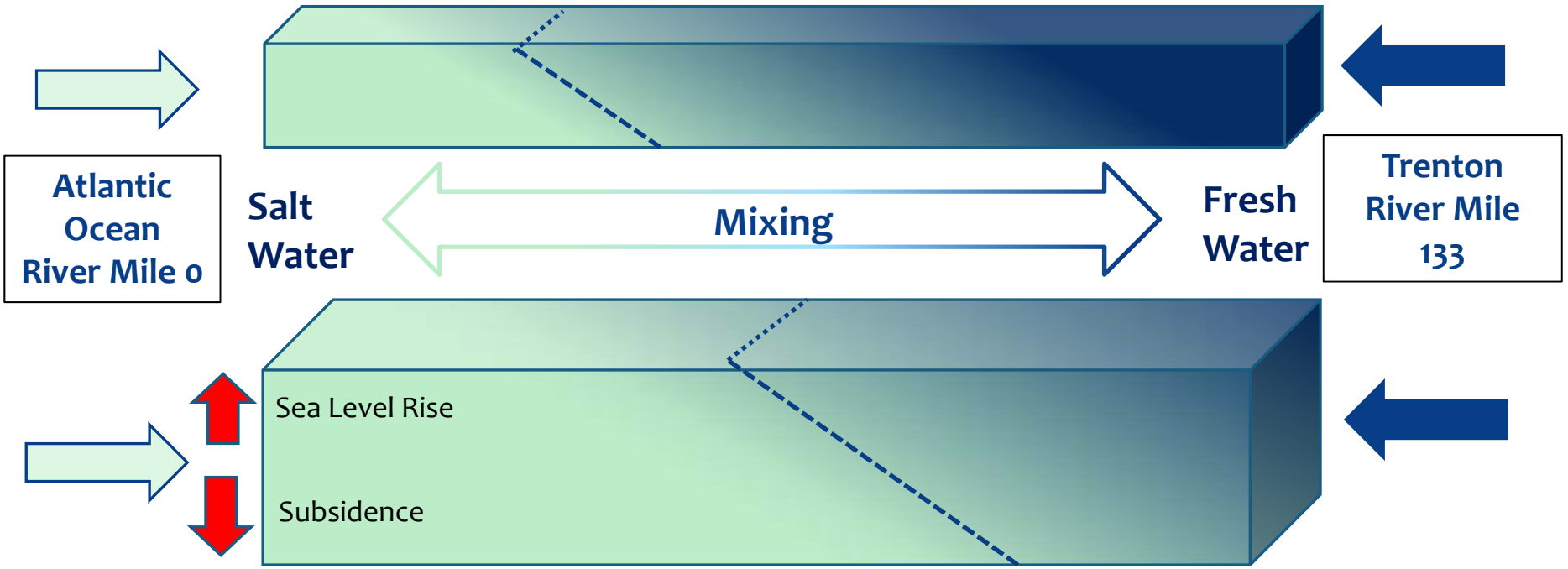
Sea Level Rise



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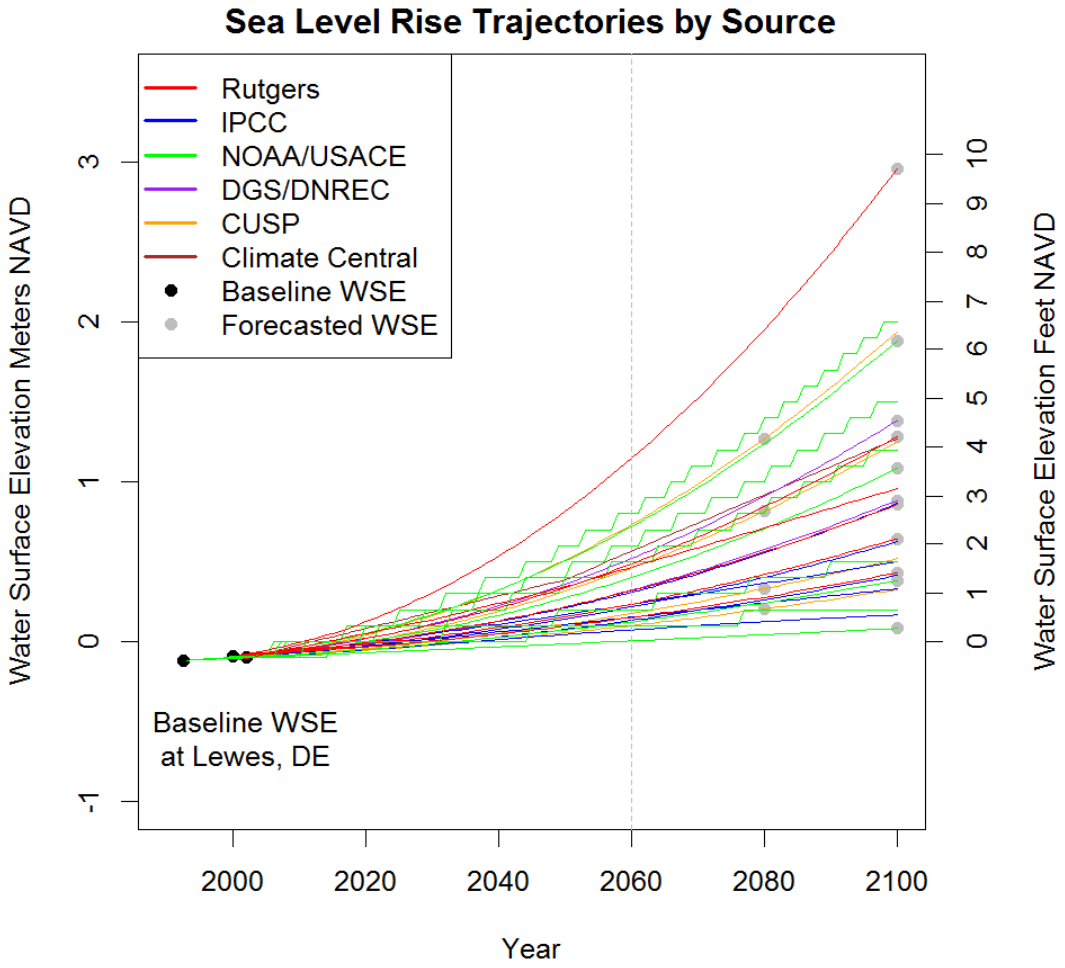
SLR Projections



Regional Projection Sources:

- Rutgers University
- Delaware GS and DNREC
- NOAA
- US Army Corps of Engineers
- Climate and Urban Systems Partnership (CUSP)
- Climate Central

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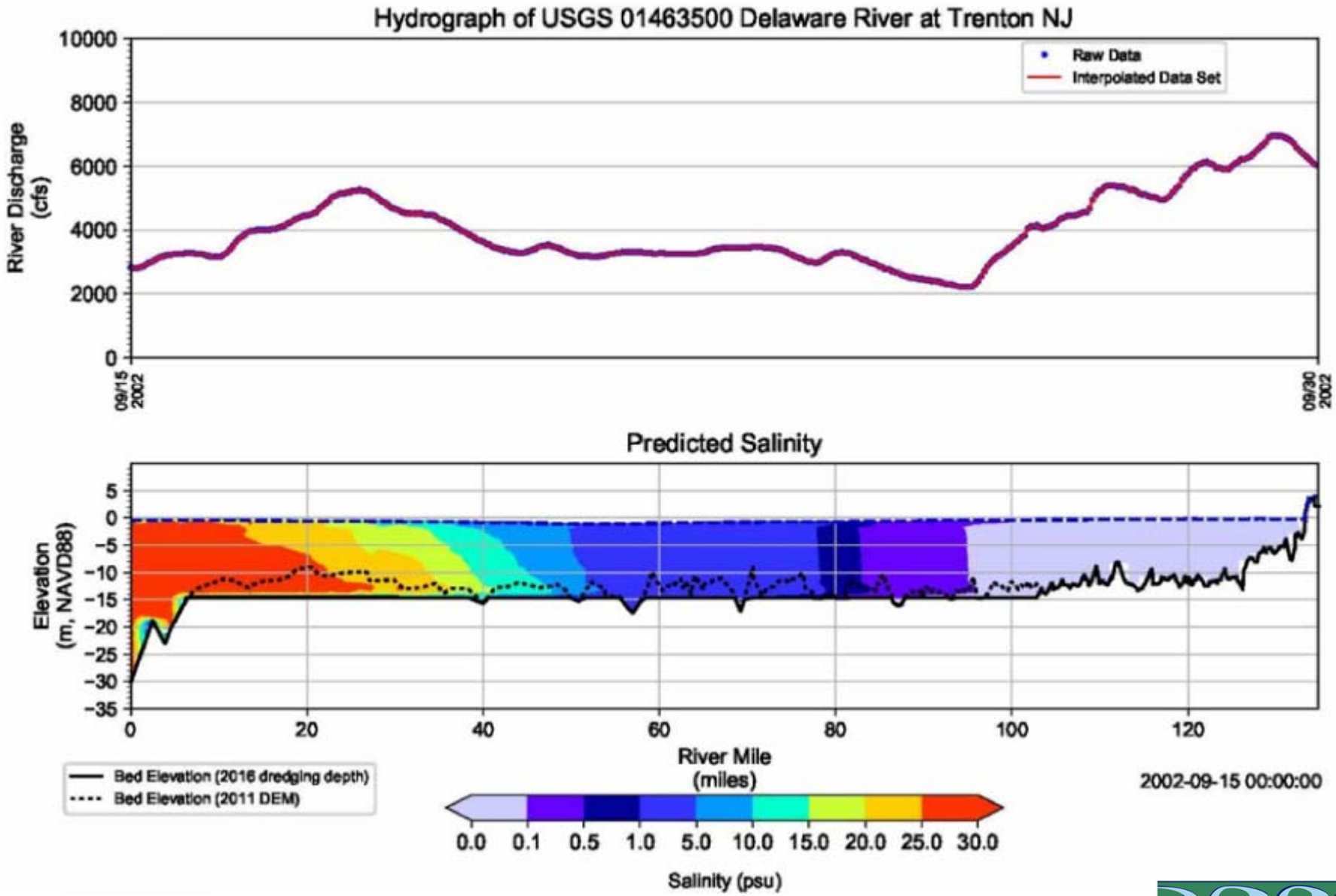

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Sea Level Rise

* June 2010 Report: Application of the Delaware Bay and River 3D Hydrodynamic Model to Assess the Impact of Sea Level Rise on Salinity (USACE)
  * Two Channel Depths (40 and 45 feet)
  * Rises of 1, 2 and 3 feet*
  * Conclusions: SLR has a greater impact on salinity than channel deepening
* **Preliminary results from the 3D EFDC model show similar intrusions**

* NOTE: Current indications are that Sea Level Rise may be 7 feet.
(NOAA SLR Viewer, Beta 3)

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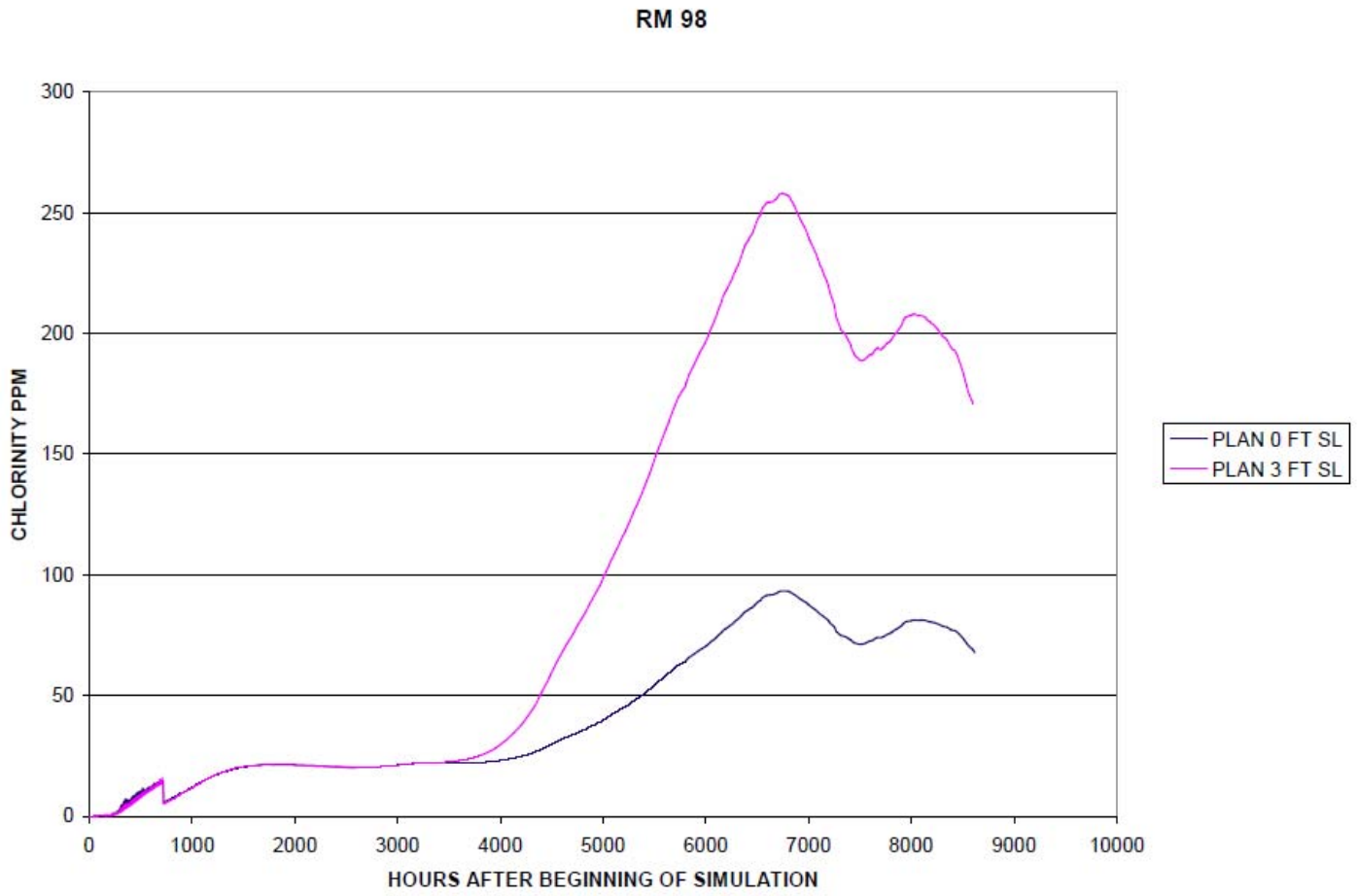
Figure 12. CH3D-Z Prediction of Chlorinity with Three (3) Foot of Sea Level Rise



a. Plan and 3 ft SL rise

Graphic represents a comparison of simulation results at River Mile 98 with Regulated 1965 Flows (from modeling) and the planned 45-foot channel dredging. Blue – no sea level rise; Pink - 3 foot of Sea Level Rise.

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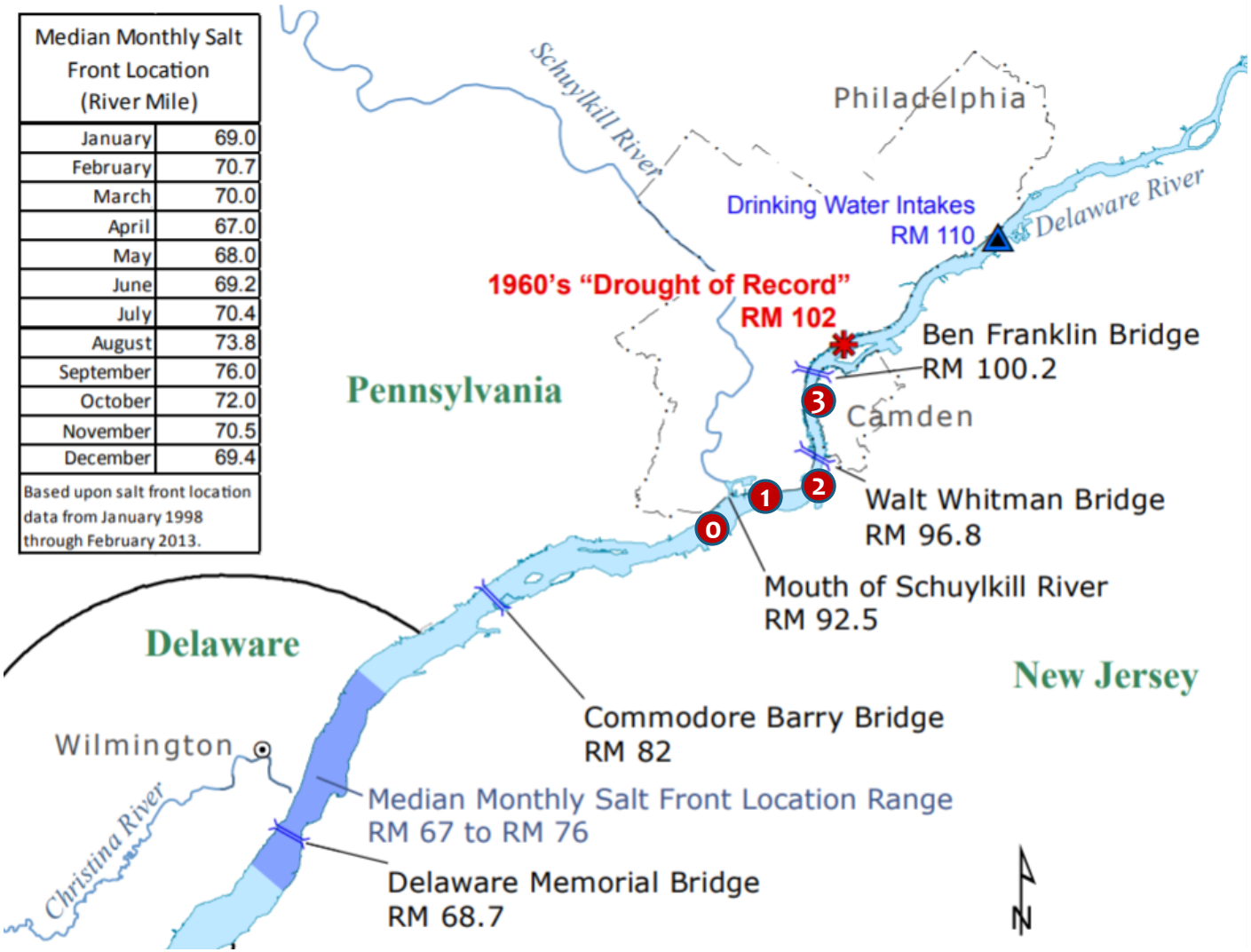
Sea Level Rise and Salt Front River Mile for a Repeat of the 1960s Drought

Median Monthly Salt Front Location (River Mile)	
January	69.0
February	70.7
March	70.0
April	67.0
May	68.0
June	69.2
July	70.4
August	73.8
September	76.0
October	72.0
November	70.5
December	69.4

Based upon salt front location data from January 1998 through February 2013.



Rise	RM
0	90
1	93
2	95
3	98

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Summary

* Salt Front is the 250 mg/l isochlor
* Salinity/Chlorinity affects drinking water treatment, industry – multi-millions/billions of dollars
* Montague and Trenton flow objectives were established to ensure freshwater flows into the estuary
* Sea-Level rise will impact estuary salinity
* Tools are available or becoming available to address salinity/ chlorides under different flow objective and SLR scenarios

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