Meeting of Model Expert Panel with DRBC Staff

Report to the Water Quality Advisory Committee

Delaware River Basin Commission

March 1, 2018

Delaware River Basin Commission
DELAWARE • NEW JERSEY
PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA

Goal

- Develop a technically sound eutrophication model for the Delaware Estuary and Bay utilizing the current state of the science within a timeframe established by the Commission
  - Identify appropriate levels of source controls, especially in relation to dissolved oxygen

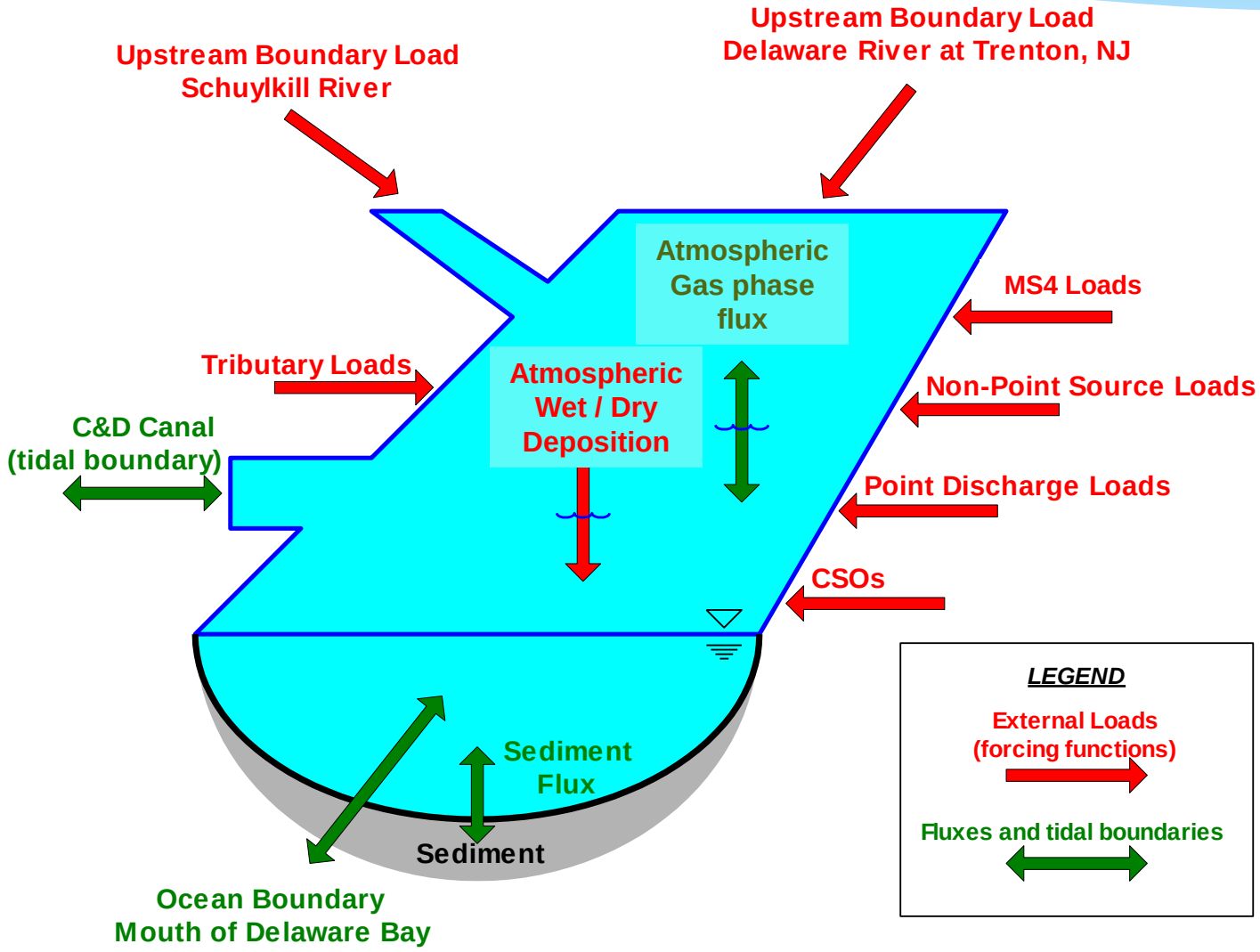
Approach

- Develop a linked hydrodynamic and water quality model
- Assess available data and conduct additional monitoring to fill gaps
  - Sources
  - Ambient water
- Calibrate linked model
  - Historical data
  - Intensive monitoring period 2018-2019
- Conduct forecast simulations with calibrated model
  - Determine levels of external sources required to achieve varying levels of ambient dissolved oxygen

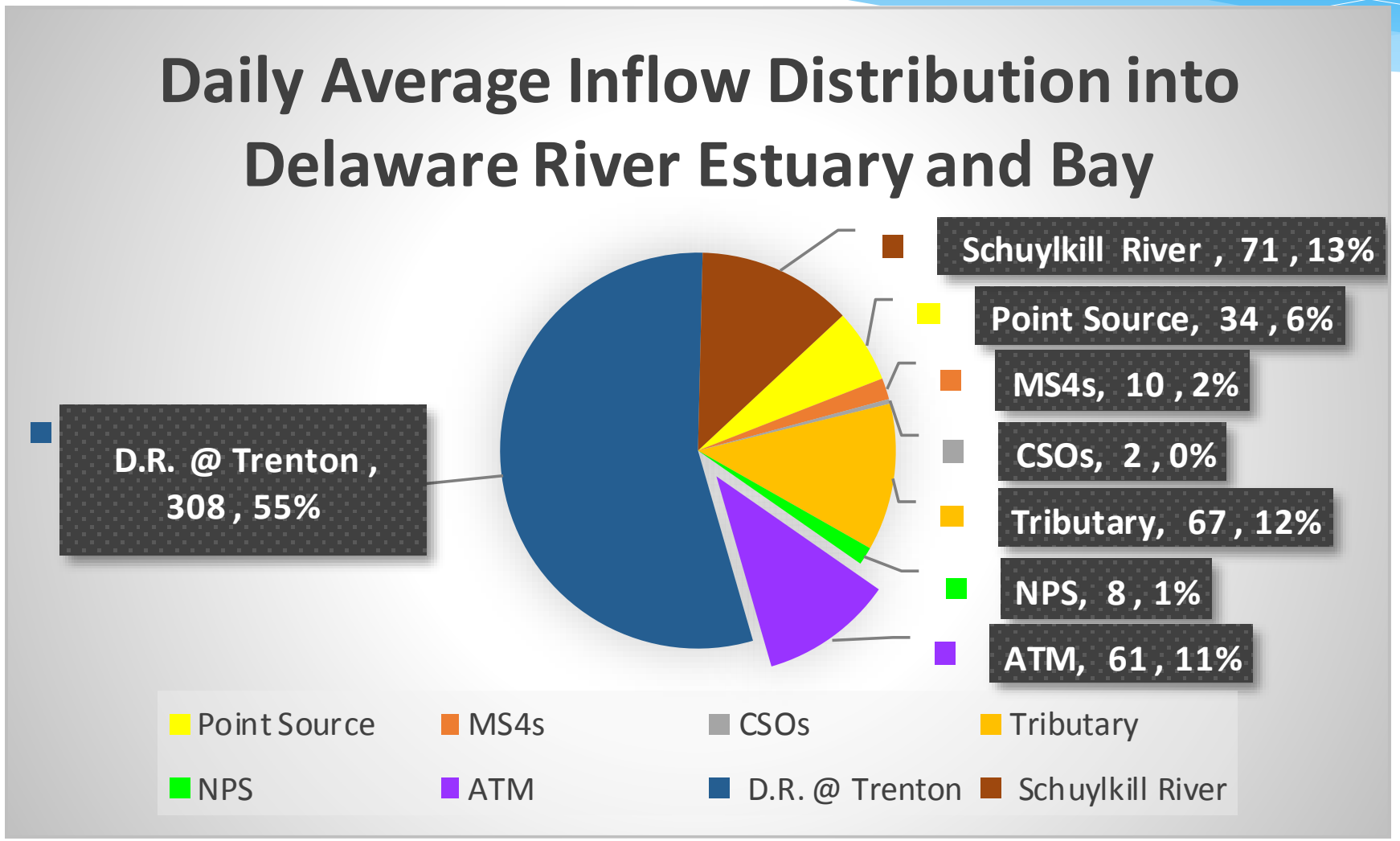
Linked Model

- Hydrodynamic Model: Environmental Fluid Dynamics Code (EFDC)
  - Screening scale level (coarse grid)
  - Full scale level (finer grid)
- Water Quality Model: Water Quality Analysis Simulation Program (WASP8)
- Both models supported by US EPA and widely used

Principal Mass Loadings and Fluxes



Inflow Distribution



In m^3/sec

Total Daily Average Inflow of 561 m^3/sec

Based on flows from February 1, 2002 to January 31, 2003 (from PCB TMDL work)

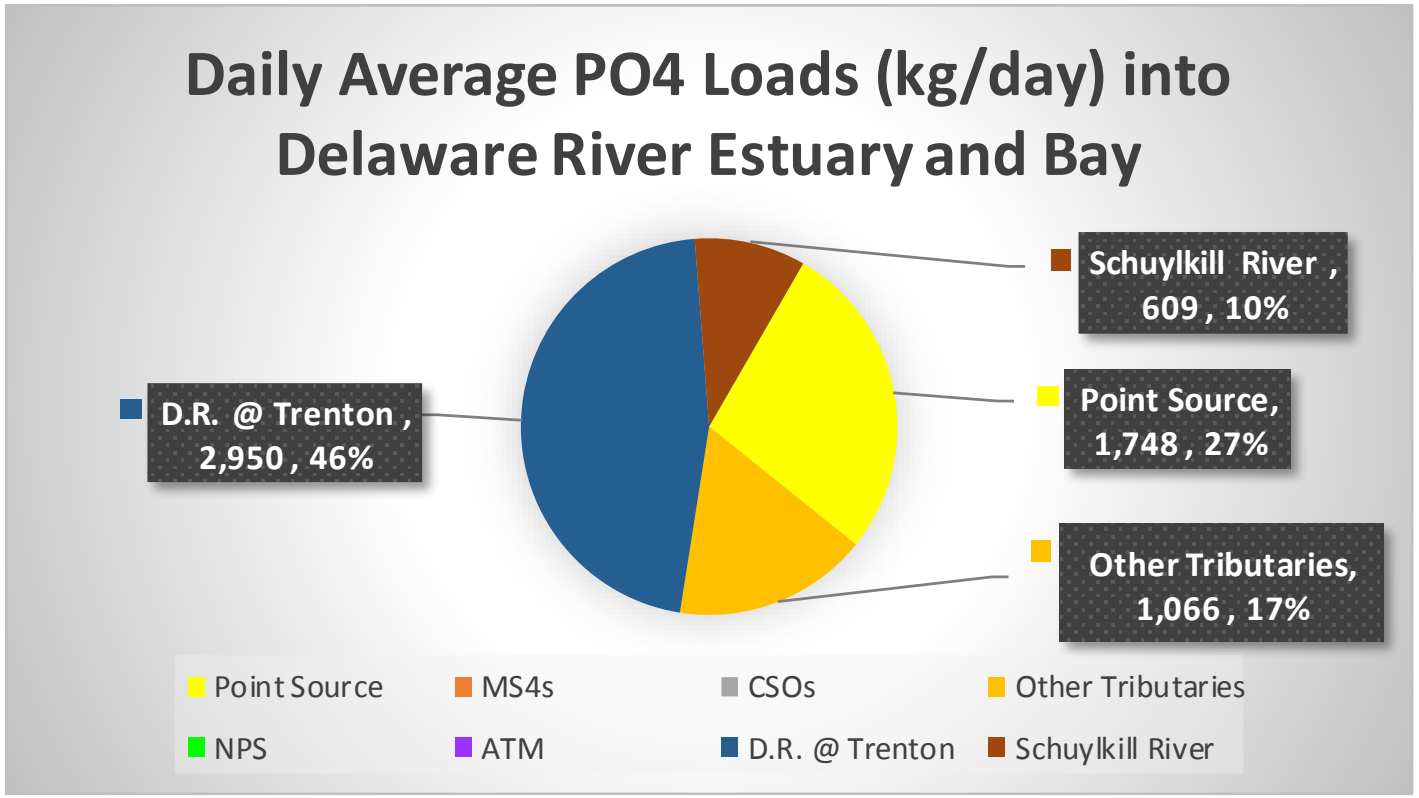
Estimation of Daily Nutrient Load for 2012 - 2013

- Based on monitored data: ~71 point sources
- Based on the approach used in the PWD modeling work
  - Delaware River at Trenton
  - Schuylkill River
  - 24 other tributaries
- PO4, NO23-N, NH3-N, NBOD and CBOD
- No estimations for CSOs, MS4s, direct NPS runoffs, atmospheric deposition, and open boundaries

Approach used in PWD modeling work:

- Set concentrations for 3 seasons, spring, summer and winter from data 1990-2013
- For each season, set concentrations for high and low flow conditions setting the deflection point from cumulative flow distribution curve of each season as a threshold flow – set at 80th percentile flow in this evaluation

PO4-P Load Estimation (2012 – 2013)



Total of 6,373kg/day of PO4-P

WWTP Monitoring for 2018-2019

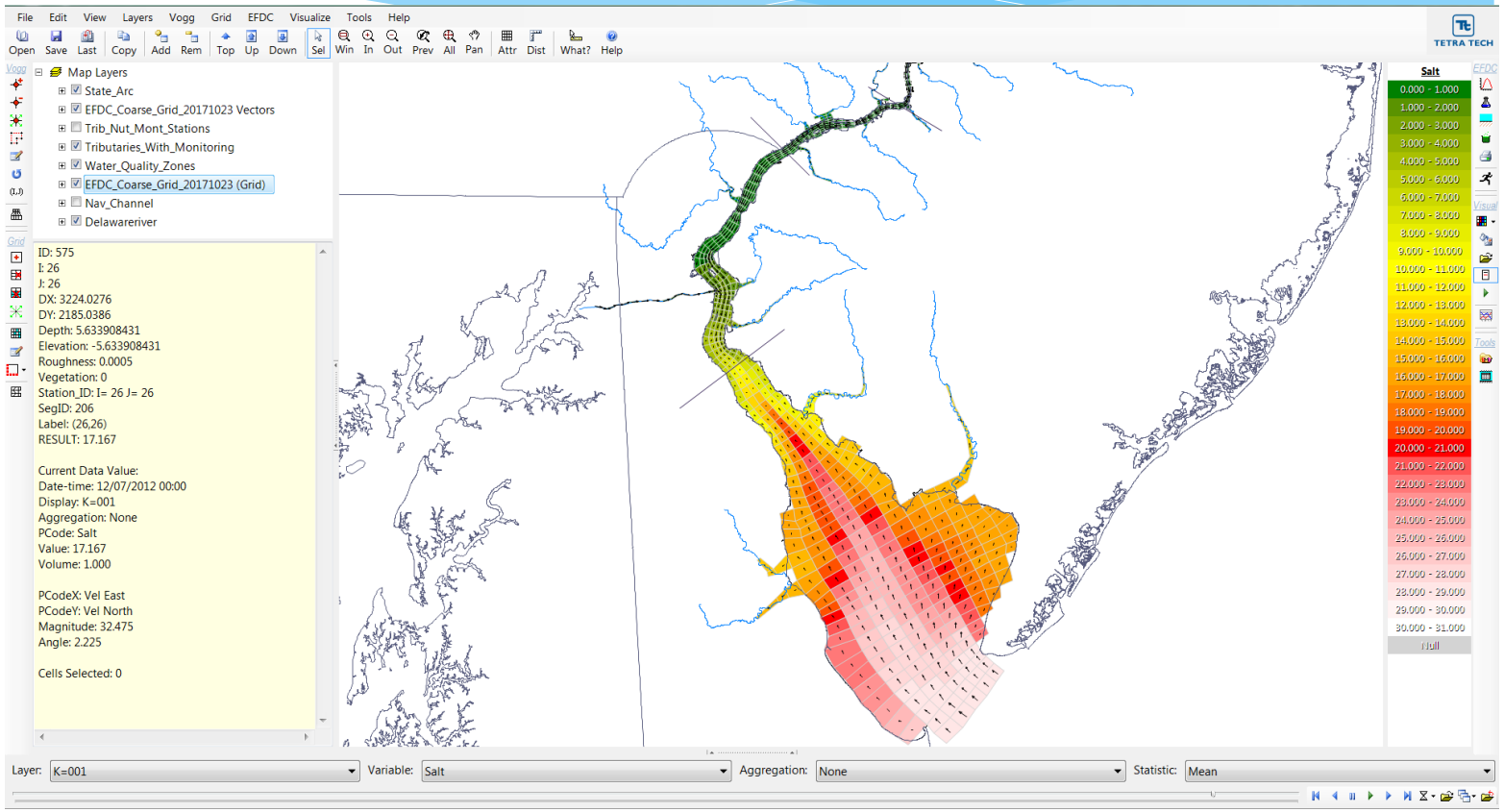
- Expert panel endorsed additional monitoring for WWTP
  - Implementation plan for 2018-2019
- Parameters
  - Phosphorus: Total Phosphorus, Soluble Reactive Phosphorus (SRP)
  - Nitrogen: Ammonia, NO3, NO2, TKN, SKN
  - BOD5, CBOD5, CBOD20 (standard and modified methods), COD, TOC
  - Temperature, D.O., Conductivity, pH
  - Discharge flow (Q) – hourly where available, daily otherwise

Ambient Monitoring for 2018-2019

- Boat Run to year round
- Nitrate Spectral analyzers at Trenton (deployed January 2018) and Chester (to be deployed April 2018)
- Tributary monitoring at 25 stations 8 times per year
- Delaware at Trenton and Schuylkill at Philadelphia twice per month
- Primary productivity in upper estuary 2018
- Light extinction parameters in 2018

Progress to Date
Hydrodynamic Model - EFDC

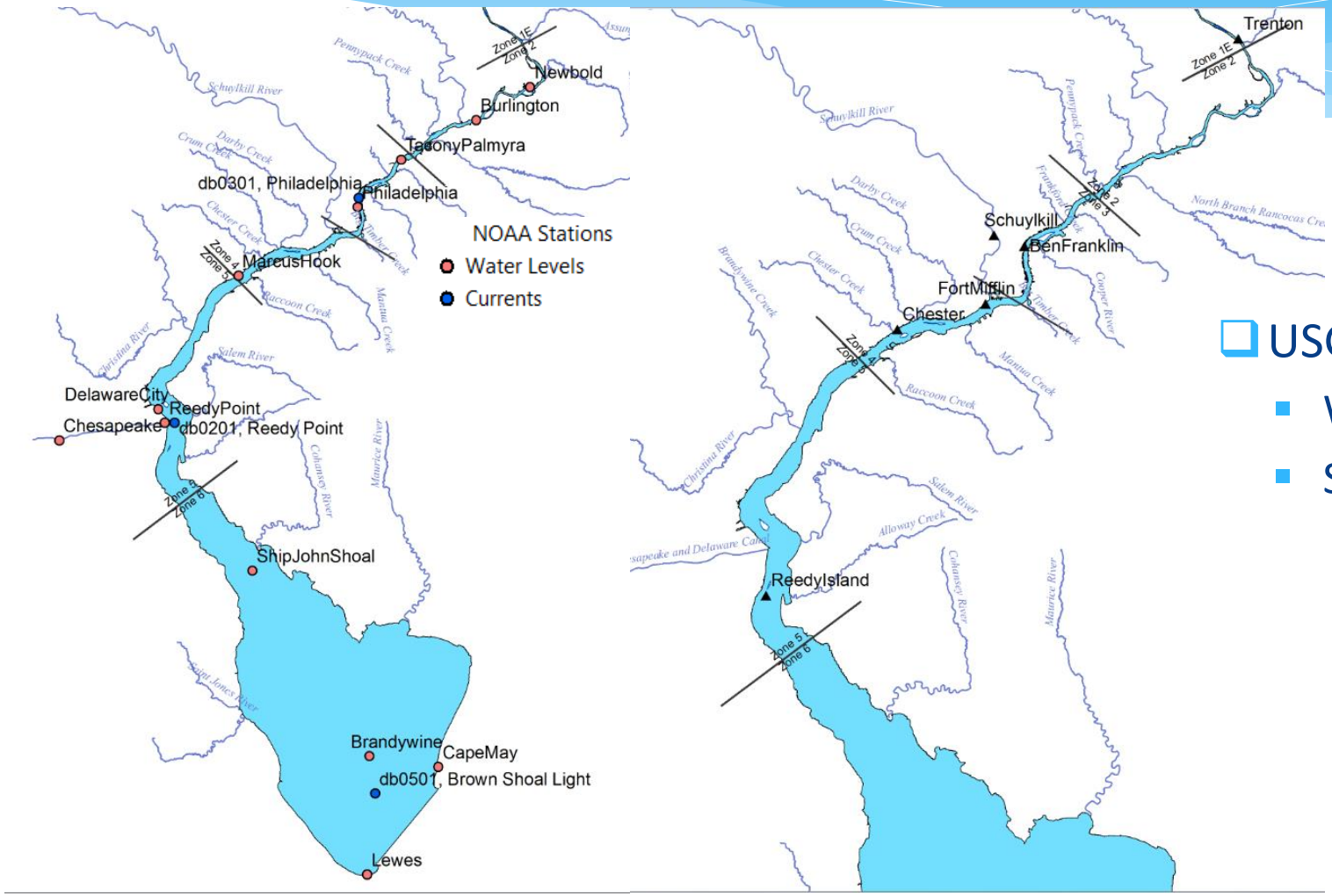
- Environmental Fluid Dynamics Code (EFDC)
  - Applied to a wide range of environmental studies
  - Build-in linkage with WASP8



Model Calibration (2012 ~ 2013)

Data and approach

- NOAA stations:
  - Tidal levels: 9
  - Currents: 3
  - Water temp.: 9
  - Salinity: 2



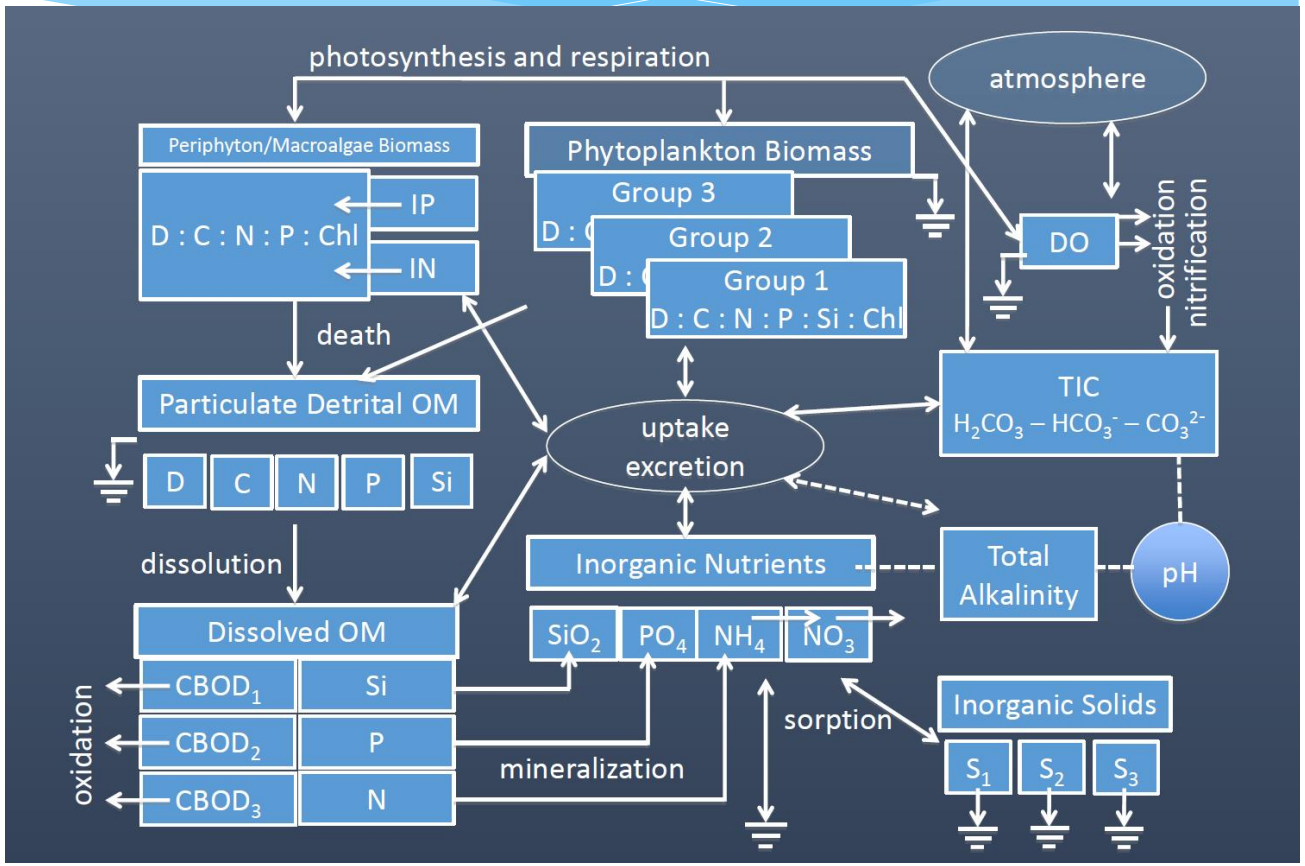
- USGS stations:
  - Water temp.: 3
  - Salinity: 3

Model Calibration (2012 ~ 2013)
Preliminary Results

- Water surface elevations and current velocities
  - General agreement with observed data
  - Under-prediction in some areas
- Water temperature
  - Better shape, but under-prediction during winter seasons at a few stations
- Salinity
  - Not calibrated yet

Progress to Date
Water Quality Model – WASP8

- Eutrophication Process
  - 5 phytoplankton classes
  - 3 Periphyton/Macroalgae (benthic algae)
  - Nutrient cycling – N, P, Si
  - 3 CBOD and dissolved oxygen
  - pH and alkalinity
  - Water Temperature



Model Set Up (2012 ~ 2013)
Status

- Computer code operational
- Assessing model state variables and processes
- Investigating specific model configuration for site and study objectives

Path Forward

- Develop a 3-D model as a parallel track to the 2-D model simulation
- Perform sensitivity analyses on salinity computations
- Perform additional sensitivity and diagnostic analyses
- Conduct preliminary analyses with WASP8 model
- Implement recommendations for data collection