

9th Annual Delaware River Watershed Forum

September 29- October 1, 2021

#DelRivForum2021

Photo Credit: Urban Promise



60 years
1961-2021



Delaware River Basin Commission

DELAWARE • NEW JERSEY
PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA

**Restoring Water Quality in the
Main Stem Delaware River:
Programs, Policies, and Strategies**

*The evolution of water quality in
the main stem of the Delaware
River Estuary*

Thank you to our Sponsors!



PSEG



Housekeeping

- This session is being recorded and will be shared.
- Attendees are muted by the host. To indicate that you would like to speak please use the raise hand button in the participants window or use the chat box.
- If you are having technical issues please message the host in the chat box.

Delaware River Basin Commission

Restoring Water Quality in the Main Stem Delaware River: Programs, Policies, and Strategies

*The evolution of water
quality in the main stem of
the Delaware River Estuary*

*Coalition for the Delaware
River Watershed Forum
September 29, 2021*



Photo: Paul Michael Bergeron



Photo: Delaware River Waterfront Corporation



Photo: Partnership for the Delaware Estuary



Delaware River Basin Commission

*Managing, Protecting & Improving the Basin's
Water Resources Since 1961*

■ Five Equal Members:

■ Delaware



■ New Jersey



■ New York



■ Pennsylvania



■ Federal Government



- Federal / Interstate water resource management agency
- Authority provided under federal and state law - the Delaware River Basin Compact
- Four Governors are the Commissioners
- Federal Commissioner is Commanding General, USACE, NAD

Note: New York City and Philadelphia are “advisors” and not members



Water Security for over 13 million people



Focus on Water Quality



Focus on the Delaware River Estuary



Why?

- This portion of the main stem river continues to be the most impacted by pollution sources.
- The primary sources of pollution that impact water quality in the Estuary comes from local area.
- Historically overburdened communities continue to be burdened by some of these WQ issues in the urban portions of the Estuary
- The Basin community needs renewed focus, priority and resources directed at Estuary WQ improvements.

Delaware River Basin Commission Session Objectives

1. Explore the evolution of Water Quality trends in the main stem interstate Delaware River Estuary using data from key water quality parameters and indicators.
2. Identify key historic, current and future pollution threats in the Delaware River Estuary.
3. Outline DRBC water quality improvement programs and strategies in the Delaware River Estuary.
4. Accept your input and provide answers to your questions.

Delaware River Basin Commission Session Outline

- ***Introductions:*** Steve Tambini, Executive Director
- ***Estuary Water Quality Data, Indicators and Trends:***
 - Sarah Beganskas, Ph.D., Water Resource Scientist
 - Jacob Bransky, Aquatic Biologist
- ***Strategies for Successful WQ Improvements:***
 - John Yagecic, Manager Water Quality Assessment
- ***Questions and Discussion:*** S. Tambini

Delaware River Basin Commission

Water Quality Trends in the Delaware River Estuary

Coalition for the Delaware River Watershed Forum

September 29, 2021

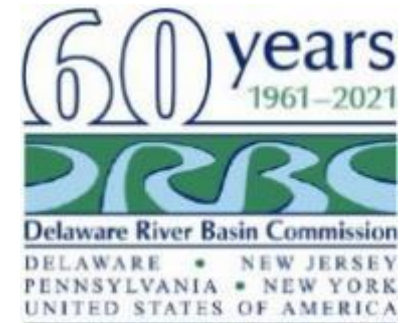
Sarah Beganskas, PhD
Water Resource Scientist, DRBC



Photo: 13383826 © Hughstoneian | Dreamstime.com



Photo: Greg Breese, USFWS

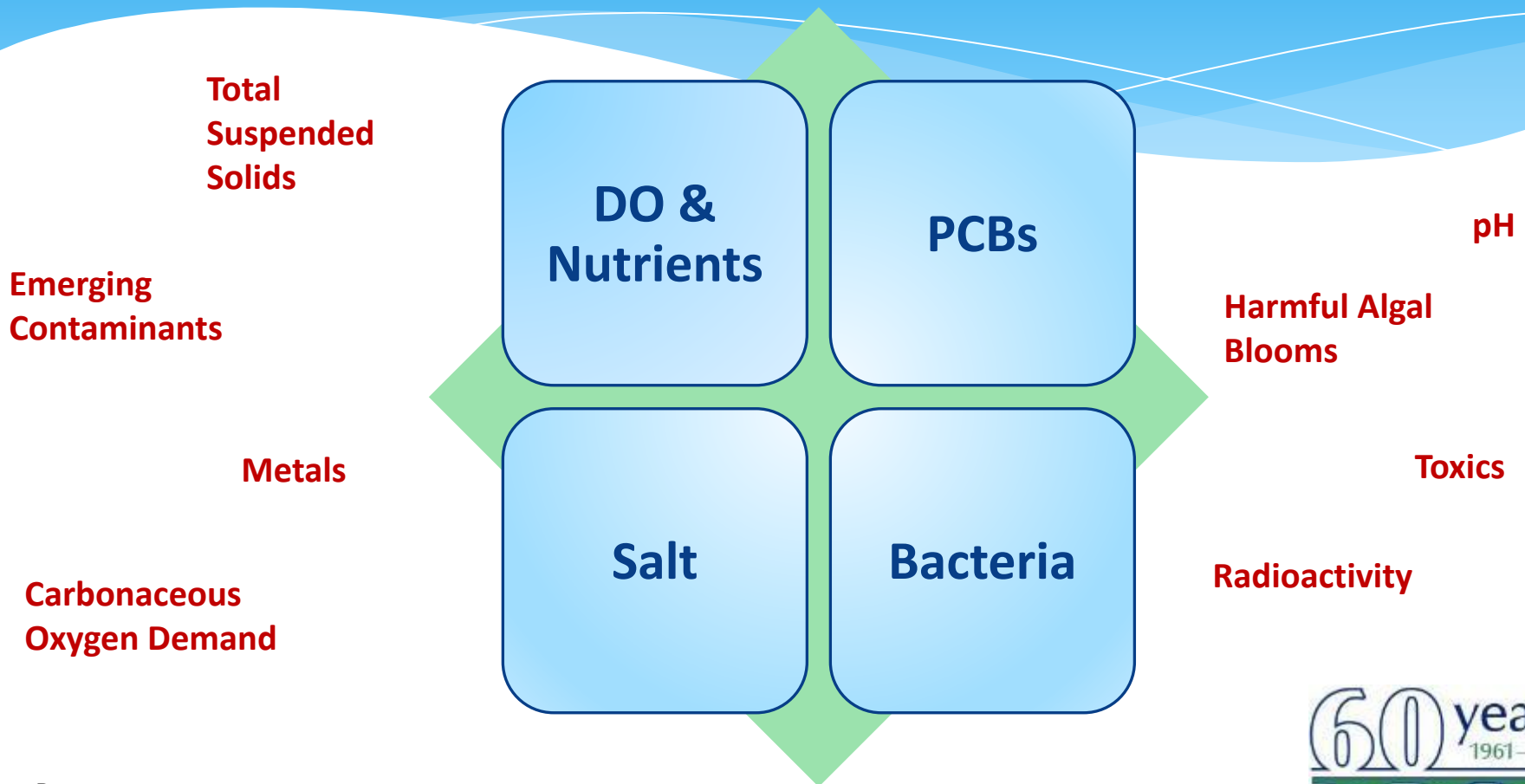


DRBC has been measuring water quality for 50+ years

- “Boat Run” monthly sampling in the Estuary at 22 locations, 50+ years
- Additional monitoring programs focused on individual water quality indicators



Many ways to assess in-stream water quality (water quality indicators)



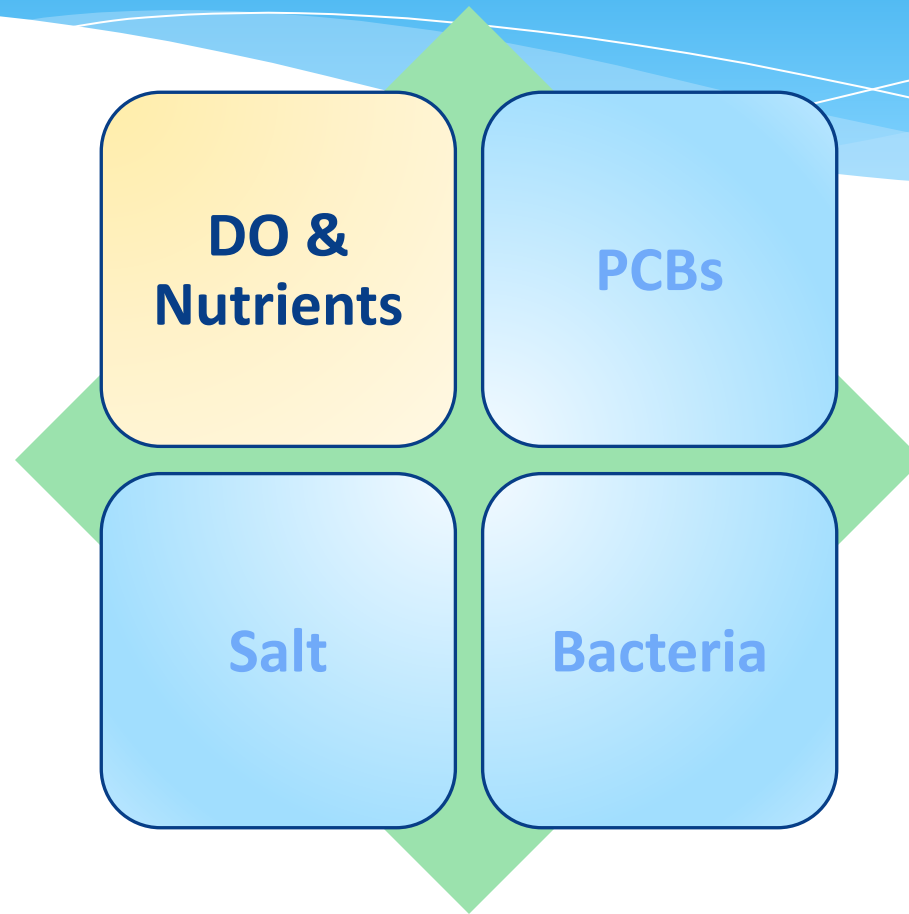
Resources:

[State of the Basin Report \(2019\)](#)

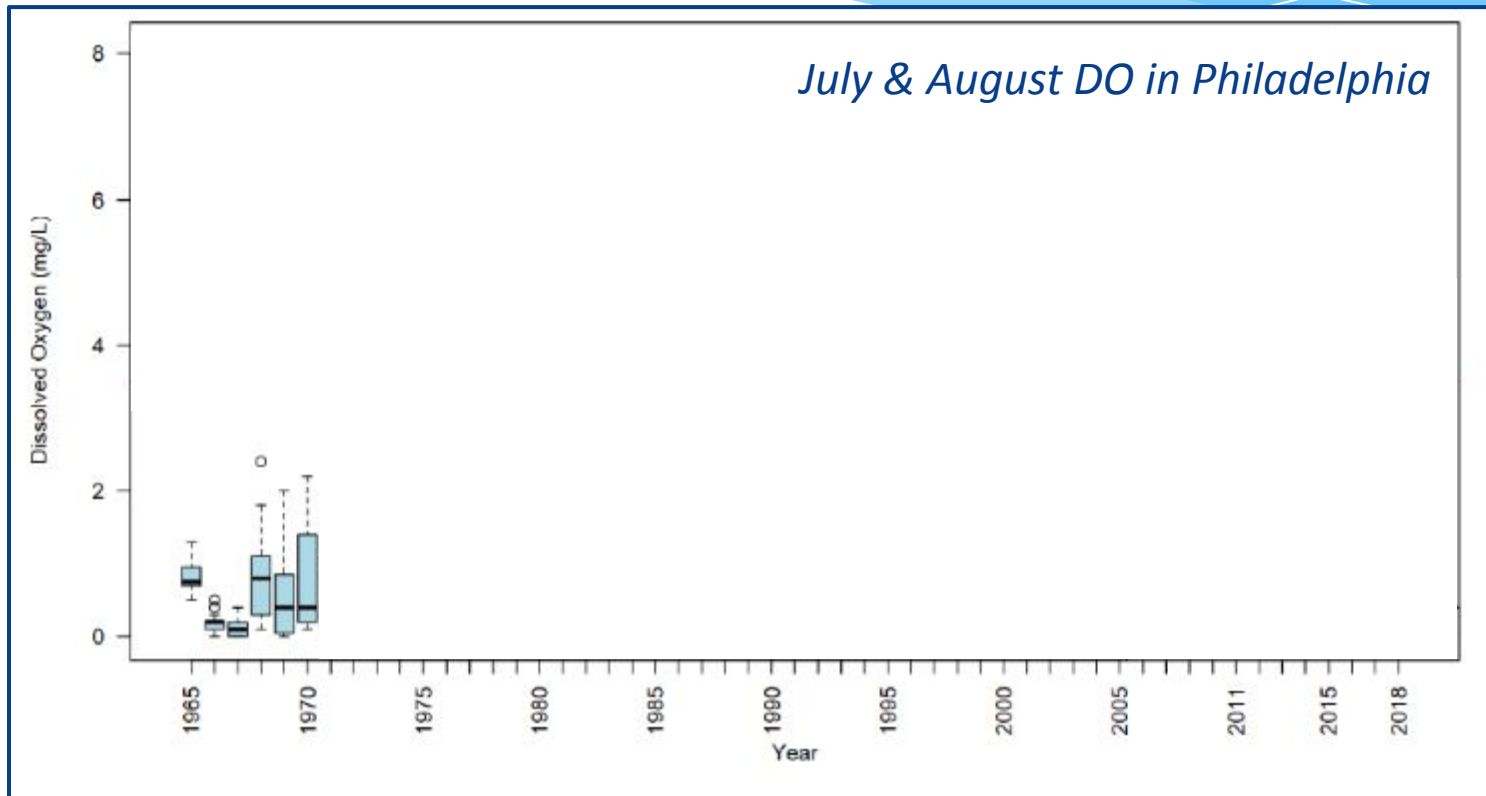
[Water Quality Assessment Report \(2018\)](#)

Many ways to assess in-stream water quality (water quality indicators)

- All aquatic animals need dissolved oxygen (DO) to breathe
- Nutrients are also needed, but high levels can deplete DO
- DO tends to be lowest during summer

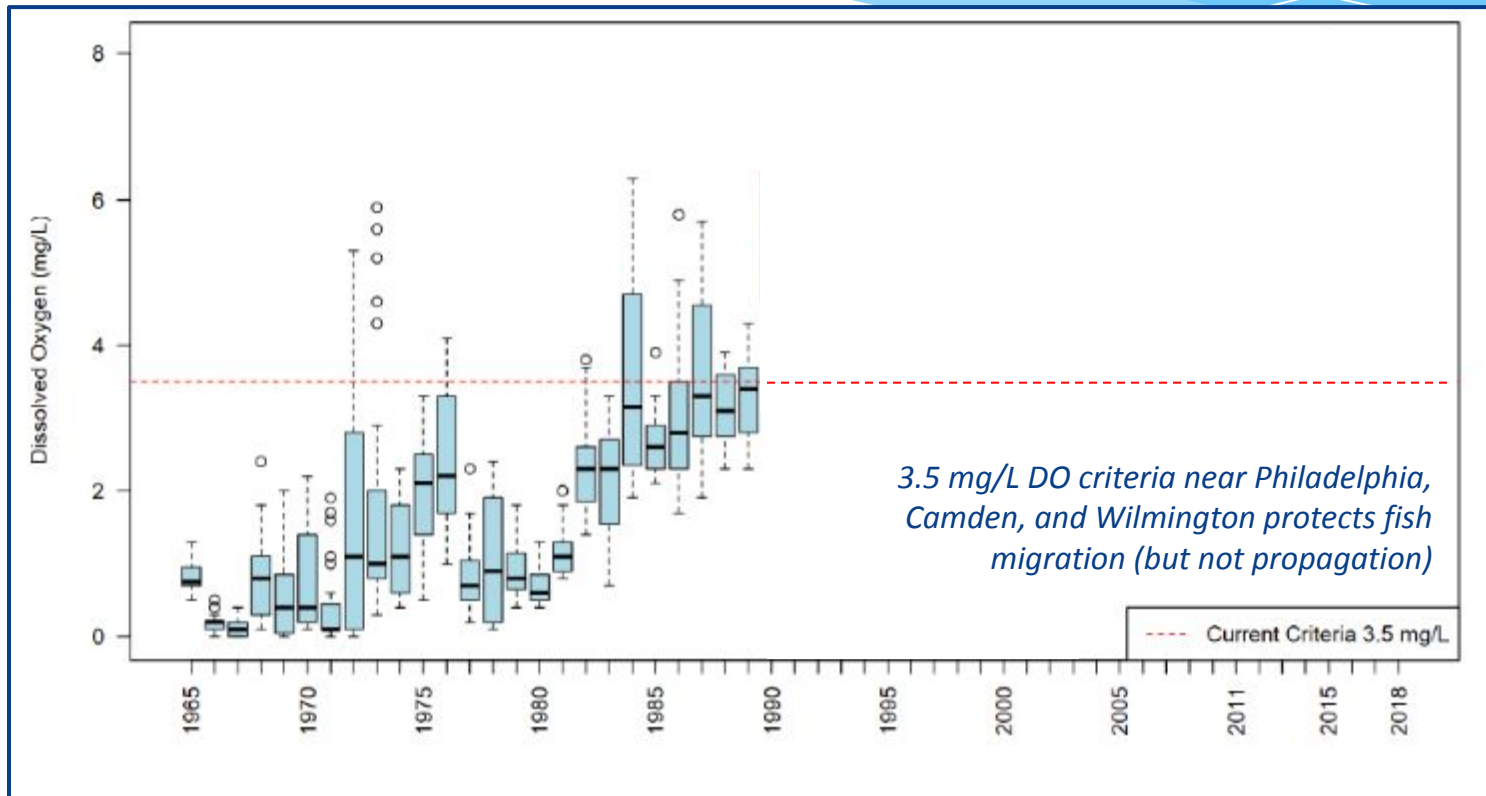


In the Philadelphia urban corridor, summertime DO was close to zero in the 1960s



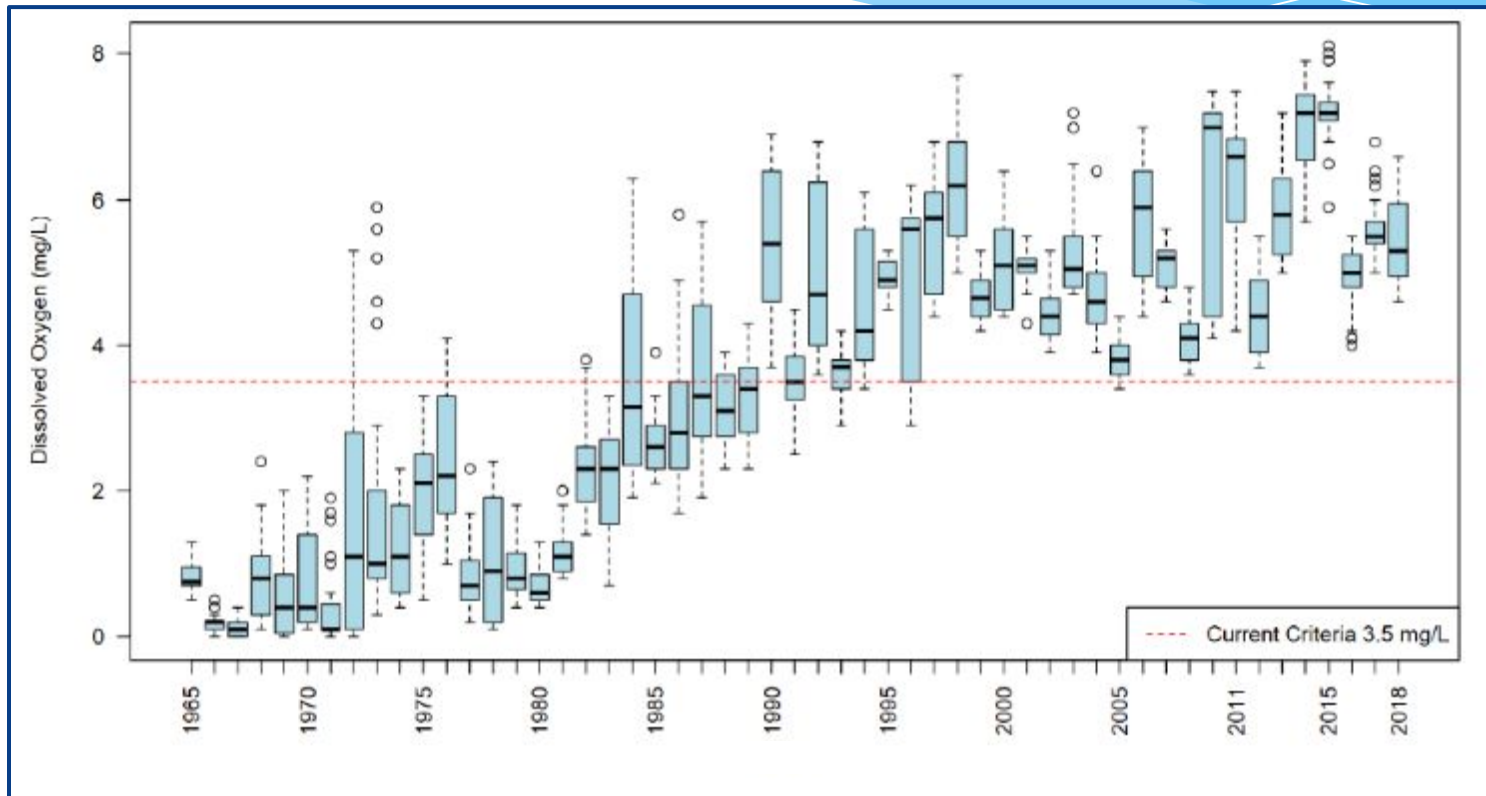
*USGS gage,
Delaware River
at Ben Franklin
Bridge
(River Mile
100)*

DRBC water quality standards, wasteload allocation, and CWA infrastructure funding contributed to rising DO levels



*USGS gage,
Delaware River
at Ben Franklin
Bridge
(River Mile
100)*

Since the mid-1990s, DO in the urban estuary consistently meet water quality criteria

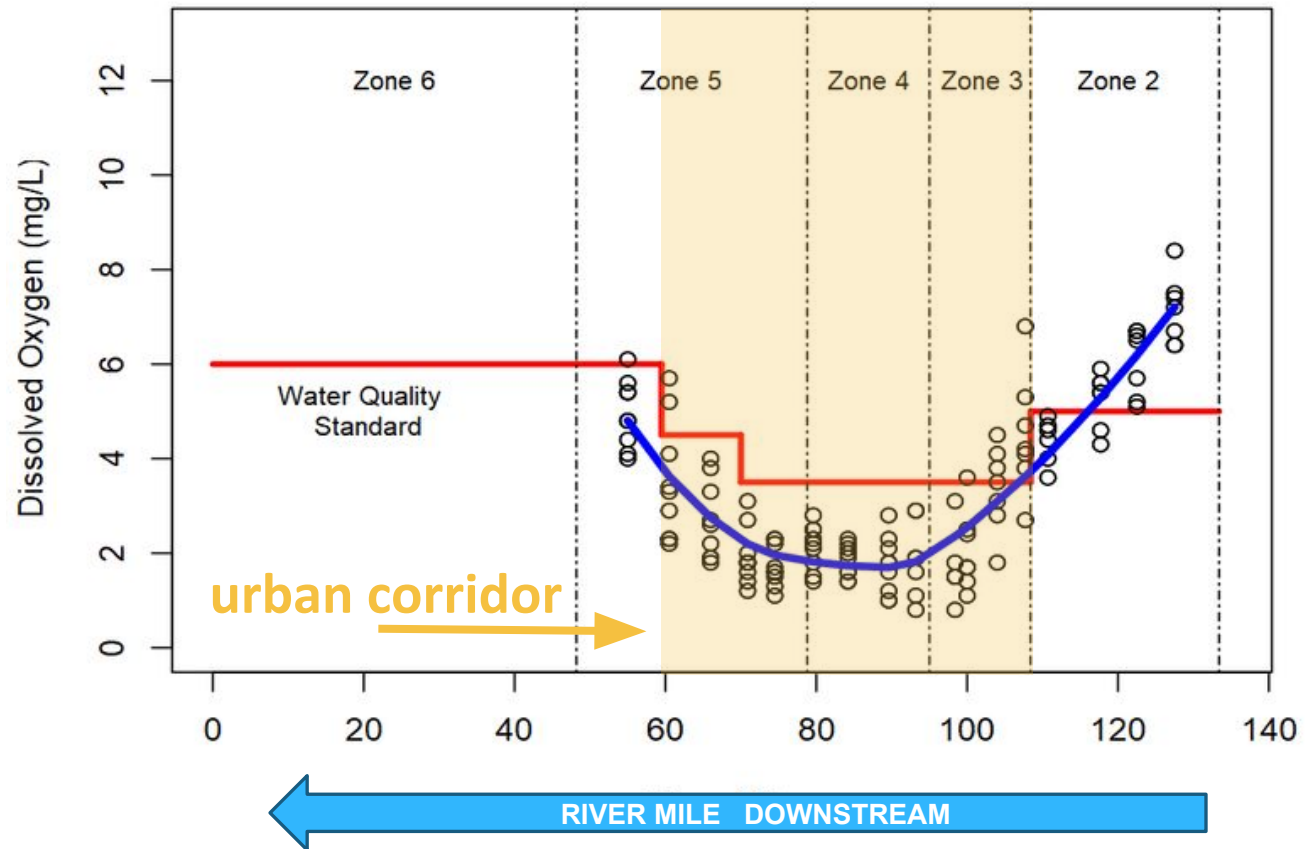


*USGS gage,
Delaware River
at Ben Franklin
Bridge
(River Mile
100)*

DO increases over time, but still “sags” in the urban corridor due to local pollution sources.

Studies are underway to inform updated DO criteria.

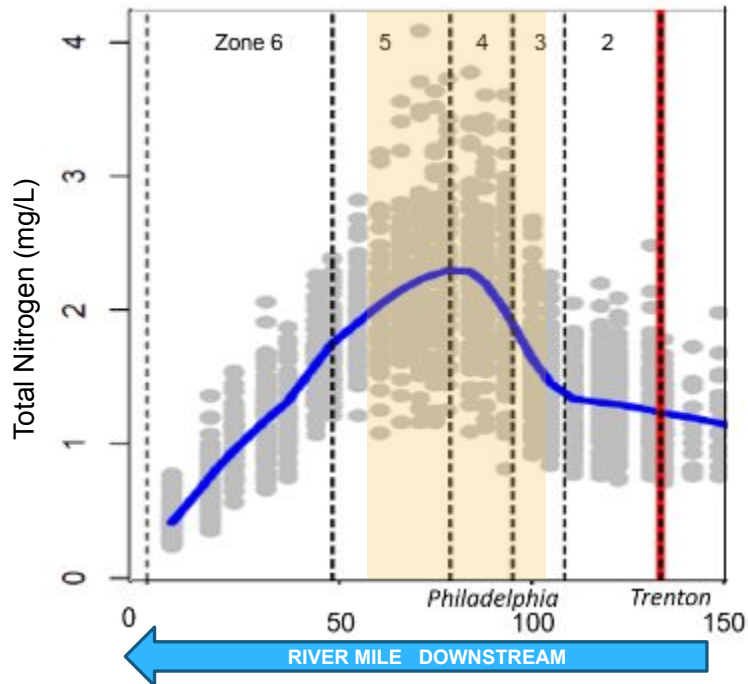
DRBC Delaware Estuary Monitoring July & August 1967



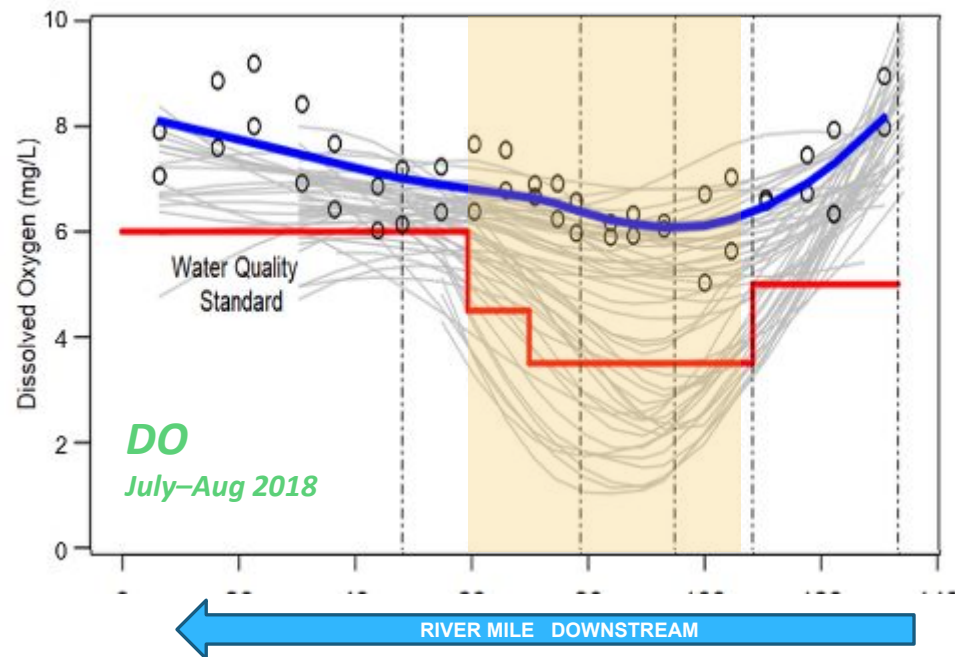
Nitrogen levels are highest in the urban estuary where DO levels are lowest



Nitrogen
2008-2016



urban corridor

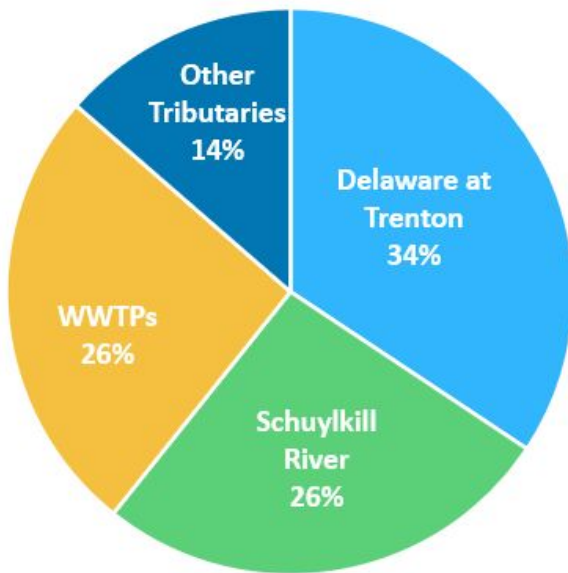


DO
July-Aug 2018

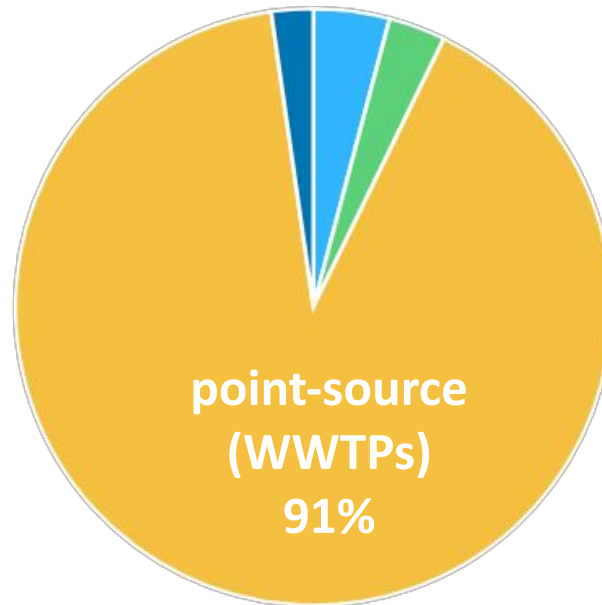
Monitoring nutrient sources helps us understand DO in the urban estuary



Total Nitrogen



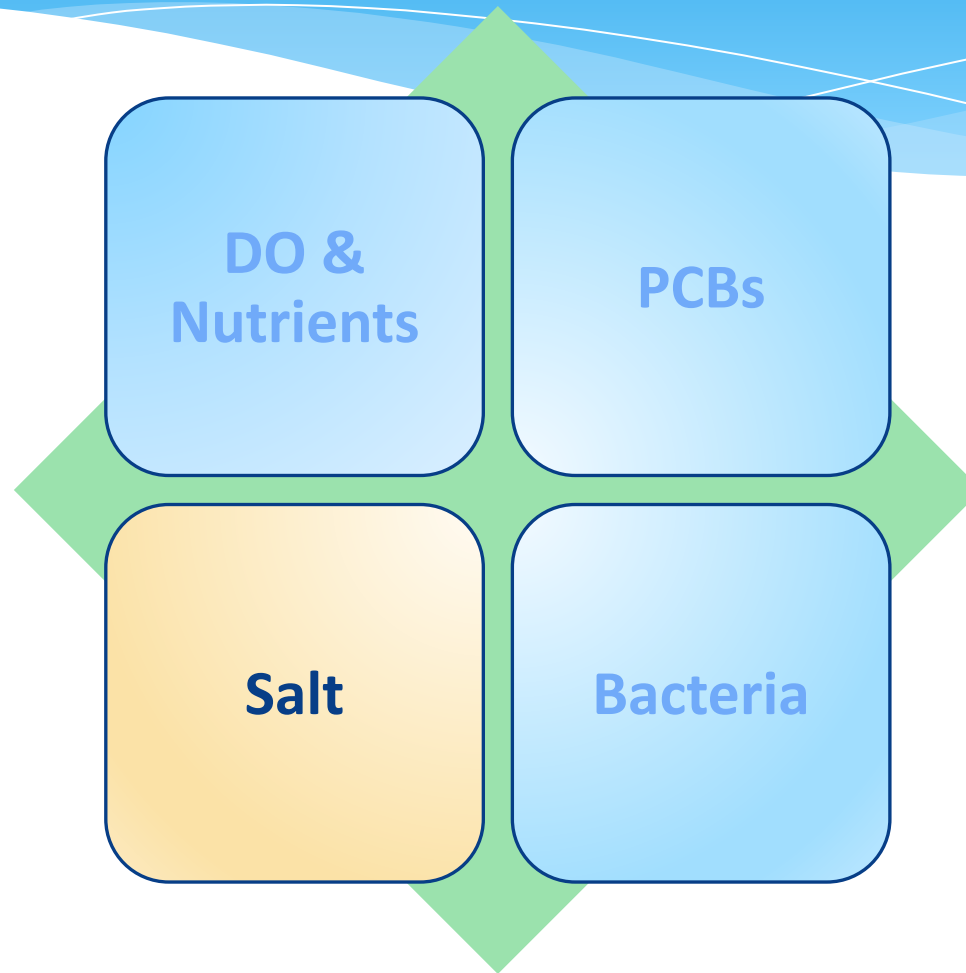
Ammonia (as N)



- Many non-point sources of N to the Delaware Estuary
- Ammonia (NH_3) is associated with low DO
- Most ammonia comes from point sources (wastewater treatment plants, WWTPs)

Many ways to assess in-stream water quality (water quality indicators)

- Toxic to freshwater plants and animals
- High levels are unsafe for drinking & irrigation and can be corrosive

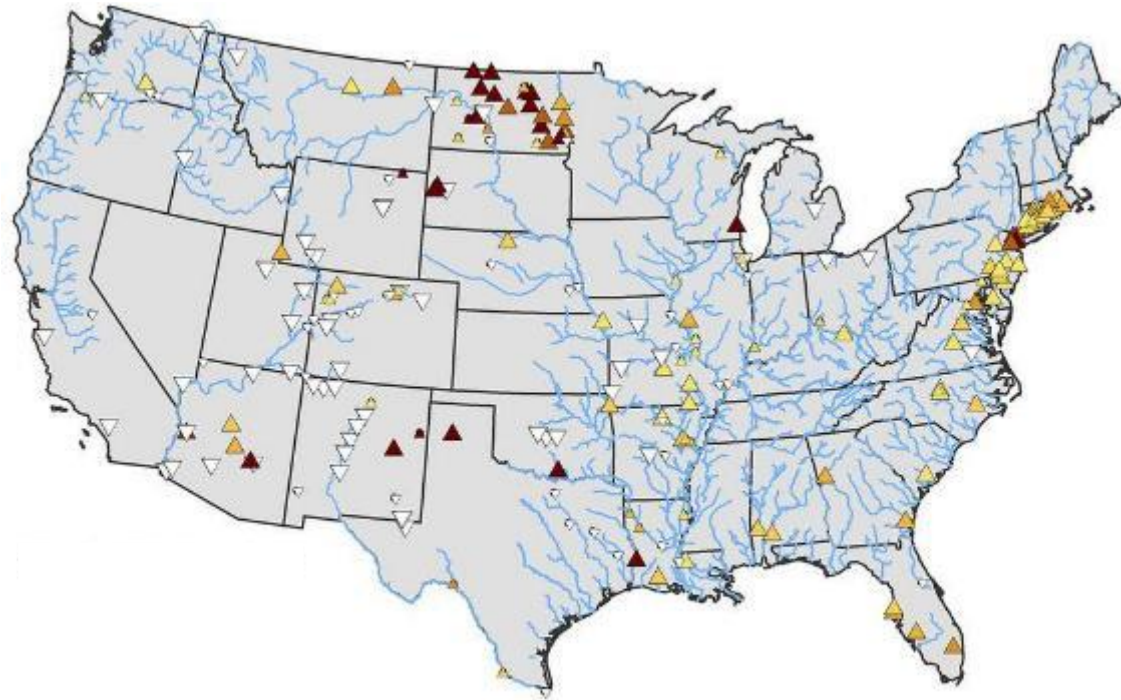


Freshwater salt levels are increasing in urban areas across the country



Primary causes of “freshwater salinization”:

- Increased salt inputs
 - Road salt application
 - Wastewater: saltier diets, water softeners, etc.
- Increased weathering rates due to mining, agriculture, acid rain, etc.



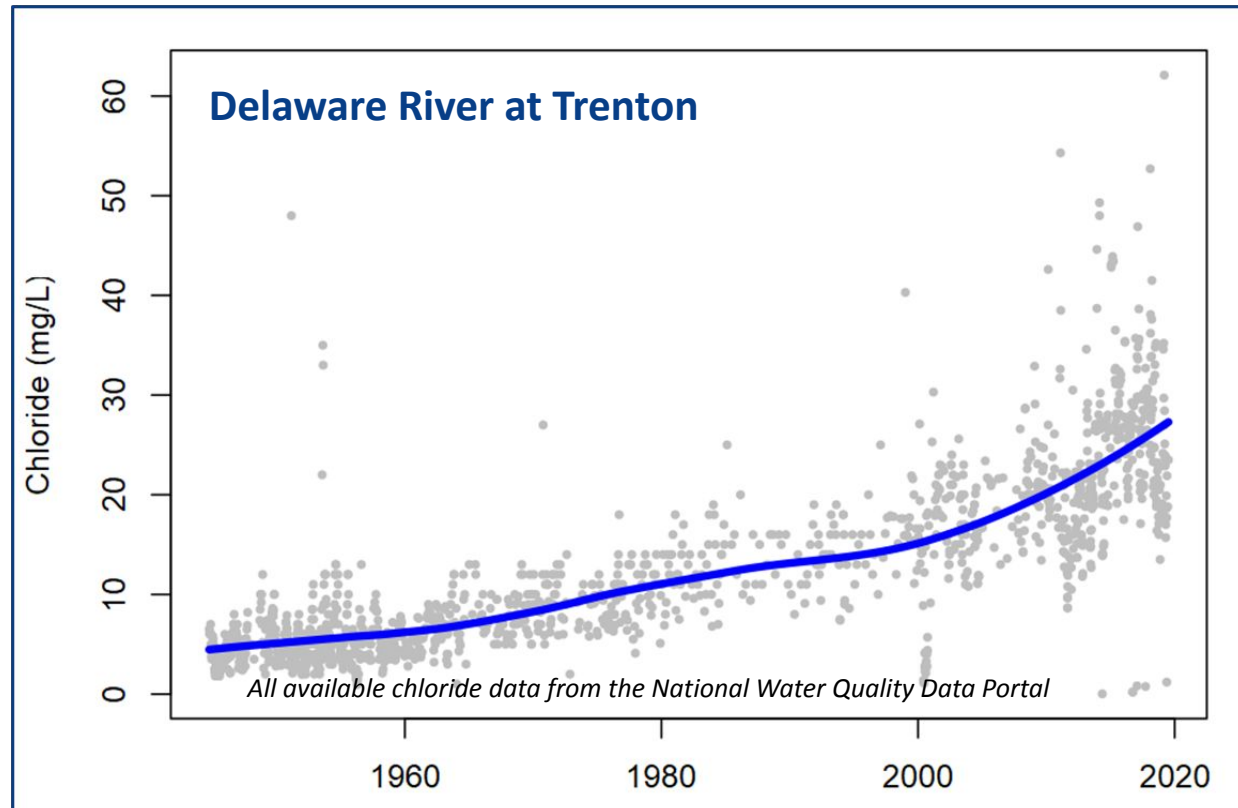
The Delaware River is no exception; salinity is increasing over time



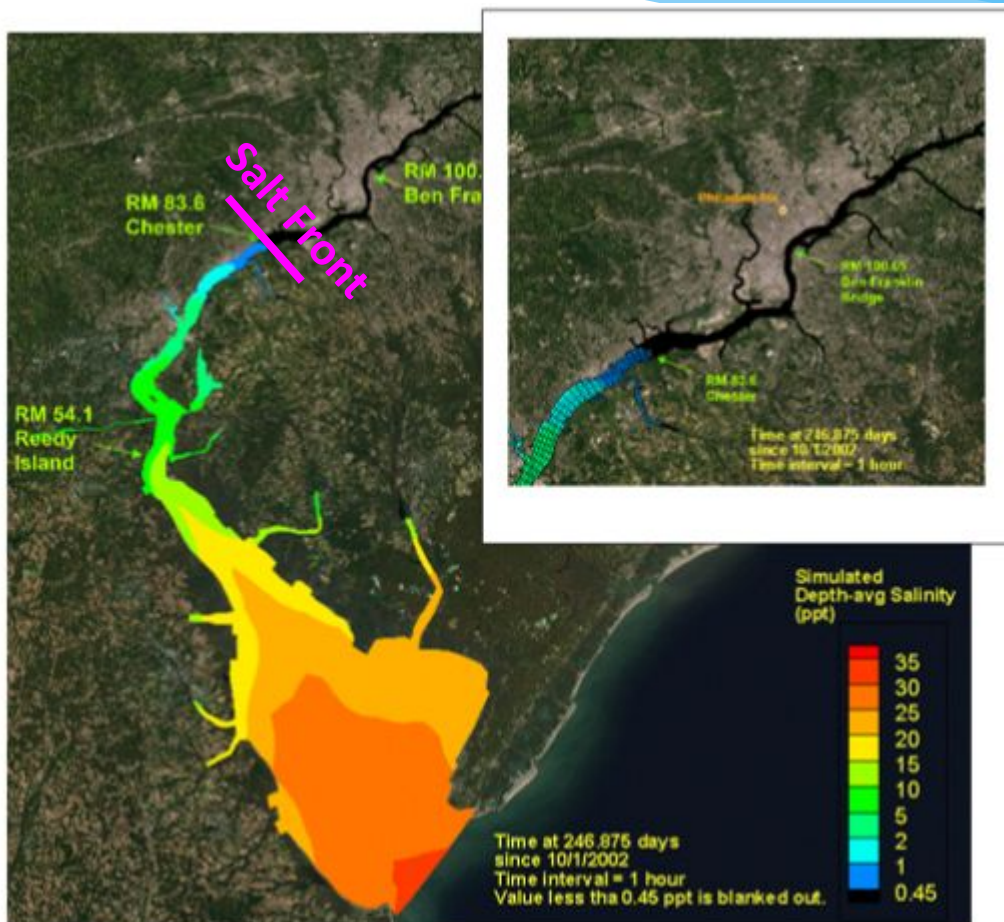
DRBC's monitoring program:

Collect field chloride data to assess the problem and inform next steps

- Sampling 20 tributaries
- 2 years (May 2021 – April 2023)



Managing the Salt Front in the Delaware Estuary

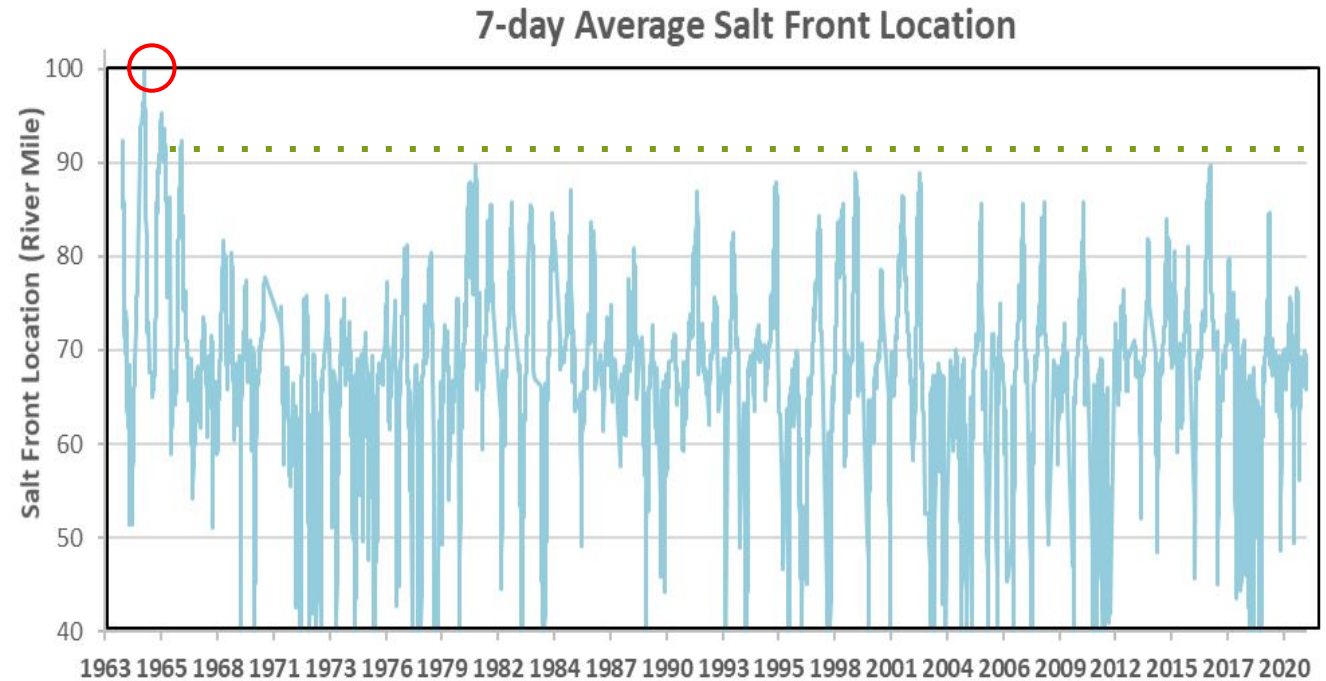


- The “Salt Front” represents where freshwater meets saltwater in the Estuary
 - 250 mg/L chloride
- Salt Front management protects drinking & industry water intakes along urban corridor

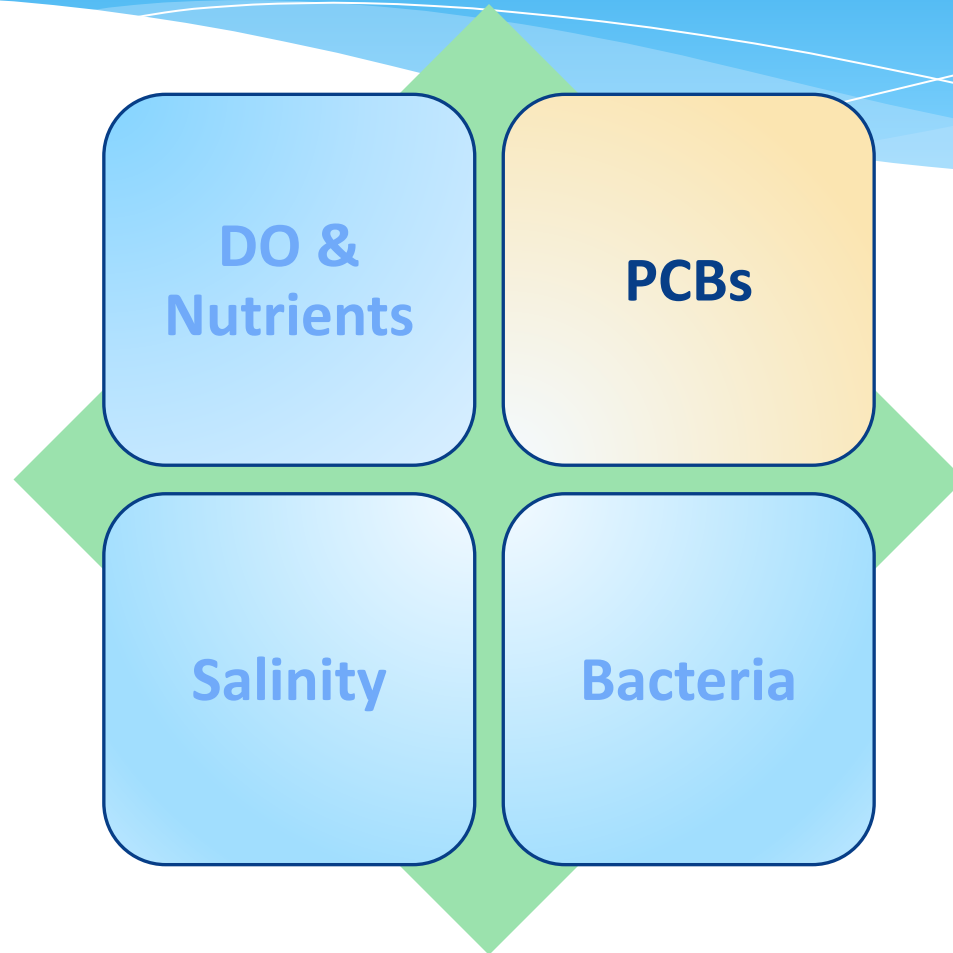
Sea-level rise will be a challenge for future salt front management



- During the 1960s, the salt front reached **RM 100**
- With drought management plan, flow targets, and water code: has not been above **RM 92**
- New planning efforts need to incorporate sea-level rise



Many ways to assess in-stream water quality (water quality indicators)

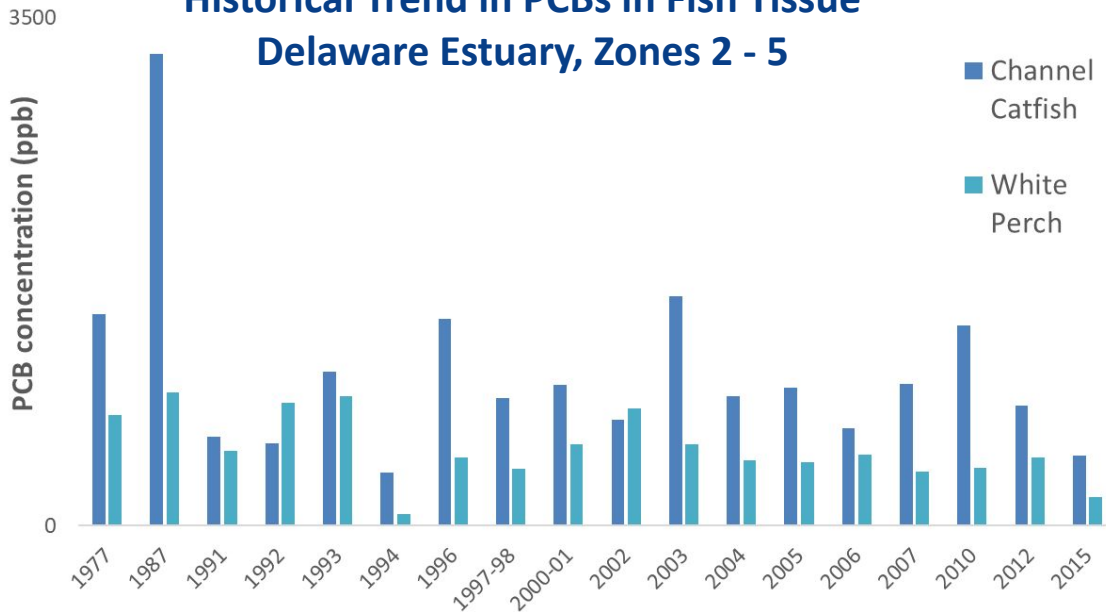


- Legacy pollutant
- Probable human carcinogen
- Drives fish consumption advisories

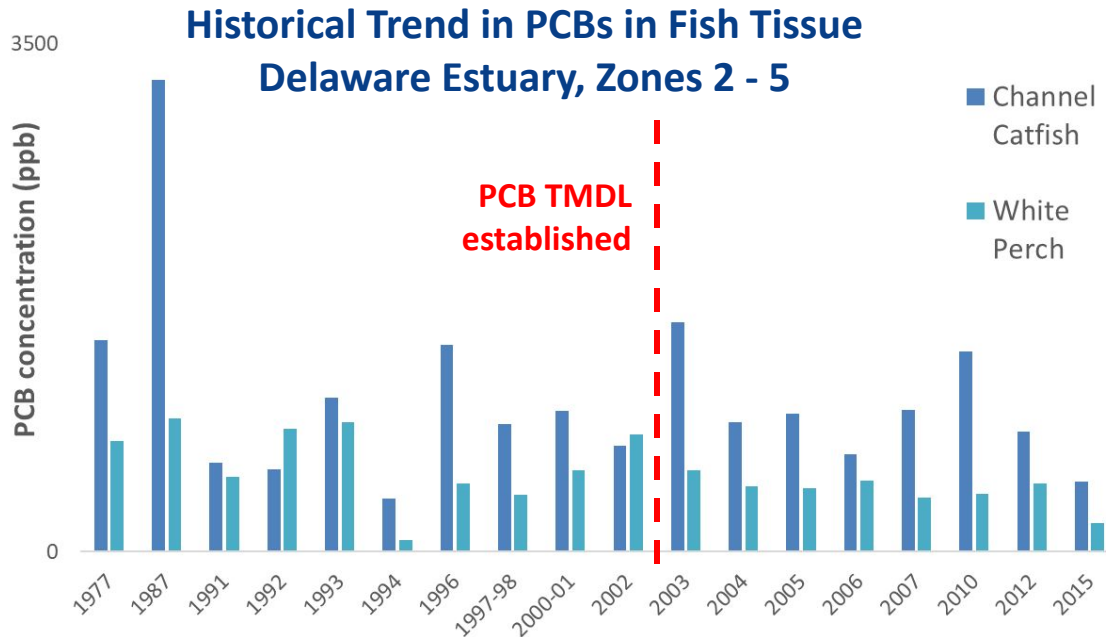
PCBs in fish tissue are historically high



Historical Trend in PCBs in Fish Tissue Delaware Estuary, Zones 2 - 5

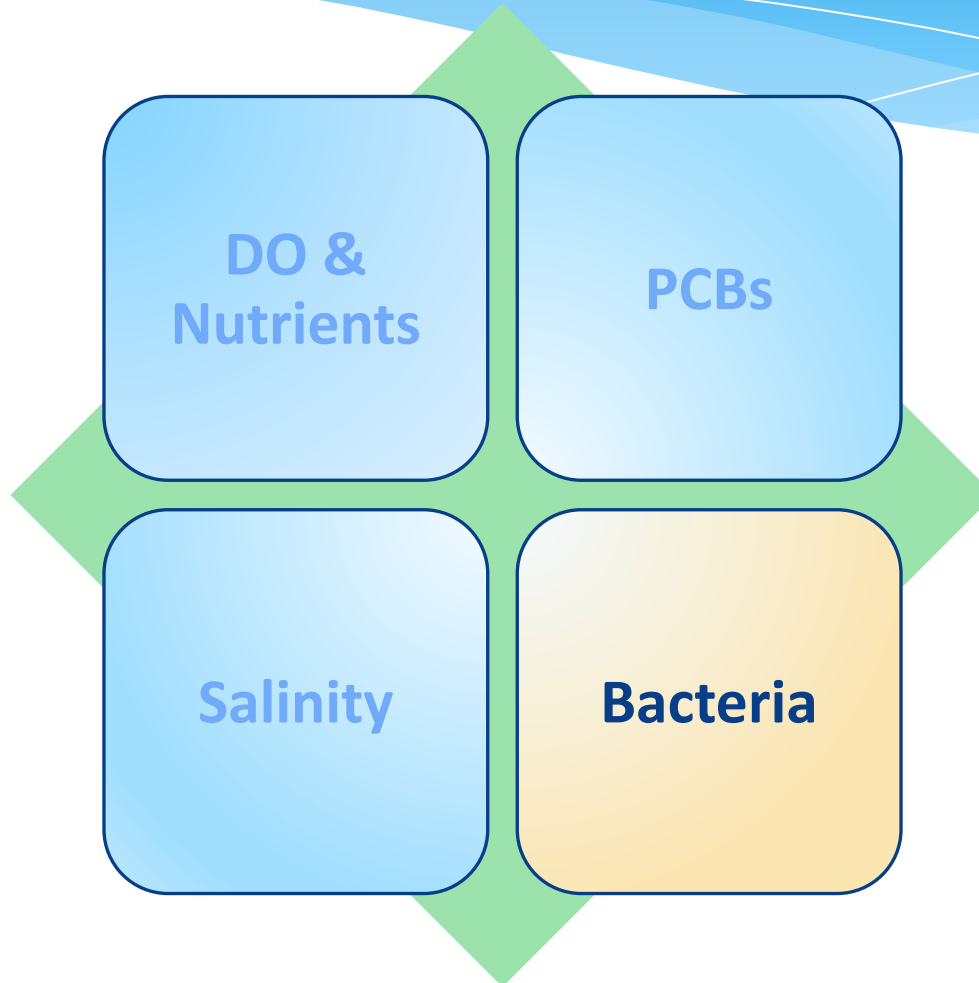


PCBs in fish tissue are historically high; After 2003 TMDLs, slight decrease



- DRBC established TMDLs to protect human health
- Consumption advisories updated to reflect reduced PCBs in certain fish tissue
- Long time for improvement
 - continued monitoring
- Stage 2 TMDLs are under development

Many ways to assess in-stream water quality (water quality indicators)

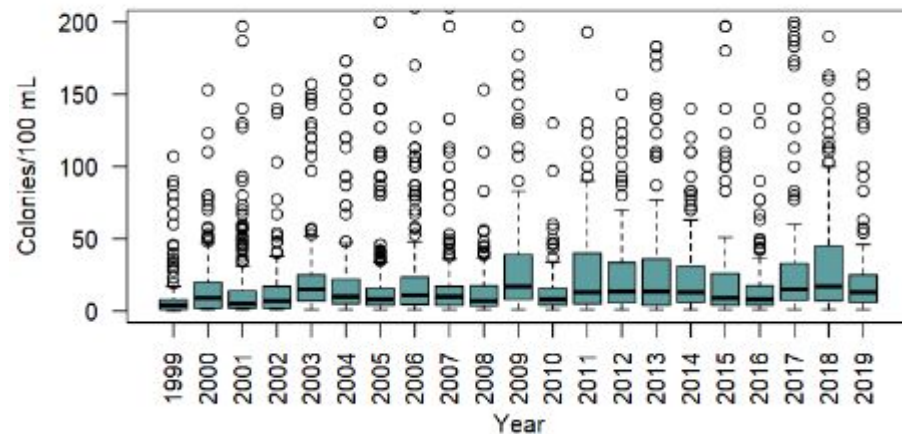


- Certain bacteria cause waterborne diseases in humans
- Indicator bacteria and related WQ criteria used to assess potential public health risks
- High variability

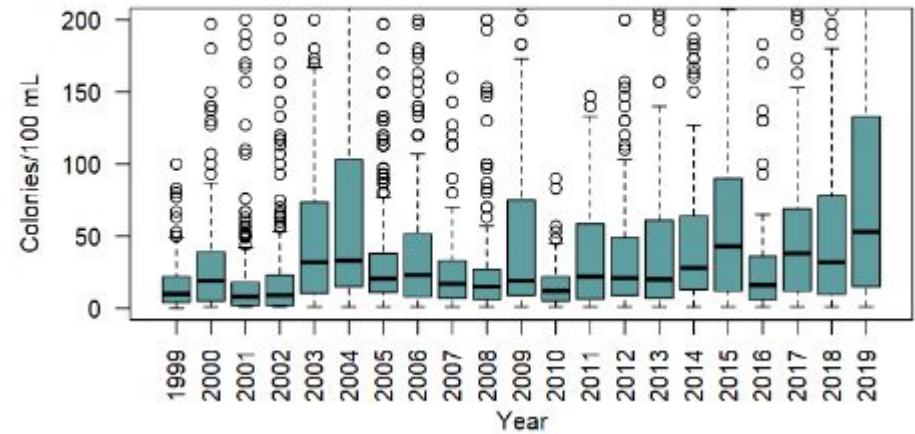
Increased bacteria monitoring efforts will supplement long-term data



Delaware Estuary Bacteria Data
Enterococcus



Delaware Estuary Bacteria Data
Escherichia coli



- Enterococcus: little change over time

- E. coli: slight increase over time

Significant water quality improvement over the years; much to learn through continued monitoring

1. Dissolved Oxygen and Nutrients

- Summer DO increased from ~0 to levels that support fish migration
- High nutrient levels linked to low DO
- New DO criteria being considered

2. Salt (Chloride)

- Increased monitoring in response to observed freshwater salinization
- Sea-level rise presents a challenge to Salt Front management

3. Polychlorinated Biphenyls (PCBs)

- <20 years after 2003 TMDL established, PCBs decreasing in some fish tissue

4. Bacteria

- Enhanced monitoring program
- Long-term CSO control plans and significant stormwater infrastructure investment likely needed for improvement

Delaware River Basin Commission

Delaware River Estuary Fisheries Trends

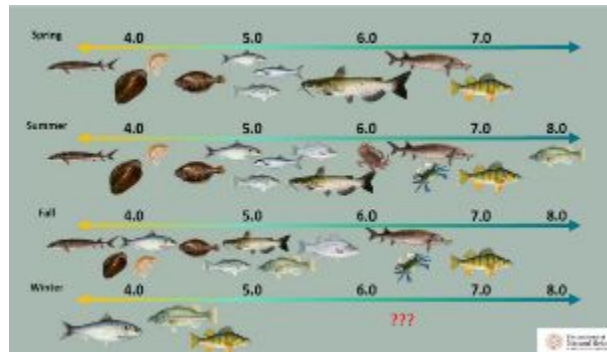
*Coalition for the Delaware
River Watershed Forum*

September 29, 2021

Jake Bransky
Aquatic Biologist, DRBC



Photo: Fisheries.noaa.gov



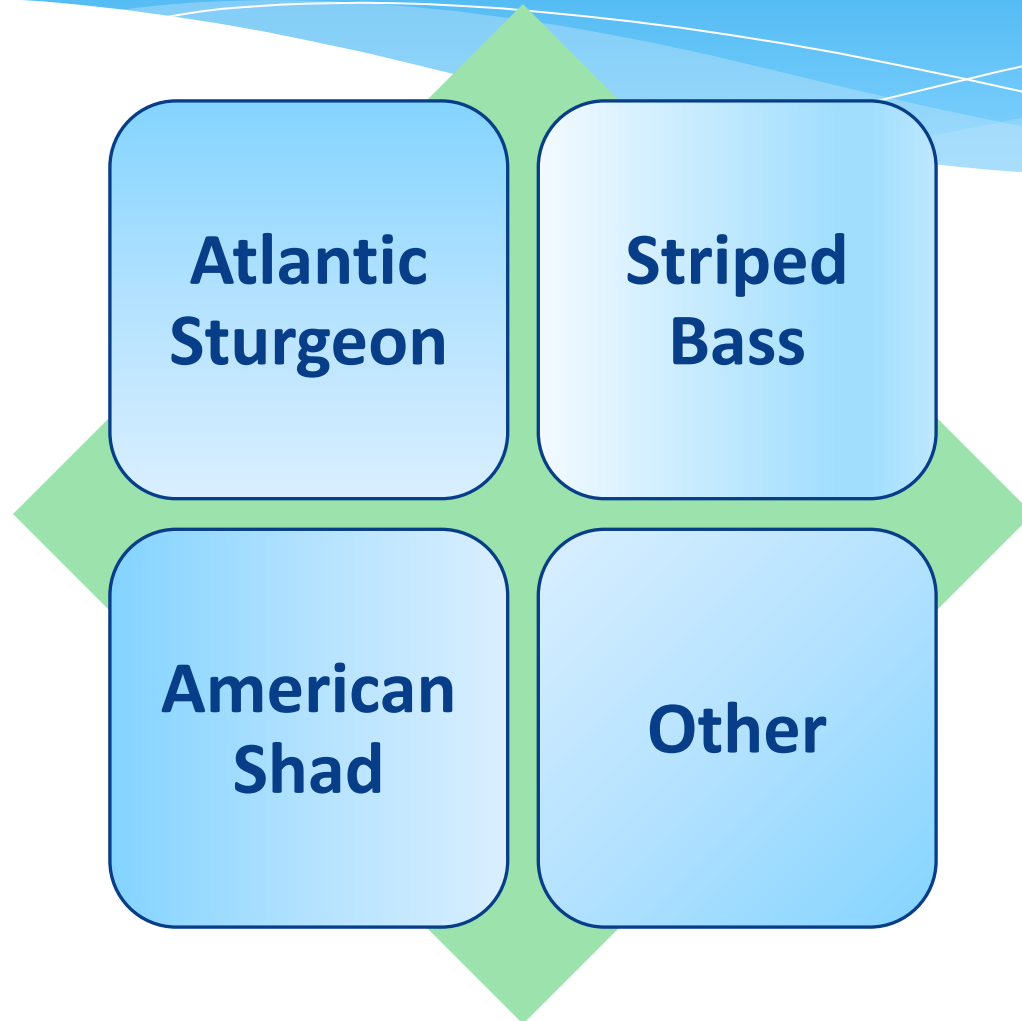
Delaware Estuary Fisheries



Map Credit: DRBC, Fish Images: PFBC

- The health of fish communities is an indicator of water quality
- The Delaware River Basin supports a diverse array of fisheries
- Location in the basin determines what species of fish will be present
- The Delaware Estuary is an important habitat for several anadromous species
 - ✓ Atlantic sturgeon
 - ✓ Striped bass
 - ✓ American shad
- Iconic species of the Delaware Estuary

Water Quality Living Resource Indicators



Atlantic Sturgeon



Photo Credit: PFBC



Juvenile Atlantic sturgeon from the Delaware Estuary collected under NOAA Fisheries Permit No. 19255-01 (Photo Credit: DRBC)



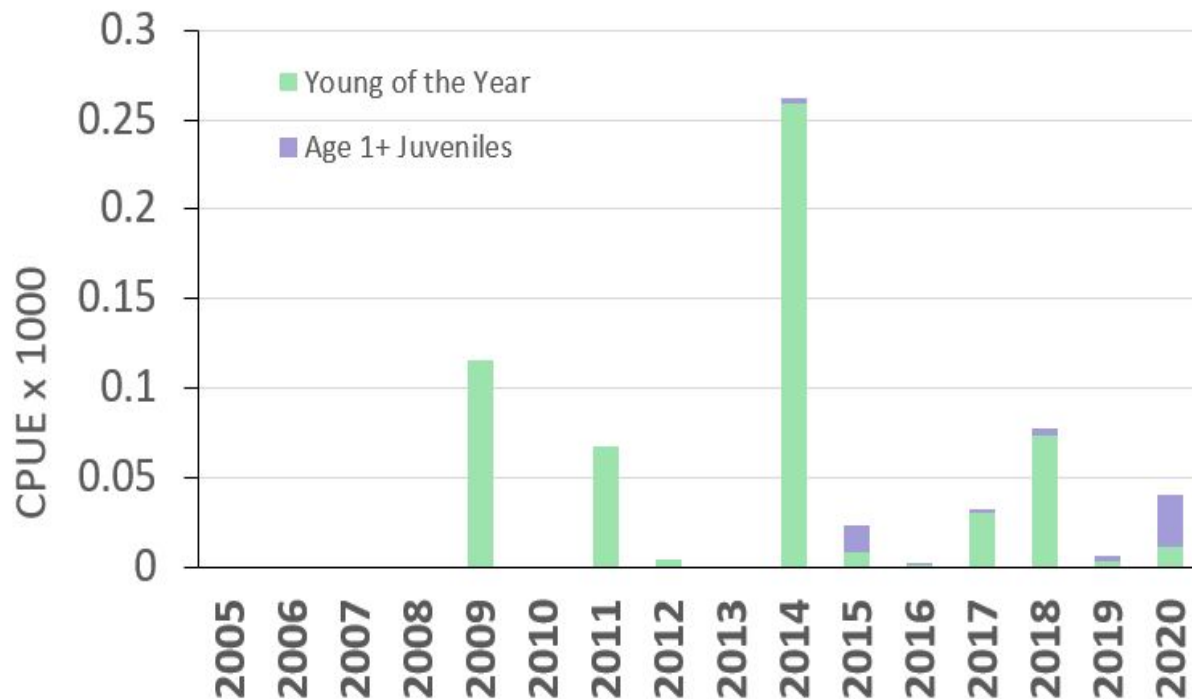
Adult Atlantic sturgeon captured in the Delaware Bay per NOAA Fisheries Permit #20548 (Photo Credit: DRBC)

- Atlantic sturgeon are a large, prehistoric fish species found in the Delaware estuary
- Atlantic sturgeon may live up to 60 years, reach lengths up to 14 feet and weigh over 800 pounds
- Depending on the life stage, Atlantic sturgeon can be found throughout the Estuary
- The Delaware River population is currently listed as endangered under the ESA

Atlantic Sturgeon



Photo Credit: PFBC



Atlantic Sturgeon CPUE from DNREC Gill Net Surveys in the Delaware Estuary (2005-2020)

- Atlantic sturgeon were once very abundant in the Delaware
 - “Caviar capital of North America”
- Population crashed in the 1900’s
 - Water quality, overfishing, habitat loss, ship-strikes
- Atlantic sturgeon populations have not fully rebounded despite fishing moratorium and water quality improvements

Striped Bass



Photo Credit: PFBC



A large striped bass from the Delaware Estuary. Photo Credit: PFBC

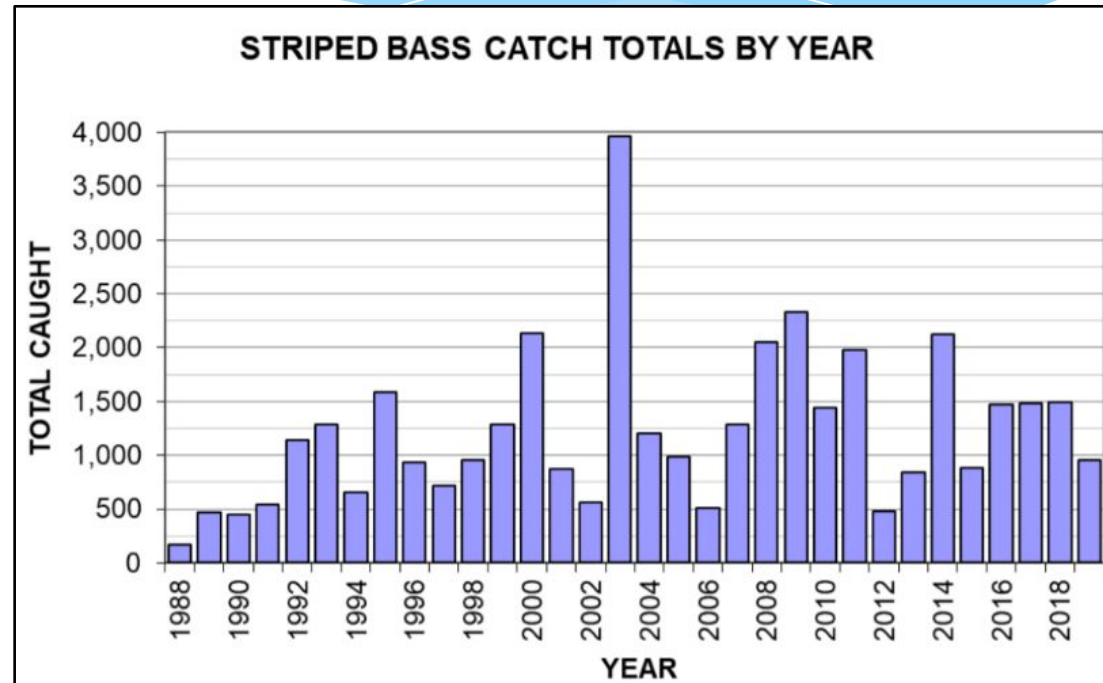
- Striped bass are the largest member of the temperate bass family
- Depending on the lifestage, striped bass can be found throughout the basin from the upper river to the Estuary
- Important food and game fish
 - Atlantic coastwide striped bass fishery generates ~\$7 billion dollars in revenue

Striped Bass



Photo Credit: PFBC

- Like sturgeon, striped bass were once very abundant in the Delaware
- Striped bass populations crashed in the Delaware in the 1950's
 - Water quality
 - Overfishing
- Striped bass populations began to rebound in the 1990's following a moratorium on striped bass fishing in the Delaware
- Today, striped bass populations have rebounded to a level that can sustain fishing pressure and harvest, however this is a moving target



Catch of striped bass in NJDFW Delaware Estuary Seine Survey (1988-2019)

American Shad



Photo Credit: PFBC



- American shad are the largest member of the herring family
- Depending on their lifestage, American shad can be found throughout the basin from the upper river to the Estuary



Photo Credit: DRBC

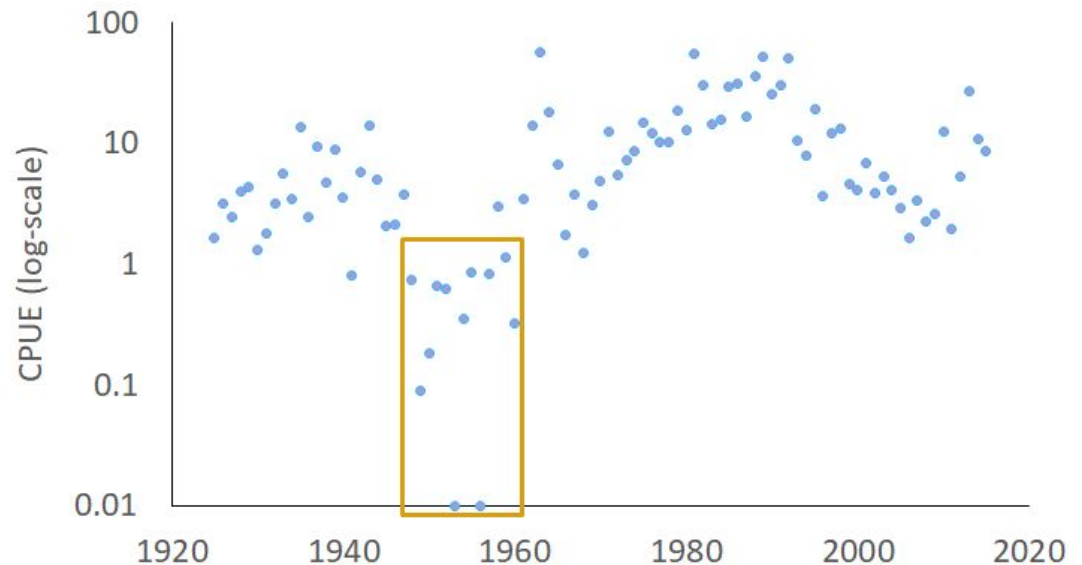
American shad migration. Photo Credit: DRBC

American Shad



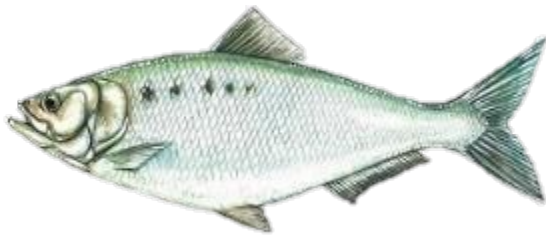
Photo Credit: PFBC

- Historically shad were very abundant in the Delaware
 - George Washington's troops at Valley Forge ate shad
- Shad populations crashed in the Delaware in the 1950's
 - Water pollution
 - Dams
- Shad population rebounded in the 1980's however there is still room for improvement



American Shad CPUE from the Lewis Haul Seine Fishery in Lambertville, NJ (1925-2015)

Fisheries Summary



- The Delaware Estuary is home to a variety of species including several historically important anadromous species
- These species were once abundant, but populations declined greatly in the mid-1900's for a variety of reasons
- Thanks to improved water quality, populations have begun to rebound in recent decades however there is still room for improvement



Photo Credits: PFBC

Delaware River Basin Commission

Strategies for Successful Water Quality Improvement Solutions

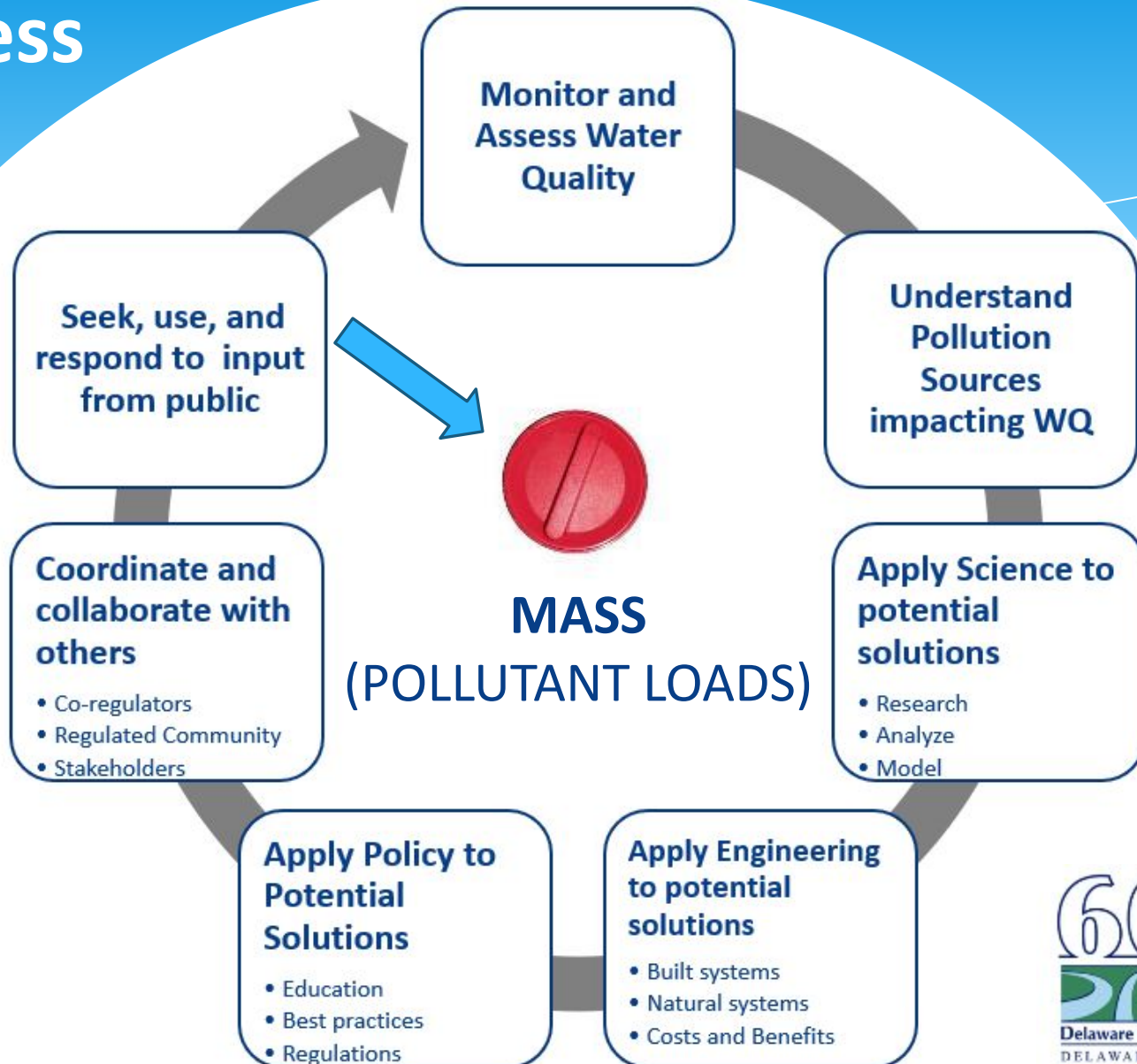
*Coalition for the Delaware River
Watershed Forum*

September 29, 2021

John Yagecic, PE
Manager, Water Quality Assessment DRBC



Process



How does DRBC create successful improvement in water quality in the Delaware River Basin?

Two Brief Examples

1. Implementing a PCB Pollutant Minimization Program
2. Determining Highest Attainable Dissolved Oxygen for the Delaware Estuary



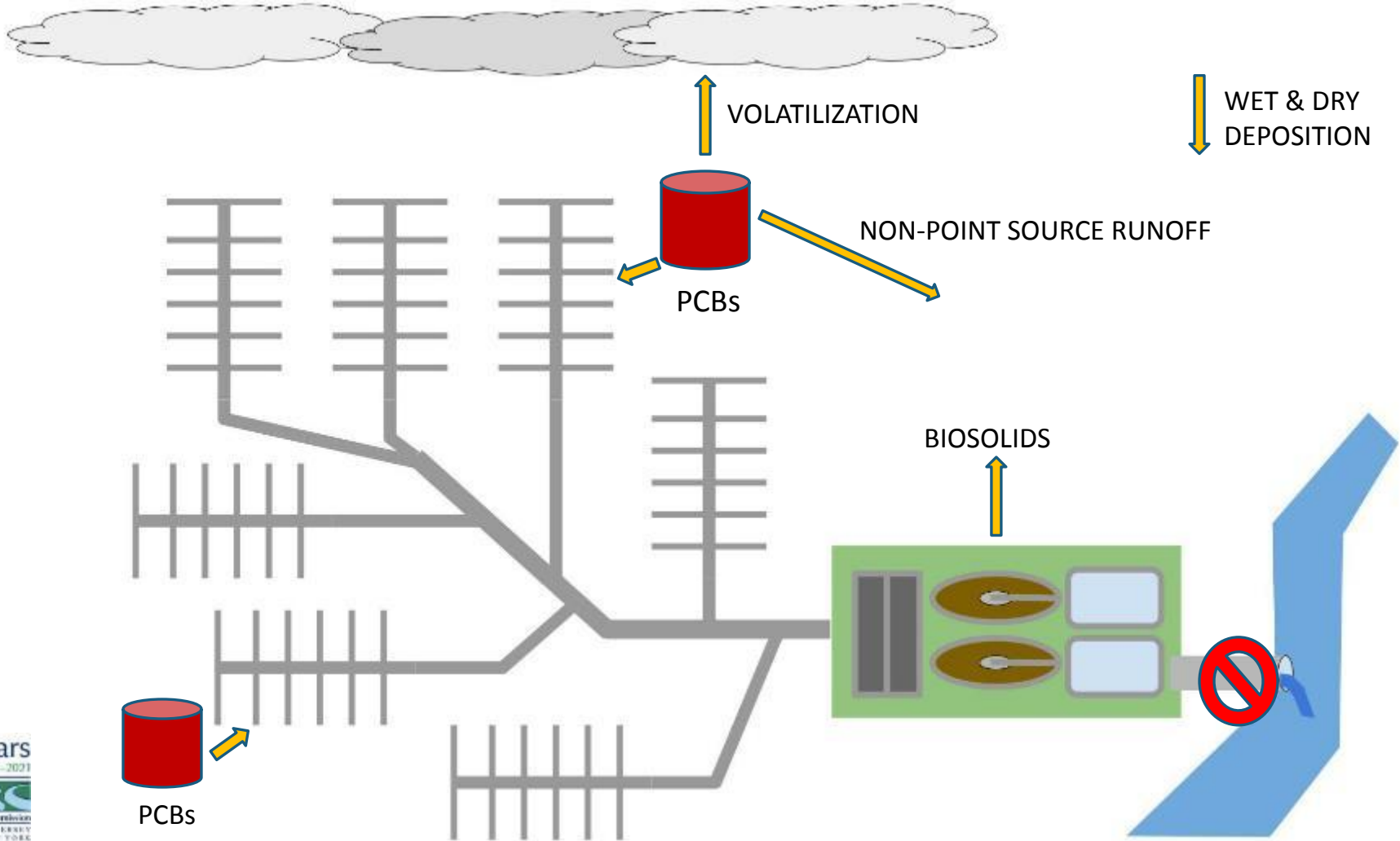
Polychlorinated Biphenyls (PCBs)

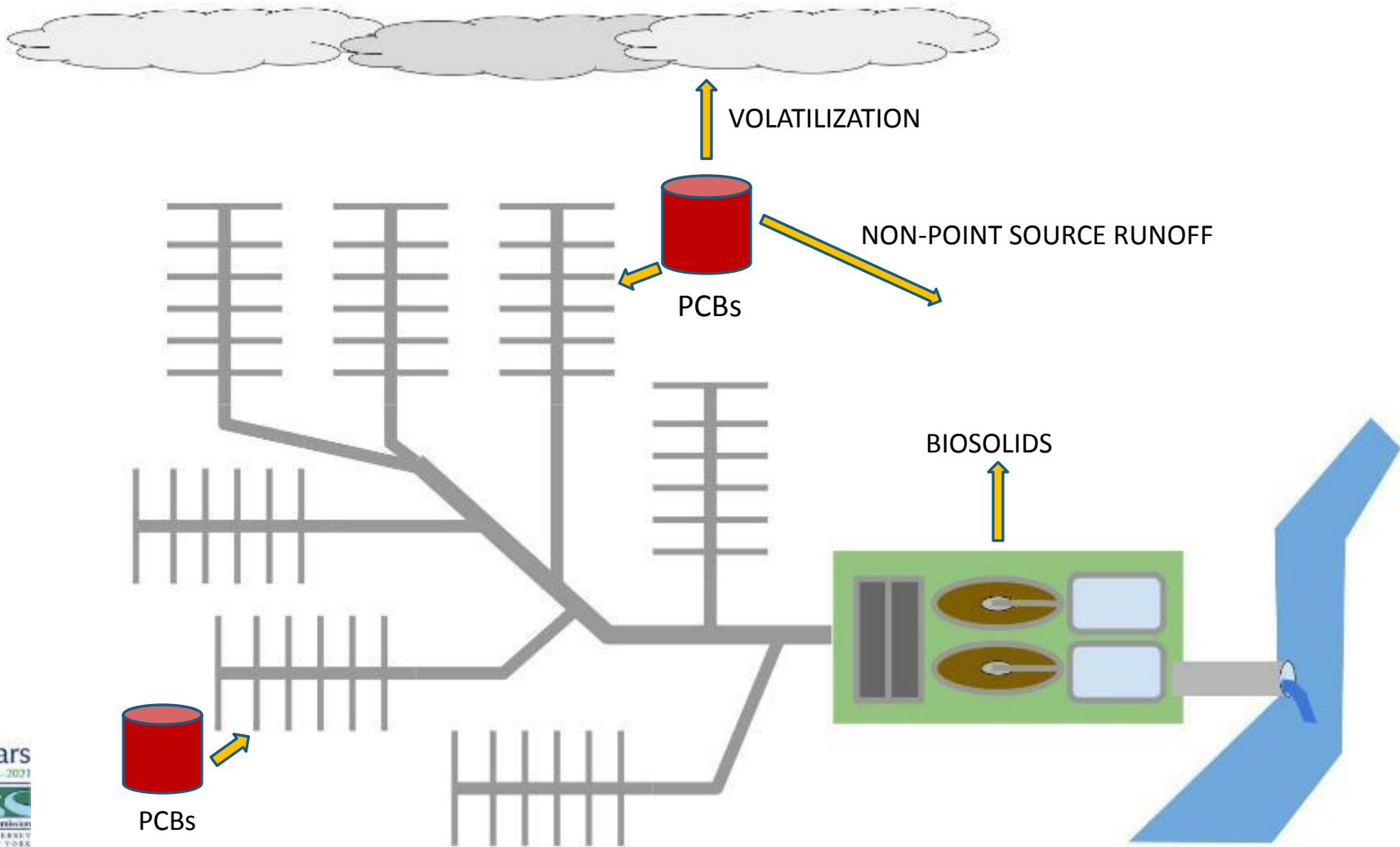
What Made it Complicated?

- Legacy Pollutant
- Sources of PCB pollution are widespread - ubiquitous
- System has a very long memory
- Sensitive analytical methods are very expensive
- End-of-pipe treatment is very expensive

Strategies for Success

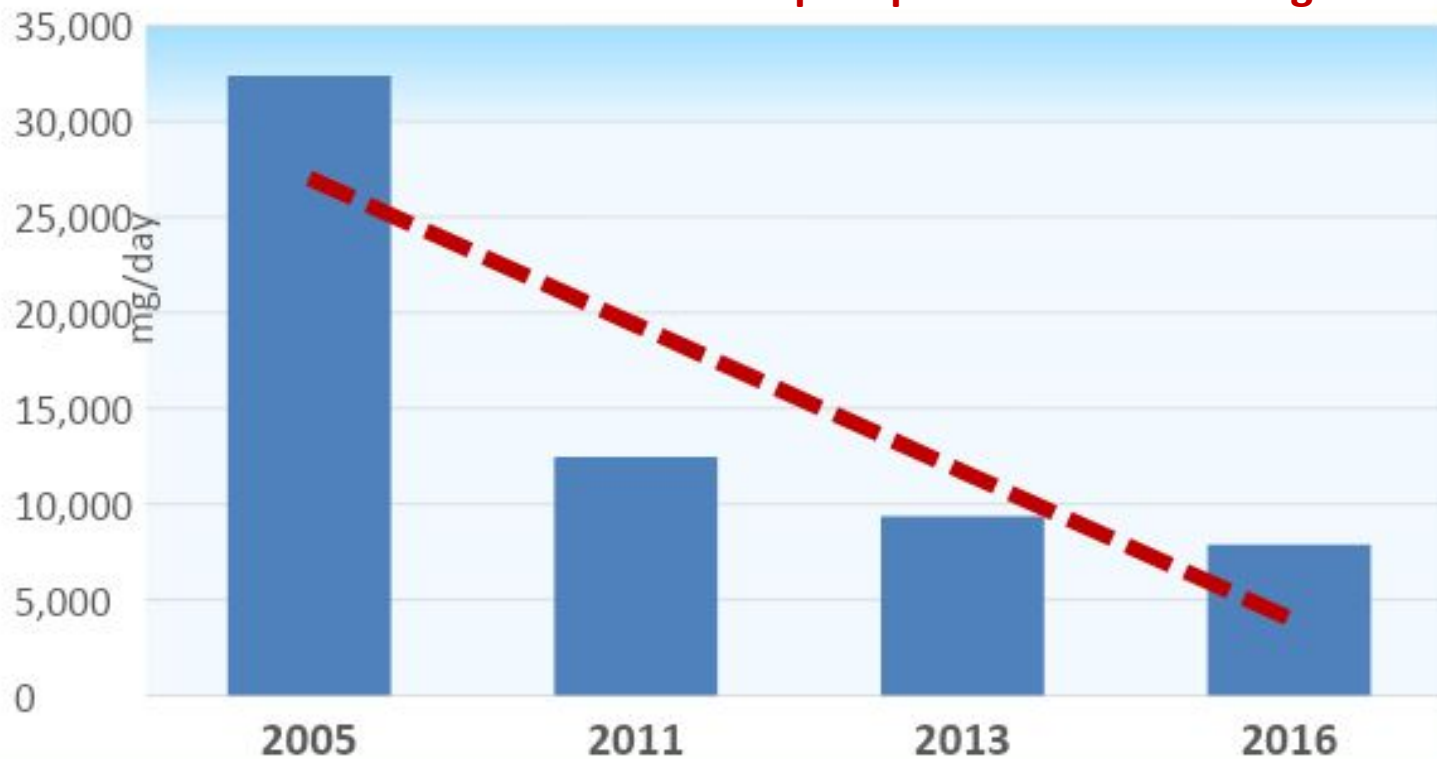
- DRBC developed loads, water quality model
- TMDL remedy implemented through Pollutant Minimization Plans
- Key feature of which was sewer-shed track down





PCB Load Reduction

76 % Reduction from top 10 point source dischargers



Highest Attainable Dissolved Oxygen

What Makes it Complicated?

- Follows a long period of improved water quality
- Early modeling results suggest that the system is more complicated (counter-intuitive) than imagined
- Competing priorities for infrastructure (lead pipe removal)

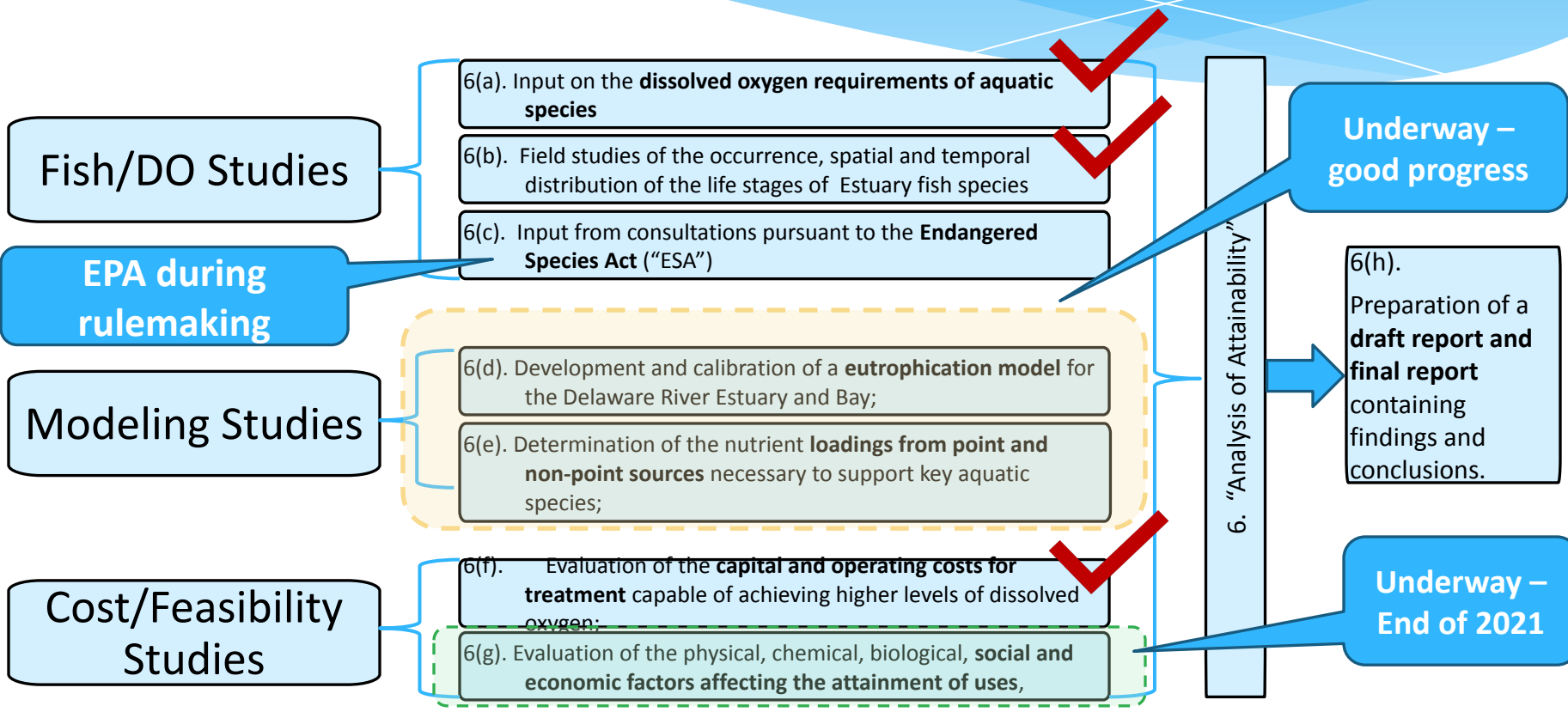
Strategies for Success

- Understand the source of pollution
- Water Quality model to test and select remedies
- Suite of technical studies to make sure we understand the system / impacts
- Front load the technical work to avoid lengthy disputes later

DRBC Resolution 2017-04

Review of Aquatic Life Designated Uses

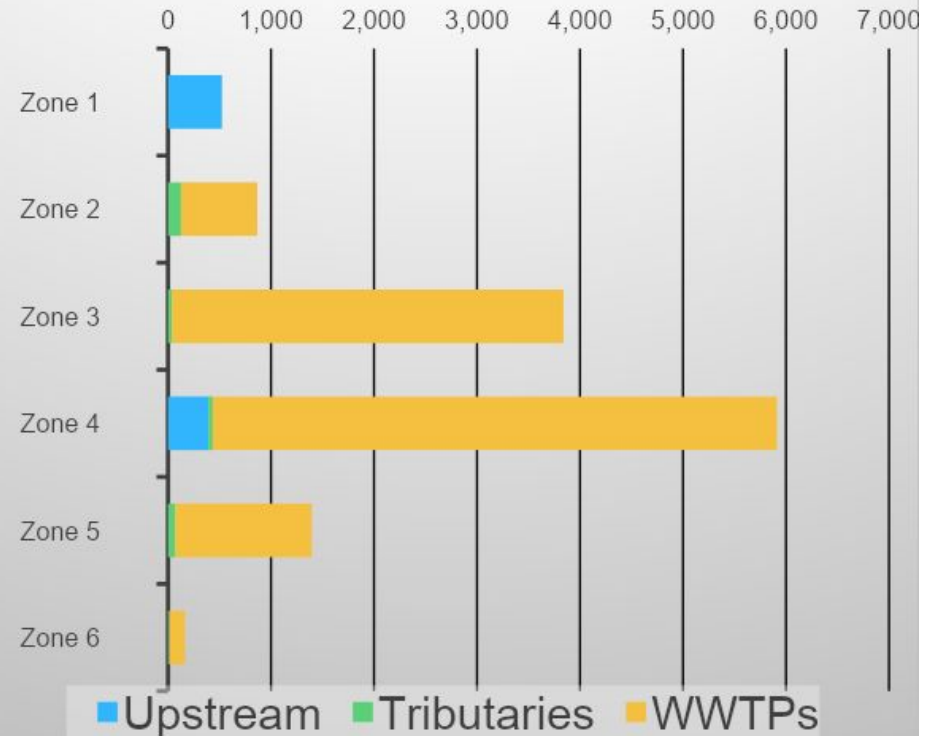
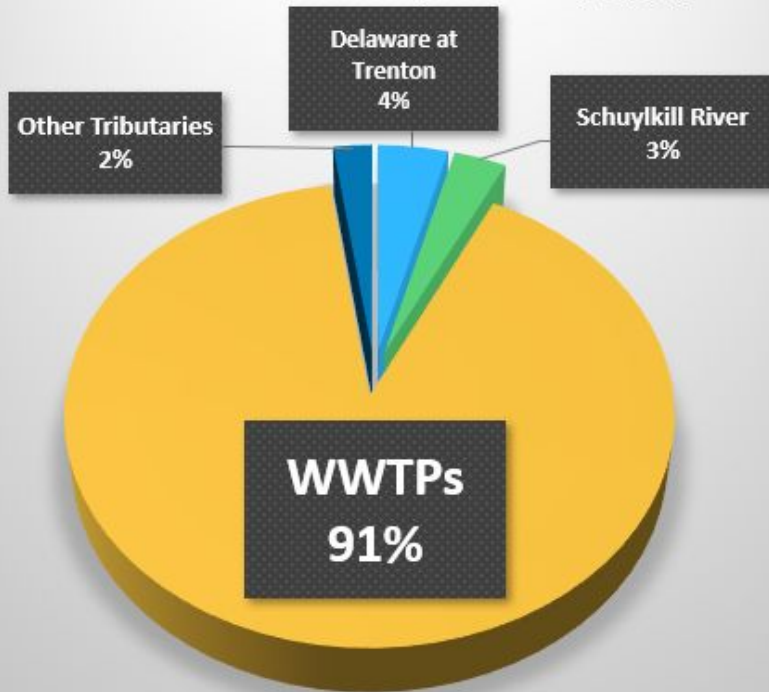
Studies required before Rulemaking



Understanding the Problem

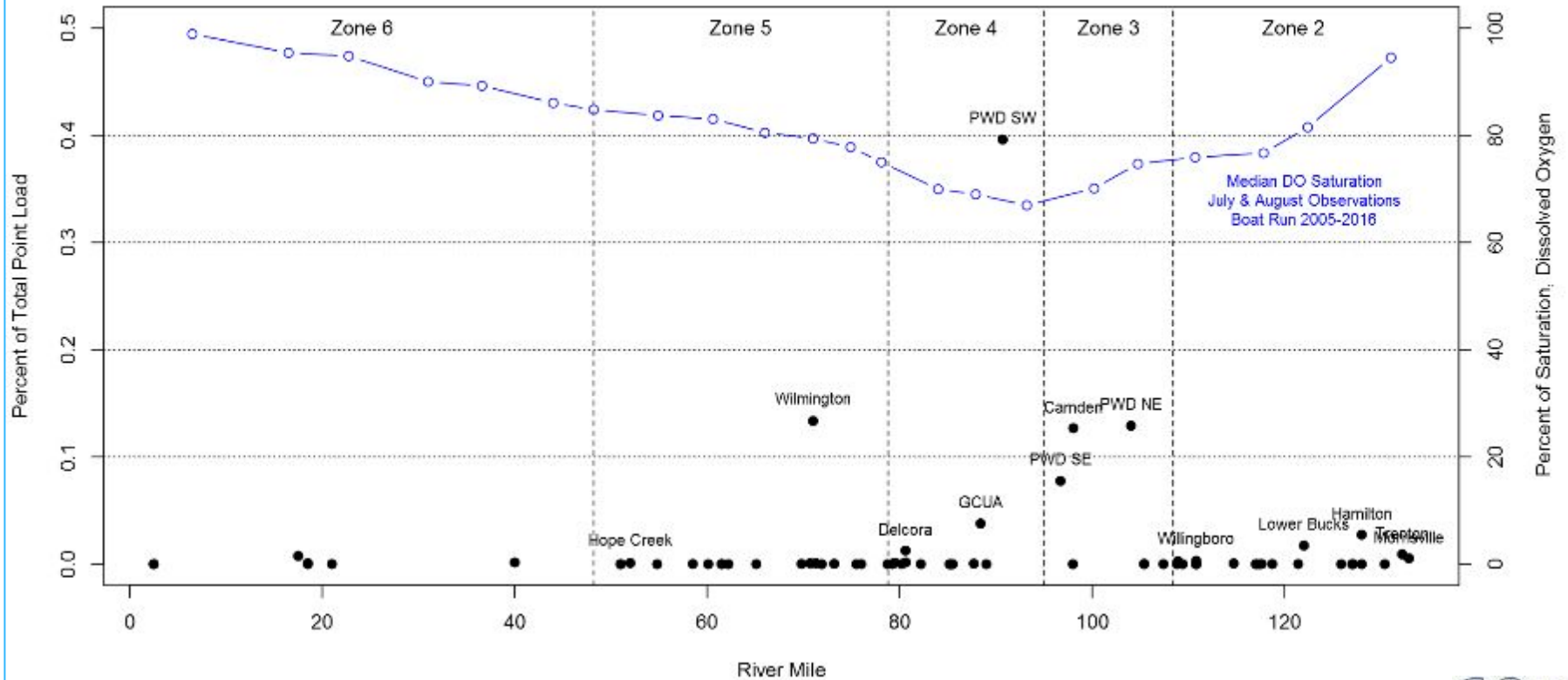


Ammonia Loads by Source (kg/yr)

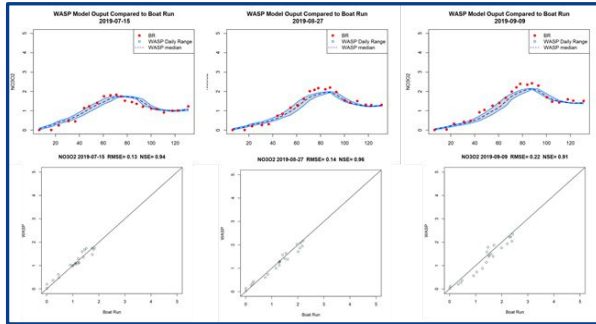


Ammonia Discharge and Remaining DO Sag

Relative Point Discharge Load by Delaware Estuary River Mile
NH₃ - Ammonia, whole water Loading



Eutrophication Model Calibration



Design Condition / Future

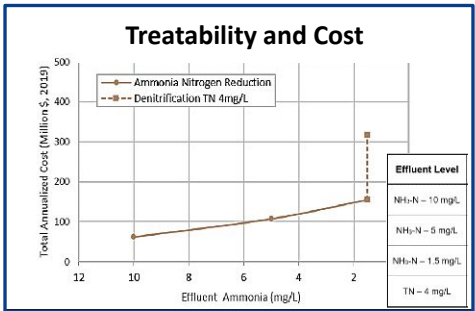
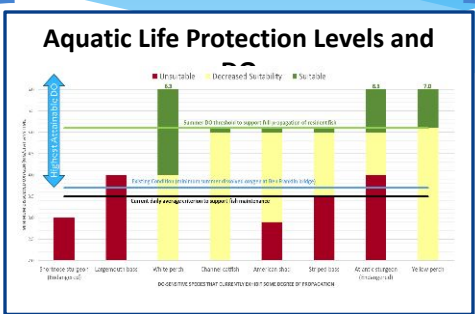
Eutro Model

Refined Candidate Scenarios

- ?
- ?
- ?
- ?

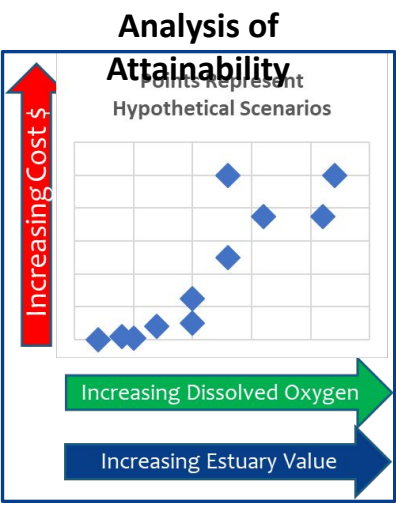
How much would DO condition improve if:

- Each of the point source nutrient scenarios were implemented
- Tributary boundaries were reduced
- Nonpoint sources were reduced
- Various sources reduced

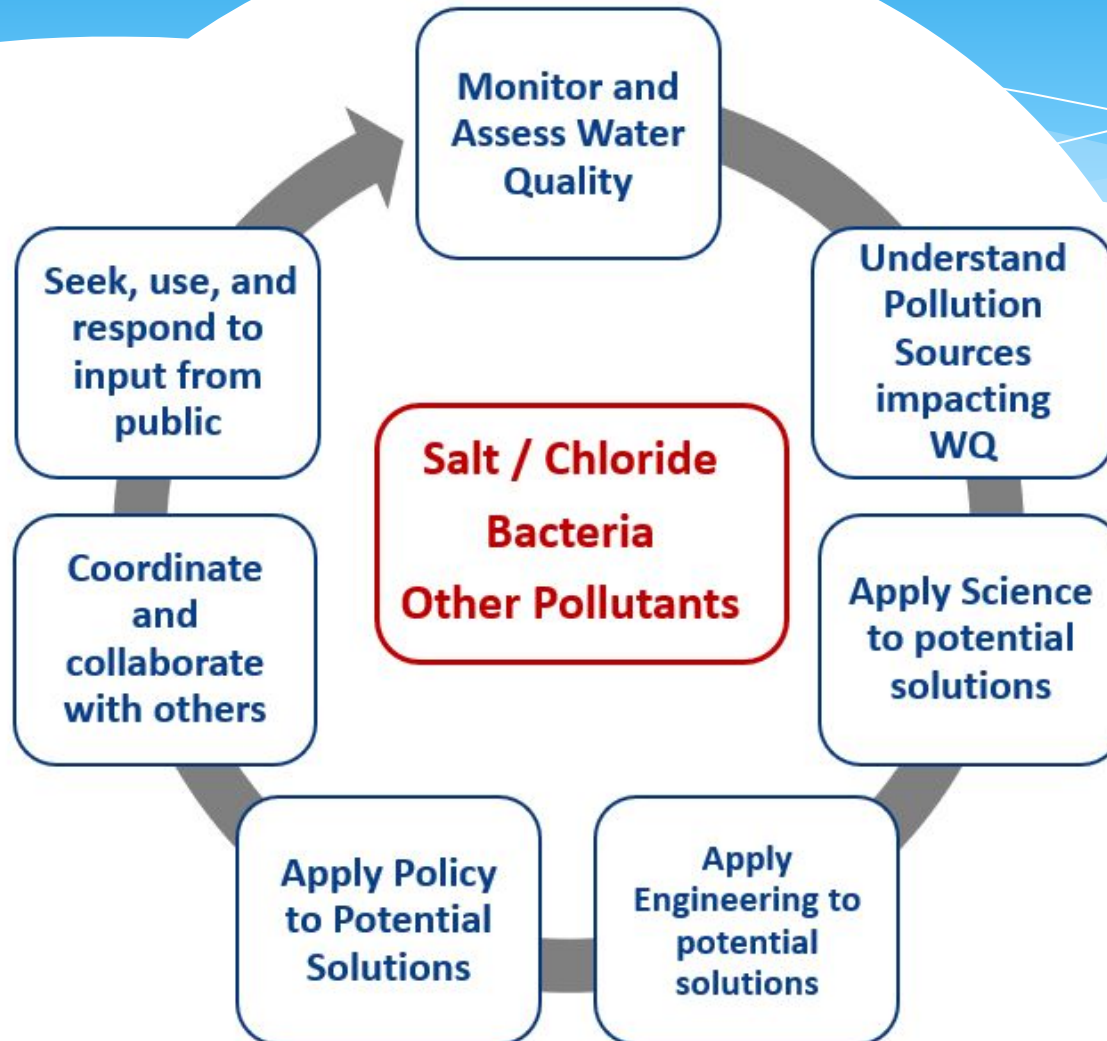


Social and Economic Evaluation

- Impact of enhanced fisheries on estuary value
- Evaluation of affordability
 - Implementation schedule
- Consideration of equity



Applying Strategy to Next Challenges

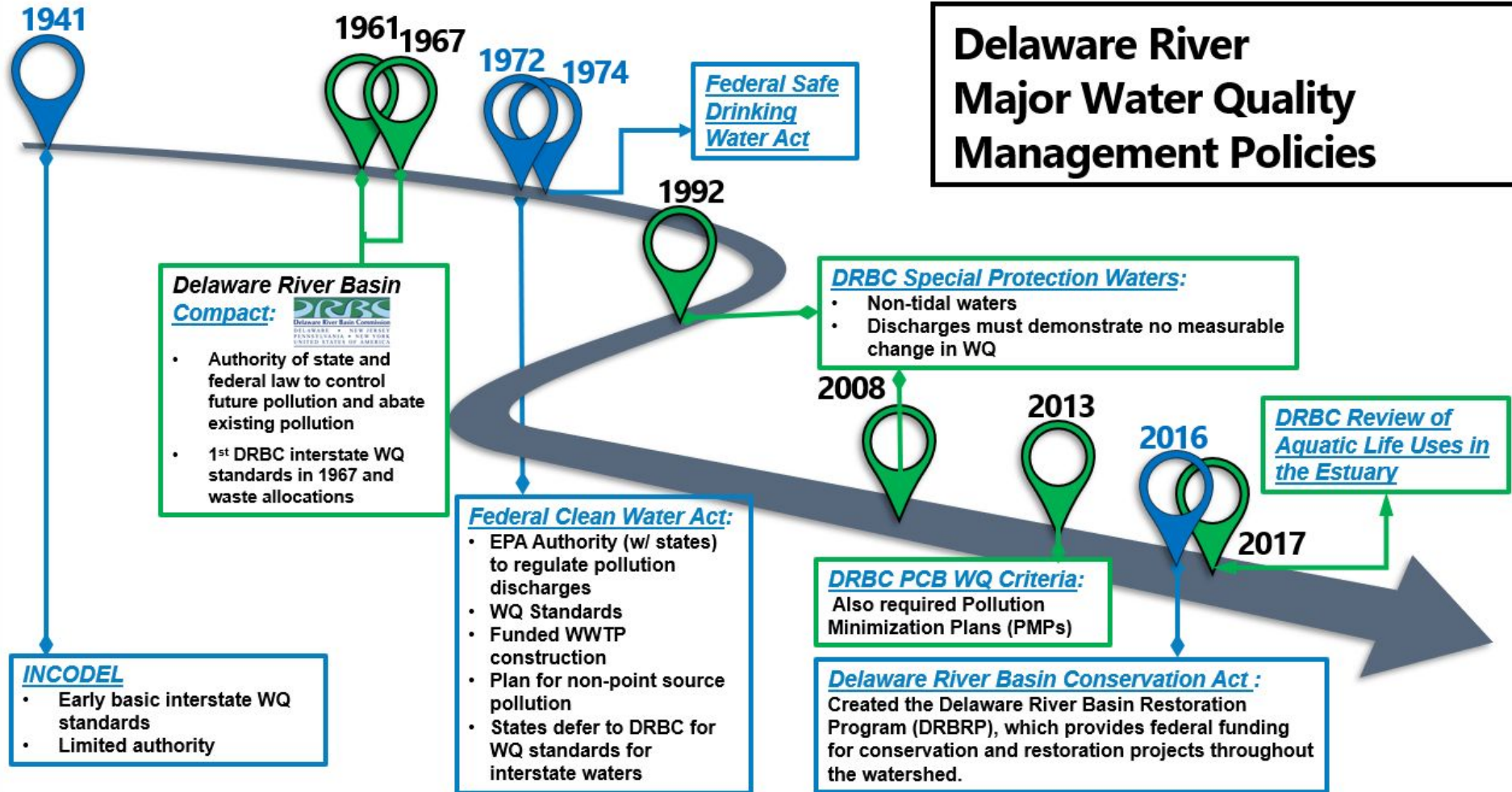


Additional Resources and Studies

- [Resolution 2017-4](#)
- [A Review of Dissolved Oxygen Requirements for Key Sensitive Species in the Delaware Estuary](#)
- [Nitrogen Reduction Cost Estimation Study: Final Summary Report](#)
- [Existing Use Evaluation for Zones 3, 4, & 5 of the Delaware Estuary Based on Spawning and Rearing of Resident and Anadromous Fishes](#)
- [WQAC meeting minutes and presentations](#)



Delaware River Major Water Quality Management Policies



Summary



- **Significant and remarkable improvement in Estuary WQ since DRBC was formed.**
- **More work needs to be done to address nutrients (ammonia); salt threats; legacy pollutants; bacteria; and other pollution sources.**
- **Success, has been, and will continue to be achieved by:**
 - ✓ Understanding sources of pollution
 - ✓ Applying good science, engineering, and policy
 - ✓ Collaborating to bring the best resources to the solution process
 - ✓ Investing in green and grey infrastructure
 - ✓ Seeking and listening to the diverse public and Basin stakeholders
 - ✓ Monitoring water quality and measuring results.

Steve Tambini, Executive Director

Steve.Tambini@drbc.gov

www.drbc.gov



Delaware River Basin Commission

DELAWARE • NEW JERSEY
PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA

***Managing, Protecting & Improving the Basin's
Water Resources Since 1961***

Thank you for joining us!

Visit the Forum Hub to find your next session!

Join the conversation on social media using **#DelRivForum2021!**



@DelRivCoalition

Coalition for the Delaware River Watershed

Thank you to our Sponsors

Basin Champions



Watershed Warriors



Spirit of the River

