Delaware River Basin Commission

Analysis of Attainability Part 1:

A Strategy to Determine Potential Designated Uses in the Delaware River Estuary

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Delaware Estuary Science and Environmental Summit

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Delaware River Basin Commission

Compact signed 1961

Five Equal Members:

- Delaware
- New Jersey
- Pennsylvania
- New York
- Federal Government

Broad Responsibilities / Authorities

- Water Supply
- Drought Management
- Flood Loss Reduction
- Water Quality
- Watershed Planning
- Regulatory Review (Permitting)
- Outreach/Education
- Recreation

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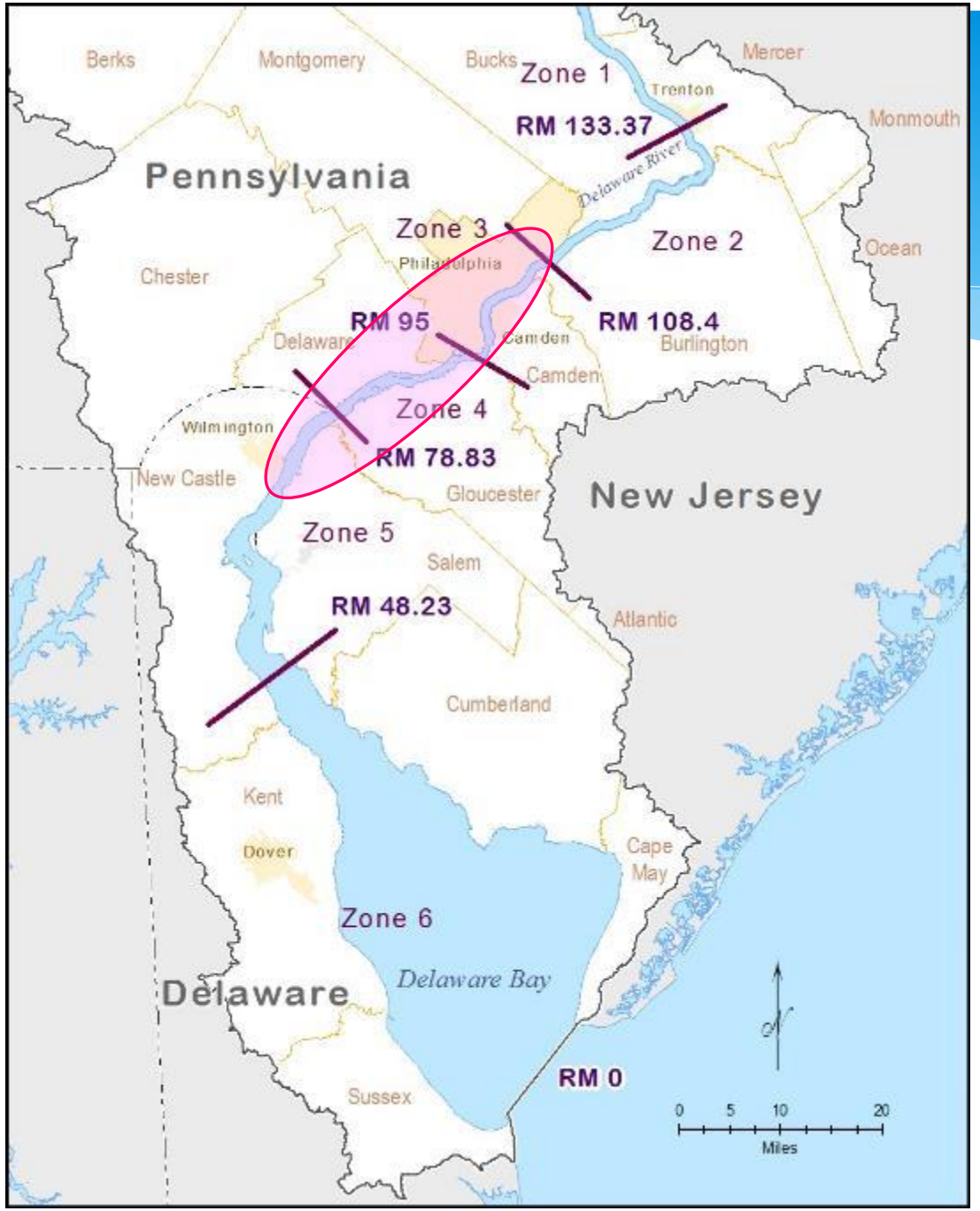

Delaware River Estuary

WQ Assessment Units:

Zone 1: Non-tidal (Upstream from Trenton)

Estuary:

Zone 2 - 5: Tidal Delaware River

Zone 6: Delaware Bay

River Miles:

RM 0.0 = Atlantic Ocean

RM 70 = City of Wilmington

RM 100 = Ben Franklin Bridge, Philadelphia/Camden

RM 133 = "Head of Tide", Trenton, NJ

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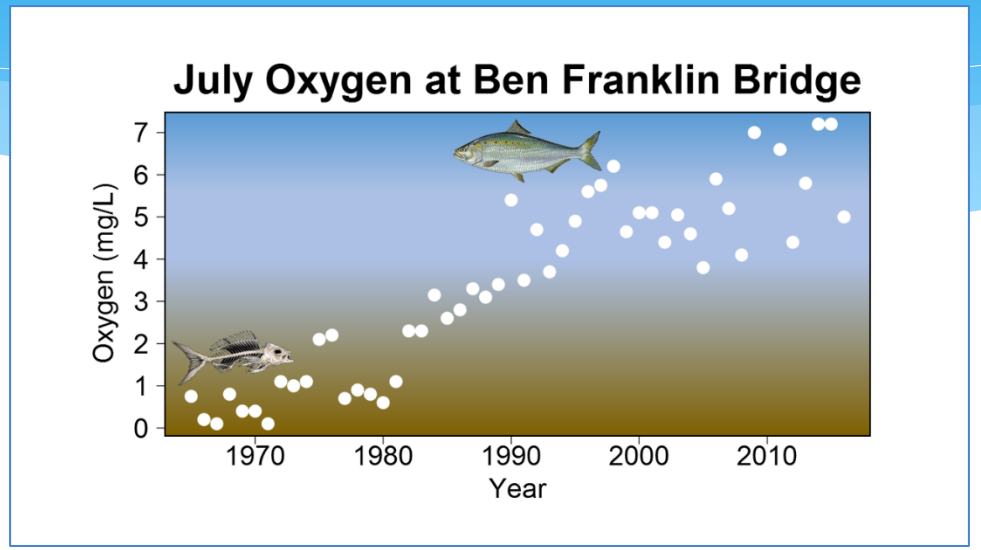
Evaluation of Existing Use in Urbanized Area

* The water quality goals established in 1967 have been exceeded
  * Dissolved oxygen exceeds 3.5 mg/L as a daily average concentration
* Fisheries enhanced due to improved dissolved oxygen condition[1]
  * Some degree of propagation has been observed
  * Full attainment of propagation has not been demonstrated

1 https://www.nj.gov/drbc/library/documents/ExistingUseRpt_zones3-5_sept2015.pdf



* DO-sensitive species that currently exhibit some degree of propagation
  * American shad
  * Atlantic sturgeon
  * Channel catfish
  * Largemouth bass
  * Shortnose sturgeon
  * Striped bass
  * White perch
  * Yellow perch

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DRBC Resolution 2017-04
Studies Required Before Rulemaking

Fish/DO Studies

- 6(a). Input on the **dissolved oxygen requirements of aquatic species**
- 6(b). Field studies of the occurrence, spatial and temporal distribution of the life stages of Estuary fish species
- 6(c). Input from consultations pursuant to the **Endangered Species Act** ("ESA")

Modeling Studies

- 6(d). Development and calibration of a **eutrophication model** for the Delaware River Estuary and Bay;
- 6(e). Determination of the nutrient **loadings from point and non-point sources** necessary to support key aquatic species;

Cost/Feasibility Studies

- 6(f). Evaluation of the **capital and operating costs for treatment** capable of achieving higher levels of dissolved oxygen;
- 6(g). Evaluation of the physical, chemical, biological, **social and economic factors affecting the attainment of uses**,

6. "Analysis of Attainability"

6(h). Preparation of a **draft report and final report** containing findings and conclusions.

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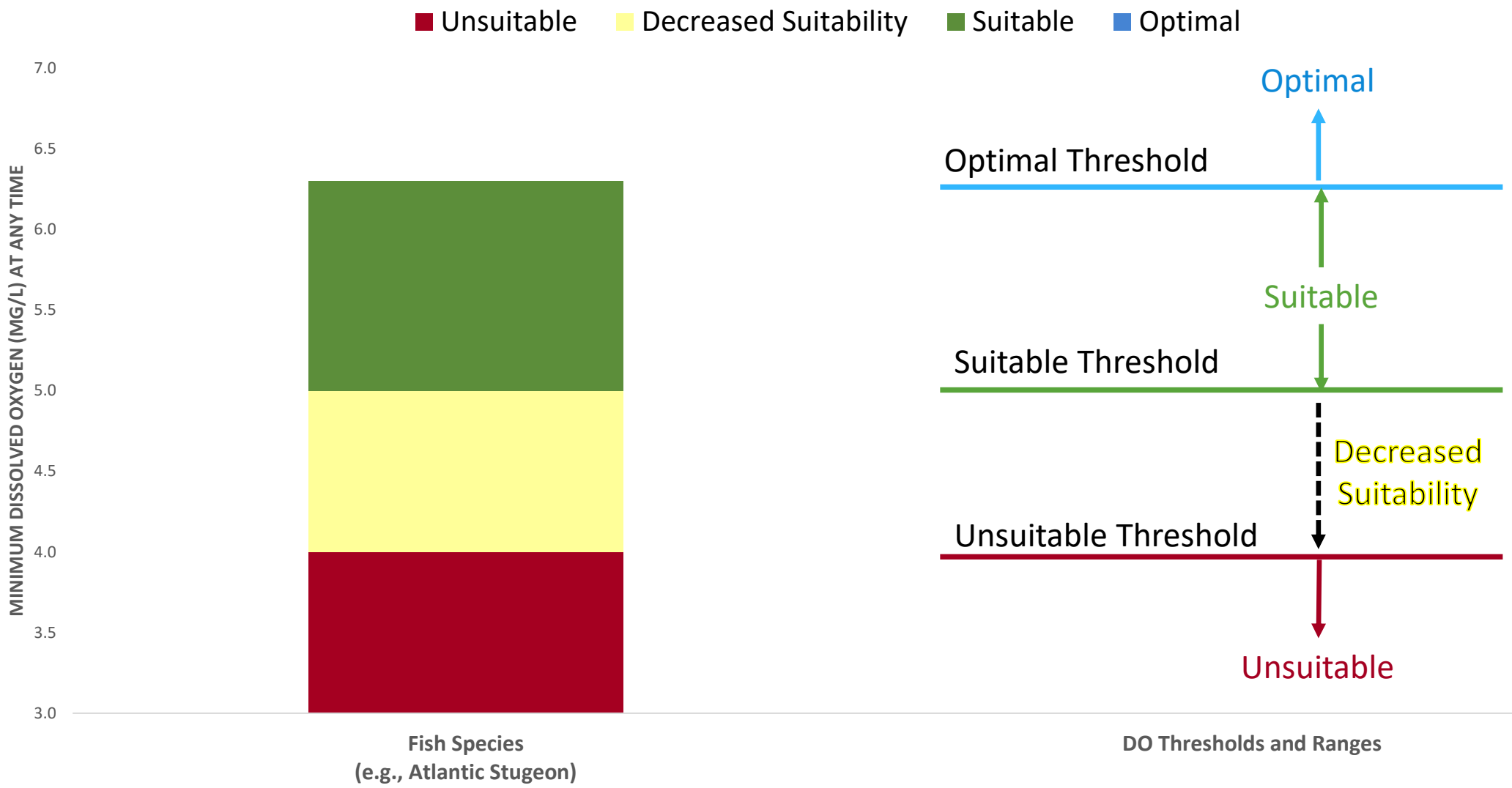
Conceptual Model Relating Dissolved Oxygen to Use



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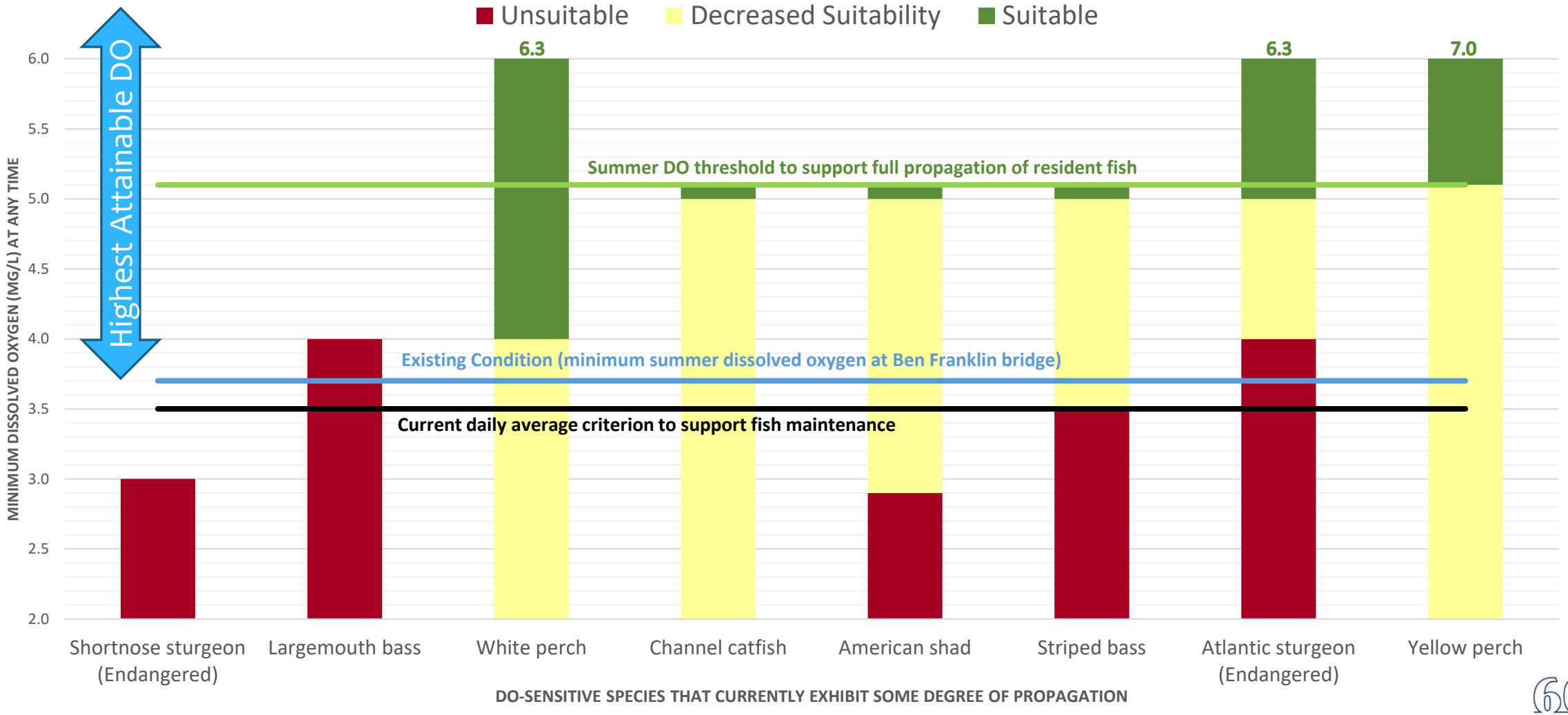
Conceptual Model Applied to Zone 3 in Summer



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What is an "Analysis of Attainability?

What We Know

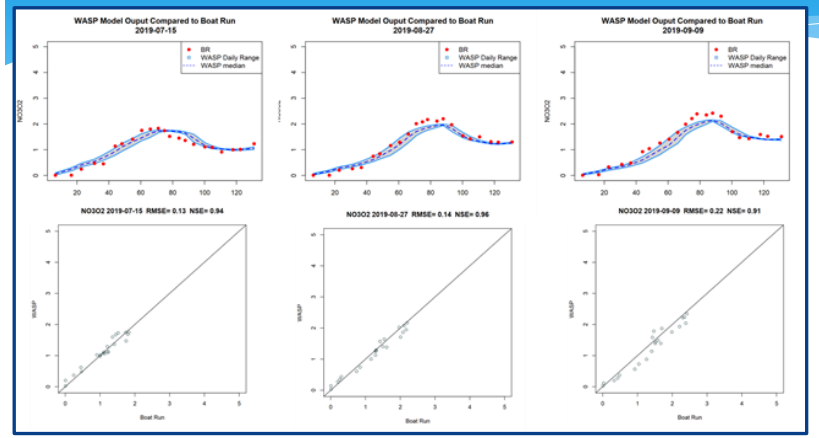
* Minimum Dissolved Oxygen conditions are critical to supporting fish propagation
* Existing DO condition supports some degree of propagation among resident fish
  * Since the degree of propagation associated with the existing DO condition is an Existing Use, it must be protected
  * Therefore, current minimum DO condition (3.7 mg/L) must be maintained or enhanced
* Higher minimum DO condition (i.e., more oxygen) will enhance the degree of fish propagation
  * Full propagation among resident fish would appear to be supported by a minimum DO of approximately 5 mg/L

What We Need to Determine

* How much can the DO condition be improved?
  * What would the DO condition be under "reference background" loading conditions?
  * What would the DO condition be under various levels of point and nonpoint source pollutant reductions?
  * Is it feasible to meet the minimum required DO to support propagation of all sensitive species?
* What would be the costs and benefits associated with the various point and nonpoint source reductions?
* DRBC must determine Highest Attainable Dissolved Oxygen (HADO) condition
  * Revised designated use will be the enhanced degree of propagation associated with the HADO condition

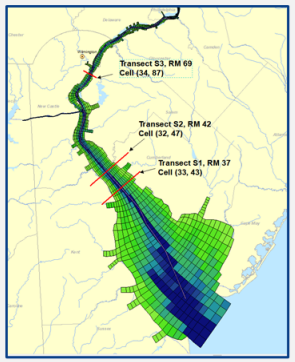
Elements of "Attainability Analysis"

Eutrophication Model Calibration



Design Condition / Future Scenarios

Eutro Model



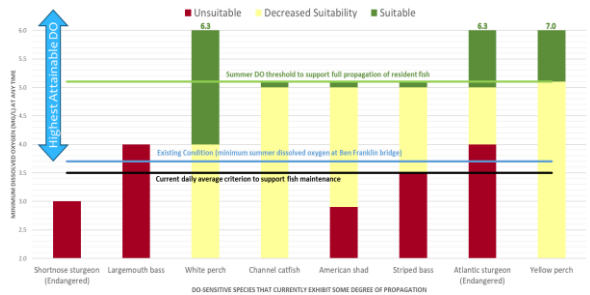
Refined Candidate Scenarios

? ? ? ?

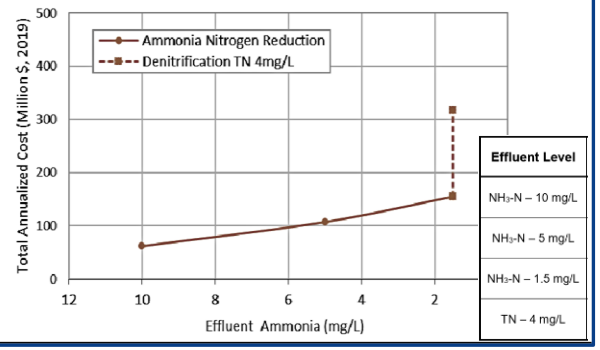
How much would DO condition improve if:

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

Aquatic Life Protection Levels and DO



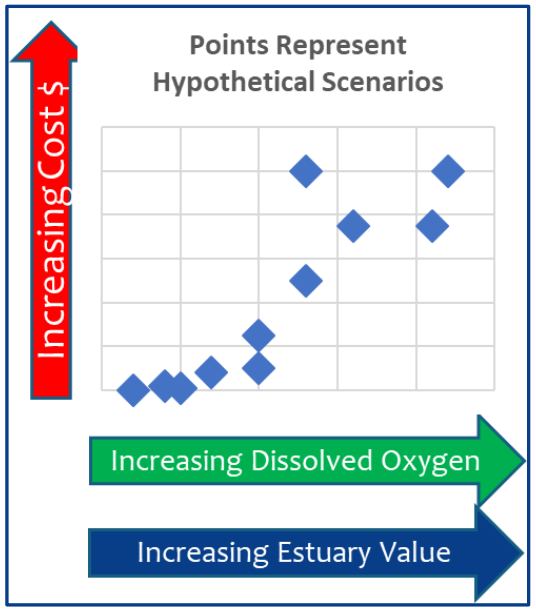
Treatability and Cost



Social and Economic Evaluation

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

Analysis of Attainability



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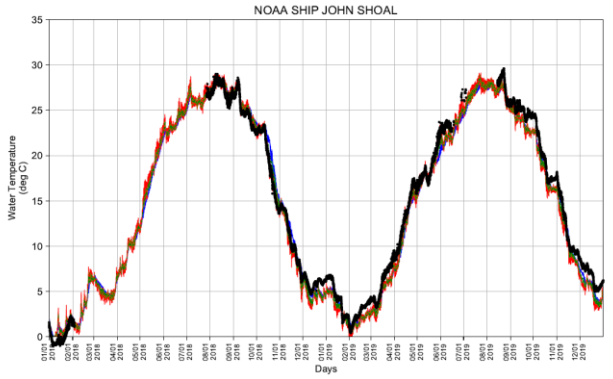
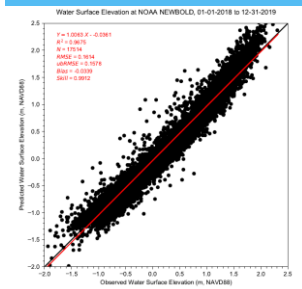
System-Wide Eutrophication Model

Hydrodynamic Model





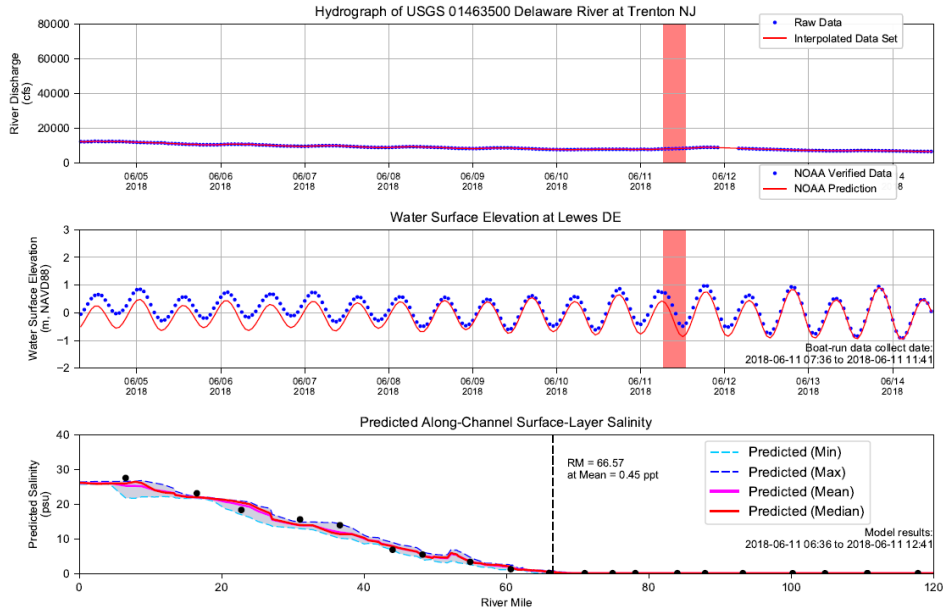
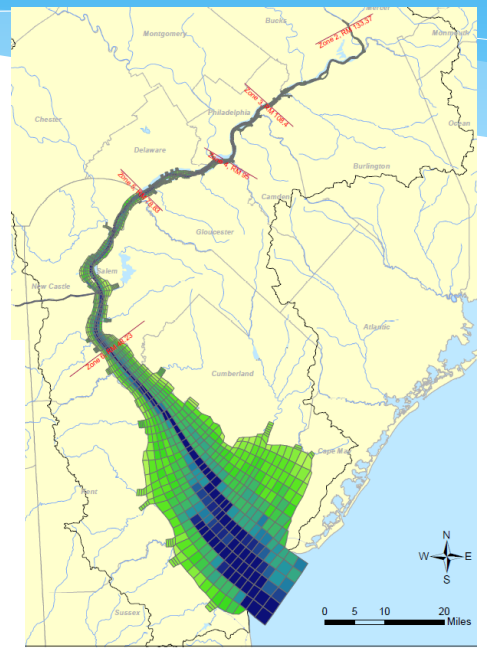


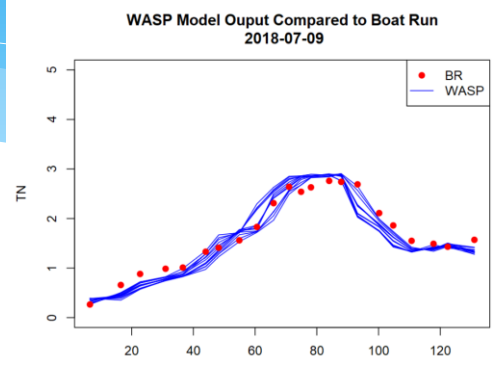
Figure --

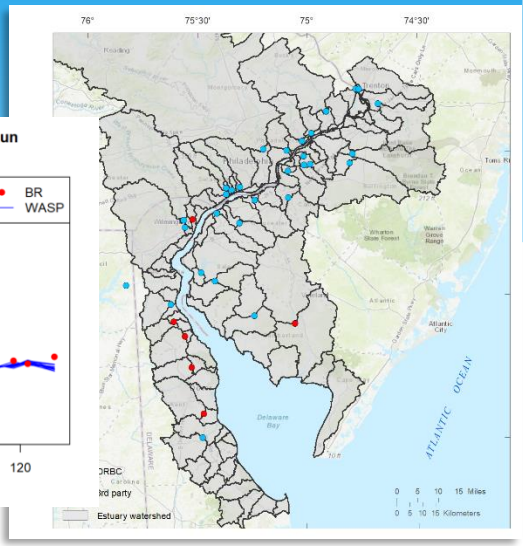
Longitudinal Profile of Salinityin Delaware River and Bay

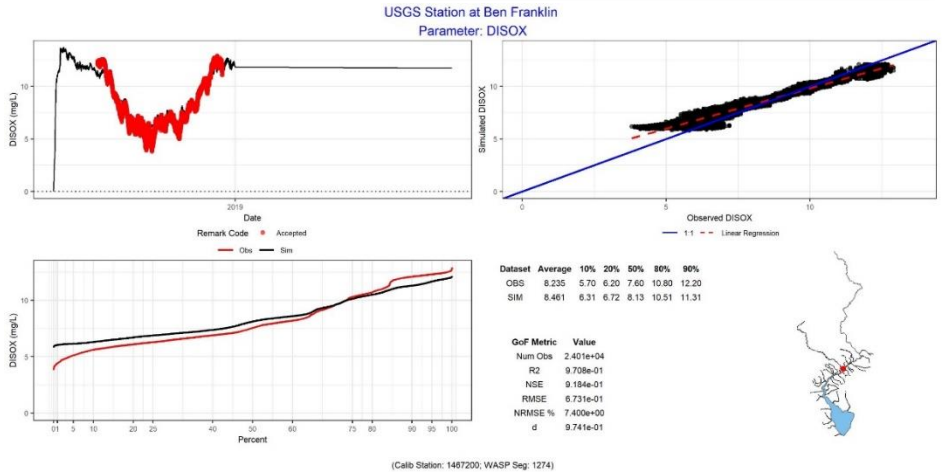
Notes: Salinity and Chloride data collected by boat-run survey were used. Date that under detention limit were set to half of the detection limit.
Red shaded area indicates the boat run survey time period: 2018-06-11 07:36 to 2018-06-11 11:41
Model results along the navigation channel during period of 2018-06-11 06:36 to 2018-06-11 12:41 were used in this analysis.



Water Quality Model







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Summary and Discussion

* Aquatic life use (degree of propagation) is directly related to dissolved oxygen conditions
  * System supports some degree of propagation for a variety of critical species now
  * System will support a much greater degree of propagation when Attainability Analysis is completed and implemented
* Results from seven studies identified in Resolution 2017-04 will guide "Attainability Analysis"
  * Highest Attainable Dissolved Oxygen (HADO) condition will be determined in the fish maintenance zones
  * Revised designated use will be the enhanced degree of propagation associated with the HADO condition

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