Delaware River Basin Commission

Delaware Watershed Research Fund

Evaluation of the technical, economic, and social impacts associated with updating major wastewater treatment infrastructure to address aquatic life uses and values for the Delaware Estuary

Delaware Watershed Research Conference

Academy of Natural Sciences of Drexel University
November 19, 2019

John Yagecic, P.E., Namsoo Suk, Ph.D., DRBC
Tim Bradley, P.E., Kleinfelder

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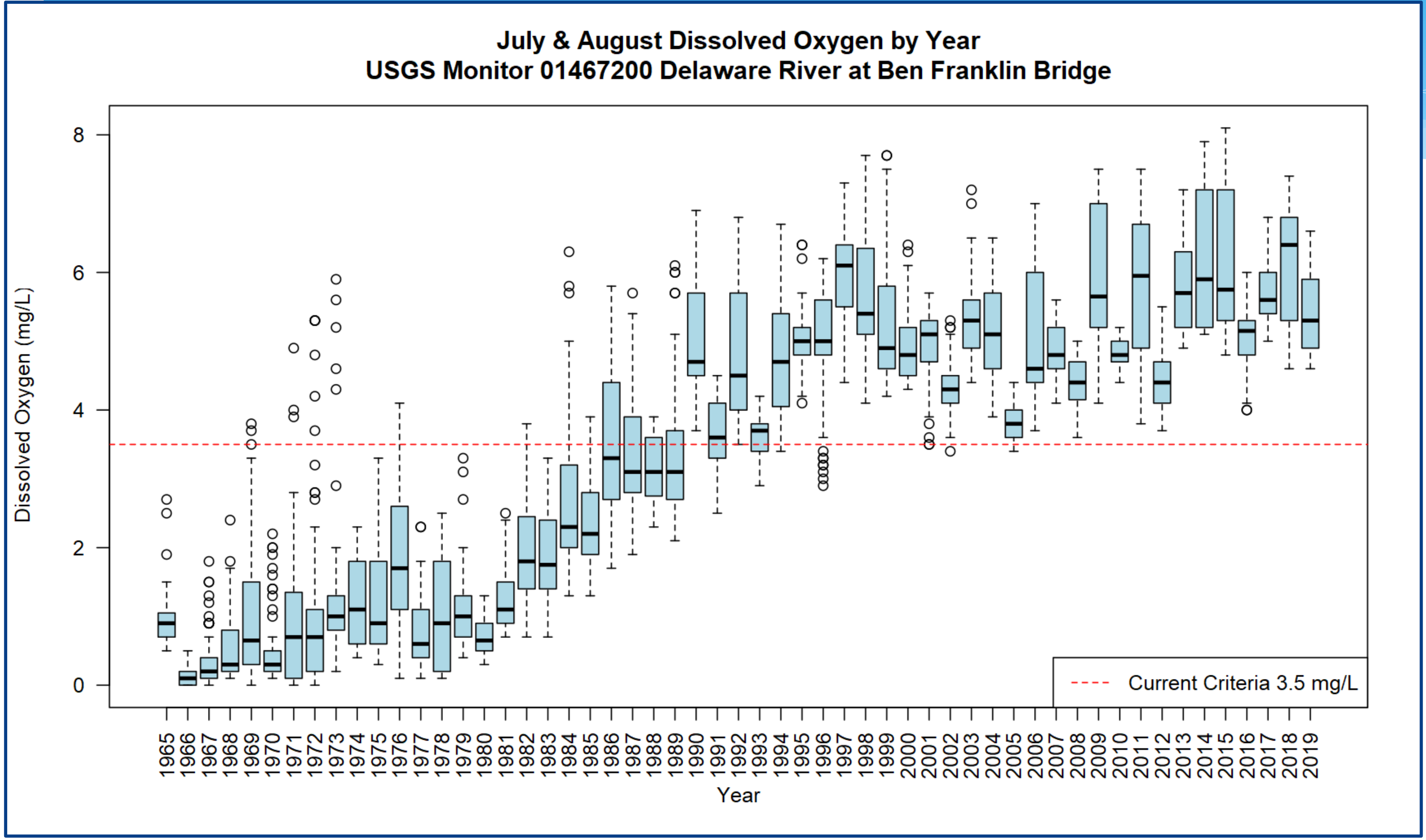
Delaware River Basin Commission

Compact signed in 1961 by Delaware, Pennsylvania, New Jersey, New York, Federal Government

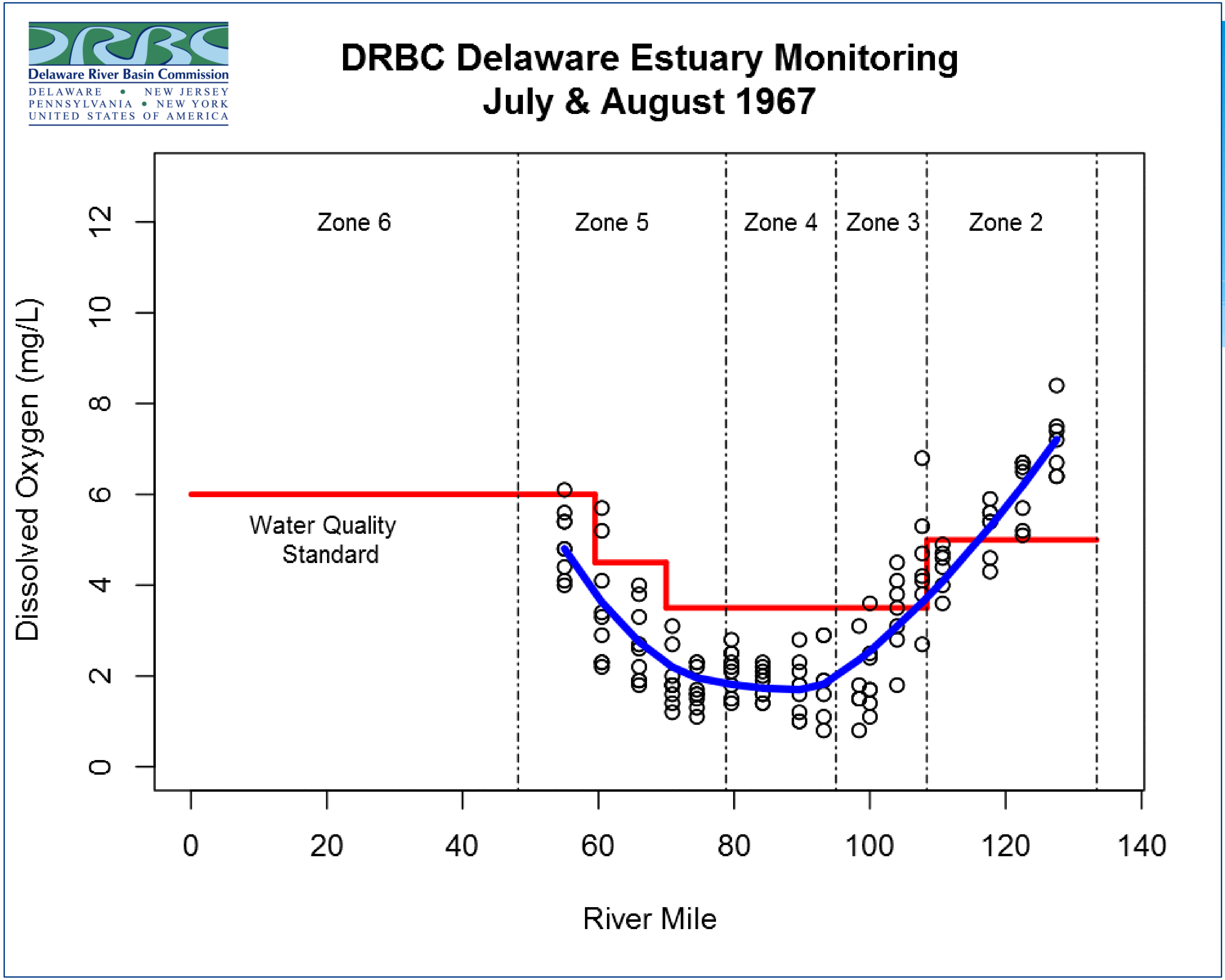
Broad Responsibilities / Authorities

- Water Supply
- Drought Management
- Flood Loss Reduction
- Water Quality
  - Establish Water Quality Standards
  - Monitoring & Assessment
  - Load Reductions
- Watershed Planning
- Regulatory Review (Permitting)
- Outreach/Education
- Recreation

Dissolved Oxygen Improvements



- Historically, summer DO too low for migratory fish to reach upstream to spawn
- DRBC adopted standards (1967) & allocations (1968)
- Secondary treatment added at wastewater treatment plants 70's & 80's – funding CWA



Dissolved Oxygen

- 3.5 mg/L criteria near Philadelphia, Camden, & Wilmington protect fish migration (not propagation)
- By 2000's that criteria is nearly always met
- Now, supporting some level of propagation

Dissolved Oxygen Next Phase

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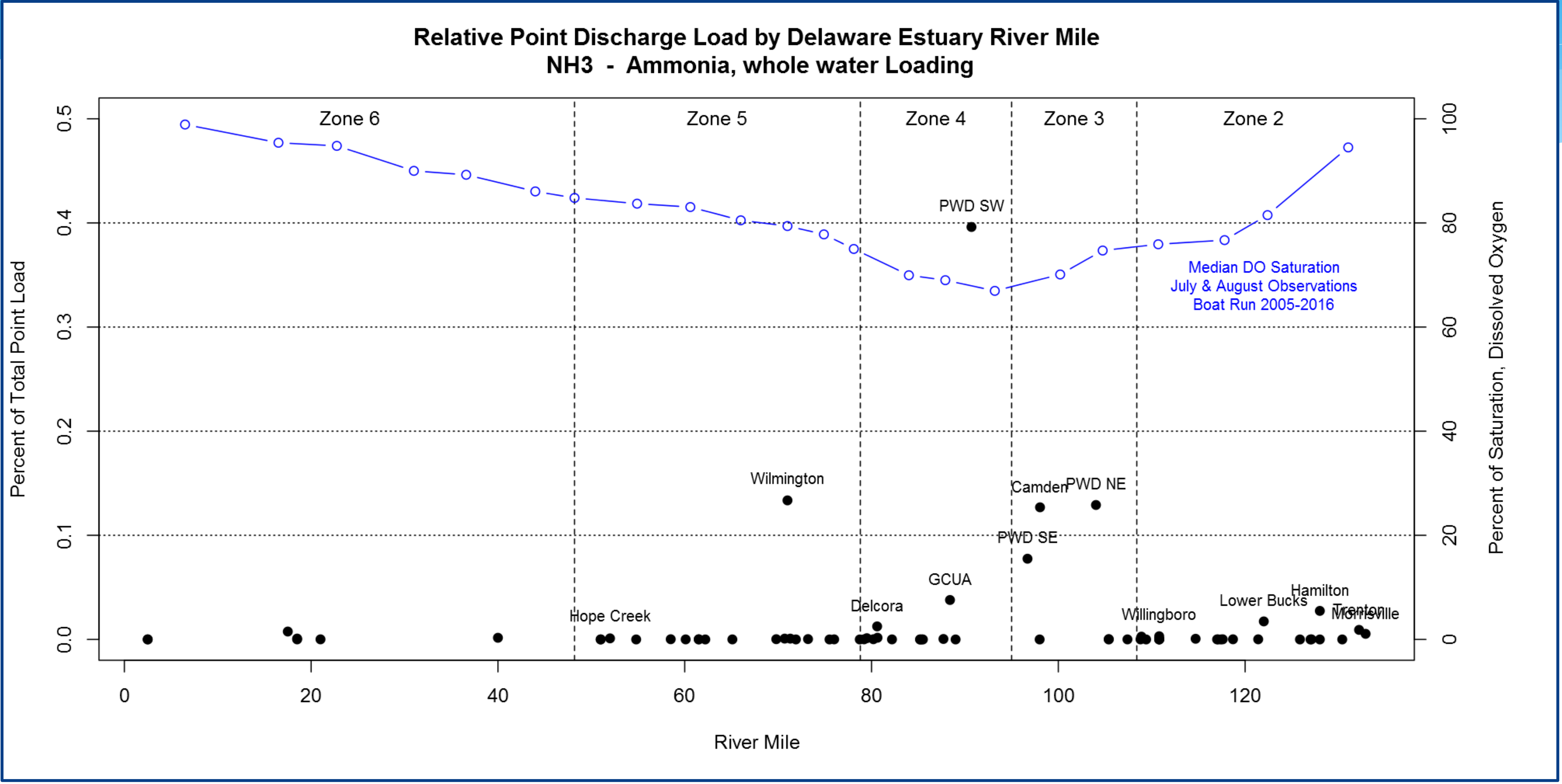

Resolution 2017-4

https://www.nj.gov/drbc/library/documents/Res2017-04_EstuaryExistingUse.pdf

- Experts on modeling water quality and dissolved oxygen requirements of aquatic species
- Studies of the occurrence, spatial and temporal distribution of life stages of Delaware River Estuary fish species
- Input concerning DO and other water quality criteria to support Atlantic sturgeon
- Development and calibration of Delaware Estuary eutrophication model
- Nutrient loadings from point and non-point sources to support needed DO
- Capital and operating costs for achieving higher levels of DO
- Evaluation of factors affecting attainment of uses
- Report of findings and conclusions with input from WQAC and other stakeholders
- Coordination with USEPA and NMFS

Engineering Evaluation & Cost Estimation

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- Contracted with Kleinfelder
- Planning level cost estimate for top 12 loading facilities to achieve new ammonia effluent levels and total nitrogen
- Coordination with facilities
- Initiated summer 2018, 2-year contract
- Tim Bradley managed a nearly identical project for New Jersey Harbor Dischargers Group
- To be followed by an evaluation of rates and benefits by University of Delaware, Water Resources Center

Engineering evaluation & cost estimate

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Preliminary Technology and Final Effluent Level Recommendations

Effluent Level	Conventional Activated Sludge	Pure Oxygen Activated Sludge	Fixed Film (RBC and TF)
NH_3-N – 10 mg/L	Conversion to IFAS with low level of media addition to aeration tanks	Add downstream BAF sized for approximately 50% of plant flow	Add downstream BAF sized for approximately 50% of plant flow
NH_3-N – 5 mg/L	Conversion to IFAS with medium level of media addition to aeration tanks	Add downstream BAF sized for approximately 75% of plant flow	Add downstream BAF sized for approximately 75% of plant flow
NH_3-N – 1.5 mg/L	Conversion to IFAS with high level of media addition to aeration tanks	Add downstream BAF sized for 100% of plant flow	Add downstream BAF sized for 100% of plant flow
TN – 4 mg/L	Conversion to IFAS with high level of media addition plus downstream DF	Add downstream BAF sized for 100% of plant flow plus DF	Add downstream BAF sized for 100% of plant flow plus DF

- IFAS – Integrated fixed film activated sludge
- BAF – Biological Aerated Filter
- DF – Denitrification Filter

Photo courtesy of University of New Mexico

Generic Capital Cost Estimates

Table 10: Generic Pure Oxygen Plant Summary of Capital Costs

Effluent Level	Capital Cost Estimate	$/gpd of capacity
NH_3-N = 10 mg/L	$80 million	1.0
NH_3-N = 5 mg/L	$105 million	1.3
NH_3-N = 1.5 mg/L	$134 million	1.6
TN = 4 mg/L	$336 million	4.0

Table 19: Generic Fixed Film Plant Summary of Capital Costs

Effluent Level	Capital Cost Estimate	$/gpd of capacity
NH_3-N = 10 mg/L	$23 million	2.5
NH_3-N = 5 mg/L	$28 million	3.1
NH_3-N = 1.5 mg/L	$33 million	3.7
TN = 4 mg/L	$57 million	6.3

Table 28: Generic Conventional Activated Sludge Plant Summary of Capital Costs

Effluent Level	Capital Cost Estimate	$/gpd of capacity
NH_3-N = 10 mg/L	$35 million	0.5
NH_3-N = 5 mg/L	$113 million	1.6
NH_3-N = 1.5 mg/L	$130 million	1.8
TN = 4 mg/L	$243 million	3.4

Technical Memorandum
September 27, 2019

Kleinfelder's Approach to DRBC's Nitrogen Reduction Cost Estimation Study

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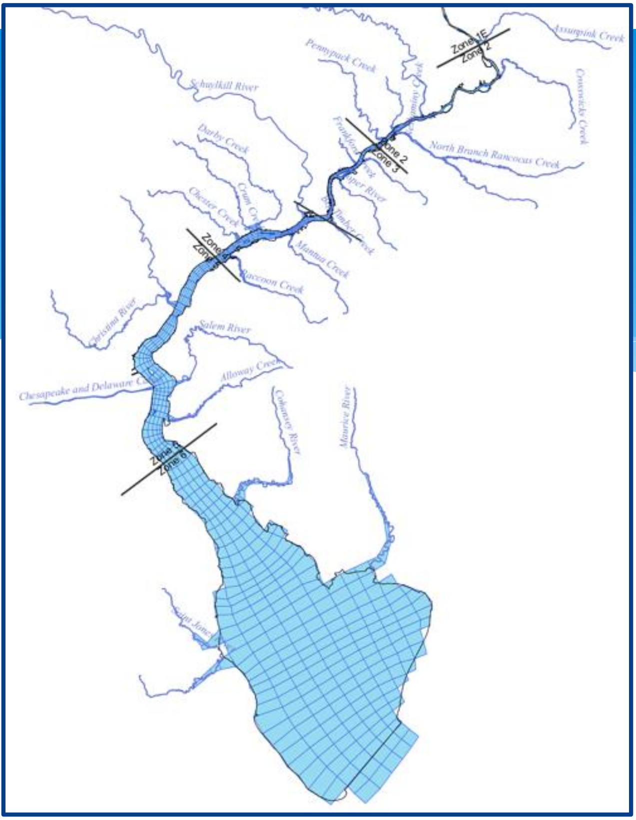
Phase 1 – Develop Costs for Generic Plants

- Evaluate Existing Plants
- Develop Generic Plant Descriptions for each Plant Type
  - Conventional Activated Sludge
  - Pure Oxygen Activated Sludge
  - Fixed Film – Trickling Filter and Rotating Biological Contactor
- Develop Technology recommendations for NH3-N and TN Removal
- Finalize effluent levels for NH3-N and TN Removal
- Develop capital cost estimates for generic plants on a $/gpd basis for each level of treatment

Phase 2 – Develop Plant Specific Cost Estimates and Cost Curves

- Use generic plant $/gpd costs to establish "base capital cost" for each plant and level of treatment
- Add/Subtract costs based on plant specific performance, issues and constraints
- Develop Plant Specific O&M costs for each plant and level of treatment
  - Staffing, chemicals, energy, sludge processing and disposal, maintenance
- Prepare cost curves based on total present cost
  - Plant specific capital costs plus present worth of O&M costs
- Also develop cost curves based on annualized cost
  - Amortized plant specific capital costs plus annual O&M cost
- Prepare Draft and Final Summary Reports
- Conduct Meetings and Perform Project Administration Activities

Other Actions Underway



- Development of estuary eutrophication model
  - Model expert panel
- DO early action workgroup
- DO needs report from ANSDU
  - https://www.nj.gov/drbc/library/documents/Review_DOreq_KeySensSpecies_DelEstuary_ANStoDRBCnov2018.pdf

- Enhanced monitoring for model development
  - Point discharge monitoring
  - Boat run to year-round
  - Added salinity at tidal boundaries
  - Added nitrate at Trenton & Chester
  - Extensive tributary monitoring
  - Light extinction monitoring
  - Primary production

Questions & Discussion

Resources

DRBC's Water Quality Advisory Committee

https://www.nj.gov/drbc/about/advisory/WQAC_index.html

DRBC e-mail groups

https://www.nj.gov/drbc/contact/interest/index.html

Contact

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