

Long-Term Monitoring of Water Quality Improvement Following Wastewater Treatment Nutrient Reductions



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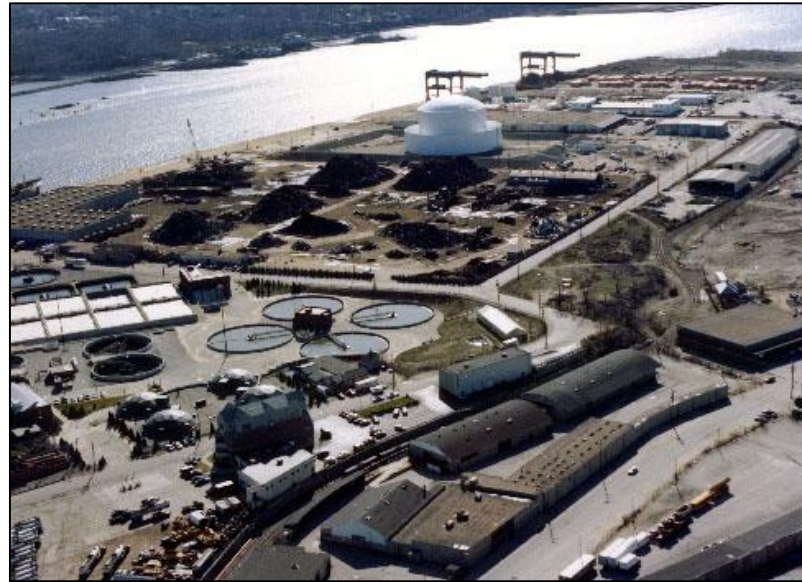
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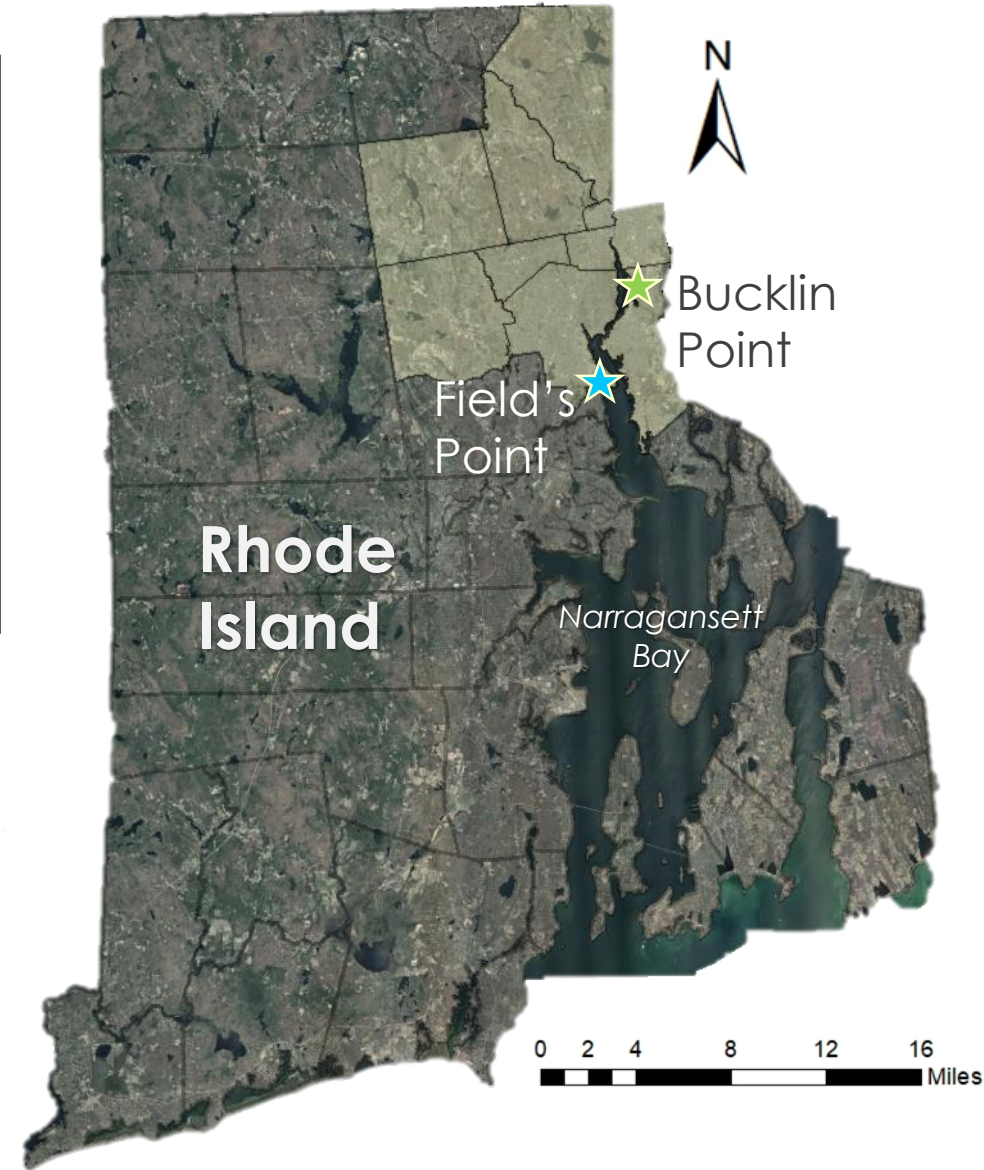
Narragansett Bay Commission (NBC)

- Quasi-state agency
- Owns and operates the two largest wastewater treatment facilities in Rhode Island
- Service area: 10 municipalities
- Over 360,000 people served, over 8,000 commercial and industrial users
- Leader in protection and enhancement of water quality in Narragansett Bay

Field's Point – Providence

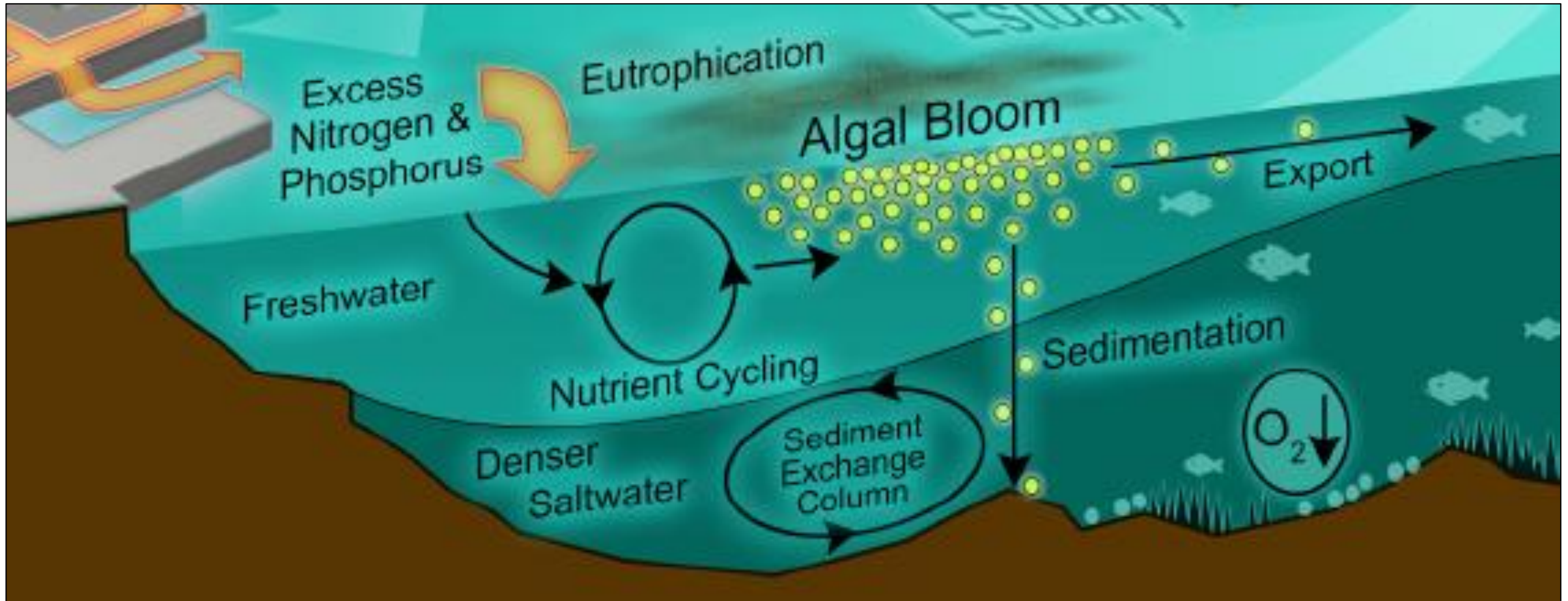


Bucklin Point – East Providence



Wastewater Treatment and Nutrients

- Source of nitrogen to estuaries worldwide
- Nitrogen, high water temperatures, and sunlight can fuel algal blooms
- Algal decomposition, low mixing – persistence of hypoxia (low-oxygen conditions)

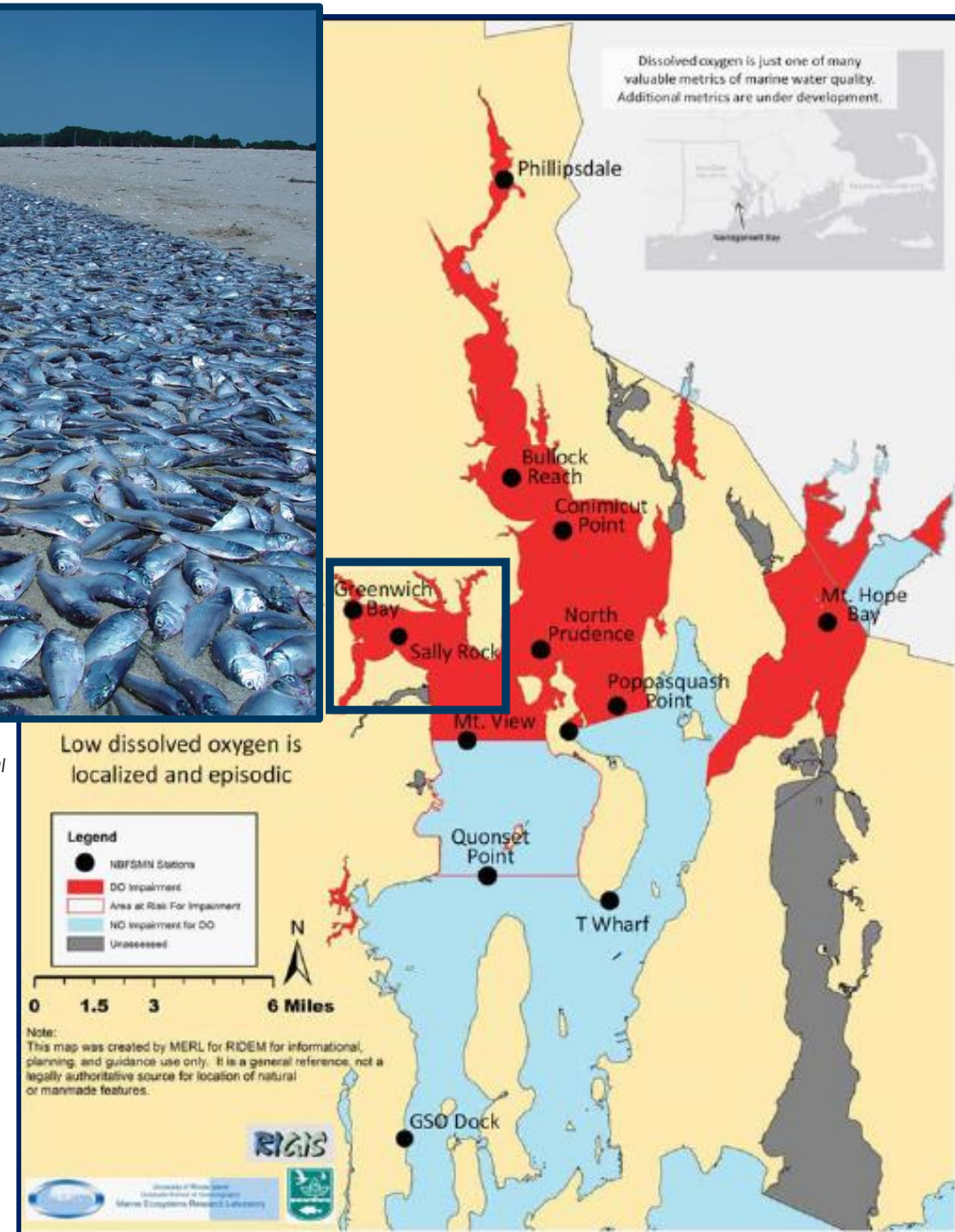


Rhode Island Hypoxia and WWTF Regulations

- Narragansett Bay: seasonal hypoxia
- Greenwich Bay fish kill in 2003: accelerated plans to initiate N reductions
- RI lawmakers: mandated WWTFs reduce nitrogen loading to Narragansett Bay by 50%
- NBC TN permit limits: 5 mg/L May-October



Source: Rhode Island Dept. of Environmental Management

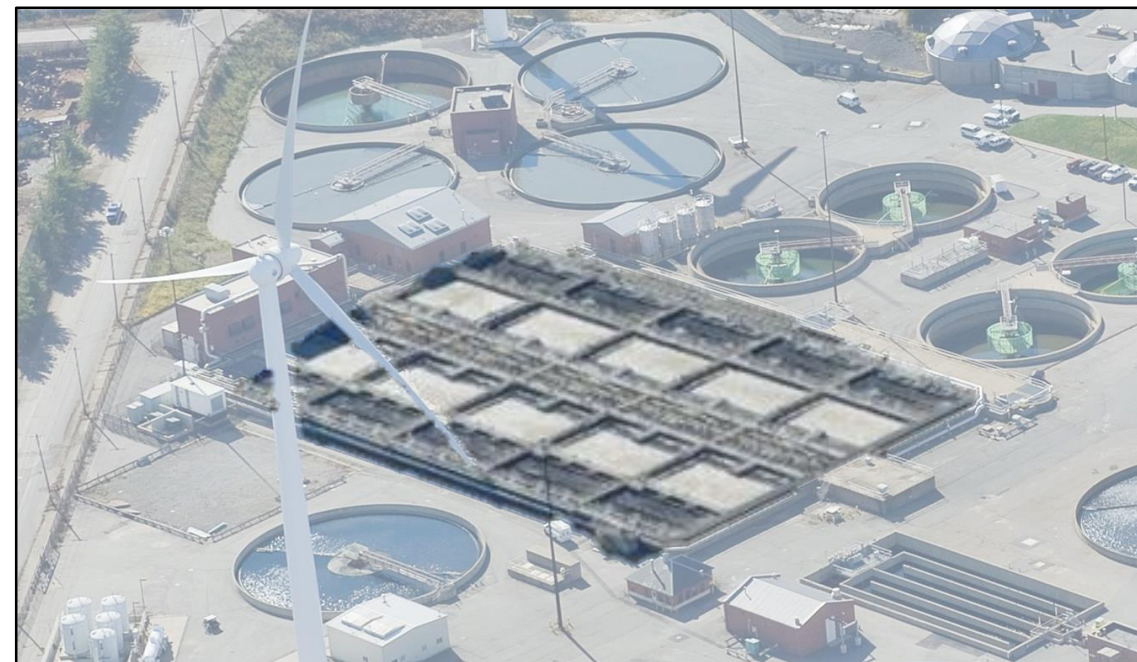
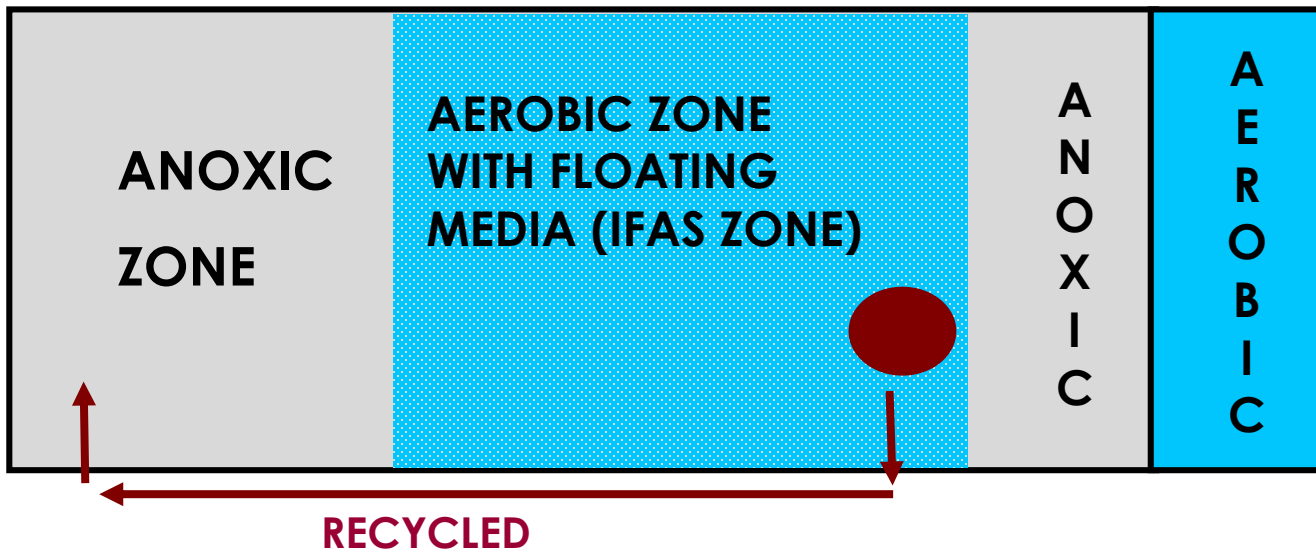


Source: University of Rhode Island Marine Ecosystem Research Laboratory for Rhode Island Department of Environmental Management

NBC Nutrient Removal Upgrades - Field's Point

Integrated Fixed-Film Activated Sludge (IFAS)

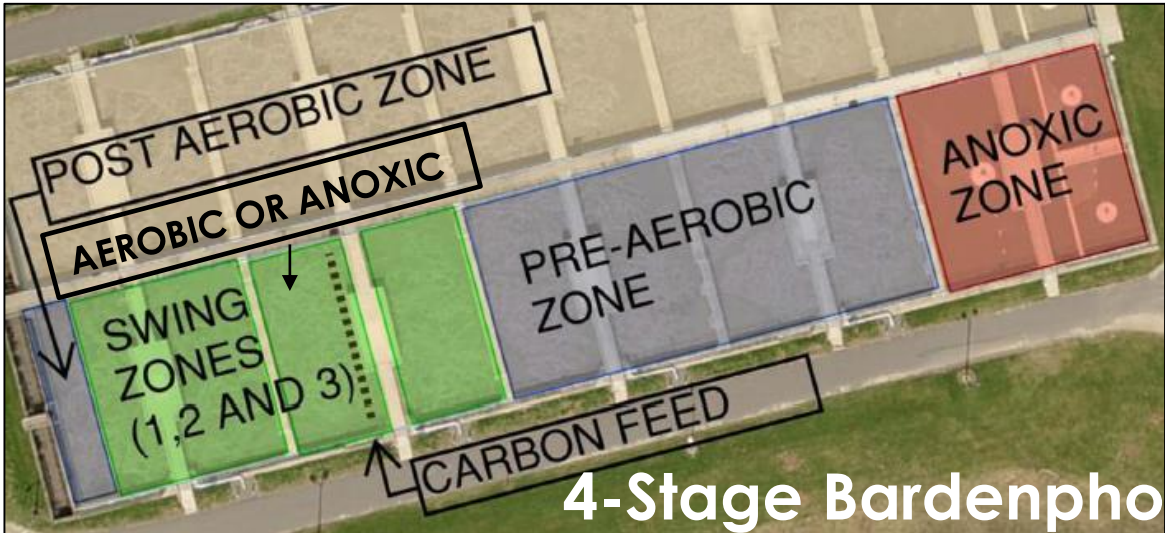
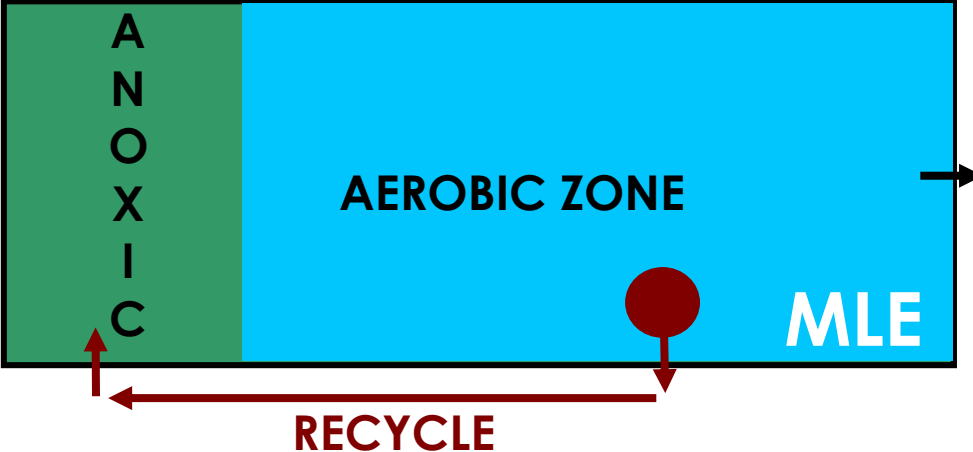
- Aeration tank filled with biological nutrient removal IFAS media
- Construction began September 2009/operation began late-2013
- Largest IFAS system in the world



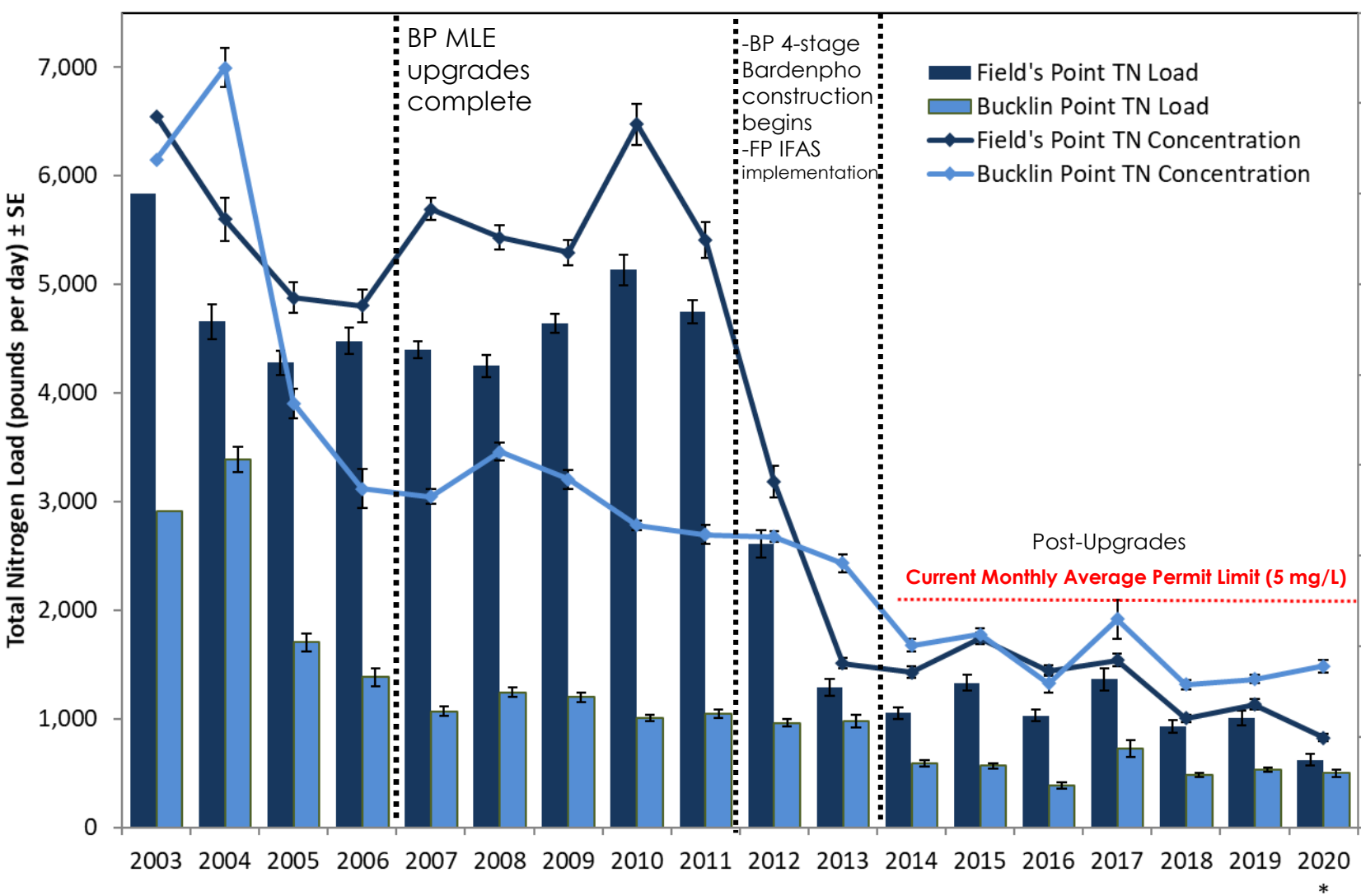
NBC Nutrient Removal Upgrades - Bucklin Point

Four-Stage Bardenpho Process during permit season (May – Oct)

- Continuous flow suspended-growth process
- Construction began 2012, completed 2014
- Former upgrade to MLE: occurred in 2005/2006
- MLE used in offseason



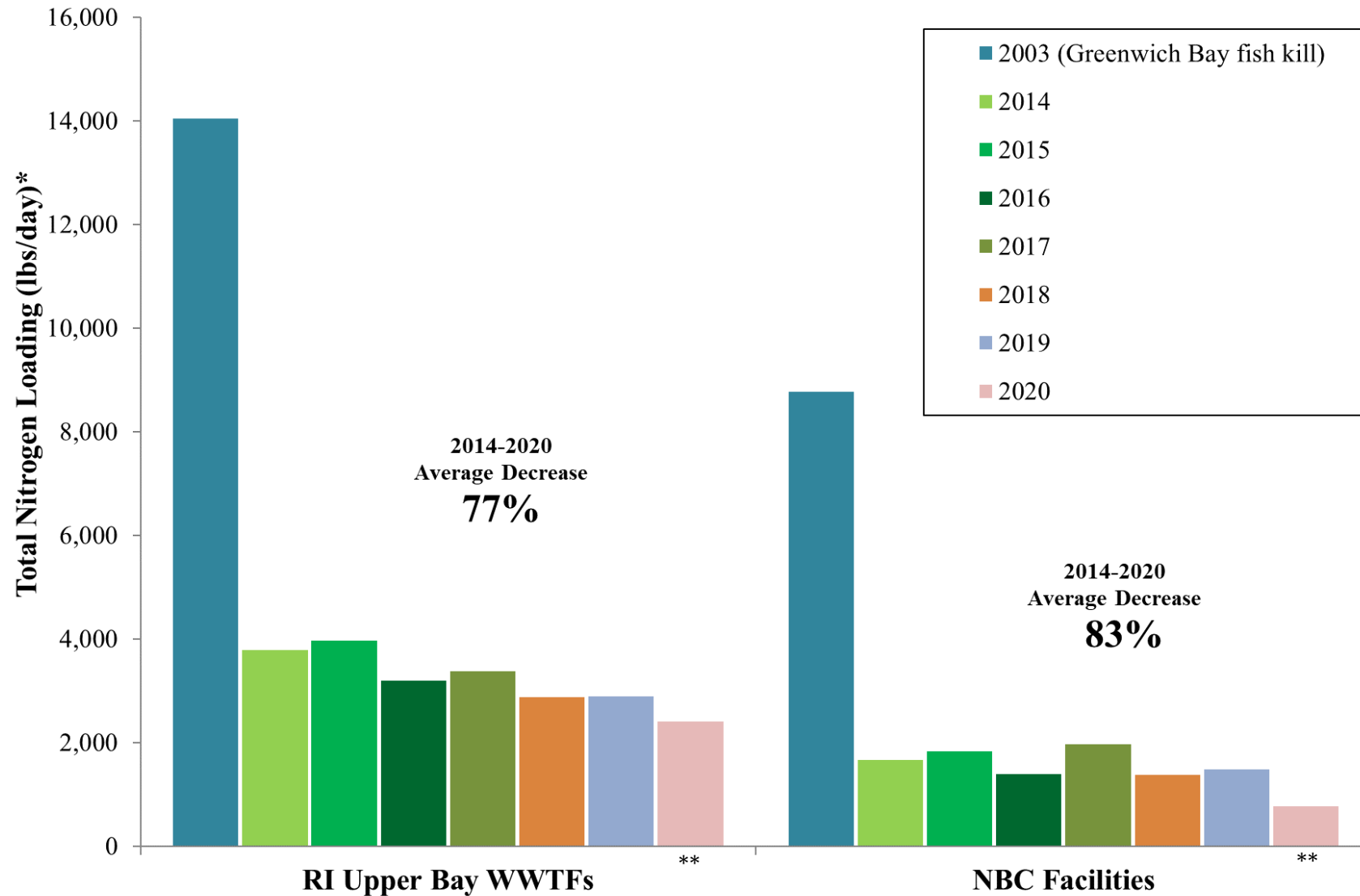
Field's Point and Bucklin Point Seasonal Average Effluent Total Nitrogen



- **Field's Point:**
- **Pre-Upgrade (2003-2011)**
13.4 mg/L
- **Post-Upgrade (2014-2020)**
3.1 mg/L
- **Bucklin Point:**
- **Pre-Upgrade 1 (2003-2004)**
15.8 mg/L
- **Post-Upgrade 1/Pre-Upgrade 2 (2007-2013)**
7.0 mg/L
- **Post-Upgrade 2 (2014-2020)**
3.8 mg/L

*Through Aug 2020

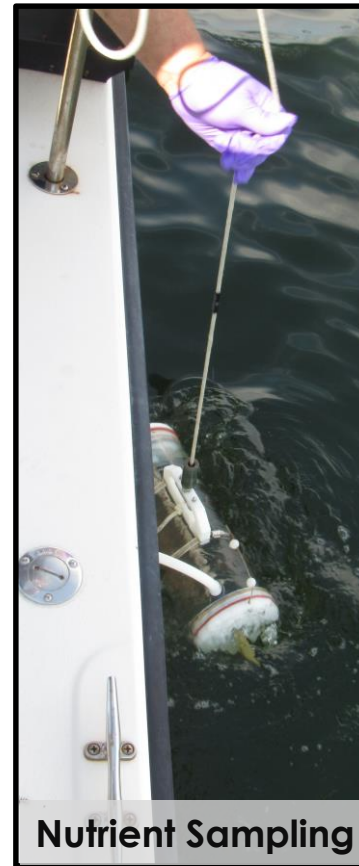
Average Seasonal (May-Oct) WWTF Total Nitrogen Loading to Narragansett Bay



*Loading calculations based upon TN monthly average concentration and monthly average flow **Data updated through July 2020

NBC Environmental Monitoring Initiatives

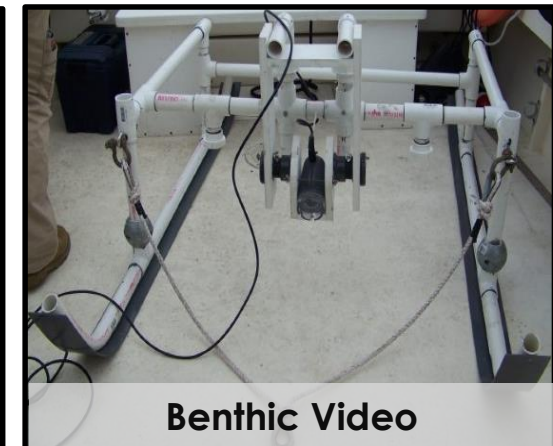
- Coastal receiving waters
 - Nutrients (Dissolved Inorganic Nitrogen)
 - Water clarity (Secchi depth)
 - Bottom dissolved oxygen – fixed-site continuous monitoring
 - Benthic video



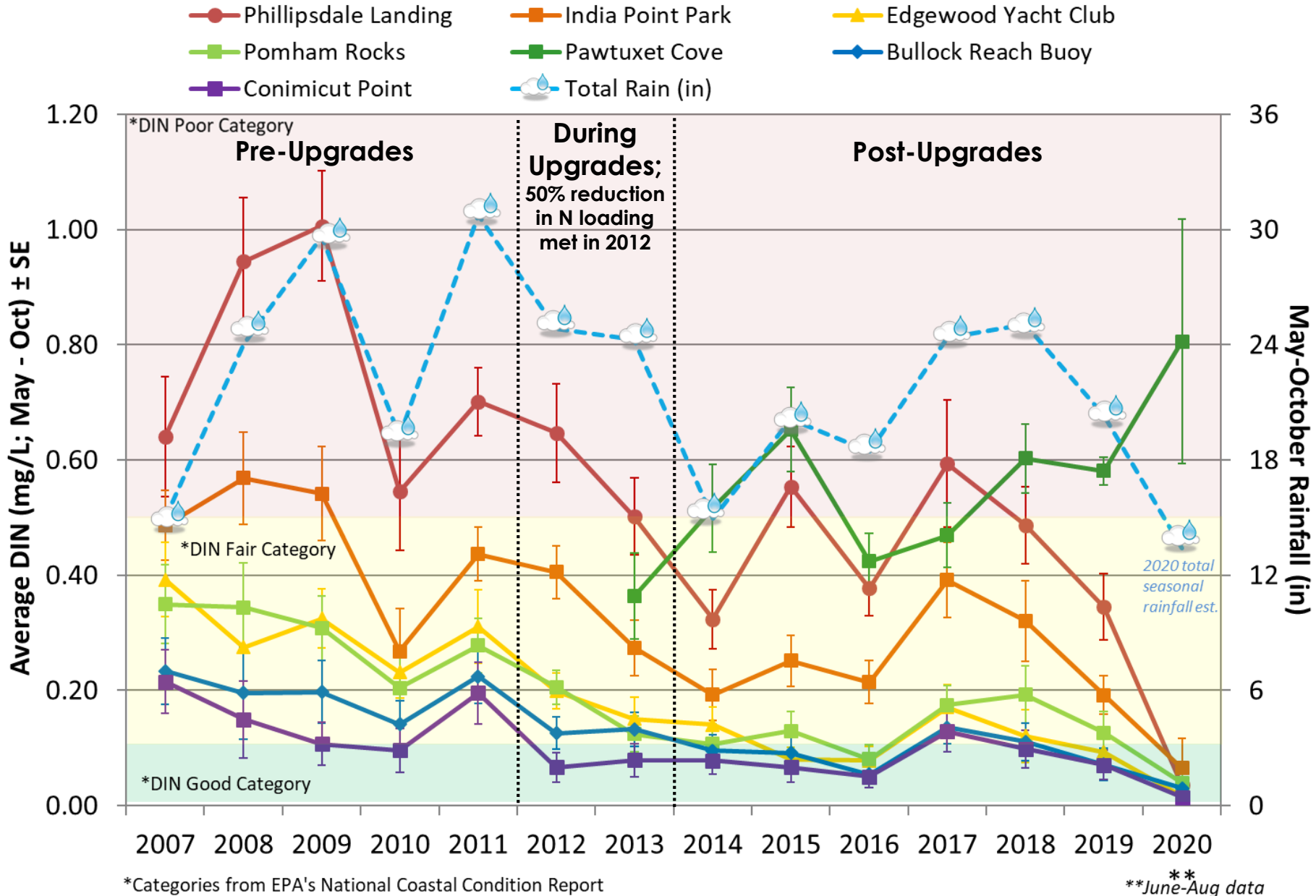
 Narragansett Bay Commission

 **SNAPSHOT**
of Upper Narragansett Bay

Data publicly available
<https://snapshot.narrabay.com>

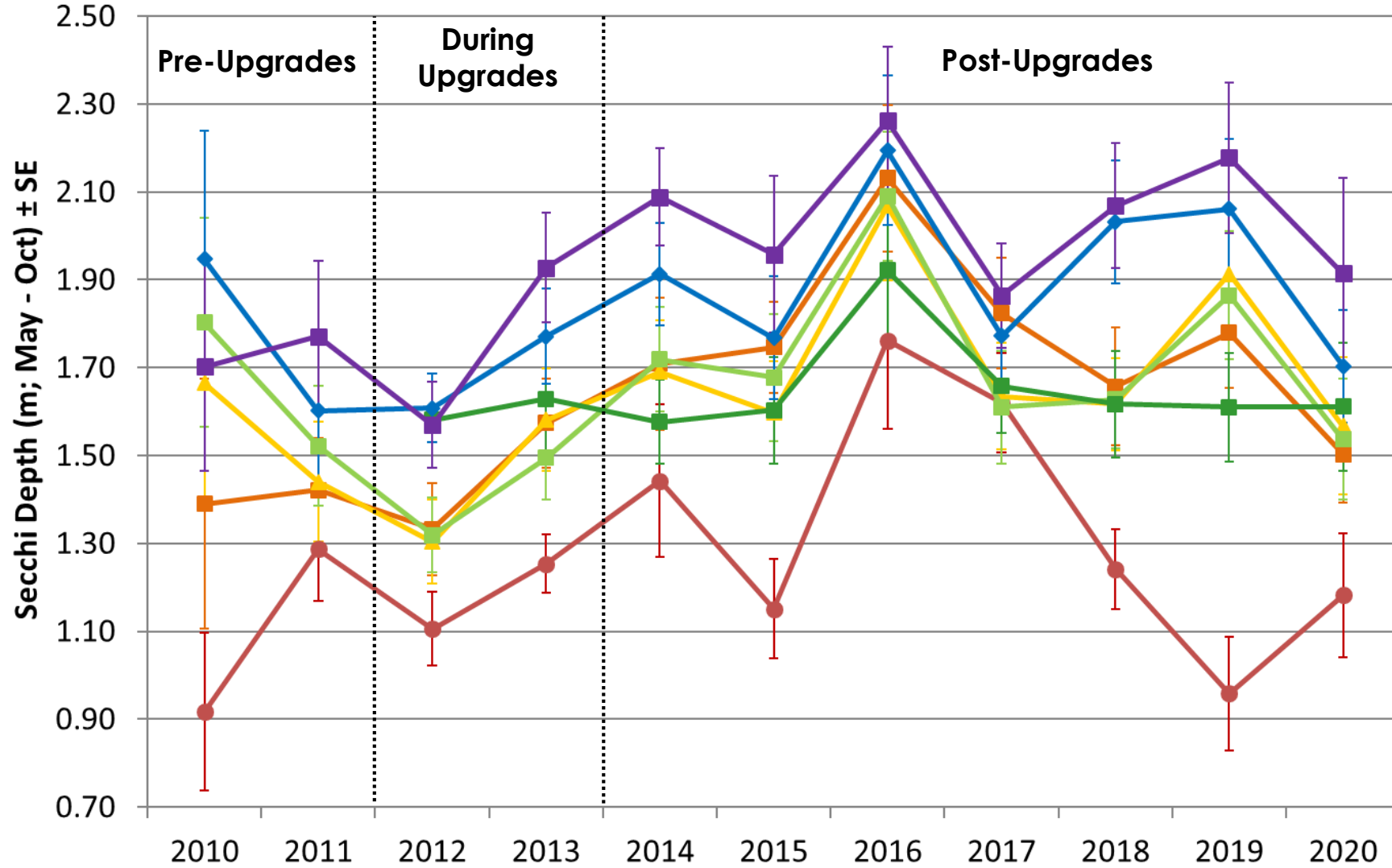


Seasonal Estuarine Dissolved Inorganic Nitrogen

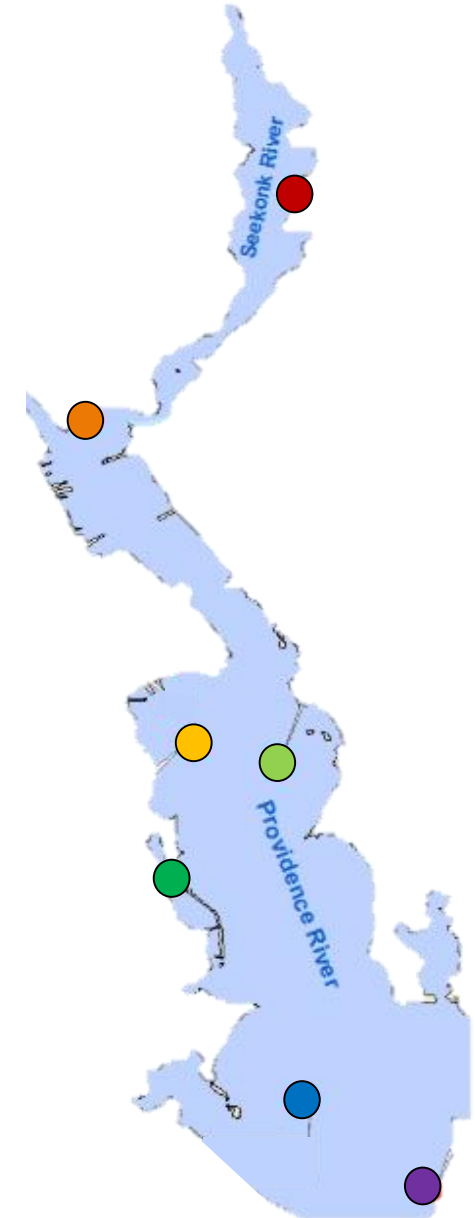


Seasonal Estuarine Water Clarity

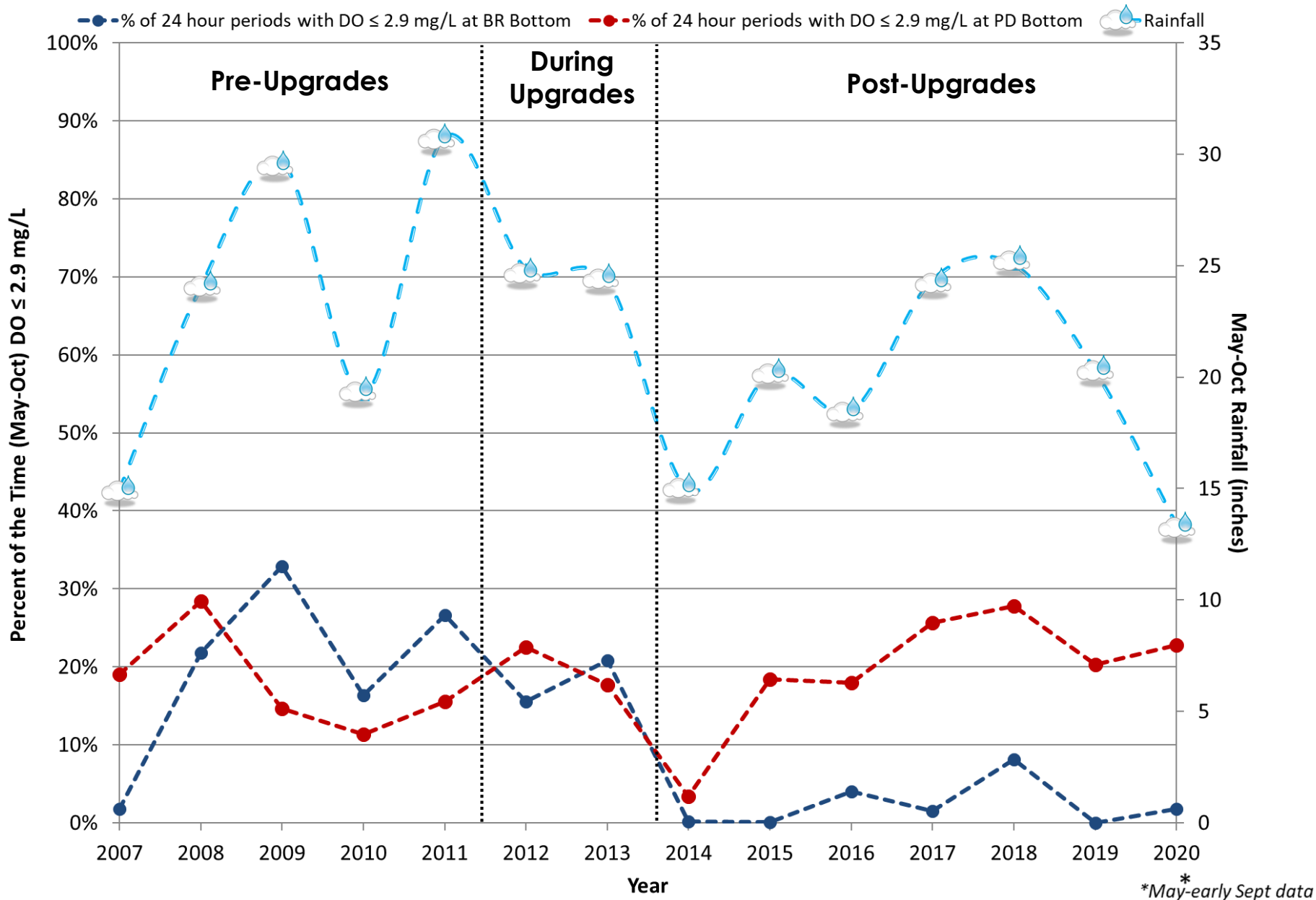
- Phillipsdale Landing
- India Point Park
- Edgewood Yacht Club
- Pomham Rocks
- Pawtuxet Cove
- Bullock Reach Buoy
- Conimicut Point



*May-early Sept data

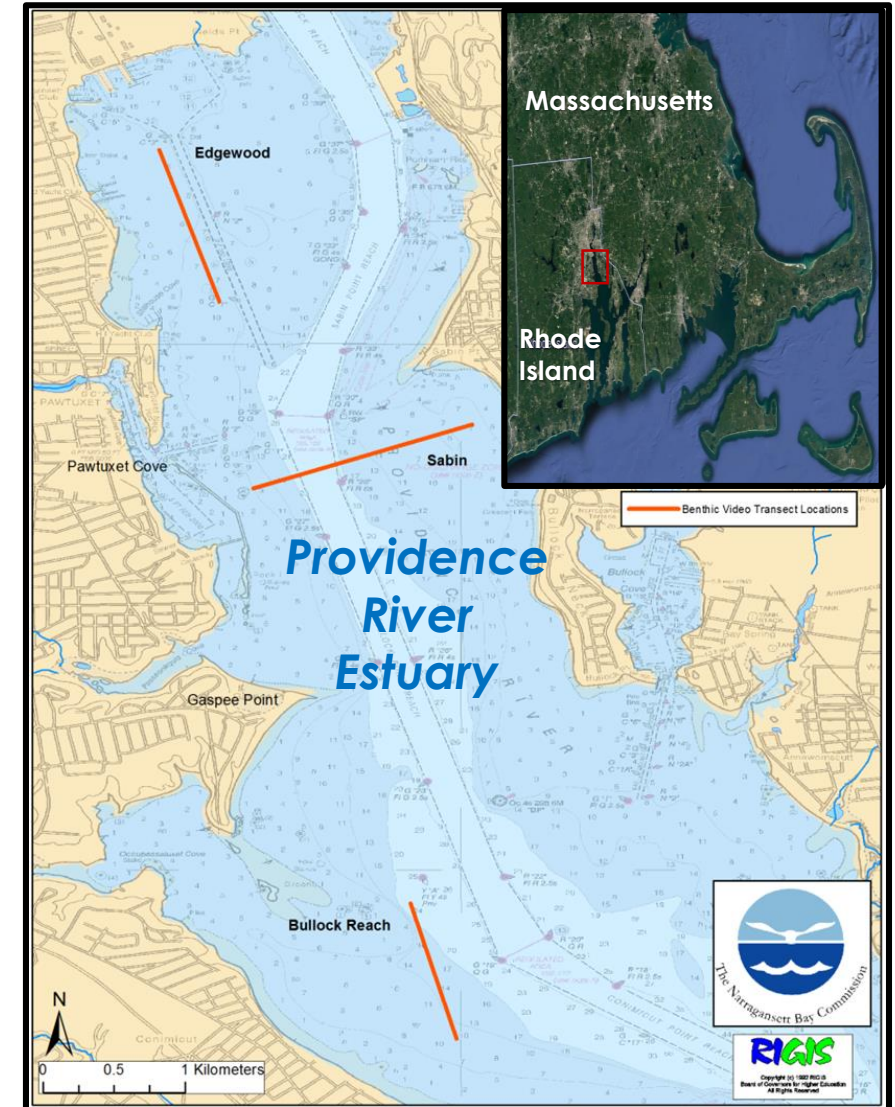


Seasonal Estuarine Hypoxia - Phillipsdale Landing and Bullock Reach Buoy



Benthic Video Insights Into Water Quality

- Algae: nutrients
- Past few years: no extensive amphipod tube mats observed
 - Lack of excessive organic enrichment
- Many species: seastars, moonsnail, softshell clam, black sea bass



Looking ahead...

- **Long-term monitoring shows water quality improvements**
 - DIN, water clarity, hypoxia, and benthic observations
- **Regional Ocean Modeling System**
 - Better understand hypoxia based on environmental conditions and nutrient reduction scenarios
 - How will changing nutrient sources, rainfall patterns, river flows, and water temperatures impact estuarine ecosystems?
- **Critical to continue environmental monitoring to ensure management of Narragansett Bay is based on sound science**

Acknowledgements

Thank you to all individuals at the Narragansett Bay Commission who are committed to keeping Narragansett Bay clean!

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<https://snapshot.narrabay.com>

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