# Achieving Water Quality Standards by Implementing Ecosystem Based Sustainable Solutions

Thomas Uva
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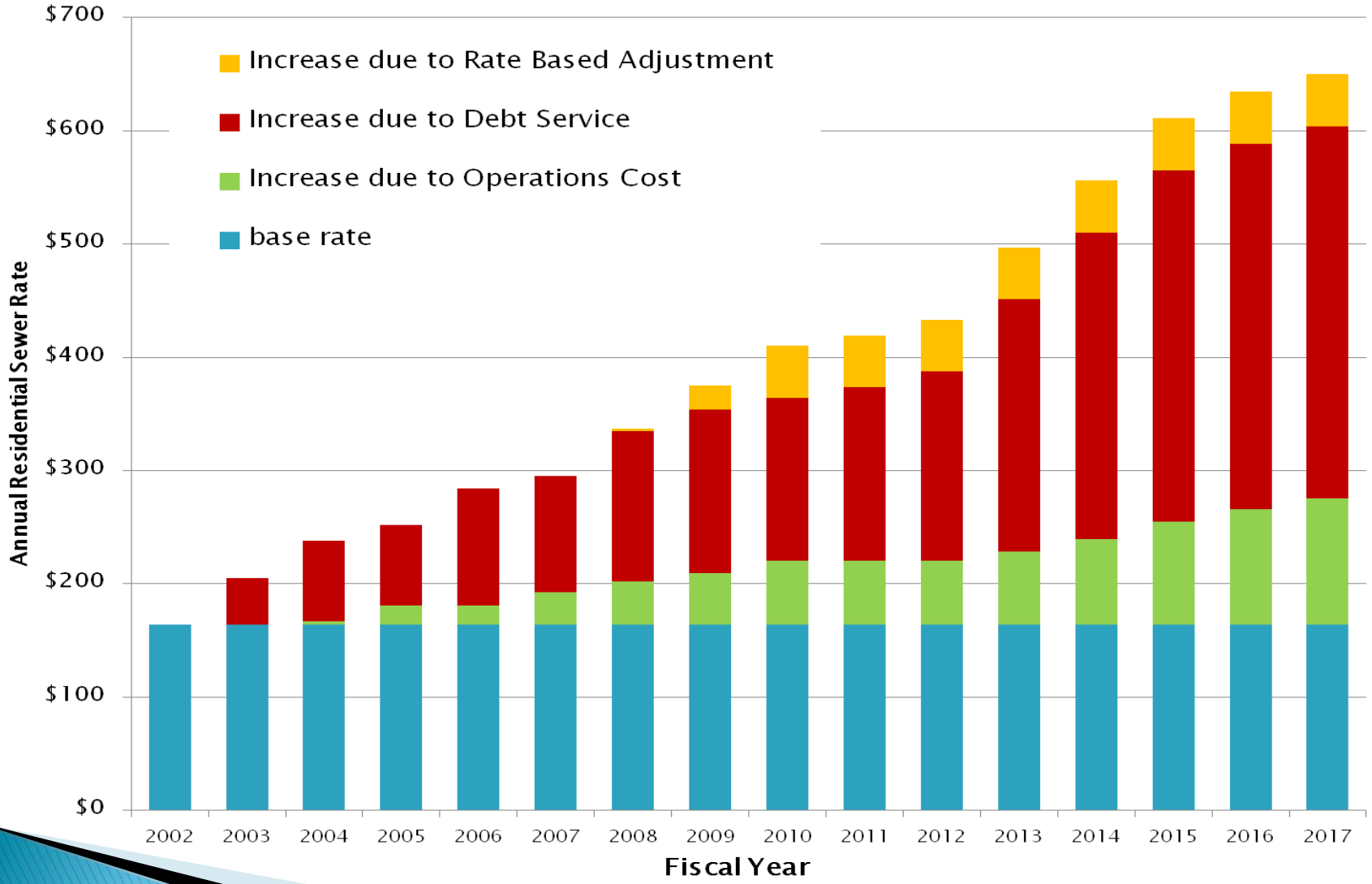
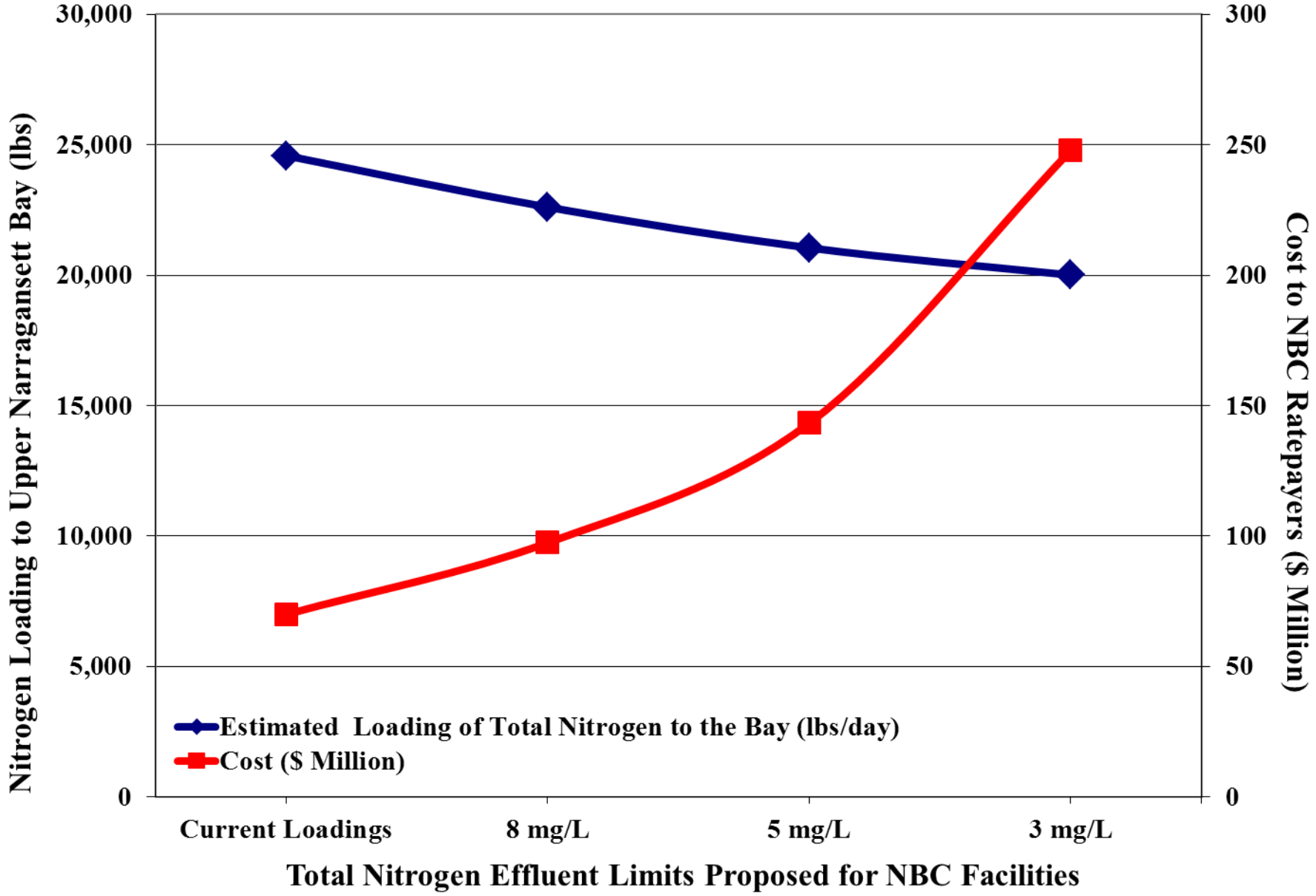
Narragansett Bay Commission

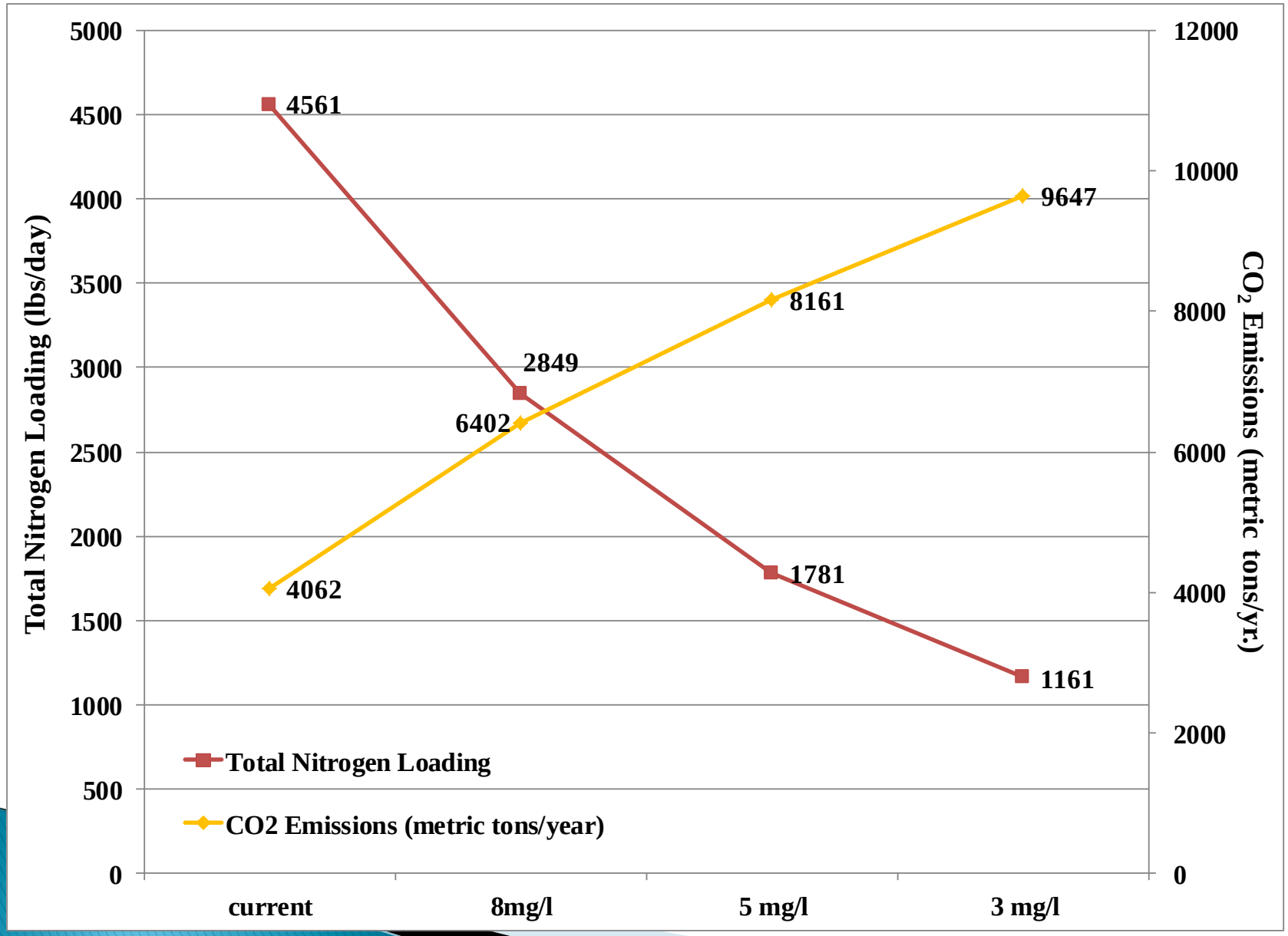
# NBC Annual Average Sewer Rates



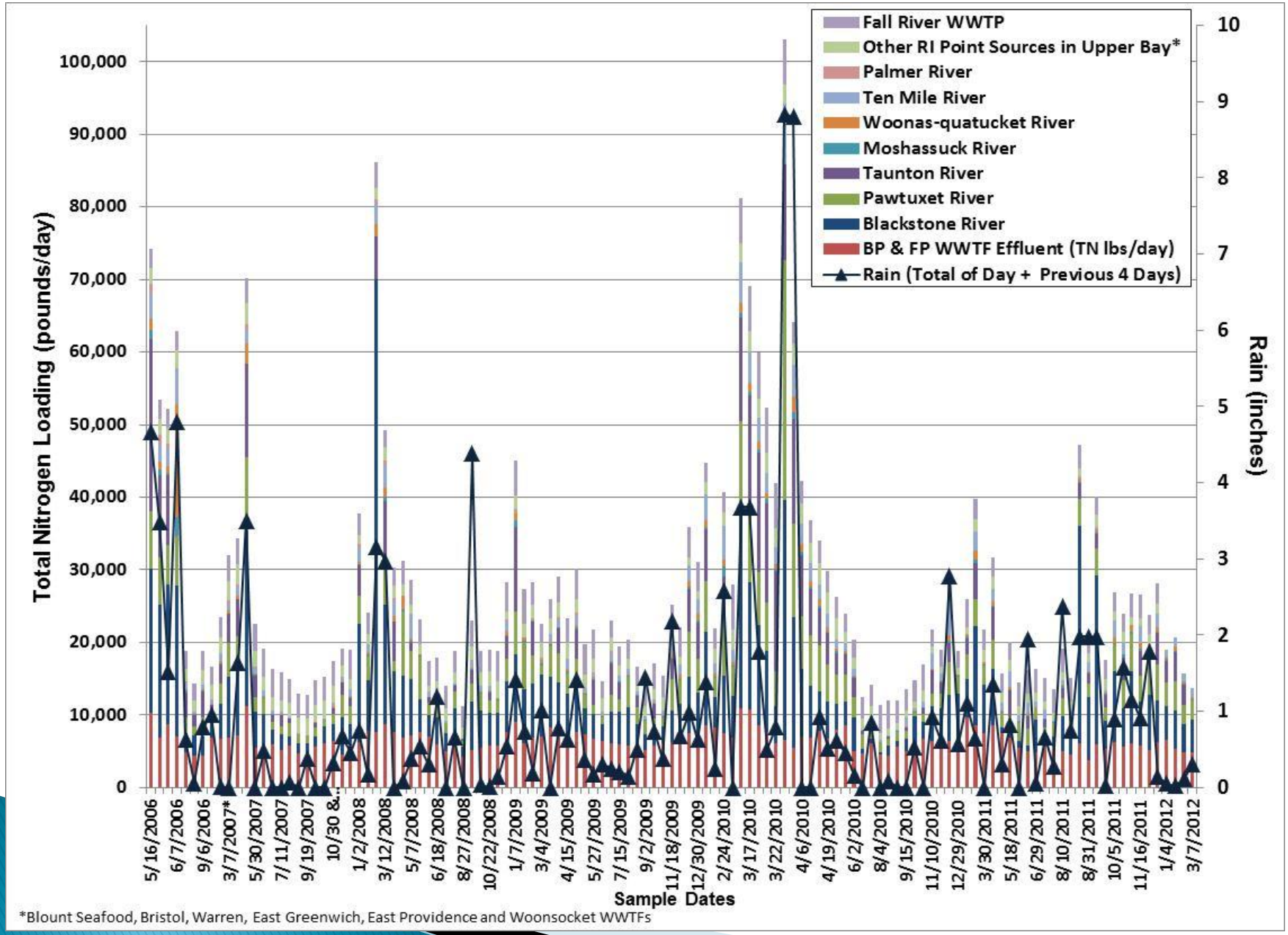
# NBC Cost vs % Nitrogen Reduction to Upper Bay



# Total Nitrogen Loading at Field's Point vs Estimated Greenhouse Gas Emissions



# Upper Bay Total Nitrogen Loading & Rainfall




*Blount Seafood, Bristol, Warren, East Greenwich, East Providence and Woonsocket WWTFs

United States Environmental Protection Agency
Office of Research and Development/Office of Water
Washington, DC 20460

EPA/842-R-08-002
December 2008
http://www.epa.gov/nccr

# National Coastal Condition Report III

**Table 1-2. Criteria for Assessing Dissolved Inorganic Nitrogen (DIN)**

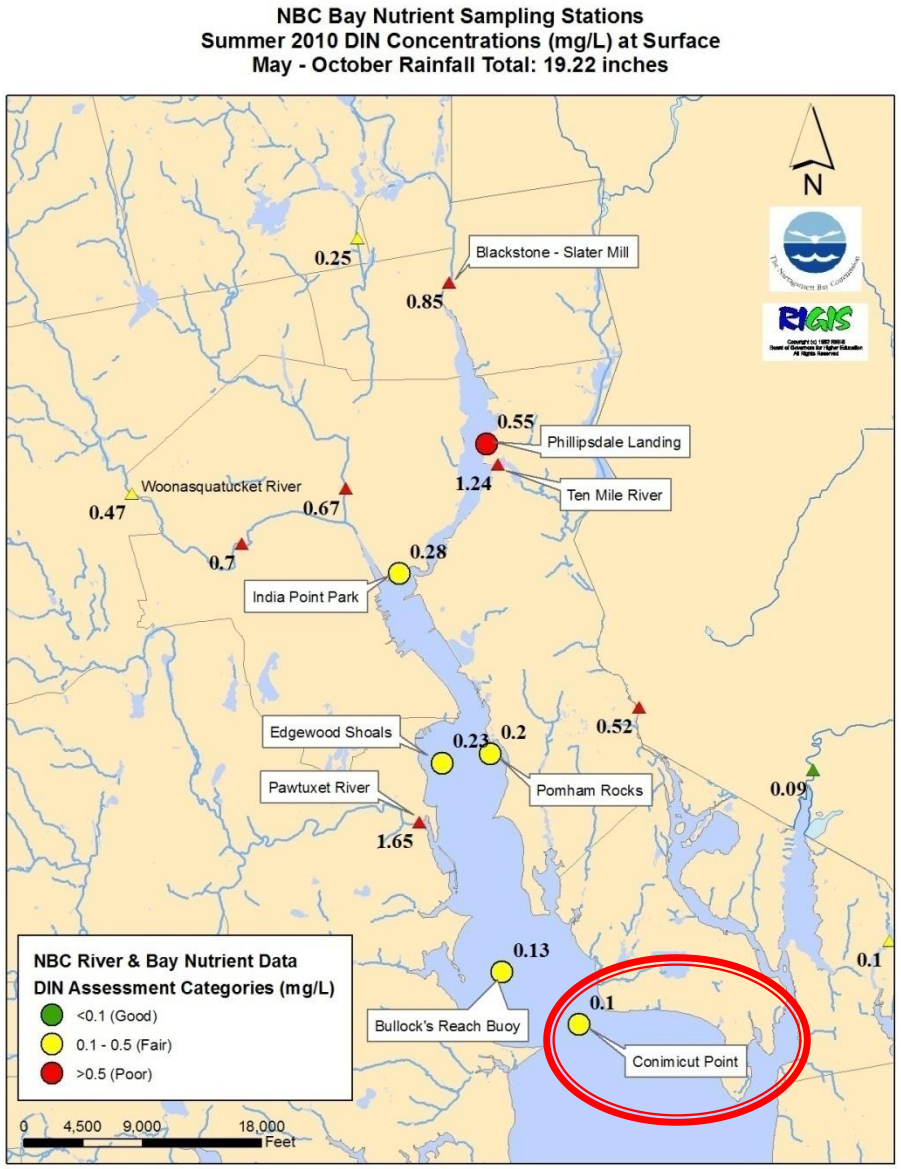
| Area | Good | Fair | Poor |
|---|---|---|---|
| Northeast, Southeast, and Gulf Coast sites | < 0.1 mg/L | 0.1–0.5 mg/L | > 0.5 mg/L |
| West Coast and Alaska sites | < 0.5 mg/L | 0.5–1.0 mg/L | > 1 mg/L |
| Hawaii, Puerto Rico, and Florida Bay sites | < 0.05 mg/L | 0.05–0.1 mg/L | > 0.1 mg/L |
| **Regions** | Less than 10% of the coastal area is in poor condition, and more than 50% of the coastal area is in good condition. | 10% to 25% of the coastal area is in poor condition, or more than 50% of the coastal area is in combined poor and fair condition. | More than 25% of the coastal area is in poor condition. |

# 2010 Dissolved Inorganic Nitrogen Conc.

May – October

Rainfall Total: **19.22 inches**

| Station<br>DIN (mg/L)<br>Good <0.1<br>Fair 0.1-0.5<br>Poor >0.5 | 2010<br>DIN (mg/L) | 2010<br>EPA NEP criteria |
|---|---|---|
| Phillipsdale Landing | 0.55 | Poor |
| India Point Park | 0.28 | Fair |
| Edgewood Yacht Club | 0.23 | Fair |
| Pomham Rocks | 0.20 | Fair |
| Bullock's Reach | 0.13 | Fair |
| Conimicut Point | 0.10 | Fair |

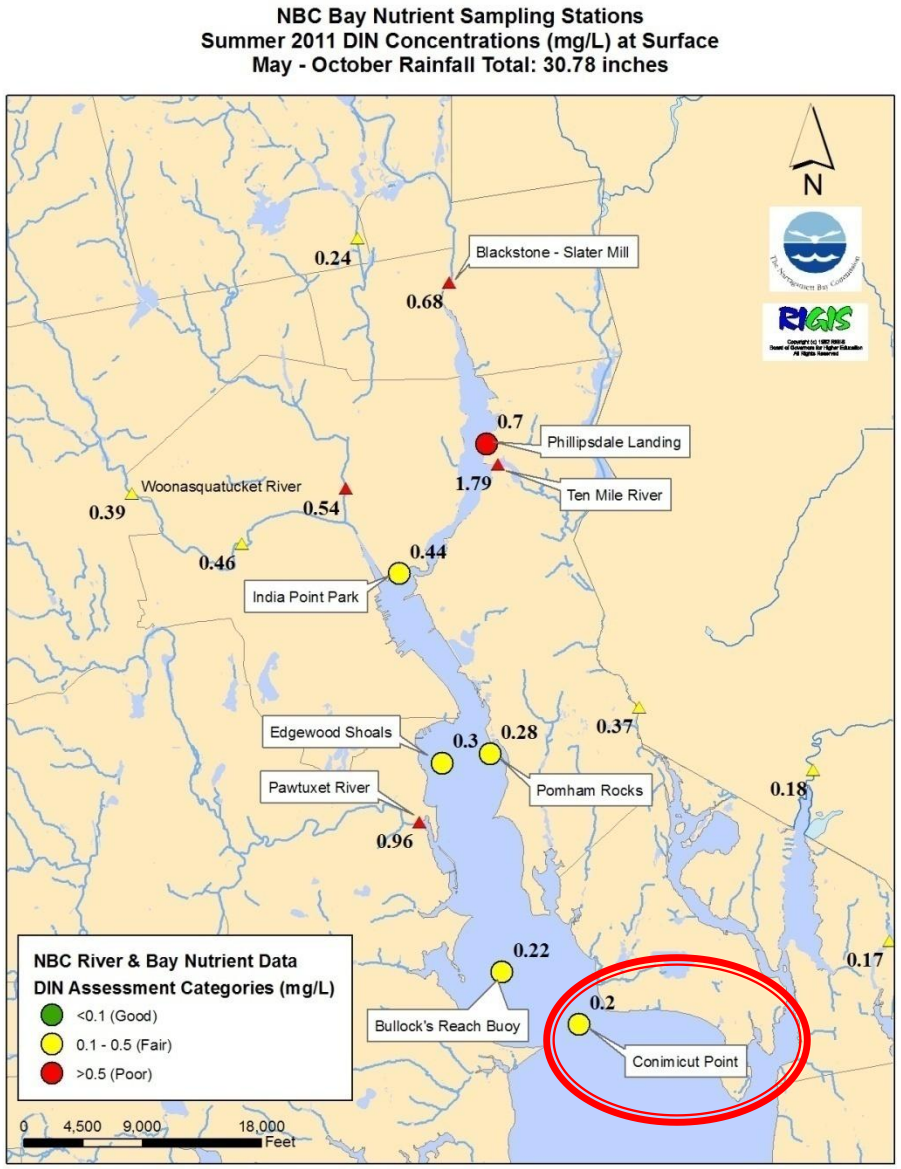


# 2011 Dissolved Inorganic Nitrogen Conc.

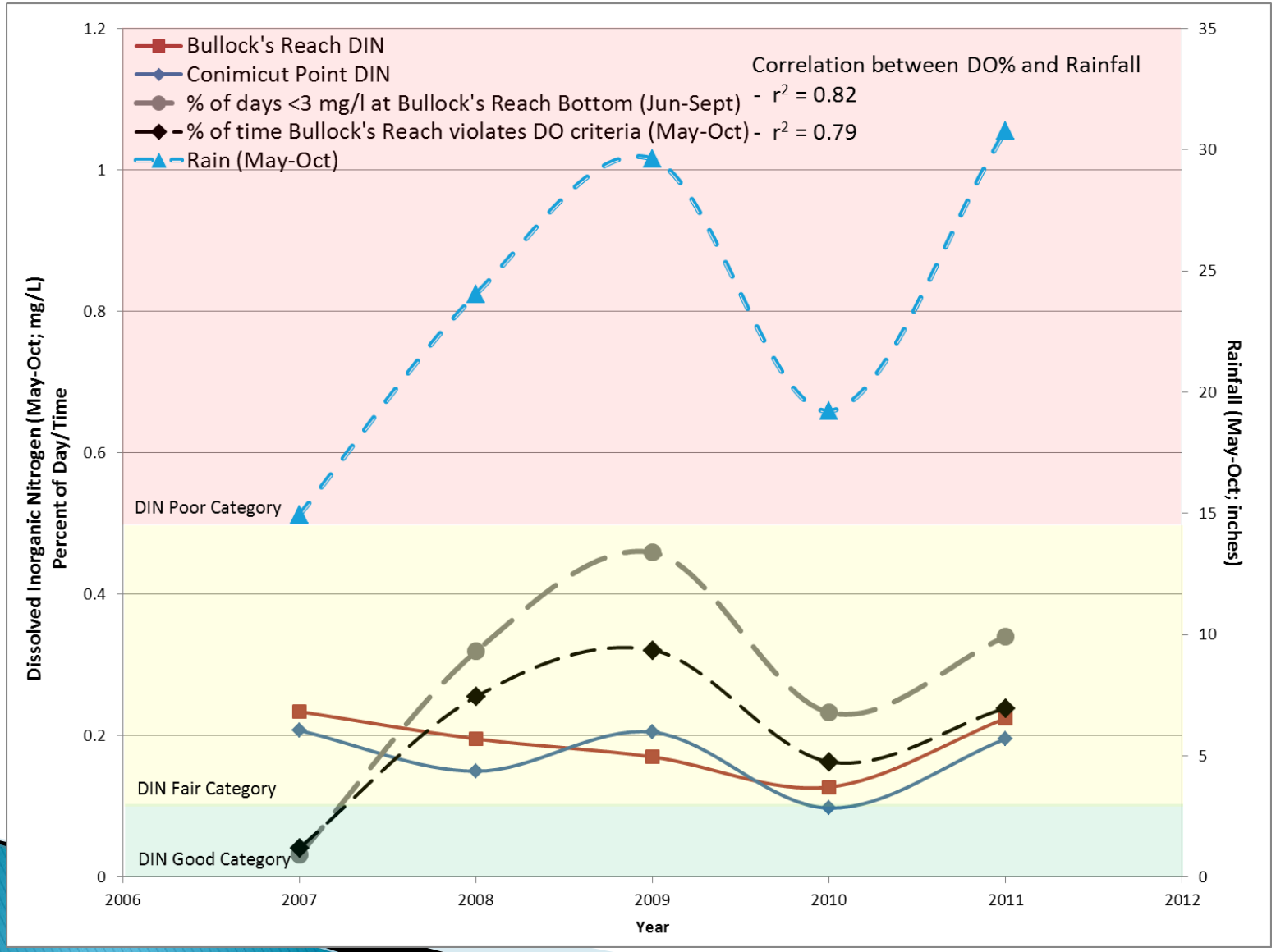
May – October

Rainfall Total: **30.78 inches**

| Station<br>DIN (mg/L)<br>Good <0.1<br>Fair 0.1-0.5<br>Poor >0.5 | 2011<br>DIN (mg/L) | 2011<br>EPA NEP criteria |
|---|---|---|
| Phillipsdale Landing | 0.70 | Poor |
| India Point Park | 0.44 | Fair |
| Edgewood Yacht Club | 0.30 | Fair |
| Pomham Rocks | 0.28 | Fair |
| Bullock's Reach | 0.22 | Fair |
| Conimicut Point | 0.20 | Fair |



# Effect of Rainfall on Hypoxia and DIN Concentrations



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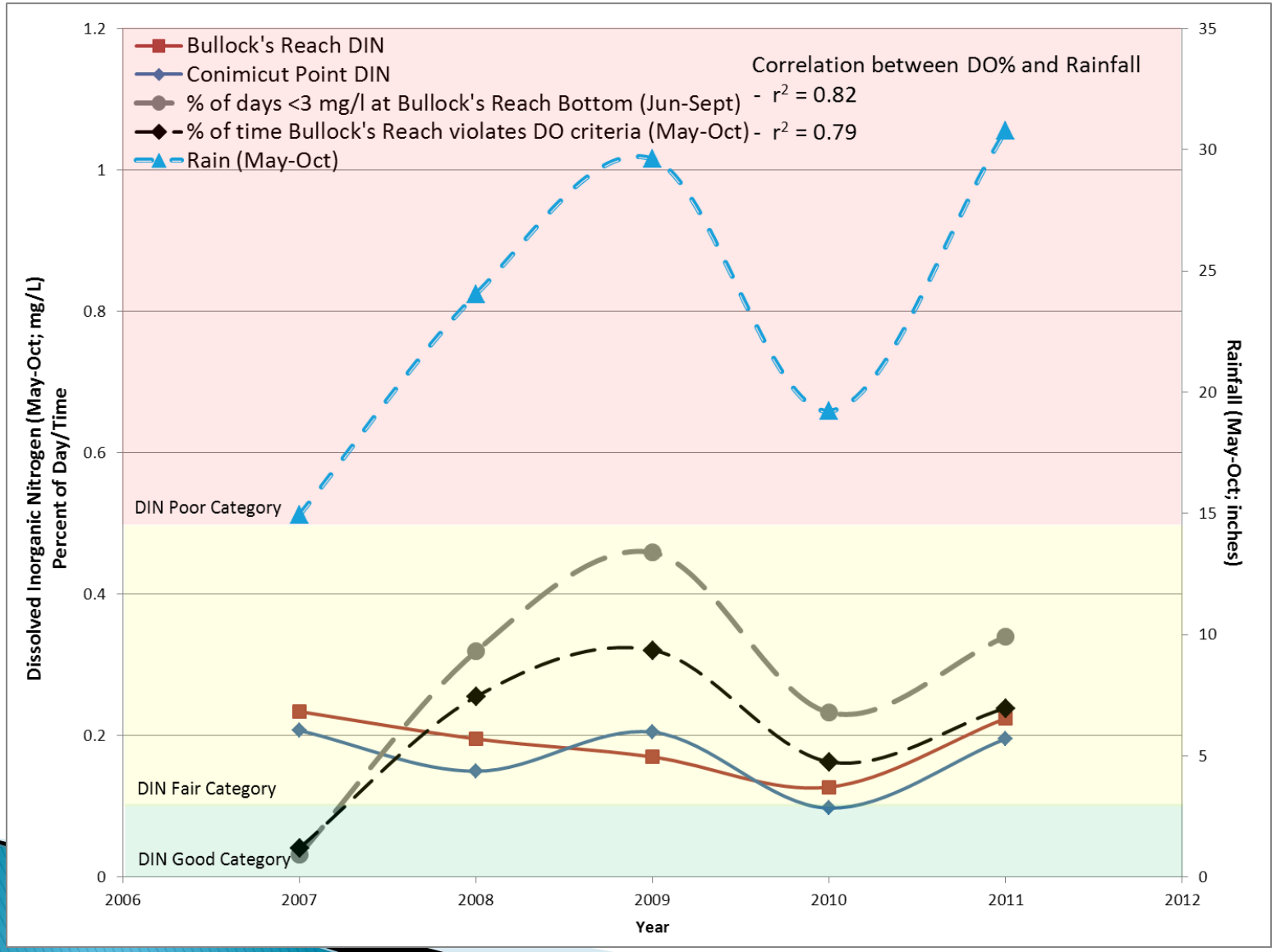

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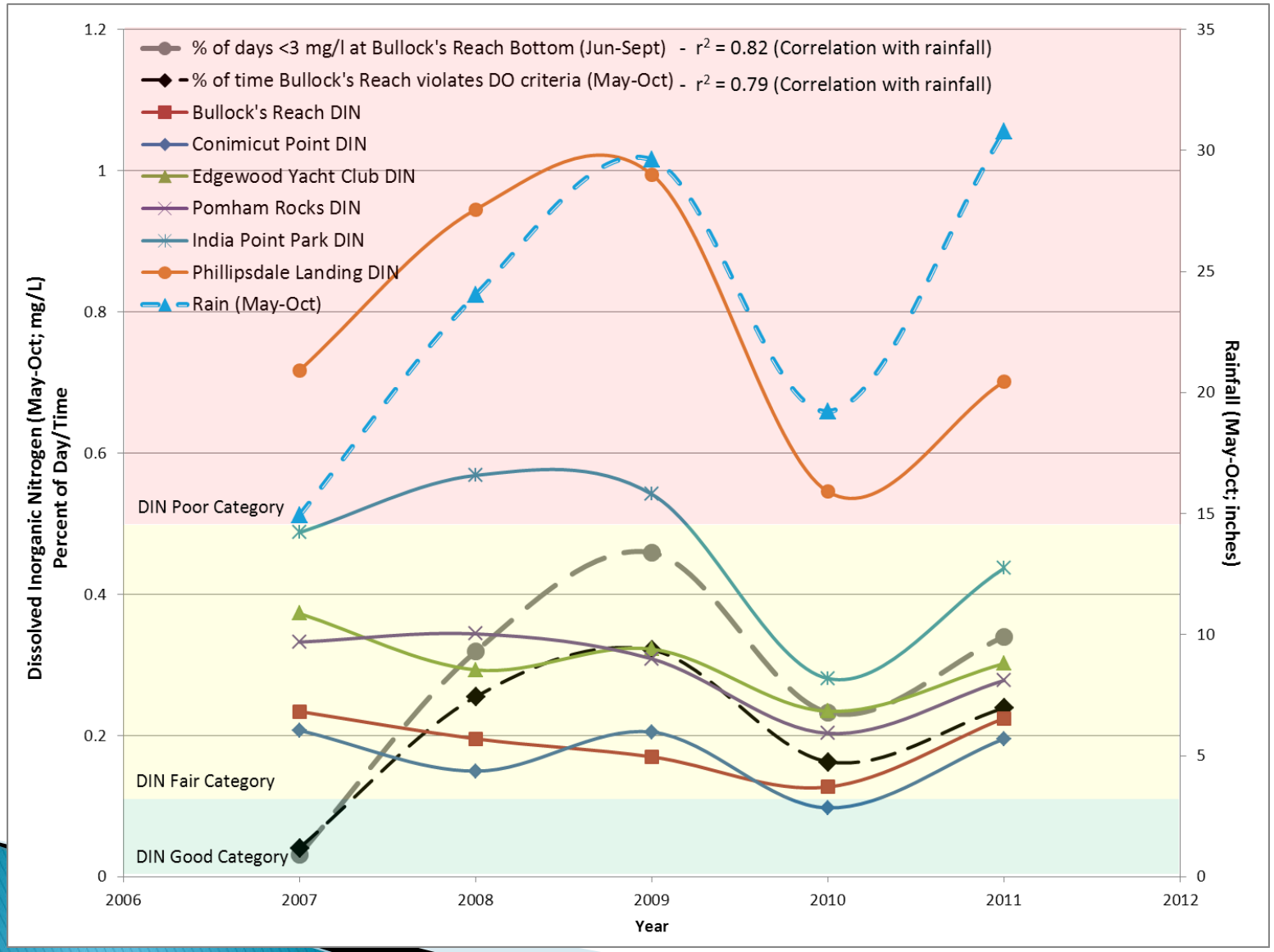


# Map of Providence Harbor in 1910

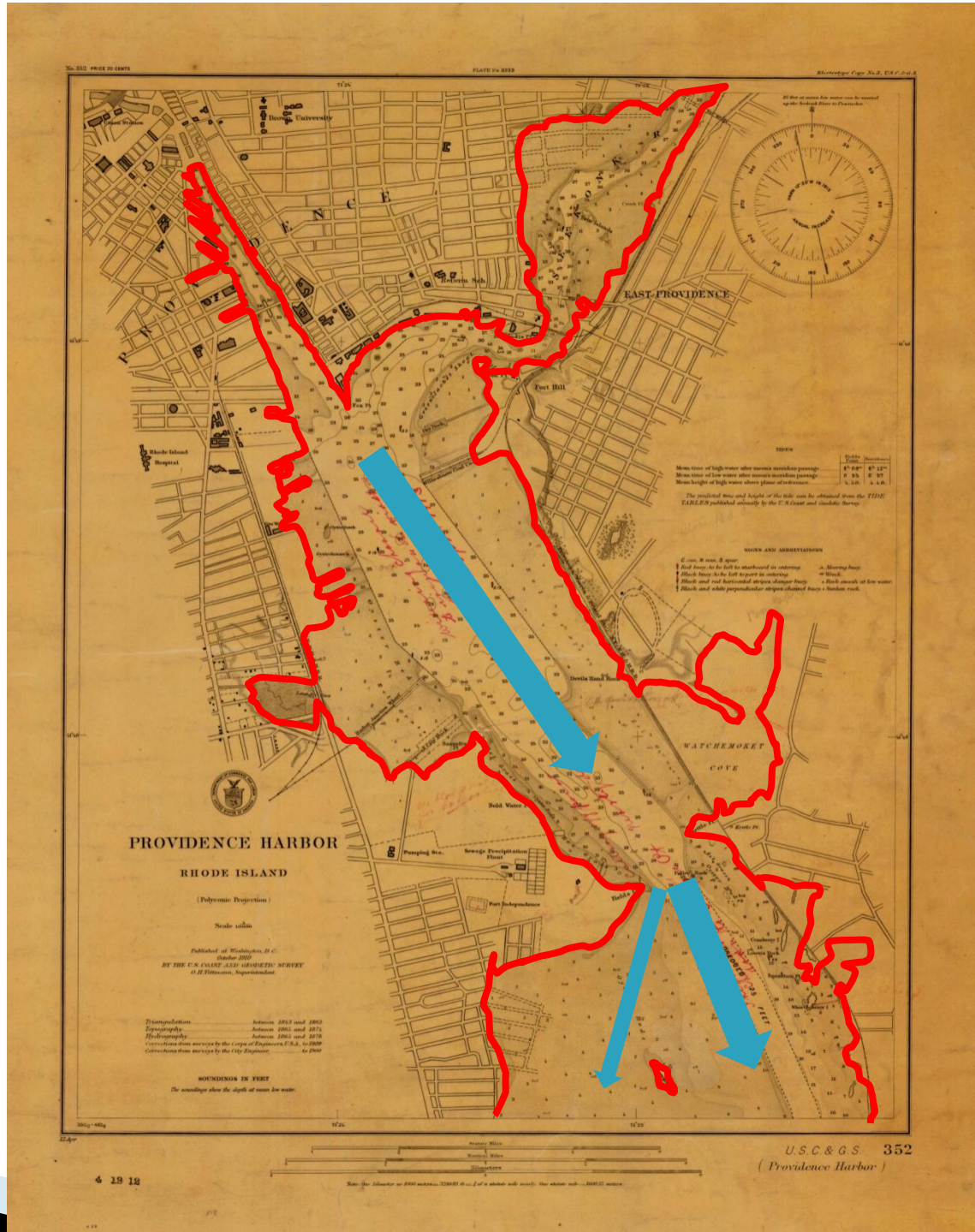
Based on 1865 – 1878 “Hydrography”

Map Clearly Shows:

- Wetlands & Eel Grass Beds
- Oyster Beds (5000 leased acres)
- Seekonk River 37’ deep
- Prov River Channel 25’ deep

# Map of Providence Harbor in 1910

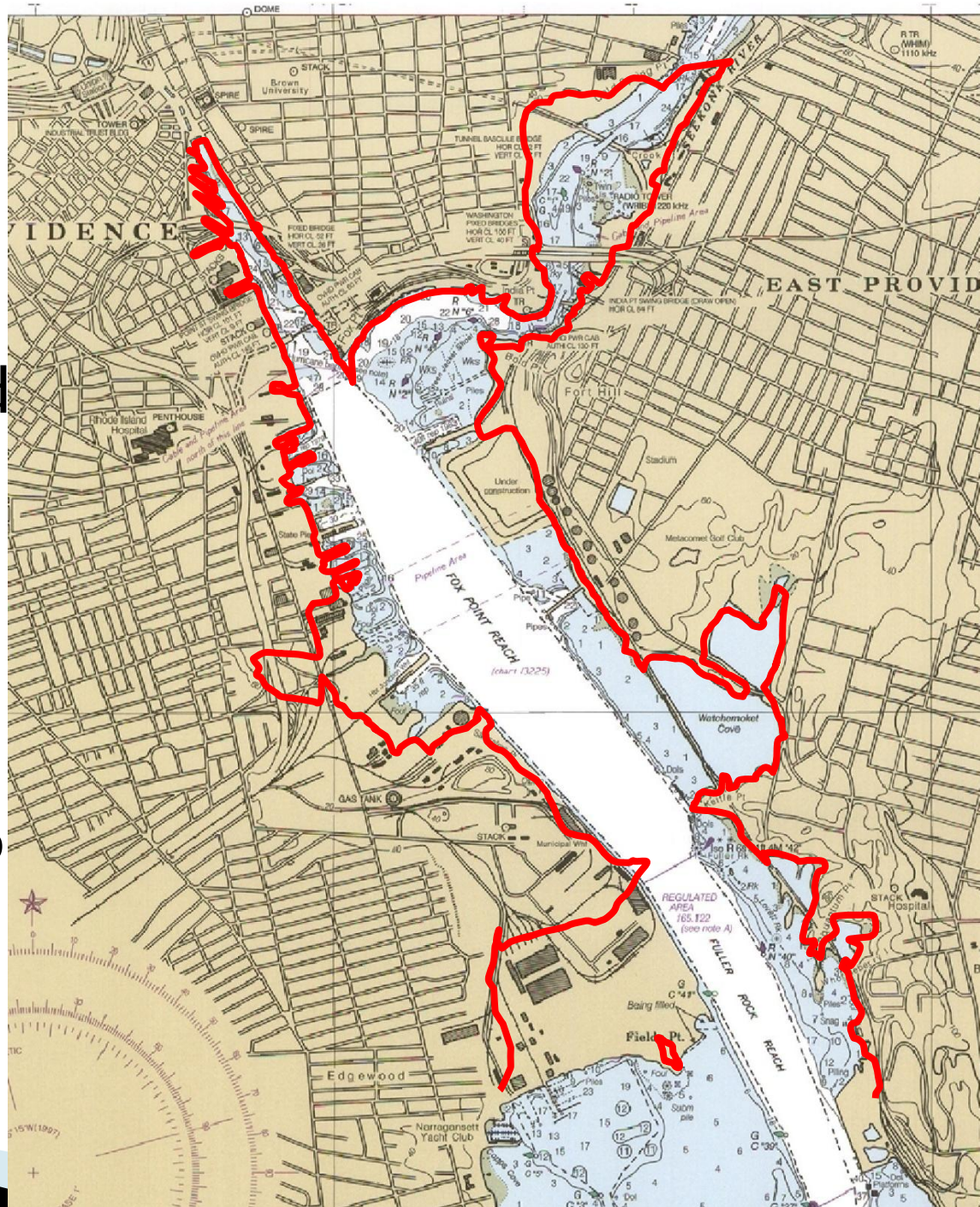
- 1910 Coast Line in Red
- City plans to Fill Bay and Build Roads
- Note:
  - Much Shallower River &
  - Starved Goat Island
- What was flow circulation pattern in 1910?



# Upper Providence River Today

1910 Coastline in Red

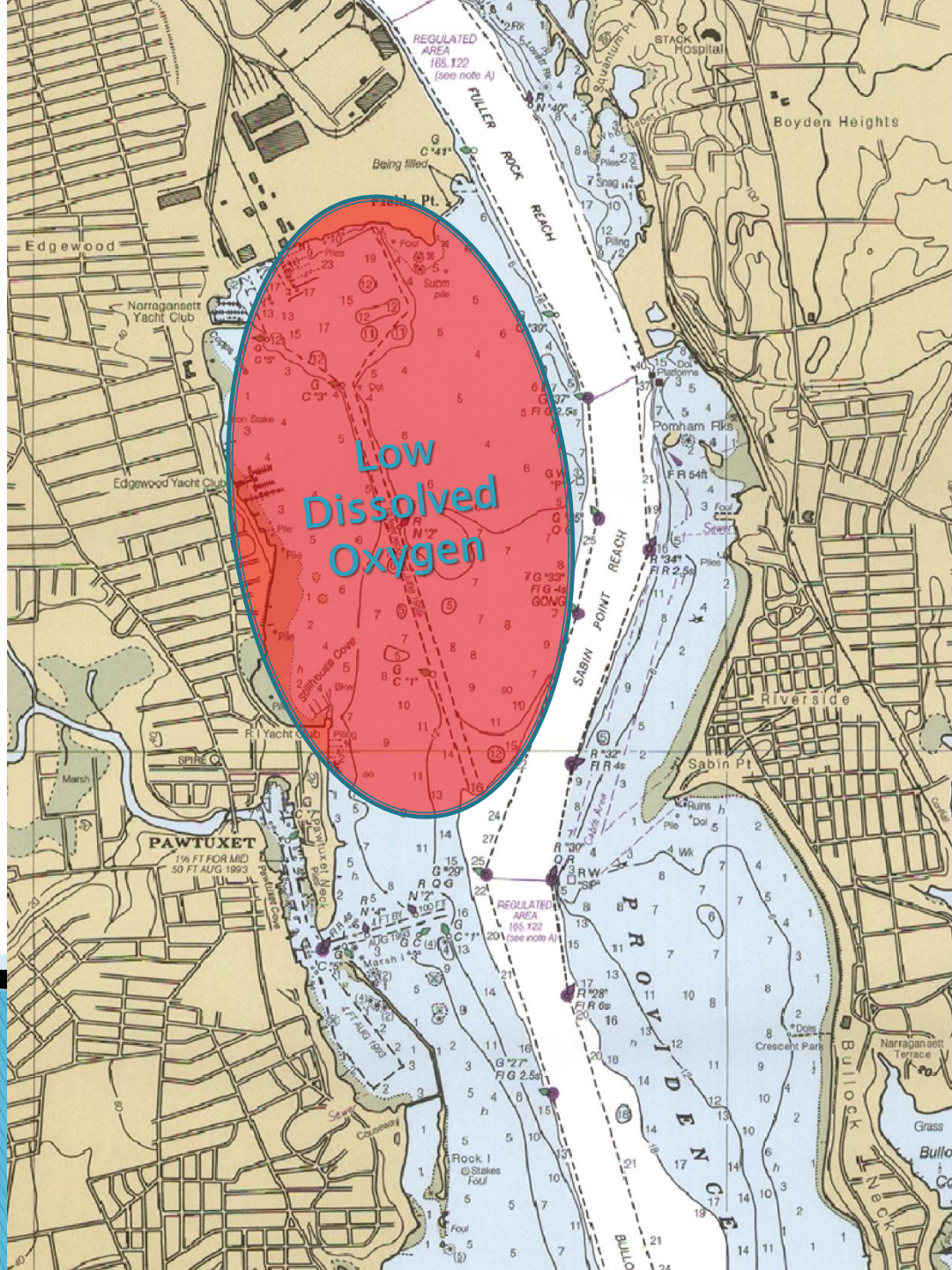
- We Filled the Bay & Wetlands
- Built the Hurricane Barrier
- Built Pawtuxet River Breakwall
- Allowed Rivers to Silt up
- Dredged Channel to 50+’



# Water Quality Problems

Edgewood Shoals area is DO impaired due to:

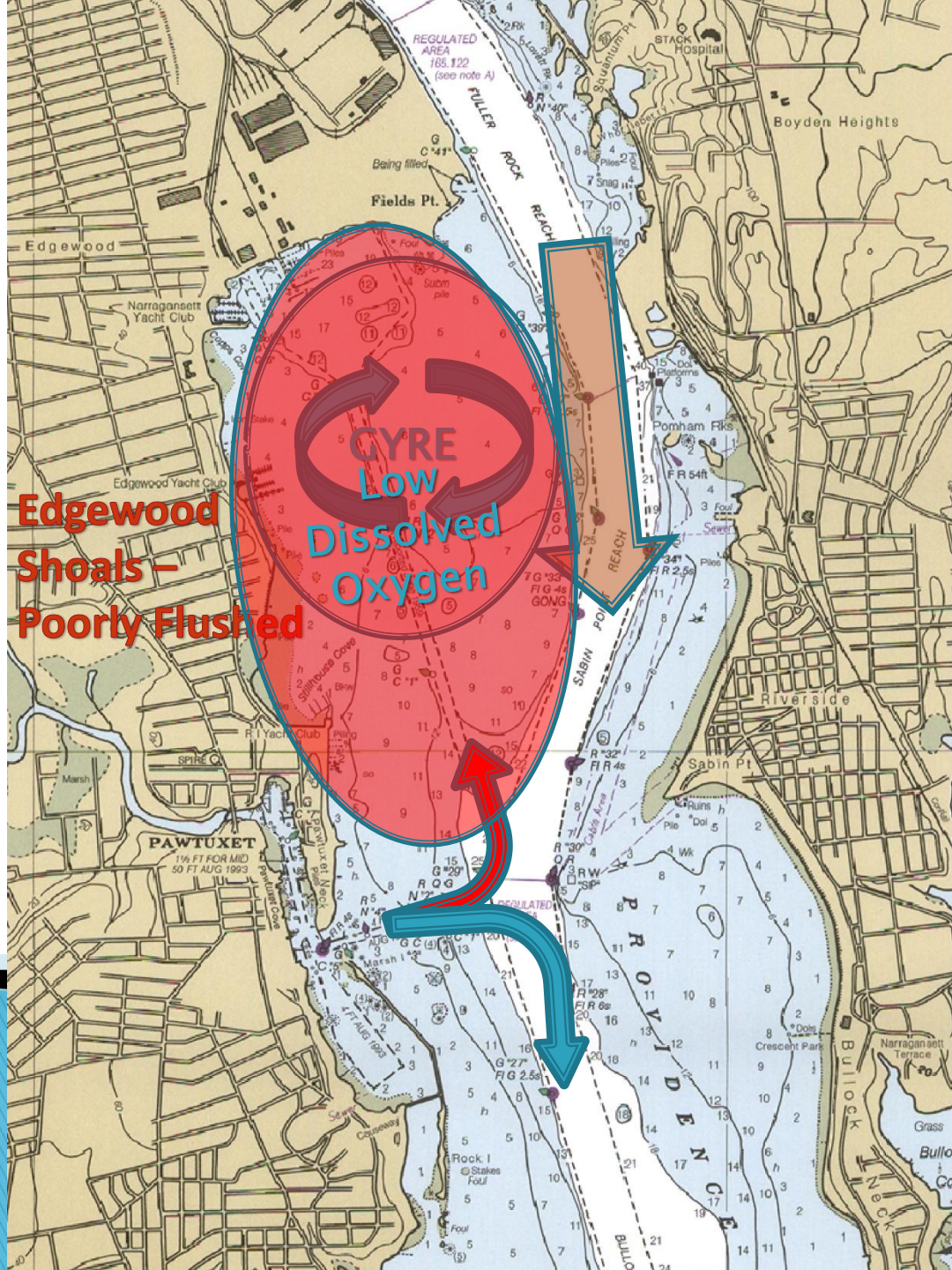
- Changed Circulation Patterns
- Poor flushing
- Nitrogen enrichment
- Stratification



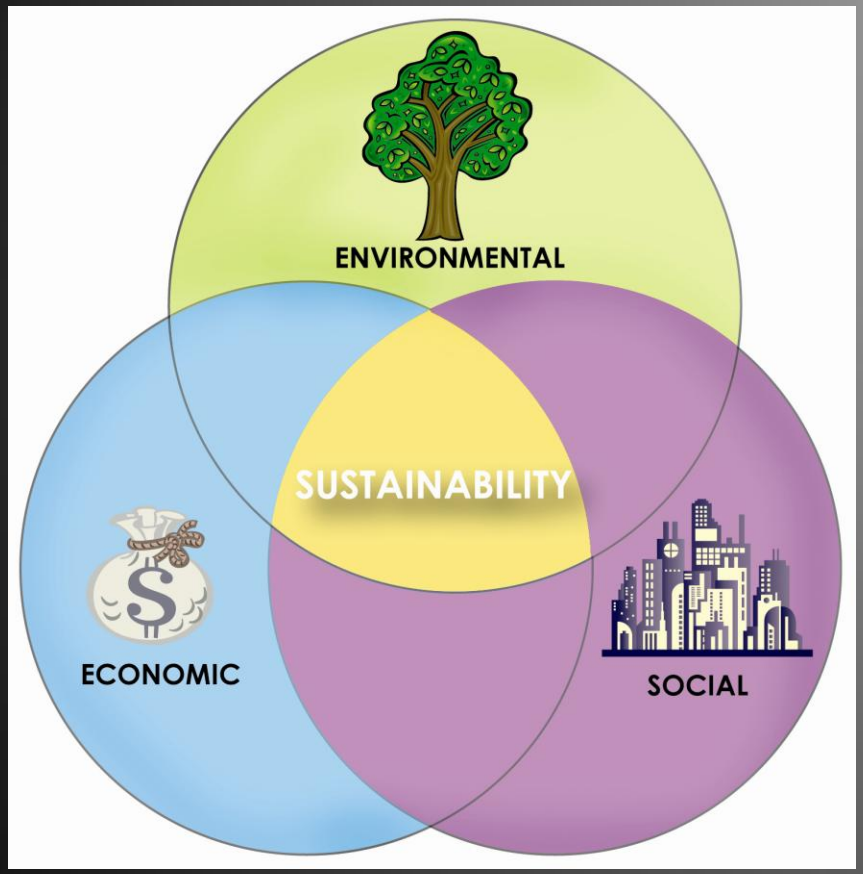
# Water Quality Problems

## ROMS Model Indicates:

- Jet of water down the shipping channel
- Sets up a clockwise Gyre on Shoal
- Bottom waters from Pawtuxet River transport Nitrogen onto the shoal



# Sustainable Solutions Needed!!!

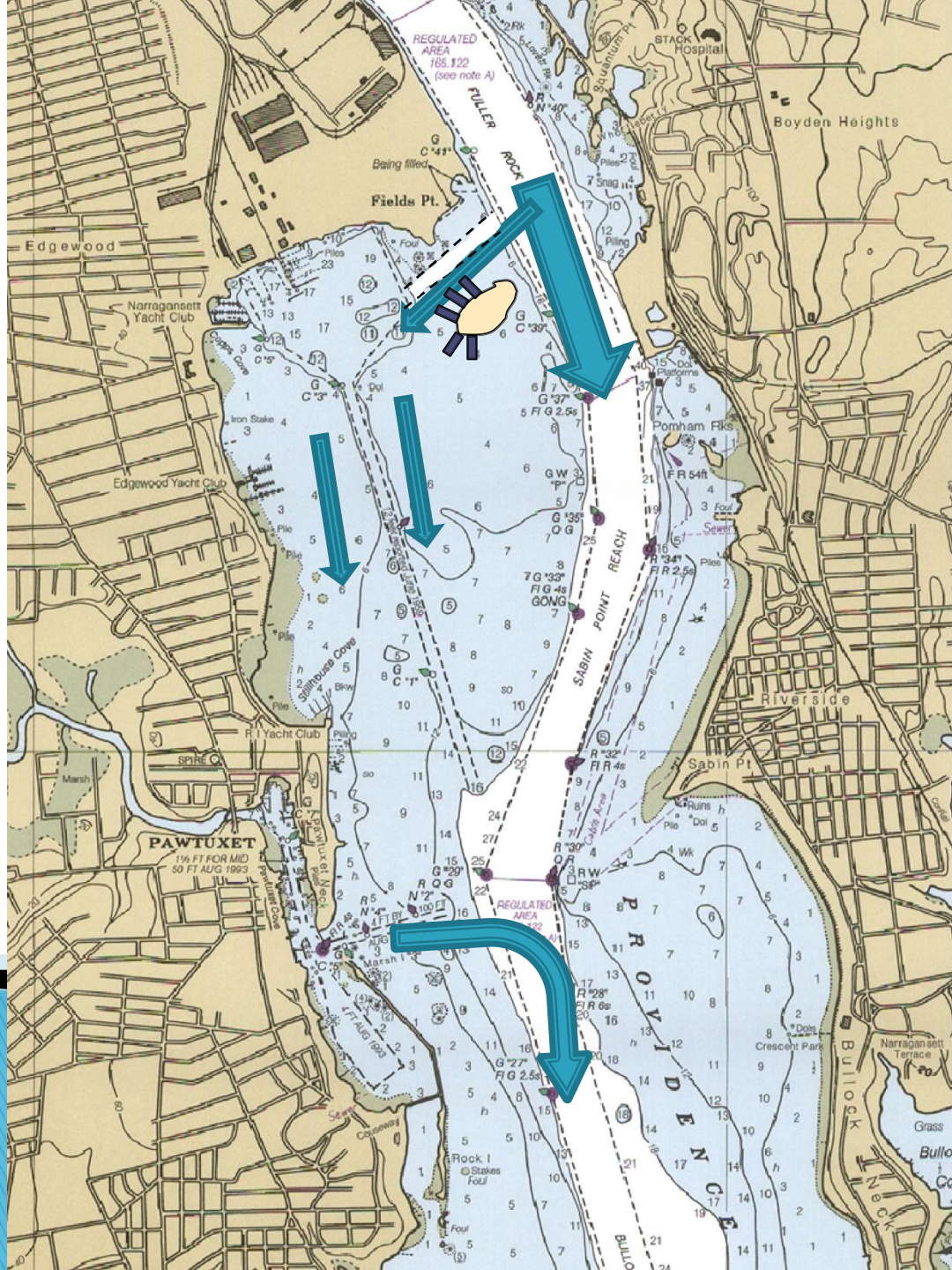



- Sustainability = Achieving the triple bottom line
- Environmental Sustainability
- Economic Sustainability
- Social Sustainability
- Ecosystem Based Solutions

# Engineered Sustainable Solutions

- *Need Holistic Approach to Watershed Management*
- *Improve Water Quality By "Smart Engineering"*

- ✓ Selective Dredging?
- ✓ Maybe create a channel to redirect flow over shoal- improve circulation?
- ✓ Create Island and Wetland Habitats?
- ✓ Establish Bio-extraction or Aquaculture Projects?



# Sustainable Solutions

- Beneficial ways to remove nutrients from the ecosystem
- Wetlands & salt marsh restoration – remove 250 to 630 g N $m^{-2}$ $yr^{-1}$
- Bio-extraction Aquaculture – Ribbed Mussels 1.2 % N
- Relay aquaculture
  - Oysters – 0.52 g N/oyster
  - Quahogs –16.2 g N/kg meat
- **Benefits**:
  - Improve Fisheries – Shellfish Restoration & Enhancement
  - Create Jobs
  - Habitat Creation & Restoration

Photos courtesy of: http://www.jaxshells.org/gdim.htm, http://viudeepbay.com/2012/02/12/design-and-construction-report-solar-flupsy-project/, and Cape Cod Cooperative Extension

# NBC Seeking Feasibility Grant Funding

- Goal: ***Complete Feasibility Study to Holistically Evaluate Sustainable Solutions for DO Improvement***
  - Altering circulation patterns
  - Bio-extraction
  - Relay Aquaculture
  - Creation of Wetlands & Salt Marshes
  - Selective Dredging
  - Identify Regulatory & Environmental roadblocks
  - Financial evaluation
- Seeking grant partners and grant opportunities to create blueprint

http://www.magazine.noaa.gov/stories/mag161.htm

http://www.edc.uri.edu/restoration/html/intro/salt.htm