

# Nutrient Monitoring in Upper Narragansett Bay

Pamela J. Reitsma  
Environmental Scientist  
Narragansett Bay Commission  
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# Narragansett Bay Commission

- \* NBC is a quasi-public agency which oversees the two largest WWTFs in Rhode Island
  - \* Bucklin Point in East Providence
  - \* Field's Point in Providence
- \* 10 municipalities in service area
- \* 360,000 people served including 8,000 businesses and industrial customers.



# NBC Nutrient Monitoring Program

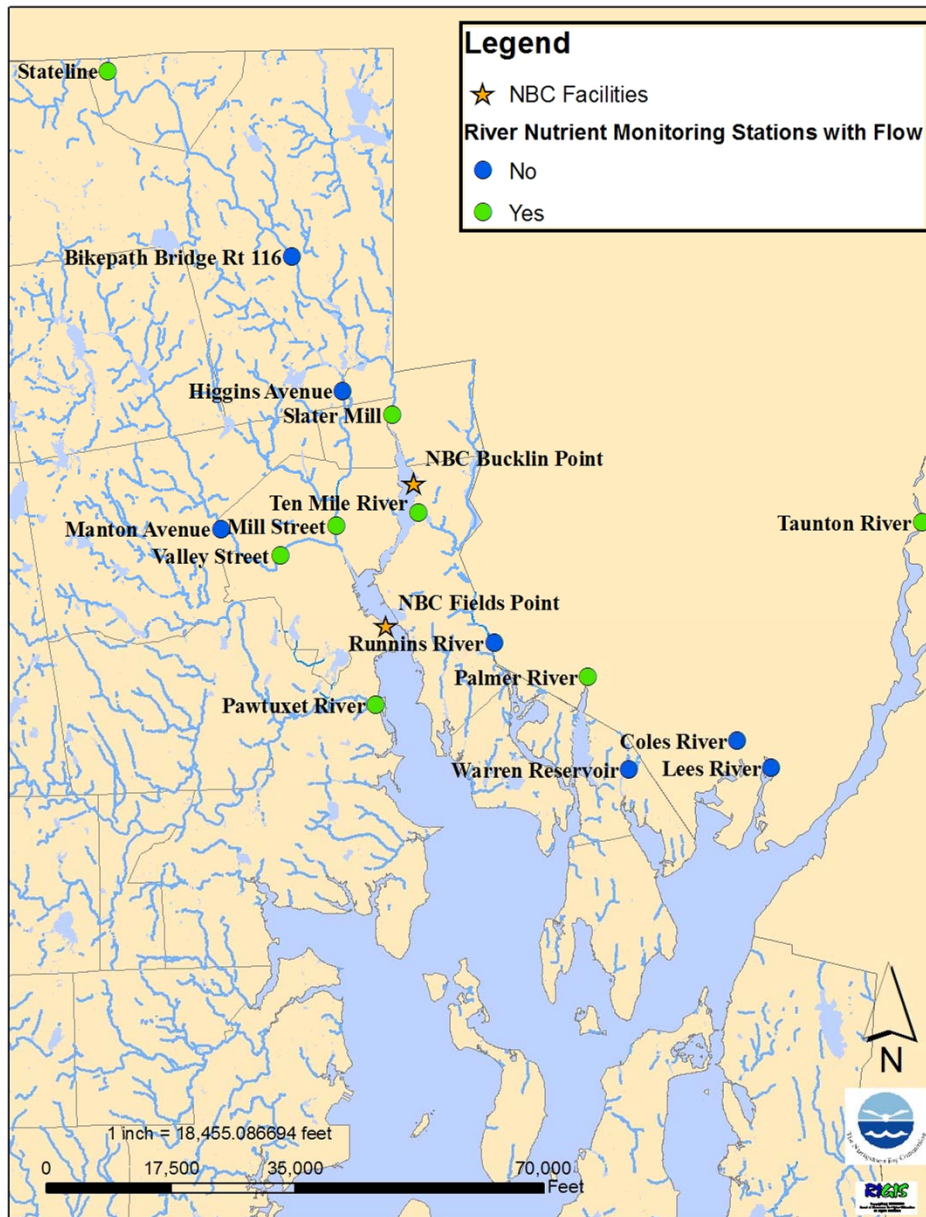
- \* Program instituted in 2005
- \* Purpose: address and understand the magnitude of impacts that facility operations have on receiving waters
- \* This sampling program was designed to evaluate nutrient loading in the urban rivers that empty into Narragansett Bay
- \* NBC will be able to more accurately determine the impact of BNR systems at the WWTFs and inform stakeholders.



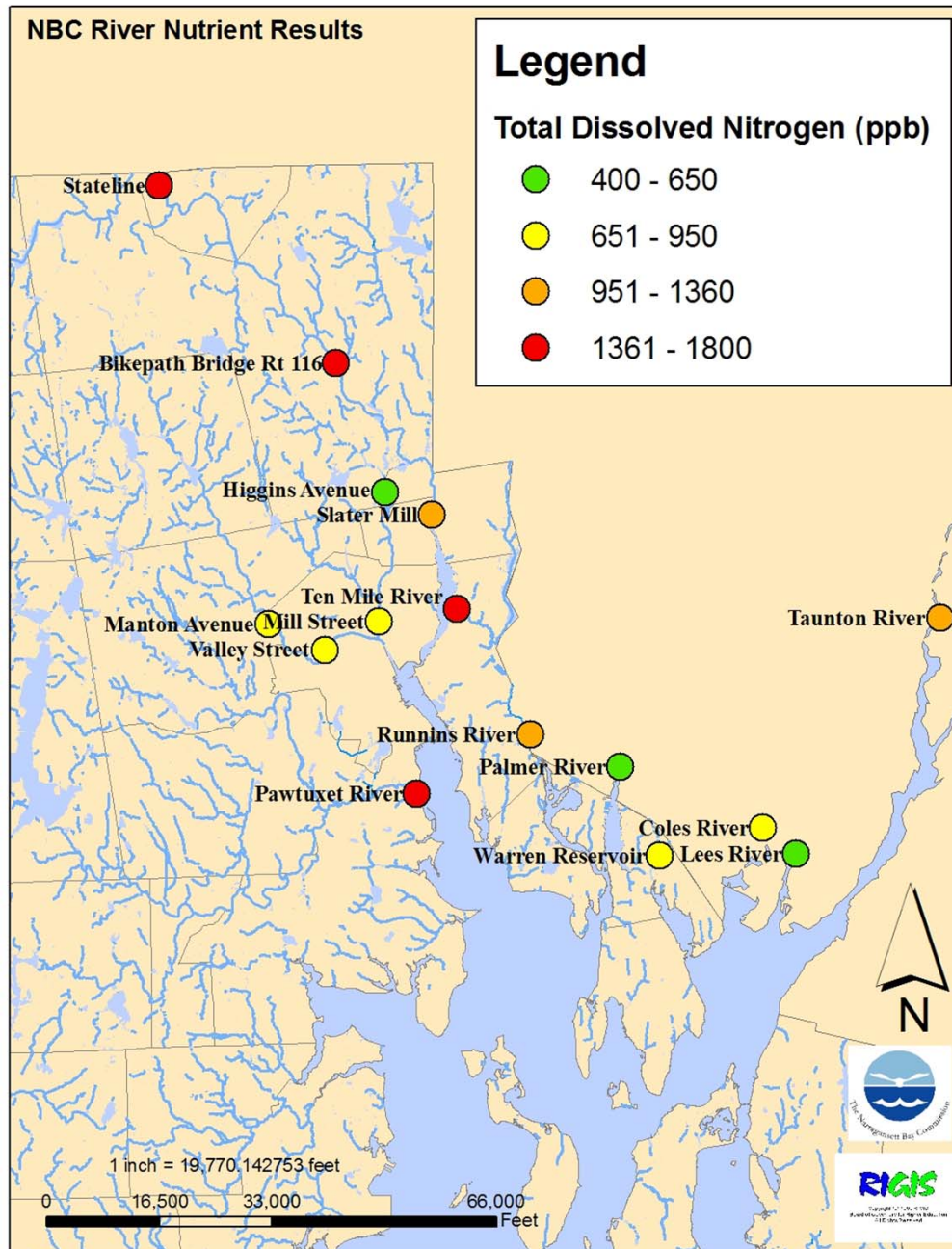
## Parameters/Methods

- \* **Nitrite/nitrate** – EPA 353.4
- \* **Nitrite** – EPA 353.2
- \* **Total Dissolved Nitrogen** - Lachat QuikChem (31-107-04-3-A)
- \* **Ammonia** – EPA 349.0
- \* **Orthophosphate** – EPA 365.5
- \* **Silicate** – EPA 366.0
- \* **Chlorophyll a** – Turner Fluorometer
- \* **Total Suspended Solids** - Standard Method 2540-D
- \* **Total Organic Carbon** - Standard Methods 5310-D

# River Nutrient Stations



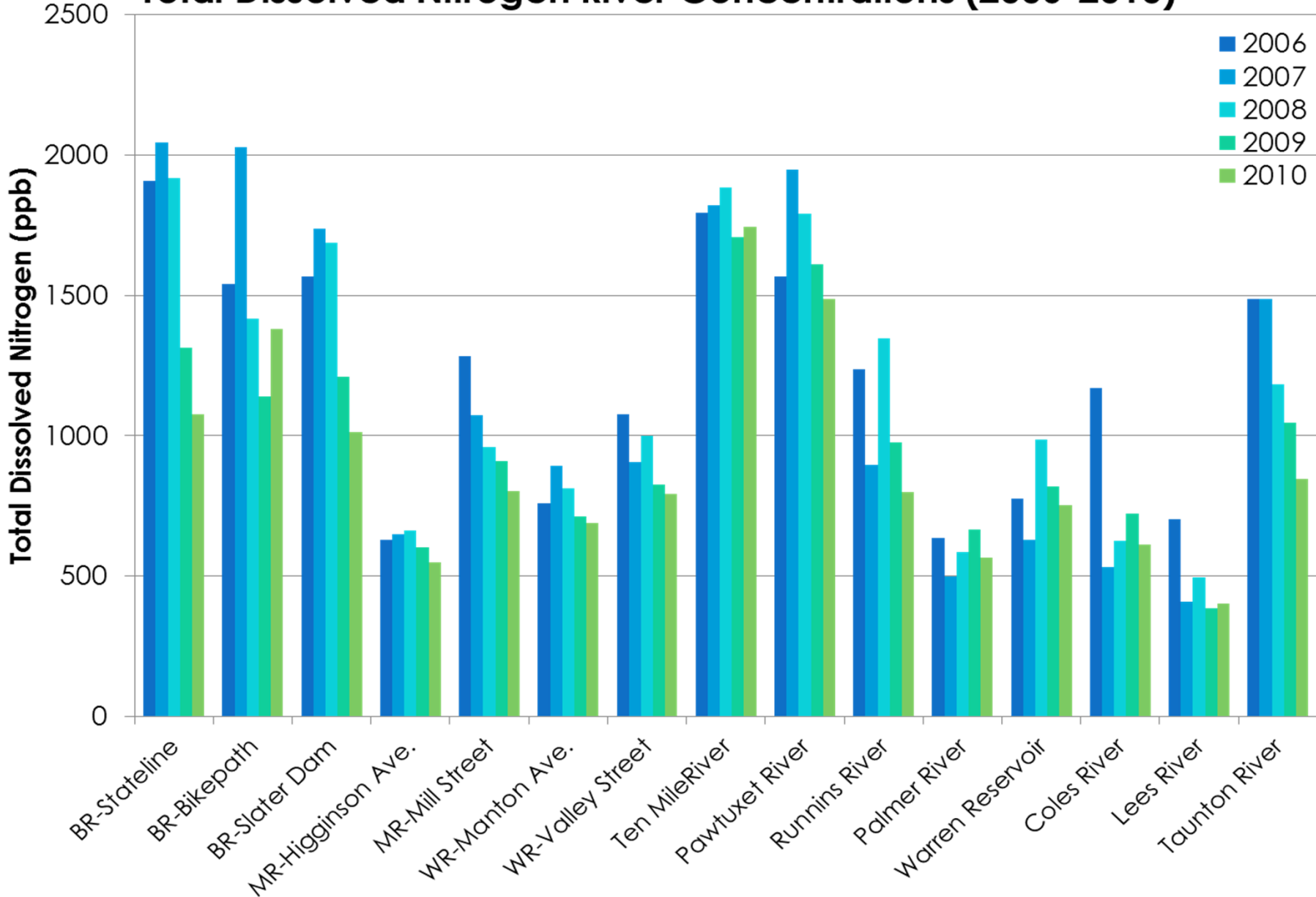
- \* Nutrients measured bi-monthly at 15 sites in RI & MA rivers
- \* Total N loading – determined by using NBC nutrient results and USGS river flow data
- \* Stations used in loading calculations based on where flow information is available:
  - \* Blackstone River @ Stateline
  - \* Moshassuck River @ Mill Street
  - \* Woonasquatucket River @ Valley St
  - \* Pawtuxet River
  - \* Taunton River
  - \* Ten Mile River
  - \* Palmer River\*



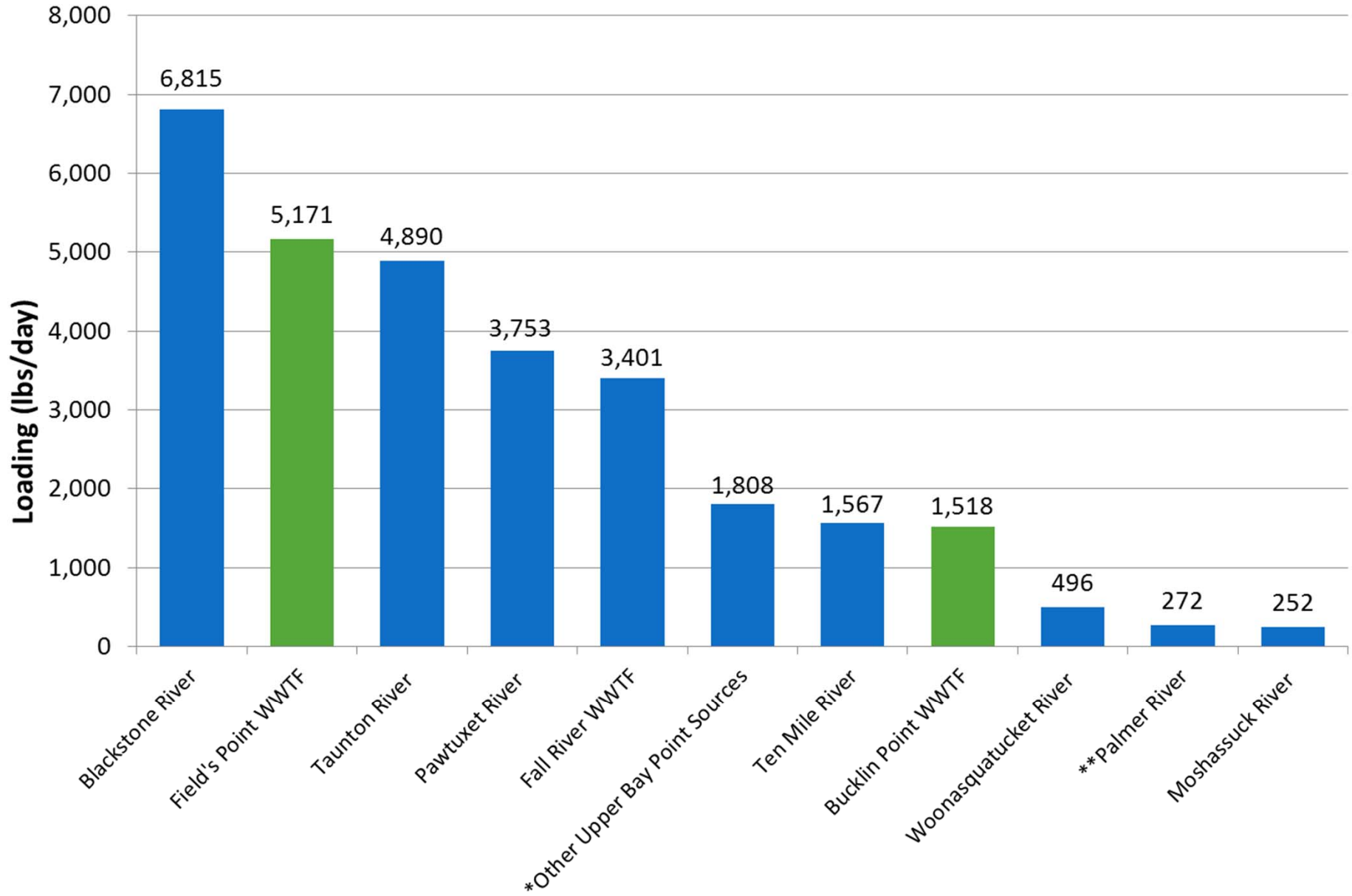
# Total Dissolved Nitrogen Conc.

- \* Concentrations are in ppb ( $\mu\text{g/L}$ )
- \* Average of all data from 2005 to 2011
- \* Values range from under 500 to over 1700 ppb
- \* Lowest concentration – Lees, Palmer and Moshassuck Rivers
- \* Highest concentration – Ten Mile, Pawtuxet and Blackstone Rivers

# Total Dissolved Nitrogen River Concentrations (2006-2010)



## Average Total Nitrogen Loading (May 2006 - April 2011)

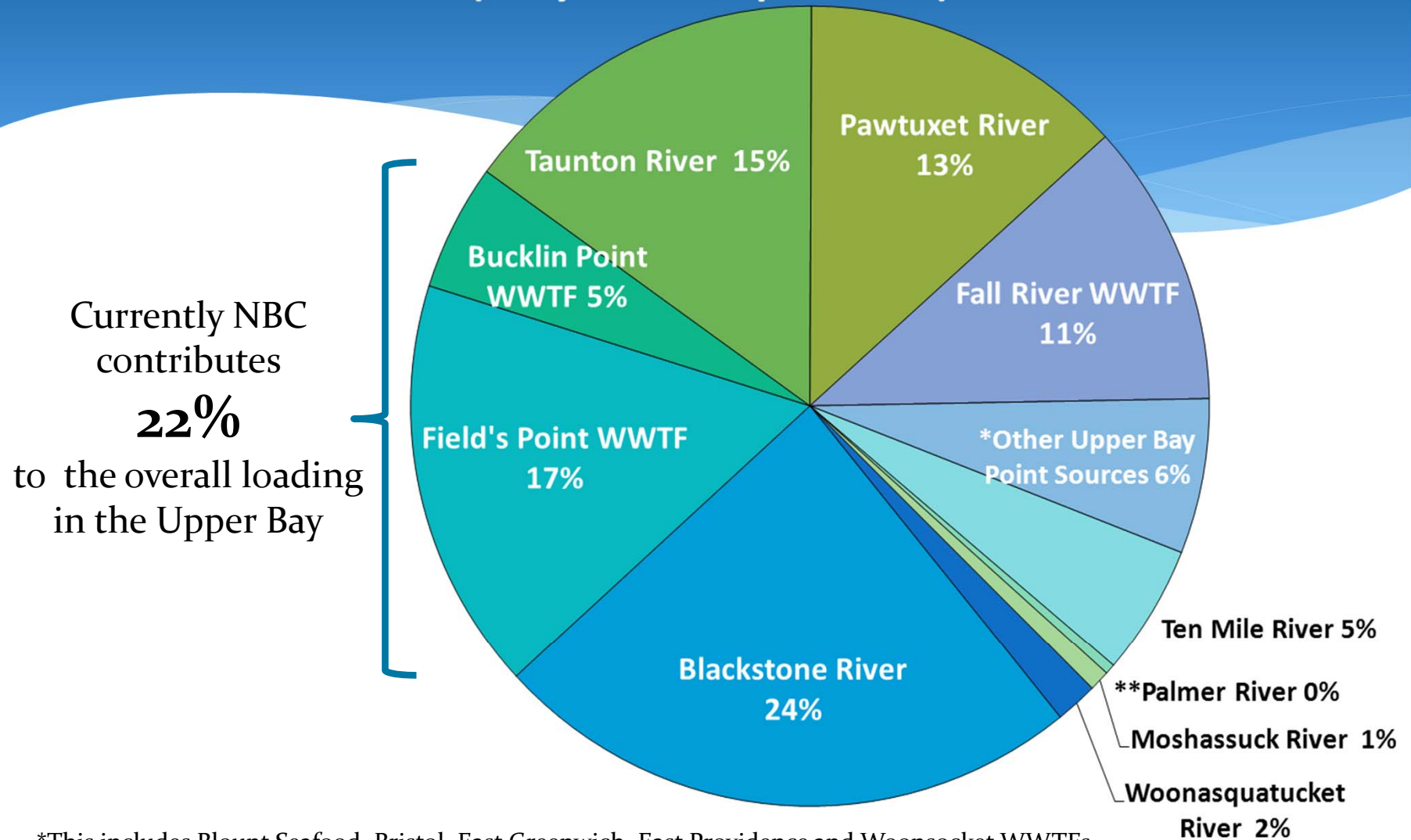


\*This includes Blount Seafood, Bristol, East Greenwich, East Providence and Woonsocket WWTFs

\*\*Flow data discontinued 7/1/09 due to lack of funding



## Estimated % Contribution to Total Nitrogen Loading (May 2006 - April 2011)

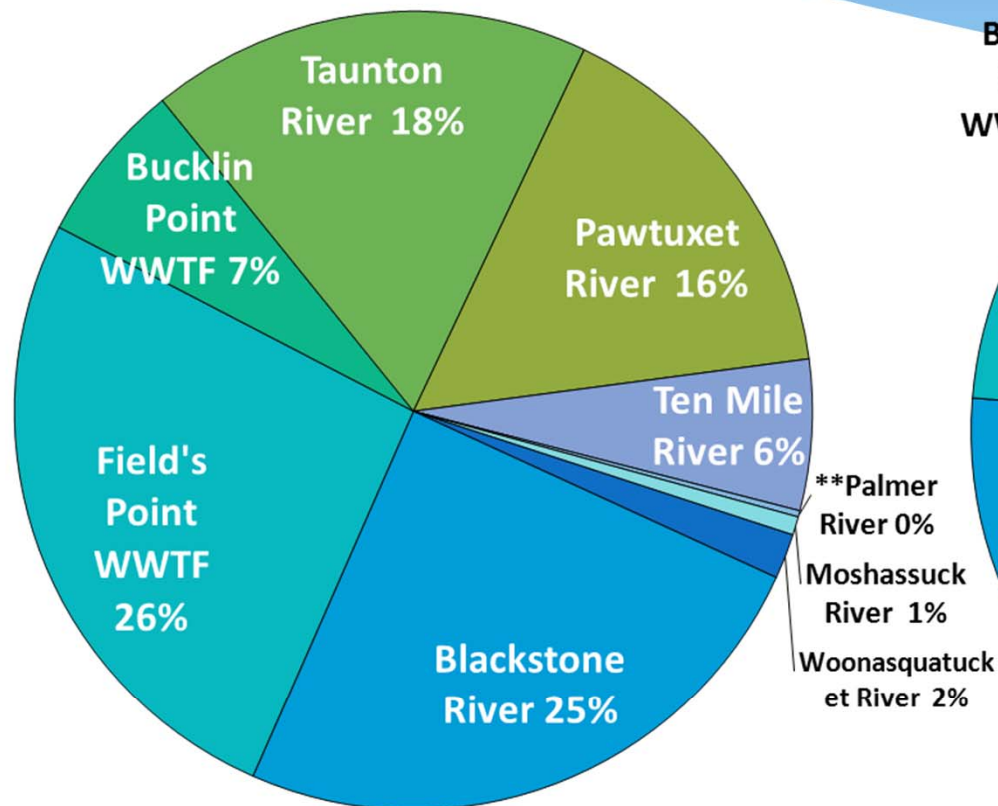


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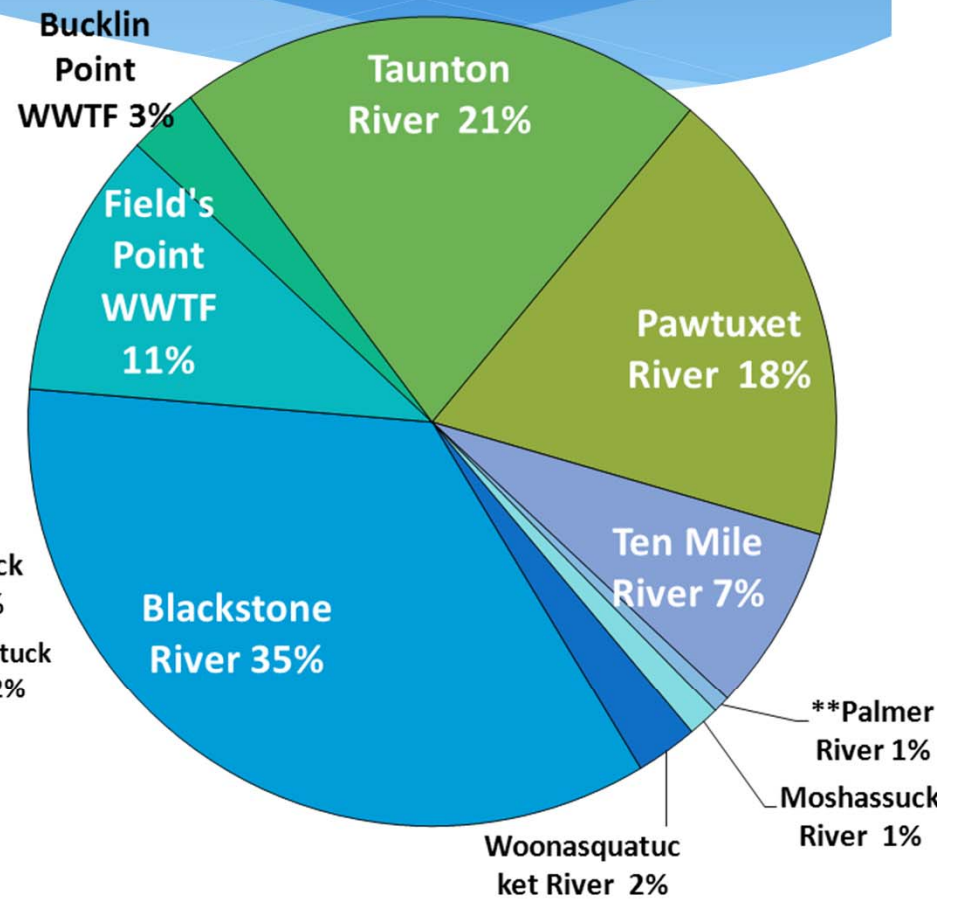
# Estimated % Contribution to Total Nitrogen

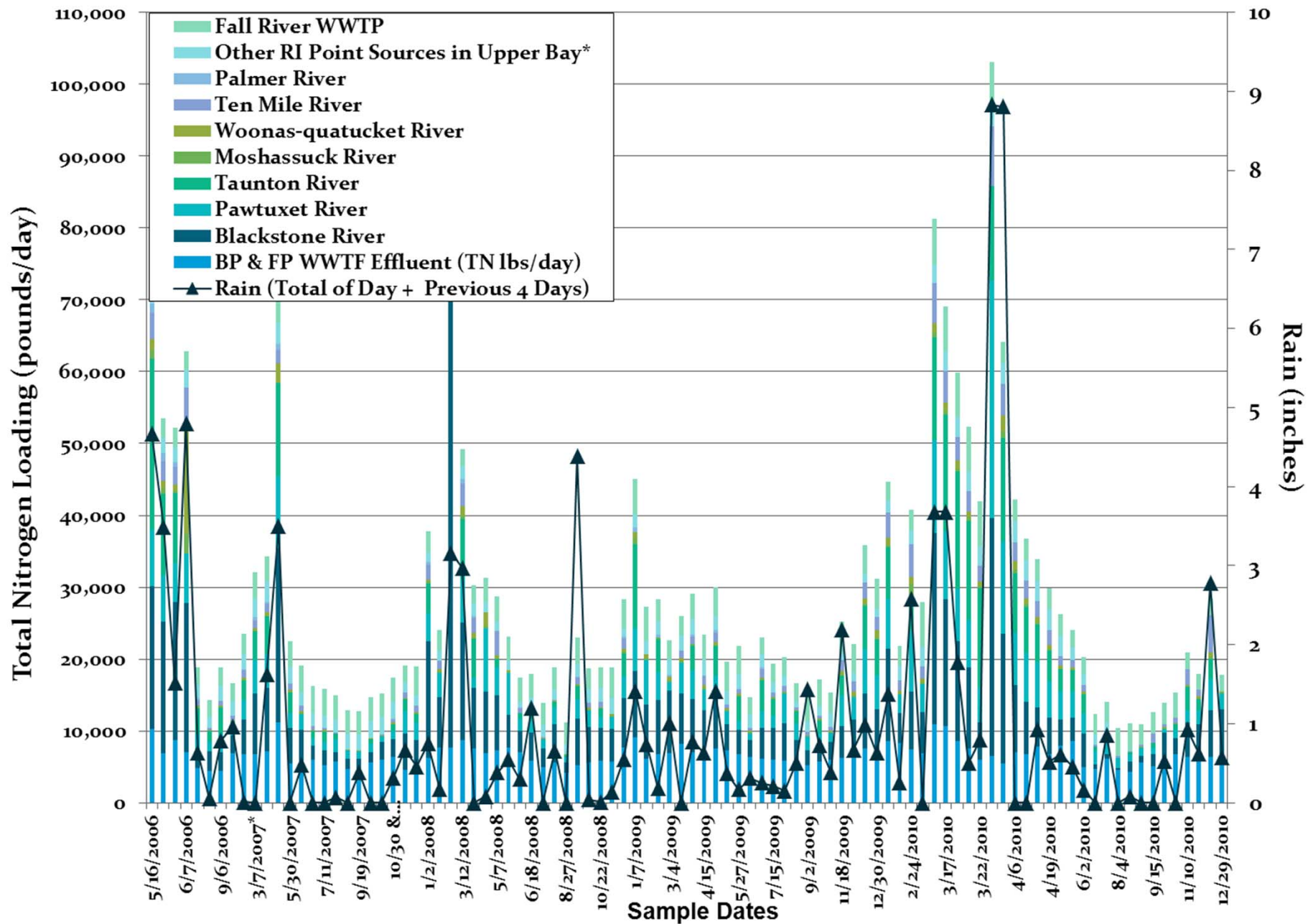
## Dry Weather Days



Dry weather – sample day in which there was <0.1 inches of rainfall in the previous 3 days.

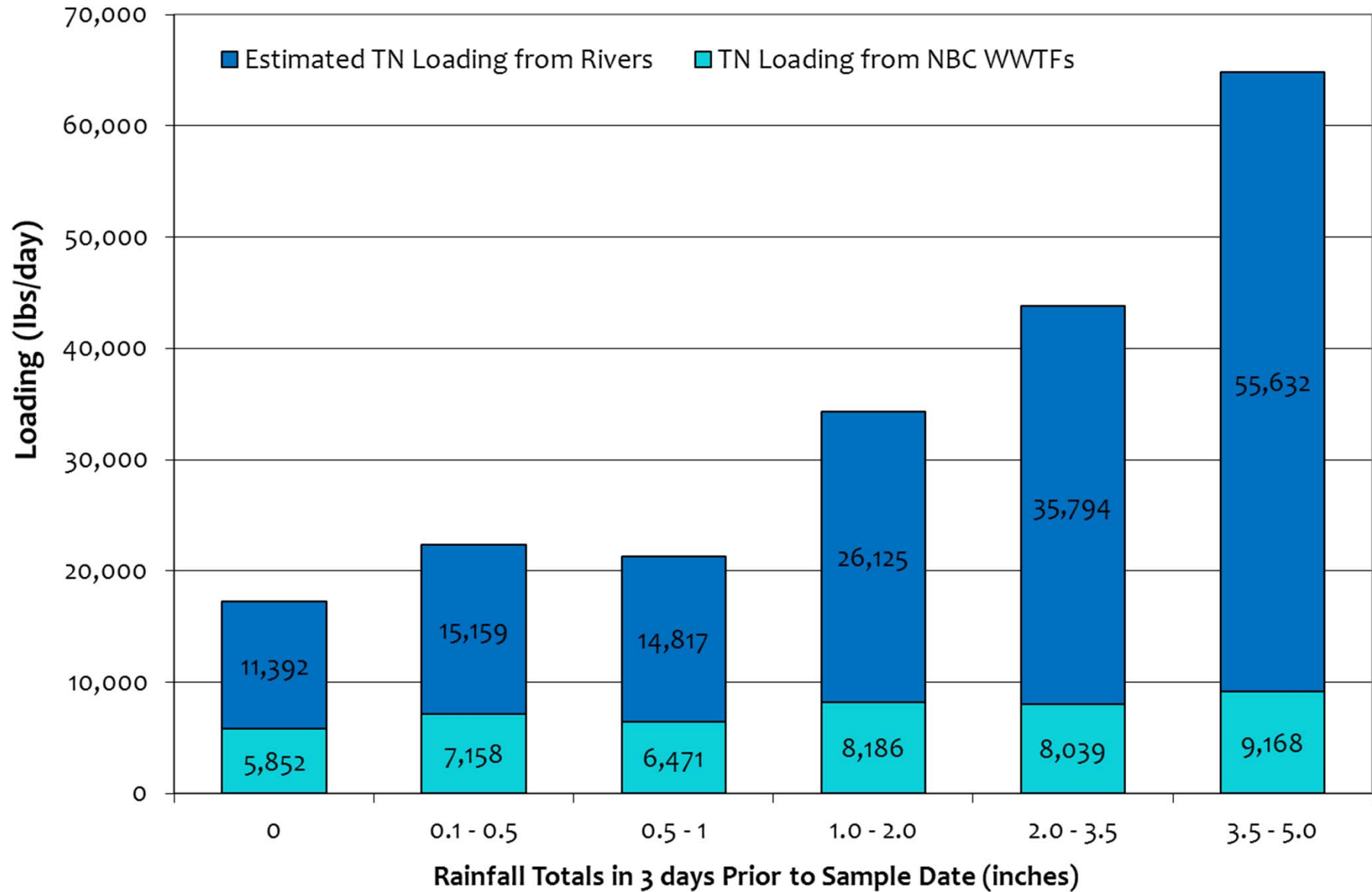
## Wet Weather Days

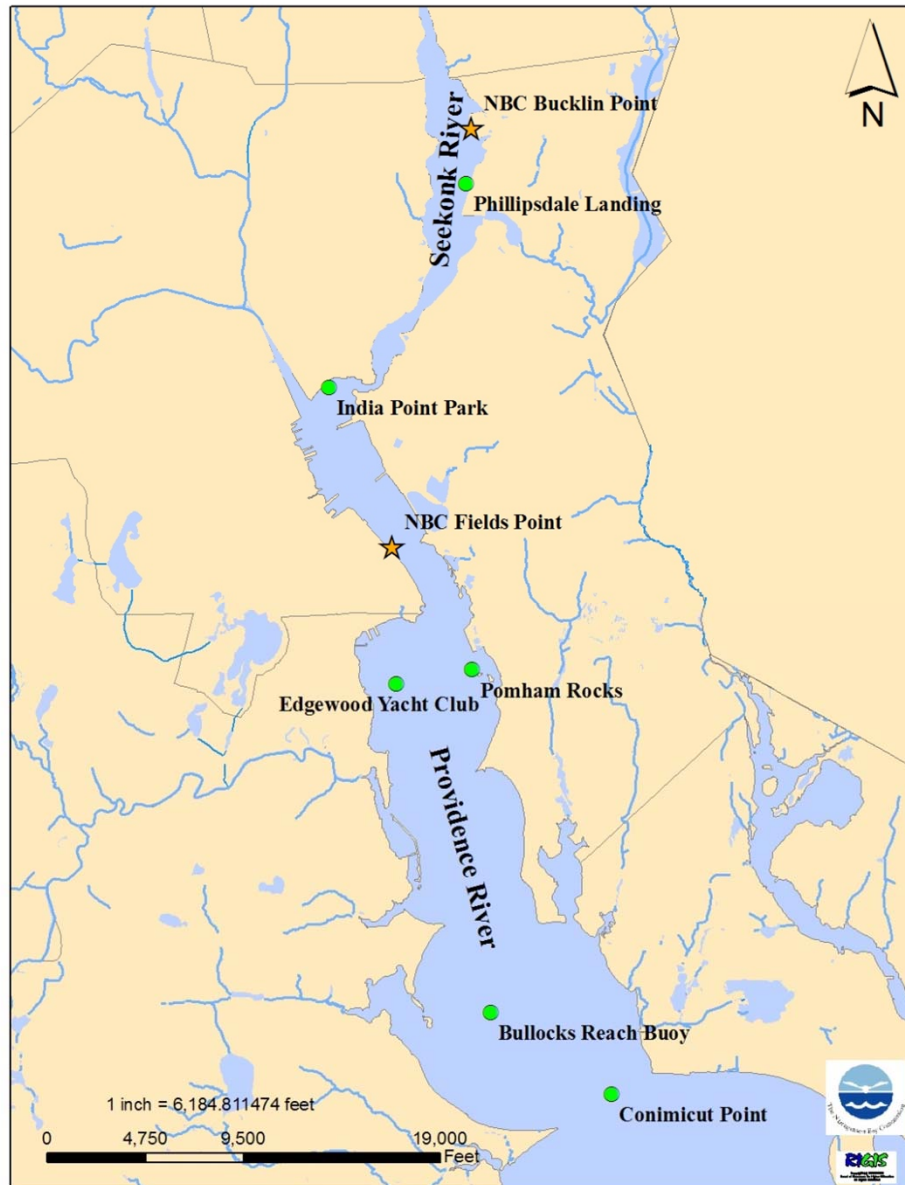




\*Blount Seafood, Bristol, East Greenwich, East Providence and Woonsocket WWTFs

### Average Nitrogen Loading from Rivers and WWTFs in the Upper Bay During NBC Sample Dates from May 2006 - April 2011

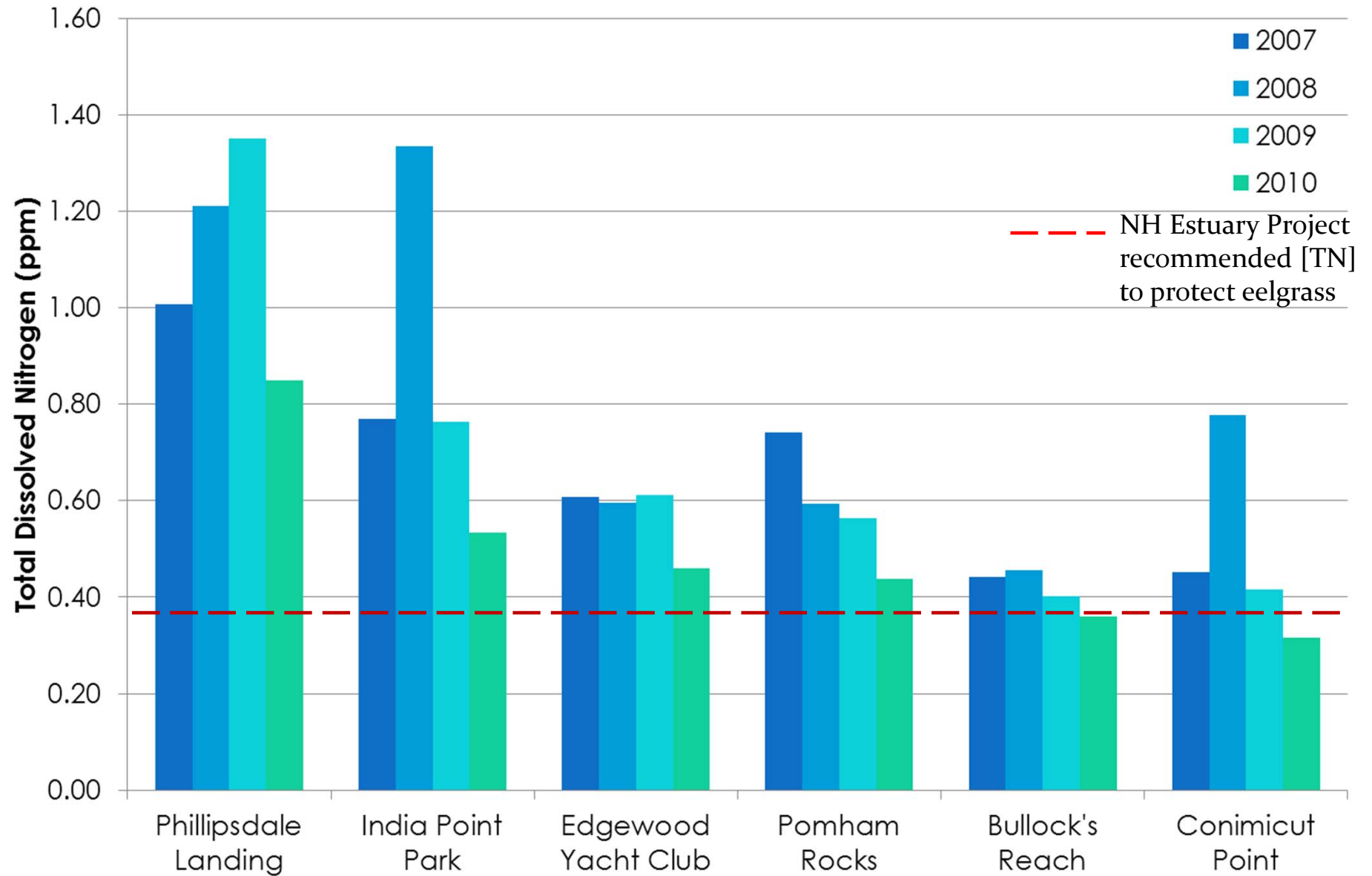




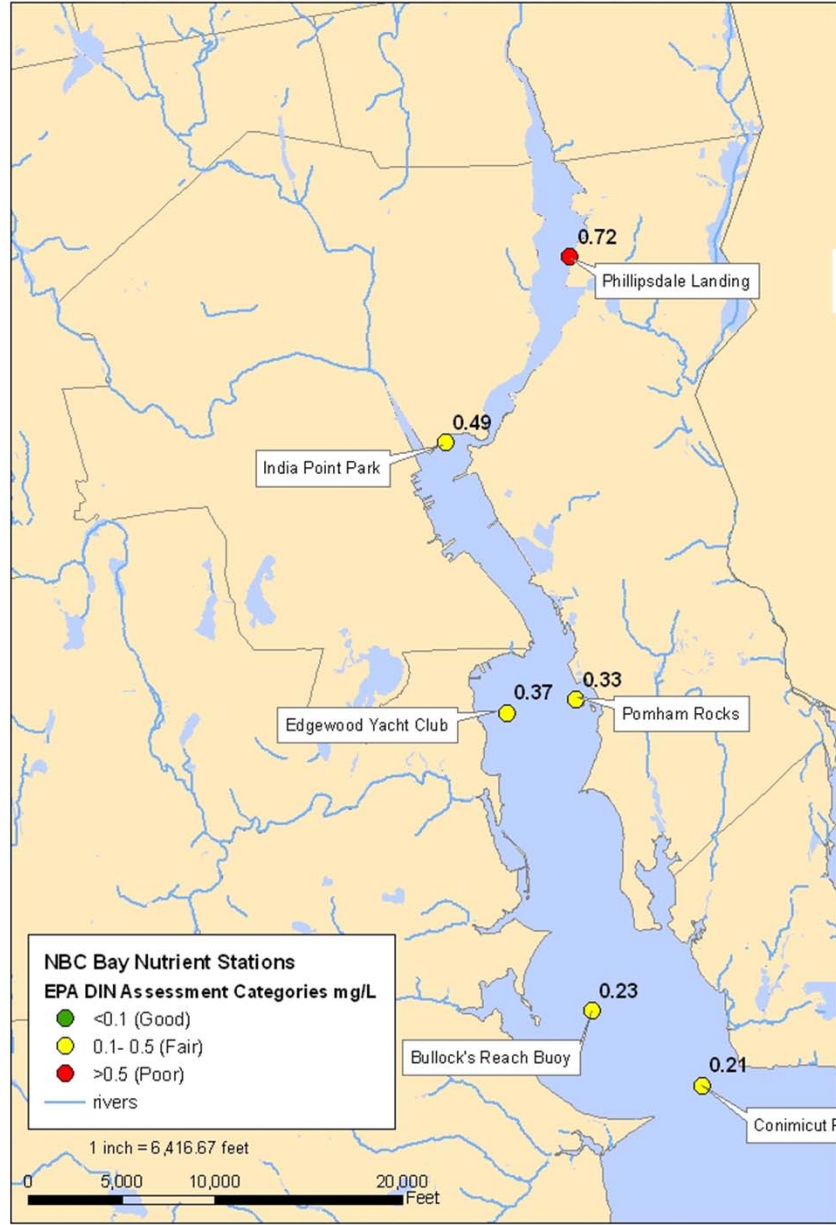
# Bay Nutrient Stations

- \* Began in 2005
- \* Nutrients measured bi-monthly at 6 sites in the Upper Bay
- \* Samples collected at the surface and the bottom
- \* Surface sample – collected 0.5 to 1 m below surface
- \* Bottom sample – collected 0.5 to 1 m above the benthos
- \* Collect at various stages of the tidal cycle throughout the year

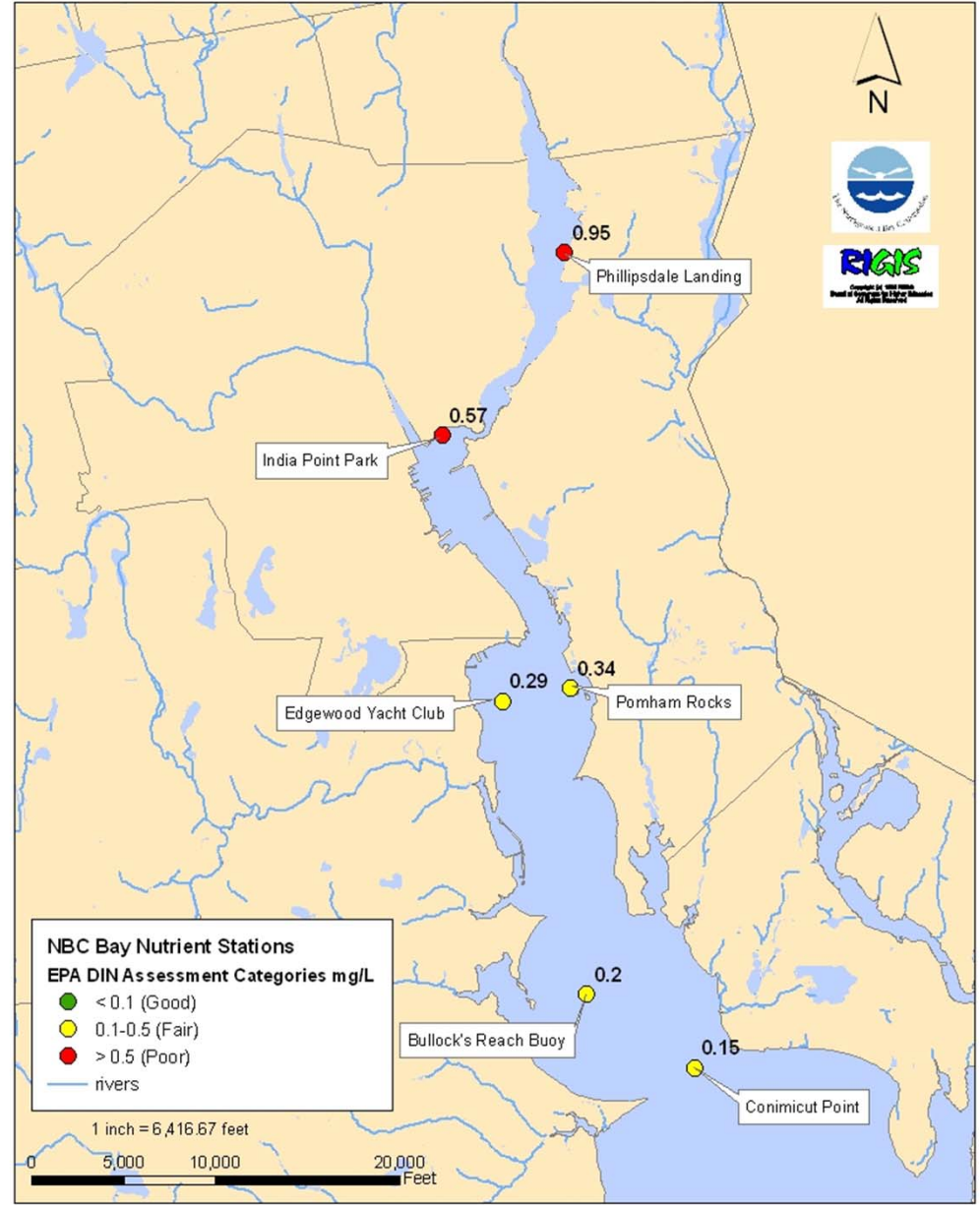
## Surface Total Dissolved Nitrogen Concentrations (May - October)



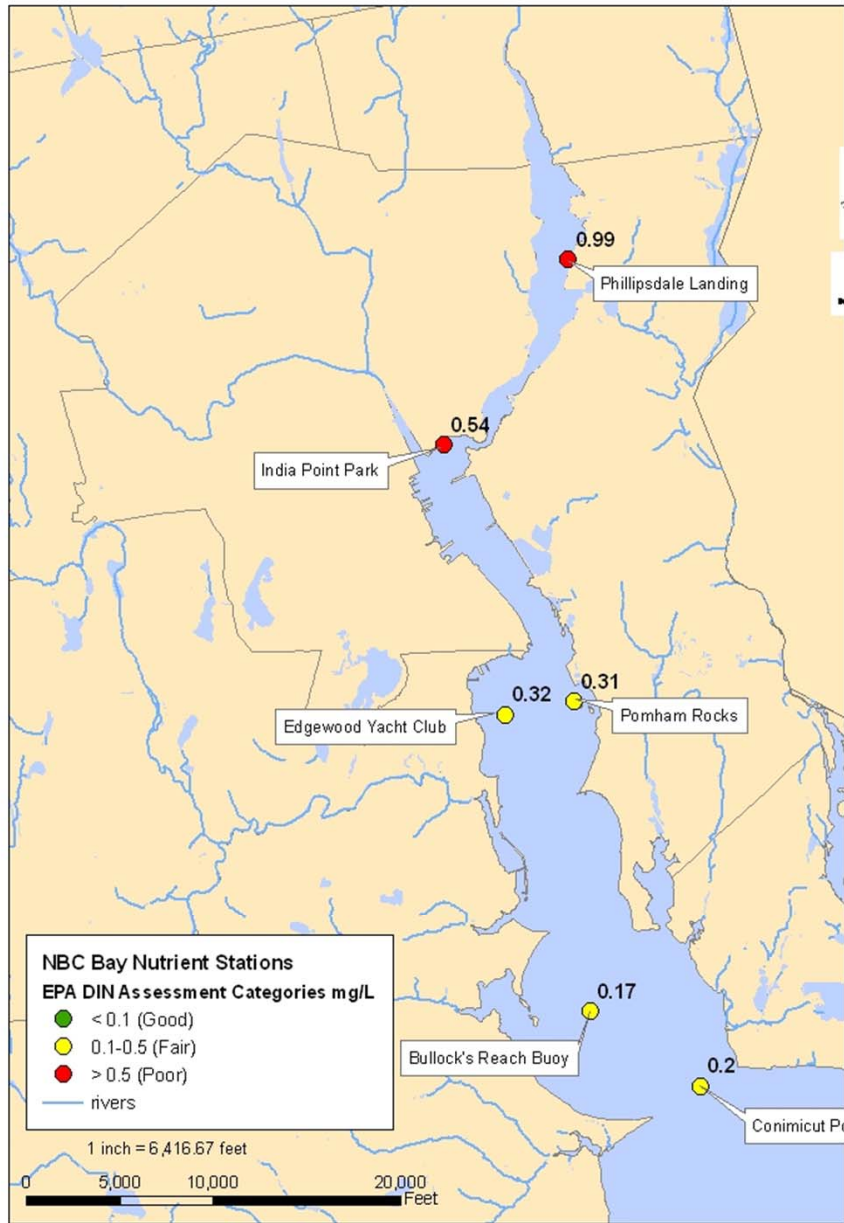
**NBC Bay Nutrient Sampling Stations**  
**Summer 2007 Average DIN Concentrations (mg/L) at Surface**



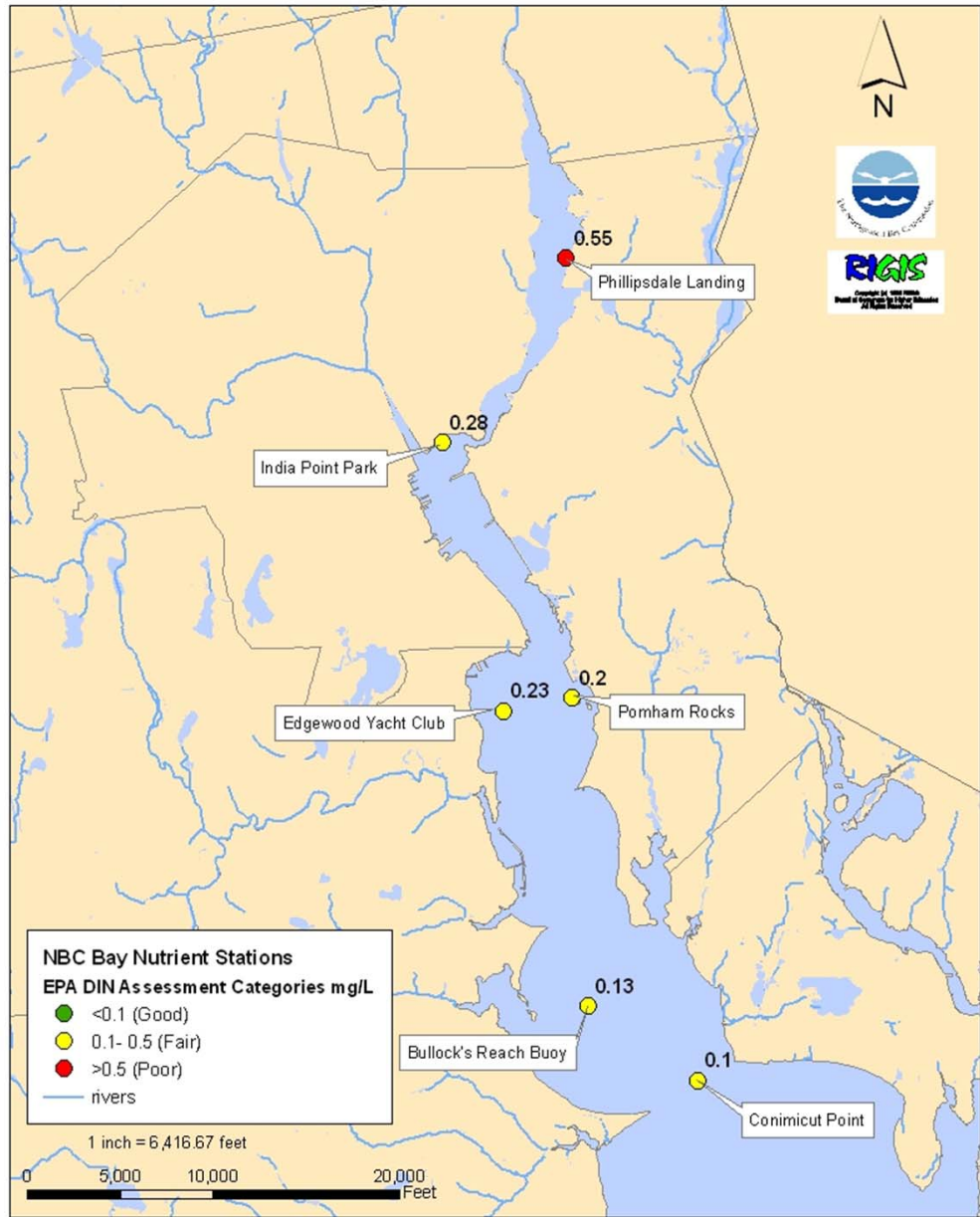
**NBC Bay Nutrient Sampling Stations**  
**Summer 2008 Average DIN Concentrations (mg/L) at Surface**



**NBC Bay Nutrient Sampling Stations**  
**Summer 2009 Average DIN Concentrations (mg/L) at Surface**



**NBC Bay Nutrient Sampling Stations**  
**Summer 2010 Average DIN Concentrations (mg/L) at Surface**





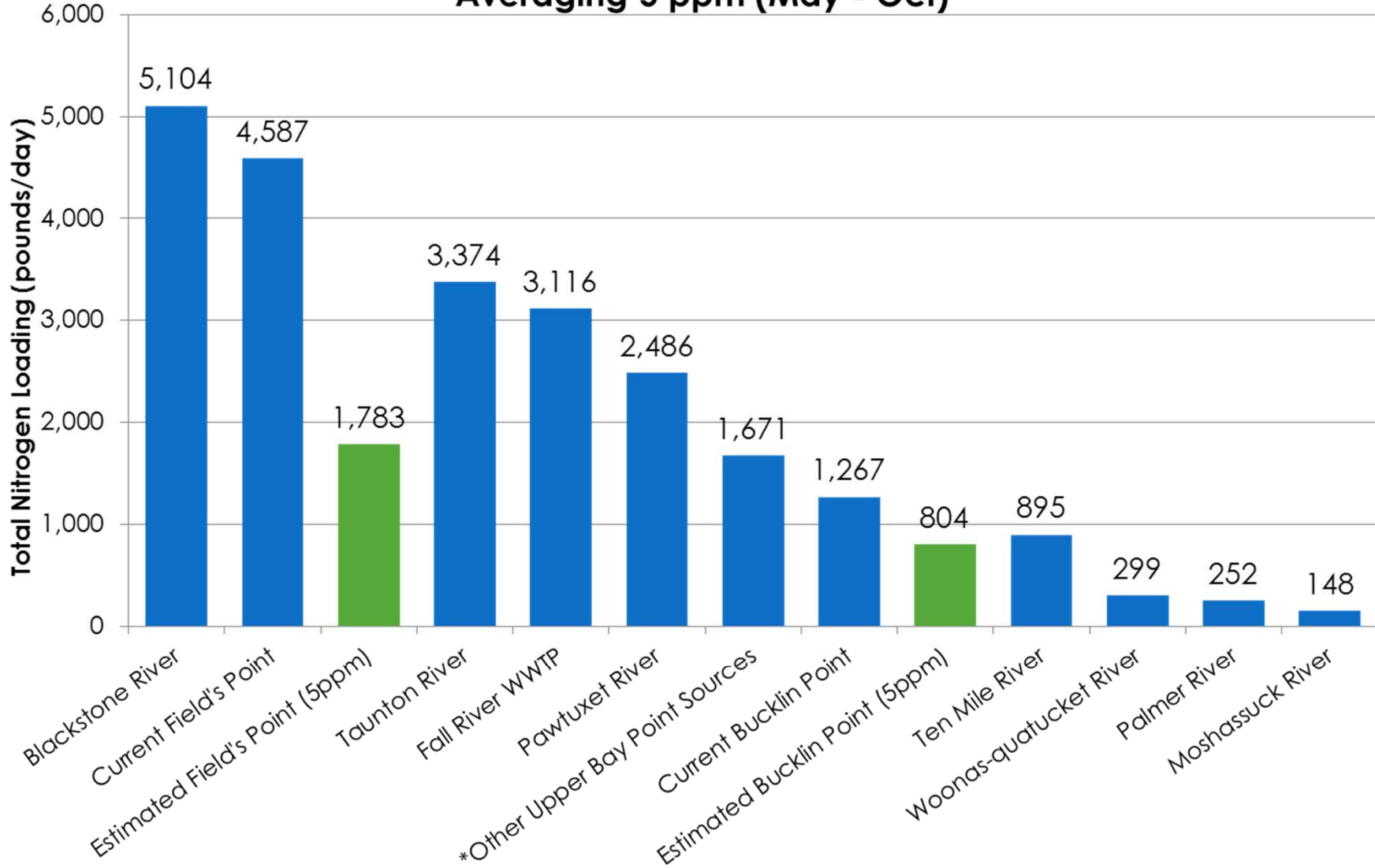
# Dissolved Inorganic Nitrogen

Station	2007		2008		2009		2010	
	DIN (mg/L)	EPA NEP criteria	DIN (mg/L)	EPA NEP criteria	DIN (mg/L)	EPA NEP criteria	DIN (mg/L)	EPA NEP criteria
DIN (mg/L) Good <0.1 Fair 0.1-0.5 Poor >0.5								
Phillipsdale Landing	0.72	Poor	0.95	Poor	0.99	Poor	0.55	Poor
India Point Park	0.49	Fair	0.57	Poor	0.54	Poor	0.28	Fair
Edgewood Yacht Club	0.37	Fair	0.29	Fair	0.32	Fair	0.23	Fair
Pomham Rocks	0.33	Fair	0.34	Fair	0.31	Fair	0.20	Fair
Bullock's Reach	0.23	Fair	0.20	Fair	0.17	Fair	0.13	Fair
Conimicut Point	0.21	Fair	0.15	Fair	0.20	Fair	0.10	Fair

# Past, Present & Future

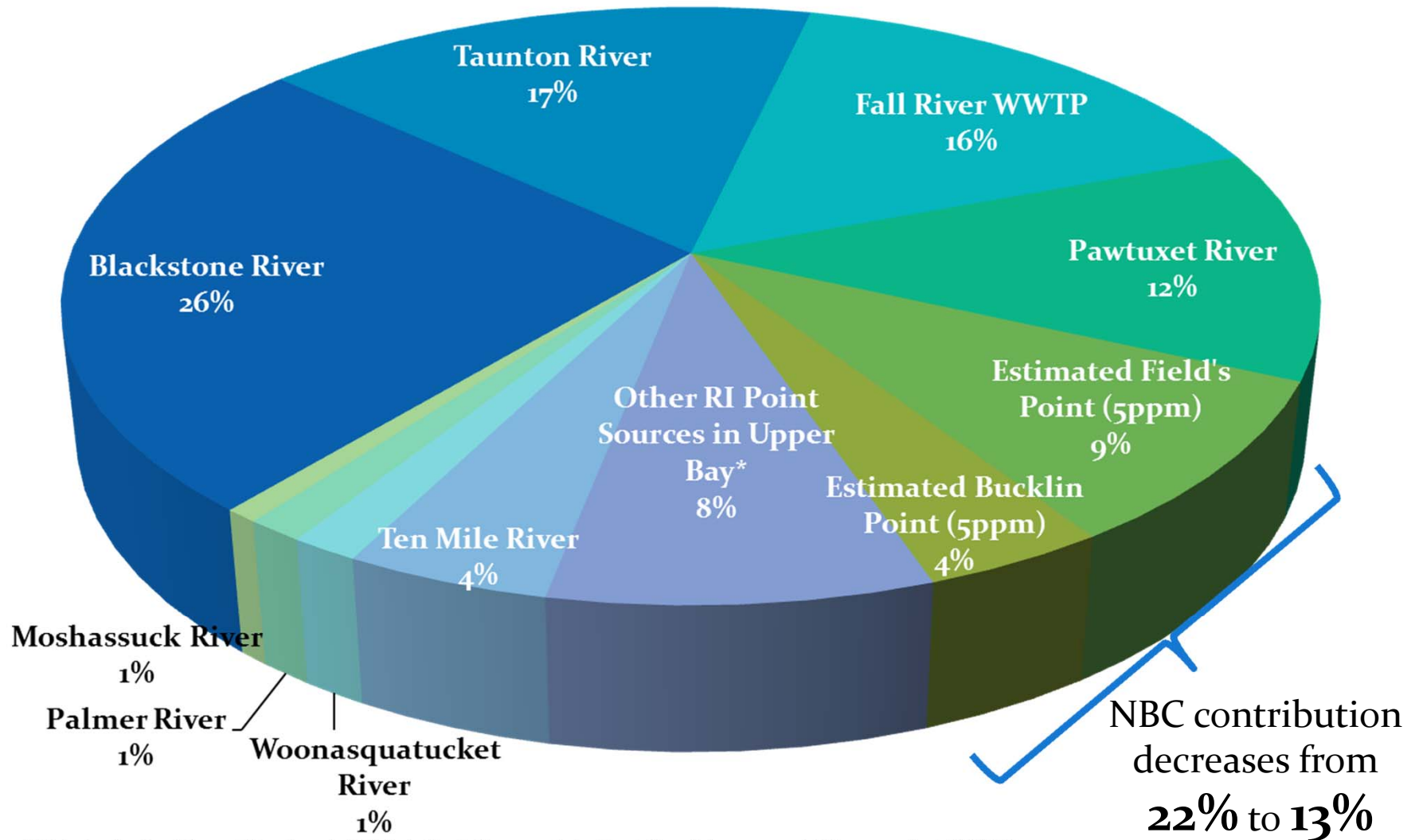
	Concentration (ppm)	Loading (lbs/day)	Percent Reduction (Loading)
<b>Field's Point TN Loading</b>			
Year of Fish Kill (2003)	15.7	5,872	
2010 Permit Year	15.5	5,132	13%
IFAS Upgrade	5.0	1,783	70%
If mandated to achieve 3 ppm	3.0	1,070	82%
<b>Bucklin Point TN Loading</b>			
Year of Fish Kill (2003)	14.8	2,920	
2010 Permit Year	6.7	1,004	66%
IFAS Upgrade	5.0	804	72%
If mandated to achieve 3 ppm	3.0	482	83%
<b>Combined NBC Facilities</b>			
Year of Fish Kill (2003)	BP=14.8, FP=15.7	8,792	
2010 Permit Year	BP=6.7, FP=15.5	6,136	30%
FP&BP Upgrade to 5 ppm	BP=5.0, FP=5.0	2,587	71%
If mandated to achieve 3 ppm	BP=3.0, FP=3.0	1,552	82%

## Estimated Daily Total Nitrogen Effluent Loading with NBC Facilities Averaging 5 ppm (May - Oct)



\*This includes Blount Seafood, Bristol, East Greenwich, East Providence and Woonsocket WWTFs

## Estimated % Contribution of Total Nitrogen to Upper Bay when NBC Facilities Average 5 ppm (May - Oct)



\*This includes Blount Seafood, Bristol, East Greenwich, East Providence and Woonsocket WWTFs

# Summary

- \* Blackstone, Taunton, and Pawtuxet Rivers contribute 15,458 lbs./day or 52% of the total nitrogen measured entering the Upper Bay.
- \* Our results indicate that in Wet Weather nitrogen loading from area rivers can increase between 65 – 282% during a rainfall event.
- \* During large rain events, loadings from the rivers can increase by over ~55,000 lbs. depending on the amount of rainfall.
- \* NBC WWTFs currently contribute 6,689 lbs./day or 22% of the Total Nitrogen entering the Upper Bay.
- \* In 2014, these loading will be reduced by 71% to 2,587 lbs./day of the Total Nitrogen entering the Upper Bay with the completion of the BNR upgrades.



**Questions?**