



# Rhode Island Water Quality Improvements Linked to WWTF Pollutant Effluent Reductions



RIDEM Office of Water Resources  
2023 National NPDES Permitting Meeting



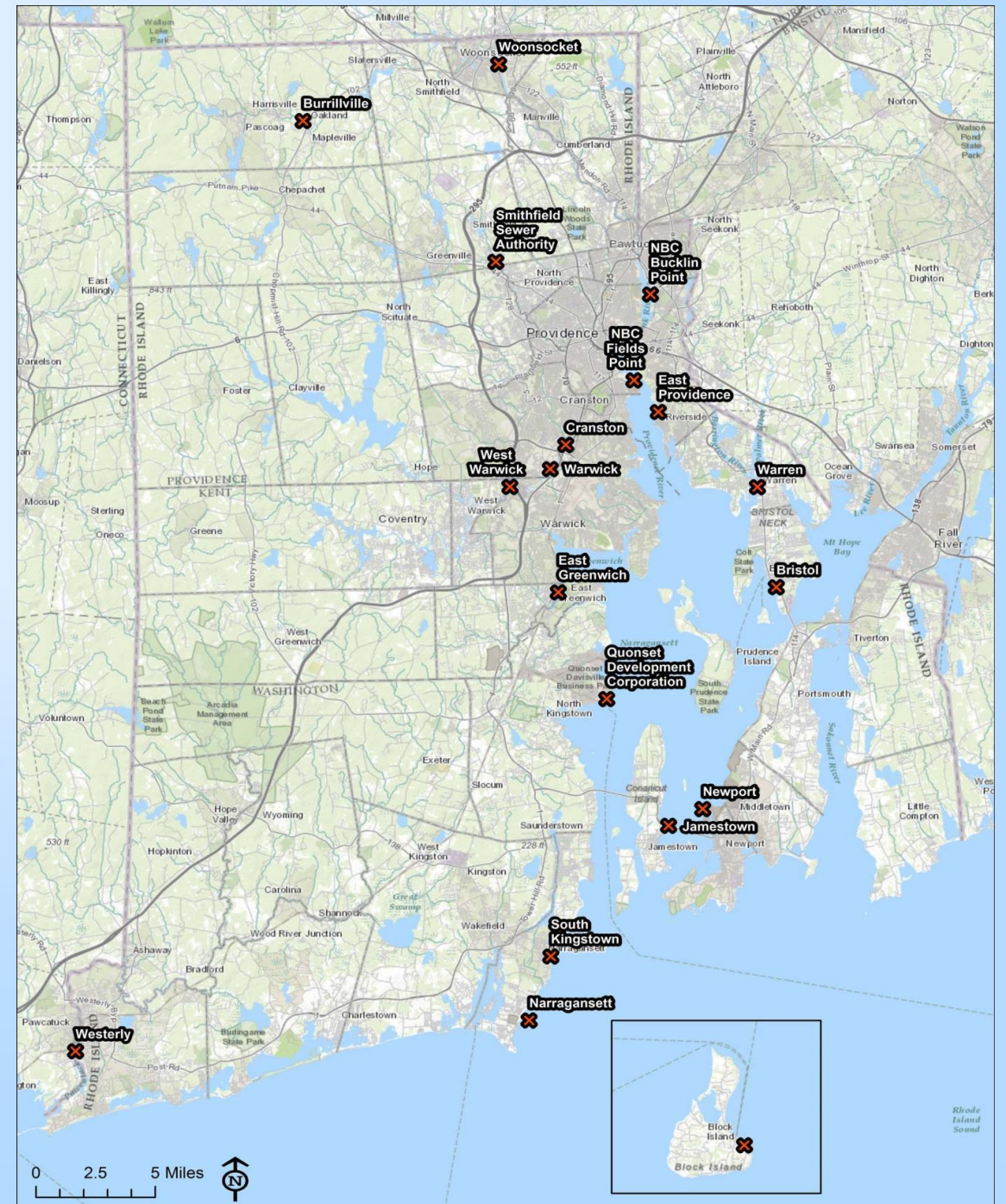
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# 19 Rhode Island Municipal WWTFs

6 Freshwater Discharges

13 Saltwater Discharges

3 Systems with Combined  
Sewer Overflows

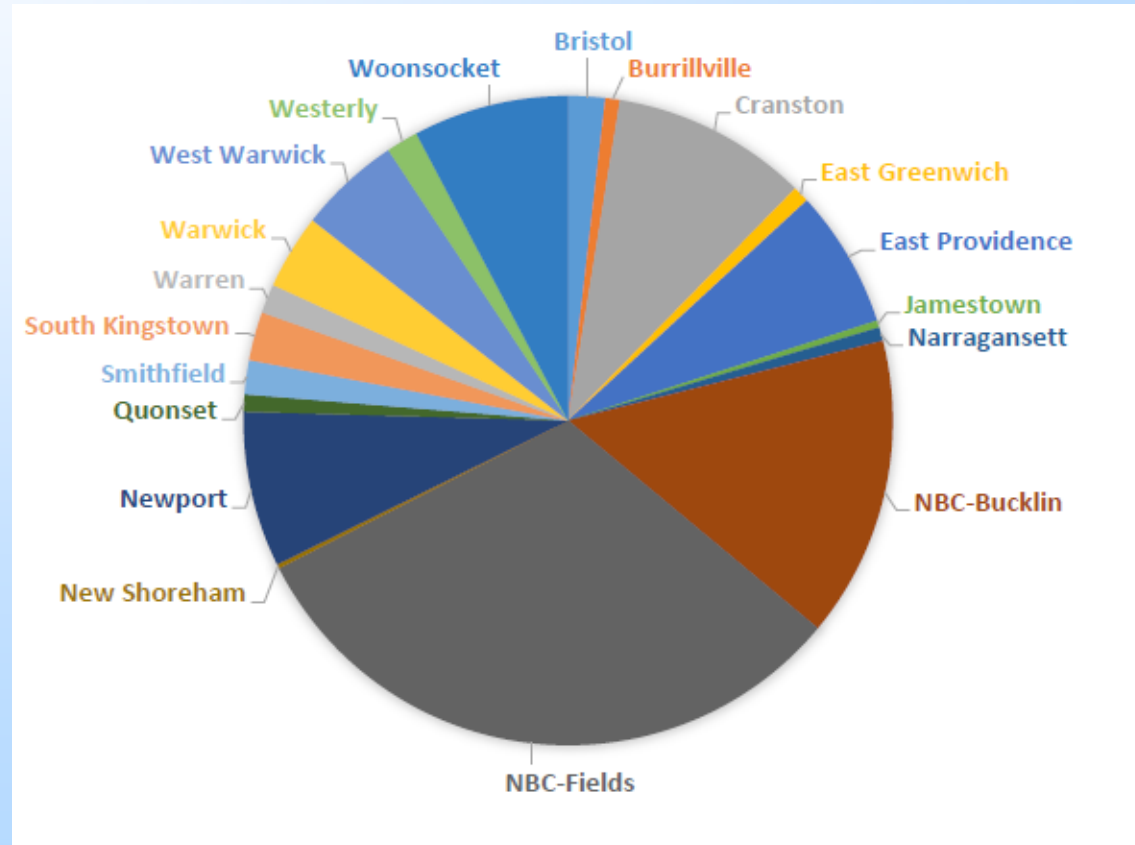






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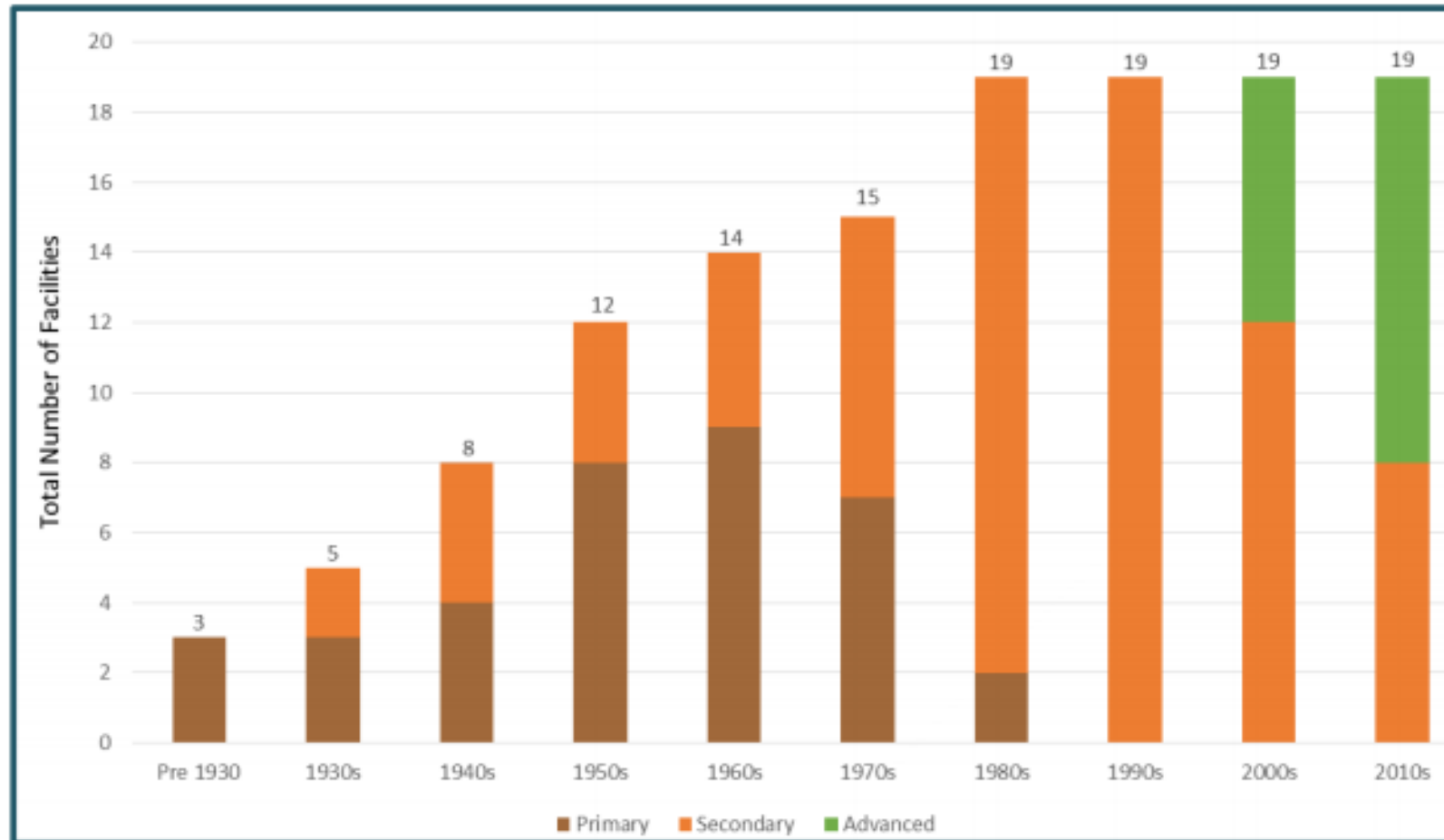
# RI WWTF Design Flows Relative Contribution





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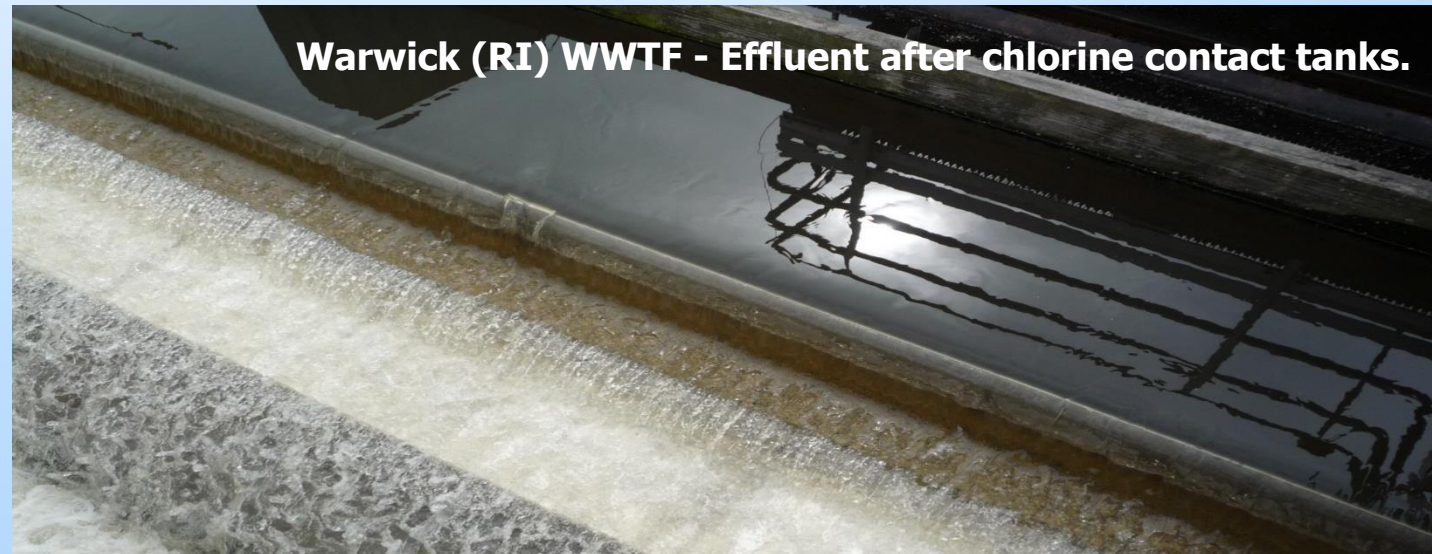
**Figure 8, Trends in Level of Treatment at RI Wastewater Facilities**  
(Source: DEM)





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# Wastewater Disinfection



<https://www.southbendin.gov/government/content/treatment-plant>

[https://www.tpomag.com/editorial/2015/01/asset\\_management\\_gets\\_big\\_attention\\_at\\_the\\_newly\\_upgraded\\_plant\\_bucklin\\_poi](https://www.tpomag.com/editorial/2015/01/asset_management_gets_big_attention_at_the_newly_upgraded_plant_bucklin_poi)



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## Limiting Chlorine to Protect Aquatic Life

EPA saltwater standard based on most sensitive of 24 species.



**Eastern  
Oyster**



**Coho**



**Atlantic silverside**

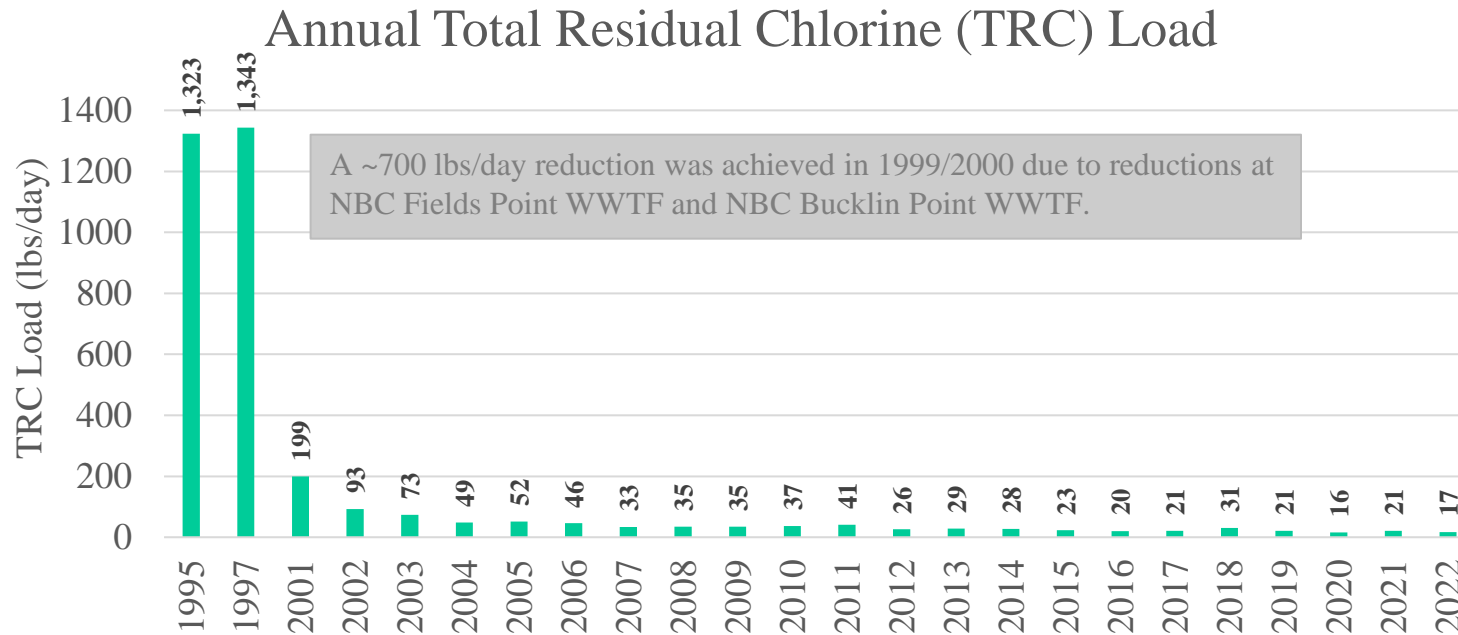
<https://commons.wikimedia.org/wiki/File:Coho.jpg>

[https://commons.wikimedia.org/wiki/File:Atlantic\\_silverside.jpg](https://commons.wikimedia.org/wiki/File:Atlantic_silverside.jpg)

[https://commons.wikimedia.org/wiki/File:Eastern\\_Oyster\\_\(Crassostrea\\_virginica\)\\_Top\\_\(16114506758\).jpg](https://commons.wikimedia.org/wiki/File:Eastern_Oyster_(Crassostrea_virginica)_Top_(16114506758).jpg)



# Rhode Island WWTF Total Residual Chlorine Load



A ~700 lbs/day reduction was achieved in 1999/2000 due to reductions at NBC Fields Point WWTF and NBC Bucklin Point WWTF.

RI WWTFs: Bristol, Burrillville, East Greenwich, East Providence, Jamestown, NBC Bucklin Point, NBC Fields Point, Newport, New Shoreham, Quonset, Scarborough, Smithfield, South Kingstown, Cranston, Warren, Warwick, Westerly, West Warwick, Woonsocket. East Greenwich (2004), NBC Bucklin Point (2005), Newport (2019), and West Warwick (2005) have all switched to UV for disinfection.

As of 2023, four of the nineteen WWTFs have switched to UV disinfection eliminating their TRC discharge.





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## Excess Nitrogen in Narragansett Bay







# WWTF Nitrogen Reductions

WWTFs impacting Upper Narragansett Bay (including Greenwich Bay)

**74.2% Summer** (May through October) Total Nitrogen Load Reduction from six Massachusetts and eleven Rhode Island WWTFs between early 2000s and 2022.

WWTFs impacting all of Narragansett Bay (including Upper Narragansett Bay and Taunton River)

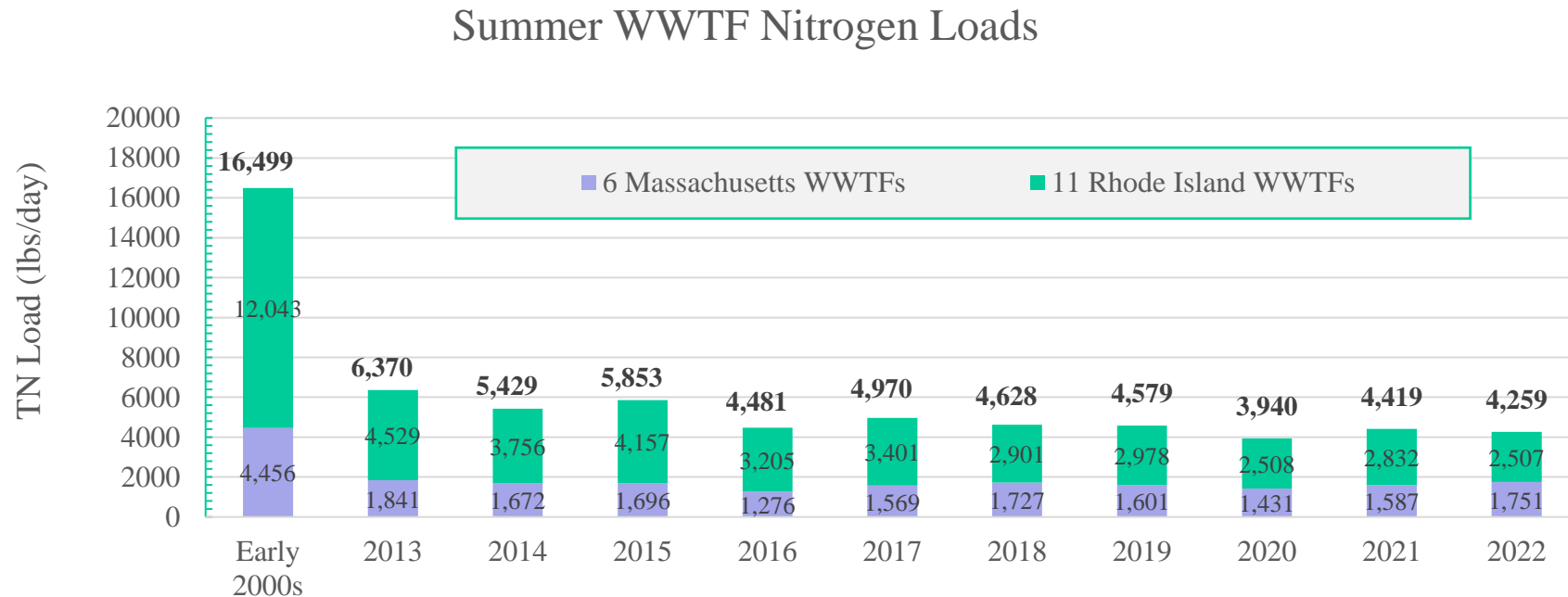
**49% Annual** Total Nitrogen Reduction<sup>1</sup> between early 2000s and 2013-2015 with WWTFs discharging 55% of annual load to the entire Bay in 2013-2015.

<sup>1</sup>Narragansett Bay Estuary Program. 2017. State of Narragansett Bay and Its Watershed (Chapter 8, Nutrient Loading, pages 166-189). Technical Report. Providence, RI.



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## RI and MA WWTFS Summer Nitrogen Loads



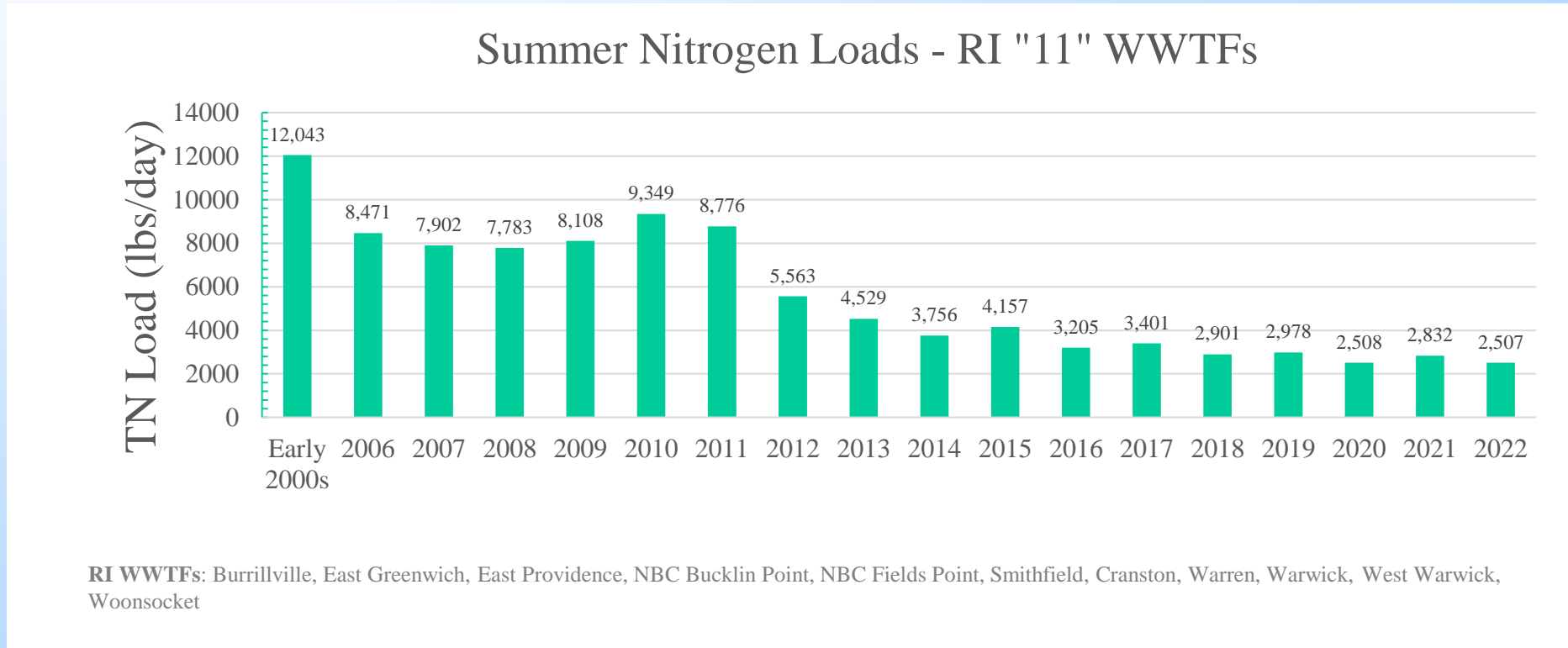
RI WWTFS: Burrillville, East Greenwich, East Providence, NBC Bucklin Point, NBC Fields Point, Smithfield, Cranston, Warren, Warwick, West Warwick, Woonsocket; MA WWTFS: Attleboro, Graton, North Attleborough, Northbridge, UBWPAD, Uxbridge

Summer load reductions from the eleven Rhode Island WWTFS and six Massachusetts WWTFS that impact Upper Narragansett Bay are ~74% from the early 2000s.



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## Rhode Island WWTF Summer Nitrogen Loads



Twelve of the nineteen Rhode Island WWTFs have nitrogen limits. Eleven of these discharges impact upper Narragansett Bay. These eleven have achieved >75% reduction in summer total nitrogen loads since the early 2000s.





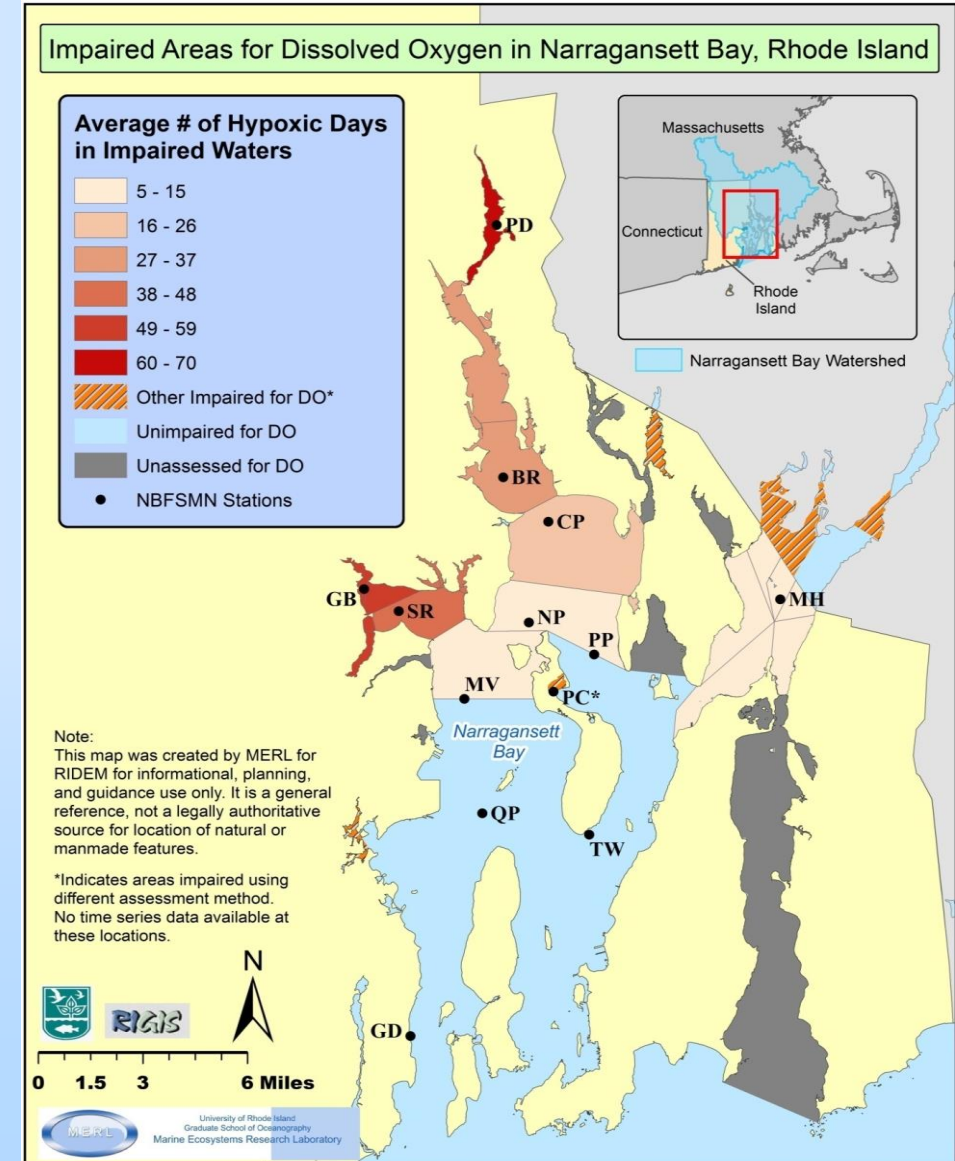
# Hypoxia in Narragansett Bay

In 2006, DEM adopted saltwater oxygen criteria developed at EPA Narragansett Lab based on a 95% larval survivability for four most sensitive species studied, which included lobster.

Narragansett Bay has a complex coastline with multiple passages and embayments. There is a north to south gradient in nutrient pollution, primary productivity, chlorophyll levels, and hypoxia.

Seasonal intermittent hypoxia events from May to October threaten ecological health with the most intense hypoxia occurring in the north (Seekonk River) and west (Greenwich Bay).

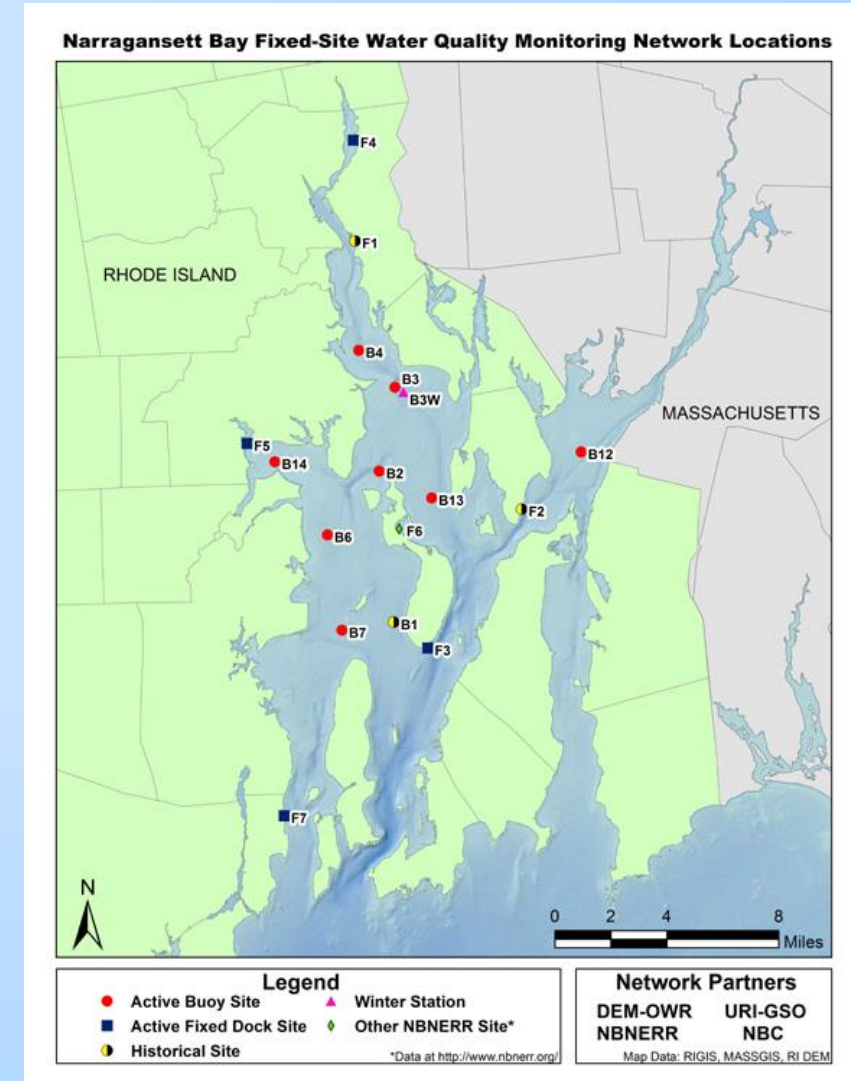
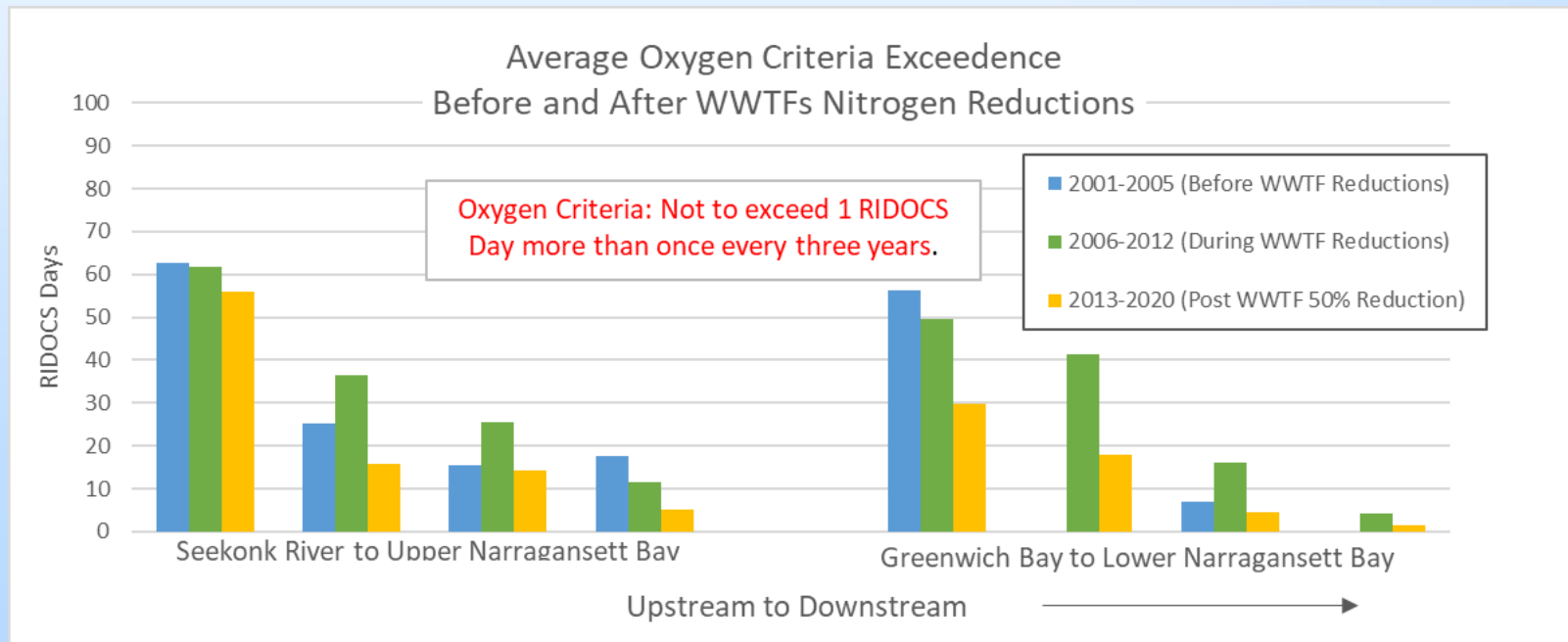
Hypoxia events ( $< 2.9 \text{ mg L}^{-1}$ ) last from  $\sim 1$  day to about  $\sim 2$  weeks (typically 2-7 days). Typically, 2 to 5 events per season, depending upon location





# Water Quality Improvements Linked to WWTF Investments

Less low oxygen days throughout the Narragansett Bay. Greenwich Bay is seeing a 10-17% reduction in hypoxia although it remains severely hypoxic.





## Phosphorus Reductions

Total phosphorus load to all Narragansett Bay (including Upper Narragansett Bay and Taunton River)

Reductions at RI and MA WWTFs along the Blackstone, Pawtuxet, Taunton, Ten Mile, and Woonasquatucket Rivers contributed to a 37% annual reduction in Bay-wide phosphorus loads from the early 2000s to 2013-15 and a 57% reduction between the early 2000s and 1982-83<sup>1</sup>.

<sup>1</sup>Narragansett Bay Estuary Program. 2017. State of Narragansett Bay and Its Watershed (Chapter 8, Nutrient Loading, pages 166-189). Technical Report. Providence, RI.

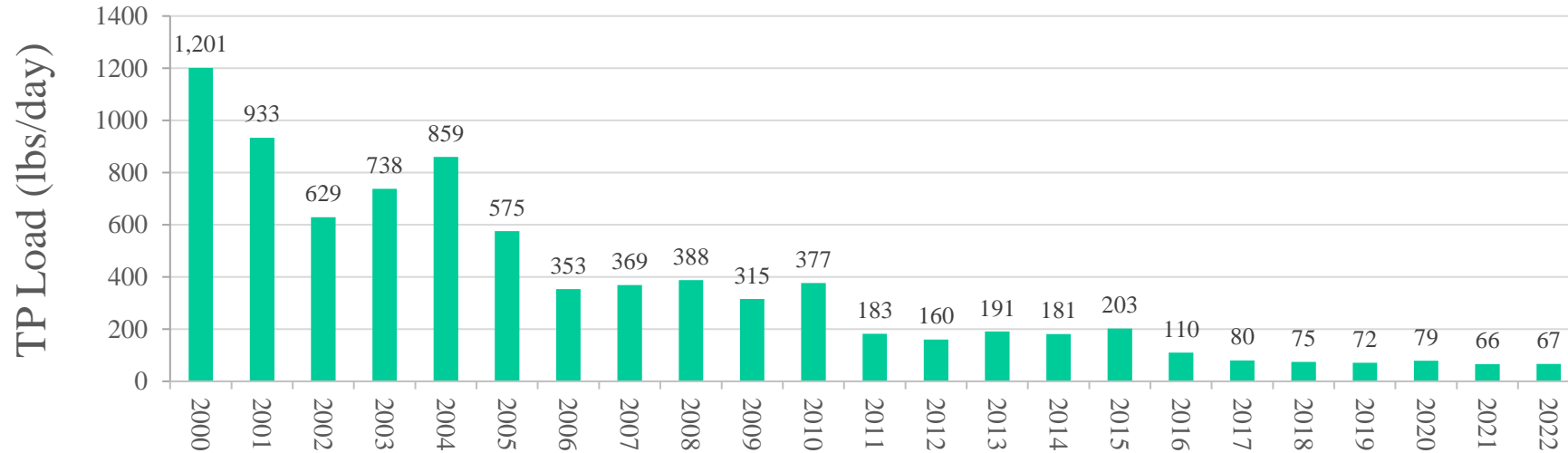




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## Rhode Island Freshwater WWTF Phosphorus Load

Annual Total Phosphorus Loads - RI "6" WWTFs



RI WWTFs: Burrillville, Smithfield, Cranston, Warwick, West Warwick, Woonsocket

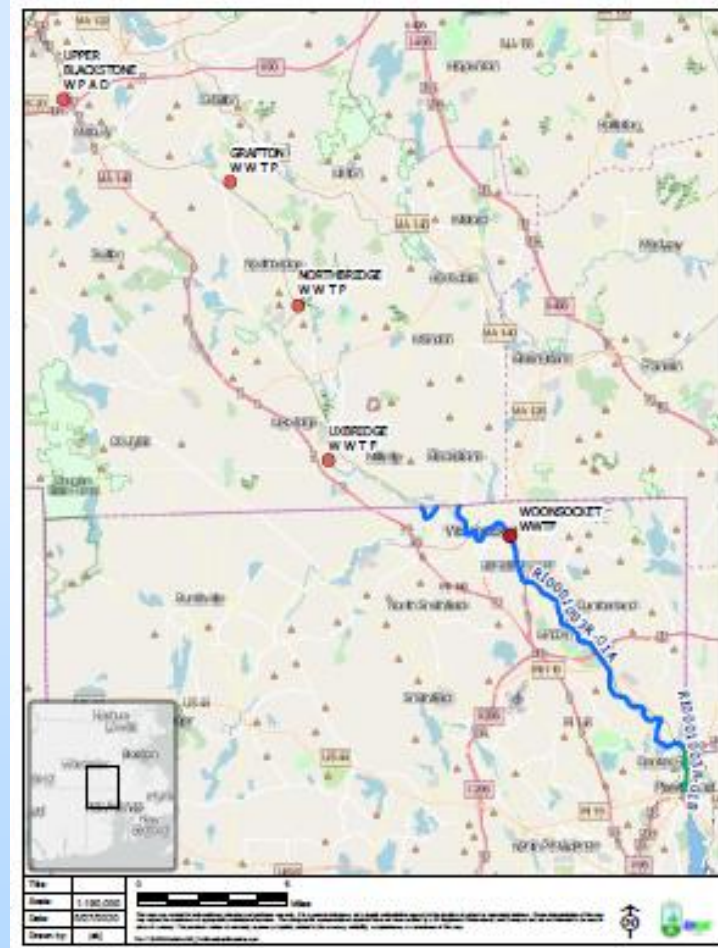
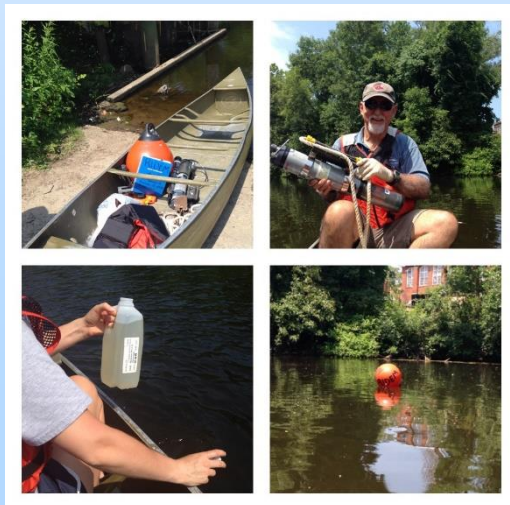
Six of the nineteen Rhode Island WWTFs discharge to three freshwater rivers within the metro Providence area. Annual total phosphorus load reductions from these six WWTFs are >90% since the early 2000s.



# Water Quality Restoration Linked to WWTF Investments

## Blackstone River\*

- Removed Aquatic Life Use Parameters (Dissolved Oxygen and Total Phosphorus) from 303(d) List of Impaired Waters in 2018-2020.
- Phosphorus Reductions from one Rhode Island and four Massachusetts Wastewater Treatment Facilities.

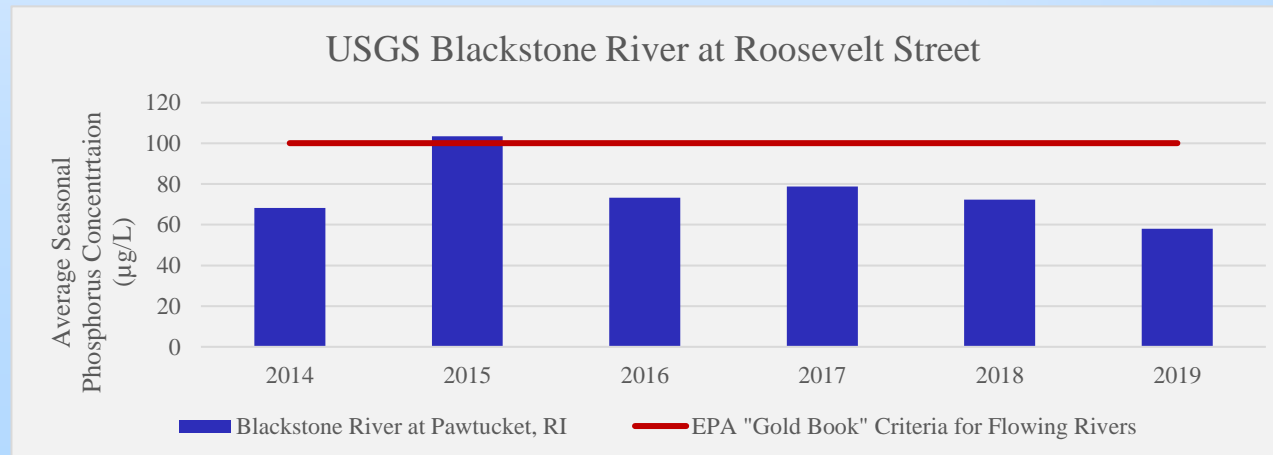
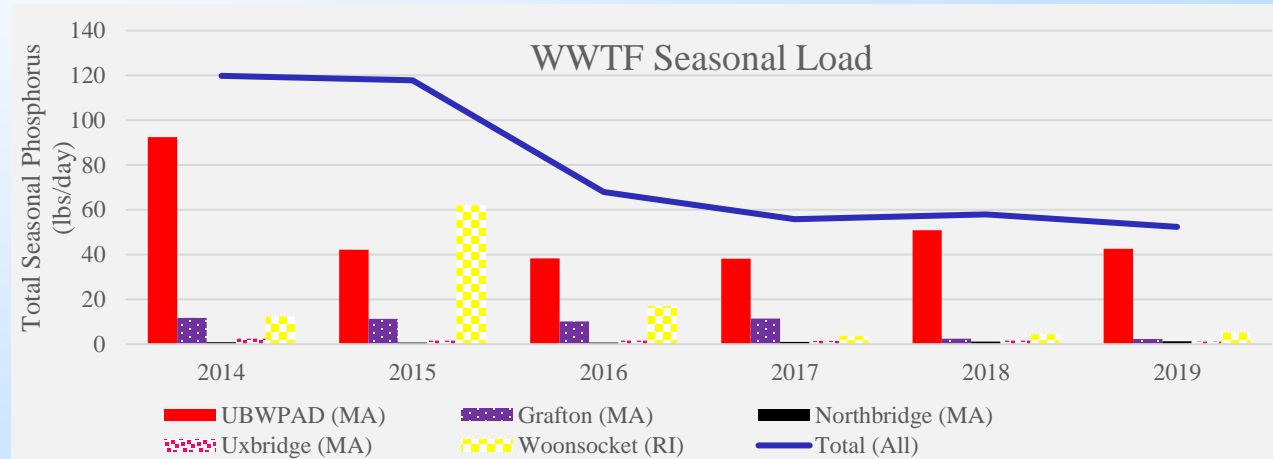


\*Delisting applied only to RI Waters.



# Water Quality Restoration Linked to WWTF Investments

## Total Phosphorus Blackstone River\*



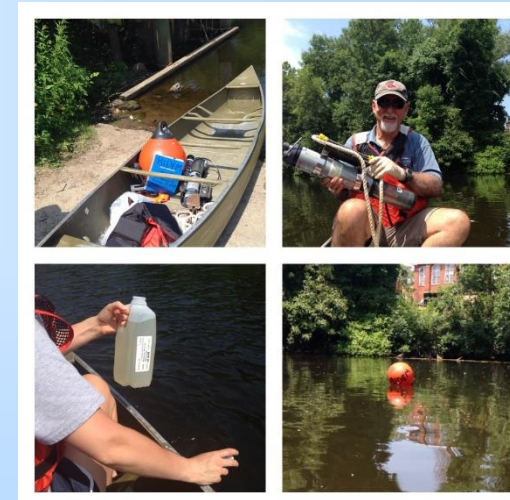
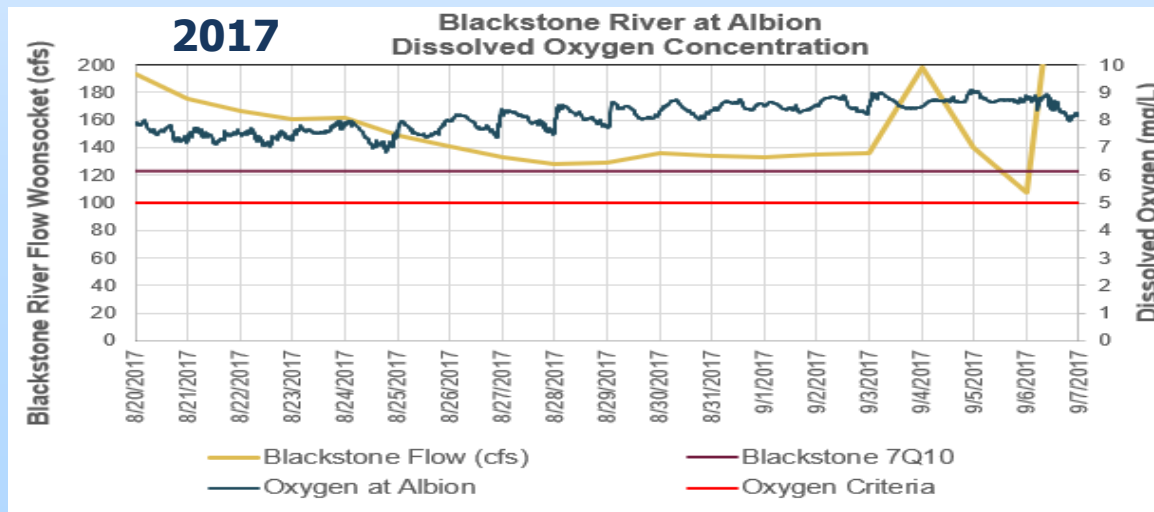
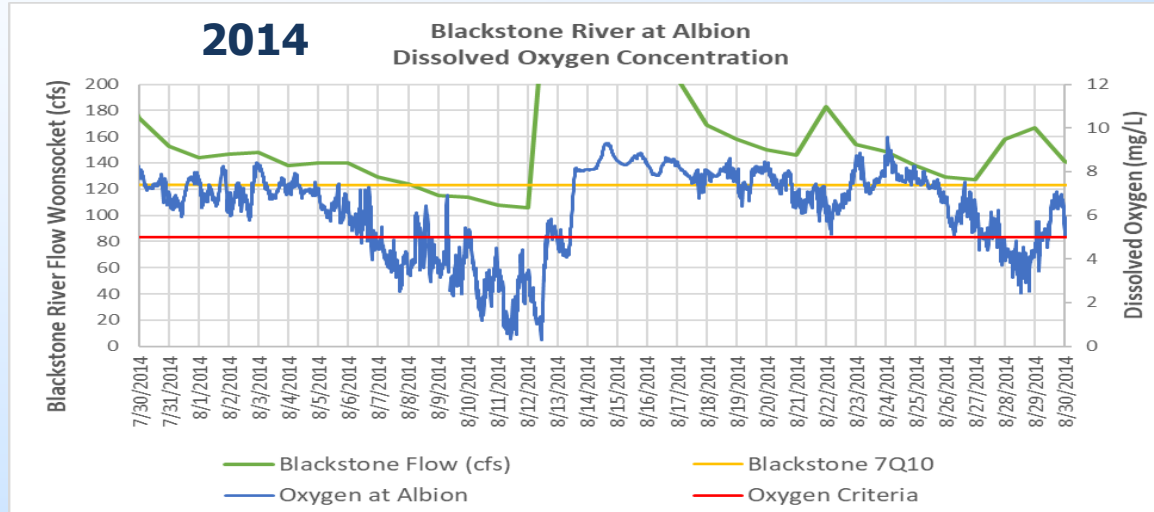
\*Delisting applied only to RI Waters.





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# Water Quality Restoration Linked to WWTf Investments Dissolved Oxygen Blackstone River\*

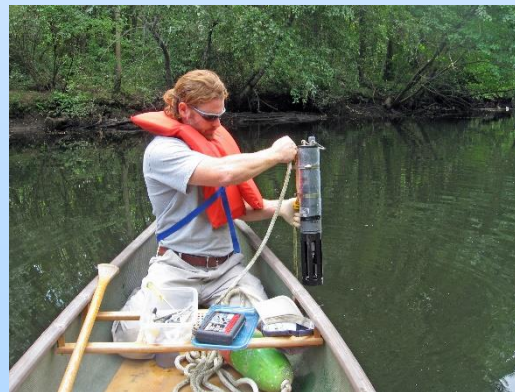


\*Delisting applied only to RI Waters.

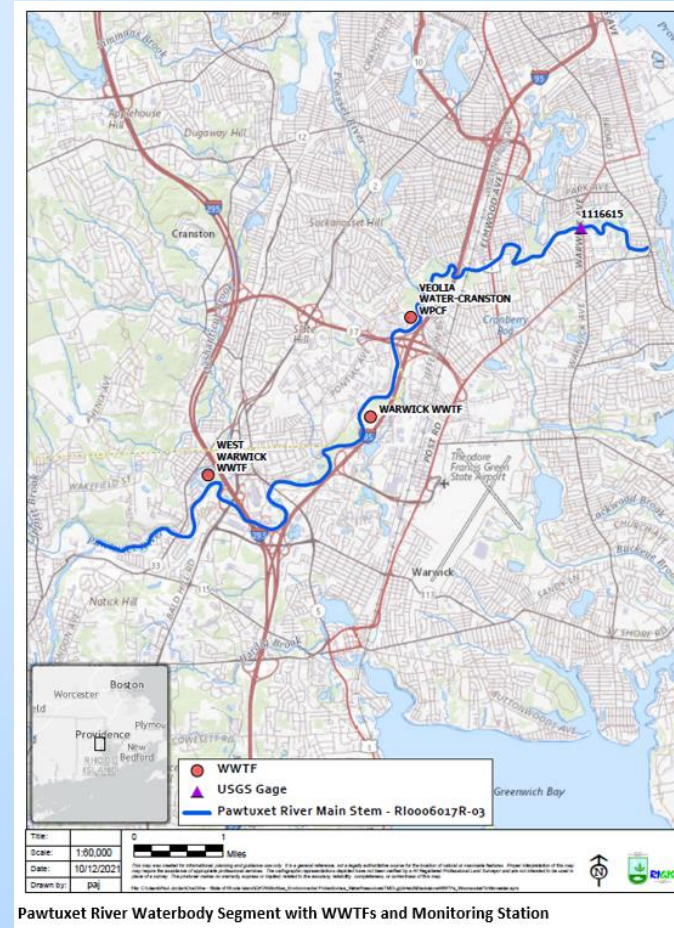
# Water Quality Restoration Linked to WWTf Investments

## Pawtuxet River Main Stem

- Removed Aquatic Life Use Parameters (Total Phosphorus and Dissolved Oxygen) from 303(d) List of Impaired Waters in 2022 and 2008, respectively.
- Phosphorus Reductions at three Rhode Island Wastewater Treatment Facilities.



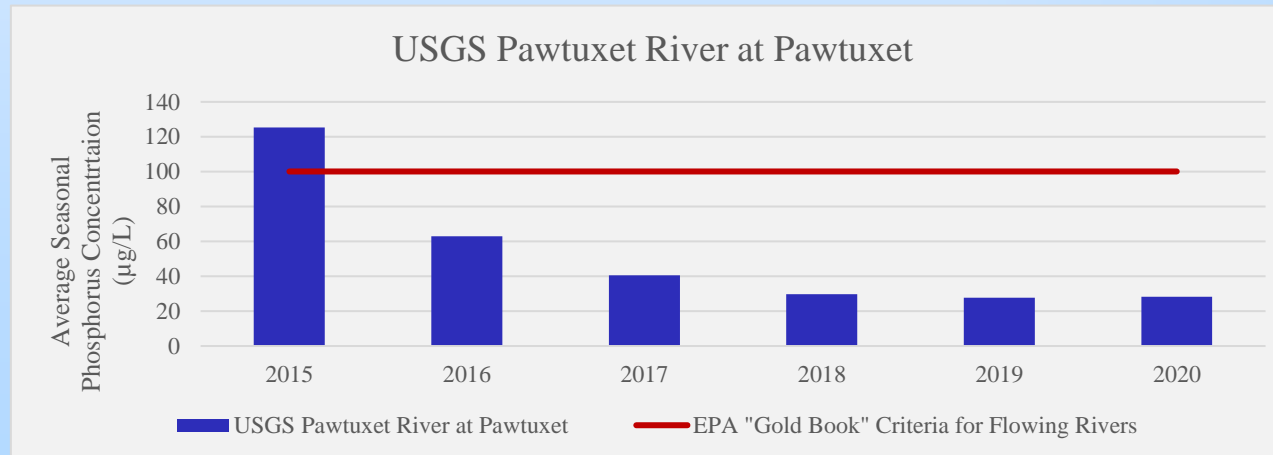
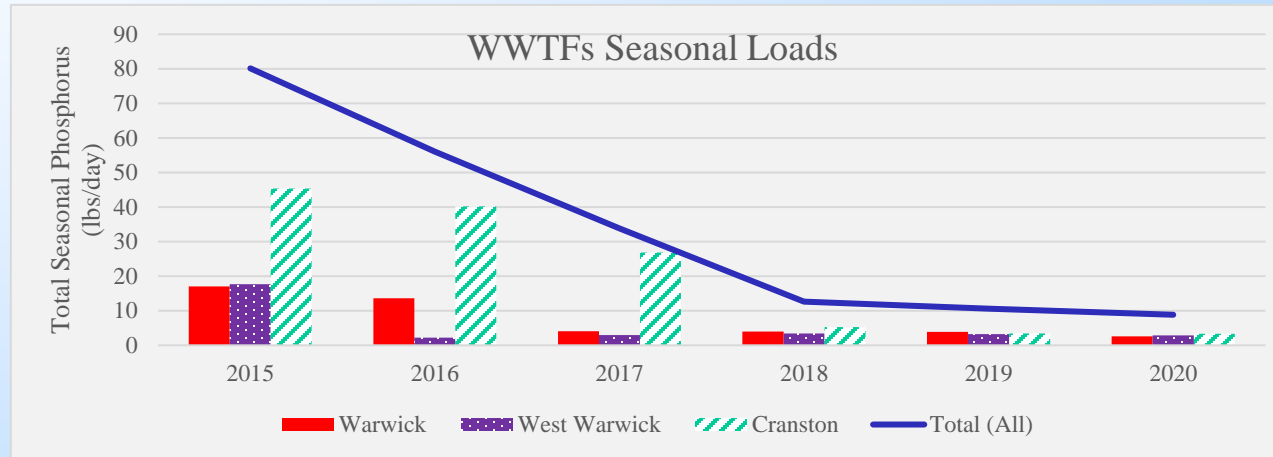
Pawtuxet River  
2008 Dissolved Oxygen Monitoring





# Water Quality Restoration Linked to WWTF Investments

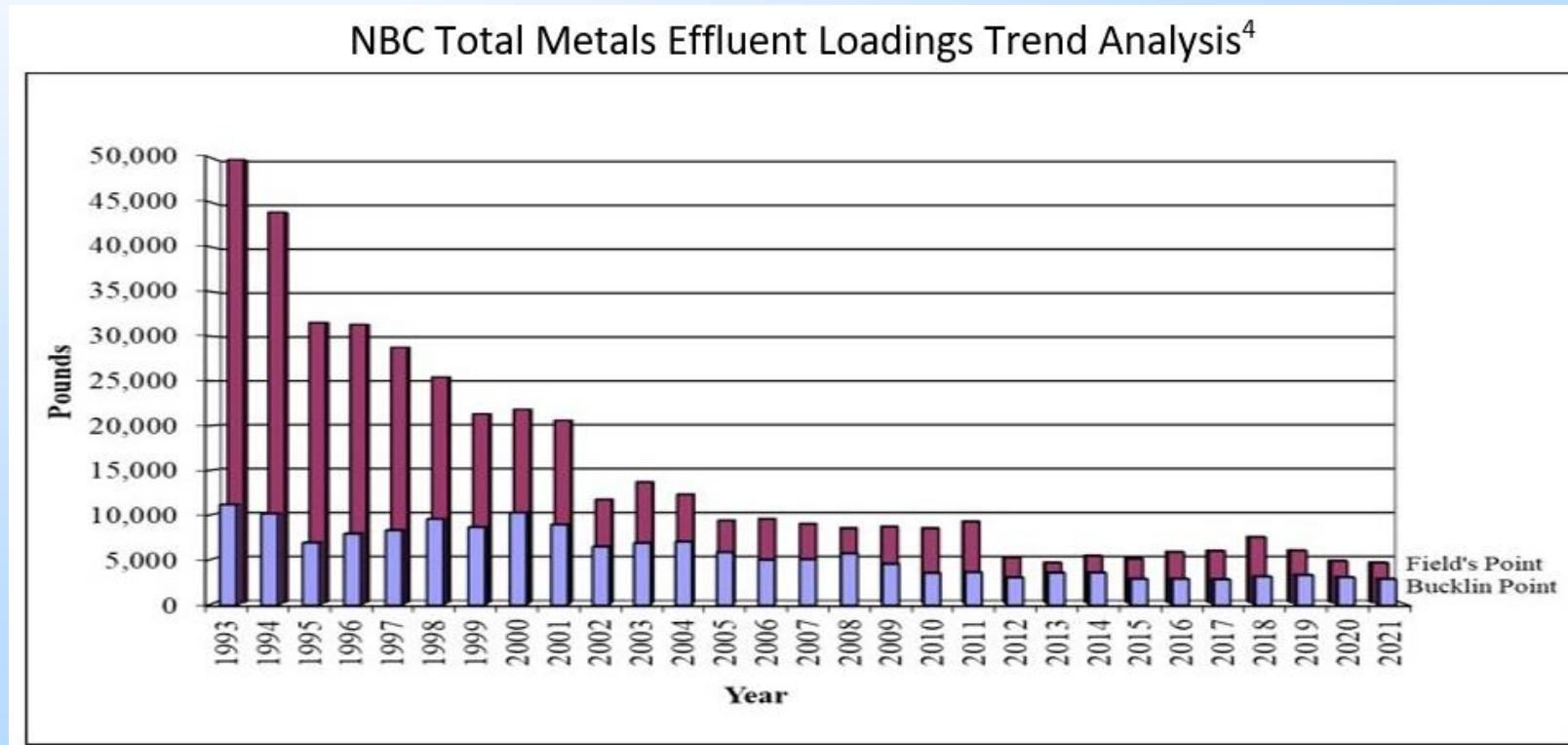
## Pawtuxet River Main Stem





# Metals

NBC Fields Point and Bucklin Point WWTFs were the largest sources of metals from RI WWTFs.



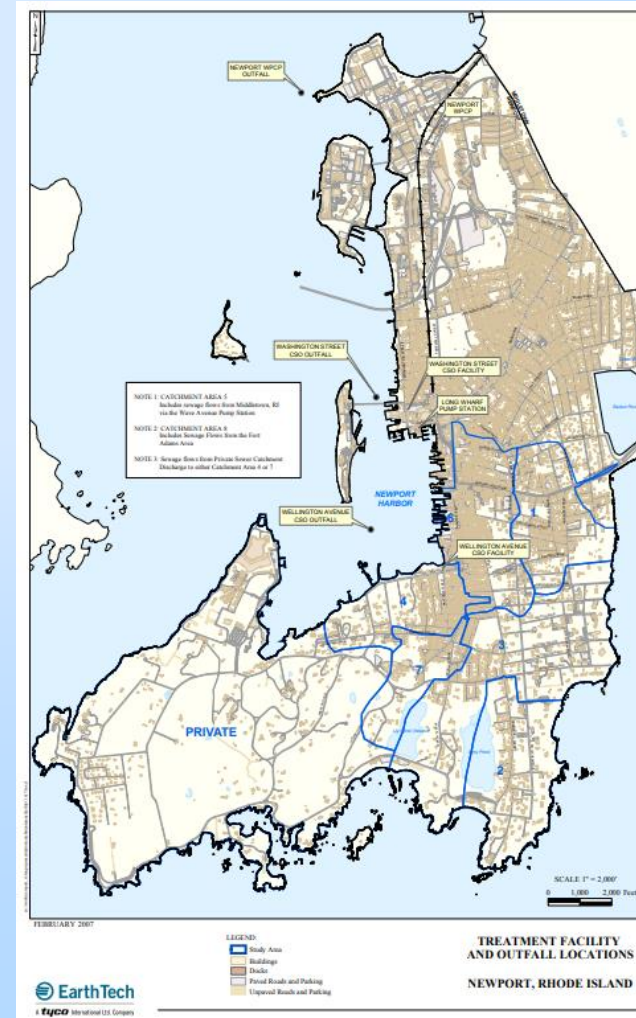
Narragansett Bay Commission. 2022. Pretreatment Annual Report January 1, 2021 – December 31, 2021 (Figure 23, Page 133). Providence, RI.



# Combined Sewer Overflows Newport

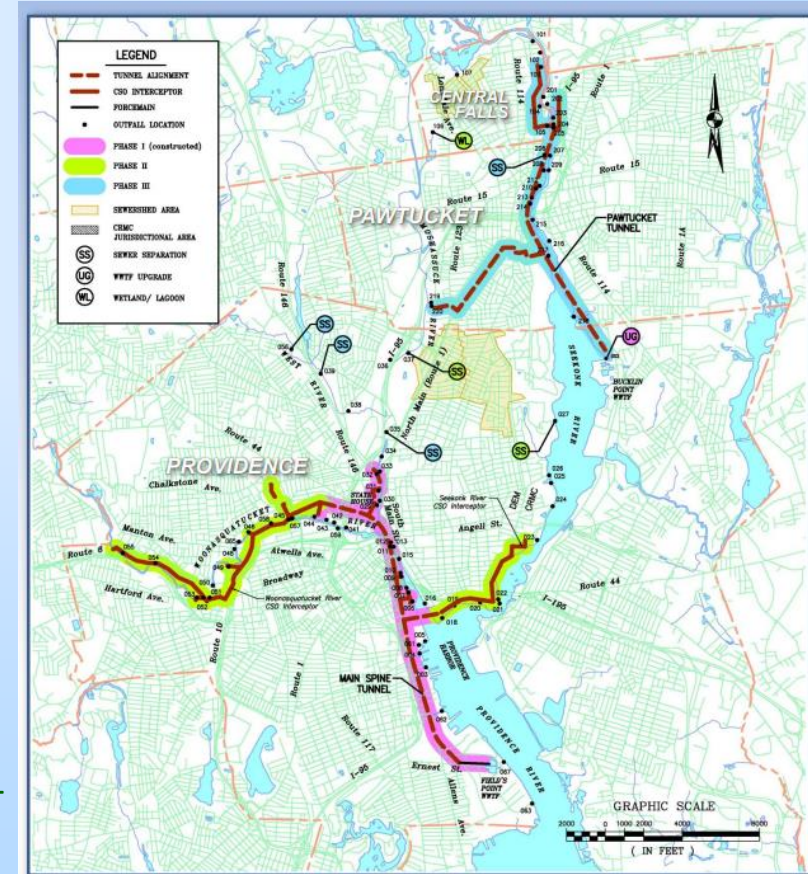
- Two CSO Locations
- Wellington Avenue CSO Facility
  - Primary treatment and chlorination in 1978. System modifications have significantly reduced the number of discharges (one discharge since 2016 during ~6-inch storm event).
- Washington Street CSO Facility
  - Primary treatment and chlorination in 1991. System modifications have reduced the number of discharges. Dechlorination added June 2016.

<https://www.cityofnewport.com/CityOfNewport/media/City-Hall/Departments/Utilities/W%20P%20C/CSO-REPORTS/CatchmentAreas.pdf>



# Combined Sewer Overflows NBC Fields Point and NBC Bucklin Point

- CSO Locations reduced from 86 to 63 (2022)
- Fields Point Service Area
  - Wet Weather Facility Primary Treatment and Chlorination began 1995. Used 1-8 Times per Year Since CSO Phase I and II Completion in 2015.
  - Phase 1 CSO Tunnel Construction Complete in October 2008.
  - Phase 2 CSO Interceptor and sewer Separation Construction Complete in January 2015.
- Bucklin Point CSOs
  - Wet Weather Facility Constructed in December 2005 for primary treatment, chlorination, and dechlorination.
  - Phase 3 Divided into 4 Sub-Phases. Phase IIIA Design Complete with Project Completion in 2027-2028.







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# Water Quality Restoration Linked to WWTf Investments

## Upper Narragansett Bay

- Removed Shellfish Harvesting Use (fecal coliform) from 303(d) List of Impaired Waters in 2018-2020 after shellfish harvesting restrictions were removed in May 2017.
- CSO Infrastructure Improvements by the Narragansett Bay Commission.



<https://snapshot.narrabay.com/app/Services/MossFile.ashx?file=/s/emda/snapshot/Documents/Publications/Water%20Quality%20Reports/Water%20Quality%20Improvements%20Associated%20with%20Phase%20I%20CSO%20%20Tunnel.pdf>

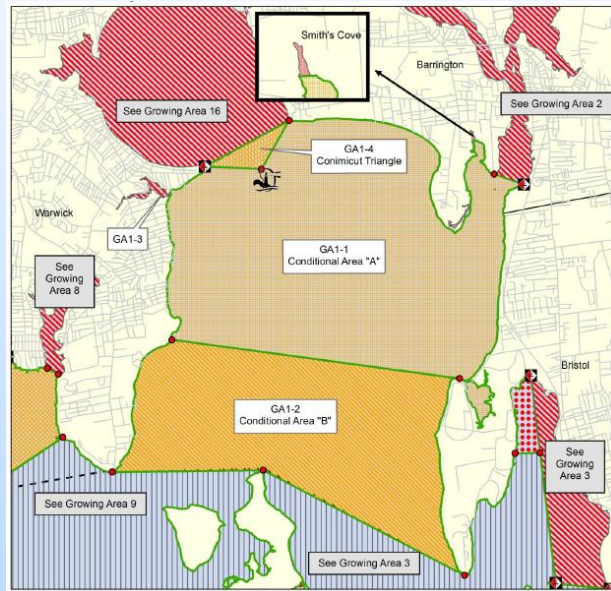




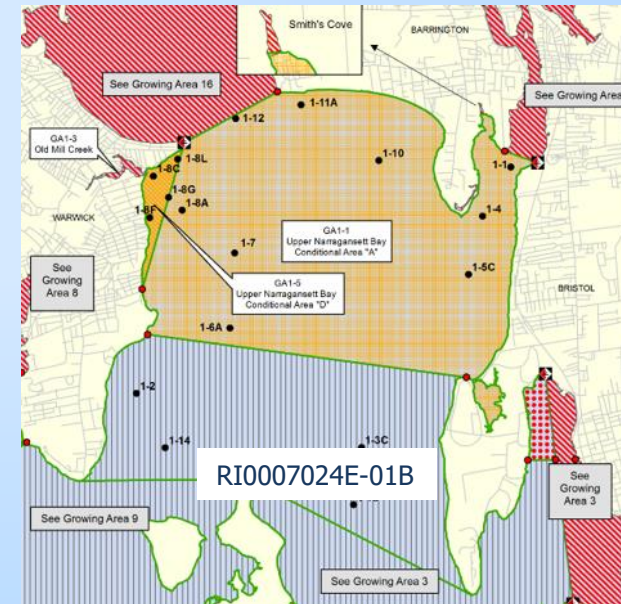
# Water Quality Restoration Linked to WWTF Investments

## Upper Narragansett Bay

Shellfish harvesting restrictions removed in May 2017 after a ~70-year closure.



Shellfish Growing Area Map Showing Conditional Area B as a Conditional Shellfish Harvesting Water.



Shellfish Growing Area Map Showing Former Conditional Area B as an Approved Shellfish Harvesting Water.



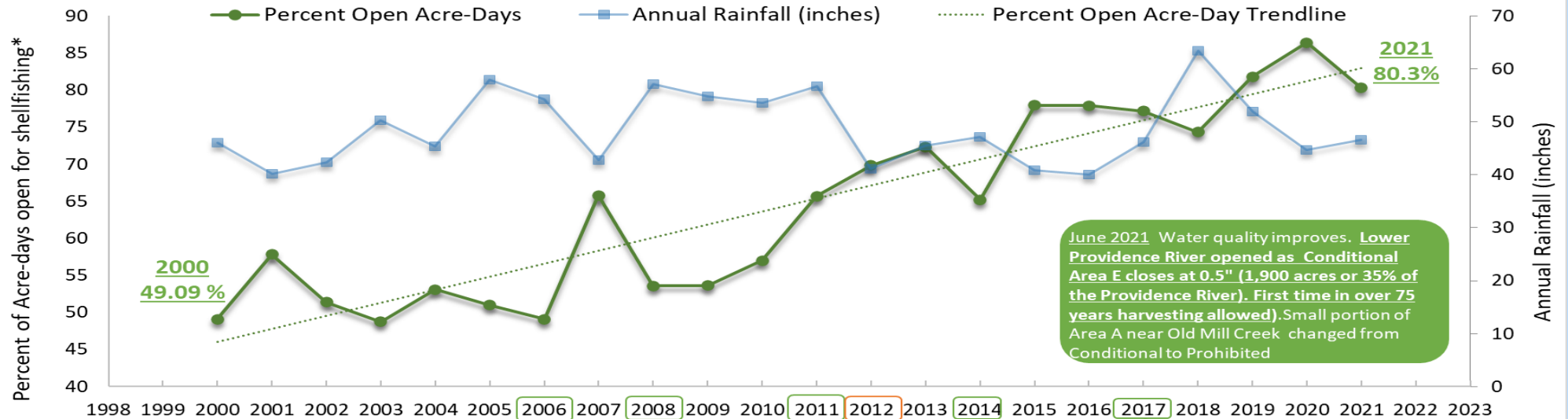


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# Water Quality Restoration Linked to WWTF Investments

## Upper Narragansett Bay

Improvements to Shellfishing Opportunities in Upper Narragansett Bay from 2000 to 2021



**June 2021** Water quality improves. Lower Providence River opened as Conditional Area E closes at 0.5" (1,900 acres or 35% of the Providence River). First time in over 75 years harvesting allowed). Small portion of Area A near Old Mill Creek changed from Conditional to Prohibited

**June 2006:** Area A closes at 0.5", Area B closes at 1.0" or more of rain in 24 hours. Area A bypass criteria changed due to improvements at Bucklin Pt CSO Wet Weather facility.

**June 2008:** Conimicut Triangle "Prohibited" to shellfishing due to unacceptable water quality.

**November 2008:** Phase I of NBC the Combined Sewer Overflow (CSO) Abatement project completed, adding a tunnel to the Fields Point WWTF to capture and treat CSOs.

**June 2011:** Water quality improves. Conimicut Triangle is conditionally opened to shellfishing and Area A and B rainfall closure criteria increased. Conimicut Triangle closes at 0.5", Area "A" closes at 0.8" and Area "B" closes at 1.5" or more of rain in 24 hours.

**June 2012:** Conimicut Triangle temporarily increased and area "A" is temporarily decreased by 462 acres due to water quality issues. Original acreage is restored in 2013.

**December 2014:** NBC completes Phase II of CSO Project, sewer interceptor connects additional CSOs to the Phase I tunnel.

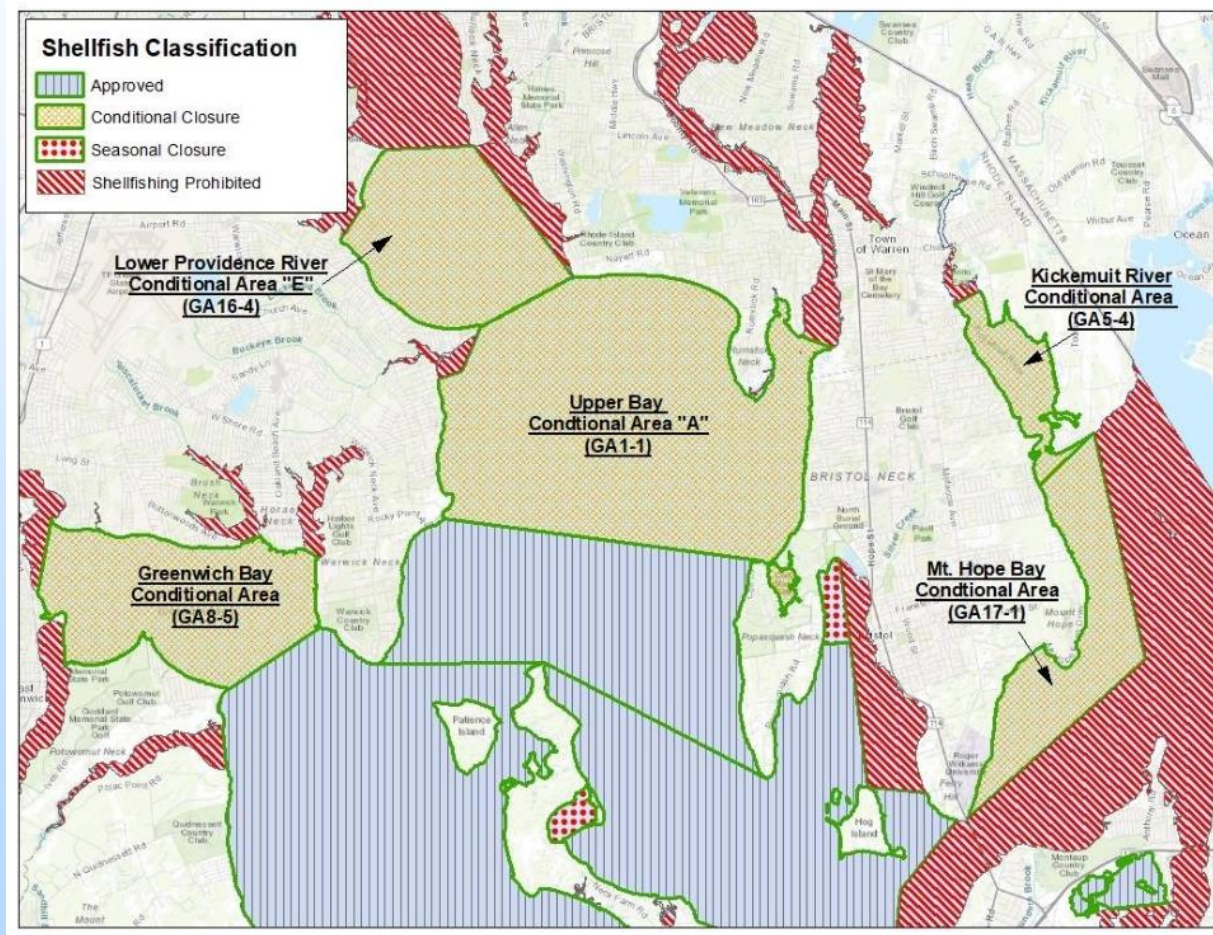
**June 2017** Water quality improves. Area A closes at 1.2", Conimicut Triangle merged with Area A and Area B changed to Approved (first time in 70 years not closed after rainfall).

\* Acre-days is a measurement of the # of days open multiplied by the number of total acres available to shellfishing in the Upper Bay, per year. The total number of acres available for shellfishing in the Upper Bay fluctuated throughout the 16 year period. Measuring in Acre-days allows for accountability of this fluctuation.



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# Lower Providence River Shellfish Harvesting Opens - 2021



Lower Providence River  
(GA16-4)

1900 Acres  
~4M Quahogs/Year





# Lower Providence River Shellfish Harvesting Opens May 26, 2021



## Clammers back in Providence River

**Alex Kuffner**

The Providence Journal USA TODAY NETWORK

BARRINGTON — It was a scene that hadn't been witnessed in generations on the Providence River: an armada of quahoggers clustered in the waters between Bullock and Gaspee points, raking the bottom for clams.



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# DEM Poster and Papers

History of Rhode Island Wastewater Treatment Facility Construction & Upgrades

RI Municipal WWTF Total Residual Chlorine (TRC) Limits History

Major Wastewater Pollutant Reduction Efforts in RI Since Meeting Secondary Treatment Standards

The screenshot shows the DEM Rhode Island website page for "Bay and Coastal Waters". The page features a navigation menu at the top with links for Home, About Us, Offices & Divisions, Online Services, Events, In the News, and Contact Us. A search bar is located in the top right corner. The main content area is titled "Bay and Coastal Waters" and includes several sections of text and links. On the right side, there is a sidebar with a "Bay & Coastal Resources" menu containing links for Narragansett Bay Estuary Program, Shellfishing, Boat Pumpouts, Invasives (CRMC), Beaches, Beach Monitoring, Water Quality, and Recreation. Below this is a "Contact" section for the Office of Water Resources, providing the address (235 Promenade Street, Providence, RI 02908-5767), phone number (401) 222-3961, fax number (401) 222-3564, and email address (DEM.WaterResources@dem.ri.gov). The main content area includes sections for "Narragansett Bay – Improvements to Wastewater Treatment", "Total Nitrogen", "Total Residual Chlorine", "Effluent Toxicity Testing", and "Phosphorus". At the bottom, there are links to download factsheets and a list of related documents: "Major Rhode Island WWTF Pollution Reduction Efforts Poster", "Major Rhode Island WWTF Pollution Reduction Efforts Report", and "RI Municipal WWTF Total Residual Chlorine Limits History and Status".

<http://www.dem.ri.gov/programs/water/bay/>