

The State of Our Watershed

Narragansett Bay
Estuary Program
2017

The State of Our Watershed

Organizing Framework

➤ Stressor indicators

- Landscape Stressors
- Climate Change Stressors
- Chemical Stressors

➤ Ecosystem indicators

- Bay conditions
- Watershed conditions

➤ Public health indicators.

The State of Our Watershed

Landscape Stressors

Population, Land Use, Impervious Cover, Wastewater, and Nutrient Loadings

Climate Change Stressors

Temperature, Precipitation, and Sea Level

Chemical Stressors

Legacy Contaminants and Emerging Contaminants

Bay Ecological Condition

Seagrasses, Salt Marsh, Benthic Habitat, Estuarine Fish Communities

Dissolved Oxygen, Chlorophyll, Water Clarity

Watershed Ecological Condition

Macroinvertebrates, Freshwater Fish Communities, Water Quality conditions for aquatic life impacted by nutrient-related pollutants, Protected Open Space, and Ecological Significant Lands

Public Health

Marine Beaches for Swimming, Water Quality for Recreational Use, and Shellfishing Areas

The State of Our Watershed

Components:

The State of Our Watershed Technical Report – Technical document

The State of Our Watershed report – Summary document

The State of Our Watershed Story Maps – Website story maps that will include narrative, photos, graphics and ArcGIS online mapping of our indicators

The State of Our Watershed

Geographic Scope

The geographic scope is consistent with the study area in the Comprehensive Conservation and Management Plan (2012) and includes three watersheds:

➤ Narragansett Bay	1,705 square miles	1,091,120 acres
➤ Little Narragansett Bay	317 square miles	202,921 acres
➤ Southwest Coastal Ponds	56 square miles	35,923 acres

The State of Our Watershed Geographic Scales

For the Narragansett Bay watershed the report includes various watershed and planning scales:

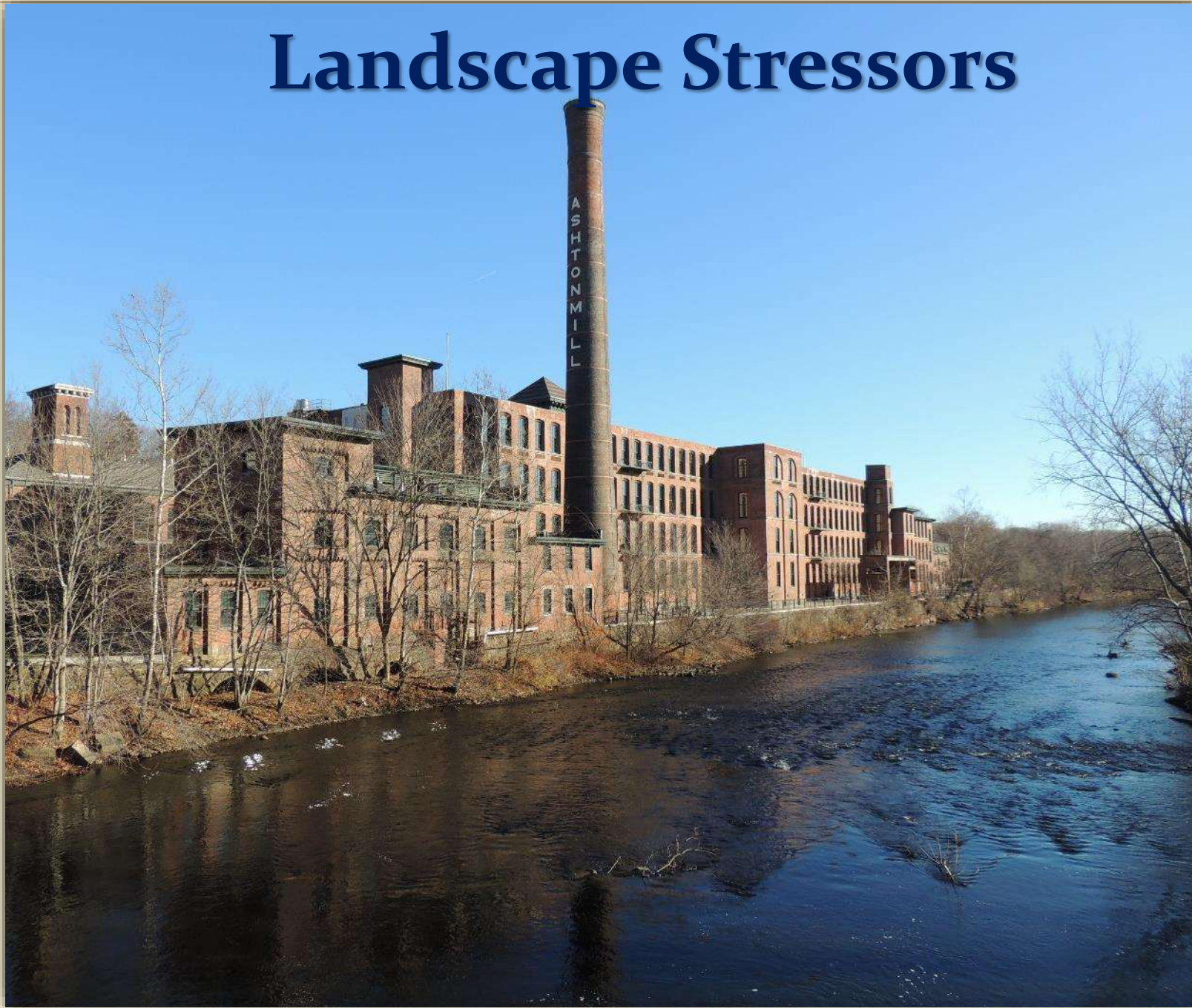
- 4 major basins (Blackstone, Taunton, Pawtuxet, Narragansett)
- 11 hydrological unit code-10 watersheds (HUC10s) that drain to Narragansett Bay
- 52 hydrological unit code-12 sub-watersheds (HUC12s) within the Narragansett Bay watershed
- 42 Watershed Planning Areas in the Narragansett Bay watershed
- 105 Municipalities in the [Narragansett Bay watershed](#)

The State of Our Watershed

Narragansett Bay is examined by the **5 regions** and **11 sections** of estuarine waters:

➤ Providence River Estuary	9.5 square miles	6,107.5 acres
➤ Warren, Palmer, & Barrington Rivers	2.4 square miles	1,513 acres
➤ Taunton River	4.9 square miles	3,127.3 acres
➤ Upper Narragansett Bay	17.3 square miles	11,079.5 acres
➤ Mount Hope Bay	15.0 square miles	9,584 acres
➤ Greenwich Bay	5.1 square miles	3,250.6 acres
➤ West Passage	39.6 square miles	25,368.2 acres
➤ East Passage	34.2 square miles	21,903.4 acres
➤ Sakonnet River	20.8 square miles	13,292.3 acres
➤ Narrow River	1.0 square mile	618.5 acres
➤ Mouth of the Bay	46.2 square miles	29,554.6 acres

Landscape Stressors

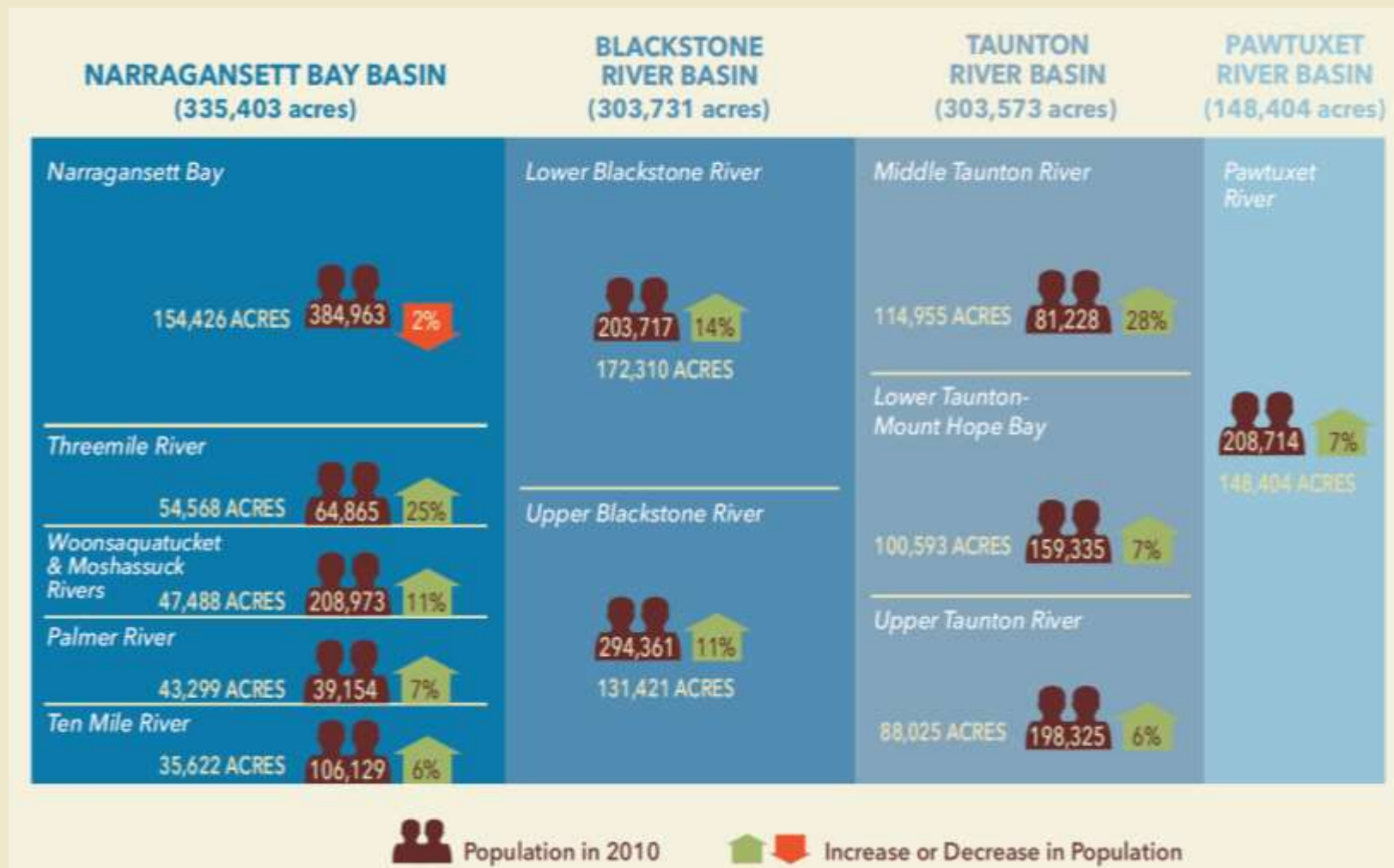


Population in the Watershed

Status & Trends:

Narragansett Bay Watershed

- 1,949,764 People (2010)
- 141,812 People (1990 – 2010)
~ 7.8 % Increase
- Population Density: 2 people per acre
- HUC10 Woonasquatucket – Moshassuck Rivers has the highest density of 4-5 people per acre
- At the subwatershed scale - HUC12s changes of population corresponds to increase of urban areas and loss of forest lands

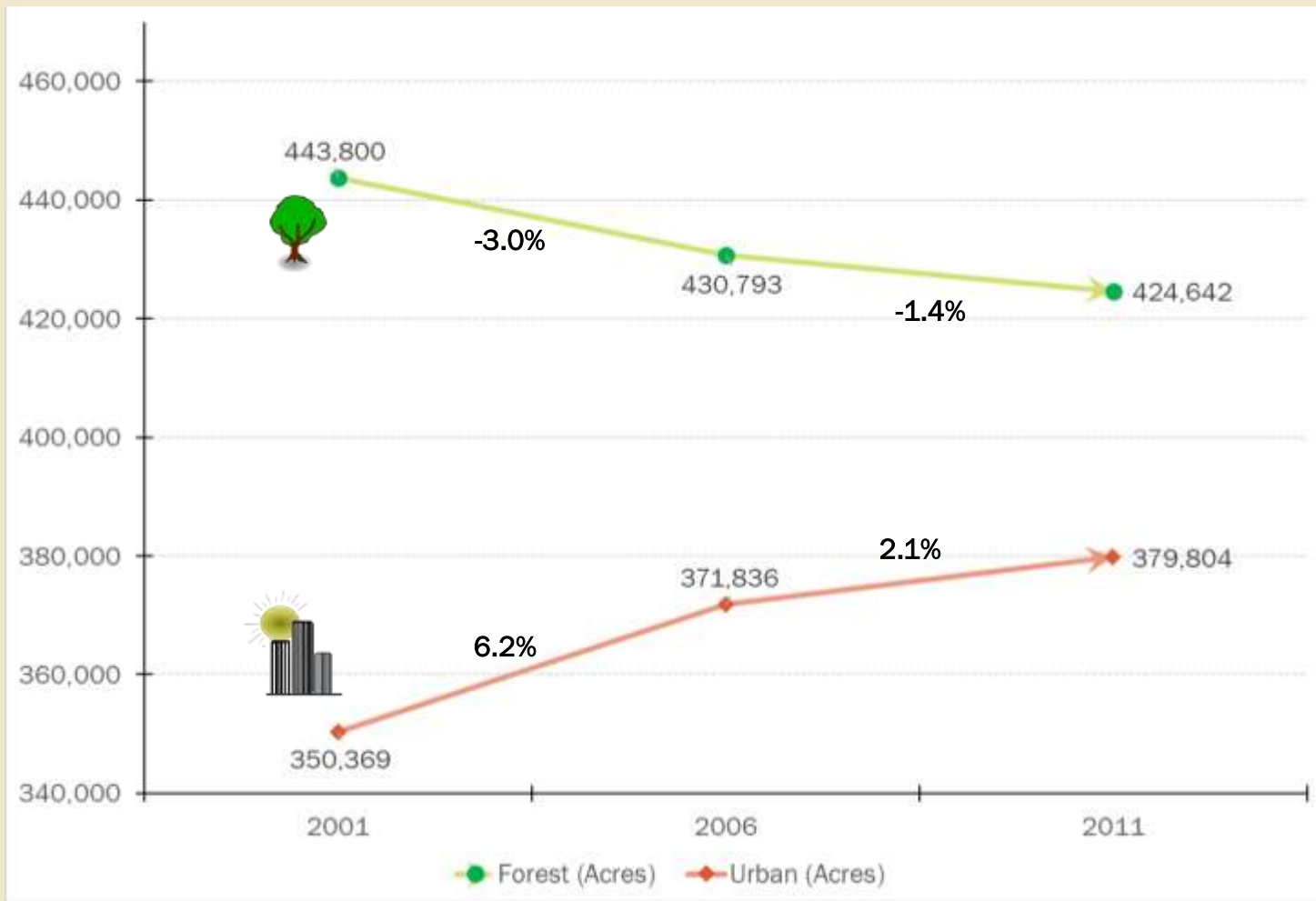


Anne Kuhn & Mike Charpentier

Land Use RI 1988, 2003-04 & 2011
Land Use MA 1985, 1999 & 2005

US Census Bureau
1990, 2000, 2010

Land Use



Status & Trends:

- Forest Lands: 424,642 Acres (39%)
✓ 2001 – 2011 Decline: 19,158 Acres (4%)
- Urban Areas: 379,804 Acres (35%)
✓ 2001 – 2011 Gain: 29,435 Acres (8%)
- HUC10s
 - ✓ Ten Mile River (-871 Acres) and Upper Taunton River (-2,797 Acres) largest forest lands decline by **9%**
 - ✓ Middle Taunton River (+3,826 Acres) largest urban increase by **18%**

National Land Cover Dataset: Resolution 30m

Developed Lands

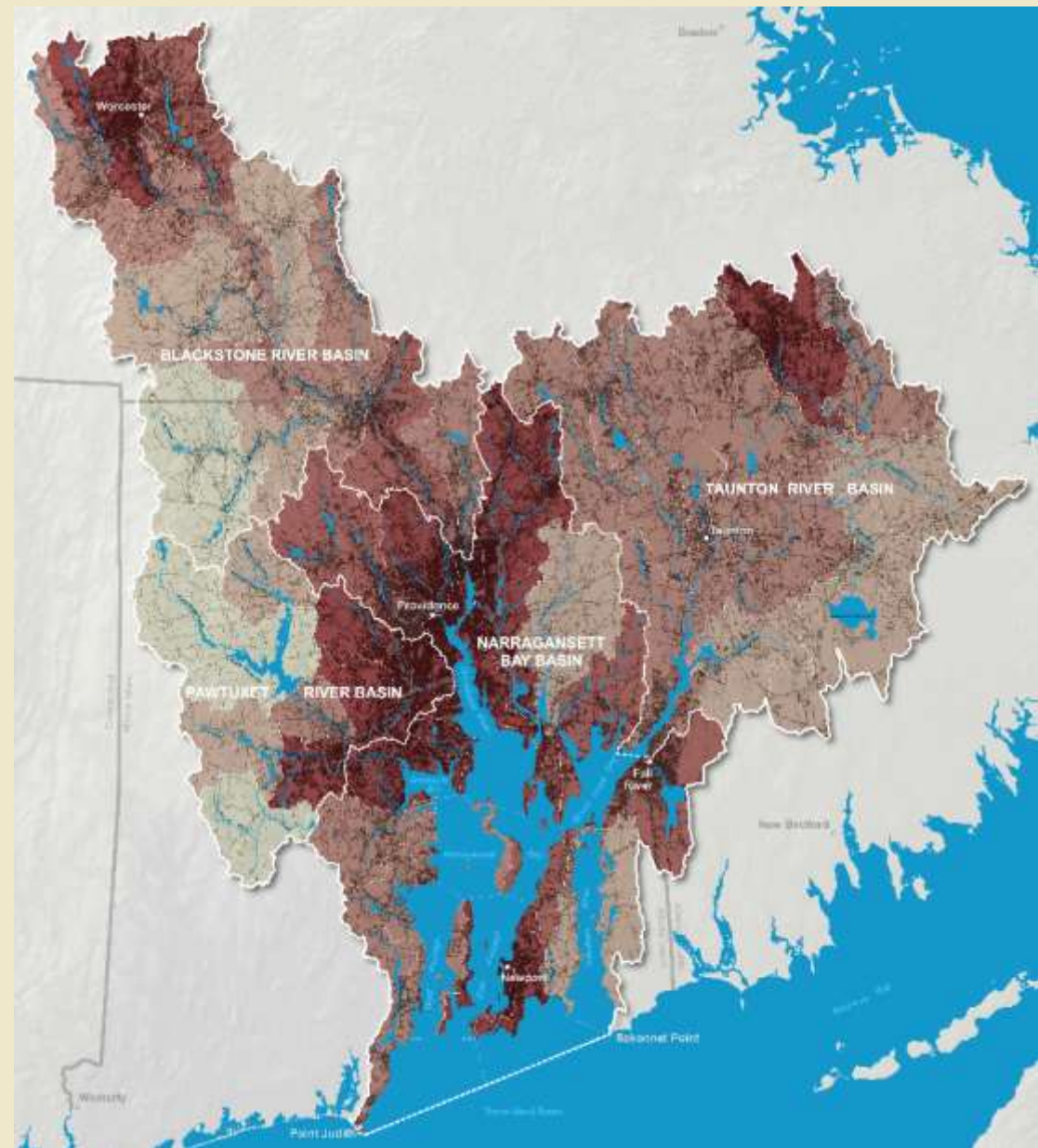
Status:

- Narragansett Bay Watershed: 14.2% (155,247 acres)
 - ✓ Narragansett Bay Basin: 19.6% (58,955 acres)
 - ✓ Blackstone River Basin: 12.4% (37,585 acres)
 - ✓ Taunton River Basin: 12.1% (41,104 acres)
 - ✓ Pawtuxet River Basin: 11.9% (17,627 acres)



MA 2005 (3.28 feet) and RI 2011 (2 feet)
Seamless Dataset (25 feet)

Paul Jordan

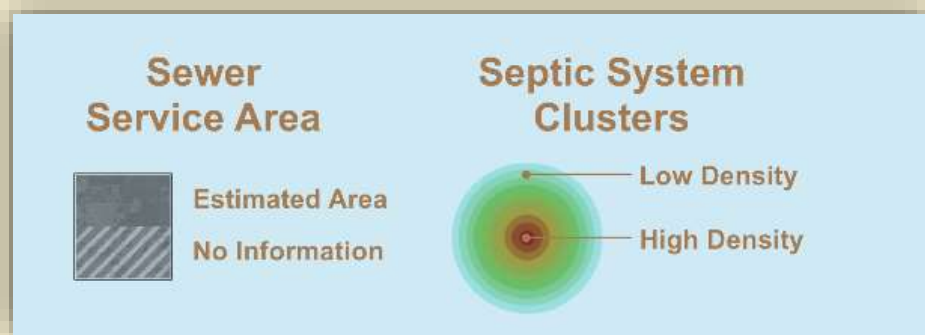


Wastewater

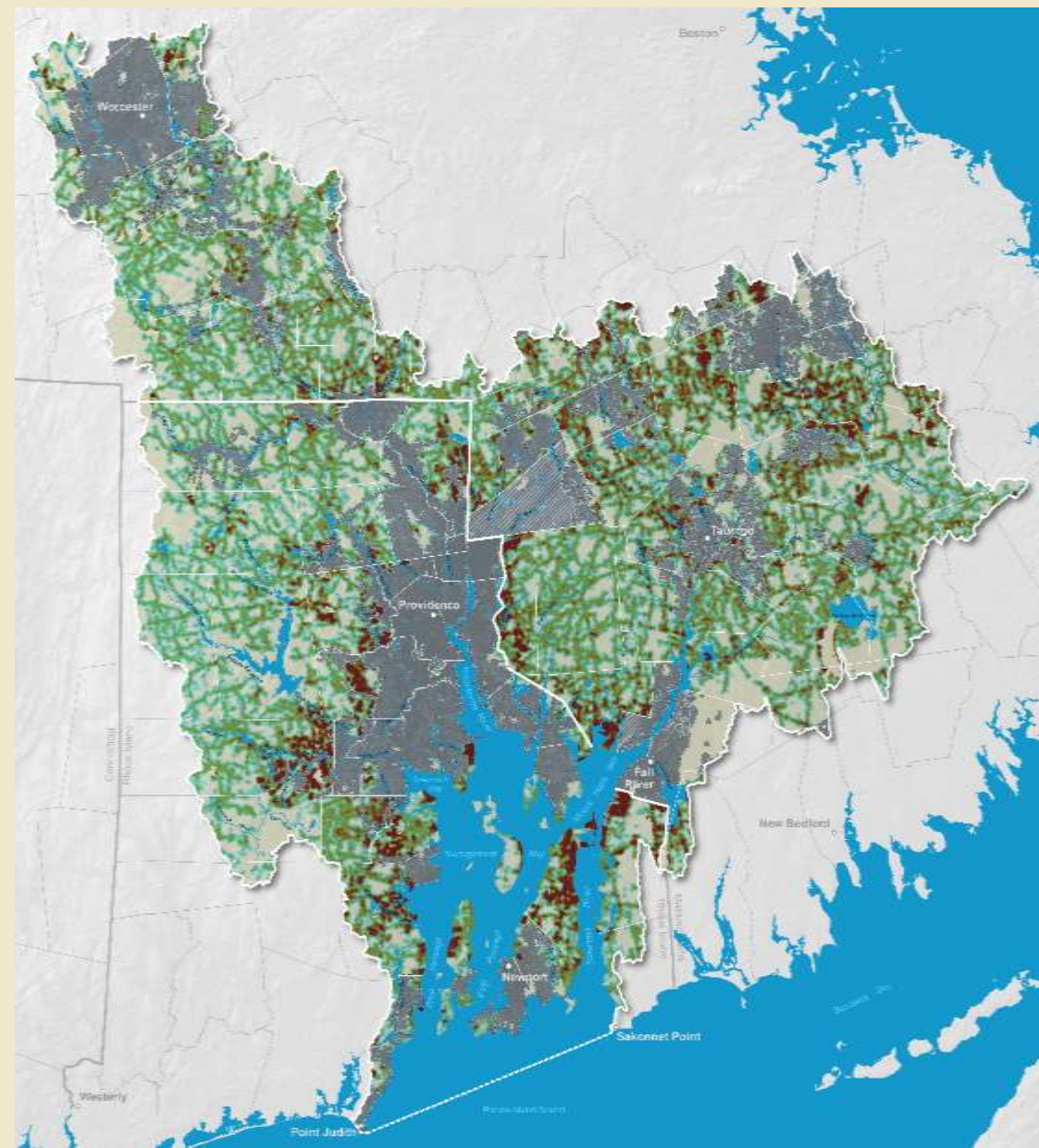
Status:

Estimated Number of Buildings Served by:

- Sewer Systems: 454,283 (~67%)
- Septic Systems: 221,422 (~33%)
- Hotspots: 90% higher than densities in the rest of the watershed (within 1 hectare)



Juliet Swigor, Brian Moore, Jennifer Ryan & Jonathan Zwarg



Nutrient Loading

Status & Trends:

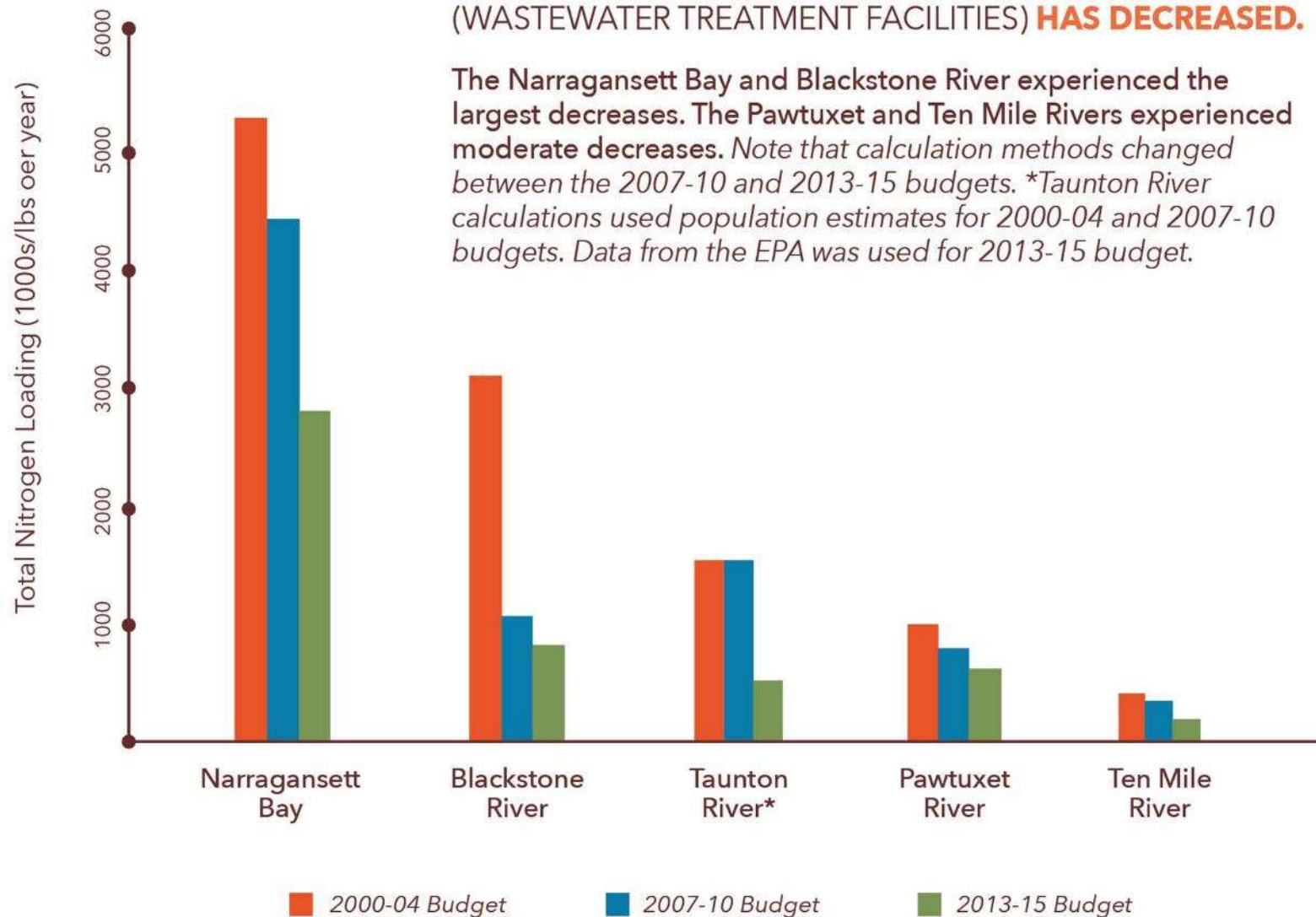
Total WWTF Loading

- 2004: 11,196 thou lbs/yr
- 2015: 4,825 thou lbs/yr
- Percent change: 57%

URI-GSO, NBC, RIDEM, USEPA, MassDEP, UBWPAD, CDM Smith, UMass-Amherst, McLaughlin Research Corp.

IN THE LAST 15 YEARS,
NITROGEN LOADING FROM POINT SOURCES
(WASTEWATER TREATMENT FACILITIES) **HAS DECREASED.**

The Narragansett Bay and Blackstone River experienced the largest decreases. The Pawtuxet and Ten Mile Rivers experienced moderate decreases. Note that calculation methods changed between the 2007-10 and 2013-15 budgets. *Taunton River calculations used population estimates for 2000-04 and 2007-10 budgets. Data from the EPA was used for 2013-15 budget.

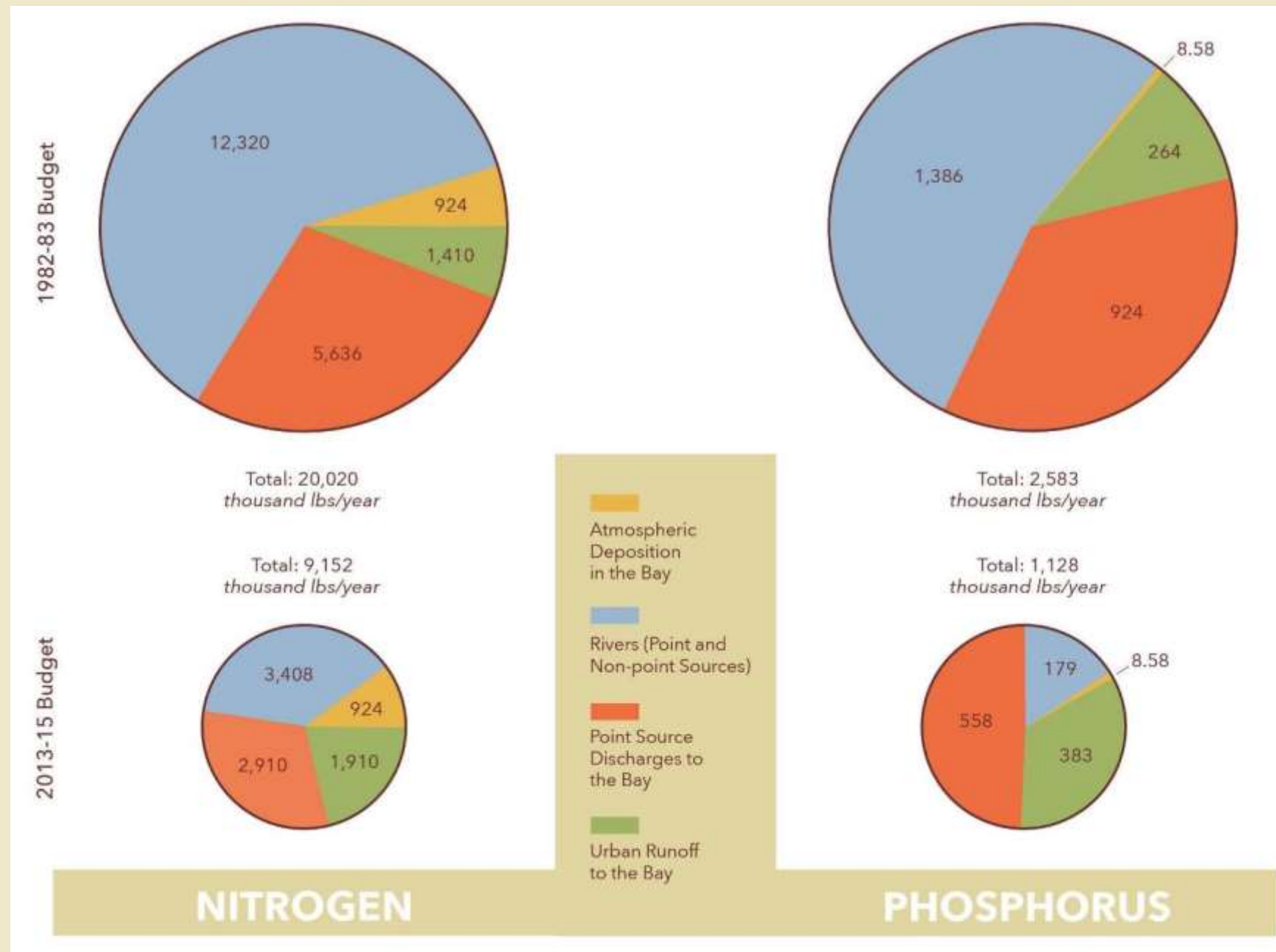


Nutrient Loading

Trends:

Since 1980s

- Loadings decreased by half
- Largest decreases in rivers and WWTF discharge
- NPS have become relatively more important



Toxins: Legacy & Emerging Contaminants

Status:

Legacy contaminants

- Metals, PCBs, PAHs

Emerging contaminants

- Antibacterial agents, pharmaceuticals, etc.

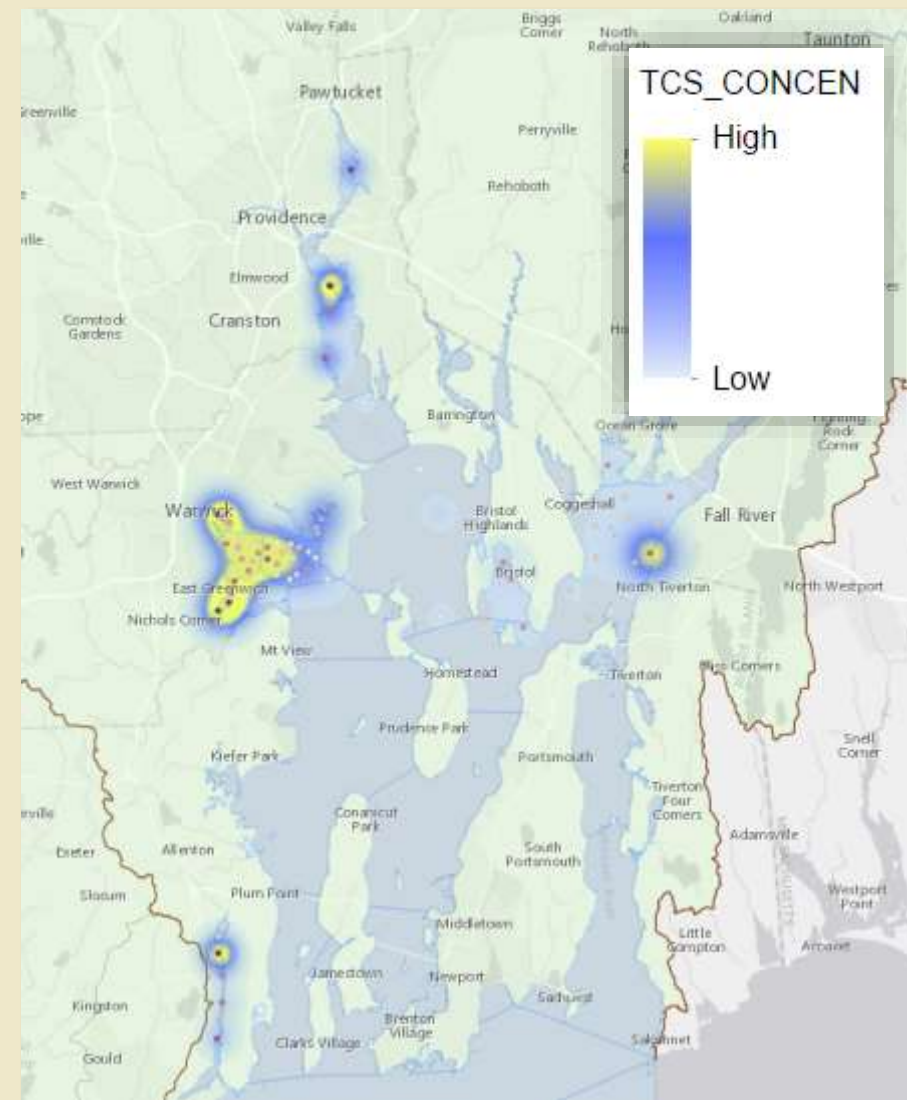
Trends:

Legacy contaminants

- Declining since 1930s-1970s

Emerging contaminants

- Not discharged in same quantities as legacy
- Environmental impact only just being explored



Climate Change Stressors



Temperature

Status & Trends:

- Air temperature increased 3.3° F since early 1900s
- Estuarine water temperature increased 2.5-2.9° F (annually) and 2.9-3.6° F (winter) since 1960s
- Freshwater stream temperatures average 52-55° F, with not enough data for trends analysis

If these trends hold:

- Air temperature could rise 6-7° F
- Estuarine waters could rise 4.9-5.8° F, and 5.8-7.2° F in the winter
- Expect freshwater stream temperatures to increase as well

BETWEEN 1900 AND 2010,
AIR TEMPERATURE
HAS **INCREASED** BY

3.3° F



BETWEEN 1960 AND 2010,
BAY TEMPERATURE
HAS **INCREASED** BY

2.5-2.9° F

Precipitation

Status:

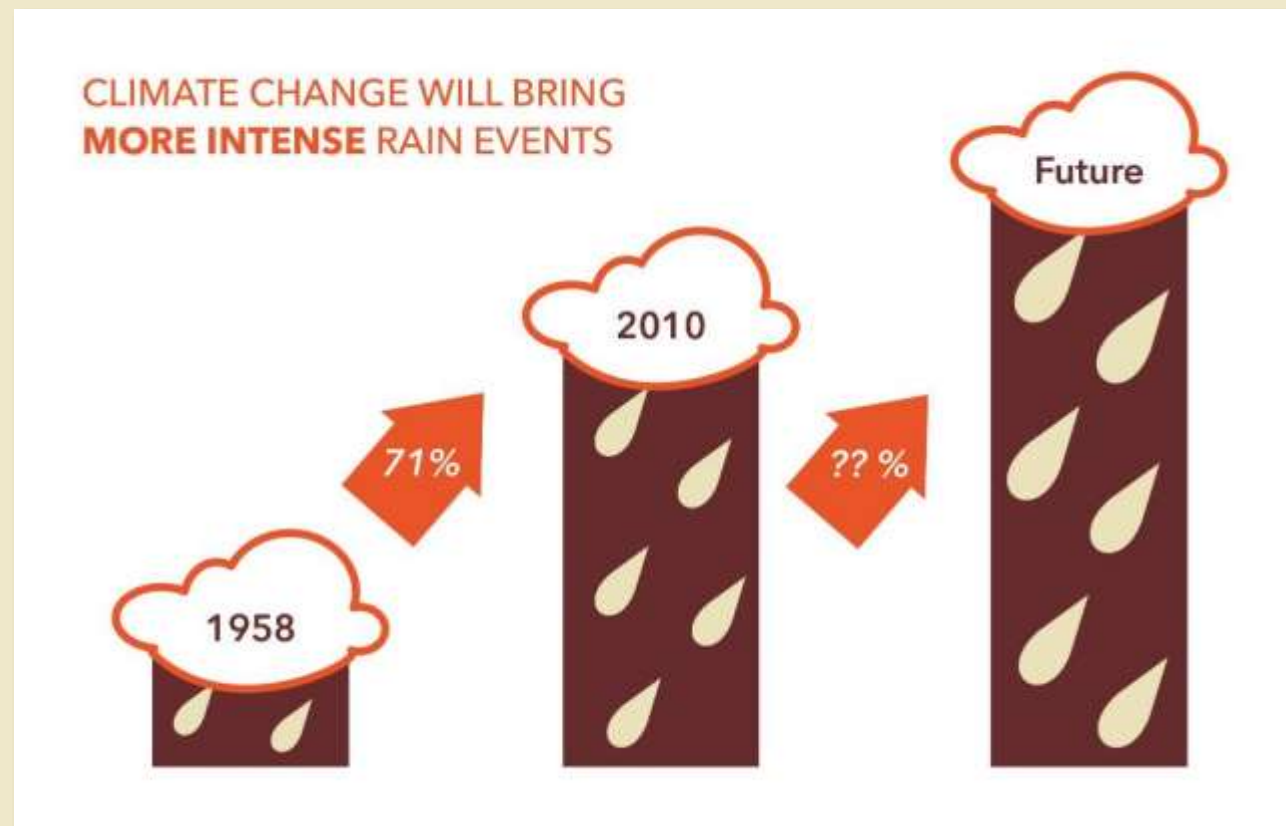
2015: Both MA and RI received average ~40 inches of precipitation

Trends:

MA and RI show increased precipitation

Discussion:

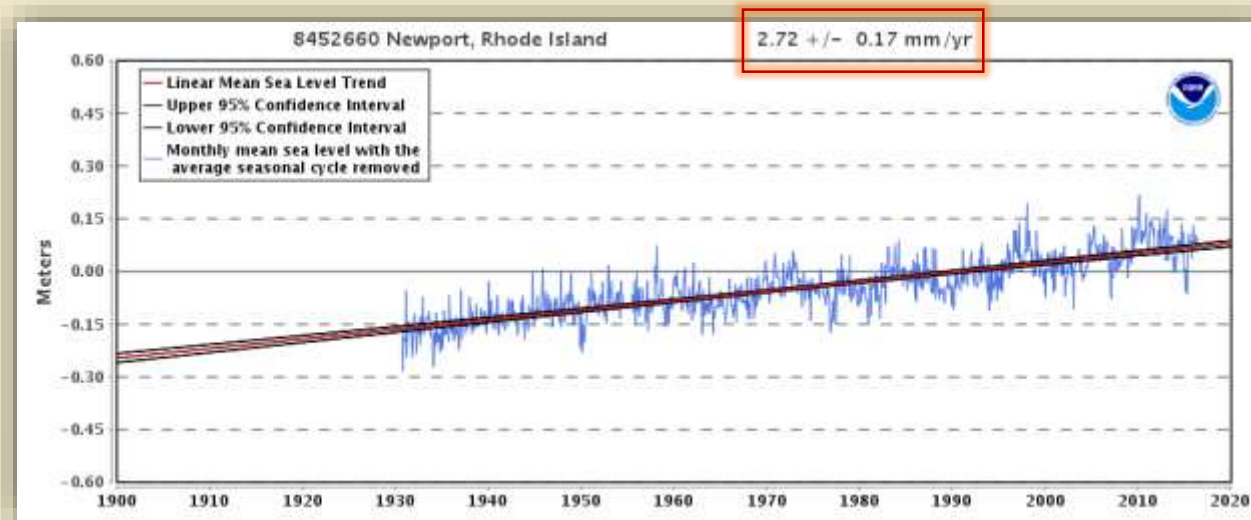
- Masks the importance of when precipitation delivered and periods of drought
- Masks the frequency and intensity of precipitation
- Need focus on frequency and intensity in the future



Sea Level

Sea Level Rise Trends:

- Global: 1.3 inches per Decade (1993 – 2010)
- Newport Tide Gauge: 1.1 inch per Decade (1930 – 2015)
- NOAA Future SLR Projections: 6.6 feet by 2100 above 1990 levels
- Plus Storm Surge



Current and Future Impacts:

- Nuisance Flooding: Already occurring during extreme tide events (King Tide) 2.16' above MHHW ~ 10.5' water levels
- Saltmarsh loss: 52-87%

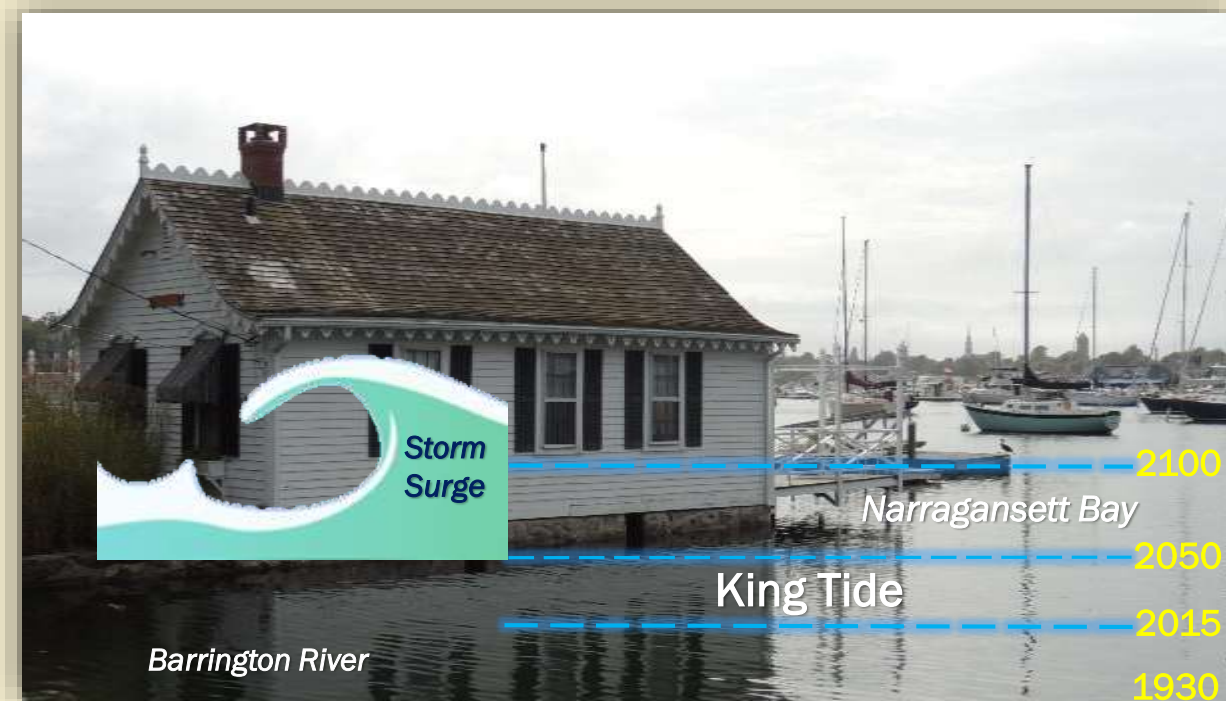
6.6 Feet above 1990 Sea Levels as Ice Sheets melts more rapidly

+ 2" sea level raise every 10 years

9"

+

Sea Level 85 years ago



Bay Ecosystem Indicators

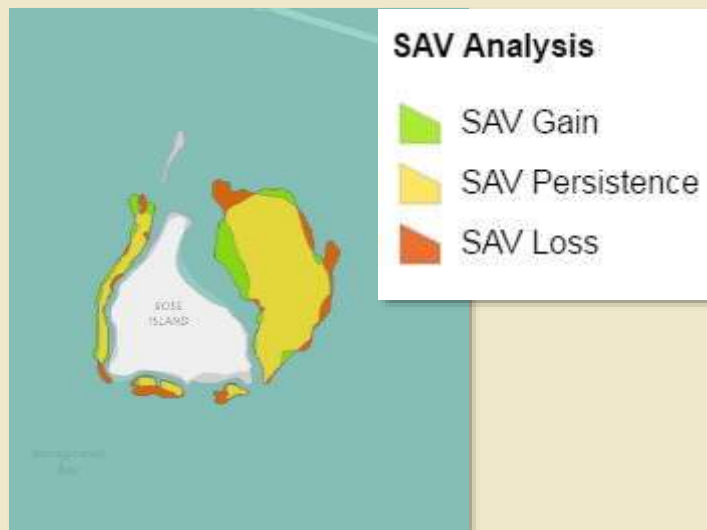


Seagrass

Status:

Narragansett Bay has **513** acres

- **29** acres in Greenwich Bay



Trends:

- Points to recovery of habitat, but no clear trends
- Between 2006 and 2012, saw increased acreage



Salt Marsh

Status:

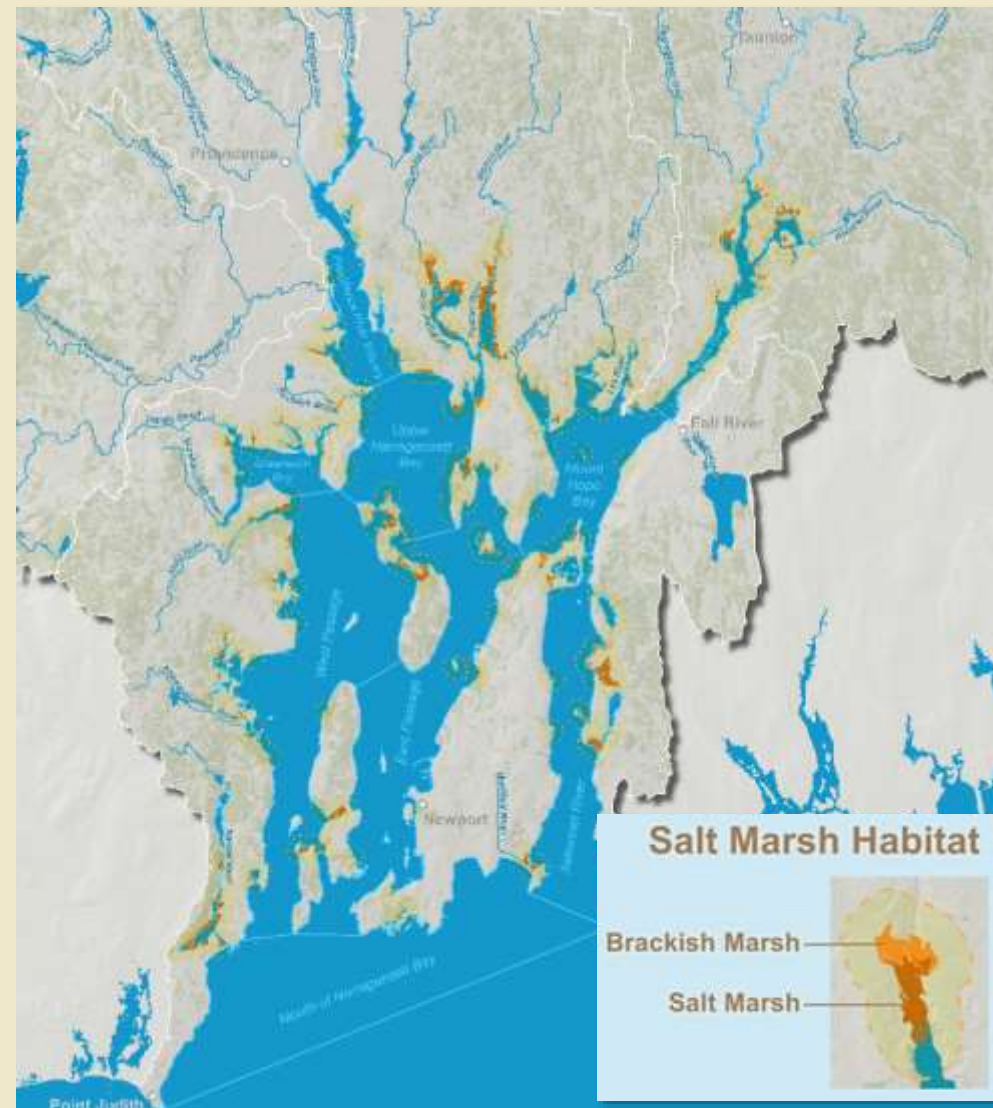
Narragansett Bay has **3,328** acres

- **903** acres in Warren, Palmer, and Barrington Rivers



Trends:

- 1800s-1980s: > 50% RI and >40% MA marshes lost
- Post-1970s: loss rates slowed to 17-20%



Benthic Habitats



Status & Trends:

1988-2008: benthic habitat quality improved

- **Providence River Estuary:** 8/10 stations changed
- **Shallow Embayments:** 6/10 stations changed
- **Open Bay:** 10/18 stations changed

1988-2008: *Ampelisa spp.* increased > 5-fold and expanded into the Providence River Estuary



*Emily Shumchenia, Marissa Guarinello,
John King co-wrote the peer-reviewed article
on which this report is based*

Fish Species Communities

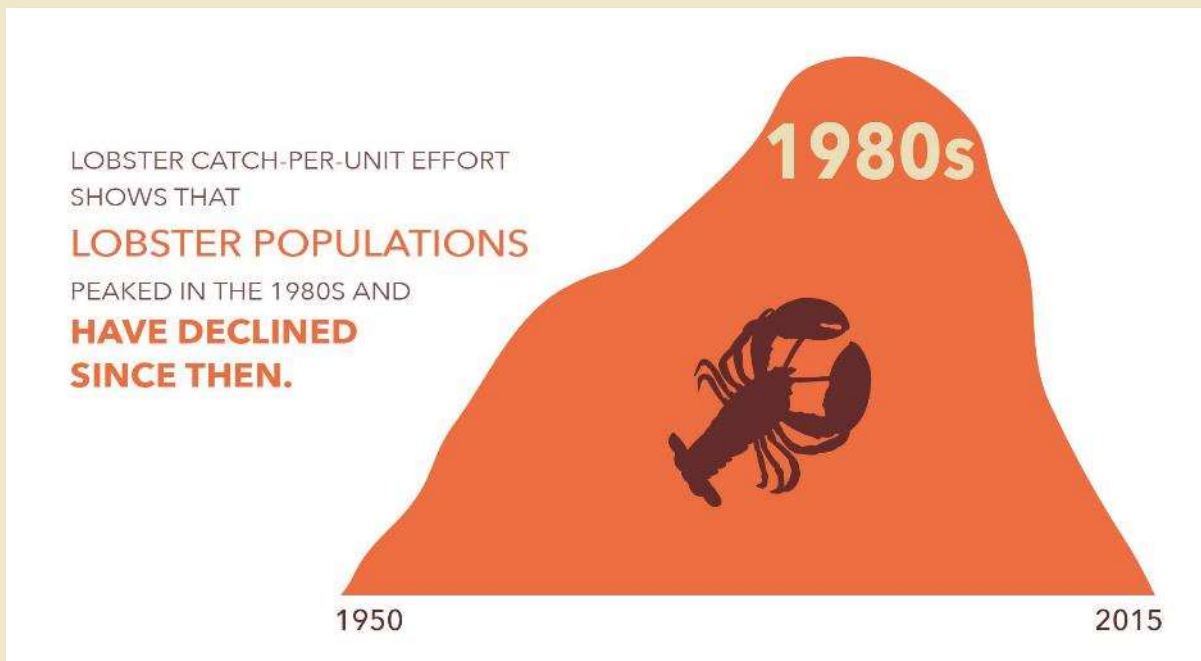


Status & Trends:

- Warm water species used to come in pulses, now coming and staying for longer periods of time
- Lobster population increased through the 1980s then collapsed

Changes linked to:

- Warming temperatures
- Pollution
- Fishing pressures
- Habitat loss



Dissolved Oxygen

Status:

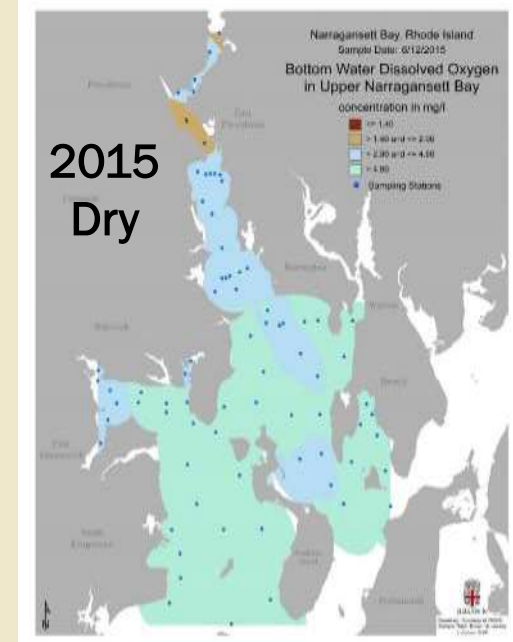
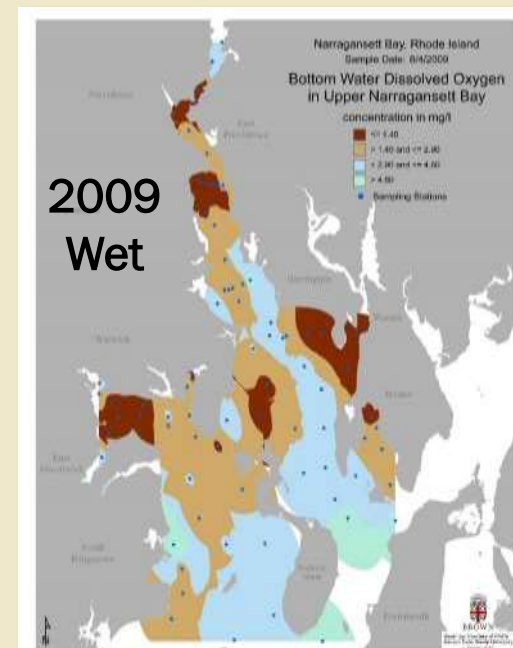
2015:

- Hypoxia low for all stations
- Hypoxia eases with distance north to south
- Current hypoxia levels linked with dry summers, and potentially linked with nutrient reductions

Trends:

2001-2015:

- North-south gradient holds each year
- Inter-annual variability linked to wet/dry summers (wet summers = more hypoxia, dry = less)



Chlorophyll

Status:

2015:

- North-south gradient in chlorophyll concentrations
- Chlorophyll levels were lower than previous years potentially linked with wet/dry years or nutrient reductions

Trends:

2005-2015 – Spatial Survey

- Chlorophyll levels decline

1972-2015 – Grab Samples

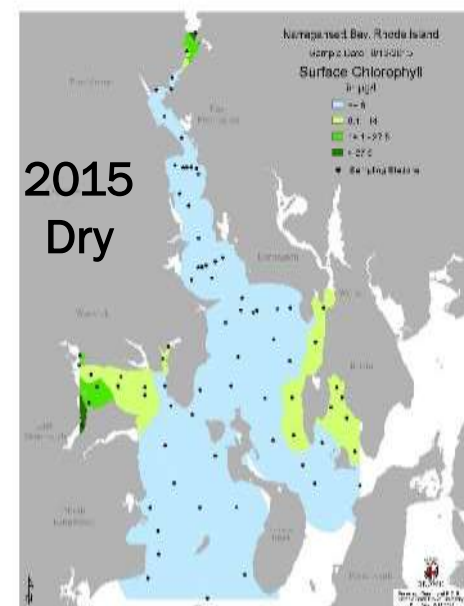
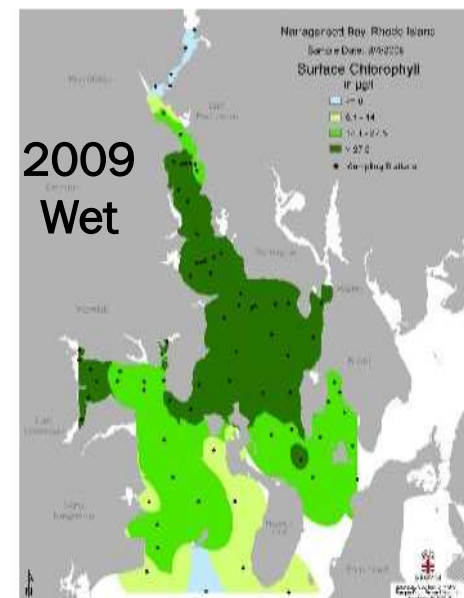
- Chlorophyll levels decline

All data

- Inter-annual variability potentially linked to wet/dry summers

2001-2015 – Chlorophyll Bloom Index

- Show no trend



Water Clarity

Status:

2014:

- Improved along a north-south gradient
- In winter, clarity similar for all stations along the gradient



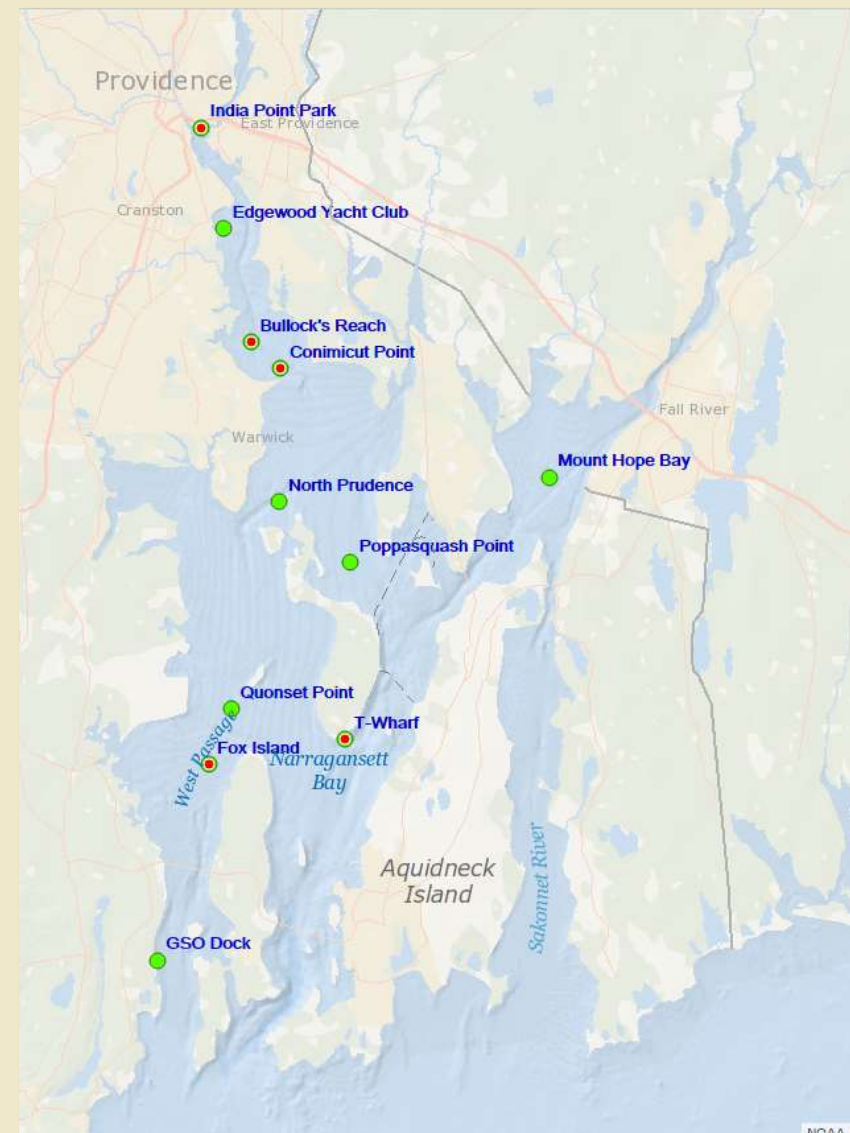
Trends:

1972-2015:

- Clarity improved by ~30% in Mid-Narragansett Bay

2007-2014:

- Clarity declined until 2012, then improved to 2014 in the Providence River & Upper Bay
- Potentially linked to summer precipitation levels and reductions in nutrient pollution



NBC, URI-GSO, RIDEM, NBNERR

Watershed Ecosystem Indicators



Stream Invertebrates

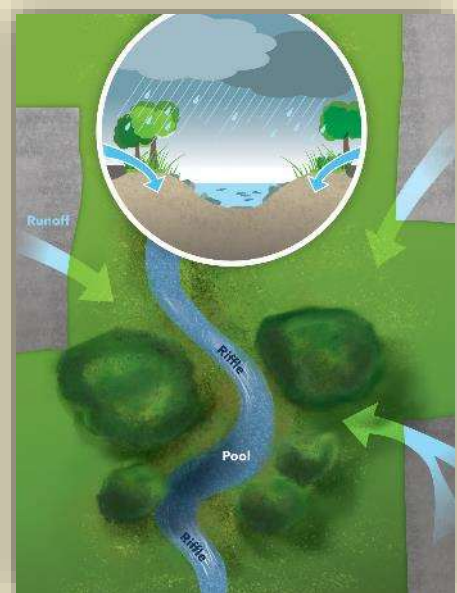
78 riffle sites are assessed in Narragansett Bay watershed

Status 59 of 78 are excellent or good

How is the Biological Community?

How is the habitat?

	Healthy	Slightly Unhealthy	Moderately Disturbed	Very Disturbed
Excellent	59 sites		18 sites	
Good			1 site	
Fair				
Poor				
This can indicate:	Good Water Quality		Poor Water Quality	

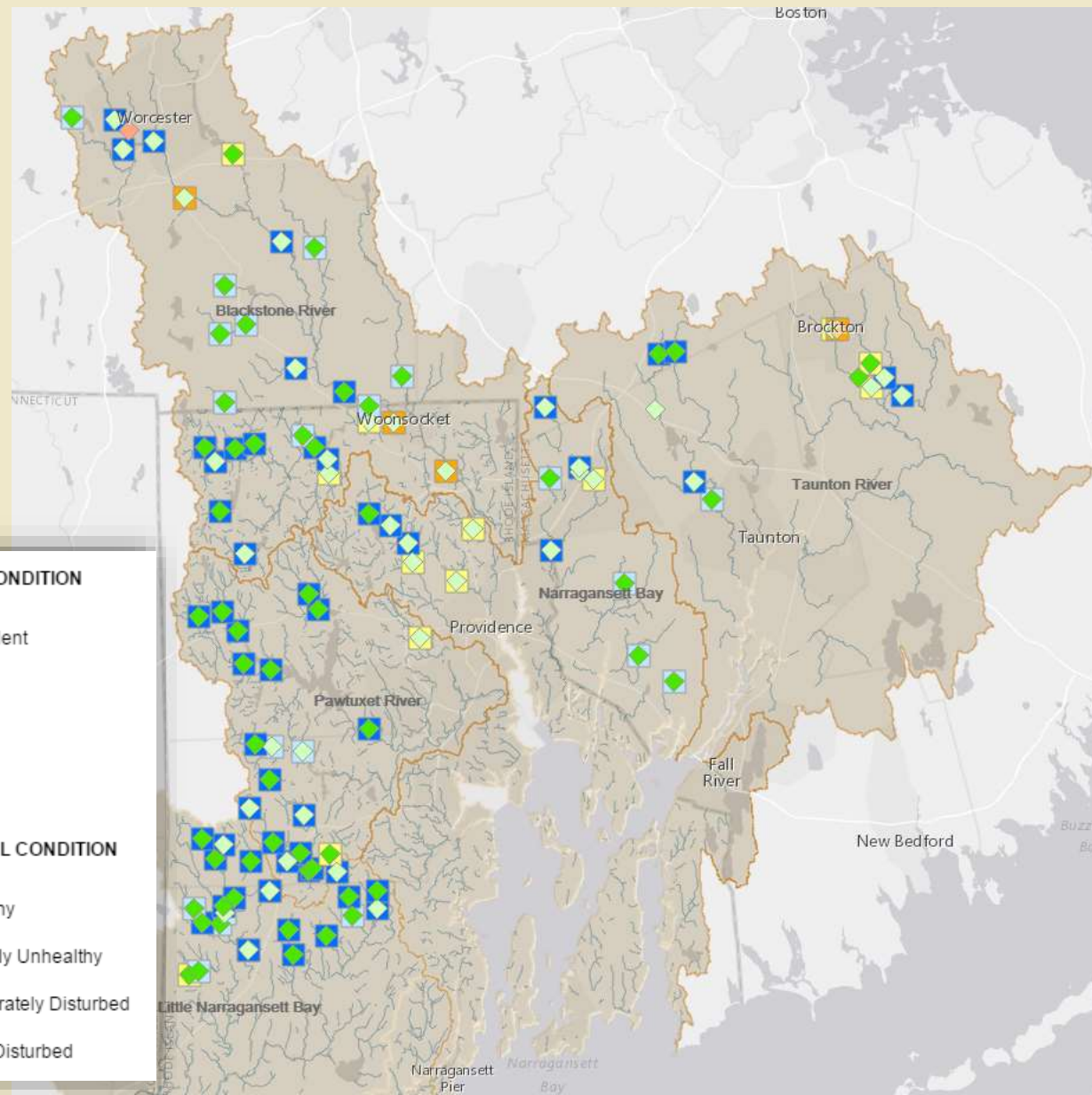


HABITAT CONDITION

- ◆ Excellent
- ◆ Good
- ◆ Fair
- ◆ Poor

BIOLOGICAL CONDITION

- Healthy
- Slightly Unhealthy
- Moderately Disturbed
- Very Disturbed



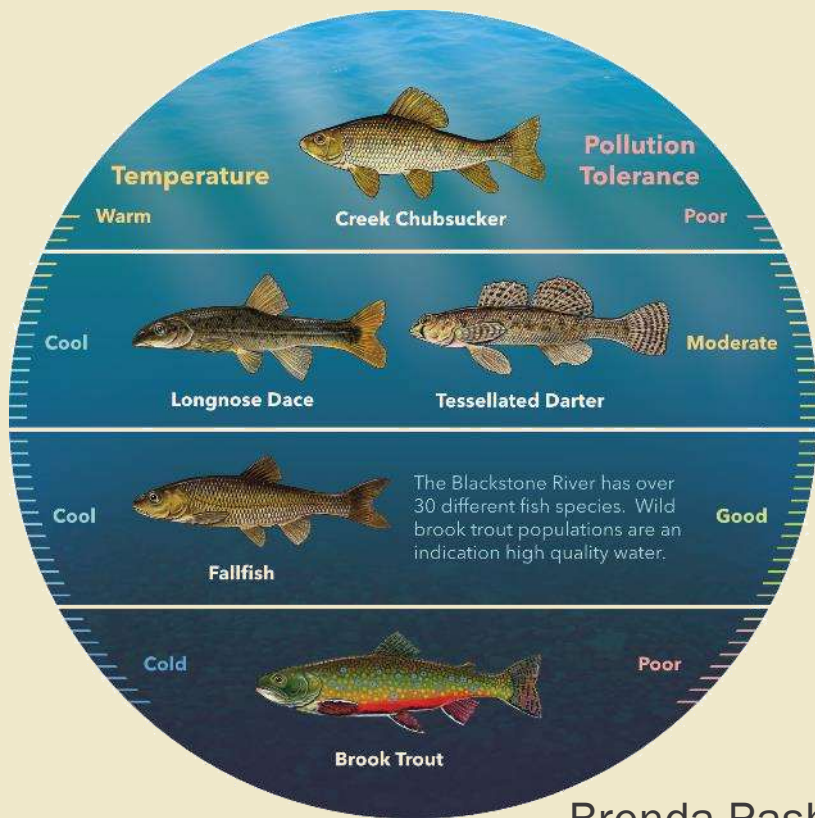
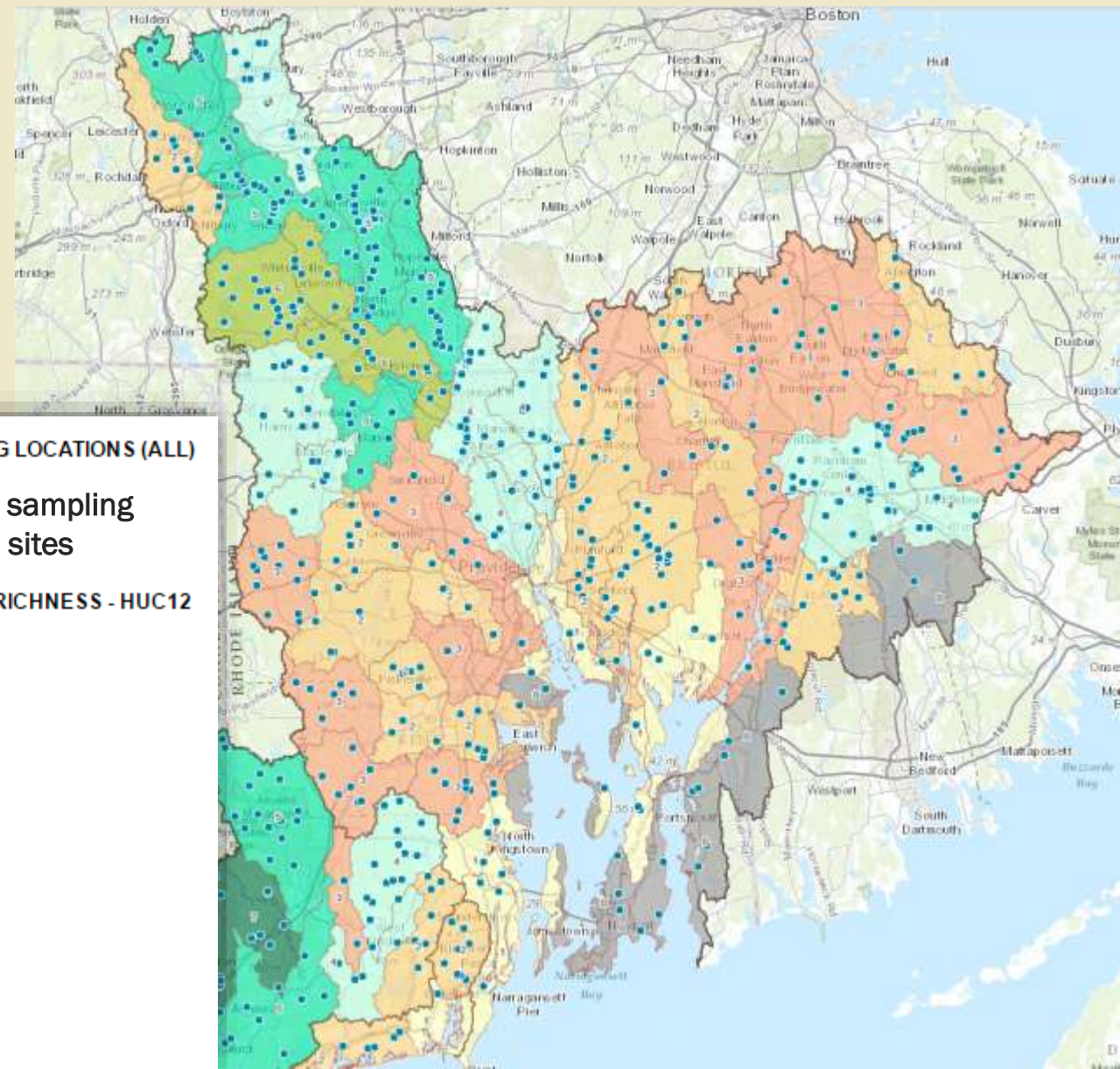
Katie DeGoosh & Robert Nuzzo

Freshwater Fish

Fluvial Fish (Native Species) in Narragansett Bay Watershed

Status:

- 8 fluvial fish, the maximum fluvial fish richness at a site within the HUC10 and HUC12 ranges from 2 to 6



The Blackstone River has over 30 different fish species. Wild brook trout populations are an indication high quality water.

FISH SAMPLING LOCATIONS (ALL)

● 533 sampling sites

FLUVIAL FISH RICHNESS - HUC12

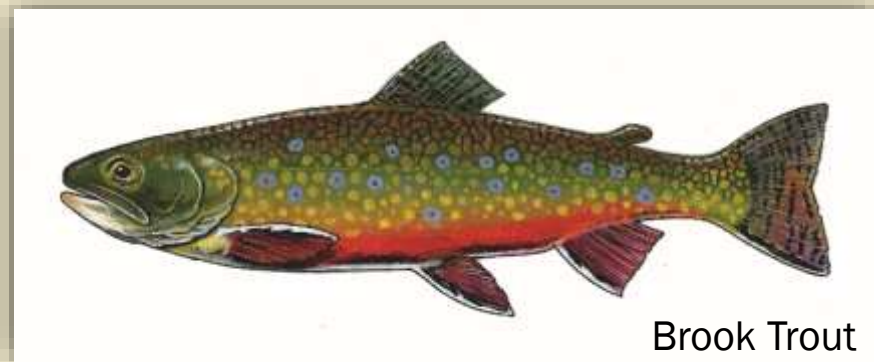


Freshwater Fish

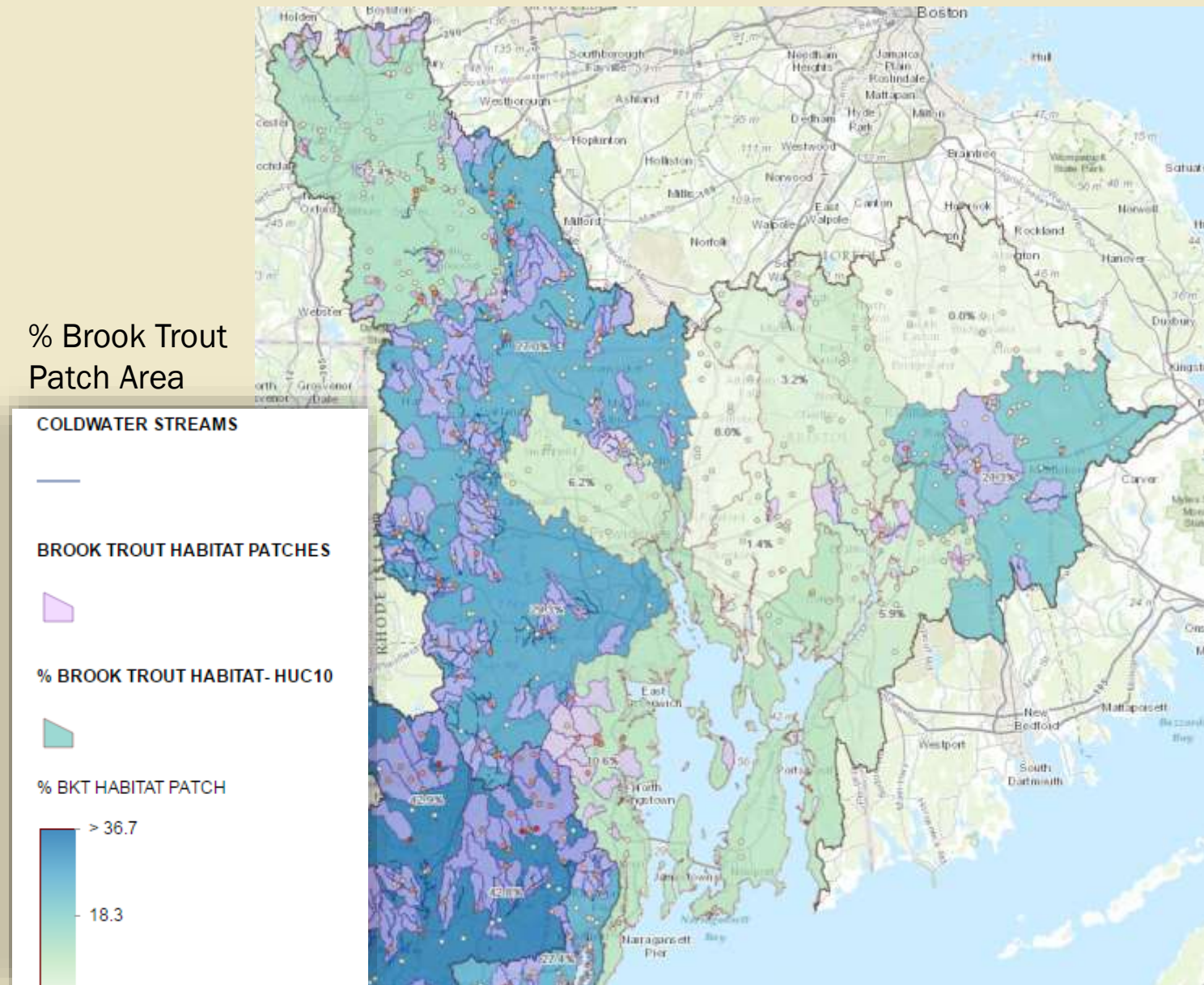
Brook Trout Habitat in Narragansett Bay Watershed

Status:

- **14.5%** Potential Habitat By Catchments
- ✓ Pawtuxet River Basin: **29.3%**
- ✓ Blackstone River Basin: **20.6%**
- ✓ Taunton River Basin: **9.5%**
- ✓ Narragansett Bay Basin: **6.7%**



Eastern Brook Trout Joint Venture



Water Quality and Aquatic Life

Assessed:

- Estuarine: **156 sq. miles** (80% of the Bay)
- Rivers and Streams: **1,345 miles** (38% of NHD)
- Ponds and Lakes: **390 (34,830 acres)**

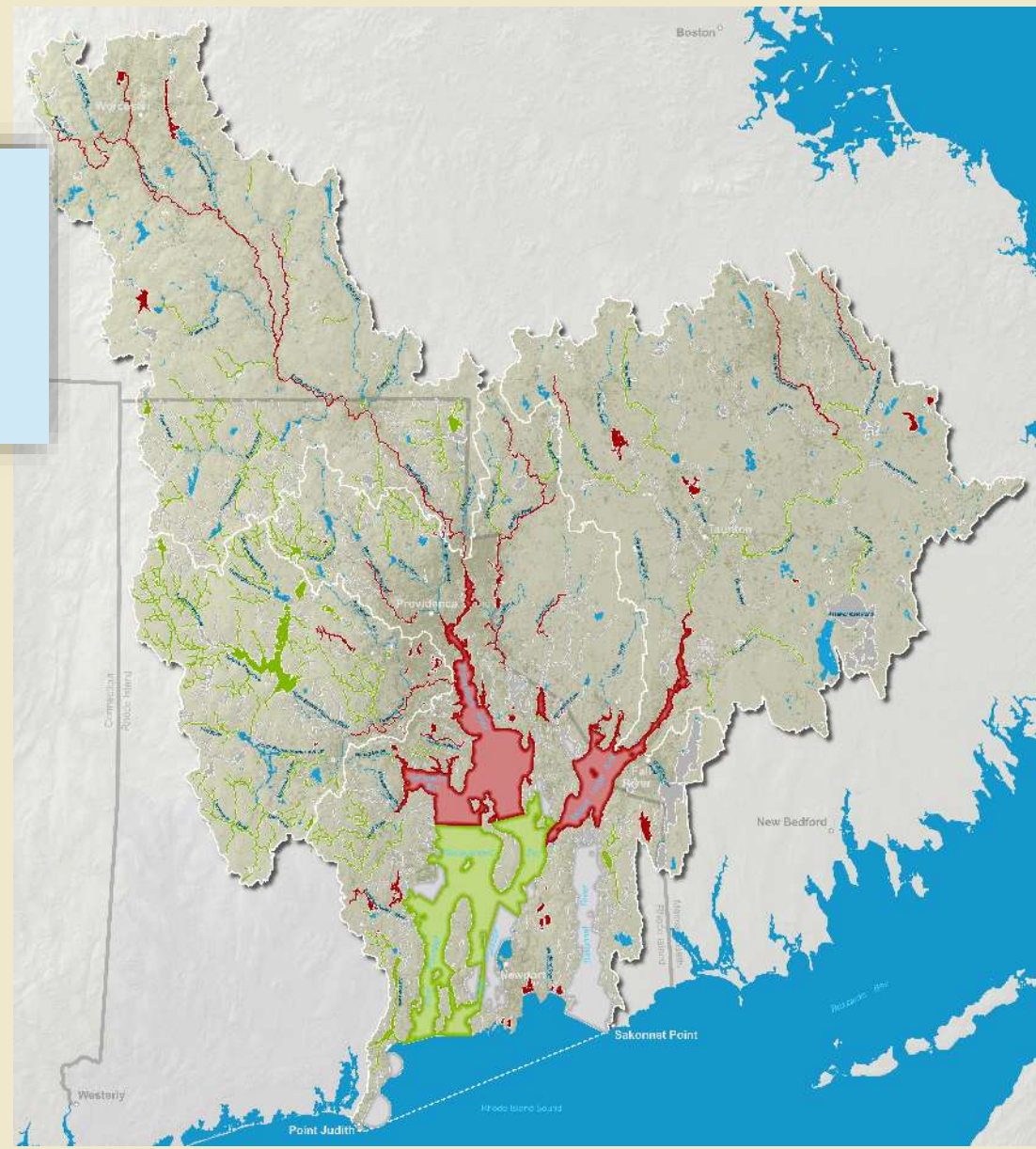


Status:

- **Acceptable** conditions: **56 sq. miles** of the Bay, **450 miles** of streams, and **17 ponds**
- **Impacted by Nutrient Related Pollutants**: **57 sq. miles** of the Bay, **166 miles** of streams, and **48 ponds**
- **Unknown** conditions: **41 sq. miles** of the Bay, **506 miles** of streams, and **47 ponds**

Major Basins:

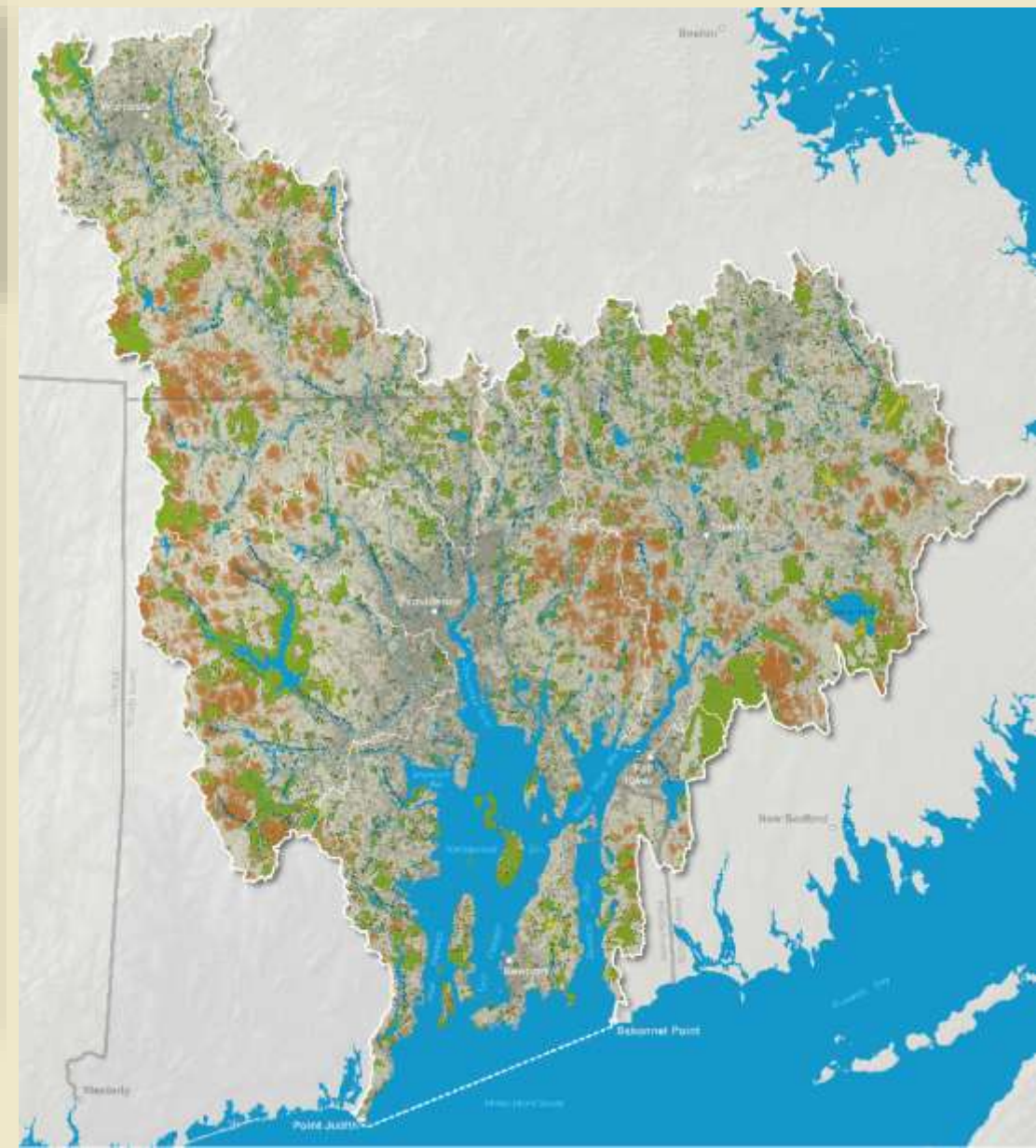
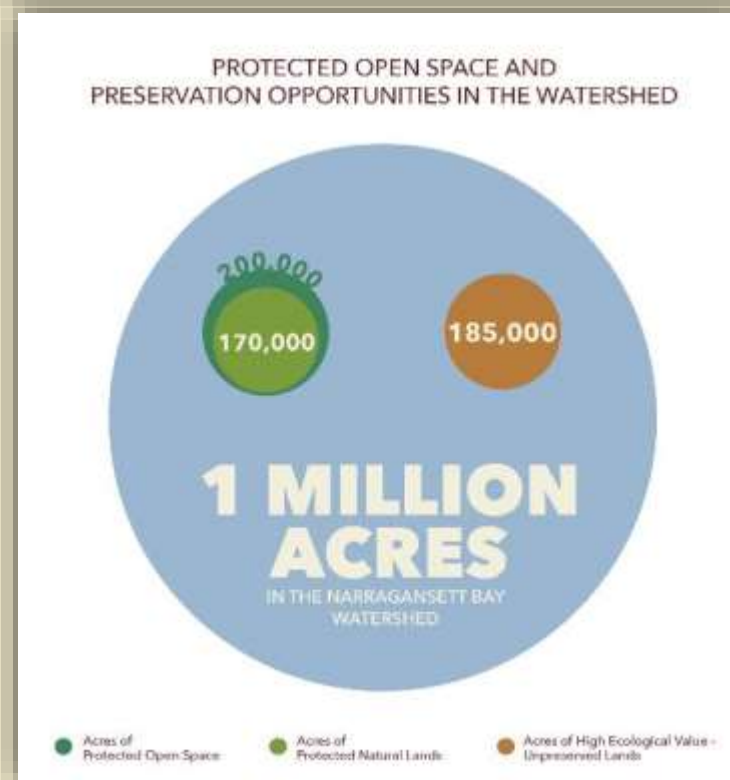
- Entire **Blackstone River and Upper Estuary** are impacted by Nutrients and Low DO



Open Space

Status:

- Pawtuxet River Basin**
 Natural Open Space: 20.8%
 Unpreserved: 22.3%
- Taunton River Basin**
 Natural Open Space: 16.1%
 Unpreserved: 17.6%
- Blackstone River Basin**
 Natural Open Space: 14.6%
 Unpreserved: 19.3%
- Narragansett Bay Basin**
 Natural Open Space: 13.9%
 Unpreserved: 11.4%



Paul Jordan, Benjamin Smith & Scott Jackson

Public Health Indicators



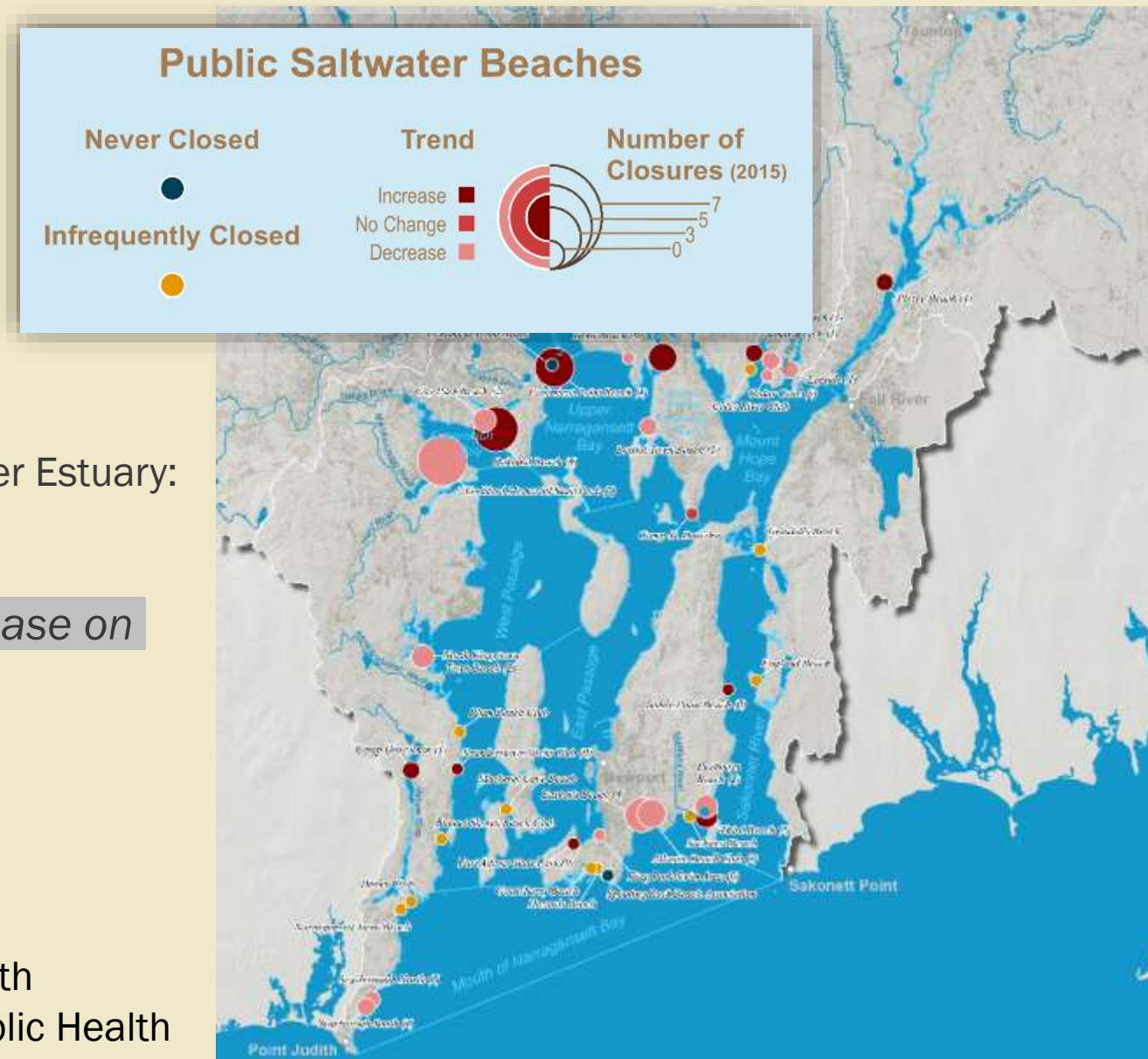
Swimming at Our Beaches

Closure Events and Frequency (2004 – 2015)

38 Saltwater Beaches in Narragansett Bay

Status & Trends:

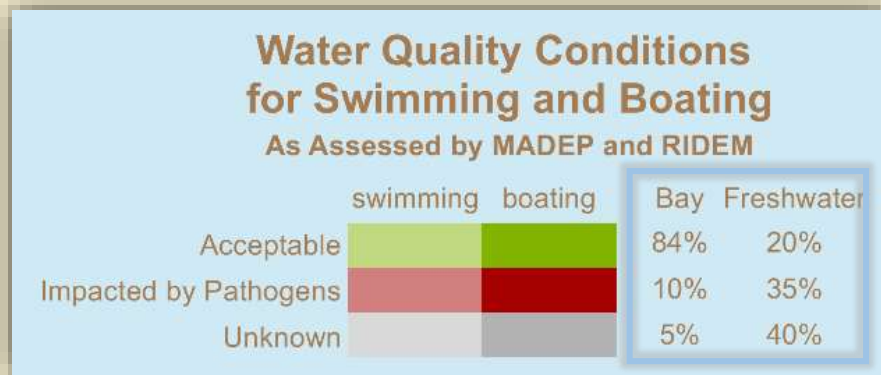
- # Closure events in 2015: 44 at 18 Beaches
- Regular Frequency: 25 Beaches
 - ✓ Most closures and changes have occurred in the Upper Estuary: Providence River, Greenwich Bay, Mount Hope Bay
- **14** have shown slightly decline and **10** slightly increase on closure events
- Irregular Frequency: 11 Beaches
- No closures: 1 Beach



Swimming and Boating

Assessed:

- Estuarine **156 sq. miles**
- Rivers and Streams
1,345 miles
- Ponds and Lakes
390 (34,830 acres)

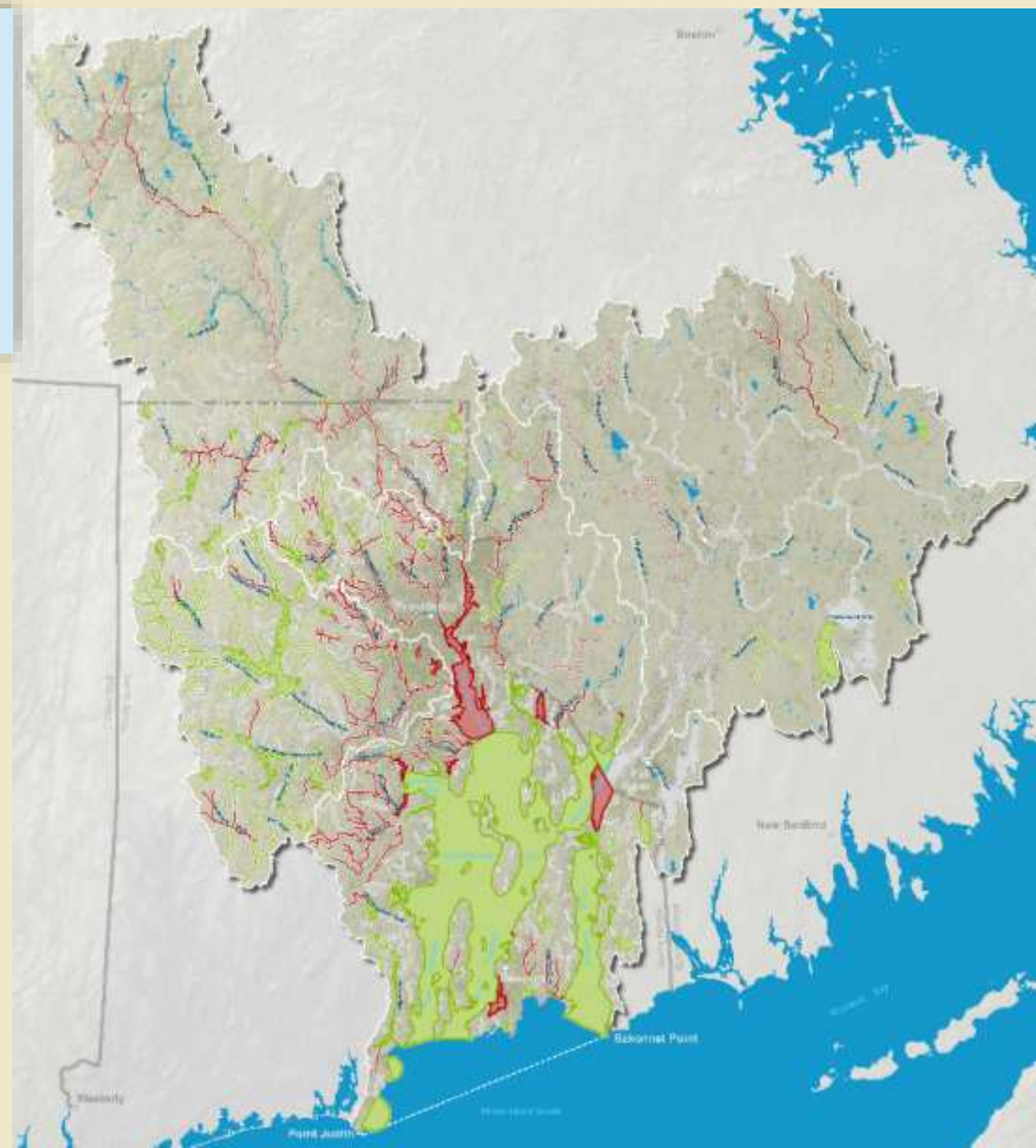


Status:

- Acceptable conditions: **131** sq. miles of the Bay, **291** miles of streams, and **74** ponds
- Impacted by Pathogens: **15.4** sq. miles of the Bay, **484** miles of streams, and **7** ponds
- Unknown conditions: **8.0** sq. miles of the Bay, **580** miles of streams, and **229** ponds

Major Basins:

- Entire **Blackstone River** is impacted by Pathogens
- Freshwater bodies in the **Taunton River Basin** have the largest data gap for these designated uses.



Shellfishing

Status & Trends

Narragansett Bay

- 63% of the Bay have approved areas for shellfishing; 13% are approved with some restrictions; and 24% are closed.
- Acreage of “Prohibited” areas for shellfishing are decreasing while “Conditionally Approved” areas are increasing.

Upper Estuary

- Only 6.2% is open without restrictions; 43.7% is conditionally approved; and 49.5% is closed for shellfishing.
- ~1,500 acres upgraded to Conditionally Approved; most notable changes were between 2010 and 2015

