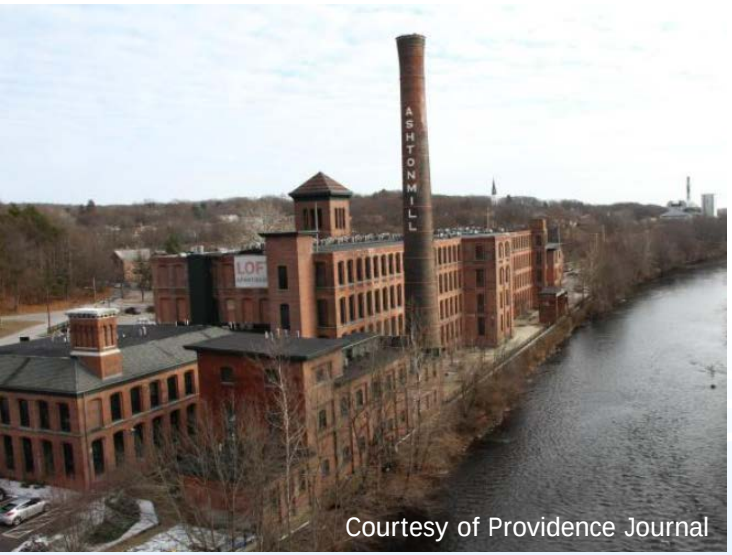
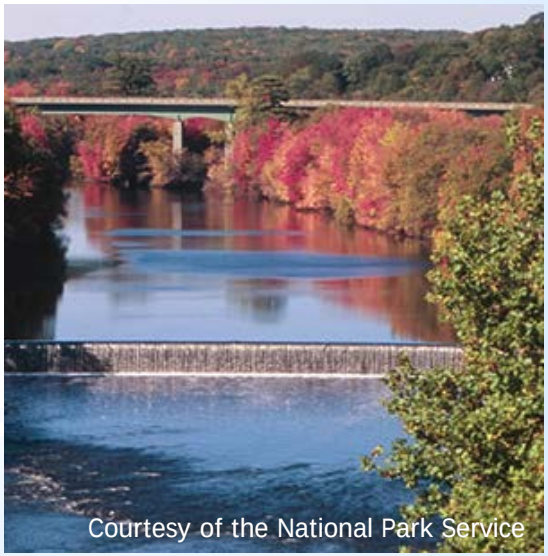
DEM
RHODE ISLAND





Blackstone River

NPDES Nutrient Permitting

DEM
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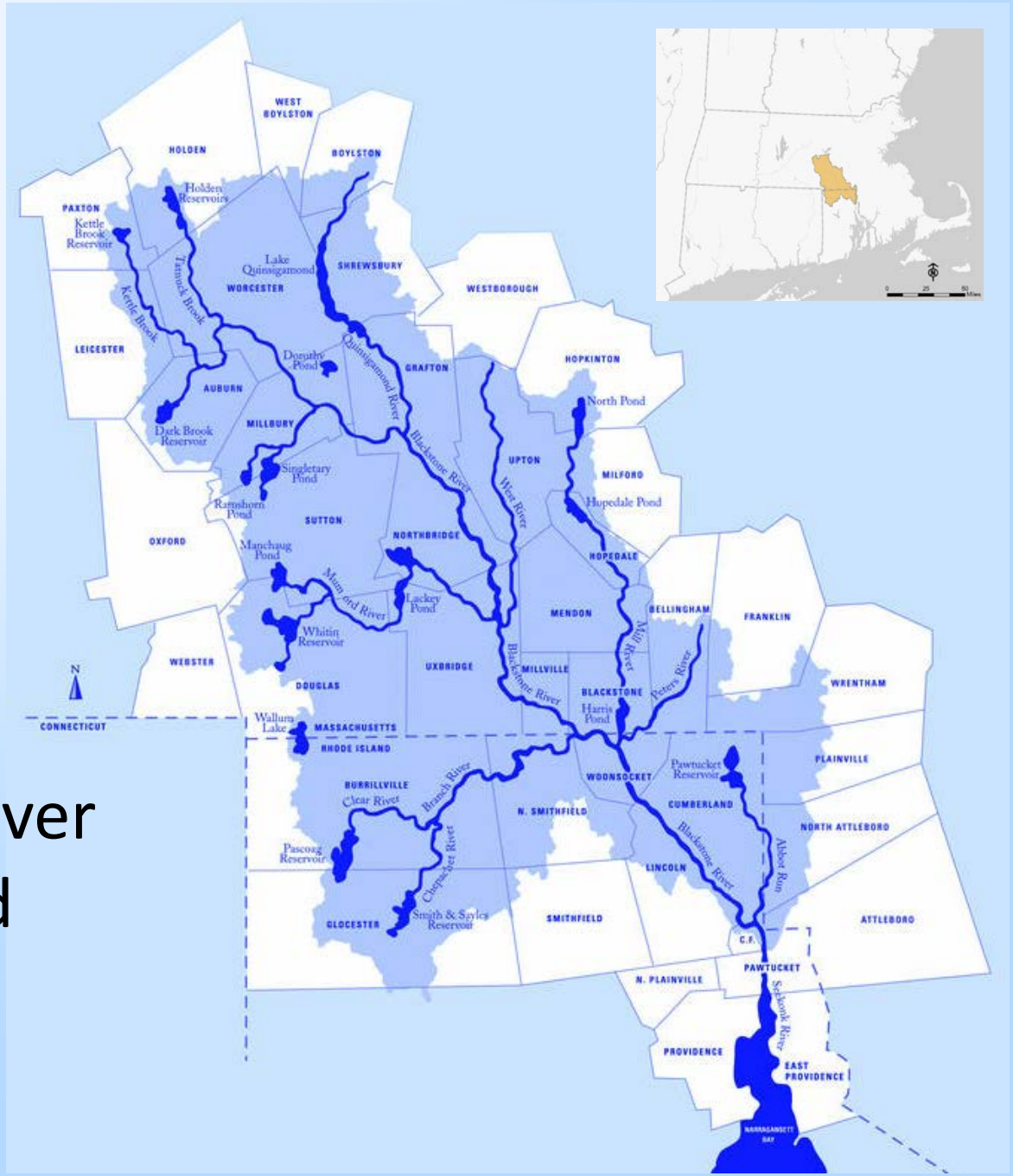
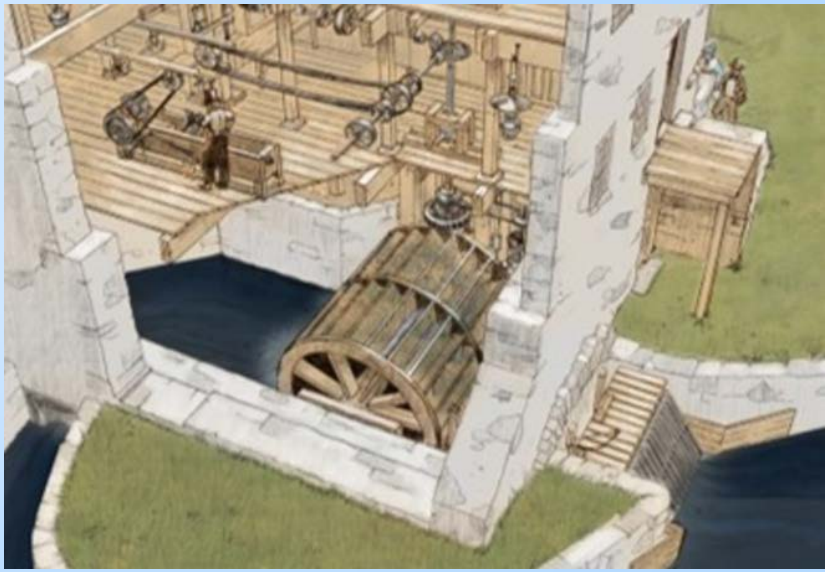
Blackstone River Watershed



https://www.massaudubon.org/our-conservation-work/policy-advocacy/shaping-climate-resilient-communities/saving-land-water-money-with-lid/blackstone-river-watershed

American Industrial Revolution

Slater Mill in Pawtucket, RI, which harnessed the roaring Blackstone River to power the first cotton spinning mill in the United States.



https://www.nps.gov/articles/000/brvnhc_winter_2021.htm?utm_source=article&utm_medium=website&utm_campaign=experience_more&utm_content=small

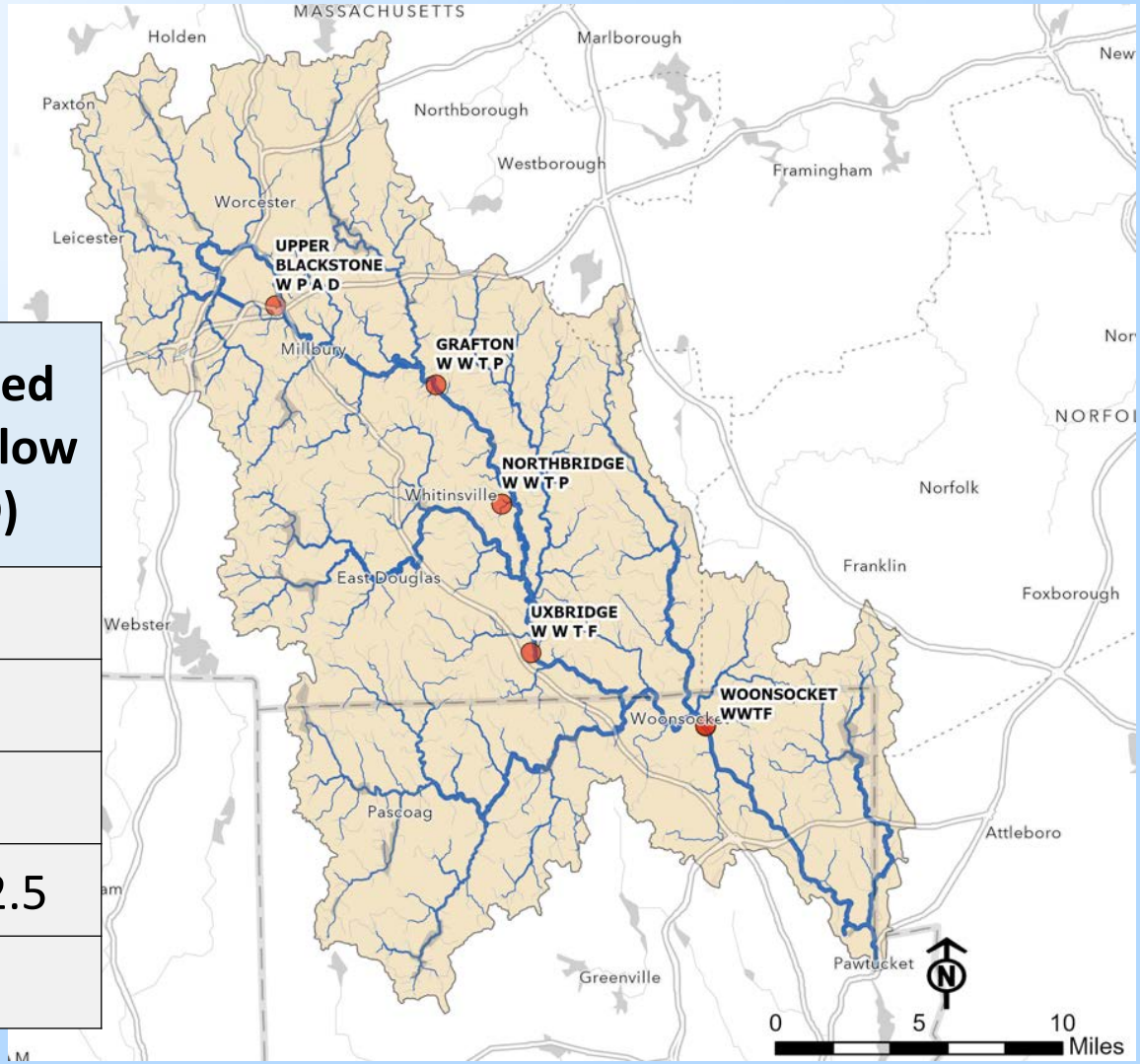
DEM
RHODE ISLAND

“Industrial River”

https://hubblecontent.osi.office.net/contentsvc/videohostpage/video?lcid=1033&syslcid=1033&uilcid=1033&app=3&ver=16&build=16.0.13801&platform=Win32&streamsso=true&appCorrelation=1A3AF6A6-7384-4C50-8A3C-1829B73AD59A&url=https%3A%2F%2Fwww.youtube.com%2Fembed%2FHIhG-NIzN80%3Ffeature%3Doembed

Municipal Wastewater Treatment Facilities

Facility	Permitted Design Flow (MGD)
UBWPAD (MA)	56
Grafton (MA)	2.4
Northbridge (MA)	2
Uxbridge (MA)	1.25 / 2.5
Woonsocket (RI)	16



Upper Blackstone Clean Water (MA)

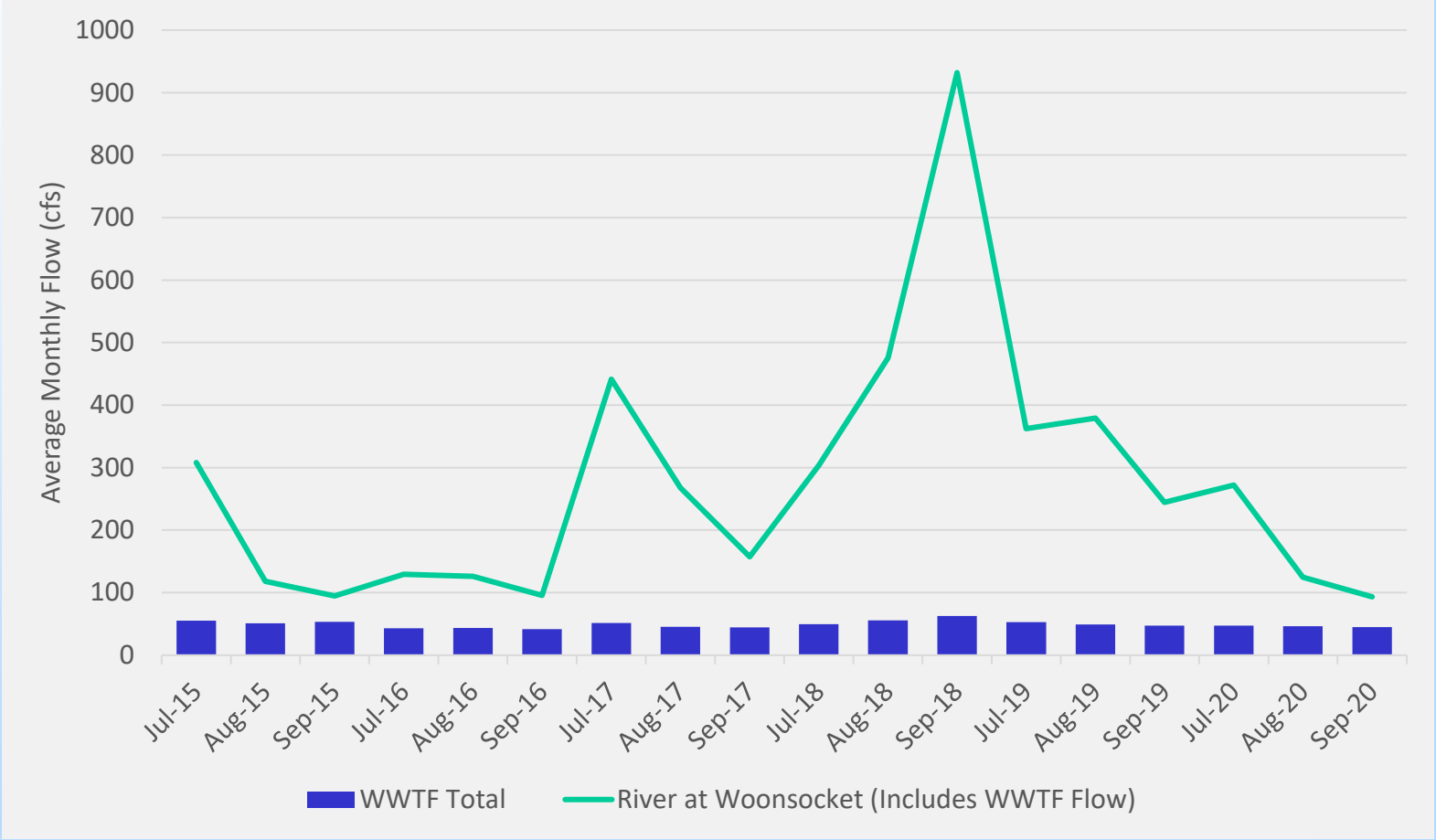
(Upper Blackstone Water Pollution Abatement District)

- Permitted to discharge an average of 56 MGD per month.
- Serves about 250,000 people in the greater Worcester, MA area.
- Discharges near the headwaters of the Blackstone River in Millbury, Massachusetts

Woonsocket (RI) WWTF

- Permitted to discharge an average of 16 MGD per month.
- Serves about 51,000 people in Woonsocket, RI and surrounding area.
- Discharges to the Blackstone River just downstream of the MA/RI Stateline.

River Flow at Woonsocket (RI) compared to WWTFs Flow



WWTF Total – Sum of average monthly flow at 5 facilities (UBWPAD, Grafton, Northbridge, Uxbridge, Woonsocket) along the Blackstone River.

River Flow at USGS Woonsocket Gage.

1970-1991 Blackstone River Dissolved Oxygen

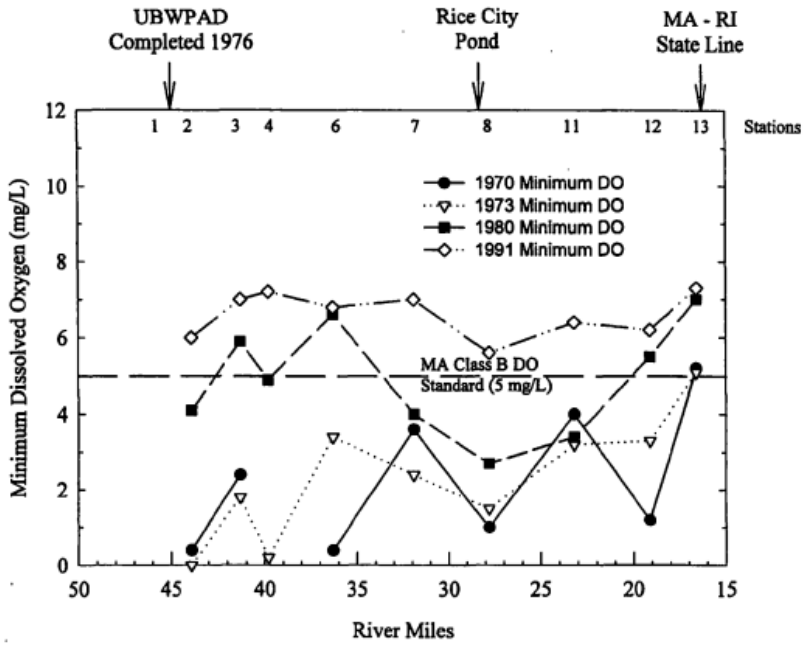


Figure 4.13 Minimum DO Values for 1970, 1973, 1980, and 1991 Surveys

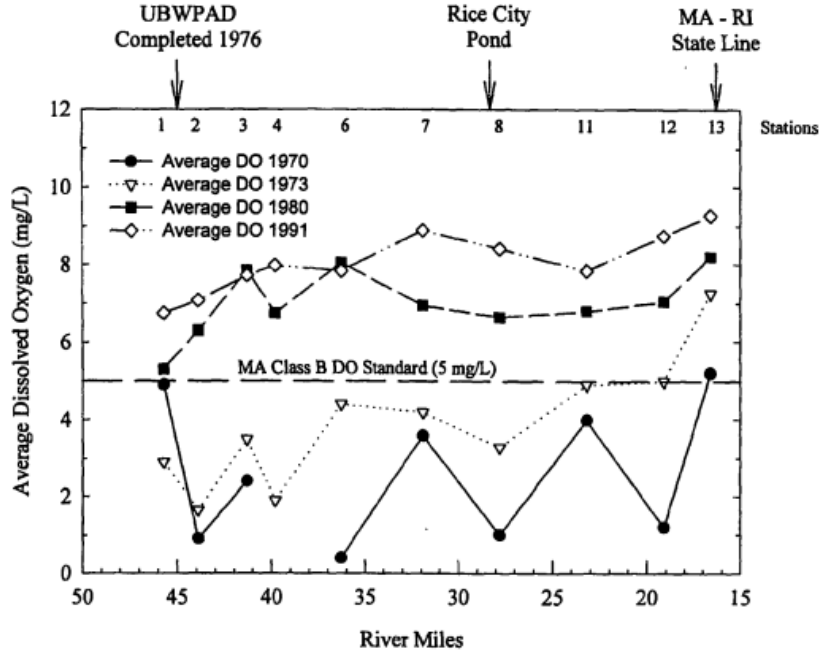


Figure 4.14 Average DO Values for 1970, 1973, 1980, and 1991 Surveys

Blackstone River Initiative Water Quality Analysis of the Blackstone River Under Wet and Dry Conditions (May 2001)

1969-1980 Dissolved Oxygen Millville (MA) USGS Station (Hourly)

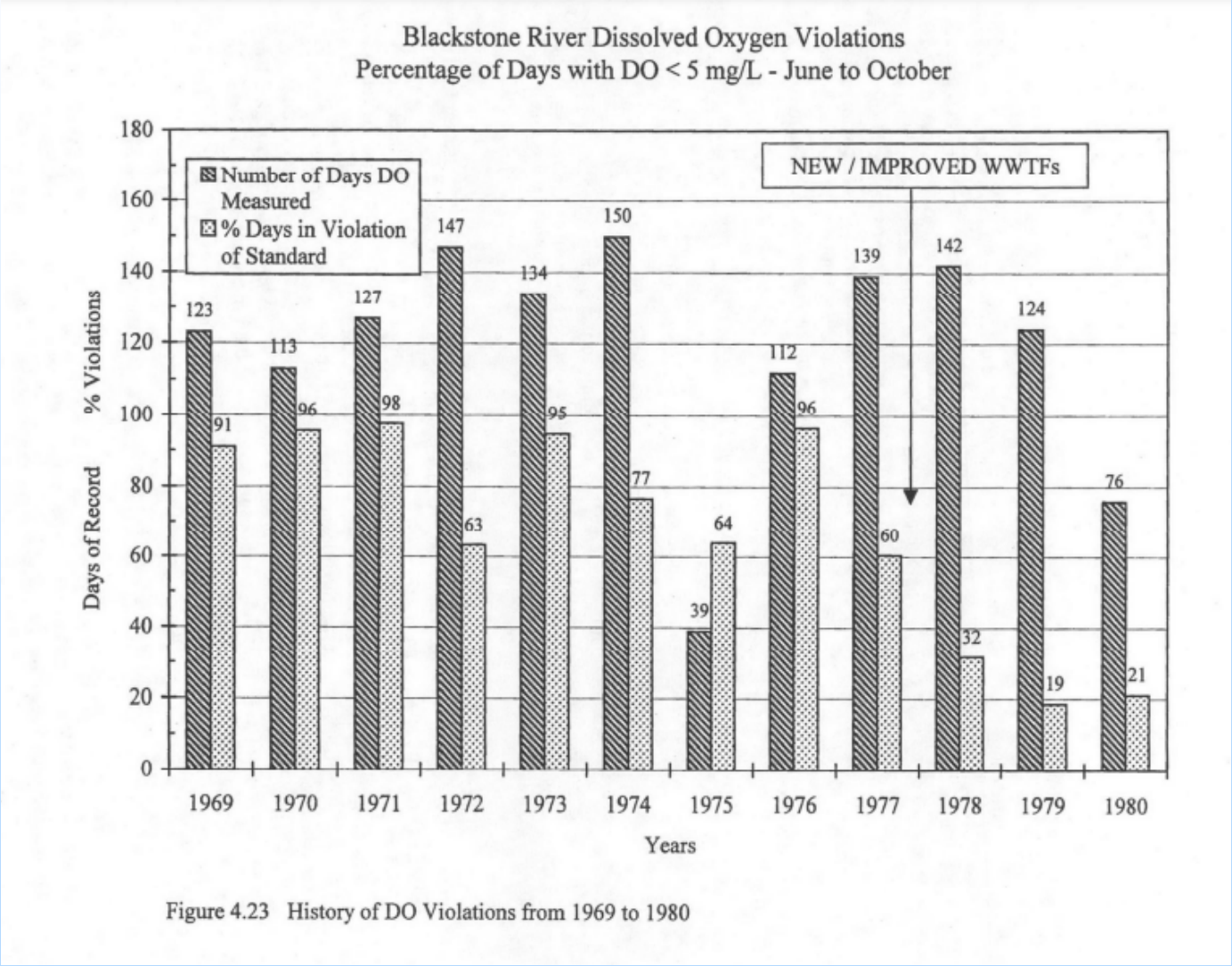
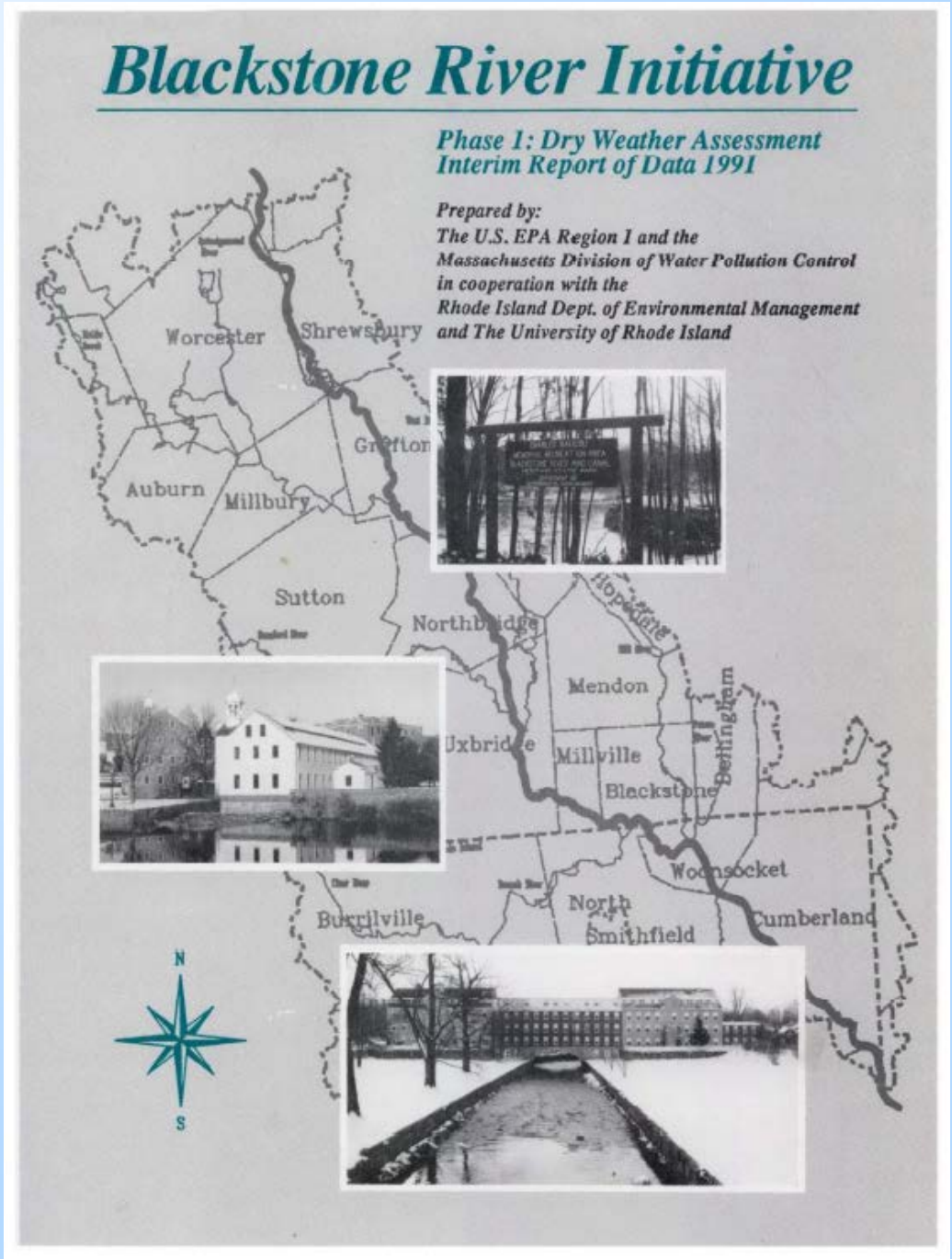


Figure 4.23 History of DO Violations from 1969 to 1980

Blackstone River Initiative Water Quality Analysis of the Blackstone River Under Wet and Dry Conditions (May 2001)

Blackstone River Initiative

Multi-phased, interagency, interstate project to conduct sampling, assessment, and modeling work necessary for the restoration of the river.



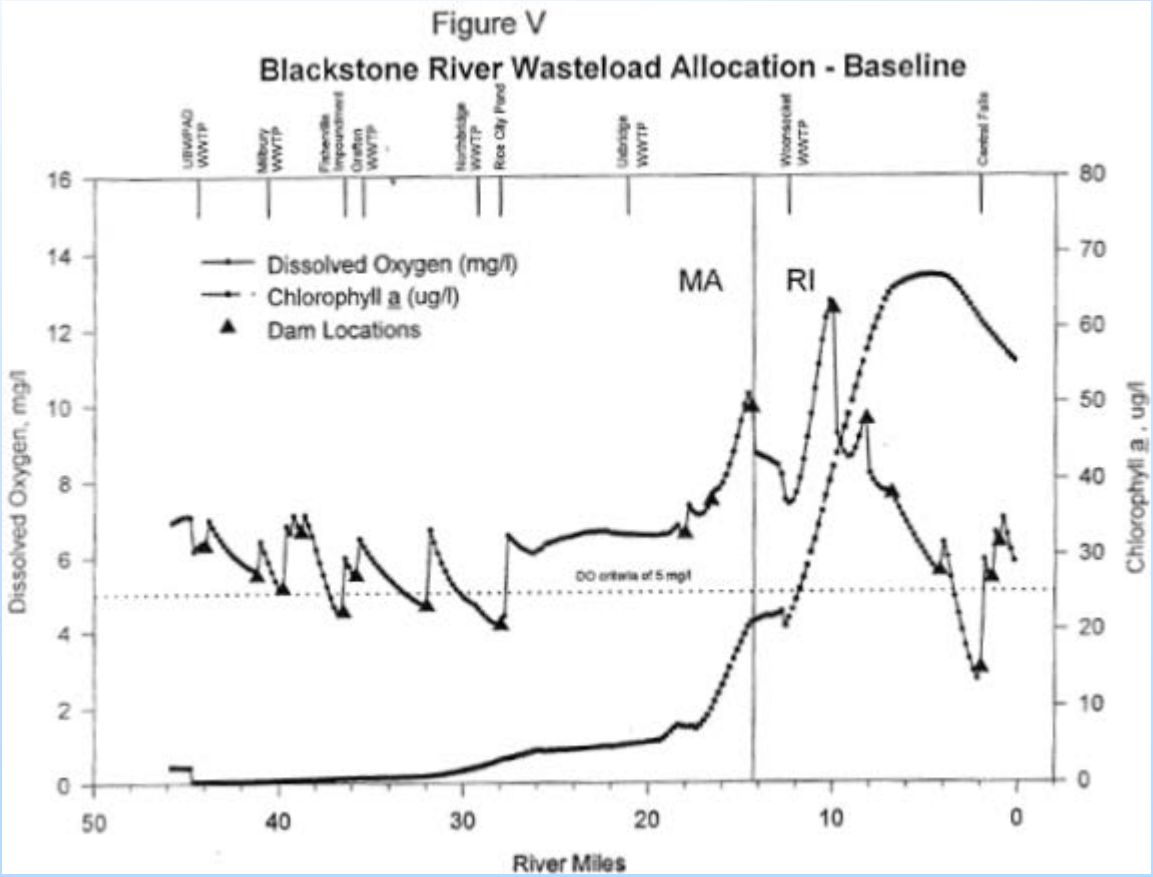
NPDES Permit Limits – 1980s

	Permit Expiration Date	Flow (MGD)	BOD (mg/l)	Ammonia (mg/l)	Phosphorus (mg/l)
Upper Blackstone	10/30/90	56	*Jun-Oct*: 10 *Nov-May:* 30	*06/01-06/14*: 5 *6/14-Oct*: 2 *No winter*	NA
Millbury*	09/22/94	1.2	30	NA	NA
Grafton	09/21/94	1.6	30	NA	NA
Northbridge	06/30/92	1.8	*Jun-Oct*: 10 *Nov-May*: 30	NA	NA
Uxbridge	12/04/89	2.5	30	NA	NA
Woonsocket	12/27/90	16	30	NA	NA

*This facility was decommissioned in 2005 and connected to the Upper Blackstone Facility.

Current Report: The Narragansett Bay Project Blackstone River (1990) NBP-92-85

Blackstone River Initiative QUAL2E Model



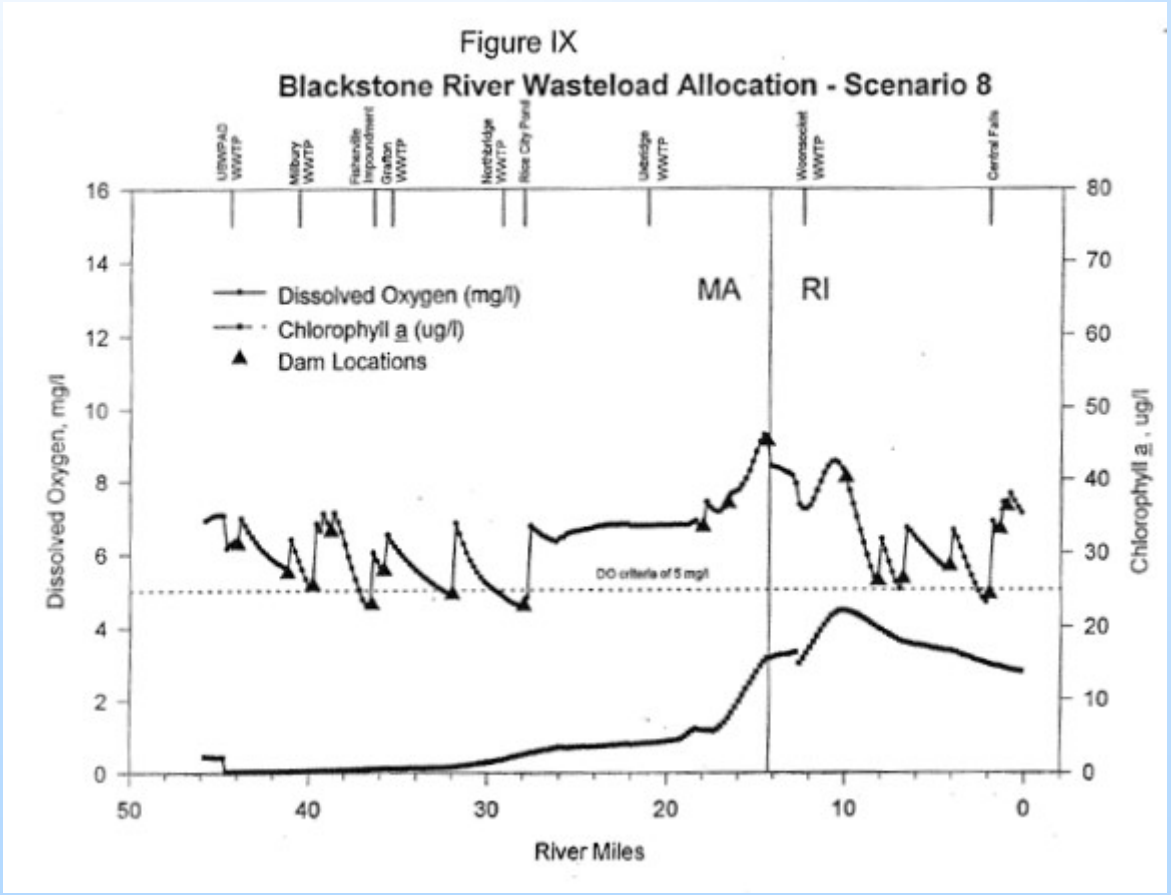
*Others: Grafton, Northbridge, Uxbridge

Baseline

- Design Flow
- Total Phosphorus
  - UBWPAD: 2.4 mg/L
  - Woonsocket: 3.8 mg/L
  - Others*: 1.9-3.7 mg/L
- NH_3
  - UBWPAD: 2 mg/L
  - Woonsocket : 5.8 mg/L
  - Others*: 15 mg/L
- BOD
  - UBWPAD: 10 mg/L
  - Woonsocket: 30 mg/L
  - Others*: 30 mg/L

Blackstone River Watershed Dissolved Oxygen Allocation for Massachusetts and Rhode Island (1997)

Blackstone River Initiative QUAL2E Model



*Others: Grafton, Northbridge, Uxbridge

Scenario 8

- Design Flow
- Total Phosphorus
  - UBWPAD: 0.75 mg/L
  - Woonsocket: 1 mg/L
  - Others: 1 mg/L
- NH_3
  - UBWPAD: 2 mg/L
  - Woonsocket : 2 mg/L
  - Others: 5 mg/L
- BOD
  - UBWPAD: 10 mg/L
  - Woonsocket: 10 mg/L
  - Others: 20 mg/L

Blackstone River Watershed Dissolved Oxygen Allocation for Massachusetts and Rhode Island (1997)

NPDES Permit Limits – 1999

	Permit Date	Flow (MGD)	BOD (mg/l)	Ammonia (mg/l)	Total Nitrogen (mg/L)	Phosphorus (mg/l)
Upper Blackstone	09/30/99	56	Jun-Oct: 10* Nov-Apr: 25*	Apr-Oct: 2 Dec-Apr: 12	NA	Apr-Oct: 0.75
Grafton	*09/30/99*			*Jun-Oct: 5*** *May: 10***	*NA***	*Summer: 1***
Northbridge	09/13/06***	2	10	May-Oct: 2 Nov-Apr: 9	NA	Apr-Oct: 0.2 Nov-Mar: 1
Uxbridge	*09/30/99*				*NA***	*Summer: 1***
Woonsocket	07/01/00	16	Jun-Oct: 10* Nov-May: 30	Jun-Oct: 2 Nov-Apr: 15 May: 12	Apr-Oct: 10	Apr-Oct: 1

*CBOD

*** Information estimated from monitoring data and/or other permit information as permit was not readily available.*

*** There was also a 09/30/99 permit. It was not readily available. It is assumed based on monitoring data that the 1999 permit had a total phosphorus limit of 1 mg/L.

NPDES Permit Limits – Current

	Permit Date	Flow (MGD)	BOD (mg/l)	Ammonia (mg/l)	Total Nitrogen (mg/L)	Phosphorus (mg/l)
Upper Blackstone	10/01/08	56	*Jun-Oct*: 10* *Nov-April*: 25* May: 20*	*Jun-Oct*: 2 *Nov*: 10 *Dec-Apr*: 12 *May*: 5	*May-Oct: 5*	*Apr-Oct*: 0.1 *Nov-Mar*: 1
Grafton	05/23/13	2.4	Jun-Oct: 20* Nov-May: 30	*Jun-Oct*: 5 *Nov*: 10 *Dec-Apr*: 15 *May*: 10	*May-Oct: 8*	*Apr-Oct*: 0.2 *Nov-Mar*: 1
Northbridge	09/13/06** 09/13/13	2	10	*May-Oct*: 2 *Nov-Apr*: 9	*May-Oct: 8*	*Apr-Oct*: 0.2 *Nov-Mar*: 1
Uxbridge	09/17/13	<1.25	*Jun-Oct*: 20 *Nov-May*: 30	*Jun-Oct*: 5 *Nov*: 10 *Dec-Apr*: 15 *May*: 10	NA	*Apr-Oct: NA* *Nov-Mar*: 1
		2.5			*May-Oct: 8*	*Apr-Oct*: 0.2 *Nov-Mar*: 1
Woonsocket	10/01/08*** 01/01/18	16	*Jun-Oct*: 10* *Nov-May*: 25*	*Jun-Oct*: 2 *Nov-Apr*: 15 *May*: 12	Apr: 10 May-Oct: 3	*Apr-Oct*: 0.1 *Nov-Mar*: 1

*CBOD

** Nutrient limits except total nitrogen have been in effect since the 2006 permit.

***Nutrient limits have been in effect since 2008 permit. BOD/CBOD did change between the 2008 and 2018 permits.

Nutrient-Related Instream Improvements

- Ammonia
- Phosphorus
- Dissolved Oxygen

Blackstone River Initiative Sampling Instream Ammonia

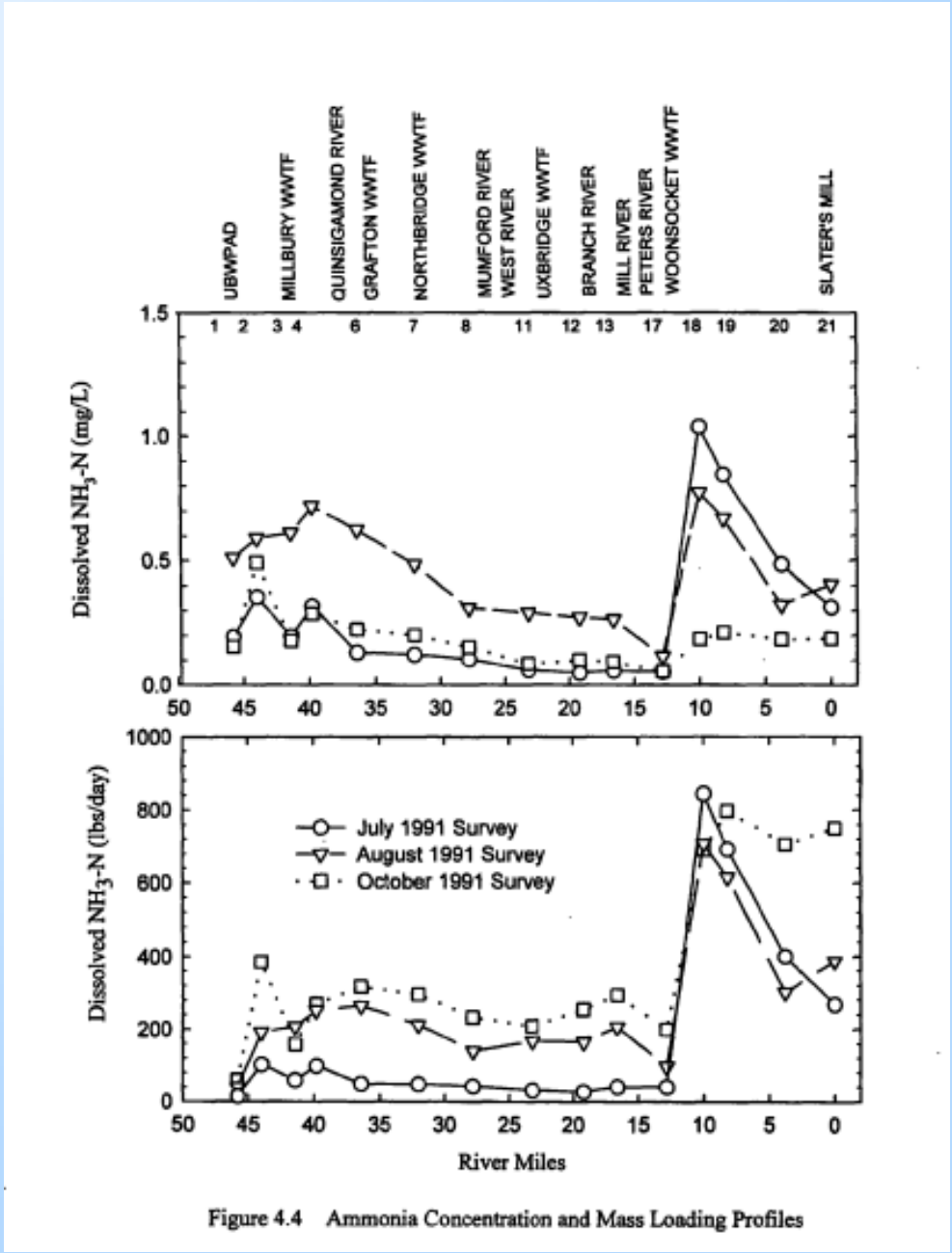
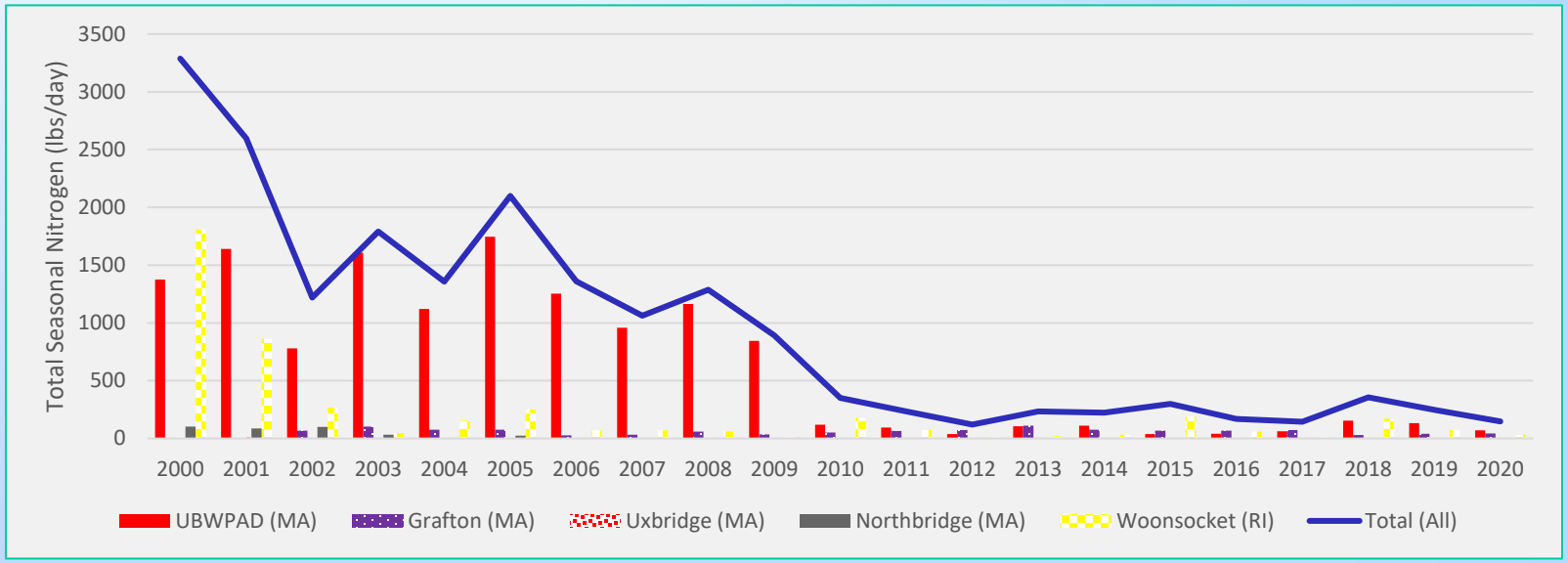


Figure 4.4 Ammonia Concentration and Mass Loading Profiles

Blackstone River Initiative Water Quality Analysis of the Blackstone River Under Wet and Dry Conditions (May 2001)

Seasonal WWTF Ammonia Loads



Seasonal: May through October

Blackstone River (RI) Ammonia

- RI Water Quality Regulations
  - Allowable chronic and acute ammonia criteria decrease as pH increases. Allowable chronic criteria is also temperature dependent with higher temperatures leading to lower allowable ammonia levels.
- RIDEM delisted the Blackstone River for Ammonia in 2008. Instream data collected as part of the RIDEM Blackstone TMDL field investigations in 2005 and 2006 showed that the river met the ammonia criteria.

Blackstone River Initiative Sampling Instream Orthophosphate

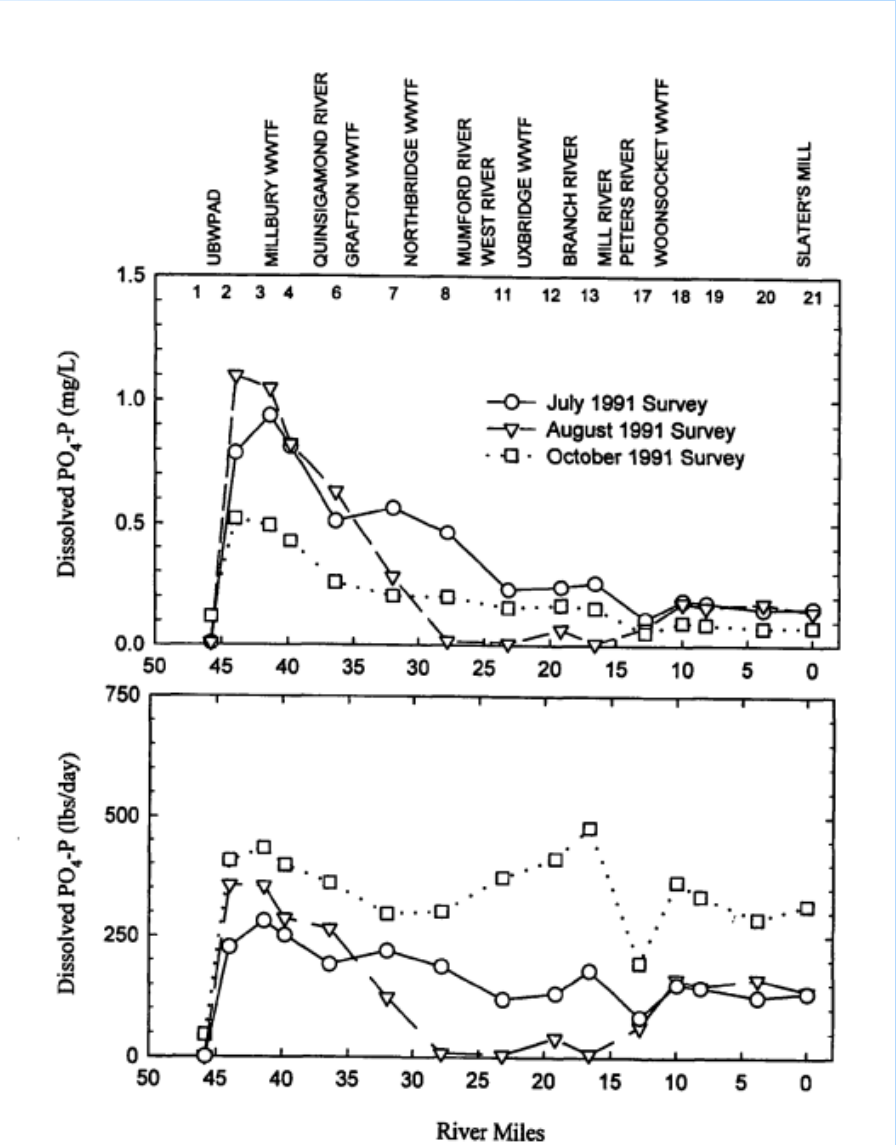
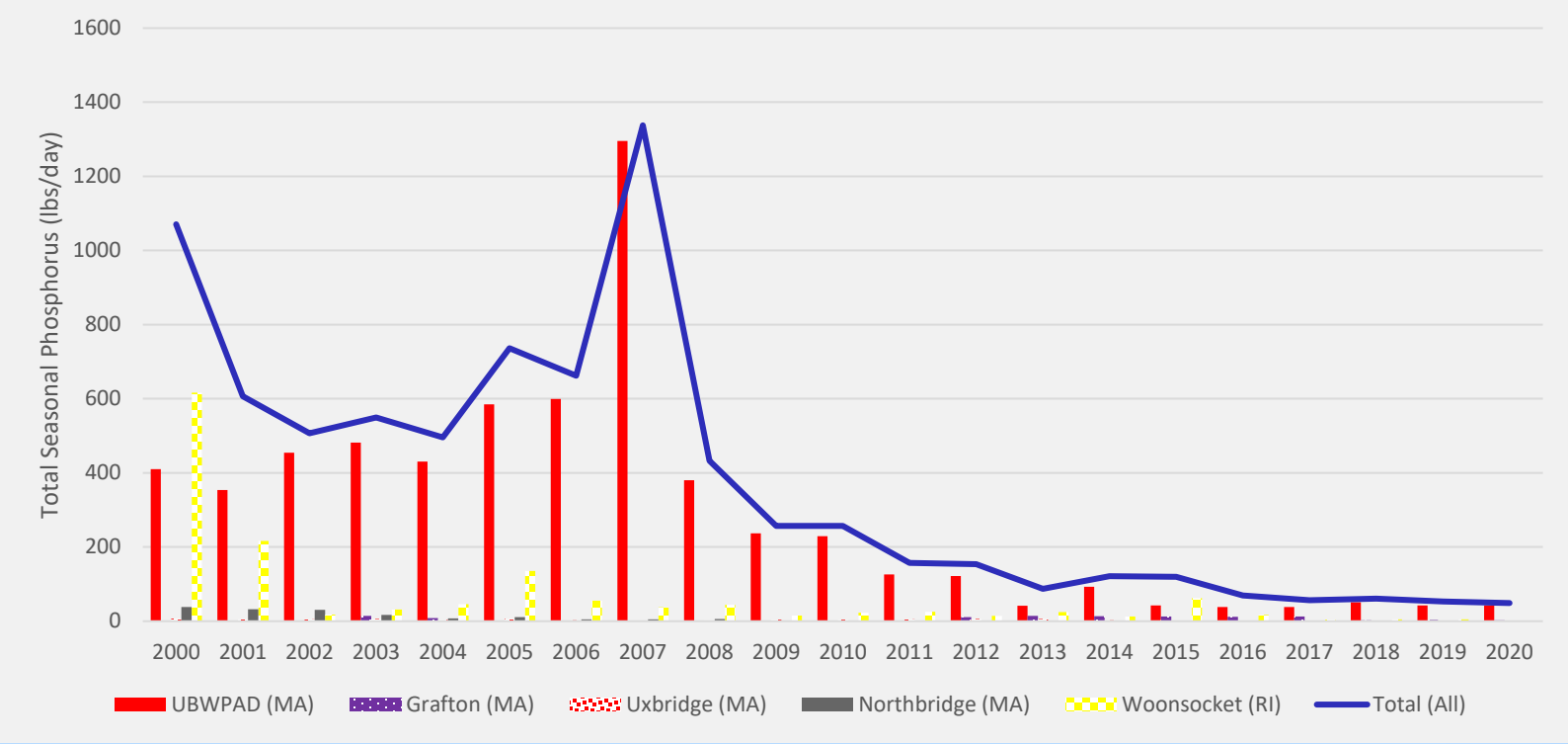


Figure 4.10 Orthophosphate as P Concentration and Mass Loading Profiles

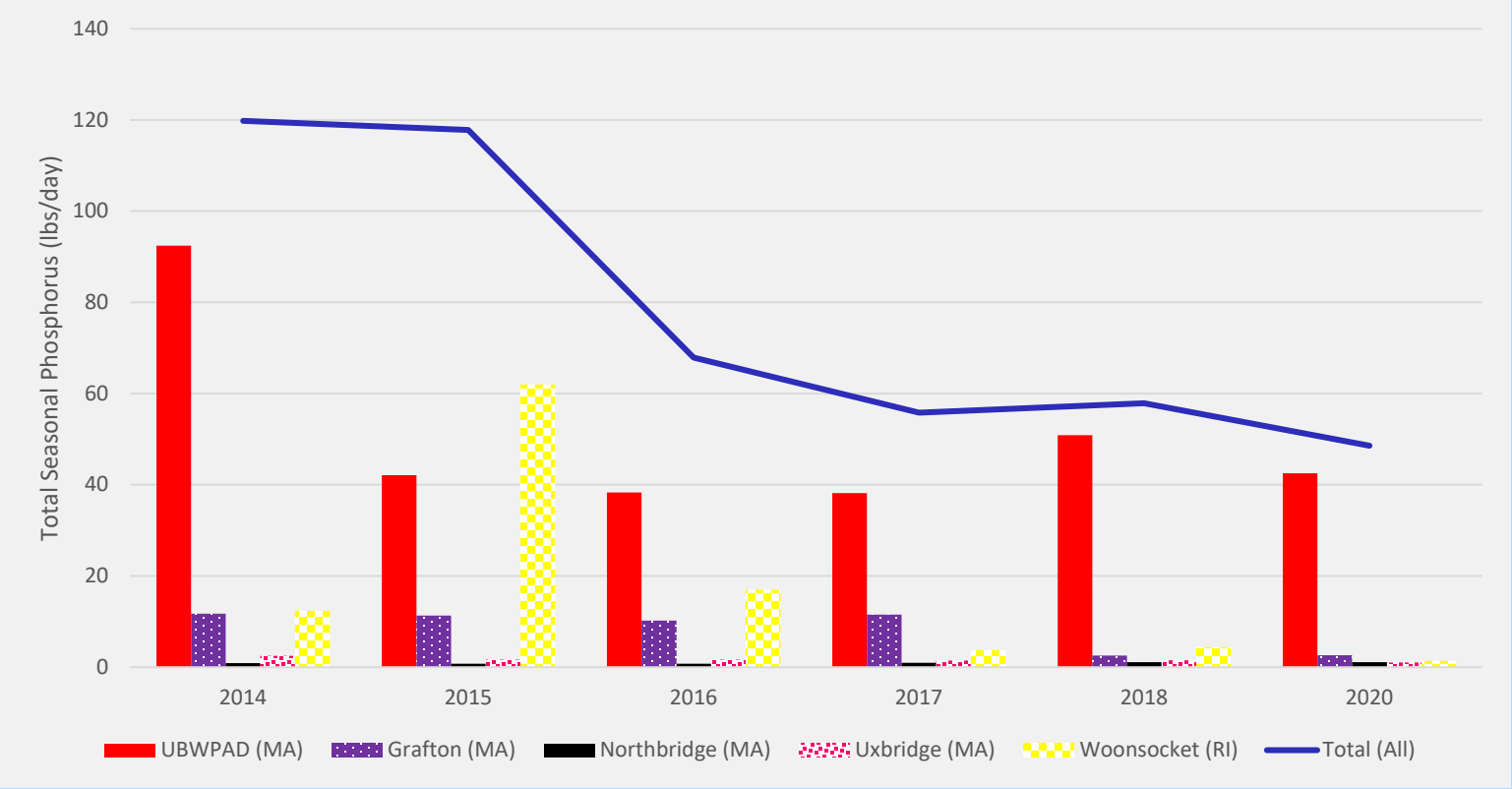
Blackstone River Initiative Water Quality Analysis of the Blackstone River Under Wet and Dry Conditions (May 2001)

Seasonal Total Phosphorus Load



Seasonal: May through October

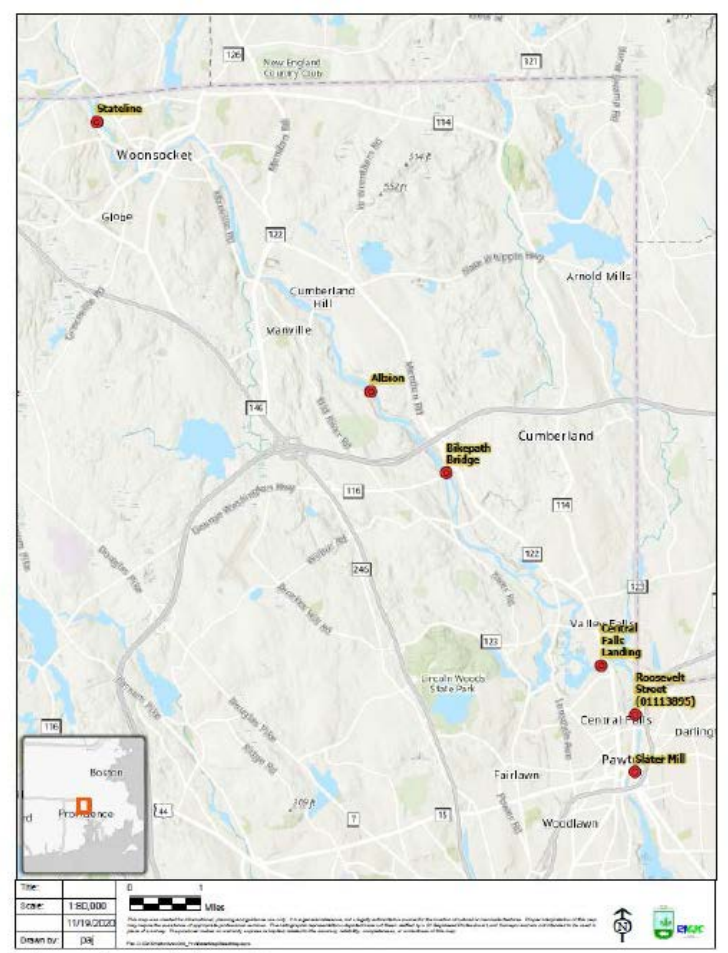
Seasonal Total Phosphorus Load



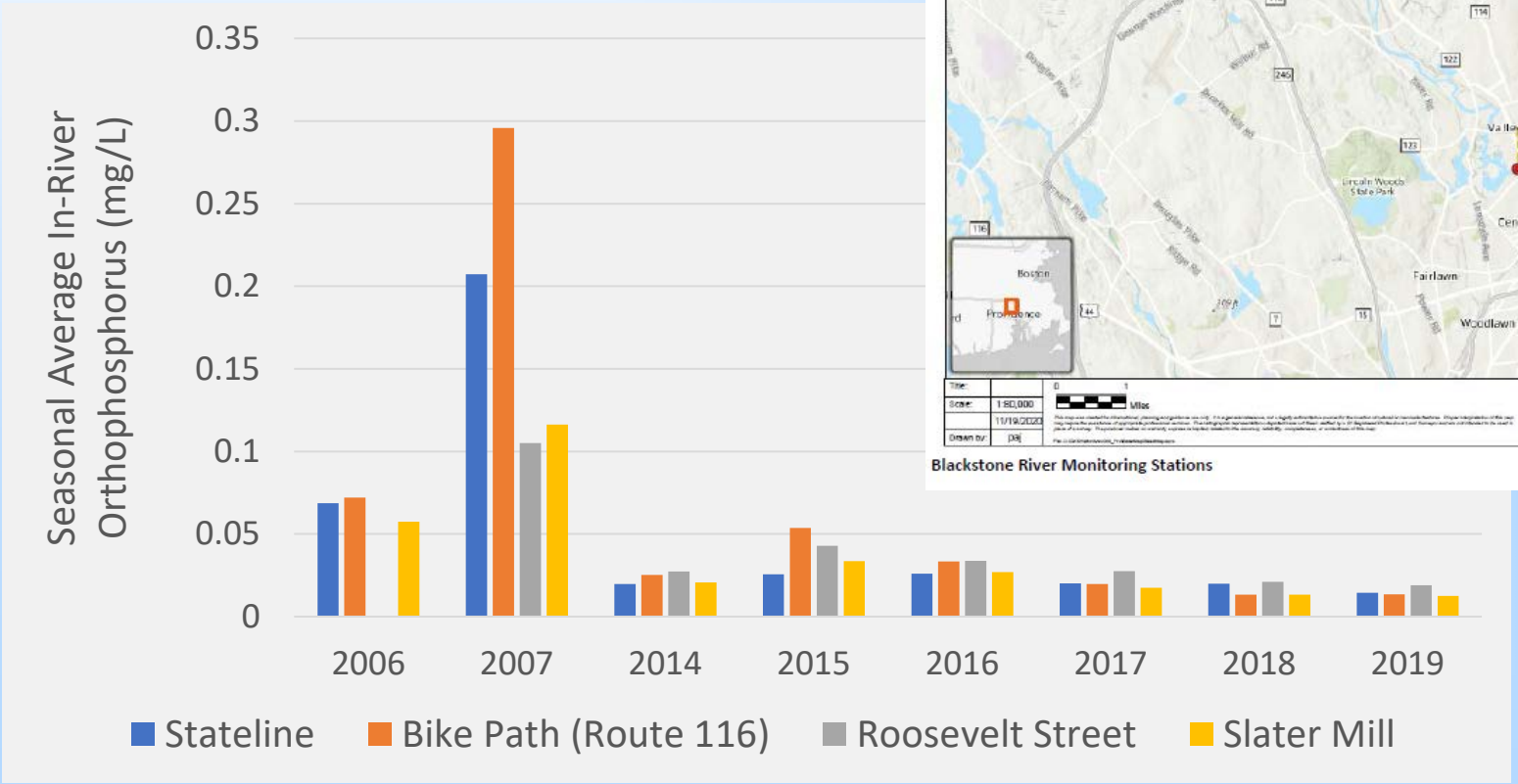
Blackstone River (RI) Phosphorus

- RI Water Quality Regulations do not contain a numeric phosphorus criterion for rivers.
- EPA Quality Criteria for Water (1986) recommends 100 µg/L (0.1 mg/L) for total phosphorus for flowing streams.
- European Union countries use ortho-phosphorus criteria.
  - United Kingdom recommends lowering their criteria to 40 or 69 µg/L (0.04 or 0.069 mg/L) depending on alkalinity from 50 or 120 µg/L (0.05 or 0.12 mg/L).
  - Ireland uses an annual average of 35 µg/L (0.035 mg/L) or a 95th percentile of 75 µg/L (0.075 mg/L) for good waters.
- RIDEM delisted the Blackstone River for total phosphorus in 2018/2020.

In-River Phosphorus Trends

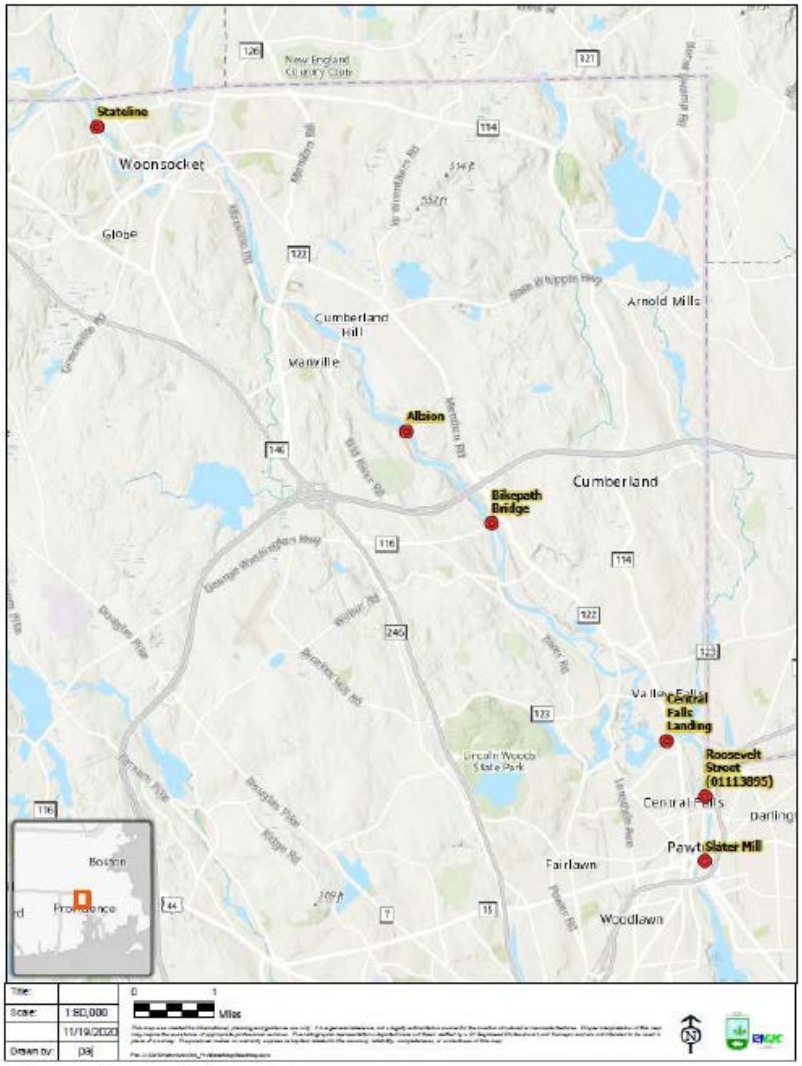


Blackstone River Monitoring Stations



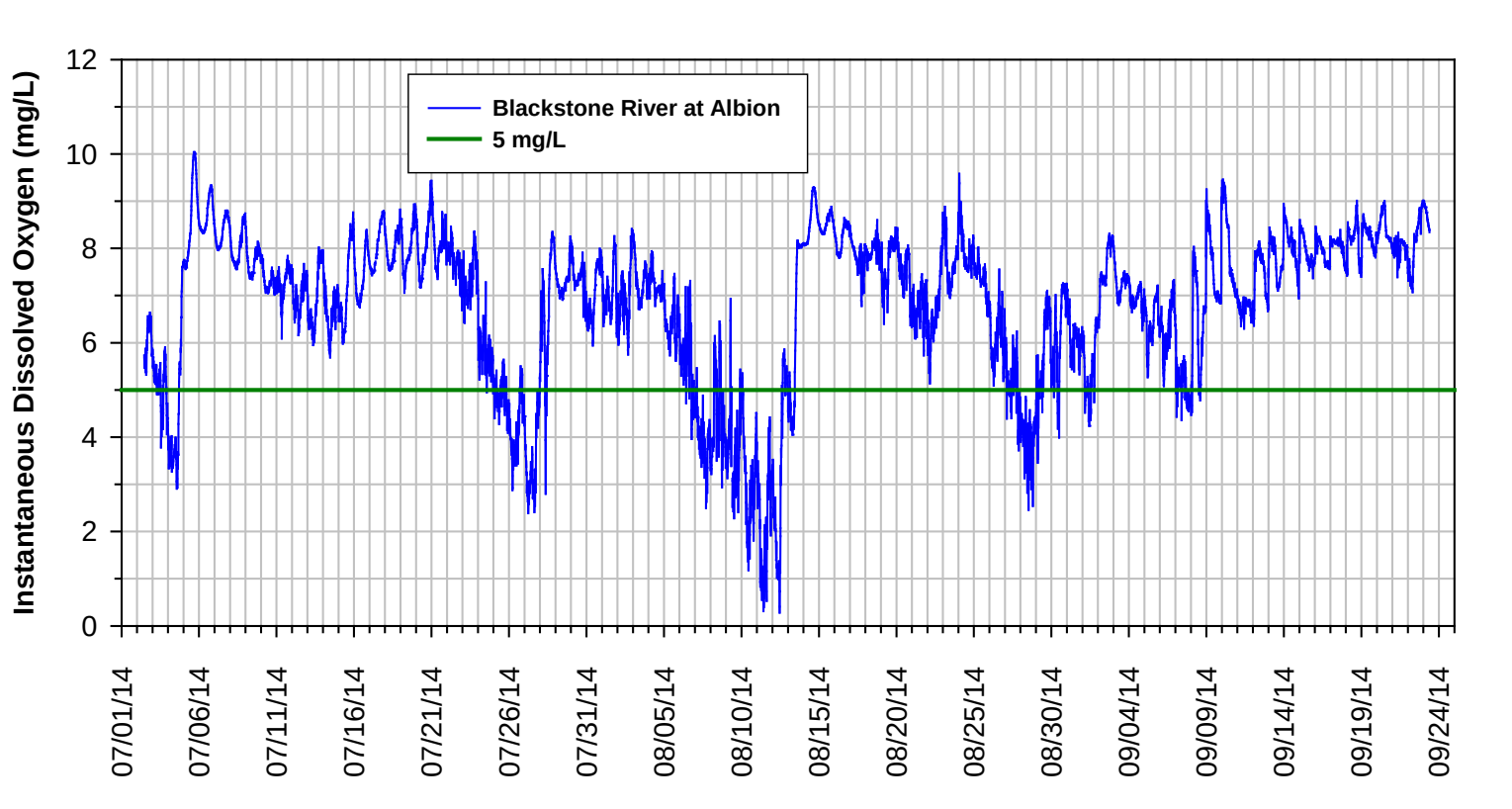
Stations are listed upstream to downstream.

Dissolved Oxygen

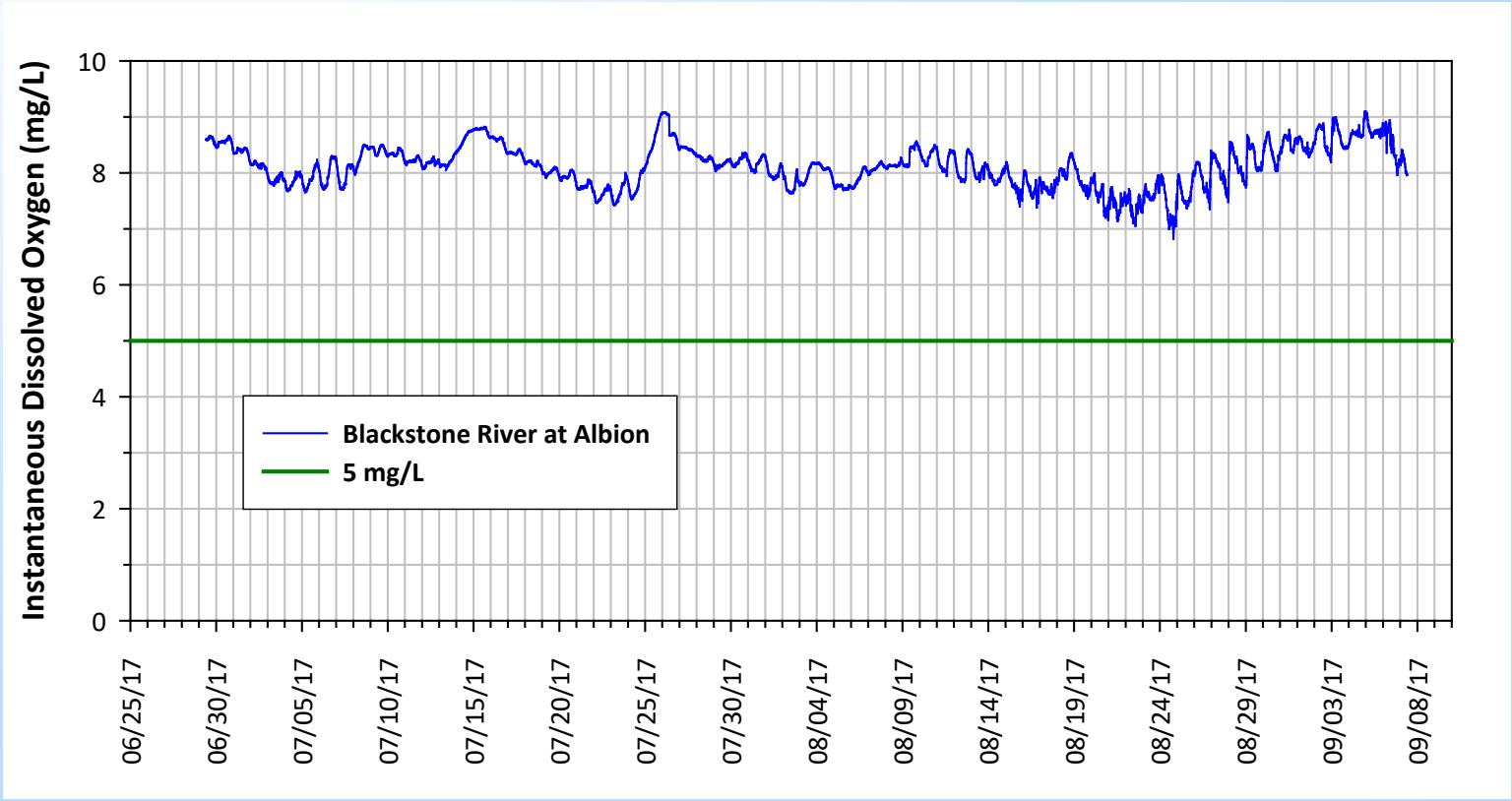


Blackstone River Monitoring Stations

2014 Continuous Dissolved Oxygen at Albion Dam



2017 Continuous Dissolved Oxygen at Albion Dam



Blackstone River (RI)
Dissolved Oxygen

- Rhode Island Water Quality Regulations for Warm Water Fish Habitat
  - Dissolved oxygen content of not less than 60% saturation, based on a daily average, and an instantaneous minimum dissolved oxygen concentration of at least 5.0 mg/l, except as naturally occurs. The 7 day mean water column dissolved oxygen concentration shall not be less than 6 mg/l.
- RIDEM delisted the Blackstone River for dissolved oxygen in 2018/2020.

Challenges Remain

- 303(d) Listings – RI Waters

	Use	Impairments
Blackstone River (RI0001003R-01A)	Fish and Wildlife Habitat	Cadmium, Iron, Lead, Non-Native Aquatic Plants
	Fish Consumption	Mercury in Fish Tissue, PCBs in Fish Tissue
	Primary Contact Recreation	Enterococci, Fecal Coliform
	Secondary Contact Recreation	Enterococci, Fecal Coliform
Blackstone River (RI0001003R-01B)	Fish and Wildlife Habitat	Cadmium, Iron, Lead
	Fish Consumption	Mercury in Fish Tissue, PCBs in Fish Tissue
	Primary Contact Recreation	Enterococci, Fecal Coliform
	Secondary Contact Recreation	Enterococci, Fecal Coliform

- Non-Point Sources and Stormwater

Blackstone Watershed Collaborative

- An umbrella organization encompassing existing partners including watershed associations, land trusts, universities, federal/state/local agencies, and others that have been working tirelessly on the ground in our watershed.
- Partners
  - Colleges and Universities (6)
  - State and Federal Agencies (11)
  - Organizations (41)

Blackstone Watershed Collaborative

Zap the Blackstone

- On September 9, 1972, 10,000 volunteers and numerous organizations spearheaded by the Providence Journal came together to clean the Blackstone River.
- Operation Zap: Blackstone River Clean-Up 1972
  - Original Film (20 Minutes): https://www.youtube.com/watch?v=dpYtjdfAYro
- Blackstone River Before and After
  - 2021 Update (1.5 Minutes): https://www.youtube.com/watch?v=HIhG-NIzN80

Selected Sources

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Wright, Raymond M. Ph.D., P.E., Peter M. Nolan, David Pincumbe, and Elaine Hartman. February 1998. *Blackstone River Initiative: Water Quality Analysis of the Blackstone River Under Wet and Dry Weather Conditions.* Final Report Submitted to the U.S. EPA.