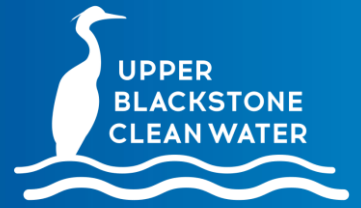
The Proof is in the River: The Upper Blackstone Long-Term Water Quality Monitoring Program

Zach Eichenwald, PE (1)
Marie-Francoise Hatte (2)
Tim Loftus (3) and Karla Sangrey, PE (3)

January 25, 2023



CDM Smith

2023 Annual Conference & Exhibit
January 22-25 | Boston

1: CDM Smith
2: UMass Amherst
3: Upper Blackstone Clean Water

Overview

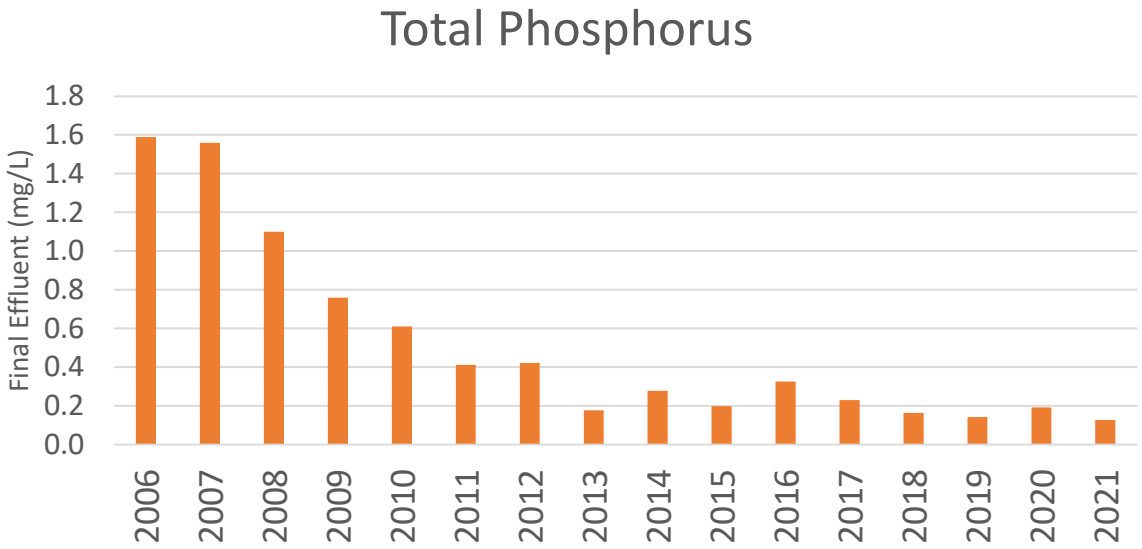
- Background
- Upper Blackstone Wastewater Treatment Facility
- Implementation of Upper Blackstone's river monitoring program
- Key findings
- Public engagement and data sharing
- Data use and future directions

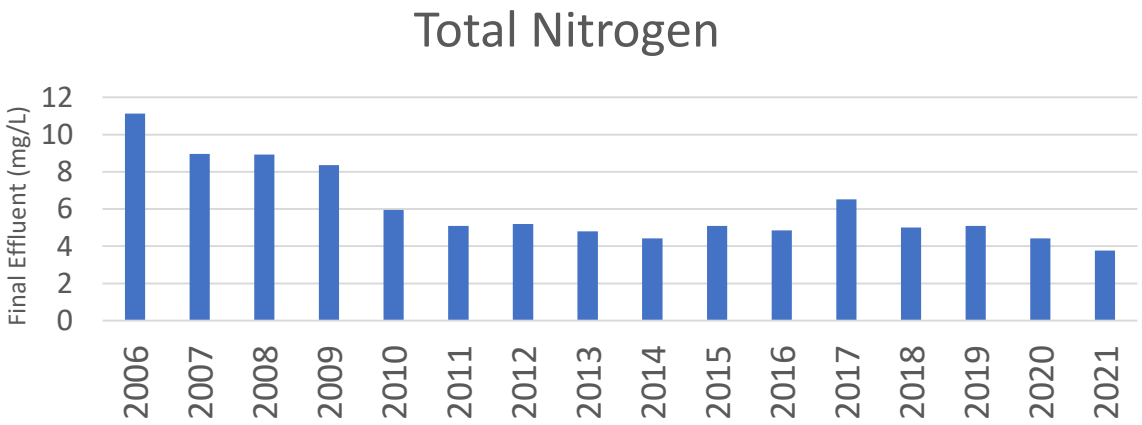
Blackstone River

- 475 square mile watershed in Massachusetts and Rhode Island
- River is 45 miles long with 17 dams
- Historical use has included textile mills (1st water powered textile mill in US - Slater Mill in RI)
- Headwaters include several point sources:
  - Primary POTW is Upper Blackstone Clean Water
  - Other point sources include Worcester's CSO treatment facility and other municipal POTWs

Upper Blackstone Clean Water

- 56 mgd advanced WWTP serving 250,000 people in central Massachusetts
- Completed a $180M upgrade in 2009 to meet stringent N and P limits
- Plant optimization in 2012 and 2017
- Significant load reduction post-upgrade:
  - Over 90% reduction in TP
  - Over 60% reduction in TN



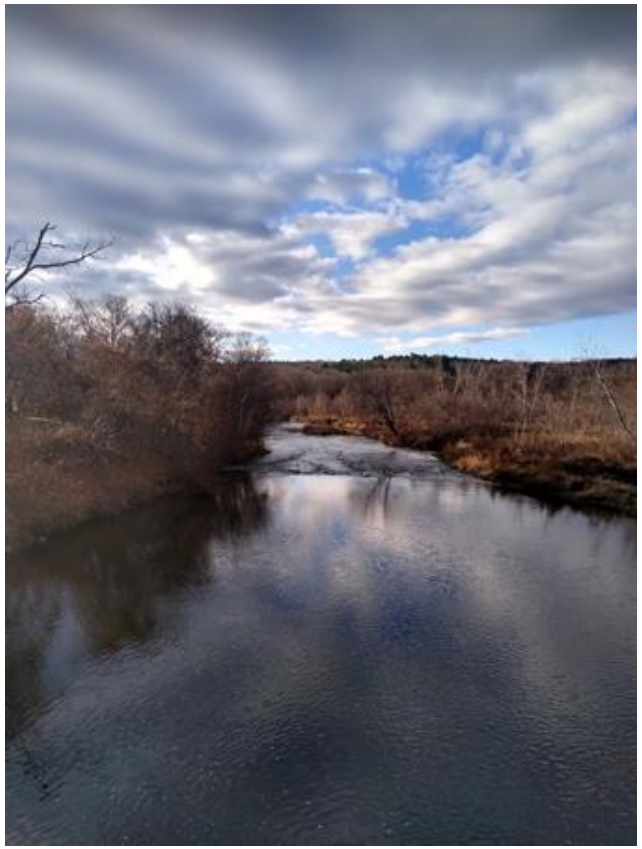


Blackstone River Study

- Voluntary program initiated by Upper Blackstone to track and evaluate river conditions following WWTP upgrade and plant optimization
- Program has consisted of:
  - Routine nutrient and chlorophyll-a monitoring at 9 river locations in MA and RI
  - Periphyton and macroinvertebrate sampling at 4 locations (select years)
  - Continuous DO monitoring at 4 locations (2017 -)
  - Time of travel study (in collaboration with USGS)
- Developed and calibrated water quality model (HSPF)

Blackstone River Monitoring Program Goals

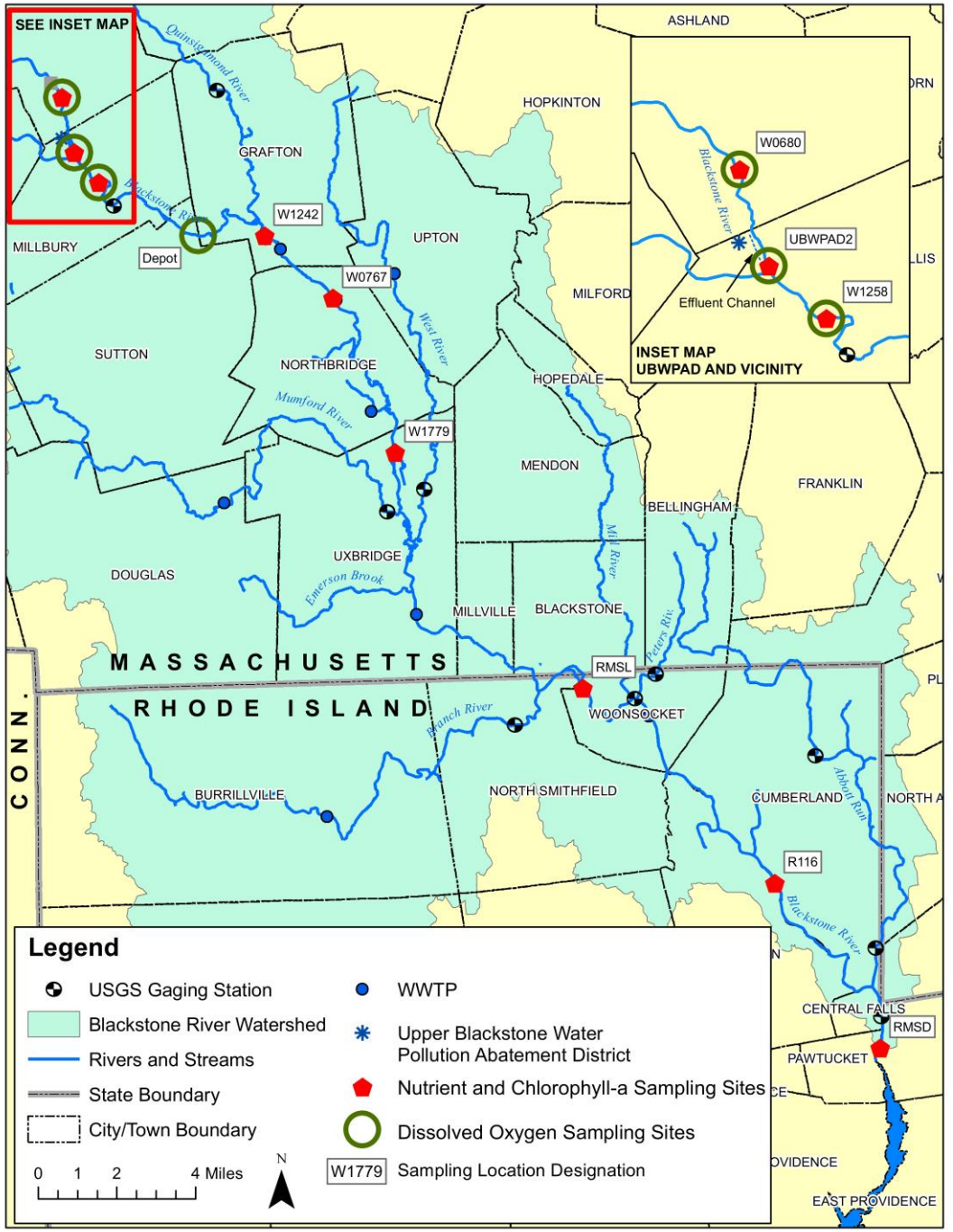
- River Sampling
  - Monitor and evaluate changes in river quality following WWTP upgrade and optimization
  - Conducted under MassDEP approved QAPP
- Facilitate continued engagement with MassDEP and other stakeholders
- Facilitate MassDEP's use of monitoring program data in watershed/water quality assessments for Massachusetts Integrated List of Waters



W1242, Looking Downstream (Grafton)

Monitoring Program Components

- River Sampling (UMass and Upper Blackstone)
  - Monthly nutrient and chlorophyll-a sampling at 9 locations, Apr - Nov
  - Periphyton and benthic macroinvertebrate samples (in select years)
- Continuous DO/T metering
  - Collaborated with MassDEP (2017)
  - Upper Blackstone purchased and deployed 4 meters (2019 – present)
- Report and data submitted to MassDEP for use in bi-annual Integrated Report assessment

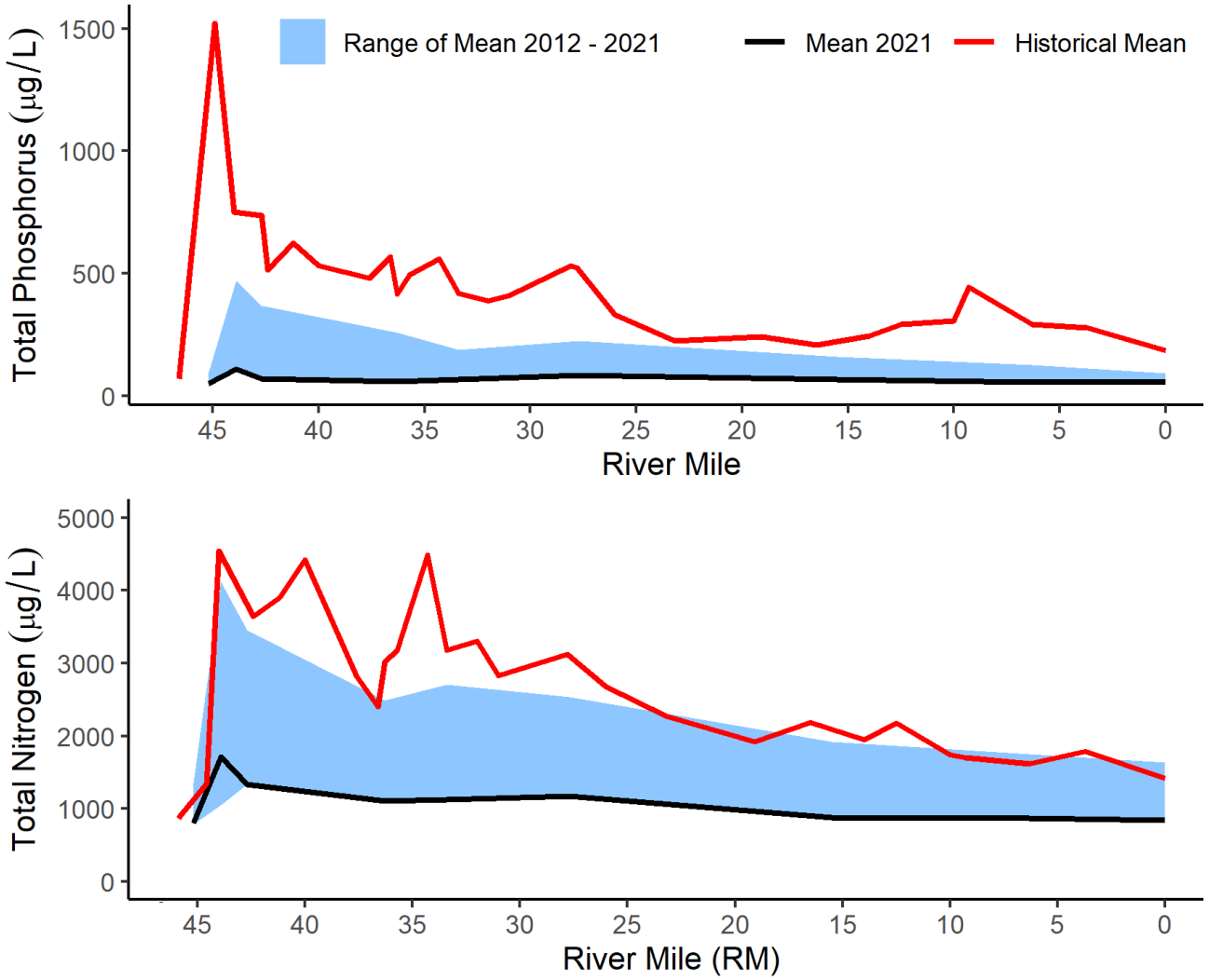


Continuous DO Monitoring

- Upper Blackstone operates 4 Onset HOBO continuous DO meters
  - Low cost and easy to deploy
- Data are adjusted for sensor drift and fouling using USGS procedures
- Staff visit each meter at least every 2 weeks
  - Measure temperature and DO before and after servicing for drift adjustment
  - Clean sensor and check calibration

Program Findings

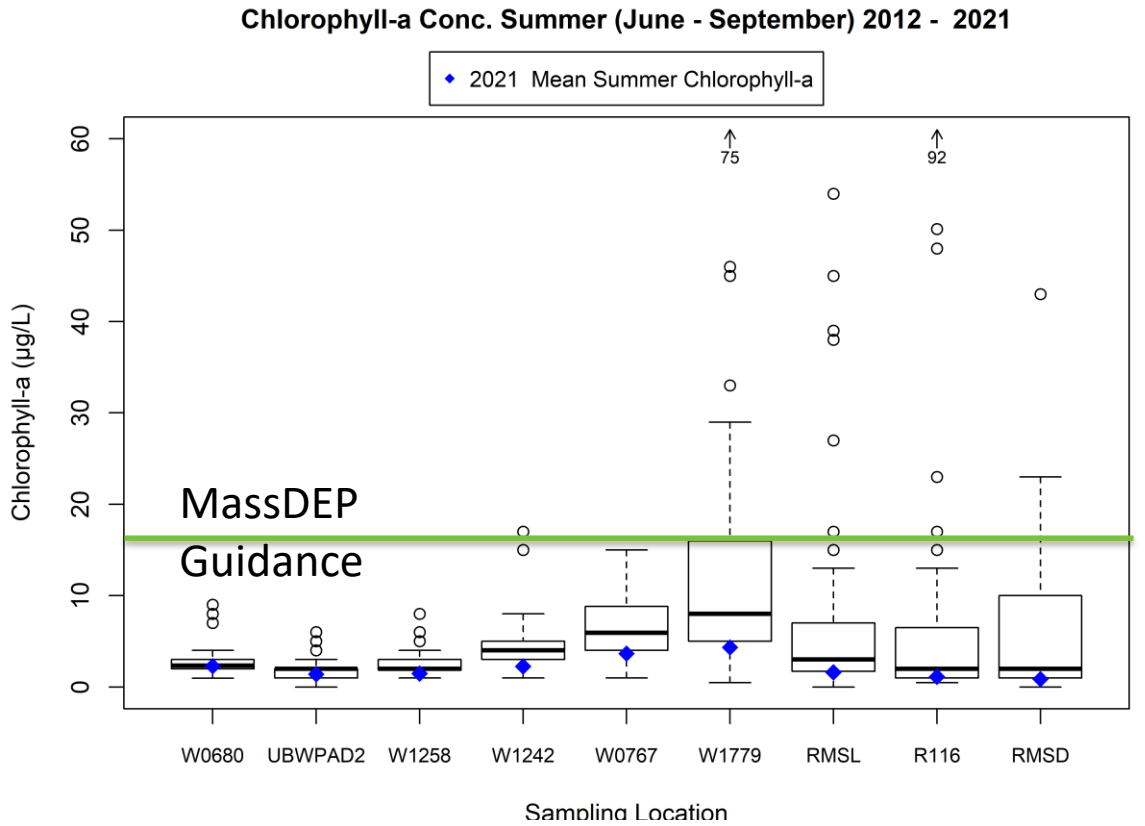
Findings: Reduced Nutrient Concentrations

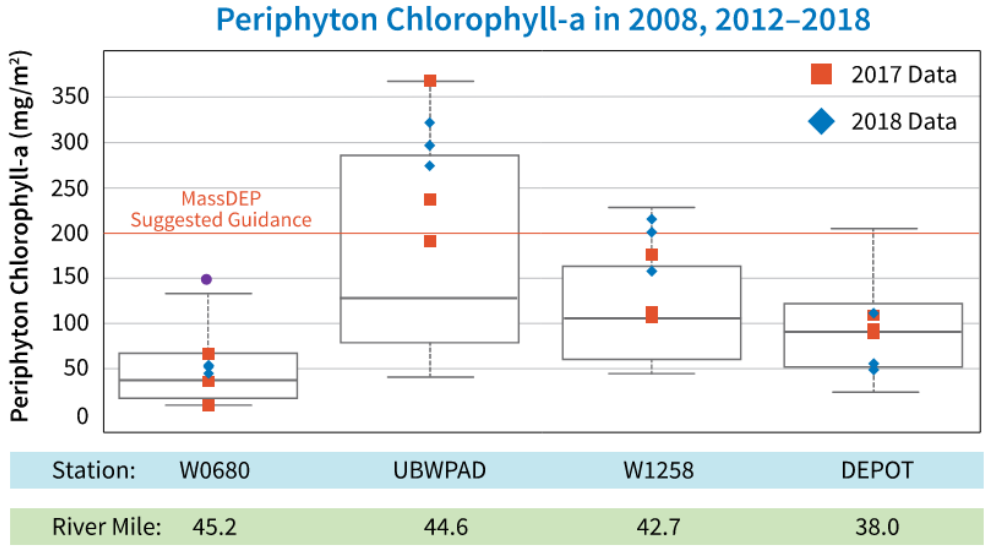


CDM Smith

Findings: Reduced Phytoplankton and Periphyton

- Mean chlorophyll-a is generally below MassDEP's 16 µg/L guidance value
  - Occasional high measurements at Rice City Pond impoundment (W1779) and RI sites
- Periphyton generally below 200 mg/L guidance value
  - Occasional exceedances at UBWPAD downstream of outfall





Findings: Dissolved Oxygen

Rhode Island

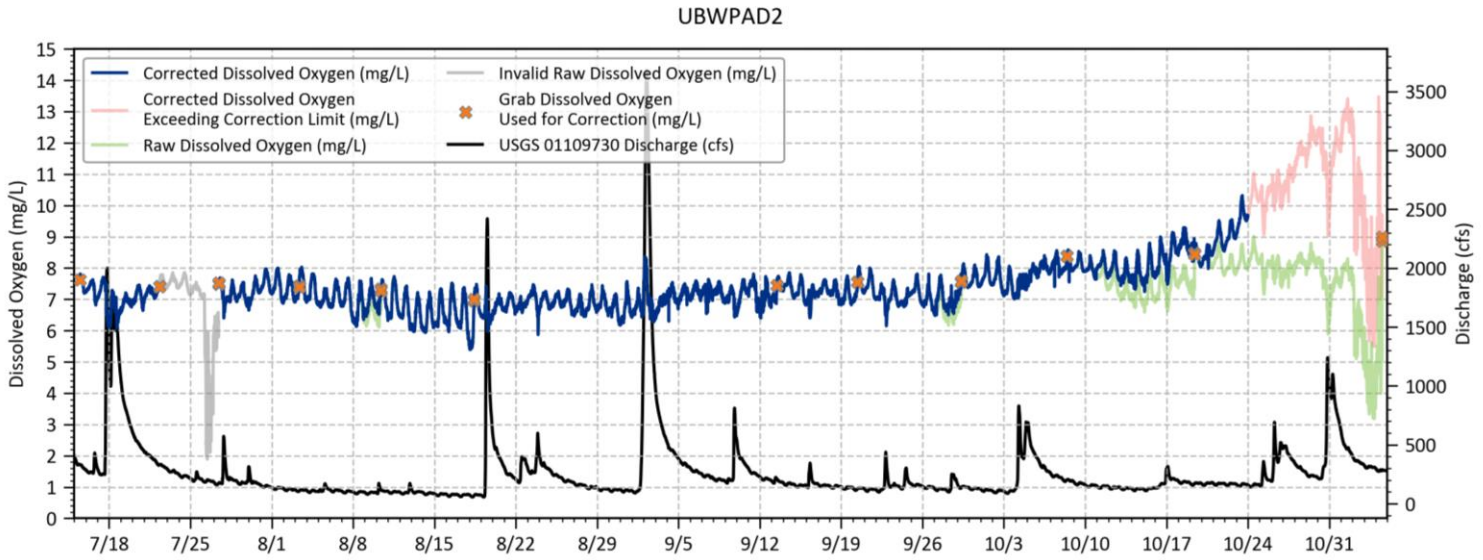
- RIDEM delisted DO impairment in 2020

Massachusetts

- Compliance with WQS over 90% of the time
- Generally meets CALM guidance for aquatic life use

Upper Blackstone DO Statistics, 2021

Metric	Rt 20 Overpass	UBWPAD2	W1258
Days of corrected data	82	95	89
Days where diel ΔDO < 3.0 mg/L	82	95	78
% of days where diel ΔDO < 3.0 mg/L	100	100	88
% of the time DO > 5.0 mg/L	100	100	90
Days where % Saturation > 125%	0	0	0



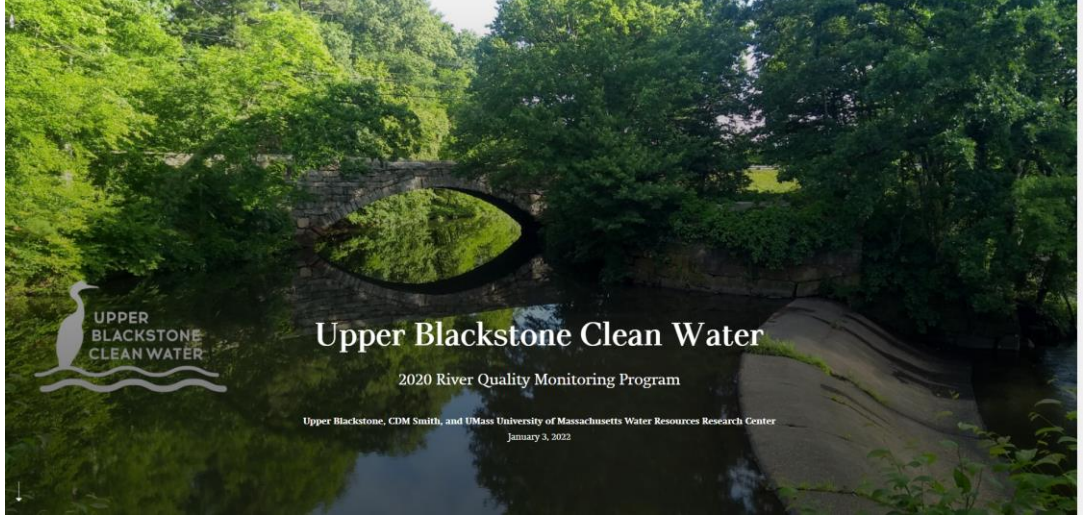
Data Use and Future Directions

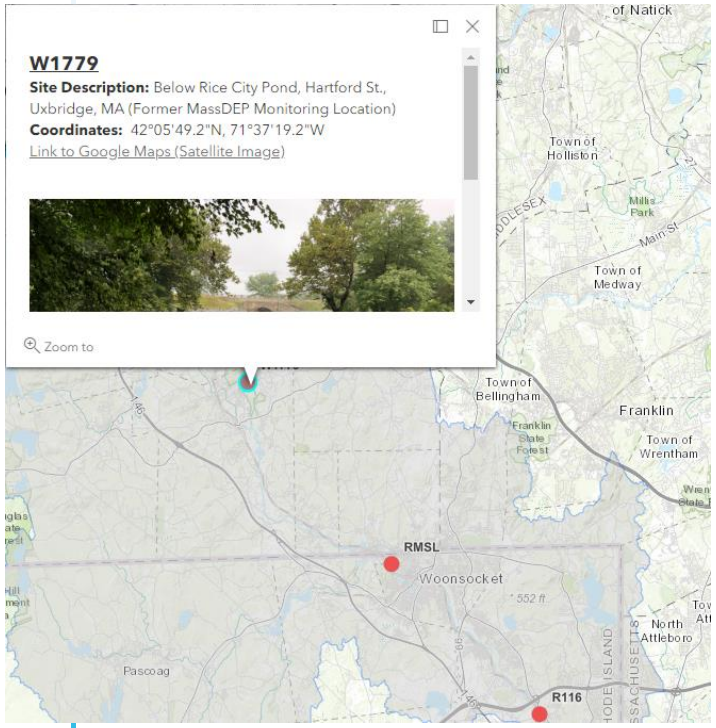
How have the data been used?

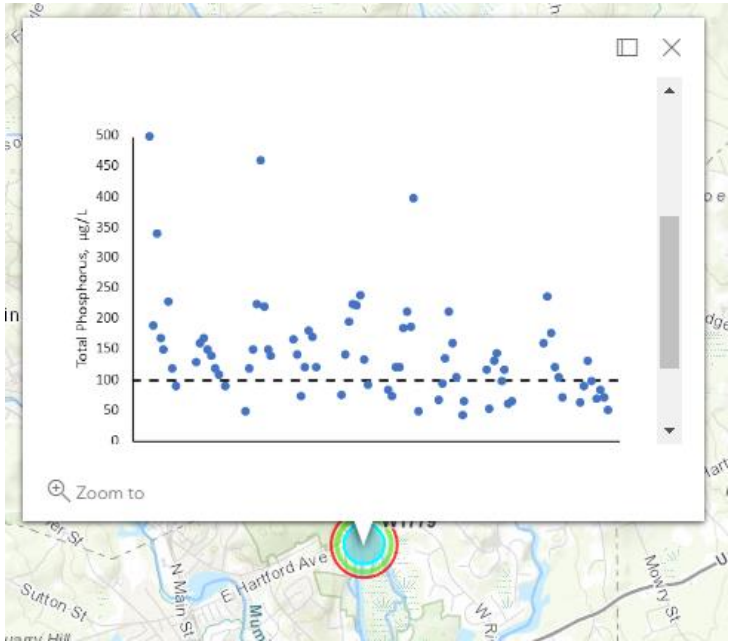
- Upper Blackstone meets annually with MassDEP staff
  - Discuss key findings
  - Plan future monitoring
- MassDEP uses data for its biannual 303(d) assessment
- Upper Blackstone, UMass, and CDM Smith evaluate improvements in water quality
- Data are shared on the USGS Water Quality Portal, annual reports, and Upper Blackstone's website

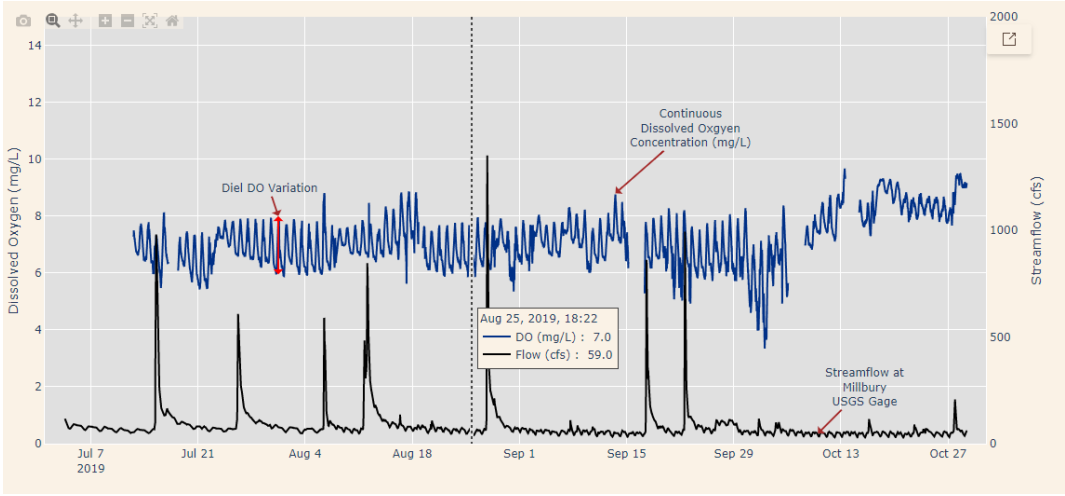
Public Engagement: StoryMap

- Annual monitoring summary website using ESRI's StoryMap format
- Accessible on Upper Blackstone website









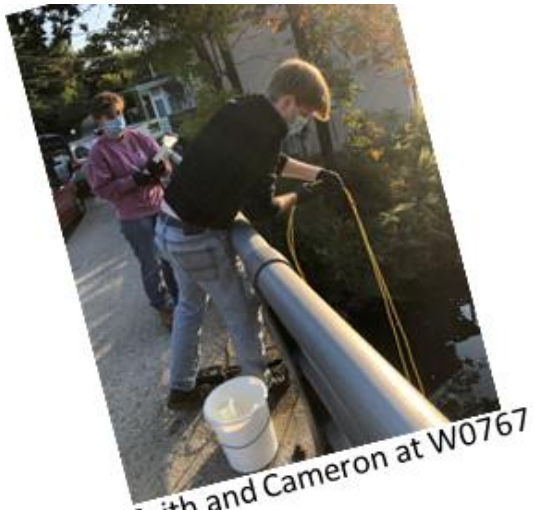
https://www.ubcleanwater.org/blackstone-river

Why collect a long-term dataset?

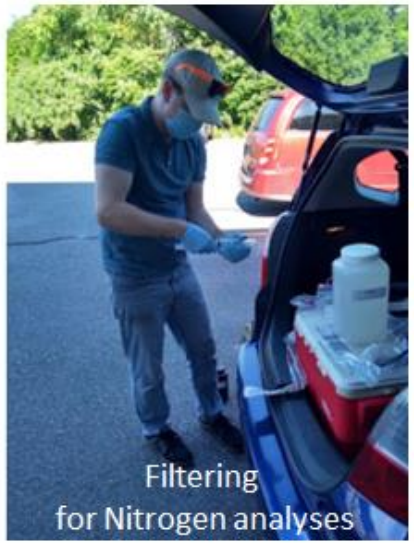
- Interannual variability in hydrology, precipitation, and temperature cause significant variability in nutrient loads and algae levels
  - 1 year of monitoring may not capture the full variability
  - Impacts of climate change may cause shifts in WQ
- Provide a baseline to assess future plant optimization efforts
- Develop an improved understanding of the relationship between nutrients (phosphorus and nitrogen) and the river response (dissolved oxygen and algae)
  - Numeric criteria do not exist (yet) for nutrients
  - MassDEP assesses water quality using the response of DO and chlorophyll-a to nutrient levels
- Improved understanding of the science can be used to:
  - Determine if current water-quality based effluent limits are sufficient
  - Whether more stringent WQBELs may be required in the future

Future Directions

- Upper Blackstone to continue monthly and continuous monitoring program
- Continue collaboration with MassDEP to collect data suitable for its bi-annual assessment program


Faith and Cameron at W0767


RMSL in September


Filtering
for Nitrogen analyses


November at UBWPAD2

Connect With Us!

Find more insights through our water partnership at cdmsmith.com/water and @CDMSmith

Water Partnership with CDM Smith

UPPER BLACKSTONE CLEAN WATER

Zach Eichenwald
CDM Smith
617-452-6000
eichenwaldZT@CDMSmith.com

Karla Sangrey and Tim Loftus
Upper Blackstone Clean Water
508-755-1286
KSangrey@UBCleanWater.org
TLoftus@UBCleanWater.org