Lowell Water Clean Stream Initiative for the Merrimack River

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NEWEA 2018, Session 31

January 24, 2018

Agenda

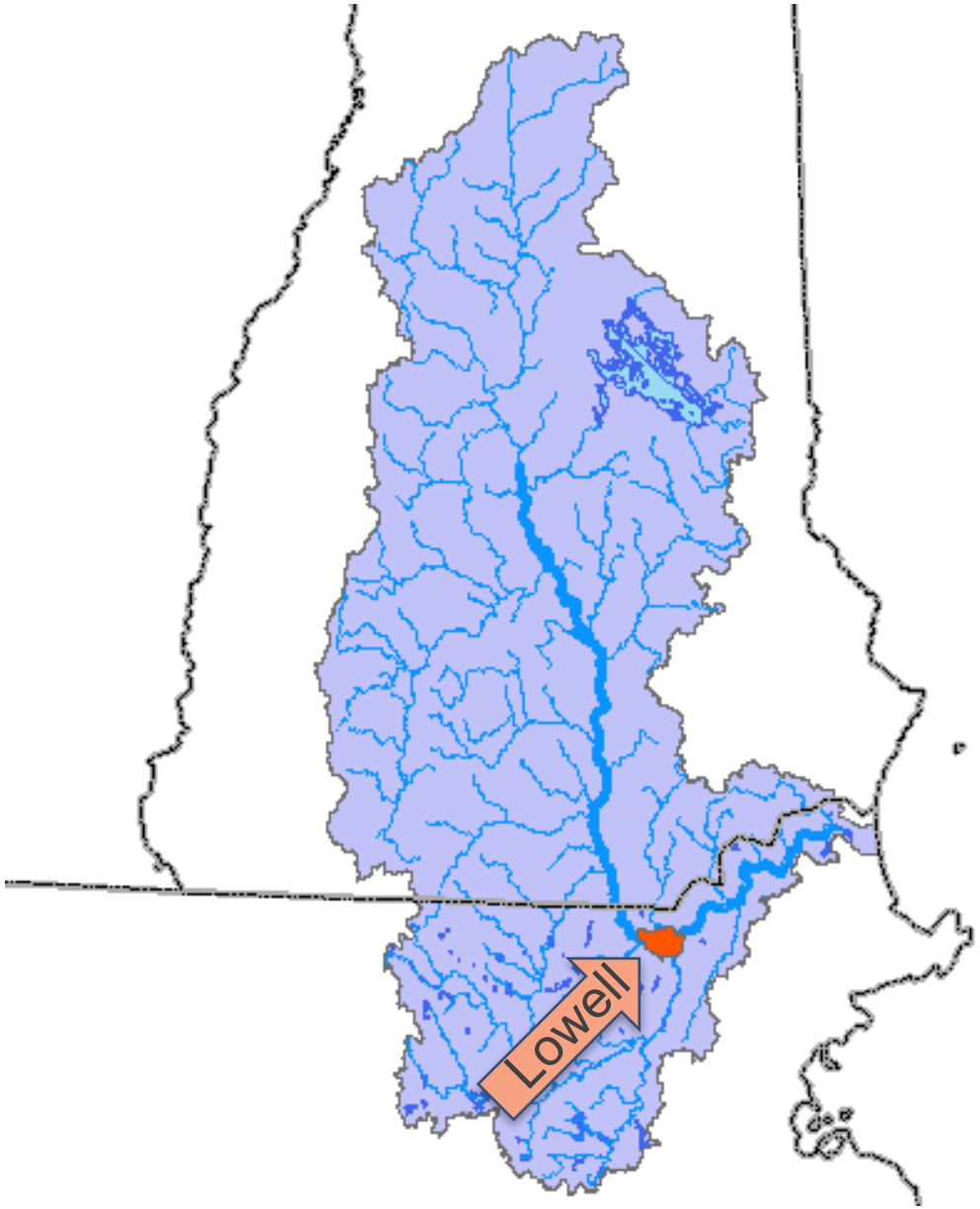
- Background and History
- Program Objectives
- Program Methods
- Water Quality Modeling
- Collaboration Partners
- Next Steps

Background

Where is the Merrimack River?

White Mountains and Lake Winnipesaukee drain to the Merrimack River in New Hampshire

Sudbury, Assabet, Concord Rivers (SuAsCo), Nashua River, Shawsheen River drain to the Merrimack in Massachusetts



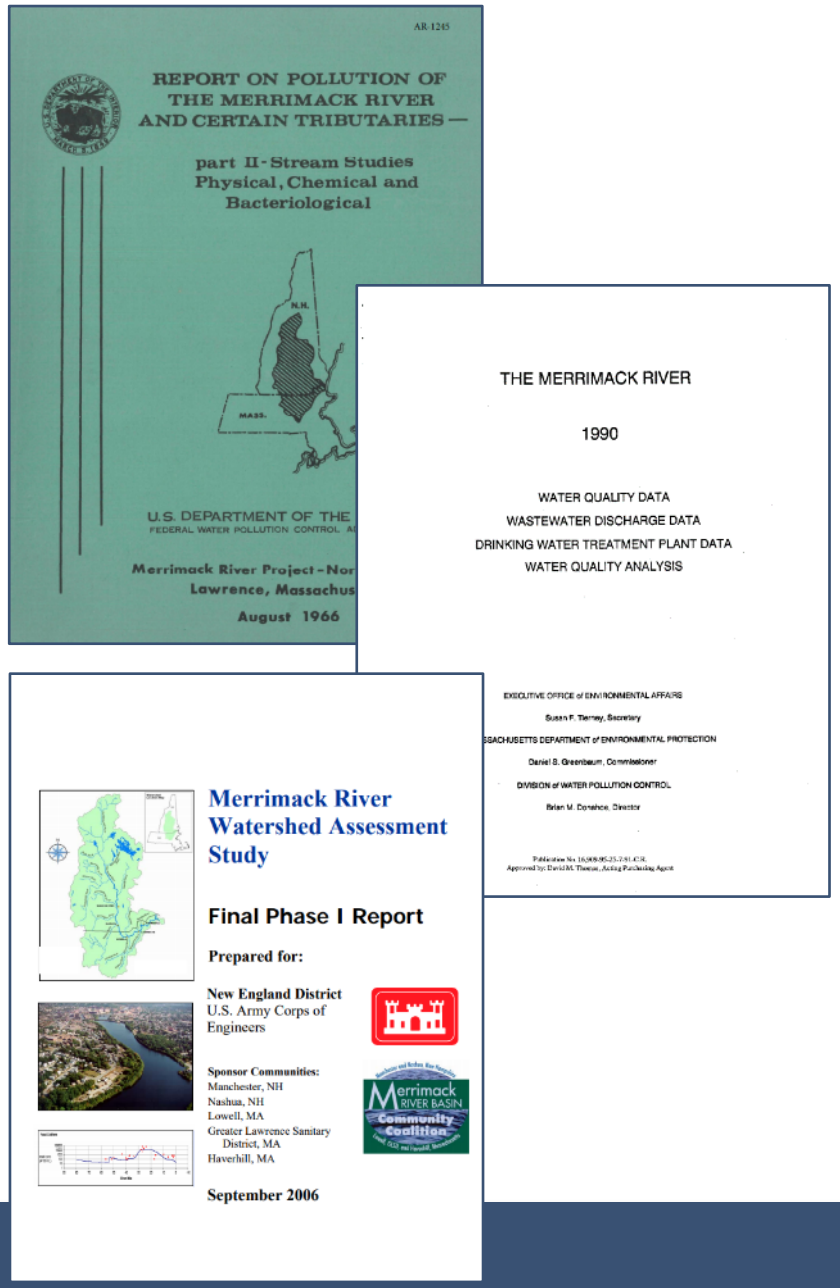
Background

Pollutant Sources in Watershed

- Wastewater Treatment Plant Loads
  - 47 NPDES Permits in Watershed
  - 0.1 - 52 MGD Design Flow
  - 0.1 - 120 MGD Wet-Weather Flow
- Combined Sewer Overflow Loads
  - 5 Dense Urban Centers Built in 1800s Or Earlier
- Urban, Suburban, Agricultural Runoff (NPS)
  - 20% of Watershed Receives Runoff From Municipal Separate Storm Sewer Systems (MS4)
- Natural and Atmospheric Loads
  - Wildlife, surficial geology, atmospheric deposition

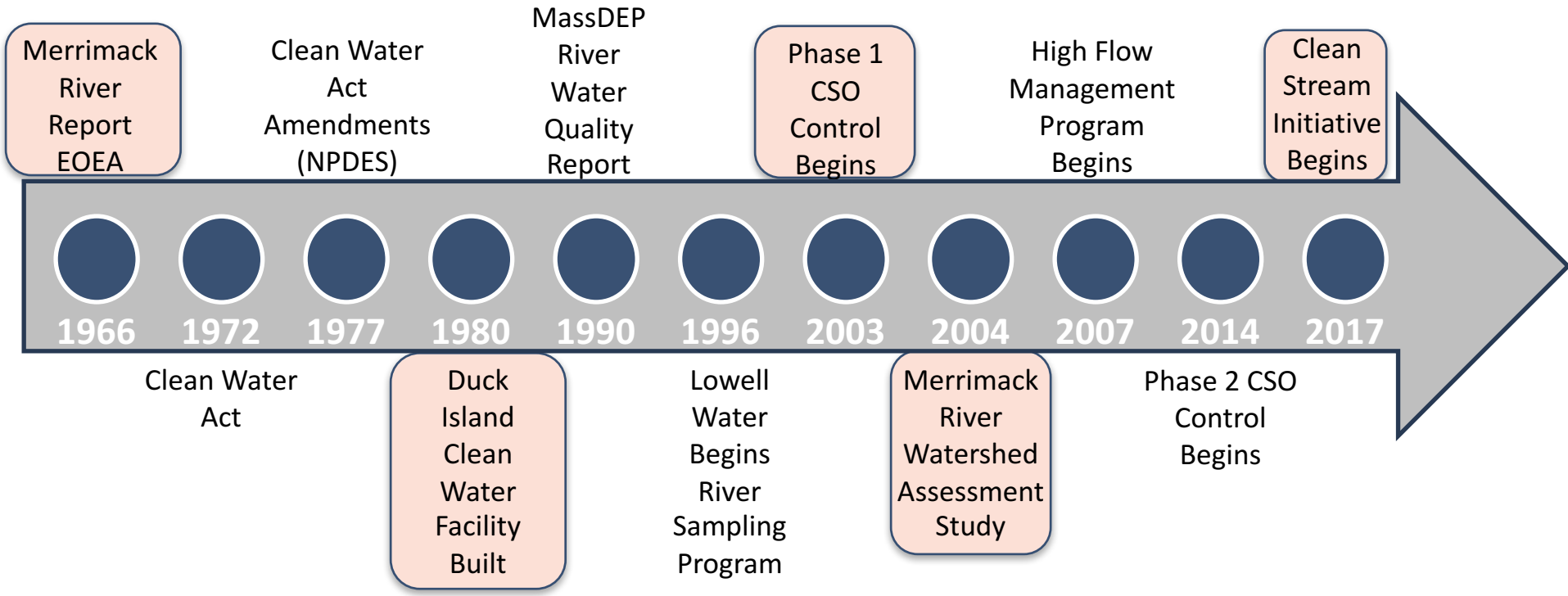
Background

- Limited amount of existing data from previous or ongoing studies
- Lowell Water is a steward of the Merrimack River
  - 20+ year river-sampling program
  - Goal to generate assessment-quality data within Lowell study area for nutrients, bacteria, and metals



Background

Timeline of Historic Events



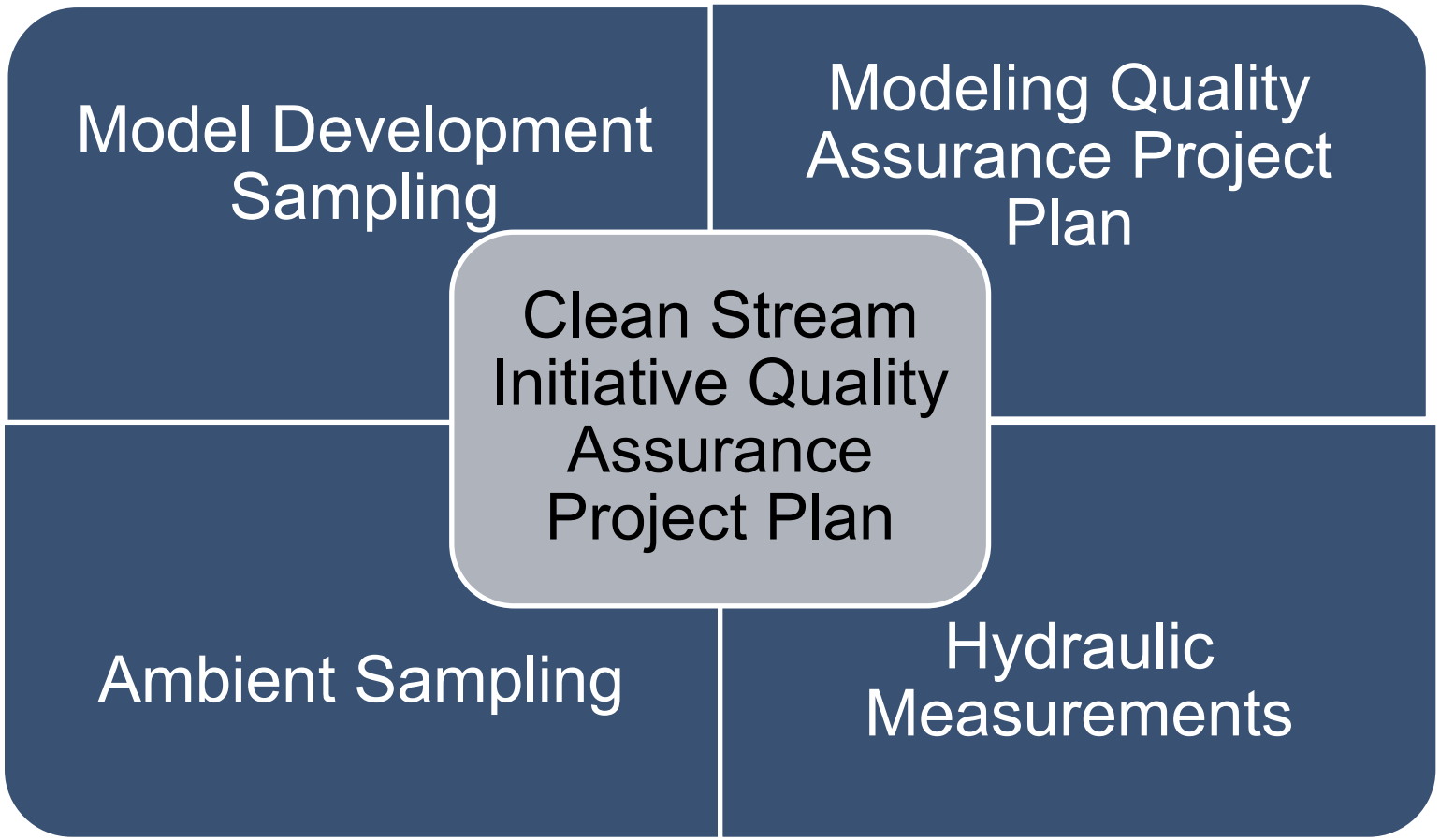
Clean Stream Initiative Purpose

The purpose of the Clean Stream Initiative is to:

- Improve the collective understanding of the Merrimack River's health
- Allow Lowell Water and other stakeholders to make informed environmental management decisions with regard to sustaining aquatic life and human use

Program Methods

Quality Assurance and Control



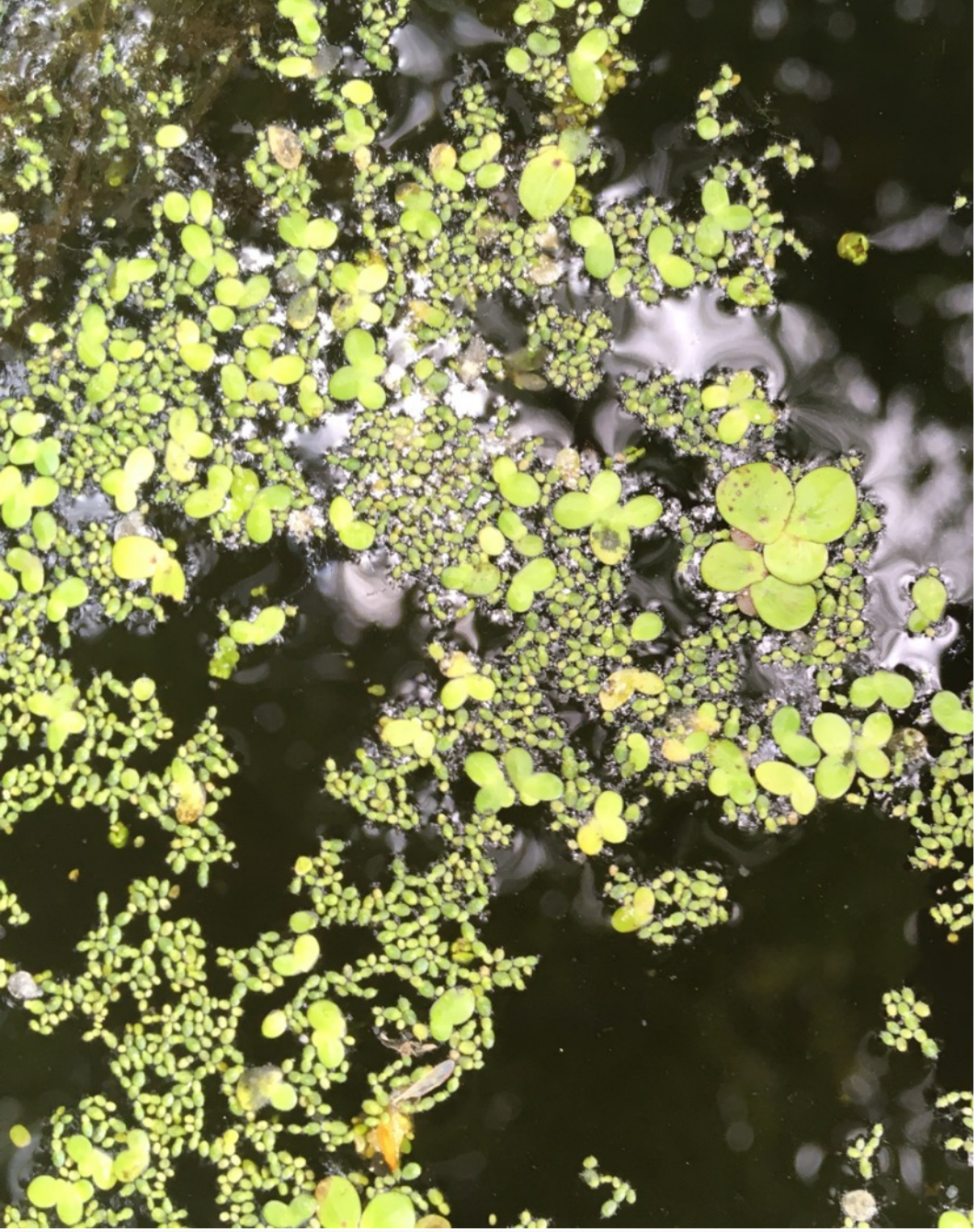
Ambient Sampling & Monitoring

Program Methods

What we are sampling

Ambient Sampling

- *E. coli* on a 5/30 day basis at minimum of 2 locations up and downstream of Lowell
- Model-dependent variables monthly in 2018, reduce to just assessment parameters in future
- April-October continuous deployment of 3 YSI sondes collecting temperature, conductivity, pH, dissolved oxygen, turbidity and/or chlorophyll fluorescence



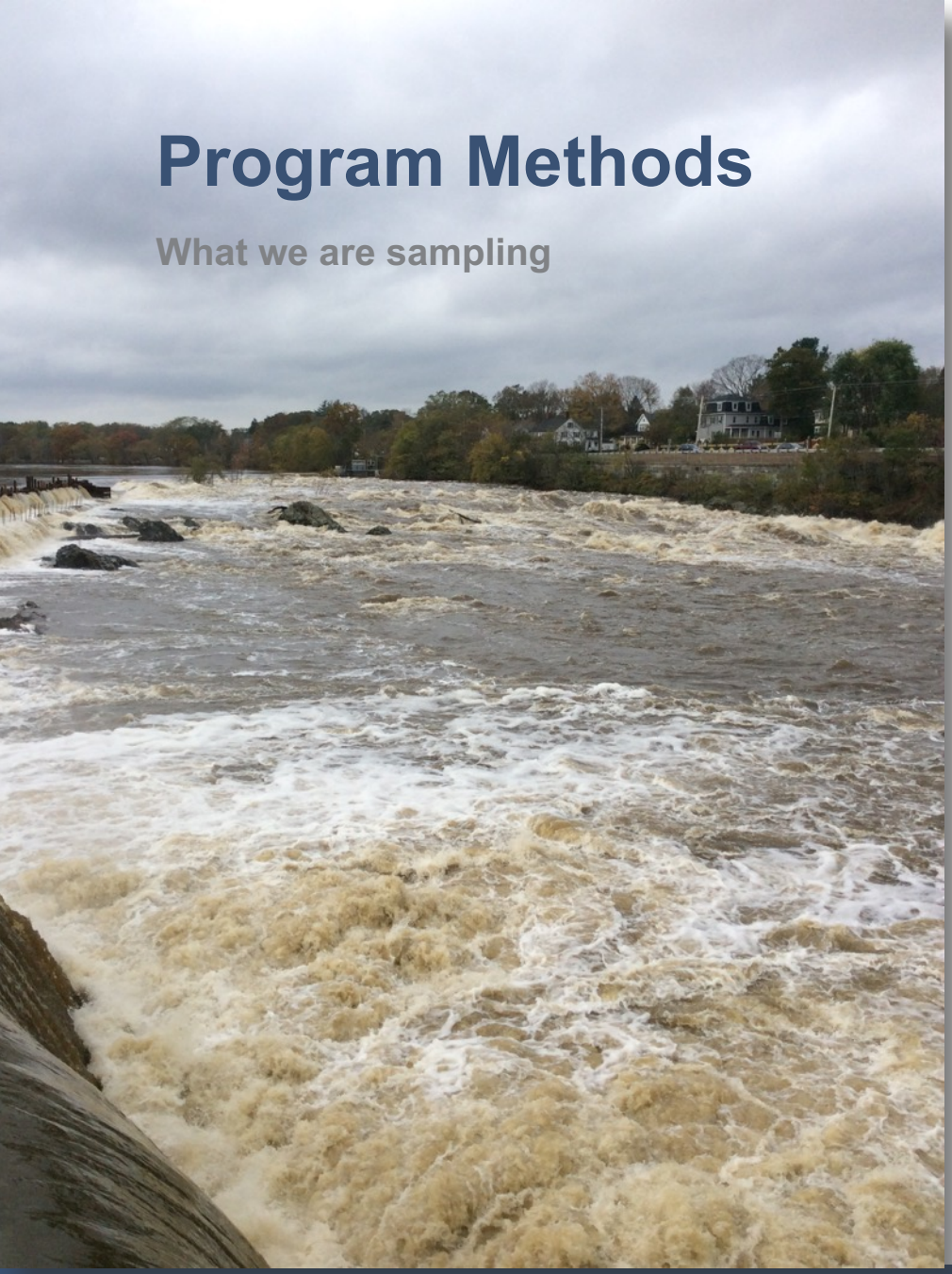
Dry Weather Model Sampling

Program Methods

What we are sampling

Dry-Weather Model Sampling

- Model-dependent variables monthly in 2018
- Two separate 5-day sweeps during critical low-flow conditions based on USGS flow predictions
- Depth profiles weekly at mid-day at both impoundments
- Monthly longitudinal survey with sonde at 4-foot depth by kayak



Program Methods

What we are sampling

Wet Weather Model Sampling

Program Methods

What we are sampling

Wet-Weather Model Sampling

- Model dependent variables monthly in 2018
- 3-4 non-CSO events in 0.1-0.5 inch range
- 3-4 CSO events in 1-20 MGD range
- Cyclic sampling covering 6 hours of storm and 1-2 days afterward depending on results
- Continuous sonde deployment captures dynamic response in 5 parameters at 3 locations

Hydraulic Measurements

Program Methods

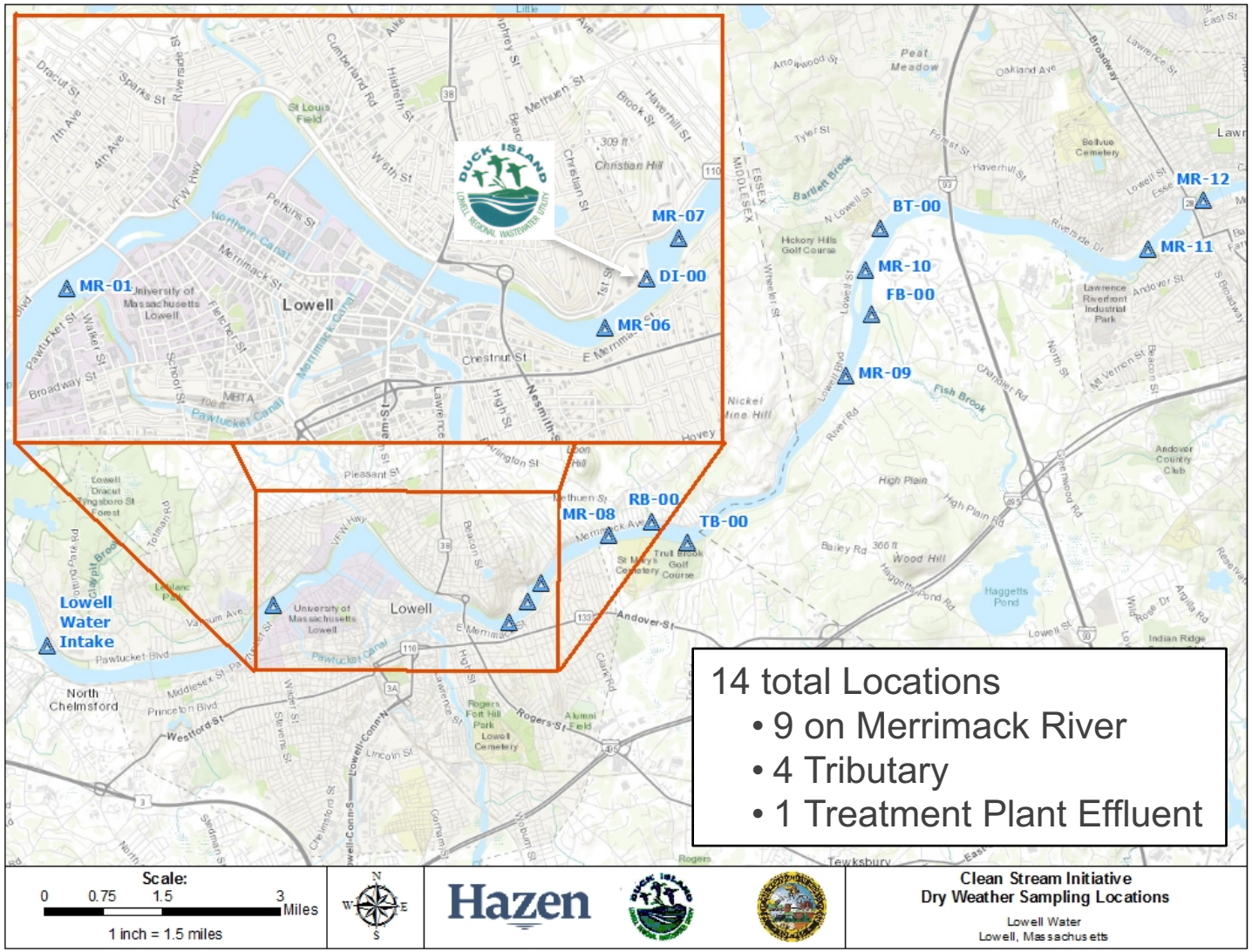
What we are sampling

Hydraulic Measurements

- Teledyne RiverPro ADCP from moving boat following USGS guidance
- Validate model hydraulics
- Inform flow-proportional sampling across sample transects

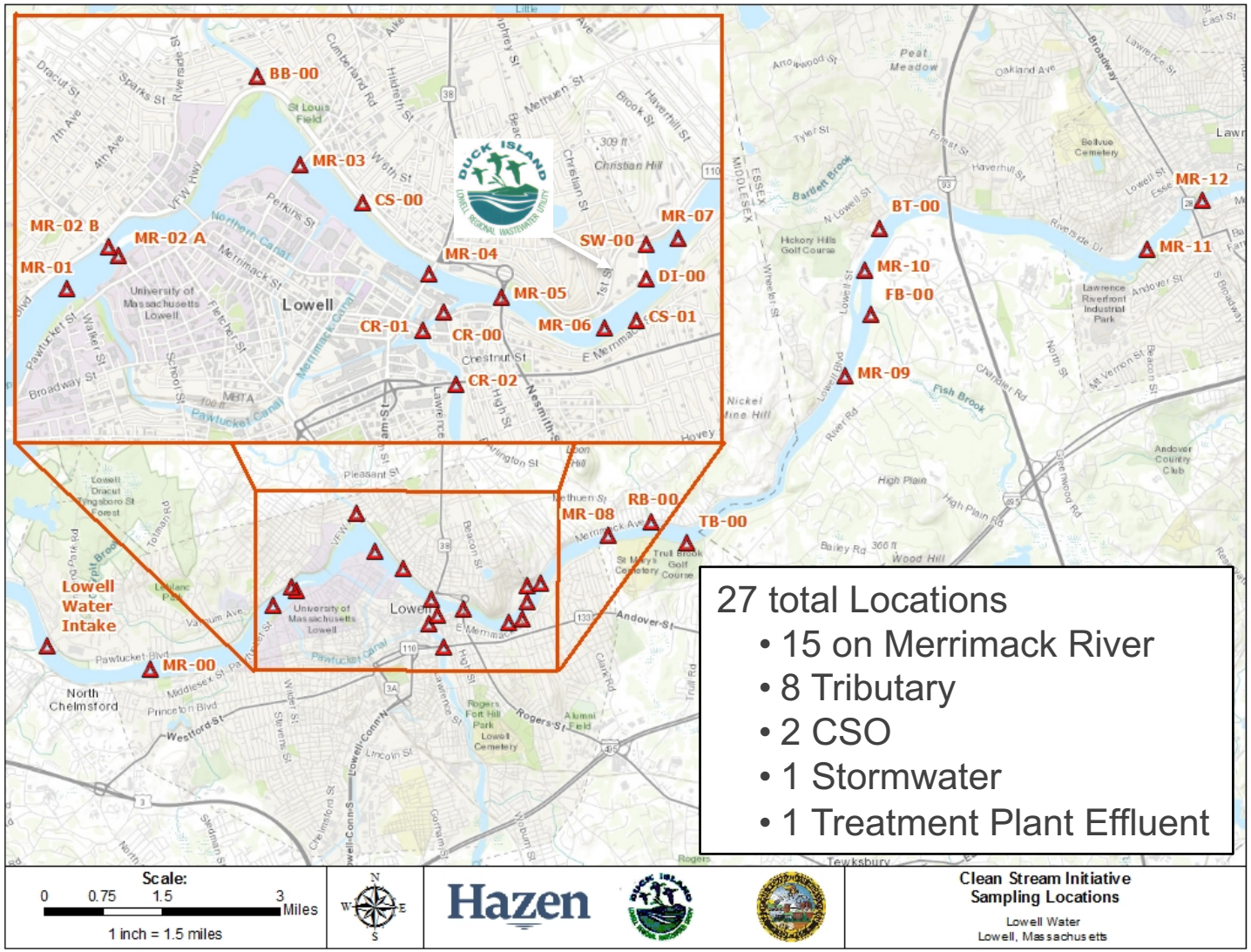
Program Methods

Where we are sampling (Clean Stream Initiative Dry Weather Sampling Locations)



Program Methods

Where we are sampling (Clean Stream Initiative Wet Weather Sampling Locations)



Program Methods

When we are sampling

Lowell Water's Clean Stream Initiative - Sampling and Analysis Frequency				
	Wet-Weather Sampling	**Ambient Bacteria**	**Ambient Dry Weather**	**Critical Low Flow**
Measuring	E. coli, TN, TP	E. coli	All Model Dependent Variables	All Model Dependent Variables
Frequency	Monthly Apr-Oct, Dec	5/30	Monthly April-Oct	2, 5-day sweeps
Samples/Event	150	3	15	15
Total/Season	1200	105	7	150

- 1560 samples in 2018 season
- Broader data set increases confidence in model simulation results

Program Methods

How we are collecting samples

ISCO Auto Samplers

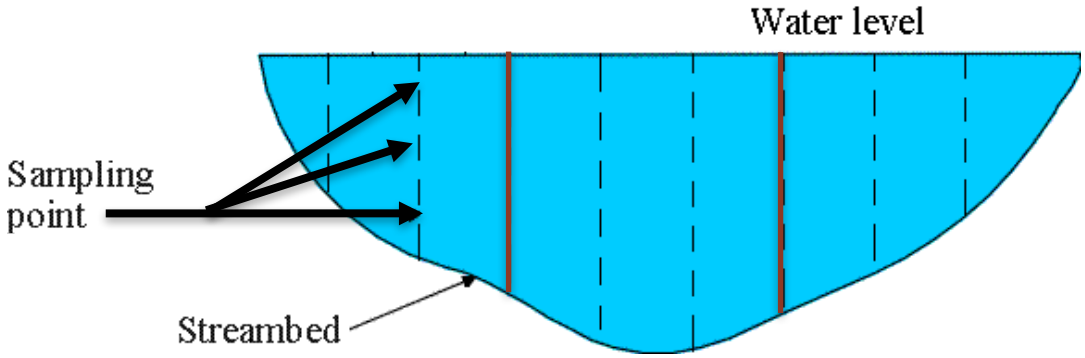
Van Dorn Grab Samplers

Program Methods

How we are collecting samples

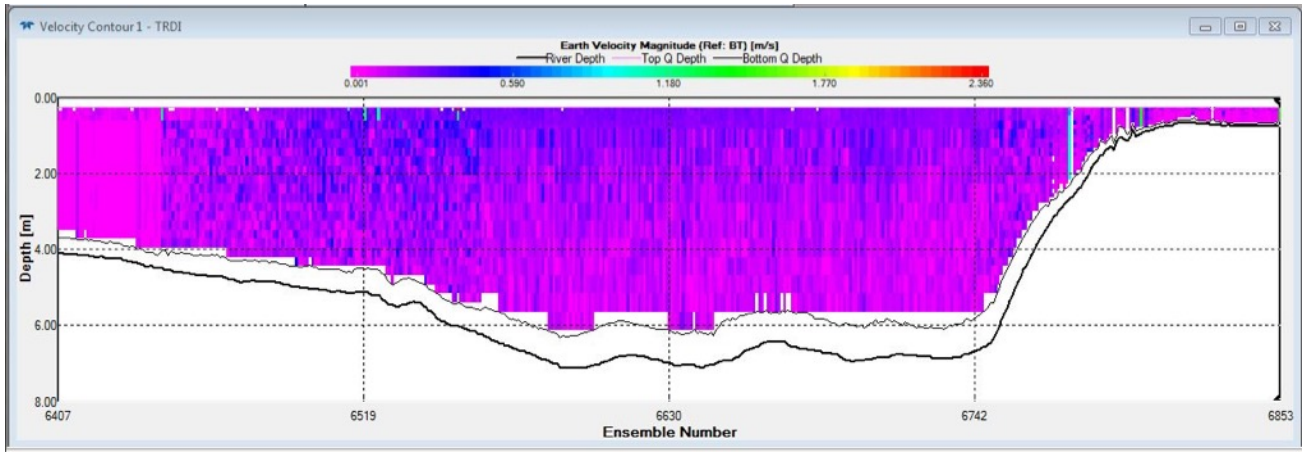
Equal-Width Increments

Sample composited from top, middle, and bottom of centerline of three equal width segments



Flow Proportional

ADCP measurements allow samples to be taken proportional to the flow through each width increment



Program Methods

How samples are analyzed

- Nutrient related analyses – UMass Dartmouth's SMAST Laboratory

- Bacterial analyses – Lowell Water's Drinking Water Laboratory (IDEXX Quantitray), and blind split laboratory QA

IDEXX

UMass Dartmouth School for Marine Science & Technology

Water Quality Modeling

Qual2K

- Written by Drs. Steven Chapra, Greg Pelletier, and Hua Tao for USEPA
- Designed for steady-state, low-flow conditions
- Multiple nutrients
- Diel shifts
- Primary production and respiration as phytoplankton and bottom algae
- Pathogens

Water Quality Modeling

USACE Merrimack River Model

- Developed by CDM-Smith for Army Corps of Engineers
- HSPF – SWMM – WASP
- Hydrologic simulation
- Time variable – run a full year
- Dynamic flow (storm simulation)
- Primary production and respiration
- Larger discretization of reaches
- Mean temperature and light variations seasonally

Partnerships

- Number of involved and contributing groups and organizations continues to grow
- Excellent example of multiple stakeholders pooling resources to work towards singular goal of a clean and healthy Merrimack River

Partnerships

Lowell Water continues to seek partnerships to build and better the Clean Stream Initiative by:

- Leveraging partnerships to increase efficient use of resources
- Building a consistent network of sampling and monitoring practices, and
- Improving support for data management and analysis throughout the watershed

USGS
science for a changing world

GREATER LAWRENCE COMMUNITY BOATING

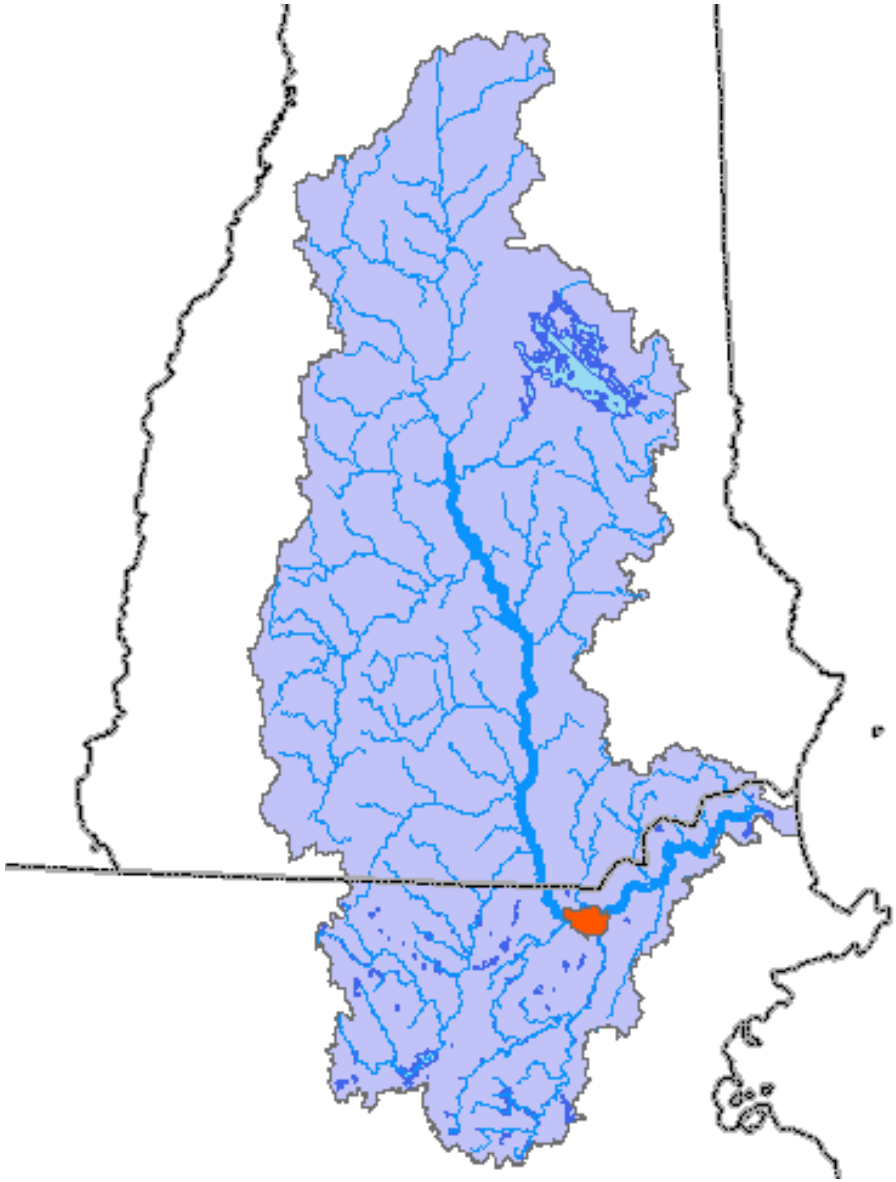
Tufts UNIVERSITY

UMass Dartmouth

Clean River Project

Next Steps

- Data collection to further develop existing water quality models
- Communicate results to other stakeholders and communities
- Incorporate economic models to ensure the most efficient use of resources for greatest environmental benefit



Acknowledgements

Lowell Water: Mark Young and Mike Stuer

MassDEP WPP: Kim Groff and Richard Chase

Hazen and Sawyer: Saya Qualls and Deb Mahoney

Clean River Project: Rocky Morrison

Questions?

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PO4
Orthophosphate
DOP
Dissolved organic Phosphorus
TP
Total Phosphorus
NH4
Ammonium
NOX
Nitrate+Nitrite
DIN
Dissolved Inorganic Nitrogen
DON
Dissolved Organic Nitrogen
TSS
Total Suspended Solids
POC
Particulate Organic Carbon

PON
Particulate Organic Nitrogen
TON
Total Organic Nitrogen
TN
Total Nitrogen (NH4+NOX+PON+DON)
CHl-a
Chlorophyll a
Phaeo
Pheophytin a
T-pig
Chlorophyll a+Pheophytin a
Alkalinity