January 2023

The Culmination of Monitoring and Modeling

Healthy Lake Boon Initiative

Brown AND Caldwell

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Background

Introduction, Challenges, Prior Studies, Objectives, Funding

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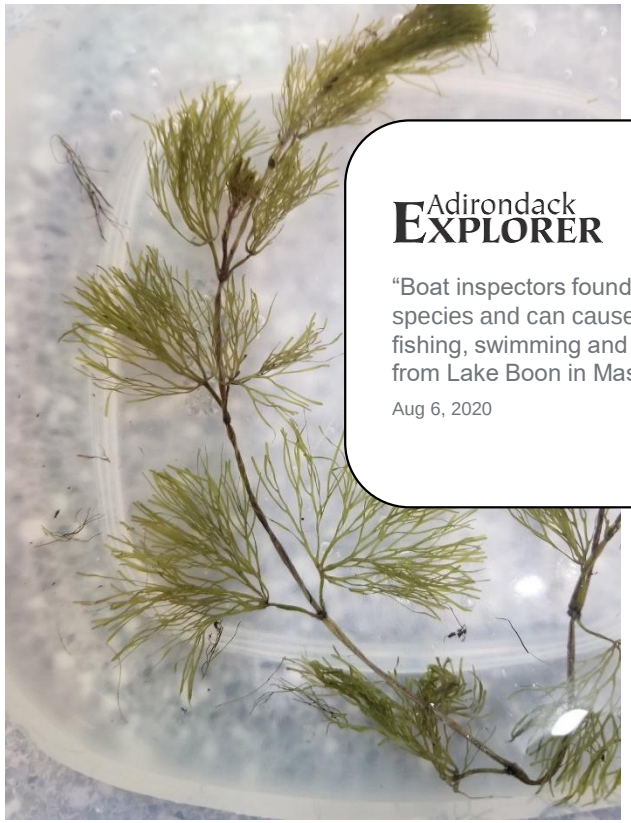
Introduction to Lake Boon

- Lake Boon covers ~163 acres between the Towns of Stow and Hudson, MA
- The Lake is within the SuAsCo watershed, and discharges ~1MGD to the Assabet River
- ~300 homes are on the Lake's waterfront, and are mostly lived in year-round
- The Lake has one semi-public beach, and entertains a variety of water activities throughout the year

Map of Lake Boon and the surrounding communities

Challenges are Impacting Lake Health…



Fanwort (Source: Adirondack Explorer)

Adirondack EXPLORER

"Boat inspectors found fanwort, an aggressive invasive species and can cause disruption to aquatic environments, fishing, swimming and boating activity… on a boat coming from Lake Boon in Massachusetts"

Aug 6, 2020

Boston.com

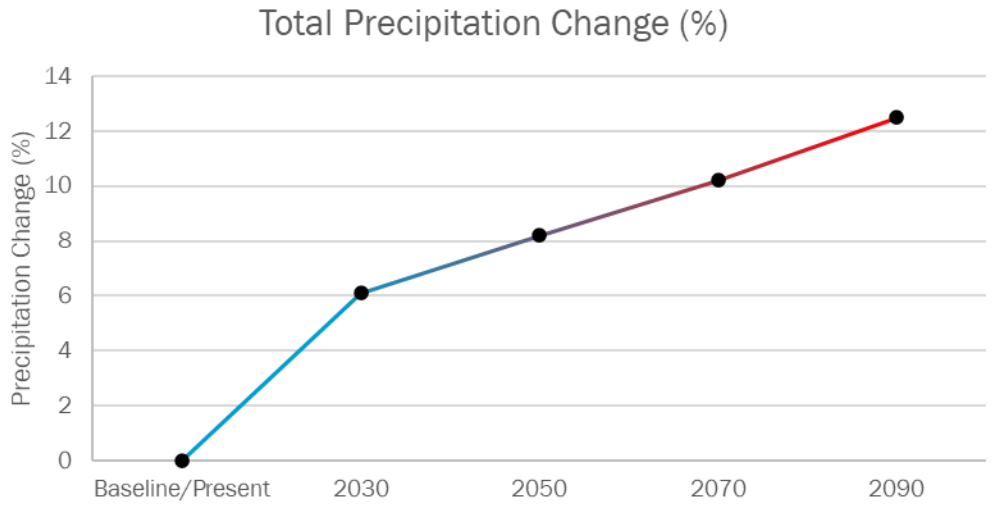
Algae bloom prompts beach closure in Stow

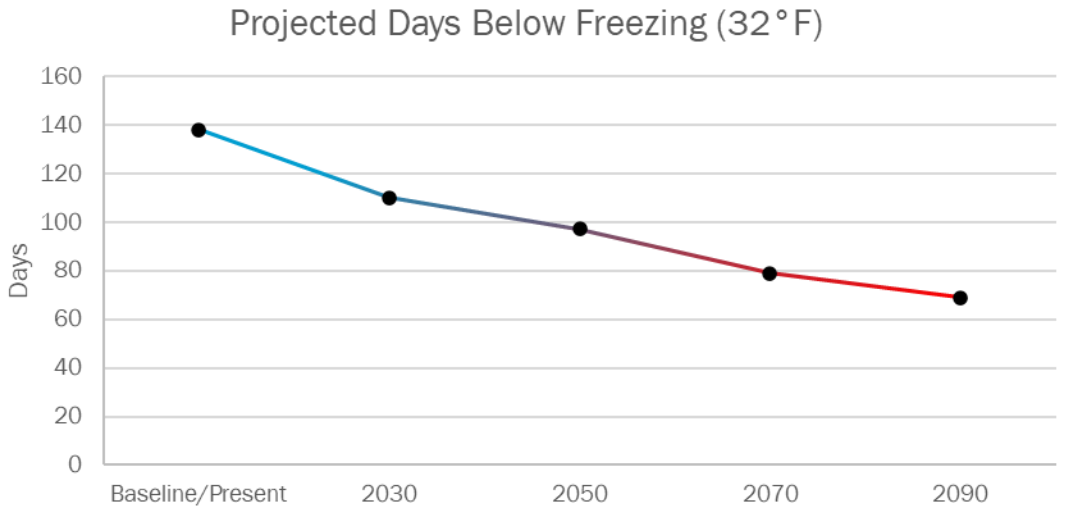
Throughout the summer, several beaches, lakes, and ponds have closed due to cyanobacteria blooms across Massachusetts, with advisories...

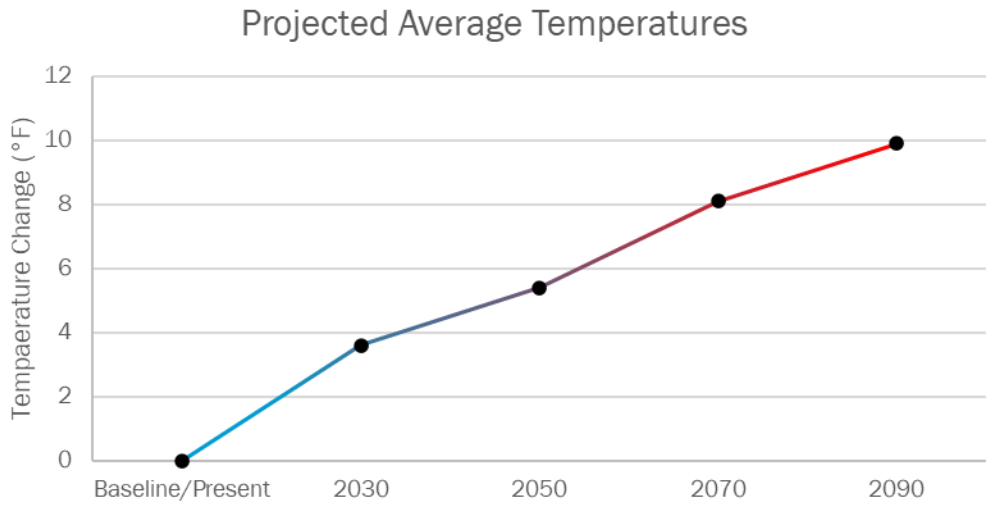
Aug 9, 2021

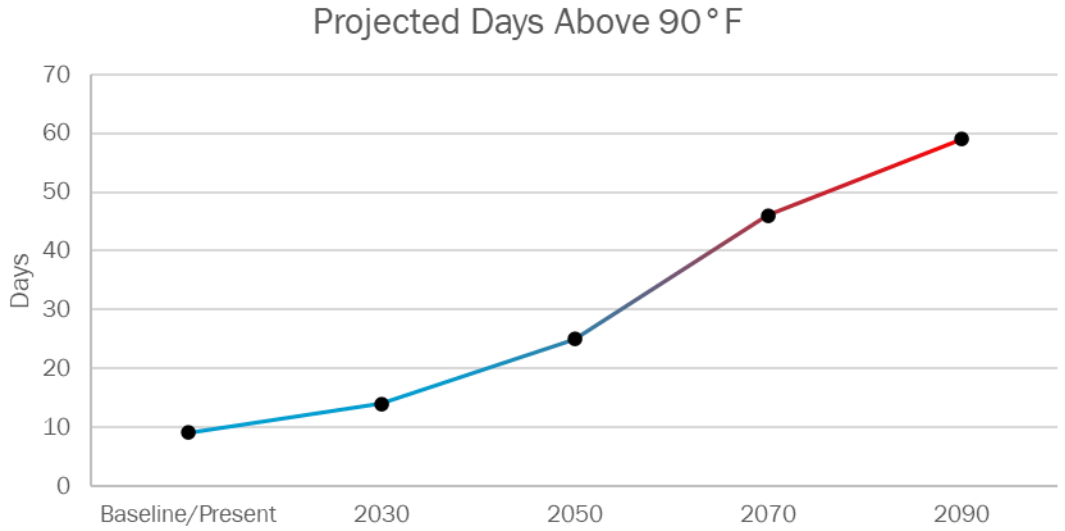
Algal Bloom Occurring in Lake Boon

…And They Could Get Worse





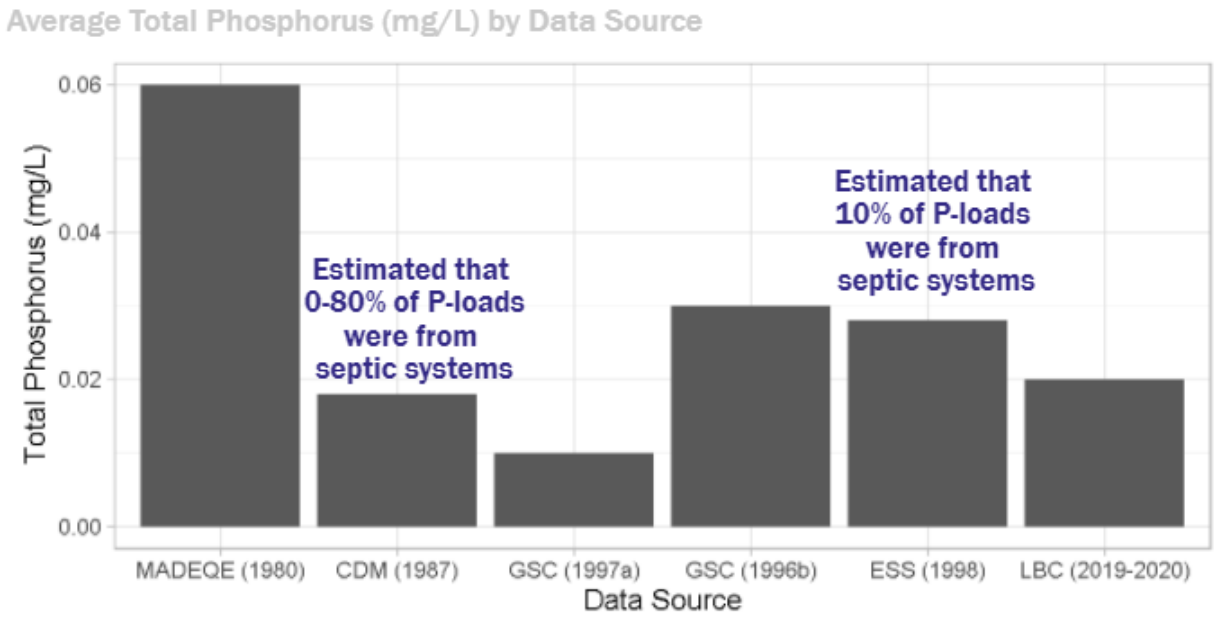




*Predictions from Resilient MA Climate Change Projections Dashboard for SuAsCo Watershed

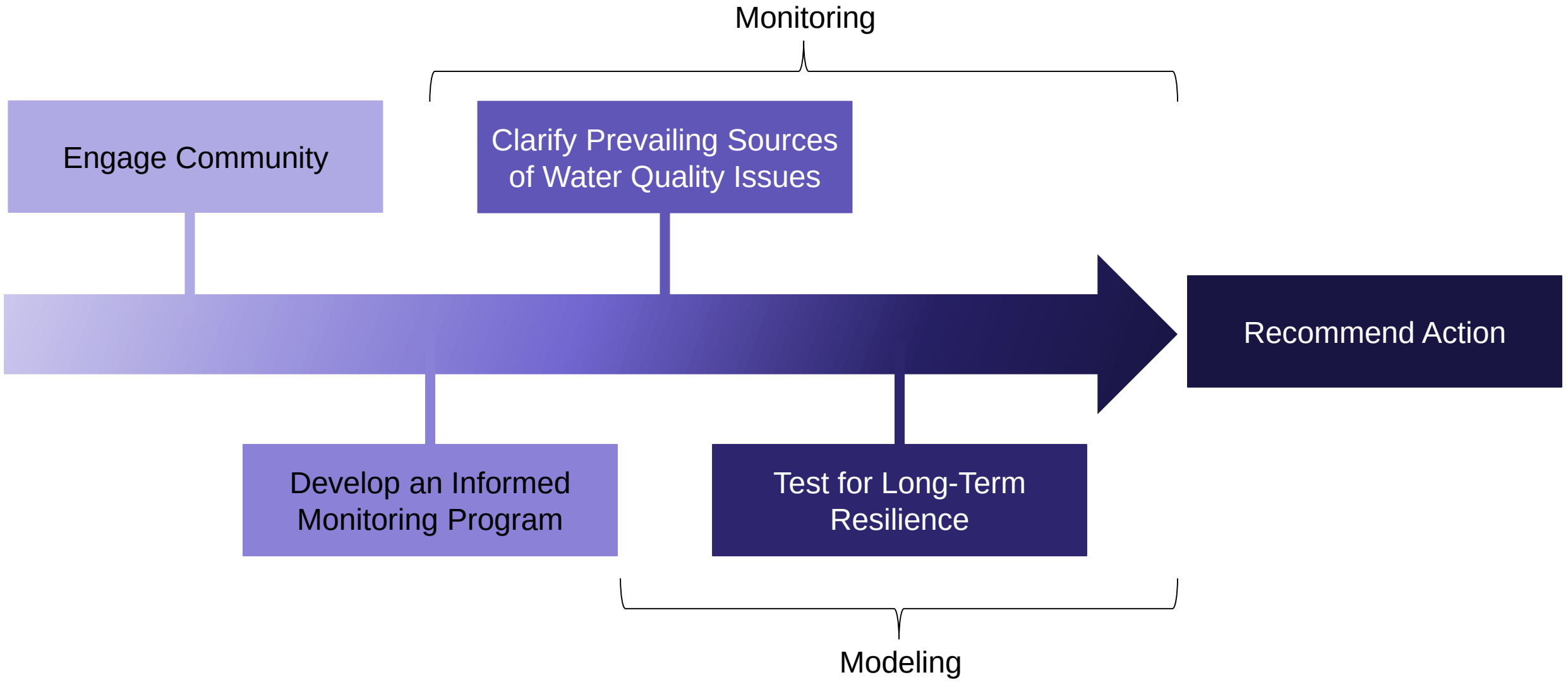
Prior Studies Conflict

- There have been multiple studies over the past 40+ years, but there is no consensus over the root cause(s) of water quality issues
- Management strategies implemented based on study results have not resolved ongoing issues
- A wholistic study was required to capture the full dynamics of the Lake and develop the right solutions



Lake conditions changed over time and phosphorus loading rates from groundwater and surface water sources varied widely under prior studies

Project Overview and Objectives



Funding

In Oct 2020, the Massachusetts Executive Office of Energy and Environmental Affairs awarded the Towns of Stow and Hudson, MA, a $154,000 grant through the Municipal Vulnerability Preparedness (MVP) Program.

Funding allowed these communities to work with the Lake Boon Commission to:

- Develop and implement a volunteer-driven monitoring program and public engagement plan
- Hire specialists to analyze the data, assess the health of the lake, and develop recommendations to sustain lake health

MVP
Municipal Vulnerability Preparedness

Monitoring

Brown AND Caldwell

Citizen Power!

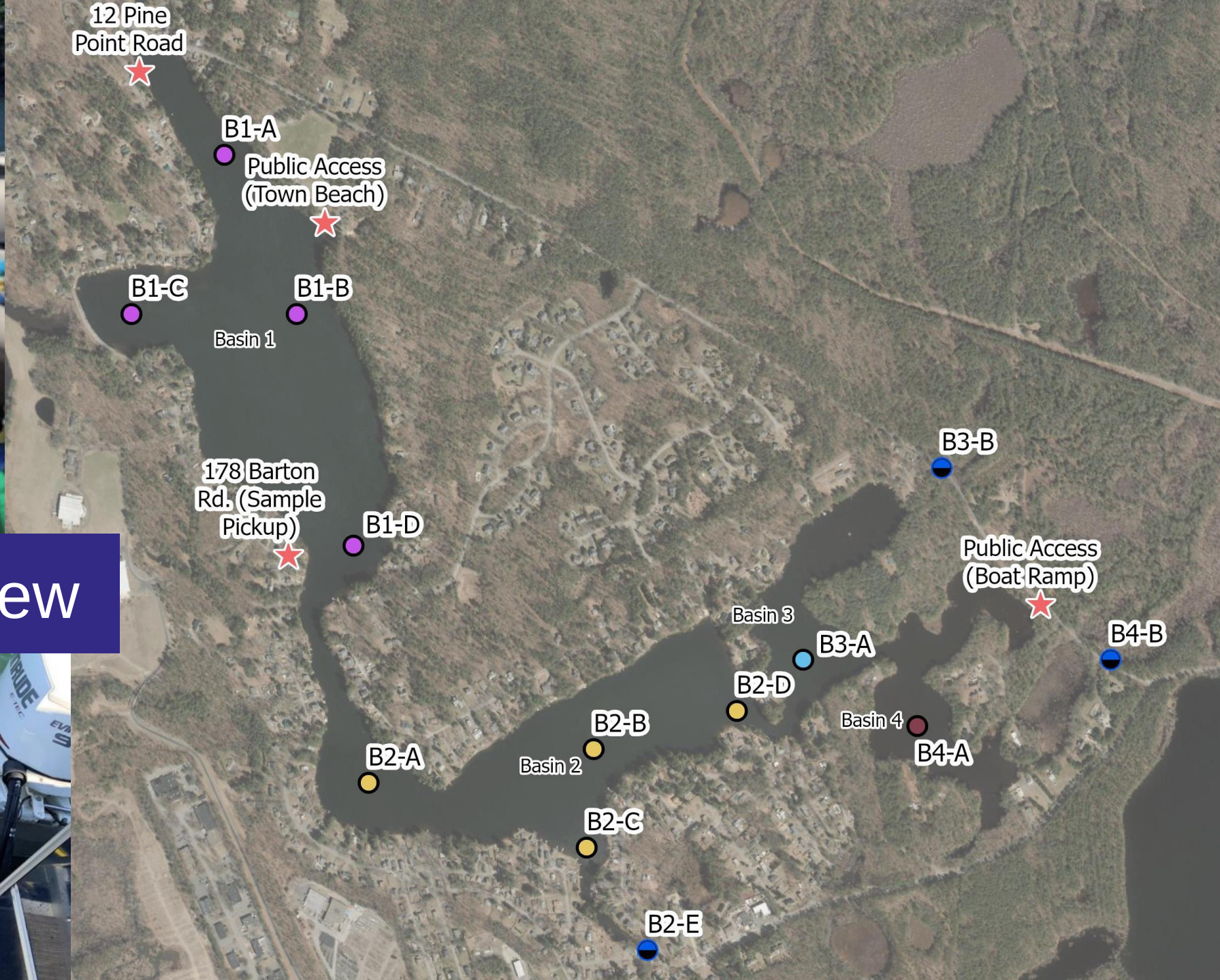
Community-Based Monitoring Program

- Community member volunteers were trained to take samples
- Training focused on both the ‘how’ and the ‘why’ to greater engage volunteers
- Monitoring Program Coordinator lead coordination and communication of volunteers

Passionate community members expanded monitoring possibilities

Photo of Lake Boon Association Members and Monitoring Volunteers

Sampling Overview



Sampling Overview

- 13 in-lake sampling sites
- 20 shallow well sampling sites
- 20 trained volunteers
- Sampled for phosphorus, nitrite, nitrate, ammonia, TKN, chlorophyll, TSS
- Measured temperature, DO, conductivity, secchi depth, and cyanotoxins, lake level
- Also obtained sediment cores – sent to UMASS Dartmouth S-MaST

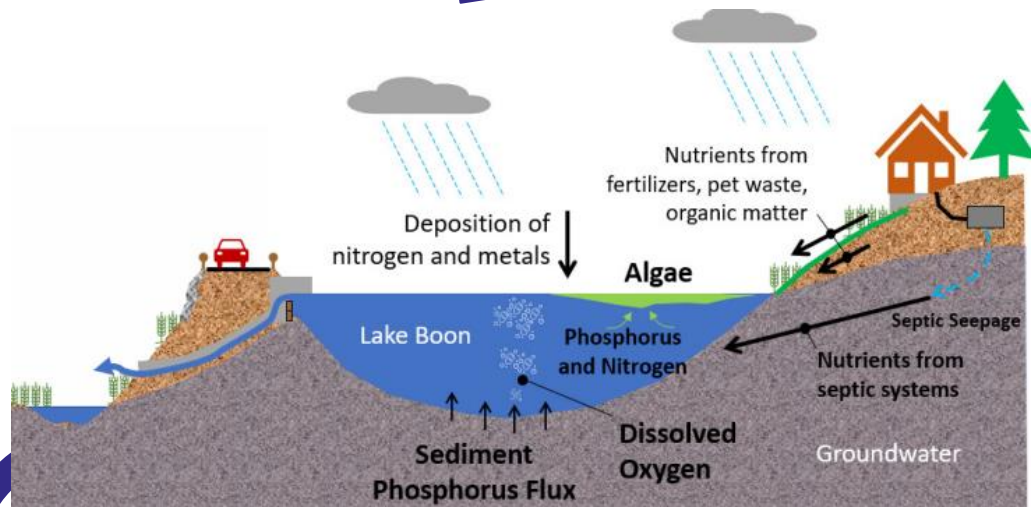
Modeling and Results

Model Overview

1 Hydrology Model

Calibrated to 2020 Lake Levels

Daily Precipitation
Daily Min/Max Temp

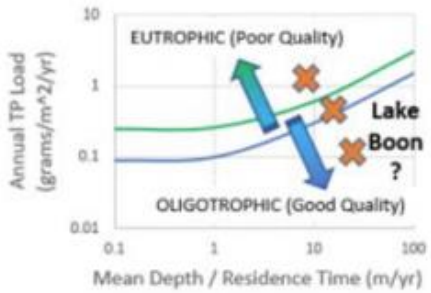


Surface Water Inflows
Surface Precipitation
Weir Outflow

Groundwater Inflows
Evaporation
Lake Level

2 Two-Step Eutrophication Screening

Vollenweider Method



Long Term TP Conc.

Long Term TP Conc. (mg/l)	Likely Trophic Status
<0.01	Oligotrophic (Good quality)
0.01-0.02	Mesotrophic (Ok for Rec, Habitat degraded)
0.02-0.05	Eutrophic (poor quality)
>0.5	Hypereutrophic (uses severely diminished)

3 Water Quality Modeling

Septic Values
Runoff Load Rates
Sediment Rates
Nutrient Cycling Rates

Load sources to target for WQ Improvements

Hydrology Model

1 Hydrology Model

Calibrated to 2020 Lake Levels

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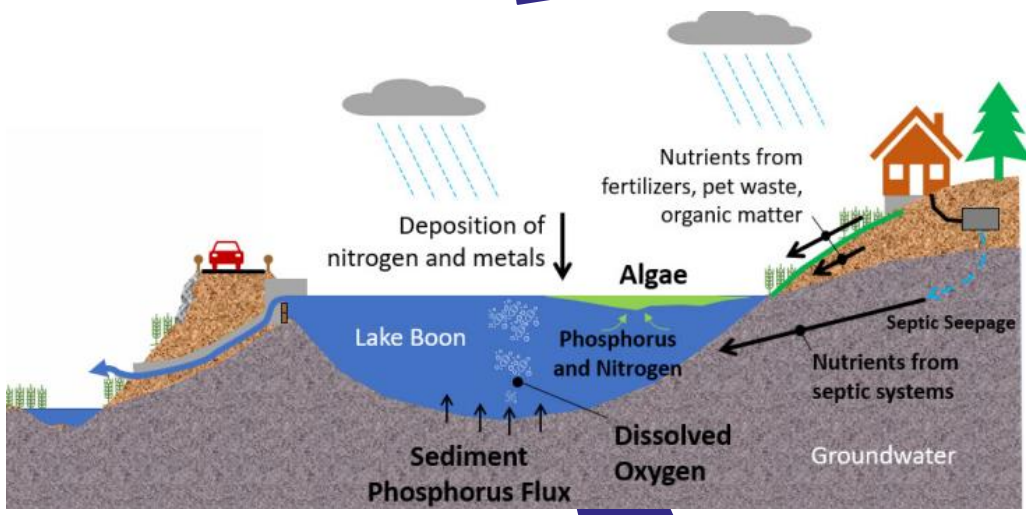
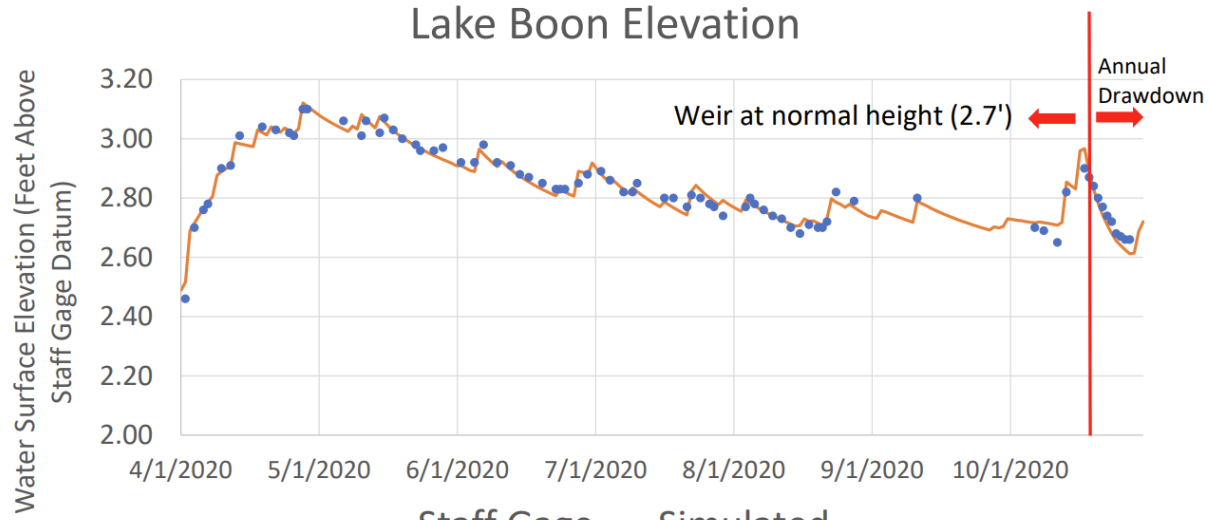
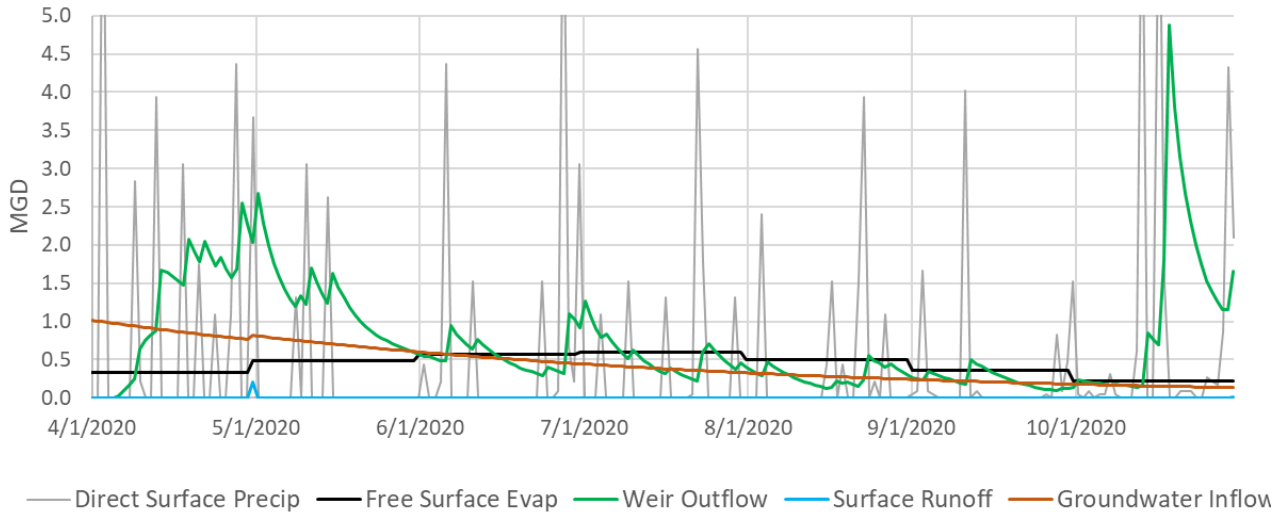
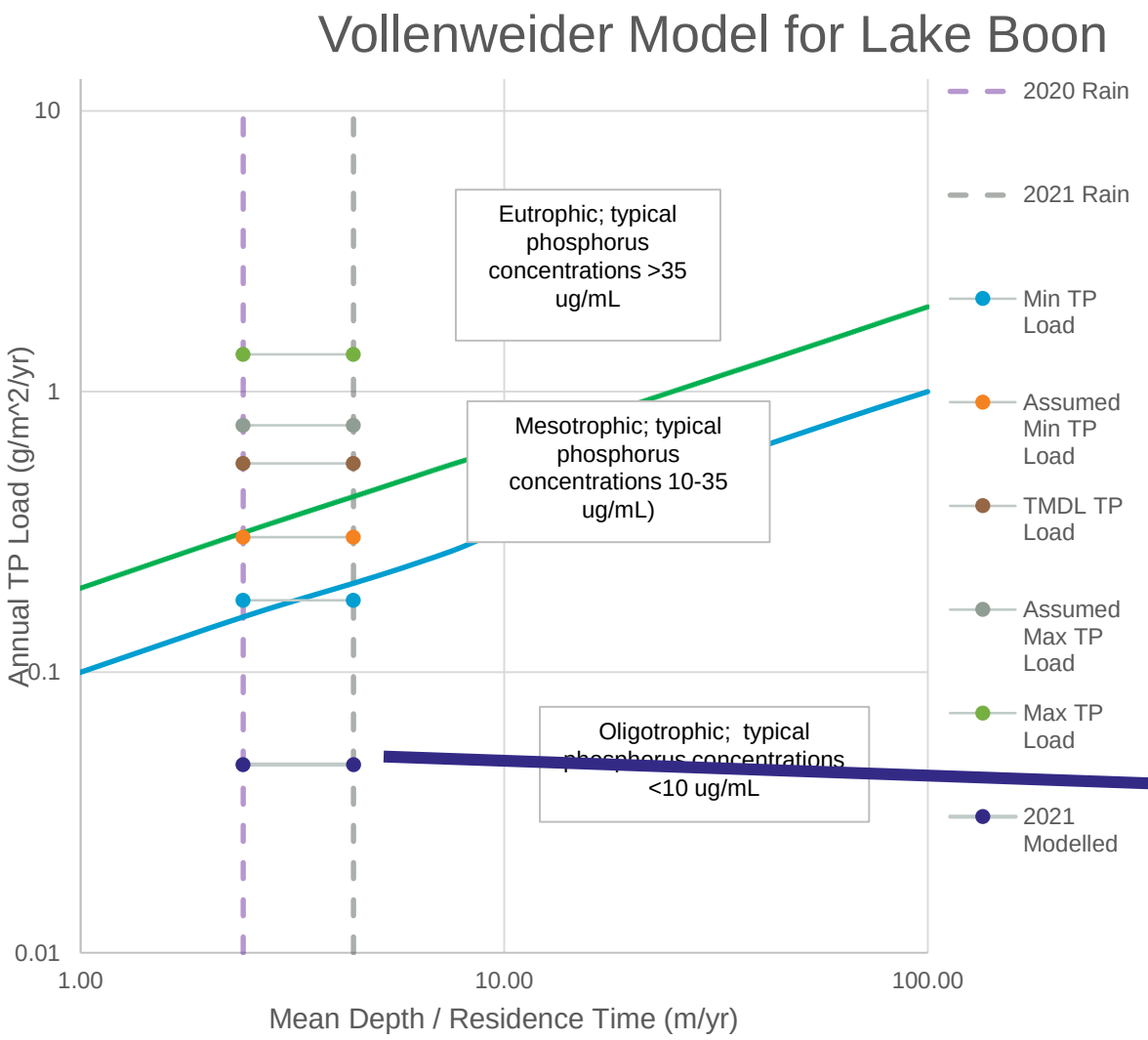






Eutrophication Screening



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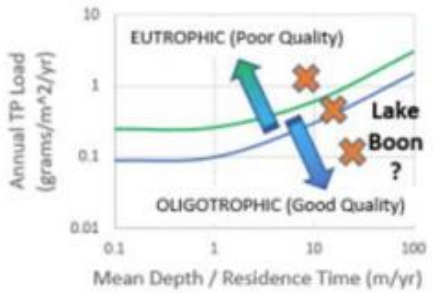

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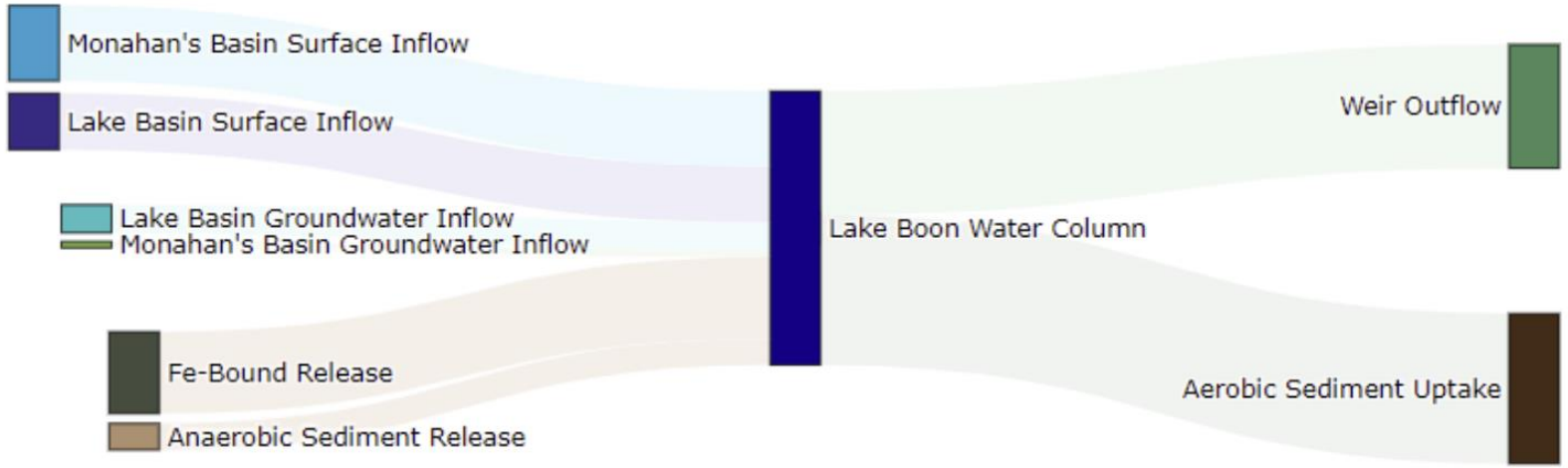
Lake is Doing Well in 2021!

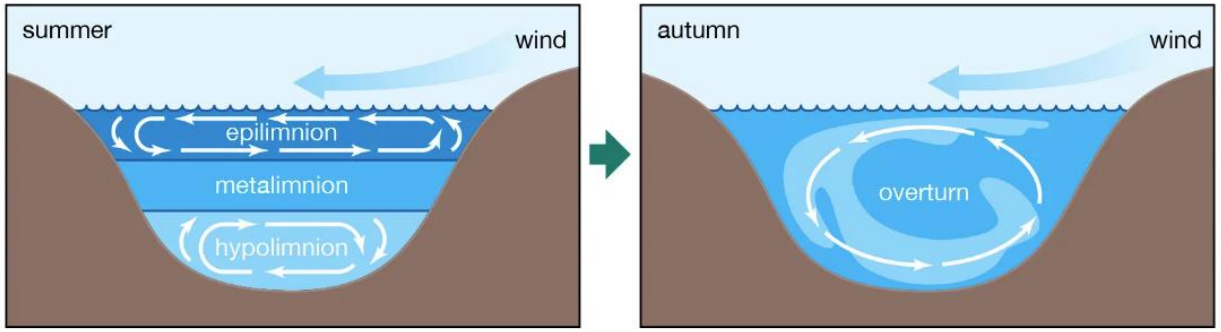
High precipitation, Lake was flushed often
For dryer years, Lake is slightly above desired levels

But why are we still seeing frequent algal blooms?

Water Quality Modeling



- Deep water becomes anoxic in the summer
- Fall turnover leads to high phosphorus concentrations
- Algal Blooms form in these conditions



Graphic from Encyclopædia Britannica
https://www.britannica.com/science/inland-water-ecosystem/Permanent-bodies-of-standing-fresh-water#/media/1/288440/36

3 Water Quality Modeling

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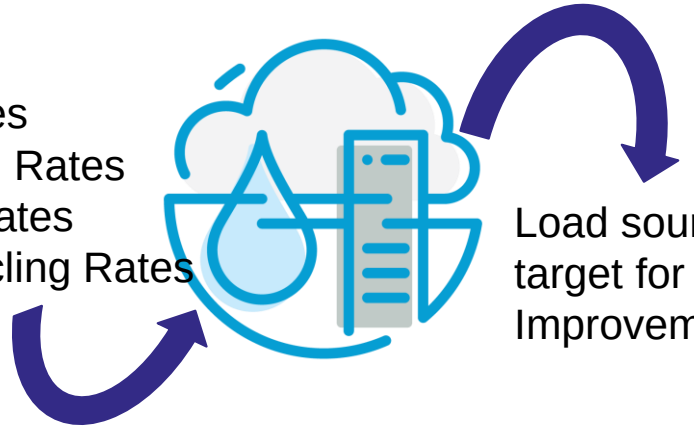
Runoff Load Rates
Sediment Rates
Nutrient Cycling Rates



Load sources to target for WQ Improvements

Informed Solutions

Brown AND Caldwell

Solutions

Surface Inflow (Runoff)

- Reduce fertilizer
- Keep leaves and clippings out of lakes
- Wash cars away from lakes
- Pick up after pets

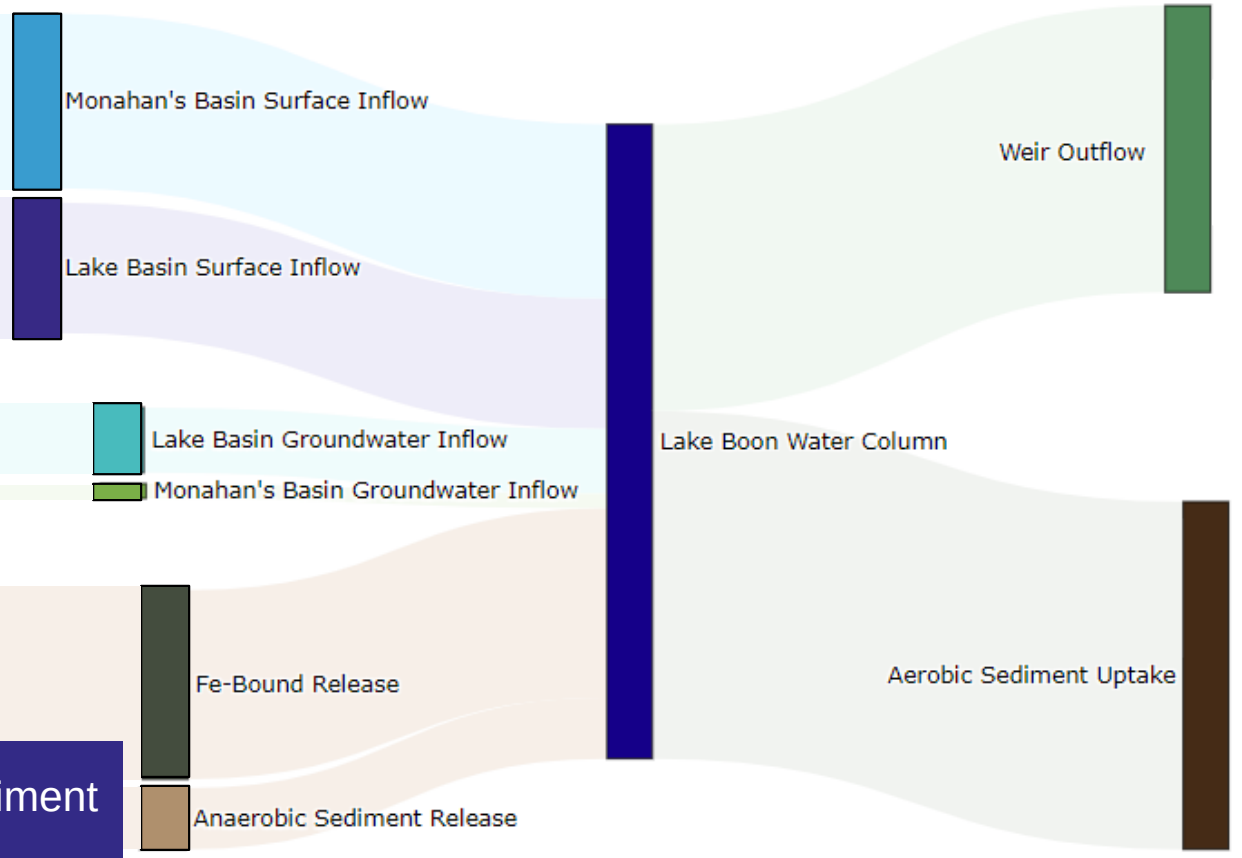
- Plant vegetative buffers, bioswales to infiltrate stormwater
- Repair upstream culverts to create more flushing in more stagnant areas of the lake

Groundwater

- Maintain Septic Systems

In-Lake and Sediment

- Weed harvesting
- Alum treatment



Reduce sources of incoming phosphorus so sediment concentrations can decrease in the long-term

Results

Community Understanding

Collaborative Solutions

Community Buy-In and Action

Future Goals for Community

1. Implement a Whole Lake Approach
2. Lake Boon Association Leads
3. Continue Lake Monitoring
4. Reduce Nutrients Getting into Lake
5. Carefully Monitor Algae and Toxins
6. Review Weed Treatment Plans
7. Reduce Shoreline Erosion
8. Active Public Communications
9. Pursue Funding

Thank you.

Questions?

Acknowledgements

Lake Boon Association
Lake Boon Commission
Dan Barstow
David Grey
Kathy Sferra – Town of Stow Conservation Agent
Pam Helinek – Town of Hudson Conservation Agent
Executive Office of Energy and Environmental Affairs
Rebecca Longvall – Coordinator
Healthy Lake Boon Steering Committee and Monitoring Program Volunteers
The Rest of the Brown and Caldwell Project Team