Case Studies of Septic System Impacts on Surface Water Quality

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North American Lake Management Society
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Senior Environmental Scientist

2026 NYSFOLA Annual Conference
May 8-9, 2026

Presentation Outline

- Septic Systems 101
- Case Study: Elizabethtown
  - Septic System Impacts on Rivers & Streams
    - Evaluation of Septic Systems, Lot Sizes & Setbacks
    - Advanced Water Quality Monitoring, Dye Testing
  - Solution
- Case Study: MAPA Lakes
  - Septic System Impacts on Lakes
    - Basic Water Quality Monitoring
  - Solution & Results

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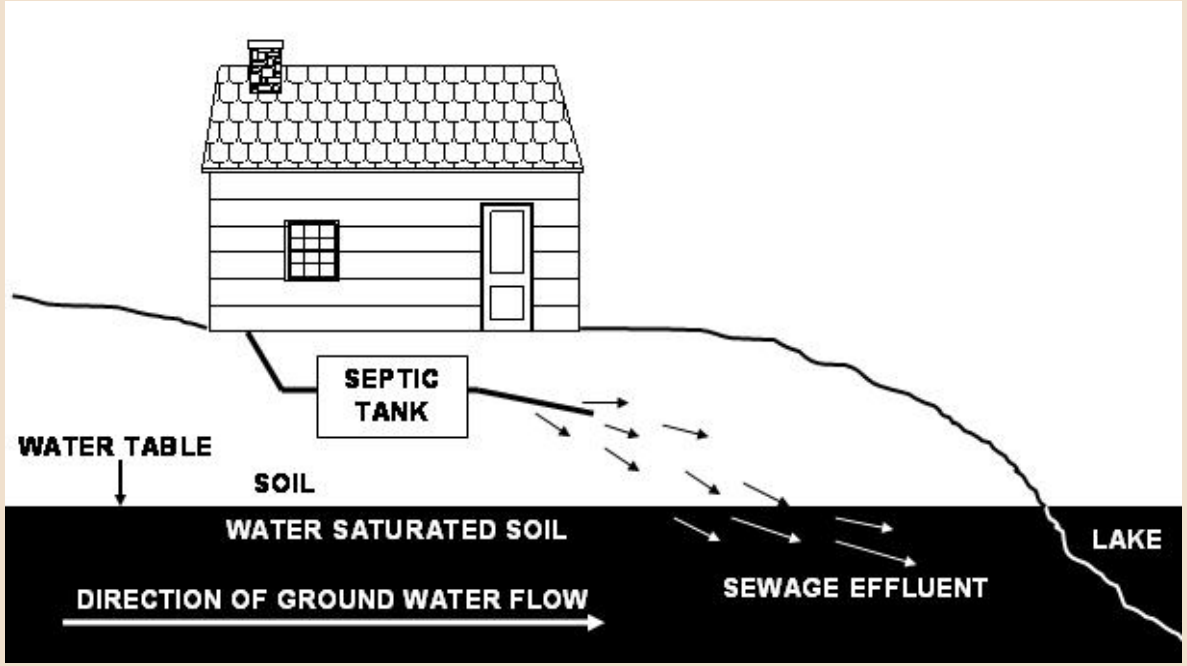
Septic Systems 101

- Dispose of wastewater leachate into soil
- Requires good soil to remove pathogens and nutrients
- Nutrient adsorptive capacity of soil is eventually used up



Source: Detecting Failing Septic Systems In Your Lake: A Cost Effective Methodology. Warren County SWCD & Adk Community College

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Case Study: Elizabethtown

On-Site Septic Systems

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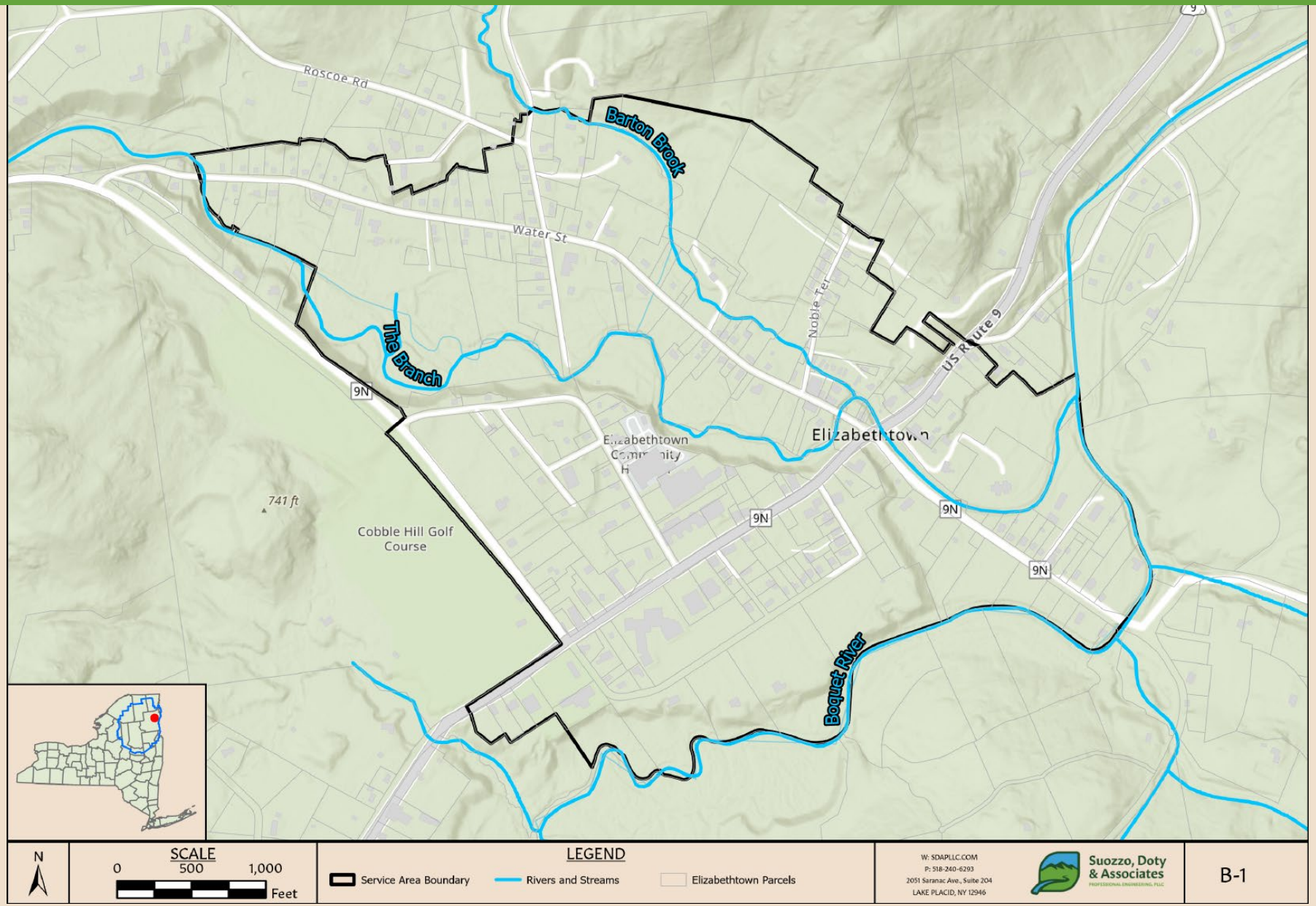
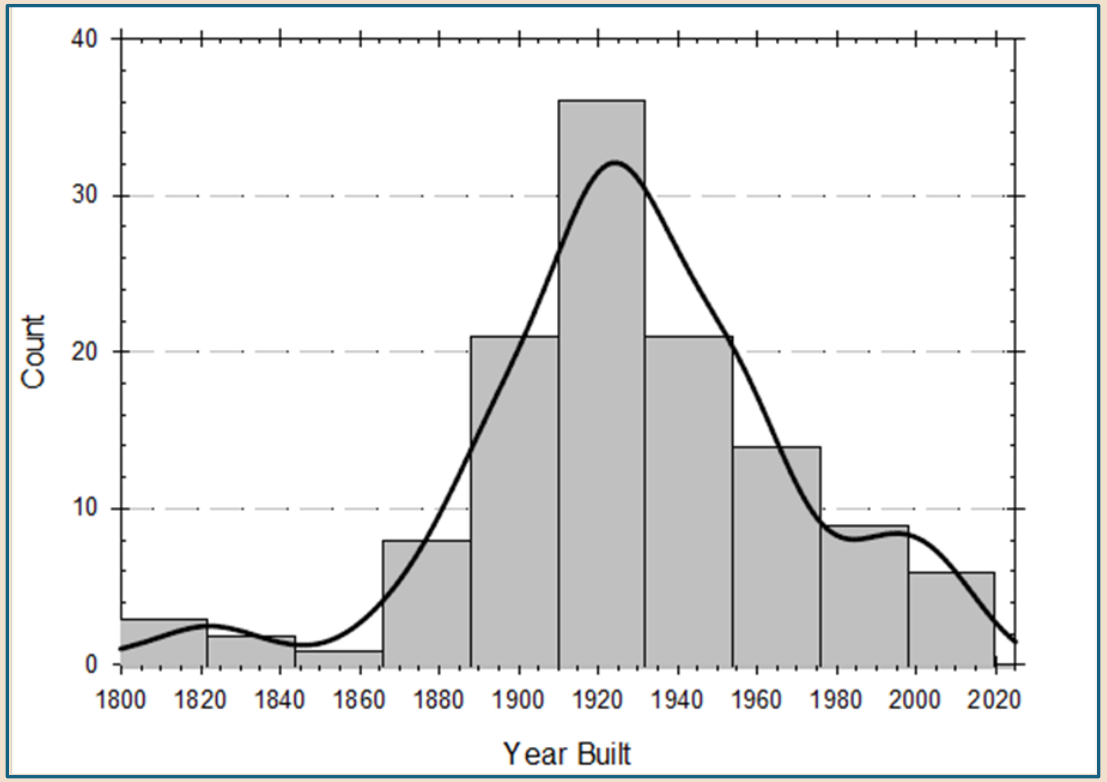
Town of Elizabethtown, NY



Aging Infrastructure – On-Site Septic Systems

- 281 parcels in Sewer District
  - 35 are vacant or vacant w/improvements
- 246 on-site systems within the Sewer District
  - 233 individual on-site systems
  - 11 commercial or municipal on-site systems
- 83% constructed between 1880 and 1976
- Since 2019
  - only 6 are new systems
  - only 9 systems repaired or replaced in-kind
- Many systems are non-conforming (Do not meet current design standards)
- Inadequate treatment area & lack of replacement area
  - 135 parcels (48 percent) are ½ acre or less
- Inadequate setbacks from wetlands or streams
  - 76 parcels (27 percent) have more than half their property within the 100-foot setback from wetlands and/or stream

Year of Construction for Buildings in Sewer District



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Suitable Area for Septic Systems Based on Required Setbacks

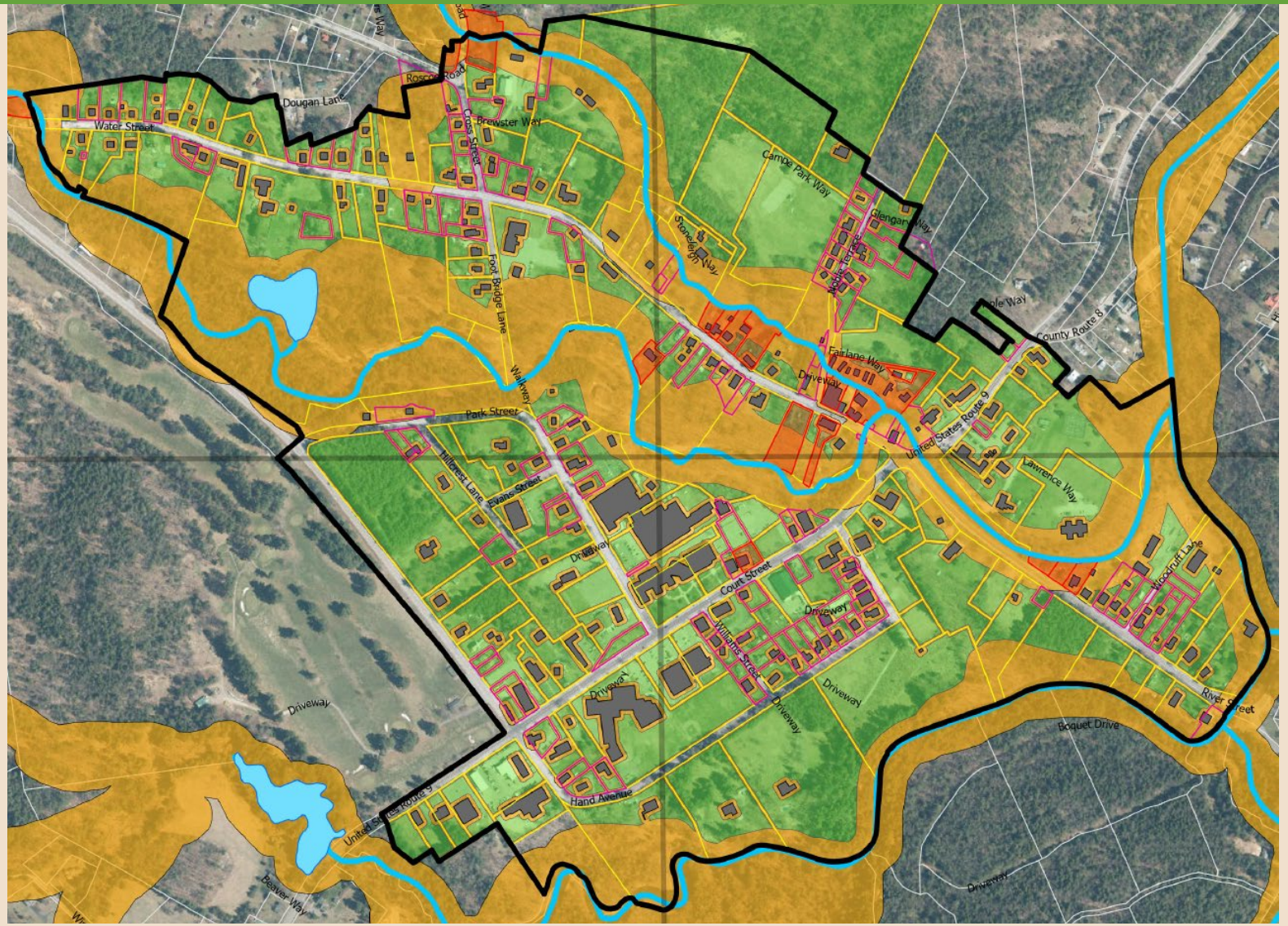
Entire Sewer District

Buffers & Setbacks

Available Area

Parcels 1/2 acre or less

Septic System Problems



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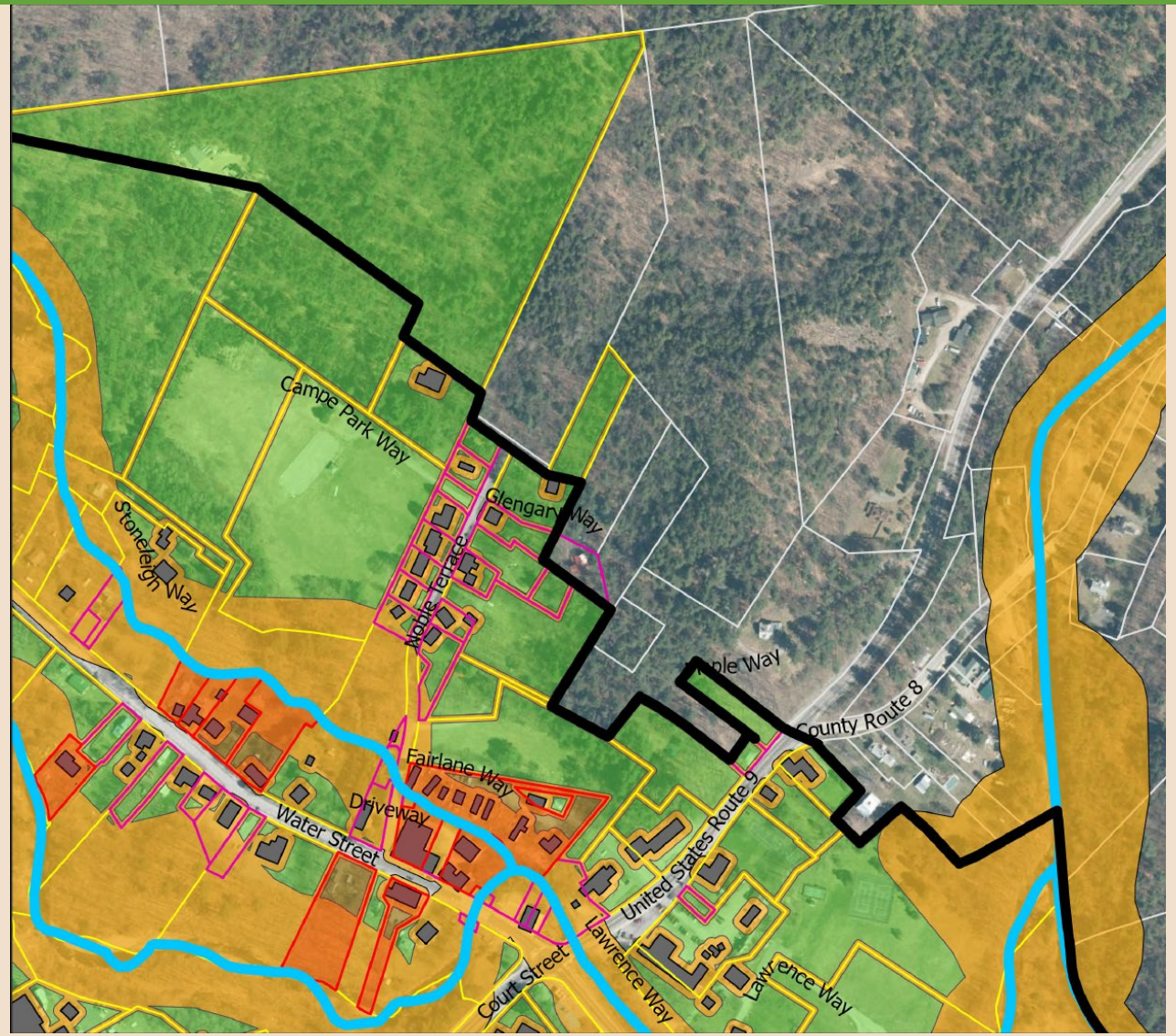
Suitable Area for Septic Systems Based on Required Setbacks

Lower
Water
Street



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Investigating the Problem

Impact of Septic System on Area Rivers and Streams

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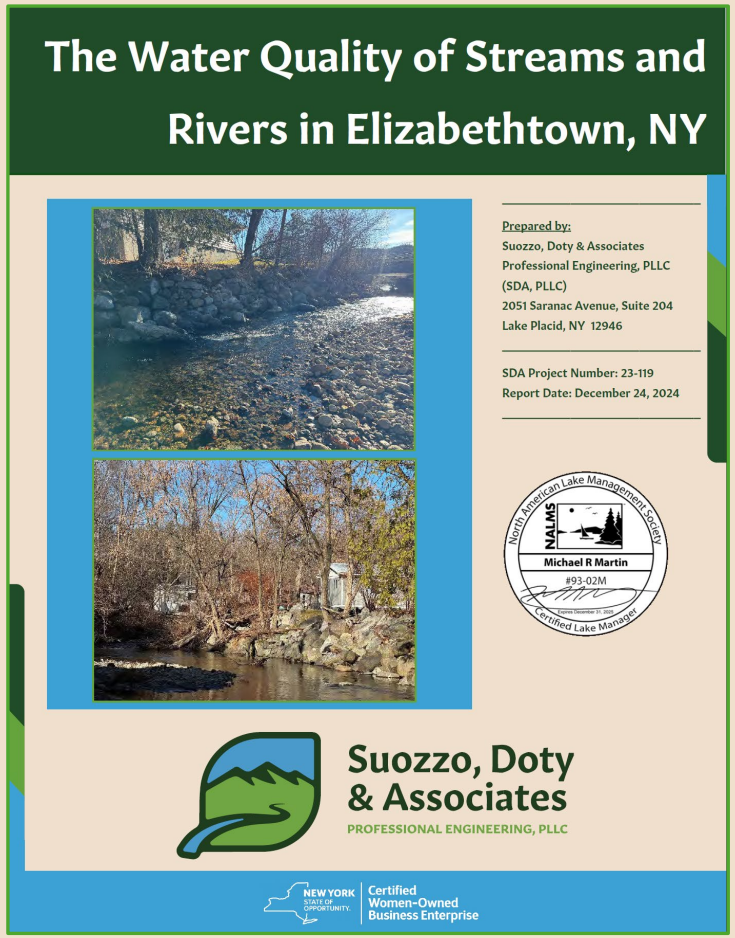
Water Quality Monitoring Program

- Eight stations on The Branch, Barton Brook and Boquet River above and below Hamlet
- Designed to detect septic system leachate
- Sampling May through November
- Weekly Sampling September through October
- Bacteriological Testing
  - Fecal coliform, E. coli
- Water Chemistry
  - pH, temperature, alkalinity, conductivity, chloride
  - total phosphorus, dissolved phosphorus, nitrate-nitrite, ammonia, total Kjeldahl nitrogen, total nitrogen
- Microbial Source Tracing
  - Human associated bacteroidetes
- Dye Testing



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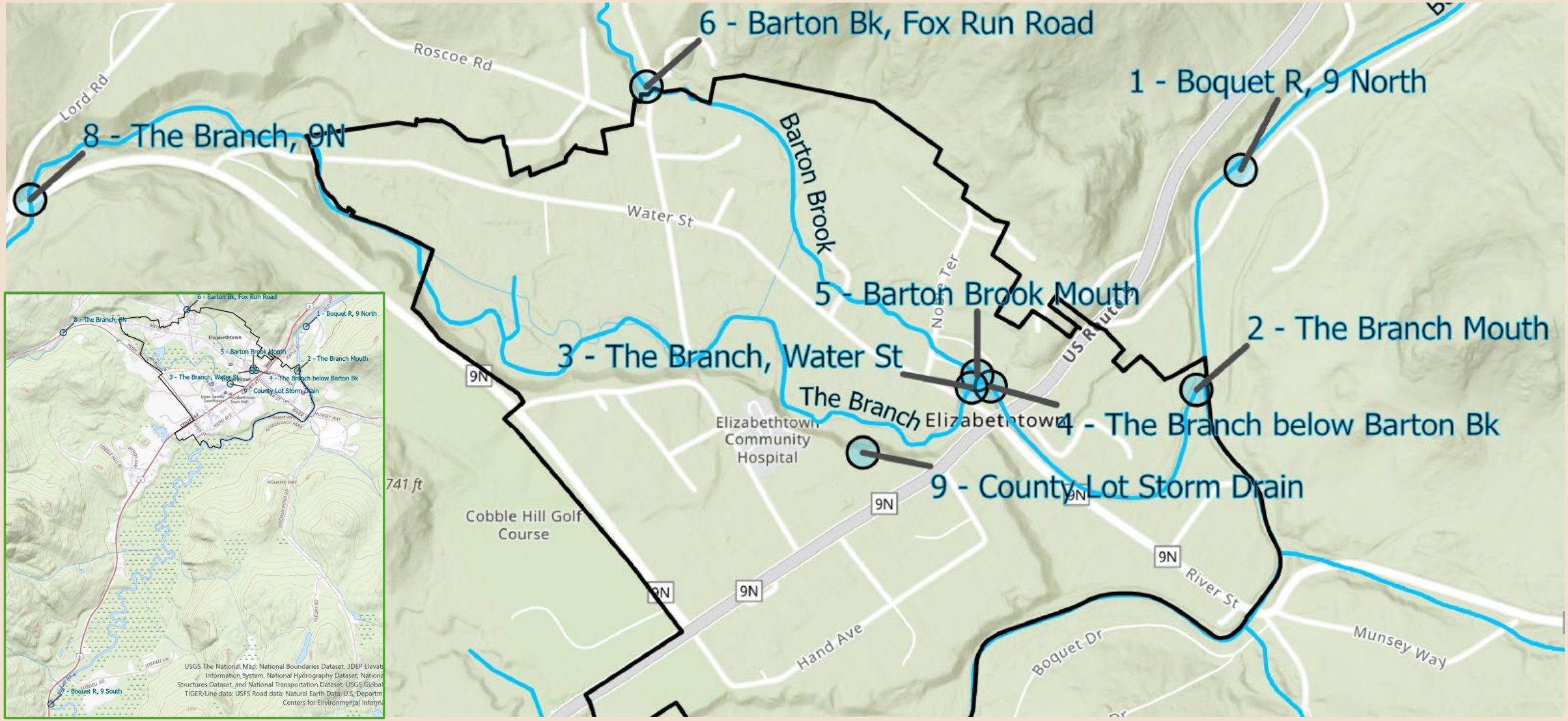
Water Quality Monitoring: Station Locations



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Water Quality Results

The Branch

- Fecal coliform bacteria higher downstream compared to upstream
- E. coli bacteria higher downstream compared to upstream
- Chloride higher downstream compared to upstream
- Conductivity higher downstream compared to upstream
- Nitrate-nitrite higher downstream compared to upstream

Barton Brook

- Fecal coliform bacteria higher downstream compared to upstream
- E. coli bacteria higher downstream compared to upstream

Essex County Parking Lot

- Fecal coliform bacteria very high after storm events
  - 980.4 to greater than 2,419 colonies per 100 milliliters
- E. coli bacteria very high after storm events
  - 980.4 to 1,553 colonies per 100 milliliters

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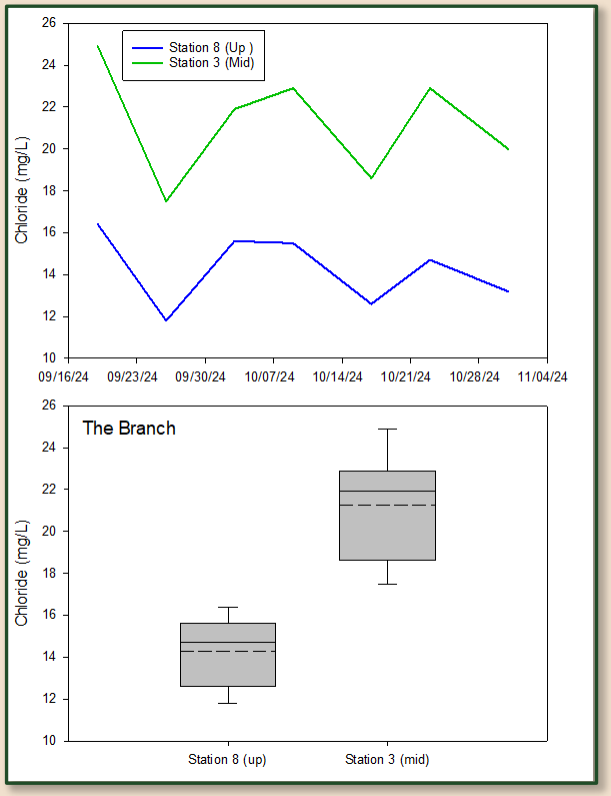
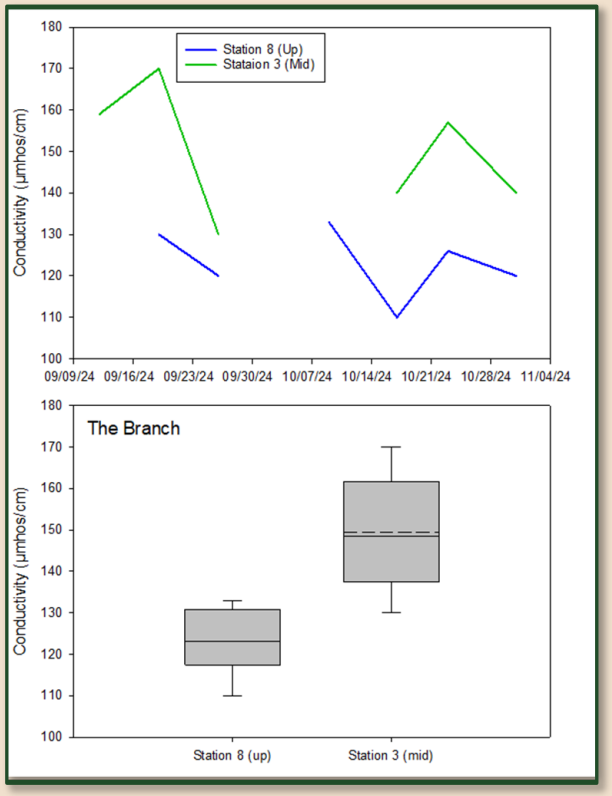
Water Quality Results – The Branch

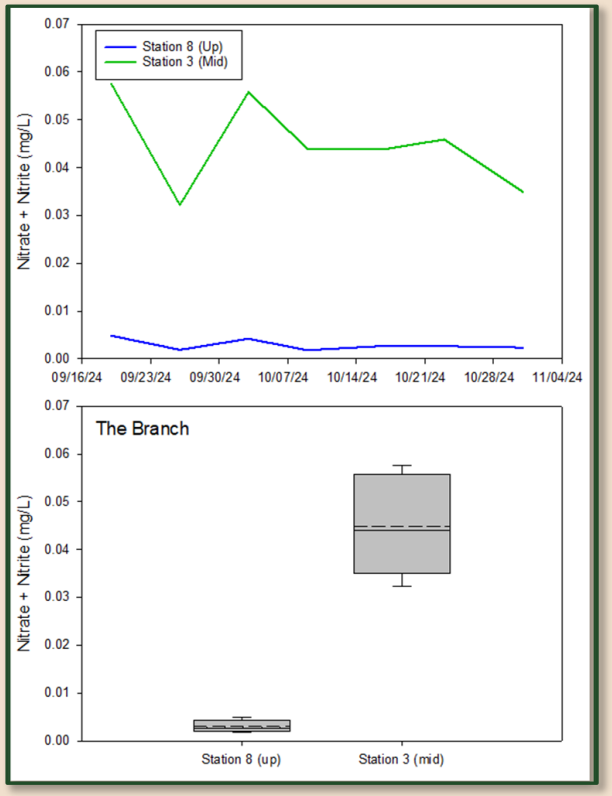
Chloride



Conductivity



Nitrate-Nitrite



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Microbial Source Tracing – DNA Human associated bacteroidetes

The Branch

- Highest value was upstream along Route 9N
  - 87 gene copies per mL
- Only other detect was below Barton Brook
  - 1.7 gene copies per mL

- High upstream likely due to proximity to a convenient pull-off

- Promising Technique but
  - Expensive
  - Laborious collection technique

Barton Brook

- Below Detection

Essex County Parking Lot

- Not Tested

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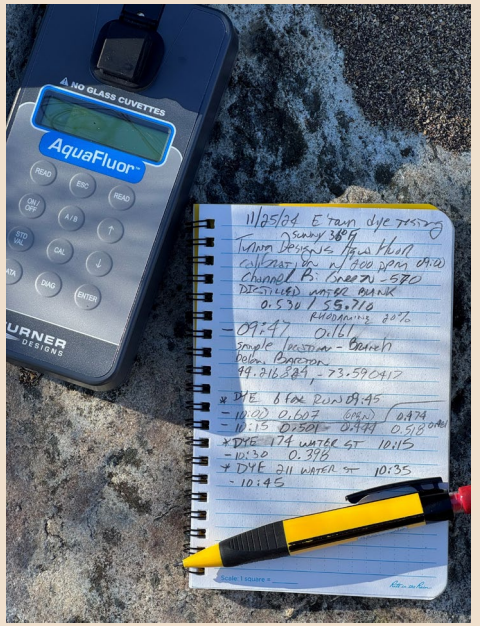
Dye Testing

- Rhodamine Dye
- Seven Properties with systems close to The Branch or Barton Brook
- Continual monitoring in The Branch below Barton Brook
- Edge of bank testing on one system on Barton Brook



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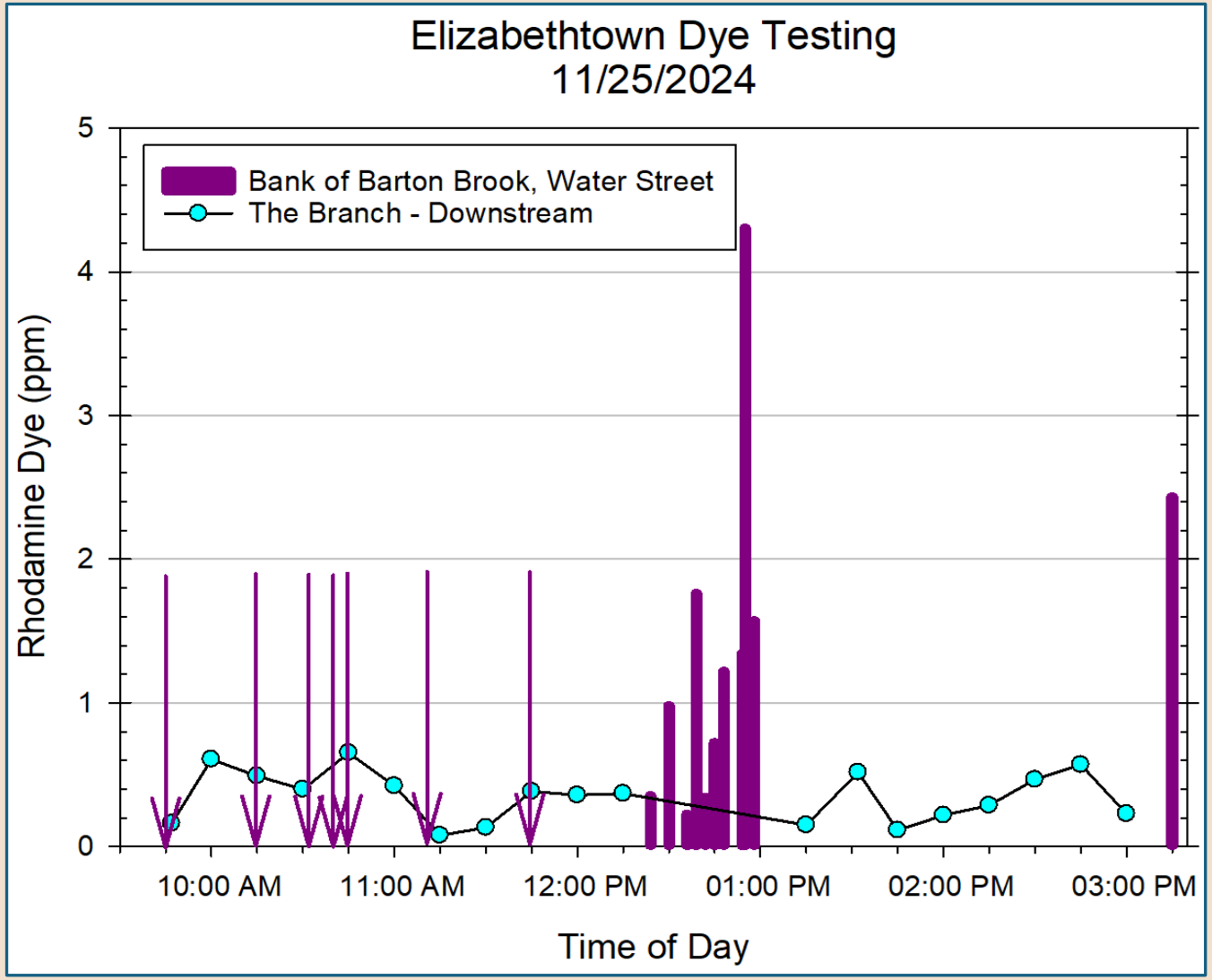
Dye Testing



Bank Readings (ppm)	Background (ppm)
0.983	0.387
1.764	0.274
0.727	0.396
1.221	0.322
1.344	0.356
4.307	0.228
1.573	0.347
2.437	

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The Solution: Wastewater Collection & Treatment System

- Gravity Mains
  - 4.2 miles of 8-inch PVC
  - 0.8 miles of 12-inch PVC
  - 1.0 mile of 12-inch effluent line
- Gravity Sewer Laterals
  - 4-inch PVC homes
  - 6 or 8-inch PVC for commercial or municipal
- Force Mains
  - HDPE or Ductile Iron
  - 2,073 feet of 6-inch
  - 4,843 feet of 8-inch
- 5 Main Pump Stations
  - Hand Avenue
  - Woodruff Street
  - Community Center
  - Noble Terrace
  - Footbridge Lane
- 15± Grinder Pump Stations
  - Individual homes
  - 1.25-inch or 2-inch HDPE

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Case Study: Two Adirondack Lakes

On-Site Septic Systems

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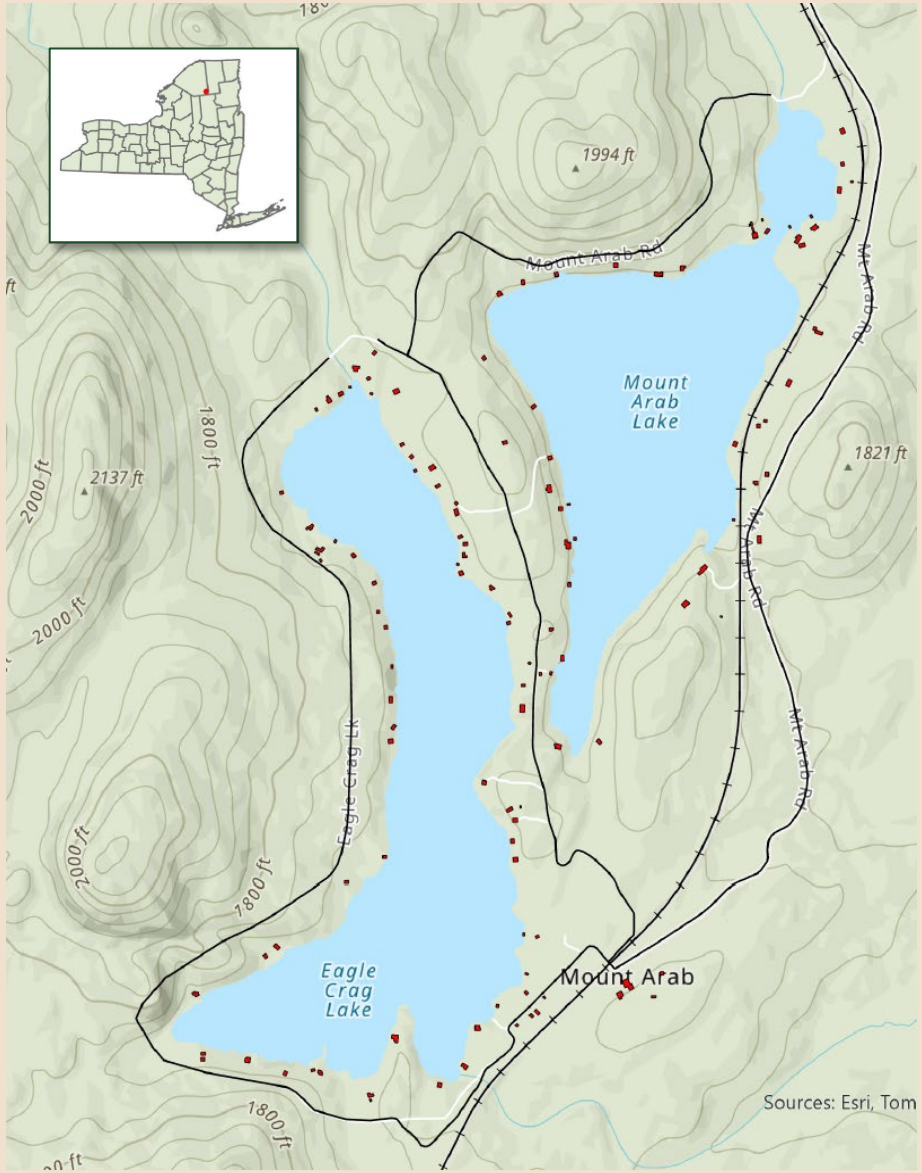
Meet the Lakes



Mount Arab Lake

- Surface Area: 115 acres
- Lake Elevation: 1,659 feet
- Maximum Depth: 60 feet (18 meters)
- Number of Camps: 70±

Eagle Crag Lake

- Surface Area: 149 acres
- Lake Elevation: 1,683 feet
- Maximum Depth: 50 feet (15 meters)
- Number of Camps: 48±

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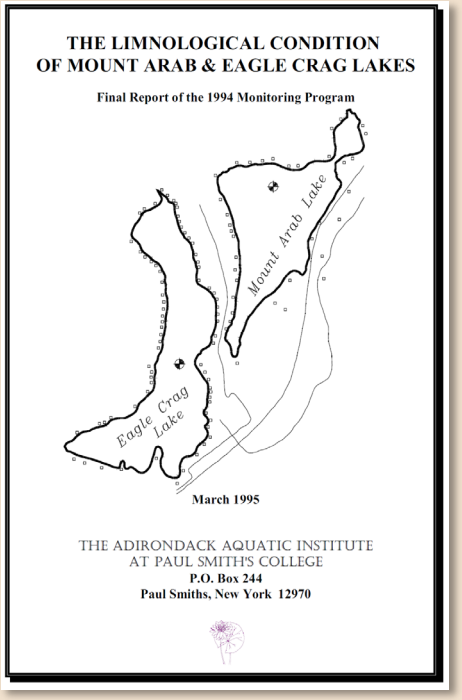
Monitoring History

- 1986-1990: CSLAP, Eagle Crag Lake only
- 1992-present:
  - Conducted by Michael R. Martin, CLM under various firms
- 2026 will be 35th year


THE LIMNOLOGICAL CONDITION
OF MOUNT ARAB & EAGLE CRAG LAKES

Final Report of the 1994 Monitoring Program

Mount Arab Lake

Eagle Crag Lake

March 1995

THE ADIRONDACK AQUATIC INSTITUTE
AT PAUL SMITH'S COLLEGE
P.O. Box 244
Paul Smiths, New York 12970


Mount Arab & Eagle Crag Lakes
2017 Water Quality Monitoring Report
Piercefield, St. Lawrence County, NY

Prepared for:

Mount Arab Preserve Association
Attn: Terry Silvester, Water Quality Chair
18 Mount Arab Lake
Tupper Lake, NY 12986

Prepared by:

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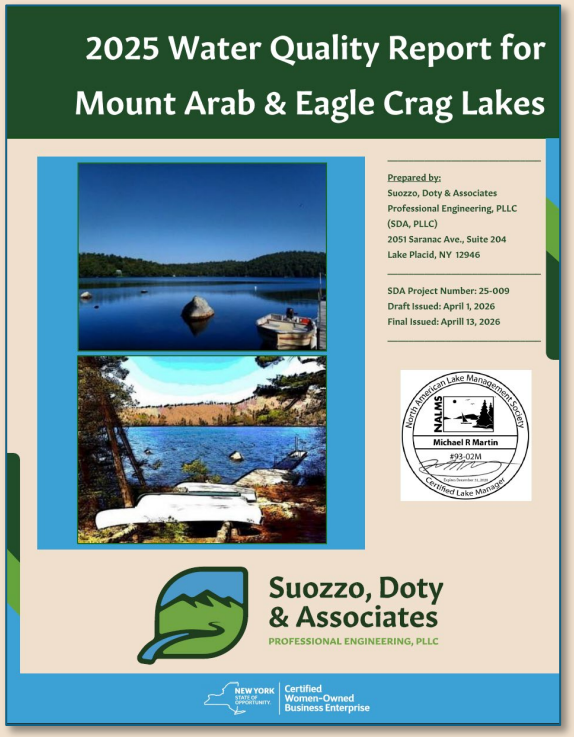
Established 2001

March 29, 2018


2025 Water Quality Report for
Mount Arab & Eagle Crag Lakes

Prepared by:
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2051 Saranac Ave., Suite 204
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SDA Project Number: 25-009
Draft Issued: April 1, 2026
Final Issued: Aprill 13, 2026

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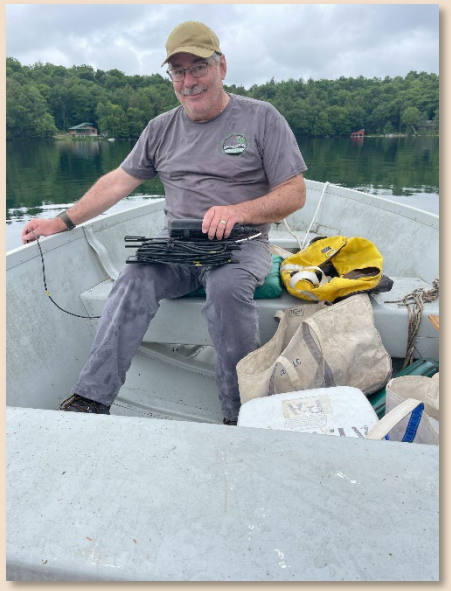
Monitoring Program

- Once per month: June, July & August
- Deepest point of each lake
- Two depths
  - Epilimnion (1.5 meters below surface)
  - Hypolimnion (1.5 meters above sediments)
- pH, Alkalinity, Conductivity, Chloride
- Total phosphorus, Nitrate/Nitrite
- Chlorophyll-*a*
- Transparency
- Dissolved oxygen & temperature profiles



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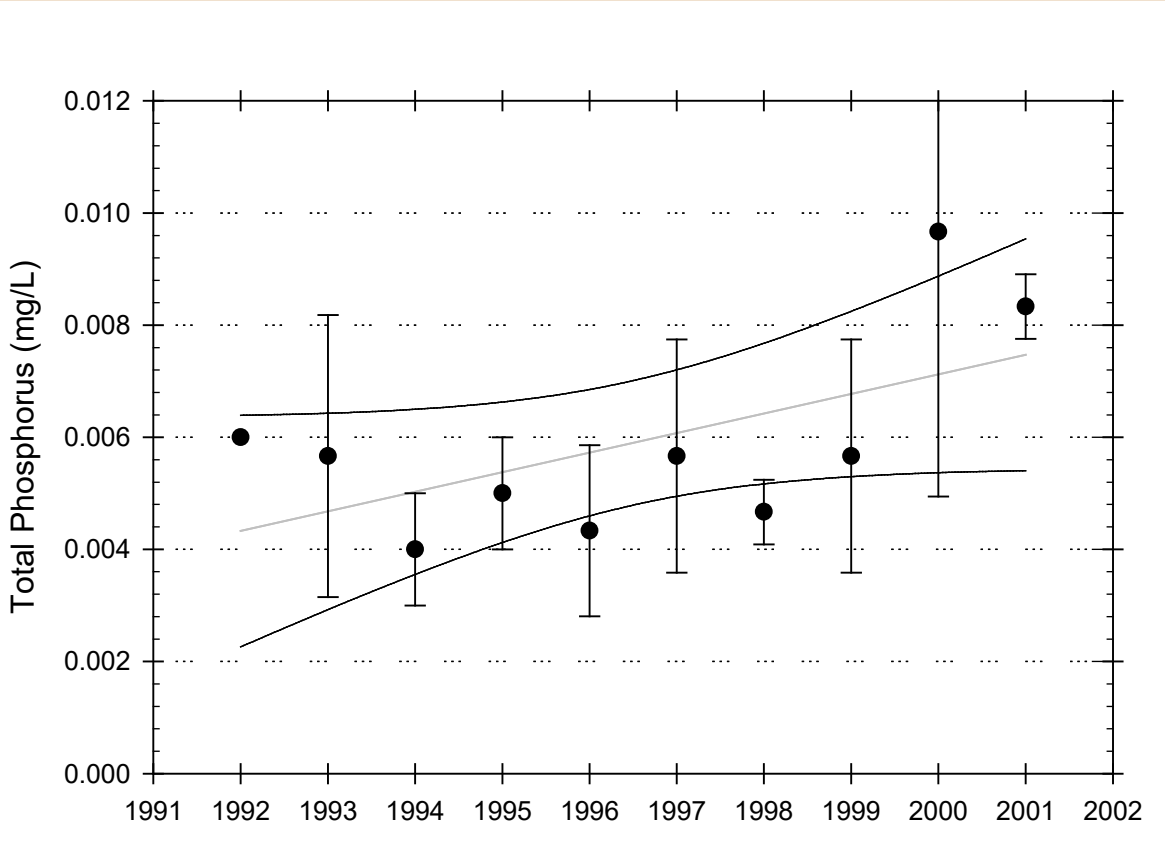
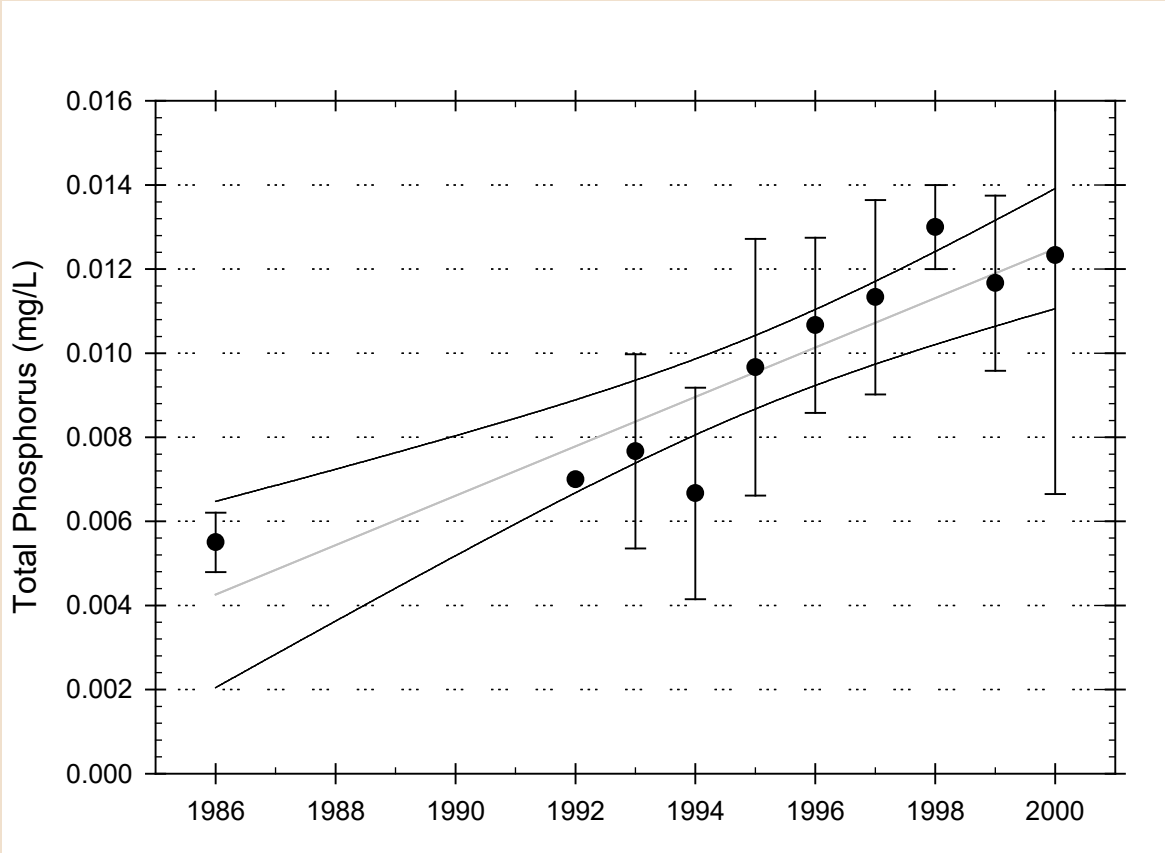
Septic Systems – Total Phosphorus

Mount Arab Lake



Eagle Crag Lake



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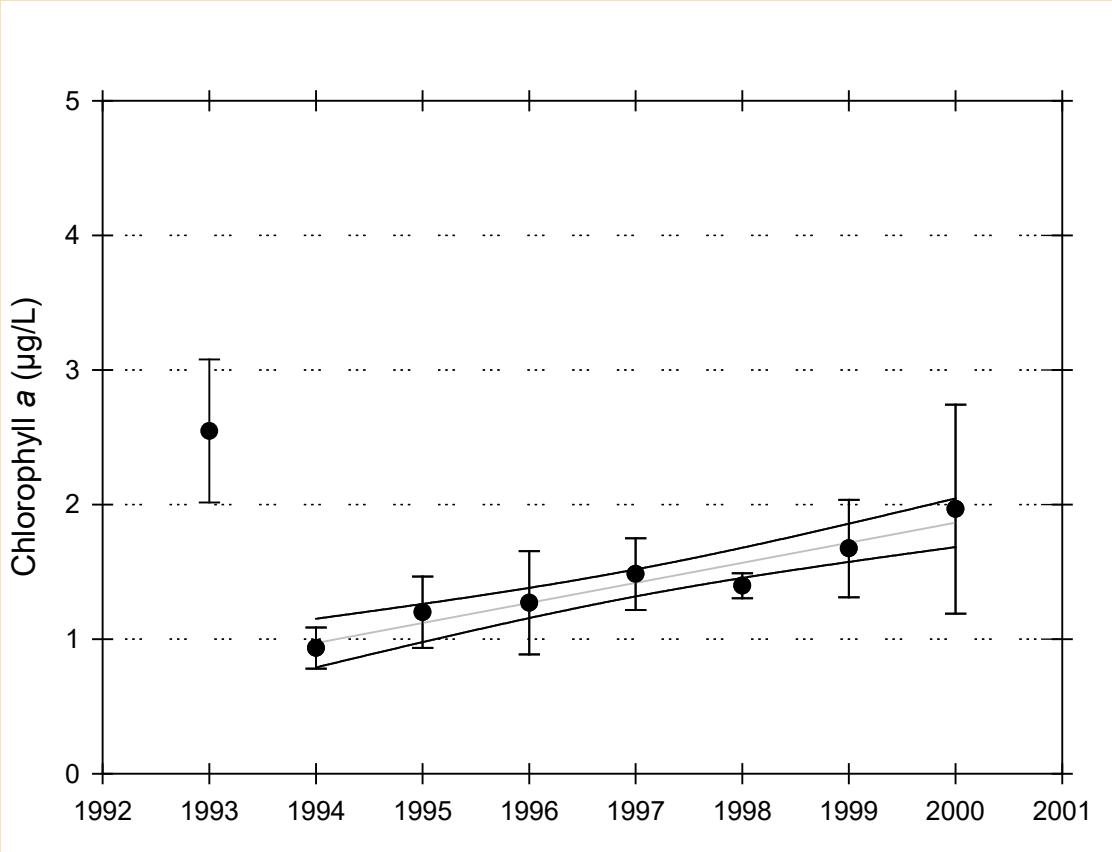
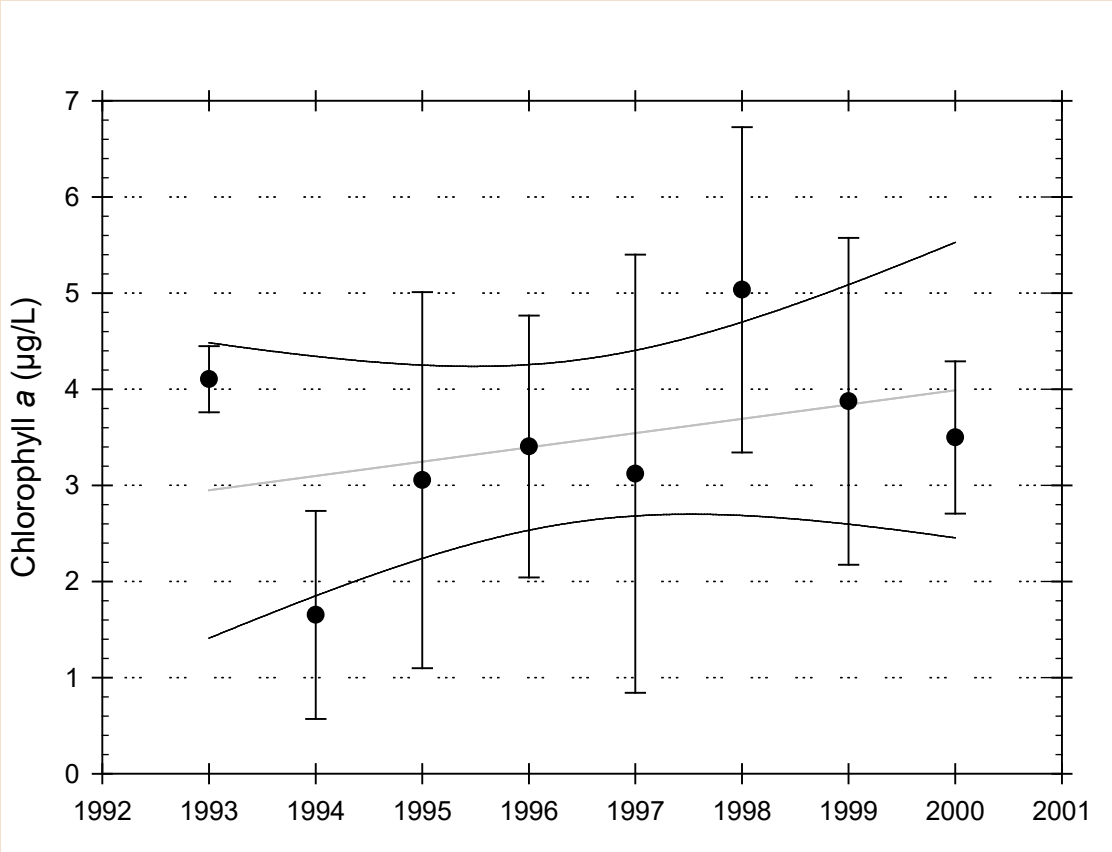
Septic Systems – Chlorophyll-*a*

Mount Arab Lake



Eagle Crag Lake



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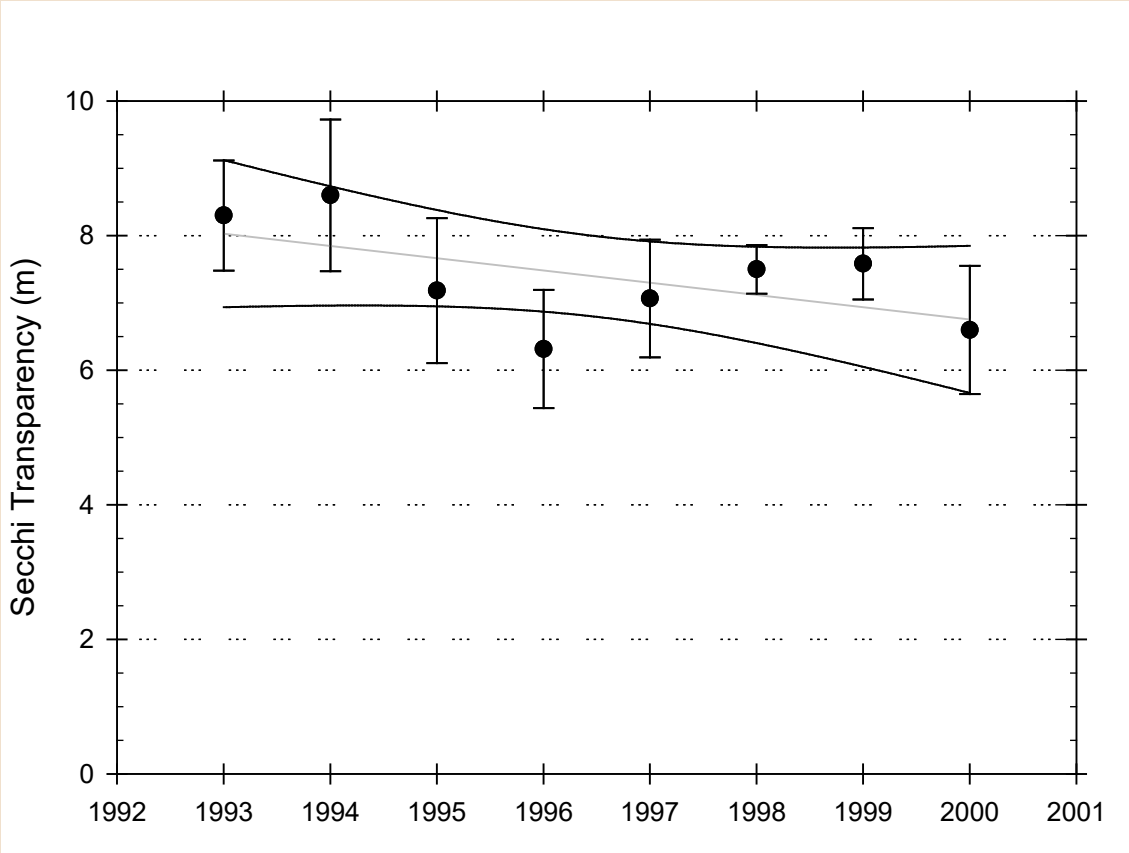
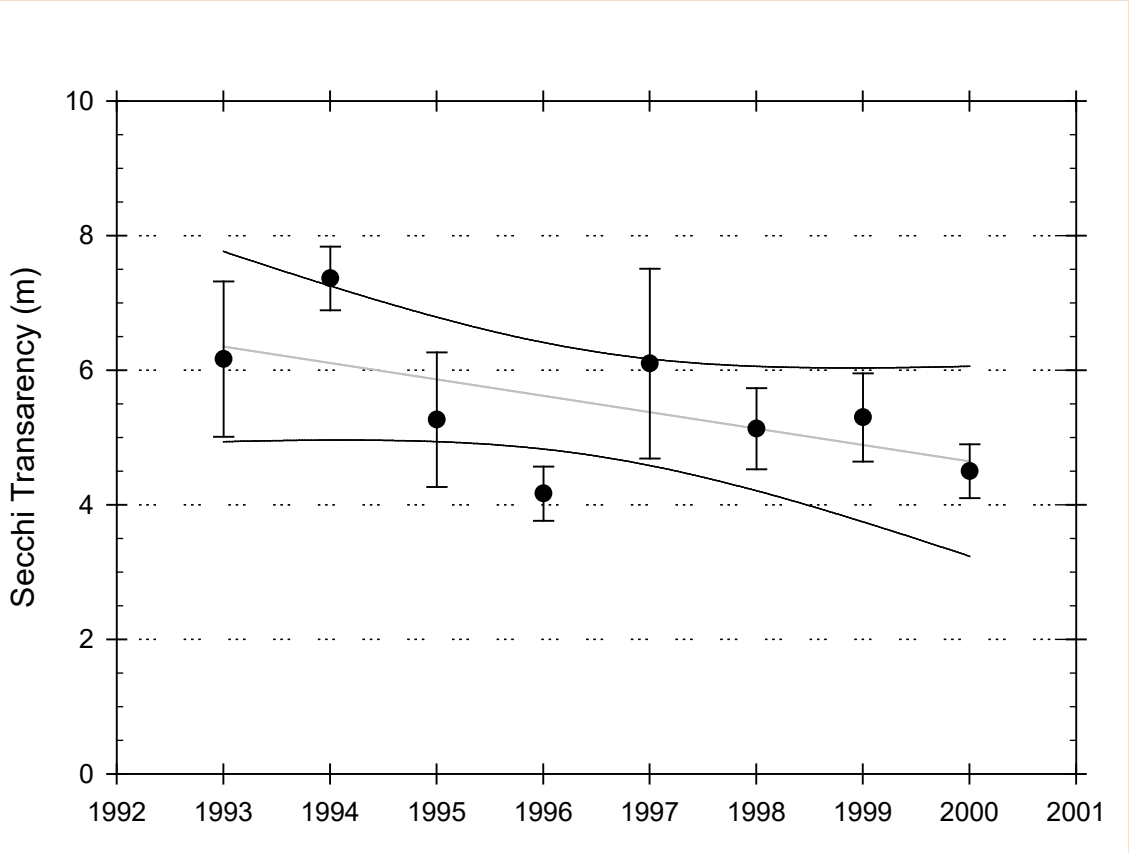
Septic Systems – Secchi Disk Depth (Transparency)

Mount Arab Lake



Eagle Crag Lake



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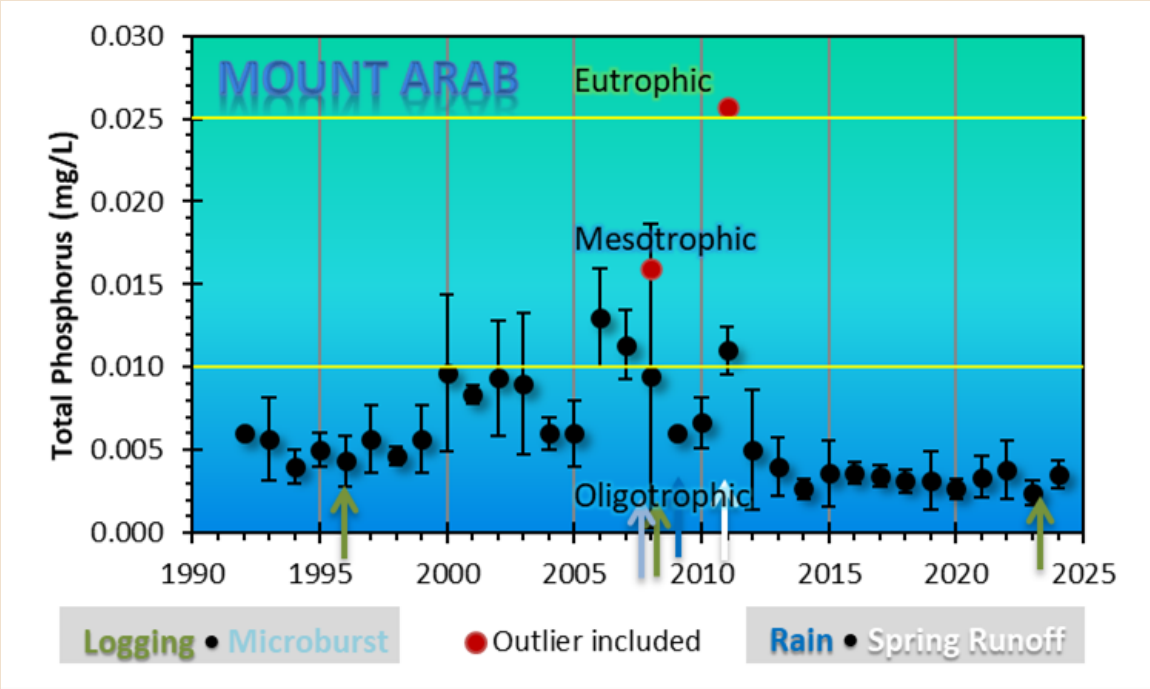
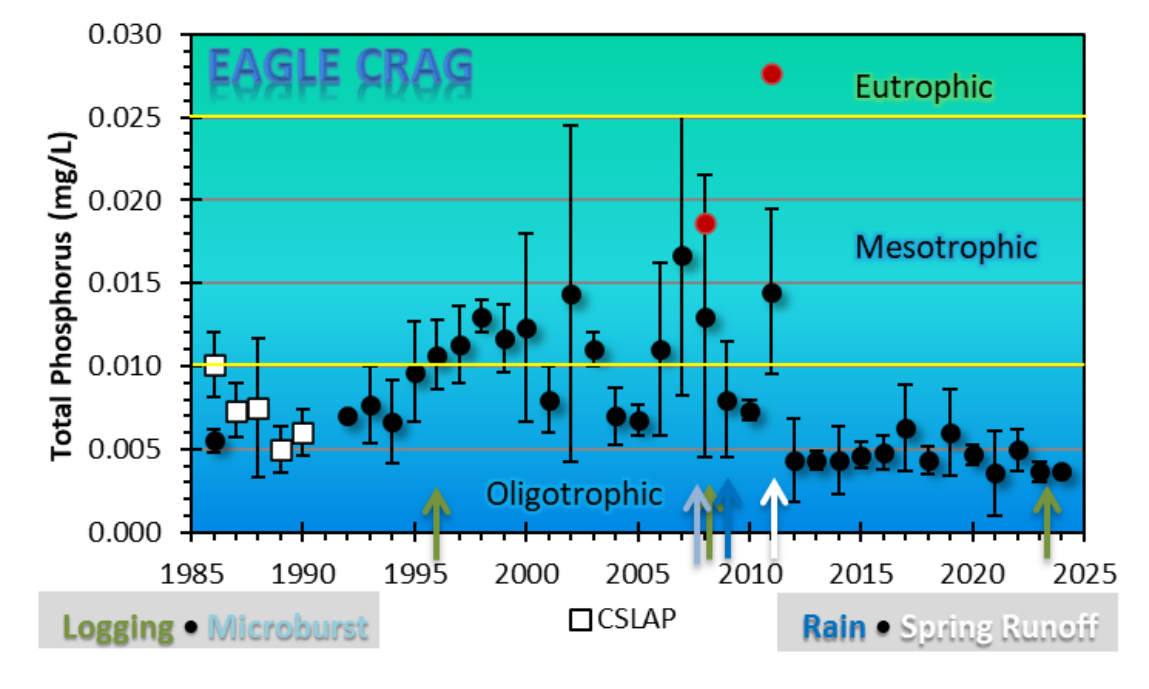
Solution: Replace Standard Systems w/Composting Toilets

- In the late-1990s a major campaign was started to replace standard on-site septic systems with composting toilets.
- Most went with central composting toilets, like the Sun-Mar, with chamber below cabin.
- Inside bathrooms look normal.
- Residents found they had to add biomass to the system due to low volumes of use
- Separated grey water from black water
- Had to work with code enforcement officers and Dept of Health to get approval for grey-water system discharges
- Gray water leach fields had to meet standard code in case system was ever converted back

Epilimnetic Total Phosphorus Trends





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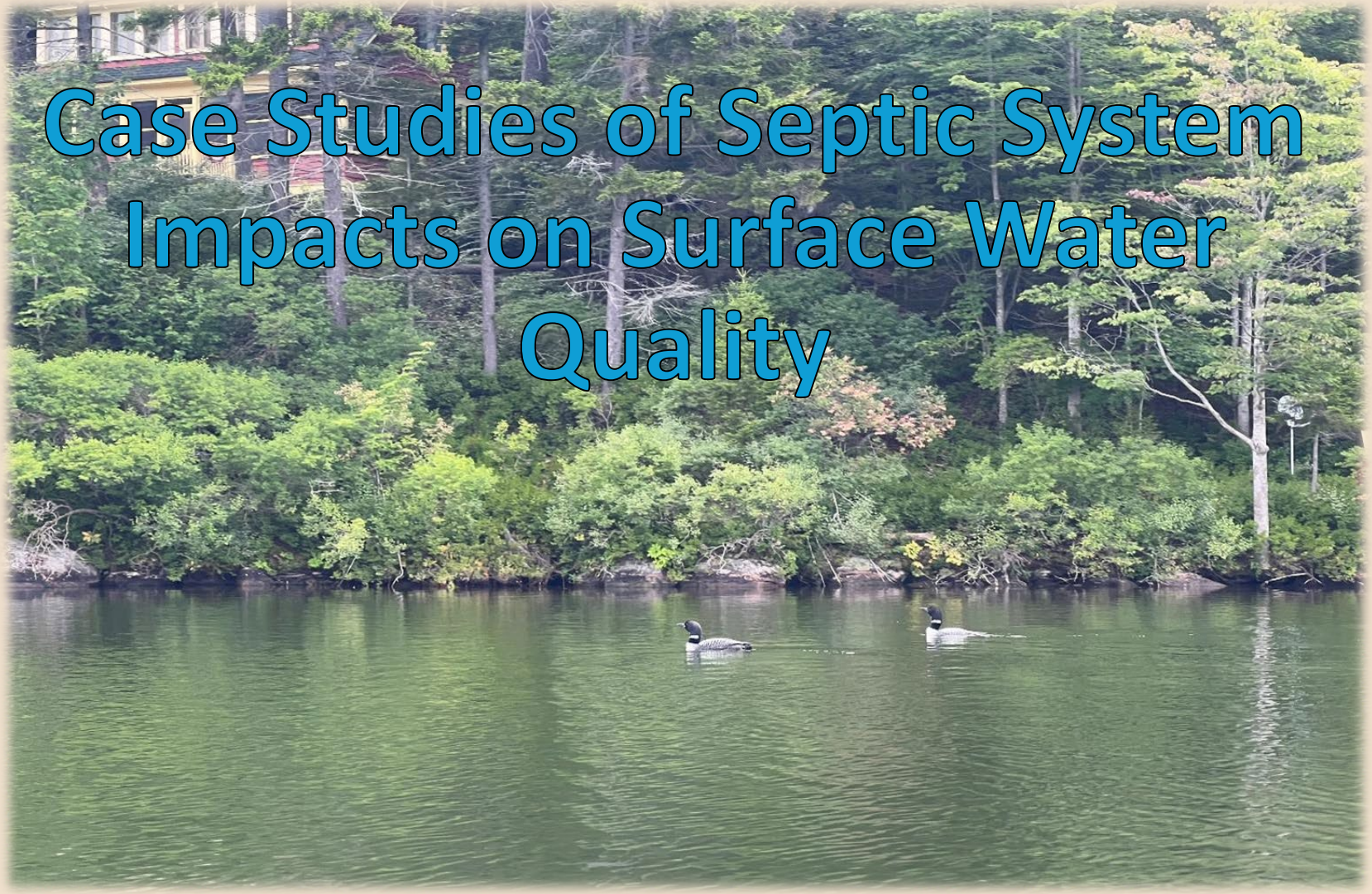
Conclusions

- Old septic systems can negatively impact water quality
  - Replacing them can positively impact water quality
- Sampling for more than bacteria is important, particularly in a lake environment
- River/Stream detection is easier to do
  - Direction of flow versus complicated mixing in lakes and pond
- Long-Term Monitoring is necessary to detect water quality trends in lakes

Questions



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