



2023 Ticklenaked Pond LaRosa Monitoring Results

Water Quality Review

Monitoring Highlights



7 sites monitored in 2023

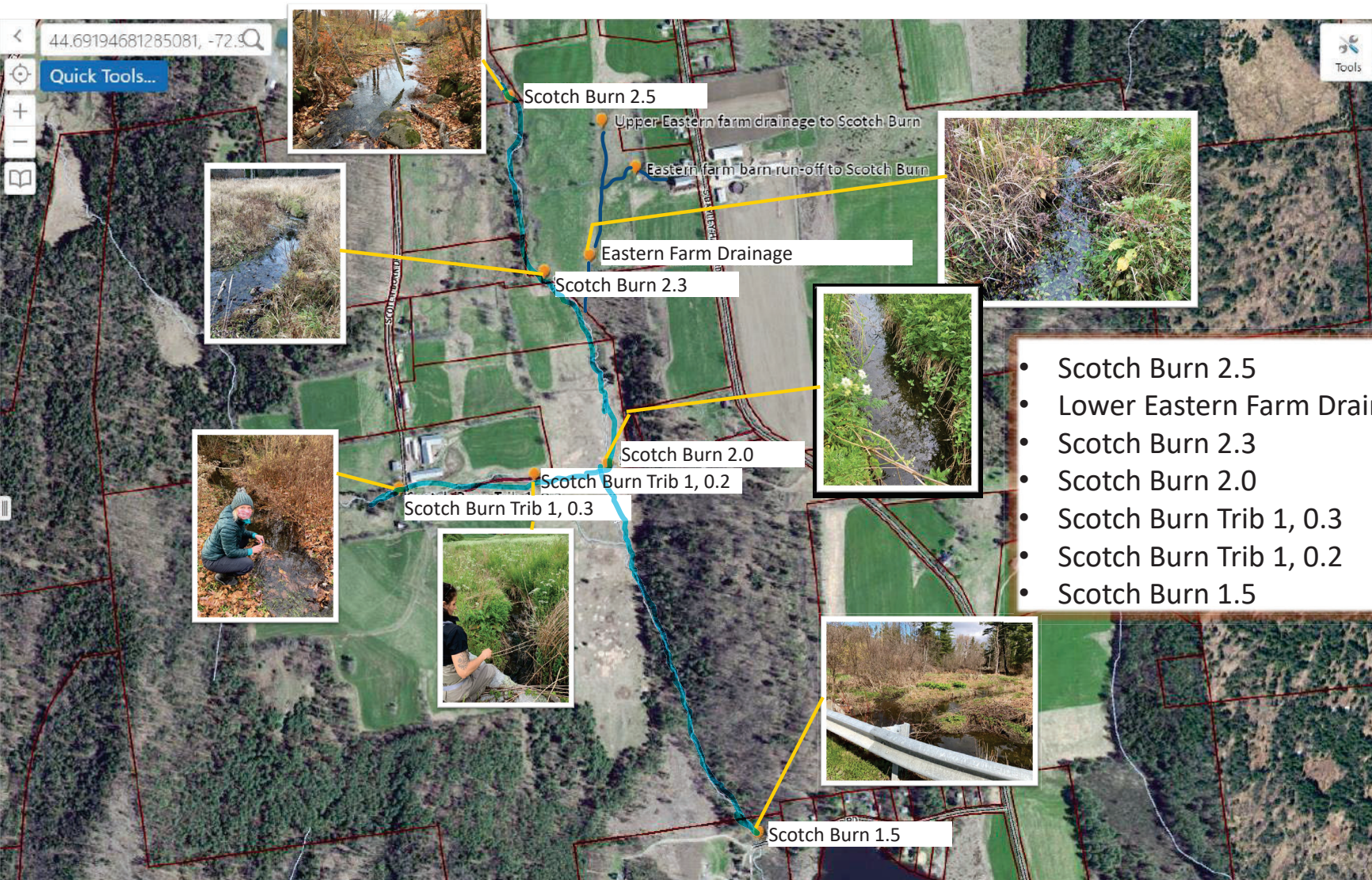
- Scotch Burn 2.5
- Lower Eastern Farm Drainage to Scotch Burn
- Scotch Burn 2.3
- Scotch Burn 2.0
- Scotch Burn Trib 1, 0.3
- Scotch Burn Trib 1, 0.2
- Scotch Burn 1.5

8 sampling events from May to August at same locations as 2022

Farmstead practices on the West Tributary have been effective

Eastern Farm Drainage likely still contributing significant loading

Site Location Map



- Scotch Burn 2.5
- Lower Eastern Farm Drainage to Scotch Burn
- Scotch Burn 2.3
- Scotch Burn 2.0
- Scotch Burn Trib 1, 0.3
- Scotch Burn Trib 1, 0.2
- Scotch Burn 1.5

Chemical Parameters – Phosphorus & Nitrogen

Total Phosphorus

- Impacts
 - Fuels cyanobacteria blooms that can be toxic
 - Swimming use
- Sources
 - Developed land runoff, roads, driveways
 - Fertilizers – lawn and agriculture
- Vermont Water Quality Standards
 - Ranges from 12-27 ug/L (ppb)
 - 12 ug/L for small high gradient streams
 - Based on baseflow conditions

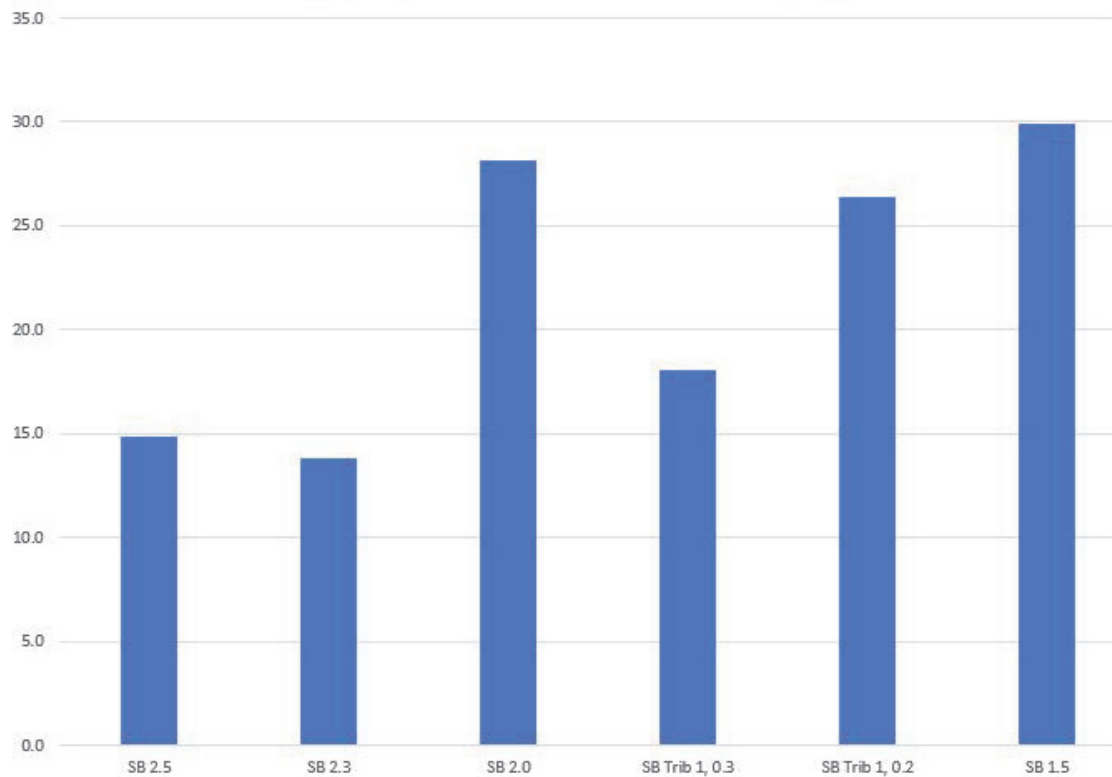
Total Nitrogen

- Impacts
 - Can fuel specific types of cyanobacteria blooms
 - Too much nitrogen, as nitrate, in drinking water can be harmful to young infants or young livestock.
- Sources
 - Fertilizers – lawn and ag
 - Sewage
- Vermont Water Quality Standards
 - Not to exceed 5.0 mg/l as nitrate, in Class B(1) and B(2) waters.
 - Not to exceed 2.0 mg/l as NO₃-N at flows exceeding low median monthly flows, in Class A(1) and A(2) waters at or below 2,500 feet altitude, National Geodetic Vertical Datum.



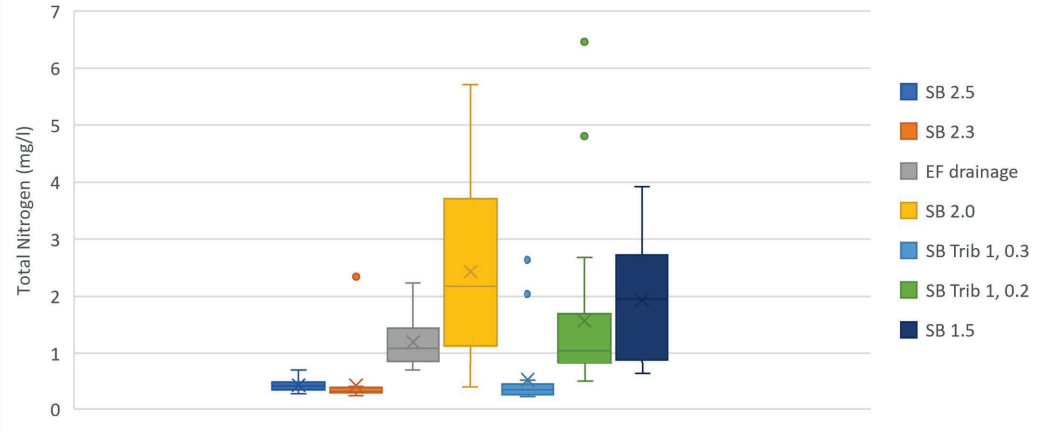
Scotch Burn Sampling Overview

Average phosphorus concentrations over all sampling dates

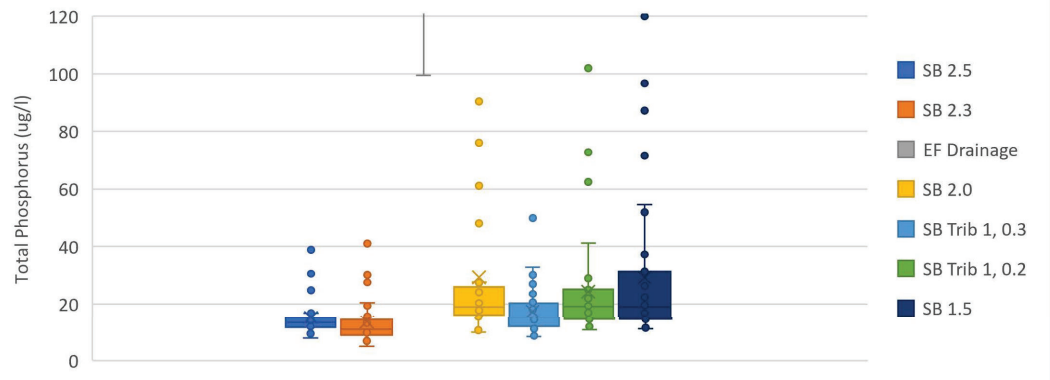




Box Plot of total Nitrogen from 2012 - 2022

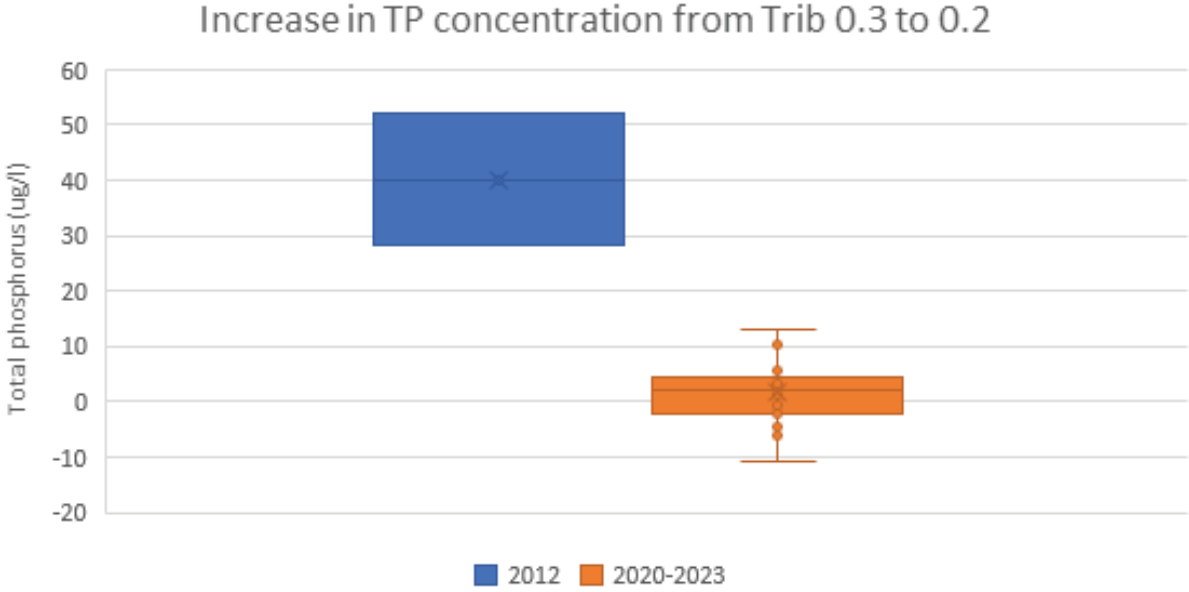


Box and Wisker Plot of phosphorus concentrations at all sites except Eastern Farm Drainage (off the chart with an average of 720 ug/l)



West Tributary WQ improvements since 2012

Farmstead practices completed after 2012 have significantly reduced phosphorus loading from the tributary.



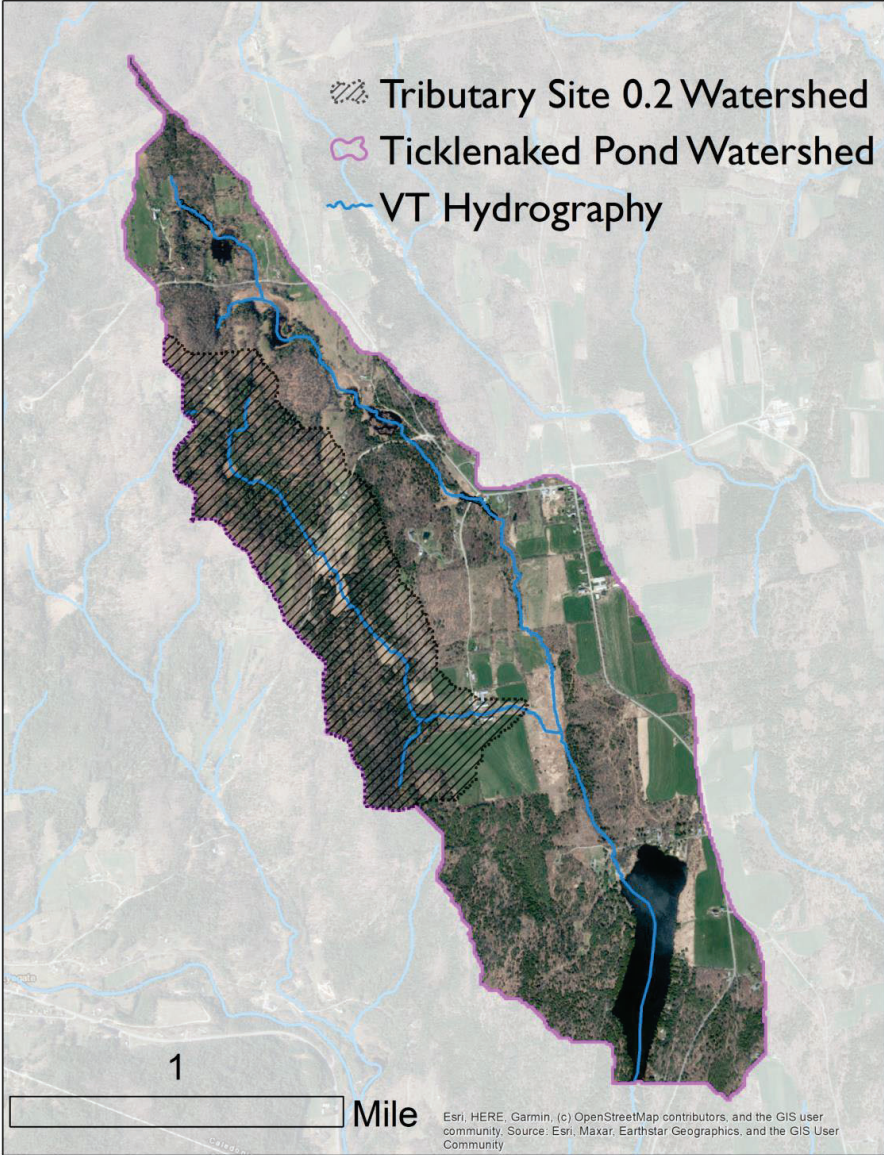
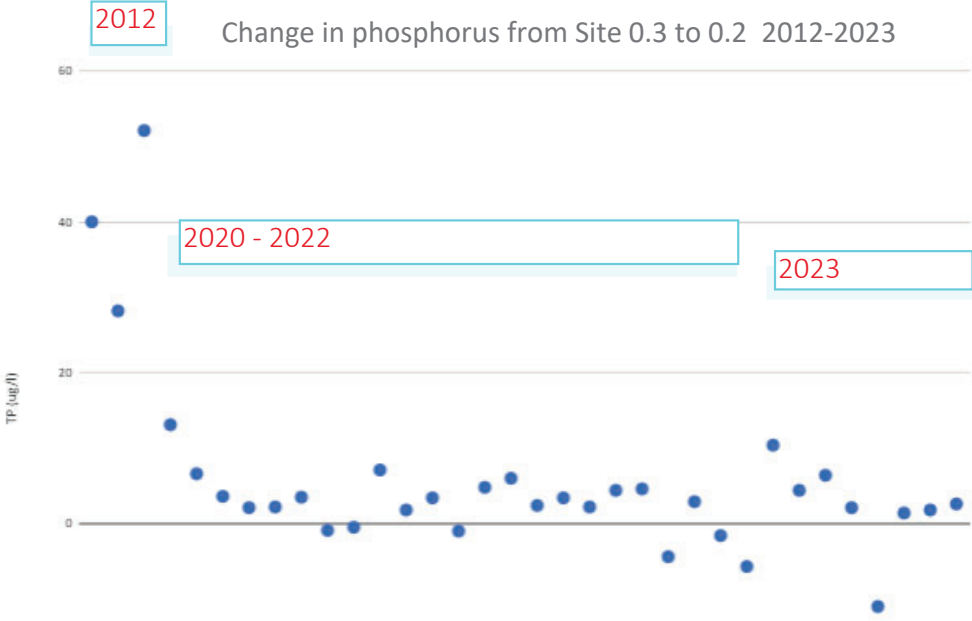
Samples on this stream were taken just above and below the farmstead.

The improvement was evaluated by looking at the reduction in the increase from site 0.3 to 0.2, where this was REDUCED from an average 38ug/l increase in 2012 (126%) to an average 3ug/l increase (16%) in 2023.

West Tributary, ctd

There are lots of assumptions necessary to evaluate reductions, but analysis suggests a **significant reduction from 2012 to 2023**.

This tributary makes up 26% of the Ticklenaked pond watershed and so these water quality improvements could represent on the order of a 10-15 % reduction in P loading to the Pond (depending on loading rate of other tributaries) as an extremely rough estimate.



Statistical analysis assumptions and qualifiers (lots of them..)

Qualifiers

1) Sampling design

In 2012, sampling only included 2 high flow events and 2 base flow events and only 3 dates at the upper site.

Only 3 sample dates sampled in 2020.

Consistent sampling approach in 2021-2022 incl. 2 targeted flow events plus 8 base flow samples aka flow targeting was done in 2012.

2) Seasonality and flow variability

2022/23 sampling dates did not include fall season.

Elevated flow conditions in 2023 may have had an impact on concentrations.

3) Limited sampling data in 2012 which is our only “pre” data

Analysis

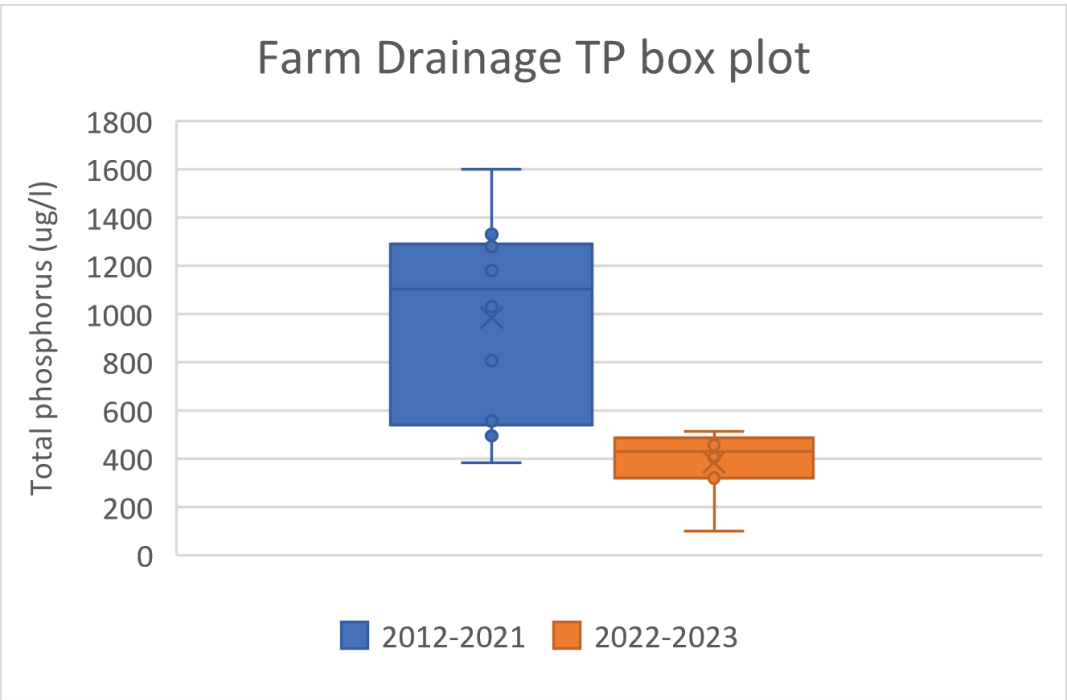
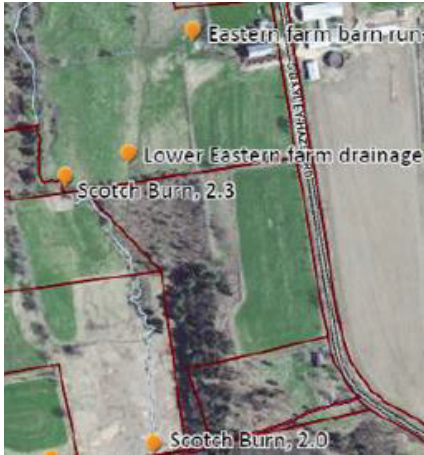
1) T-test

A basic student's T-test suggests that reductions between 2012 and 2020 - 2023 are statistically significant (p-value 0.03). However, with only 3 sets of data in 2012, this evaluation method may not be appropriate

2) Flow = to watershed size

Relative loading to Pond calculated assuming the flow at each sample is proportionate to the watershed size, which may not be the case for the much smaller Eastern Farm Drainage

Eastern Farm Drainage WQ Improvements since 2022?

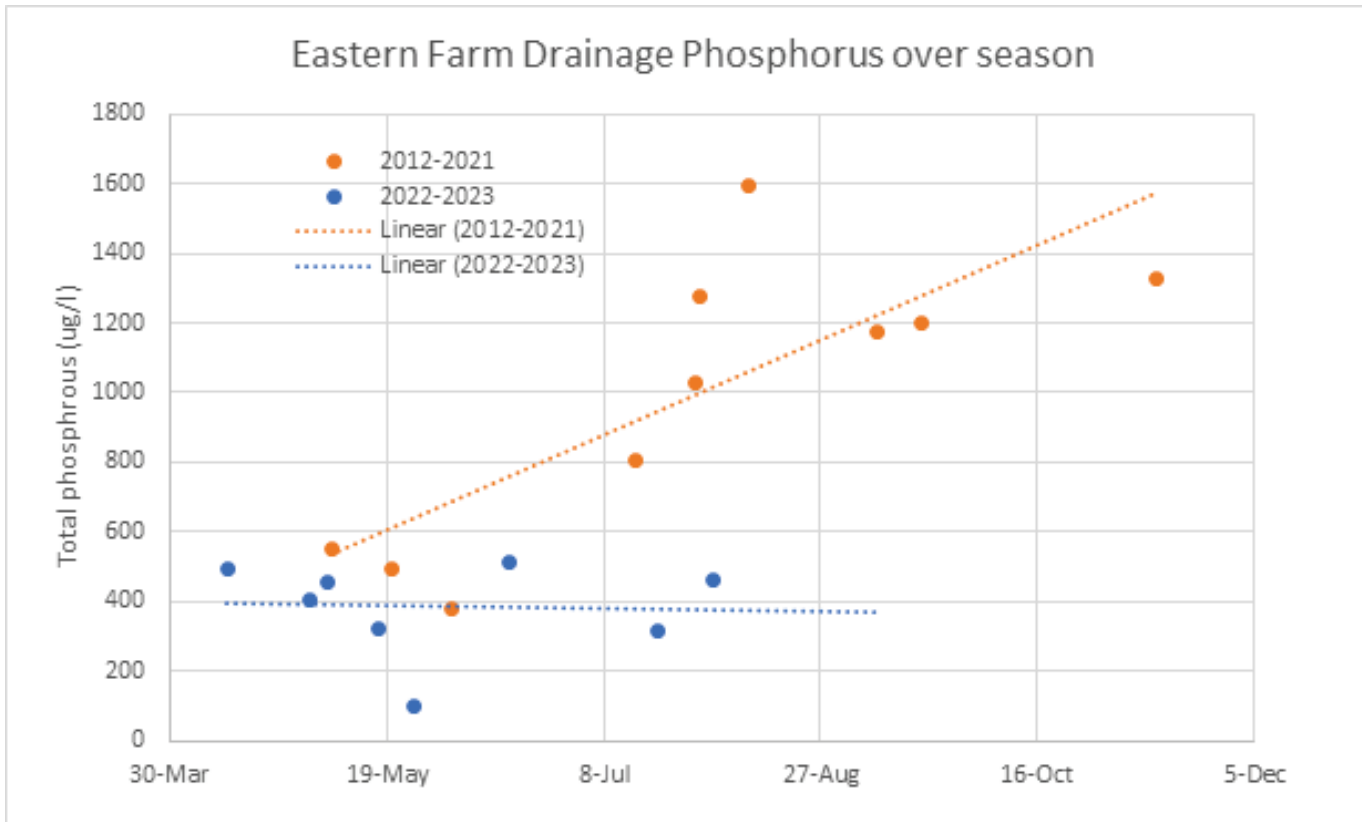


Some indications that farmstead work / management decisions in the Eastern Farm drainage watershed may have reduced phosphorus loading

The average concentration dropped from 1360 in 2020/2021 and 826 in 2022/2023.

However...

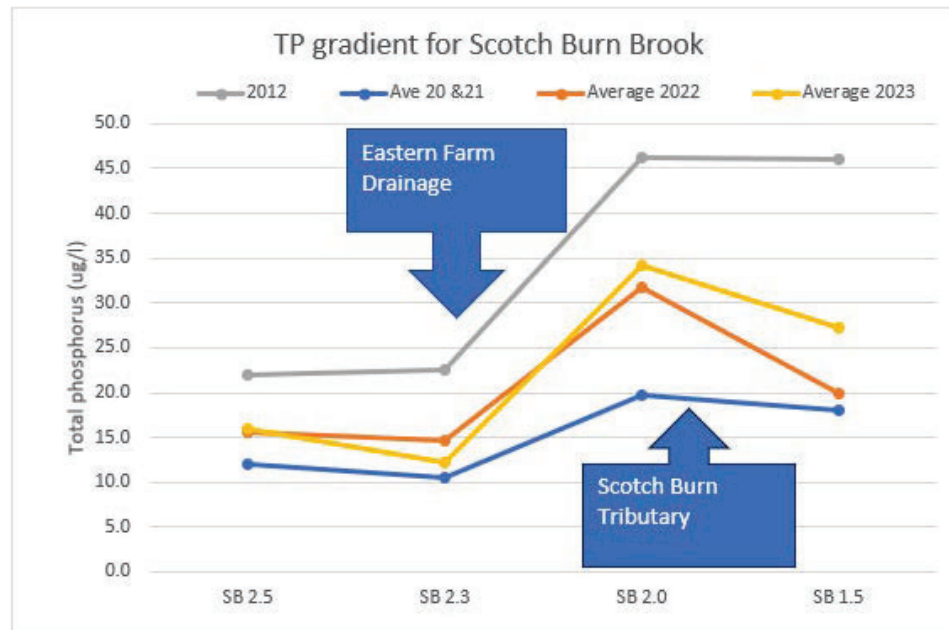
Eastern Farm Drainage Seasonality



- ... complicated by differences in sampling season in 2022/2023 AND a strong seasonal relationship where higher concentrations are seen on this drainage in late summer and fall.
- Elevated flow conditions in 2023 may also have had an impact on concentrations during this last year.
- Concentrations still seem to trend higher later in the year which suggests more of a point source.

The gradient down Scotch Burn Tributary shows an increase from above to below Farm Drainage.

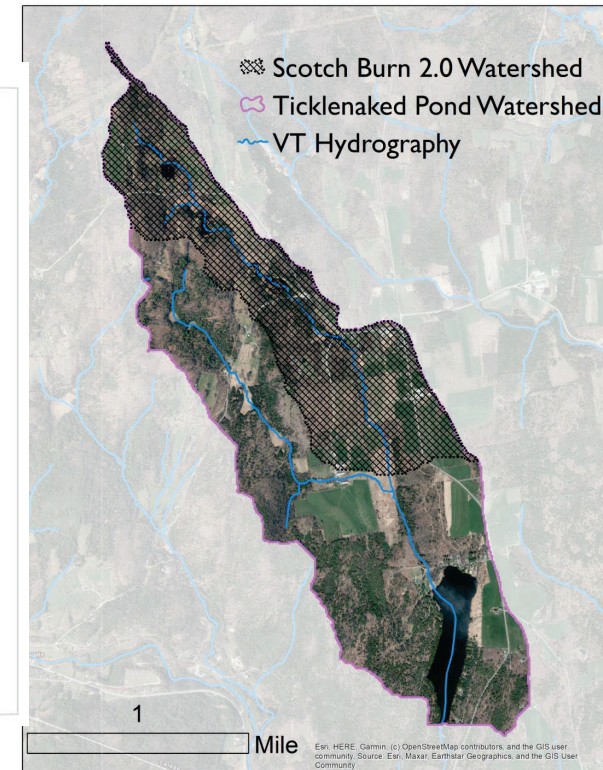
- Phosphorus concentrations double on average from site 2.3 to site 2.0 and this is consistent across all years (14 to 29ug/l)
- The watershed of Scotch Burn Brook at this location is 39% of the Ticklenaked Pond watershed.
- Could be 20 – 30% in loading between sites 2.0 to 2.3. The majority appears to be from the Eastern Farm Drainage



Site on Scotch Burn Brook

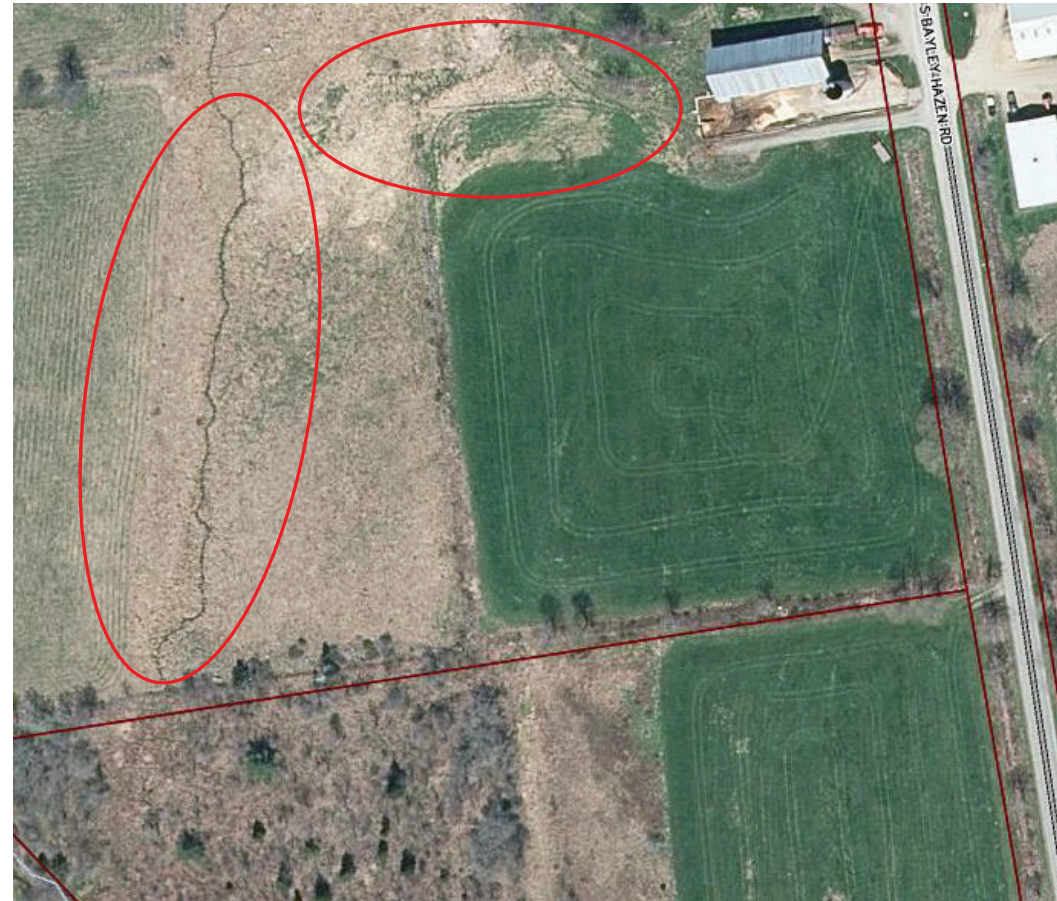
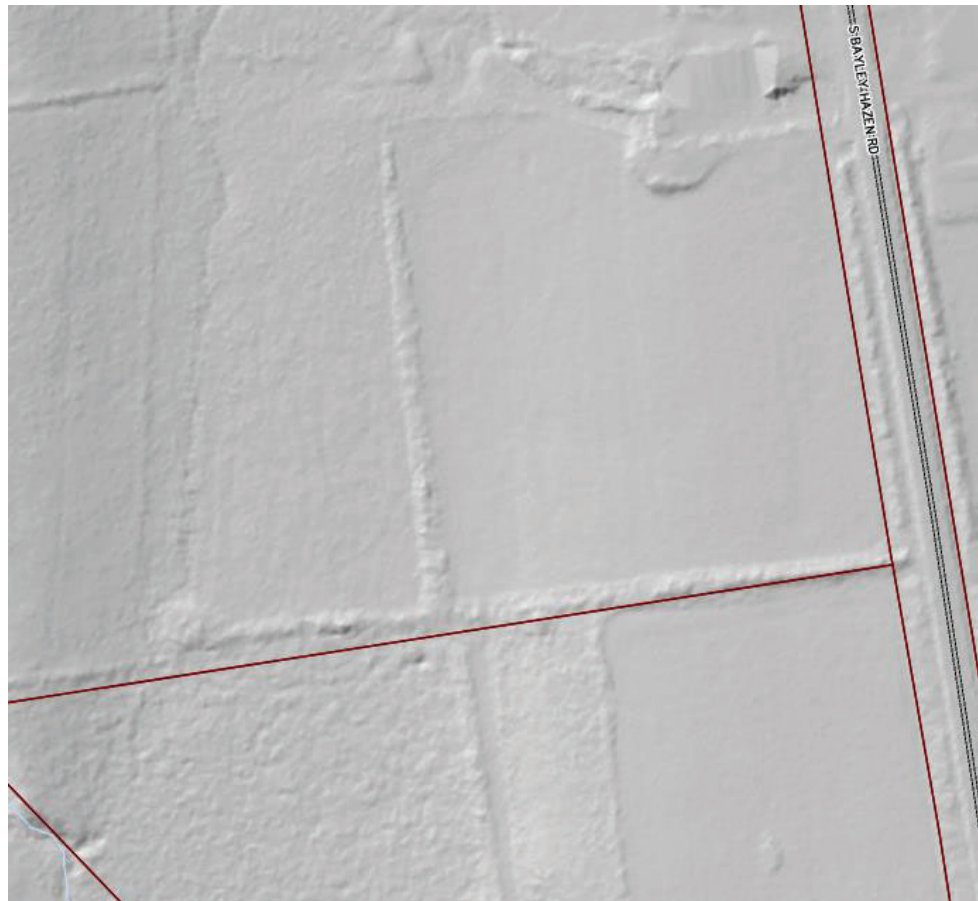
UPSTREAM

DOWNSTREAM



Eastern Farm Drainage Loading Sources

Phosphorus may continue to be elevated in the farm drainage due to nutrient storage in the pond, wet pasture, and farm drainage or an unknown source. Some reductions were seen in 2022/2023 but more data across variable flow conditions and seasonality is needed.



Recommendations
for 2024
Ticklenaked
Tributary
Monitoring

- Drop West Tributary sites from monitoring
- Continue sampling the Scotch Burn and EF Drainage
- Observe landowner management as other possible contributing P source

