



# Northeast Aquatic Research



74 Higgins Highway  
Mansfield Center, CT 06250  
www.northeastaquaticresearch.net

April 10<sup>th</sup>, 2026

TO: The Town of Bolton

FROM: Hannah Moore, Administrative Manager

CC: George Knoecklein, Owner, Principal Limnologist

**Re: Lower Bolton Lake 2025 Water Quality and Aquatic Plant Monitoring Results**

## Discussion of 2025 Water Quality Results

The water quality data included in this summary is assessed using the CT DEEP categorization of lakes, which is primarily based on the amount of nutrients in surface waters during summer conditions (**Table 1**). Due to constraints of chlorophyll analysis, we typically assess lake status based on total phosphorus, total nitrogen, and Secchi depth (water clarity) only.

The goal for Lower Bolton is oligo-mesotrophic, meaning surface water TP and TN concentrations below 15ppb and 300ppb respectively, and a Secchi depth of 4 meters or deeper.

The Friends of Bolton Lakes (FBL) collected water quality data biweekly from early May through mid-October. The bi-weekly data collection included water clarity, weather data, and in-situ profiles of temperature, dissolved oxygen, and conductivity. Water samples were collected once per month for analysis of the nutrients total phosphorus and total nitrogen. From June through October, the bottom water samples were also analyzed for total iron.

*Table 1. Parameters and defining ranges for trophic states of lakes in Connecticut.*

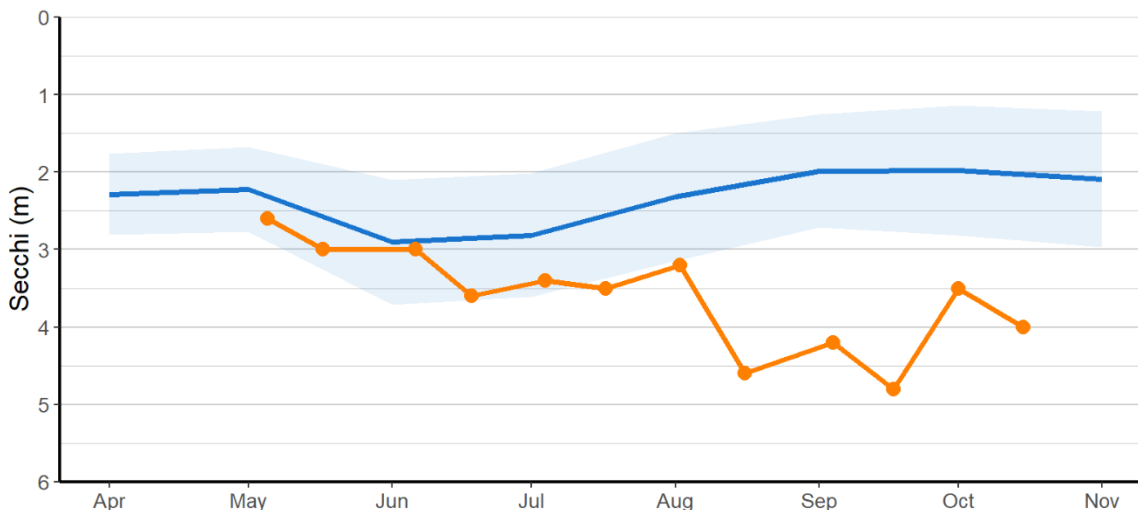
Category	Total Phosphorus (ppb)	Total Nitrogen (ppb)	Secchi Depth (m)	Chlorophyll a (ppb)
Oligotrophic	0 -- 10	2 -- 200	6 +	0 -- 2
Oligo-mesotrophic	10 -- 15	200 -- 300	4 -- 6	2 -- 5
Mesotrophic	15 -- 25	200 -- 500	3 -- 4	5 -- 10
Meso-eutrophic	25 -- 30	500 -- 600	2 -- 3	10 -- 15
Eutrophic	30 -- 50	600 -- 1000	1 -- 2	15 -- 30
Highly Eutrophic	50 +	1000 +	0 -- 1	30 +

## Water Clarity

Water clarity in 2025 was very good compared to recent years. The Secchi disk measurements in May and early June were closer to average, ranging from ~2.5 to 3m (**Figure 1**). Mid-June through early August had some of the best readings since 2020. The water clarity from mid-August through mid-September was exceptional for Lower Bolton. The August 16<sup>th</sup> and September 17<sup>th</sup> readings (4.6m and 4.8m respectively) are the best readings on record since NEAR began monitoring the lake in 2011. Water clarity declined to 3.5 meters in early October, still much better than the long-term average of 2 meters for that time of the year. The unprecedented water clarity

in 2025 led to improvements in several other parameters, including lower internal loading and significantly better dissolved oxygen in deeper water.

Figure 1. 2025 Secchi disk depths (orange line) and the long-term average for Station 1 (blue line, with shading depicting +/- one standard deviation from the mean).



## Water Temperature and Dissolved Oxygen

The water depth at the deep spot sampling station ranges from 5.5-6 meters depending on water level. The dissolved oxygen and water temperature probe used by FBL is on a 5-meter cable. Beginning in early July, data loggers were deployed at the very bottom of the deep spot (~6m) and one meter above the bottom (~5m) to collect temperature, dissolved oxygen, and % oxygen saturation data. However, based on our analysis of the data, we suspect that the bottom logger was sitting in the mud at the lake bottom at least from early September onward, if not for the entire duration of deployment. Between September 4<sup>th</sup> and October 15<sup>th</sup>, the data suggests a ~9mg/L drop in DO between 5m and 6m (**Table 2**), with fully mixed conditions above 5m (**Figure 2**). This is an extremely large decrease in DO over the span of 1m, so we have disregarded this 6m logger data. In spring 2026, NEAR staff will assess the maximum depth at the deep spot and provide a recommendation for the depth of logger deployment.

By the first sampling event in May, the surface and middle-depth water had begun warming, while the bottom water remained cold (**Figure 2**). The top layer of the water column (the epilimnion) continued to warm, reaching a maximum temperature of ~28°C in mid-July. The lake appeared to experience a mixing event in late July when the epilimnion reached nearly 5 meters. That event in turn brought fully saturated dissolved oxygen concentrations to nearly 5 meters. The mixing period ended on Aug 1<sup>st</sup> when the lake experienced a second warming, and surface water reached 28°C a second time on Aug 15<sup>th</sup>. The water column had returned to a fully mixed state by mid-September.

Dissolved oxygen concentrations remained adequate above 3.5 meters for the whole season (**Figure 3**). Water below 3.5m experienced varying degrees of dissolved oxygen depletion. Fully anoxic (DO < 1mg/L) conditions were first detected at 5m on June 15<sup>th</sup>, prior to deployment of the bottom water loggers. We anticipate that the deepest water became anoxic around late May or early June. However, even with the lack of data below 5 meters, anoxia above 5m has begun earlier in the season in recent years compared to 2025 (**Figure 4**). Anoxic conditions continued in the bottom water through to mid-July when anoxic water was recored at 4.2m from the

surface. The mixing event in late July brought dissolved oxygen rich water down to nearly 5m, essentially driving anoxia from all water shallower than 5m. There was period of renewed DO loss in deep water in mid-August but by early September, DO concentrations were nearly the same from the surface down to 5m. As discussed above, the <1mg/L (anoxic) DO values at 6m reported from early September through mid-October have been disregarded based on an assumption that the logger was in the mud.

Table 2. 5m and 6m dissolved oxygen concentrations. 5m data from HOBO probe. 6m data from miniDOT logger.

	Jul-4	Jul-17	Aug-2	Aug-16	Sep-4	Sep-17	Oct-1	Oct-15
5m	0.8	0.8	1.4	1.0	9.2	9.41	9.2	10
6m	0.33	0.17	0.04	0.03	0.03	0.06	0.06	2

Figure 2. Water temperature (°C) isopleth at Station 1 in 2025.

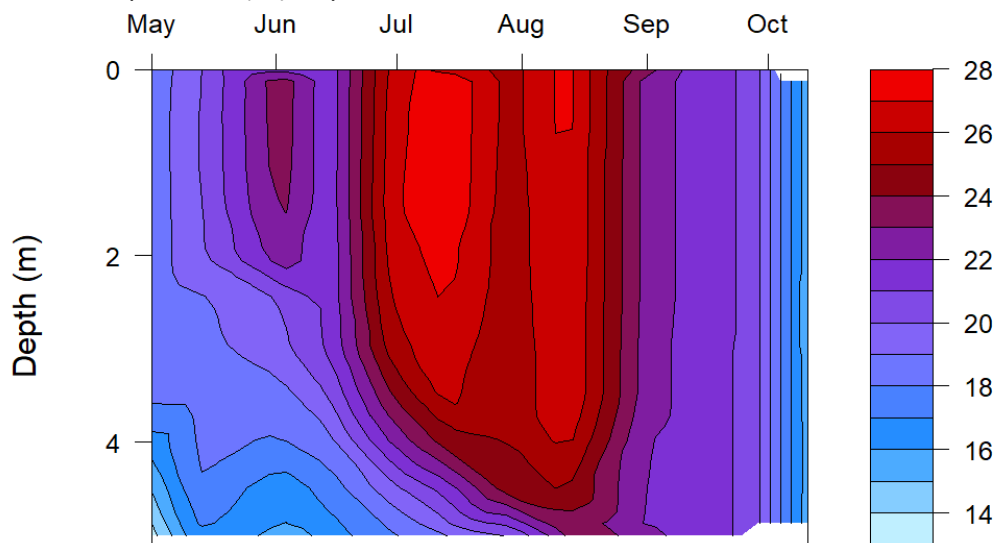


Figure 3. Dissolved oxygen (mg/L) isopleth at Station 1 in 2025.

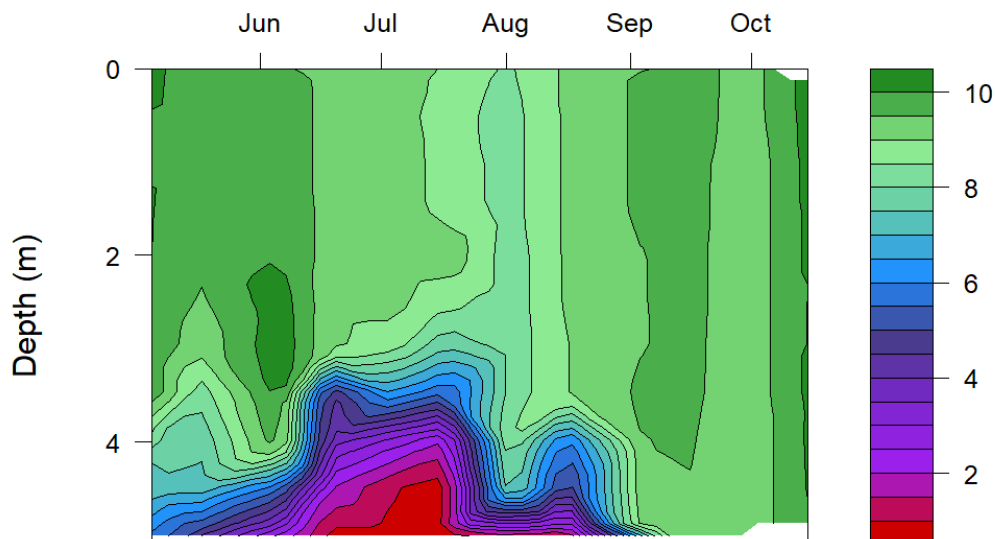
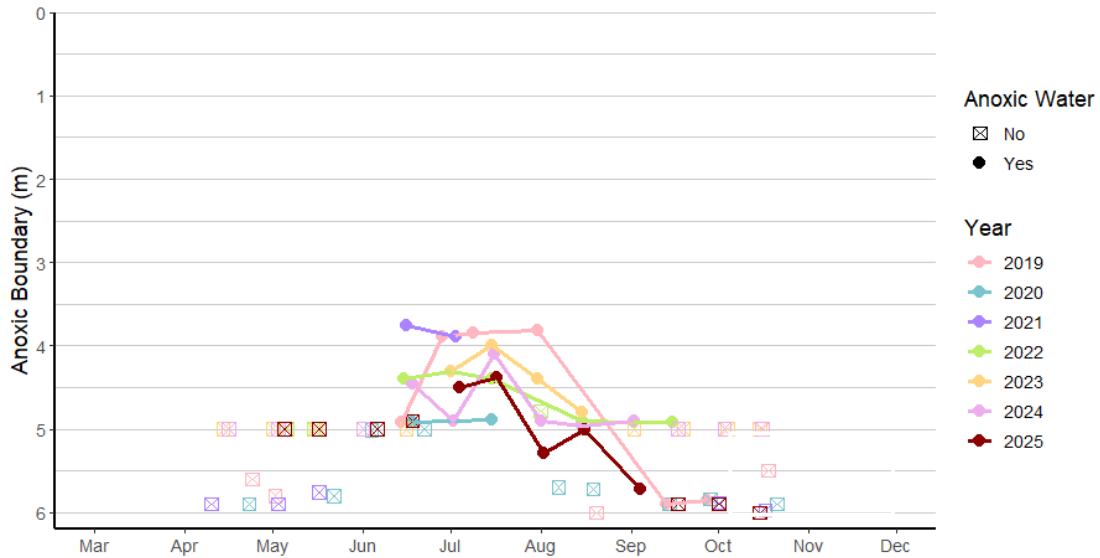


Figure 4. Anoxic boundary depths, 2019 – 2025.

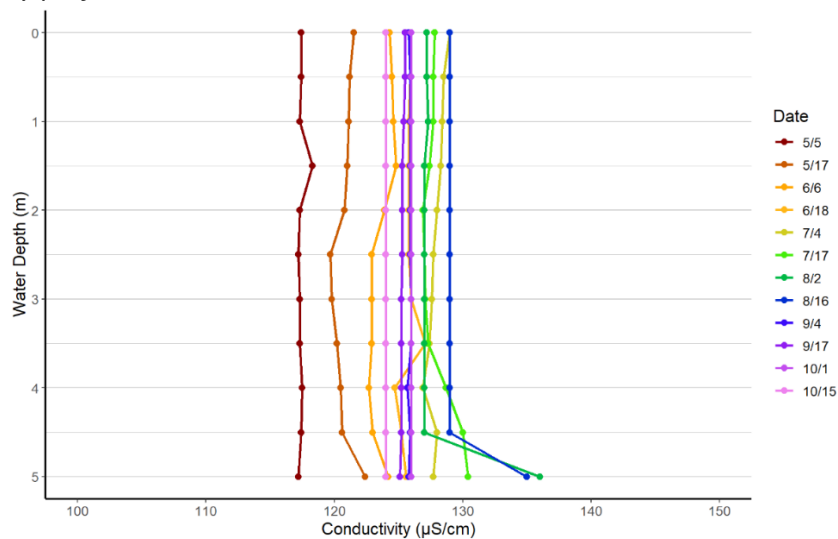


## Conductivity

Conductivity was measured for the first time since 2020. Conductivity measures the quantity of dissolved ions in water that conduct electricity, increasing as dissolved salt content increases. Conductivity is usually governed by four cations: Calcium, Magnesium, Sodium, and Potassium, and three anions, Chloride, Carbonate, and Sulfate. These can be traced to either natural mineral sources from weathering of the landscape, human inputs from road salting and septic systems, or as released salts from anoxic bottom sediments.

Conductivity in Lower Bolton Lake ranged from 117 to 136  $\mu\text{S}/\text{cm}$  in 2025, relatively stable over the course of the season (**Figure 5**). There were minor increases in conductivity in the bottom water in August, suggesting release of salts from the anoxic sediments.

Figure 5. Conductivity profiles at Station 1 in 2025.



## Nutrients

### Total Phosphorus

Surface water total phosphorus concentrations were very good in 2025, only exceeding the 10ppb threshold during the mid-May sampling (**Figure 6**). Bottom water total phosphorus was also exceptionally good, never exceeding 20ppb and only exceeding 15ppb twice (**Figure 7**). Bottom total phosphorus concentrations in June, July, August, and September 2025 were the best on record for those months since NEAR began monitoring TP in 2012.

Figure 6. 2025 1m total phosphorus concentrations.

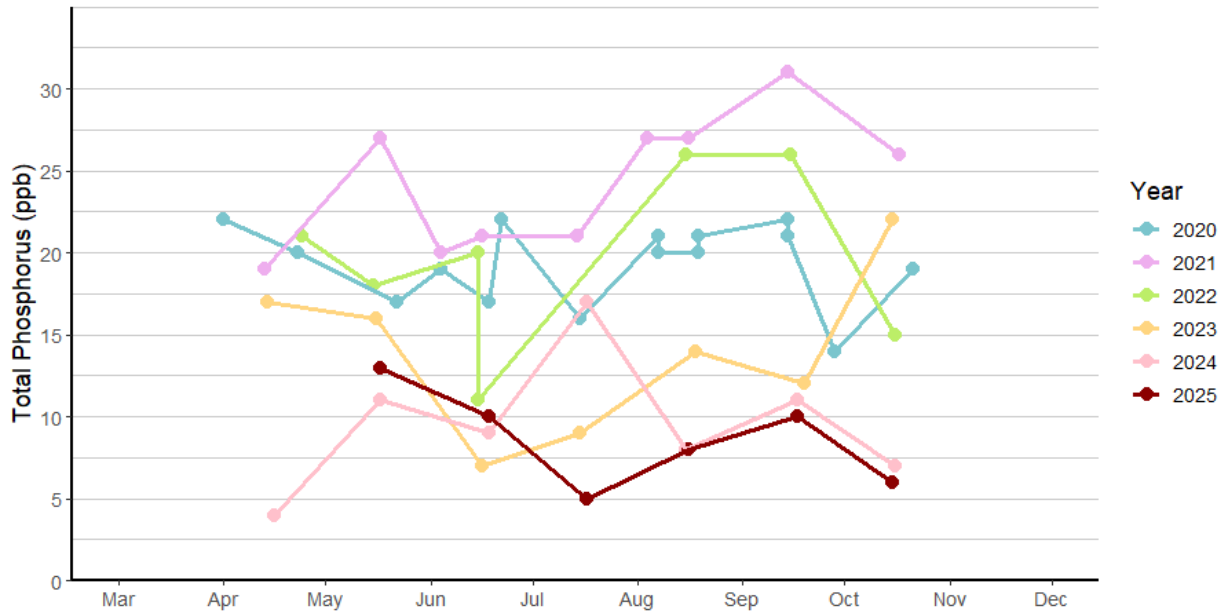
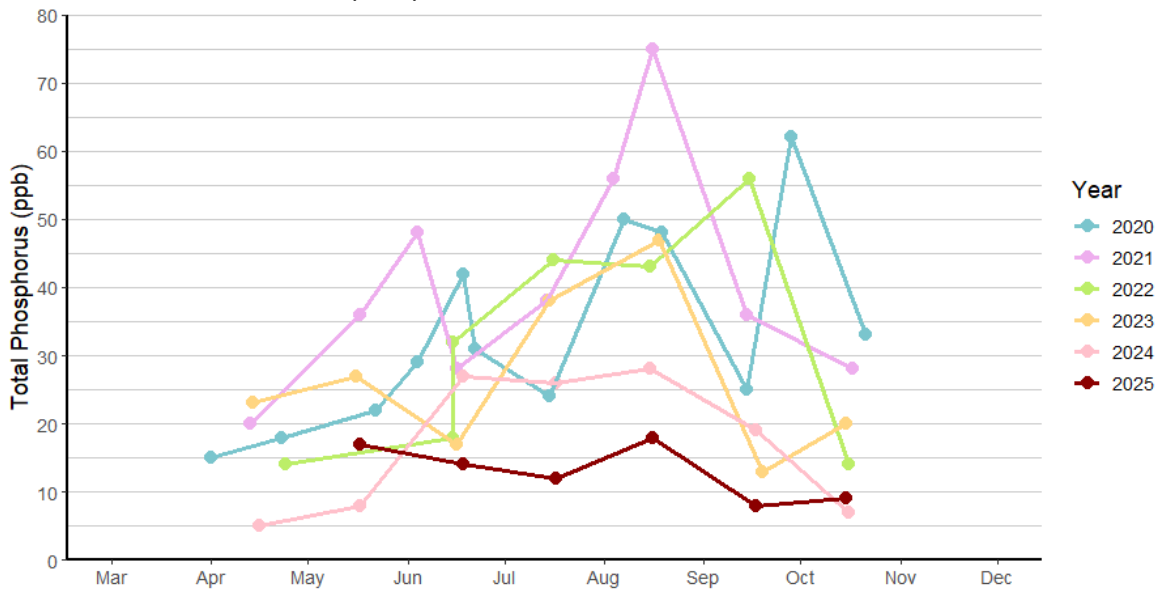


Figure 7. 2025 bottom water total phosphorus concentrations.



### Total Nitrogen

From May through July, the 1m total nitrogen concentrations were slightly higher than in recent years, although considerably lower than 2021 when TN was much higher (Figure 8). However, beginning in July, TN concentrations declined in both top and bottom water depths. TN continued to decline, reaching lowest concentrations in October. The total nitrogen concentrations were the lowest on record for those months for the past six years (Figure 9). Nitrogen concentrations in the lake may be declining due to the sewerage of the lake several years ago. The principal effluent from septic systems is nitrate via the ground water. This load has presumably been curtailed or eliminated altogether by sewers. Nitrate gets converted to biological nitrogen forms in the lake, which then accumulates in the sediments as organic nitrogen and ammonia. The decreasing internal load of nitrogen may be tied to this elimination of onsite wastewater systems around the lake. The lake also experienced the best water clarity on record during the months of August, September and October. This allowed the epilimnion, the upper layer of water in the lake with saturated dissolved oxygen, to reach deeper into the lake. Combined with a mixing event in late July, dissolved oxygen concentrations were greater than 1ppm to 5meters. This greatly decreased the release of ammonia from bottom sediments.

Figure 8. 2025 1m total nitrogen concentrations.

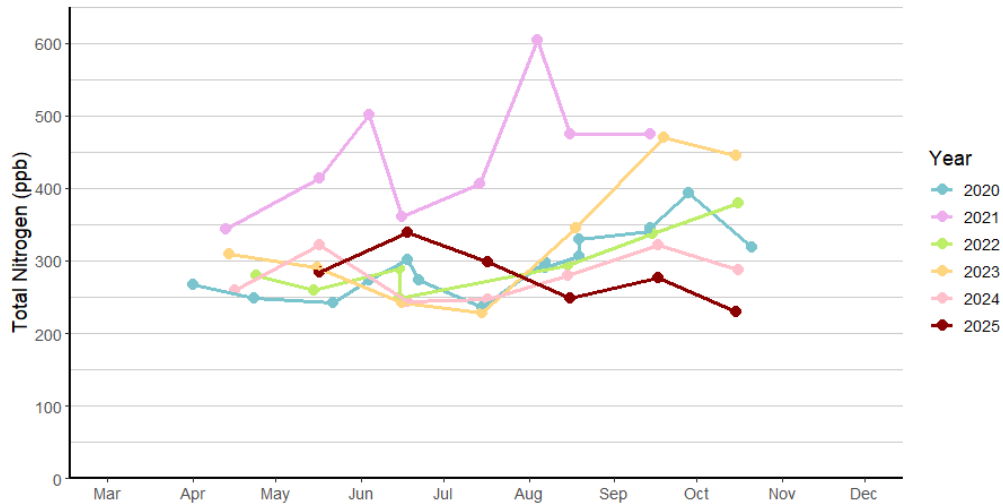
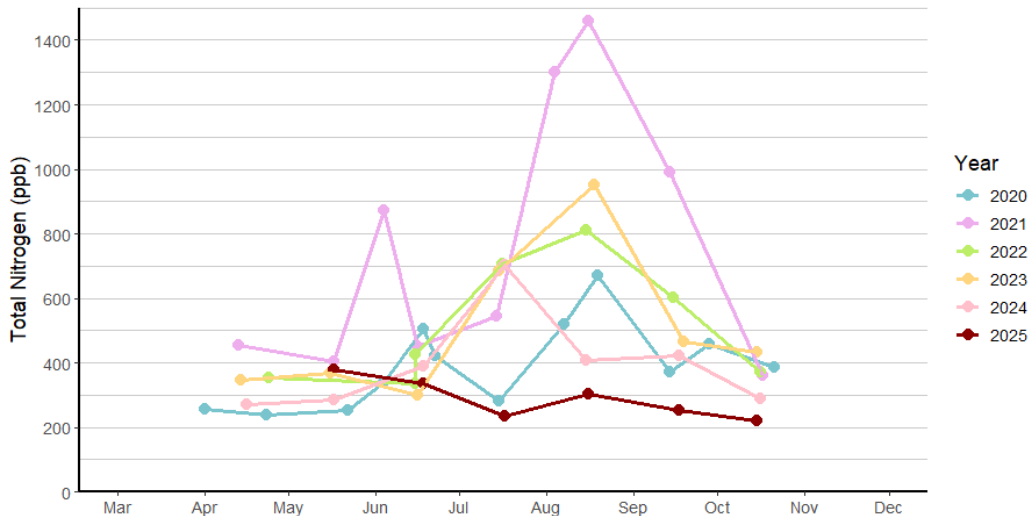


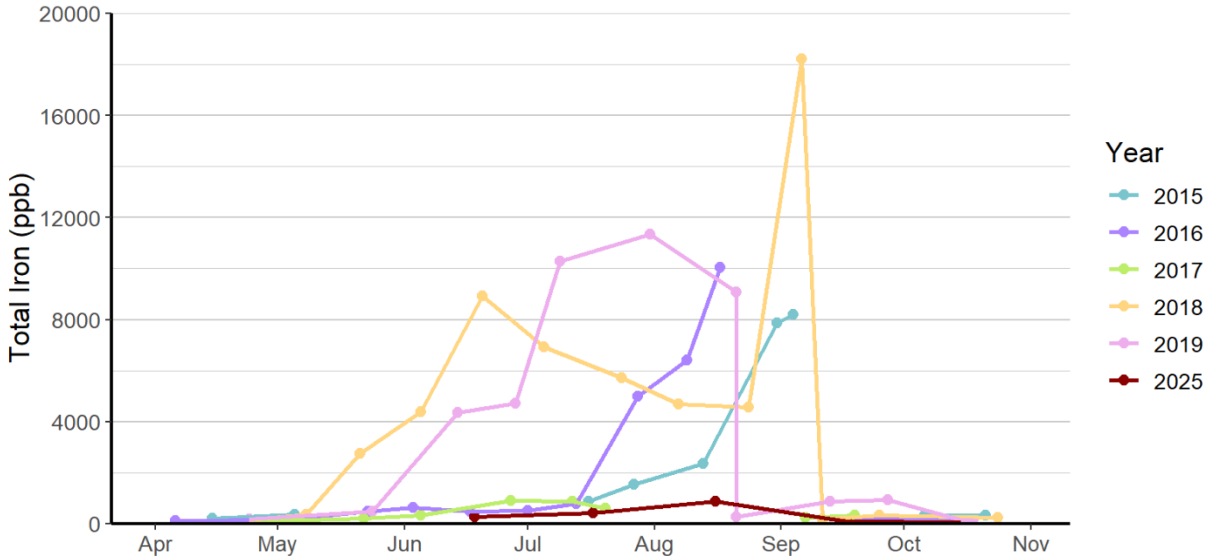
Figure 9. 2025 bottom water total nitrogen concentrations.



## Total Iron

Total iron (Fe) was tested at the bottom of Station 1 monthly during each sampling season from 2015 through 2019. Total iron was tested again in 2025, for the first time in six years. From 2015 through 2019, mid- to late-summer total iron levels regularly exceeded 8,000ppb (**Figure 10**). In 2025, Fe was much lower, ranging from 72 – 877ppb. Significantly less iron was released from sediments in 2025. This is further evidence that anaerobic respiration was greatly curtailed in bottom water in 2025, consistent with the decreased amount of anoxic water.

Figure 10. 2025 bottom water total iron concentrations.



## Aquatic Plants

Northeast Aquatic Research (NEAR) conducted a survey of the invasive *Potamogeton crispus* (Curly-leaf Pondweed) on June 4<sup>th</sup> and a comprehensive survey of the whole-lake aquatic plant community on August 25<sup>th</sup>.

During the Curly-leaf Pondweed survey on June 4<sup>th</sup>, six patches of invasive Curly-leaf Pondweed were found around the lake's shoreline (**Map 1**). Most beds were small, consisting of 2-5 plants each. One patch (identified by white arrow in **Map 1**), was larger, consisting of ~20 plants.

Thirteen aquatic plant species, as well as Filamentous Algae, were documented in the lake during the comprehensive survey on August 25<sup>th</sup> (**Table 3**). Curly-leaf Pondweed, which grows early in the season and typically dies off by mid-summer, was not found. However, the invasive species *Glossostigma cleistanthum* (Mudmat) was found in five general areas (**Map 2**). Though invasive, Mudmat is a very small, low-lying plant found in shallow water and rarely becomes a nuisance.

Dominant species (those present at greater than 20% of survey waypoints) included *Najas guadalupensis* (Southern Naiad) (**Map 3**), *Potamogeton amplifolius* (Large-leaf Pondweed) (**Map 4**), and *Potamogeton pusillus* (Small Pondweed) (**Map 5**).

Map 1. Locations of Curly-leaf Pondweed during the 6-4-25 survey.

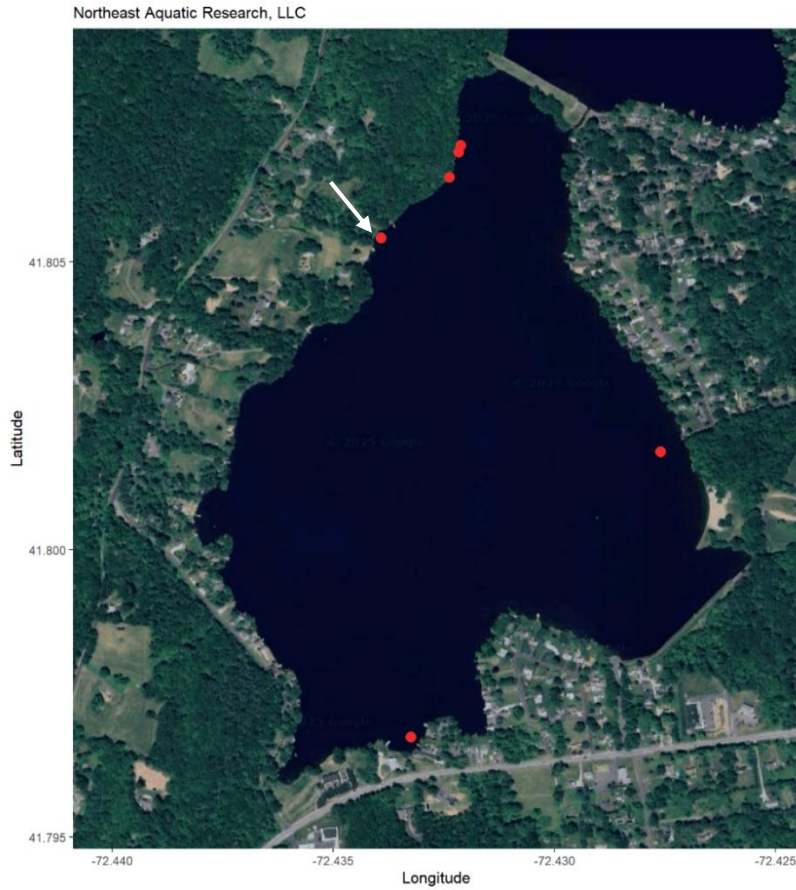
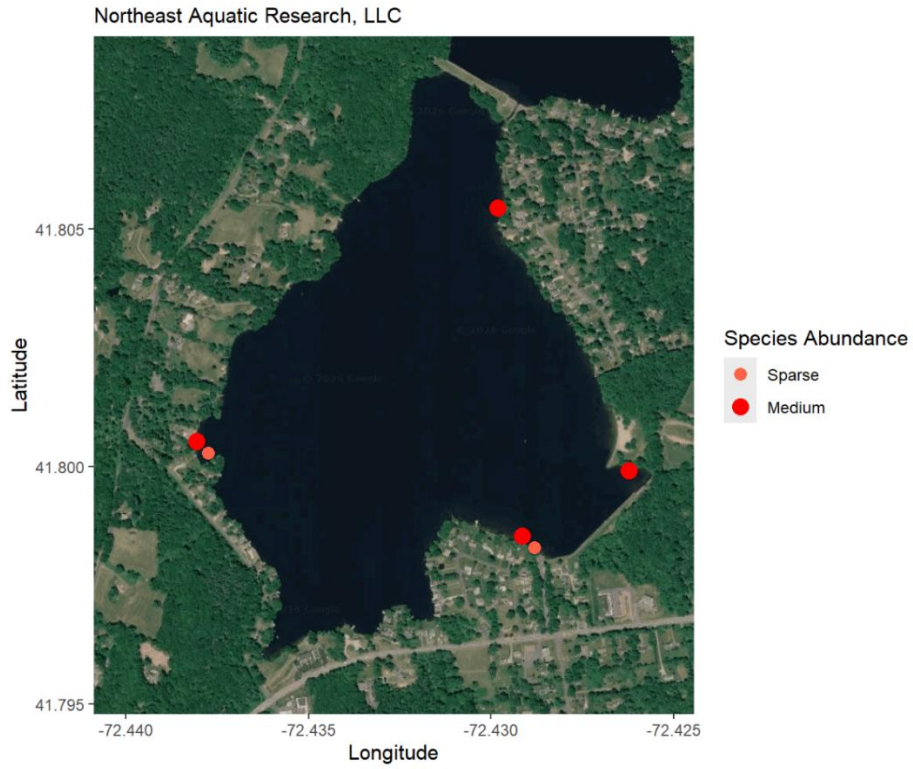


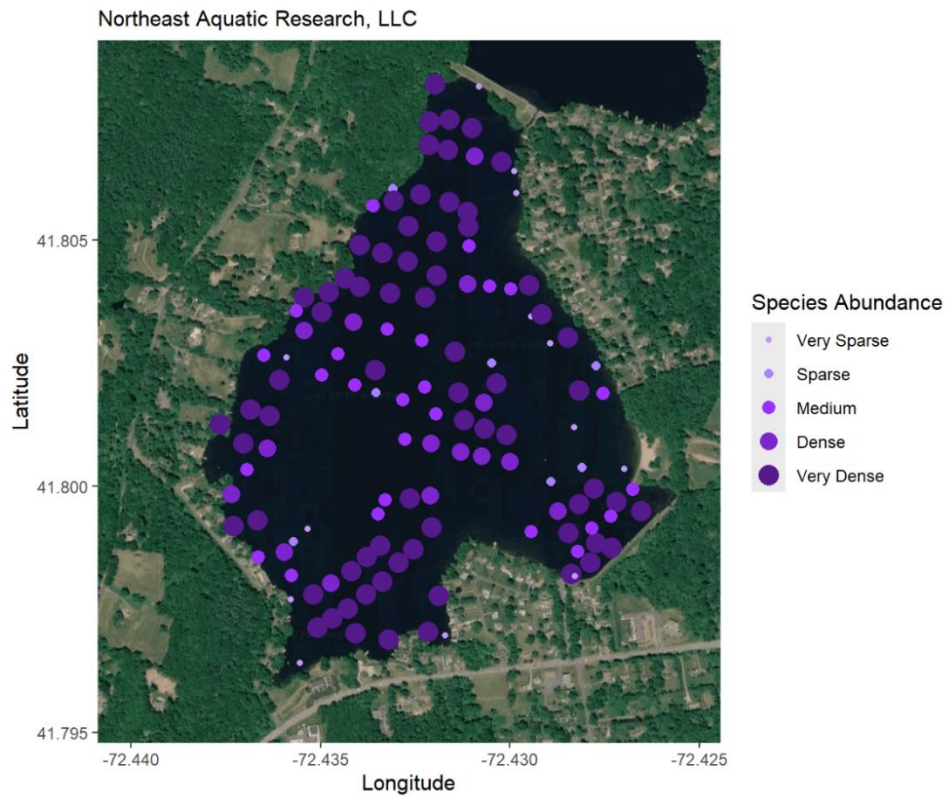
Table 3. Aquatic plant species present in Lower Bolton Lake August 25<sup>th</sup>, 2025. Red text indicates invasive species.

Scientific Name	Common Name	% Frequency	Avg. Density
<i>Ceratophyllum demersum</i>	Coontail	4	16
<i>Chara sp.</i>	Muskgrass	9	21
<i>Glossostigma</i>	Mudmat	3	32
<i>Lyngbya</i>	Benthic Cyanomat	2	7
<i>Najas guadalupensis</i>	Southern Naiad	75	67
<i>Nitella sp.</i>	Stonewort	6	28
<i>Nymphaea odorata</i>	White Water Lily	1	5
<i>Potamogeton amplifolius</i>	Large-leaf Pondweed	30	18
<i>Potamogeton bicupulatus</i>	Snail-seed Pondweed	1	5
<i>Potamogeton pusillus</i>	Small Pondweed	23	31
<i>Potamogeton epihydrus</i>	Ribbon-leaf Pondweed	2	14
<i>Sagittaria graminea</i>	Grassy Arrowhead	5	19
<i>Vallisneria americana</i>	Tapegrass	19	46
	Filamentous Algae	1	5

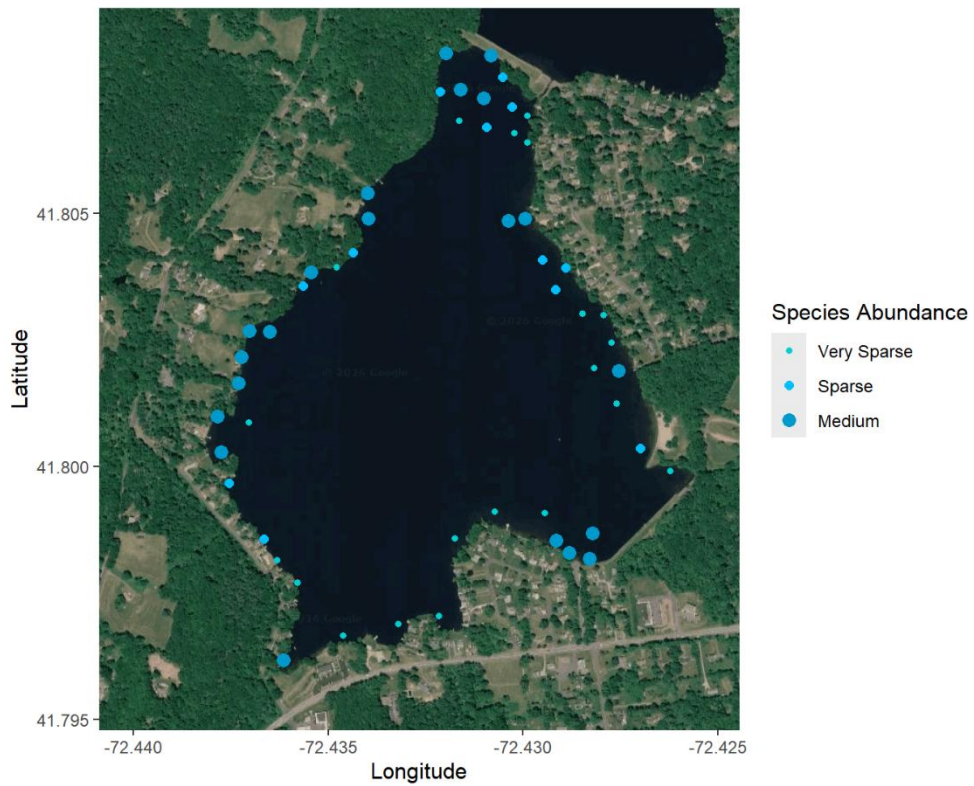
Map 2. Locations of Mudmat in Lower Bolton Lake during the August 25<sup>th</sup> survey.



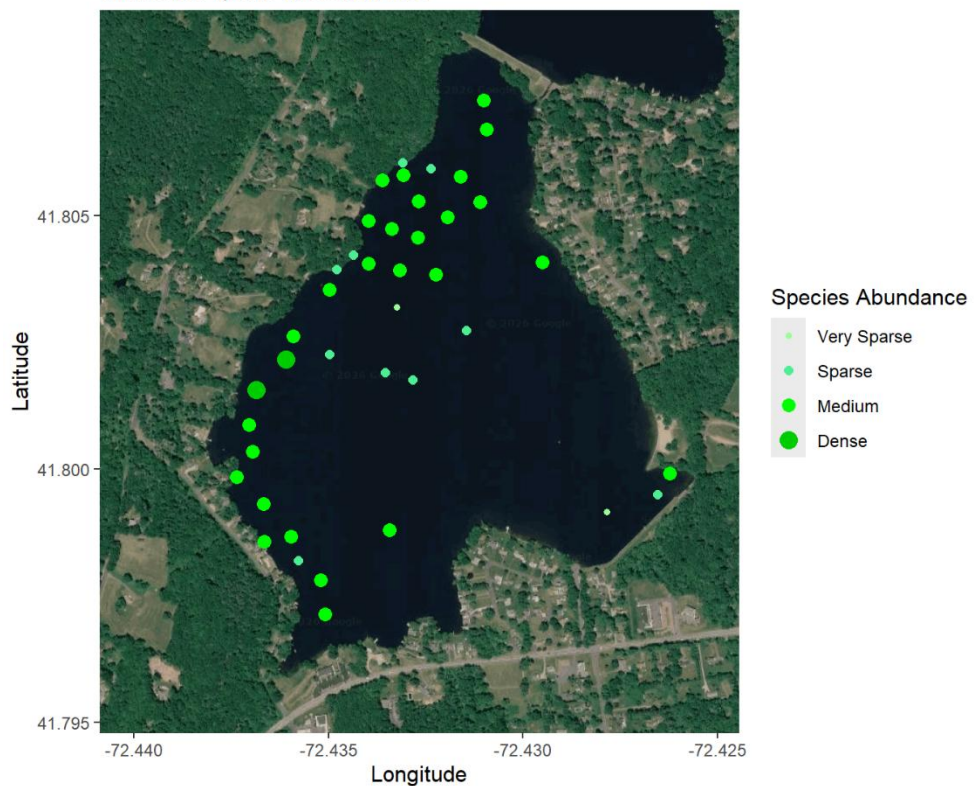
Map 3. Locations of Southern Naiad during the August 25<sup>th</sup> survey.



Map 4. Locations of Large-leaf Pondweed during the August 25<sup>th</sup> survey.  
Northeast Aquatic Research, LLC



Map 5. Locations of Small Pondweed during the August 25<sup>th</sup> survey.  
Northeast Aquatic Research, LLC



## 2025 Findings

- Water clarity was exceptionally good, with some record clarities in late summer (NEAR records go back to 2011).
- Anoxic water was not recorded above 5 meters until early July, which is later than recent years, but the anoxic boundary rose quickly and reached the highest point in the water column observed in the past seven years.
- Surface water and bottom water total phosphorus concentrations remained low throughout the season, well below the average from the previous 5 years.
- Surface and bottom water total nitrogen was average in the first half of the season, but exceptionally good in the late summer and fall, with the best (lowest) concentrations on record for the past 6 years.
- Two invasive species, Curly-leaf Pondweed and Mudmat, were found in the lake, both at low occurrences.
- The native species Southern Naiad was very abundant throughout most of the lake, covering large areas of the bottom with dense stands that reached to 12ft of water depth. Large-leaf Pondweed and Small Pondweed were also abundant. Large-leaf pondweed was found around most of the shore at moderate density out to 7ft of water depth, little to none was found deeper than 7ft. Small pondweed was found at low density consistently out to 12ft of water depth.

## Recommendations for 2026

- Begin water quality monitoring in April and continue through October to catch spring and fall mixing events.
- NEAR staff will provide a recommendation in spring 2026 regarding the depth at which the miniDOT loggers should be deployed.
- Conduct a Curly-leaf Pondweed survey in May or early June, followed by removal of all Curly-leaf plants via diver suction harvesting.
- Conduct a comprehensive survey of the aquatic plant community at the height of the growing season (around August) focusing on detection any new invasive plants and the coverage and growth form of Southern Naiad.
- Attempt to gather dissolved oxygen and temperature data below 5 meters.