THE POND AND LAKE CONNECTION

Cedar Lake
Bristol, CT

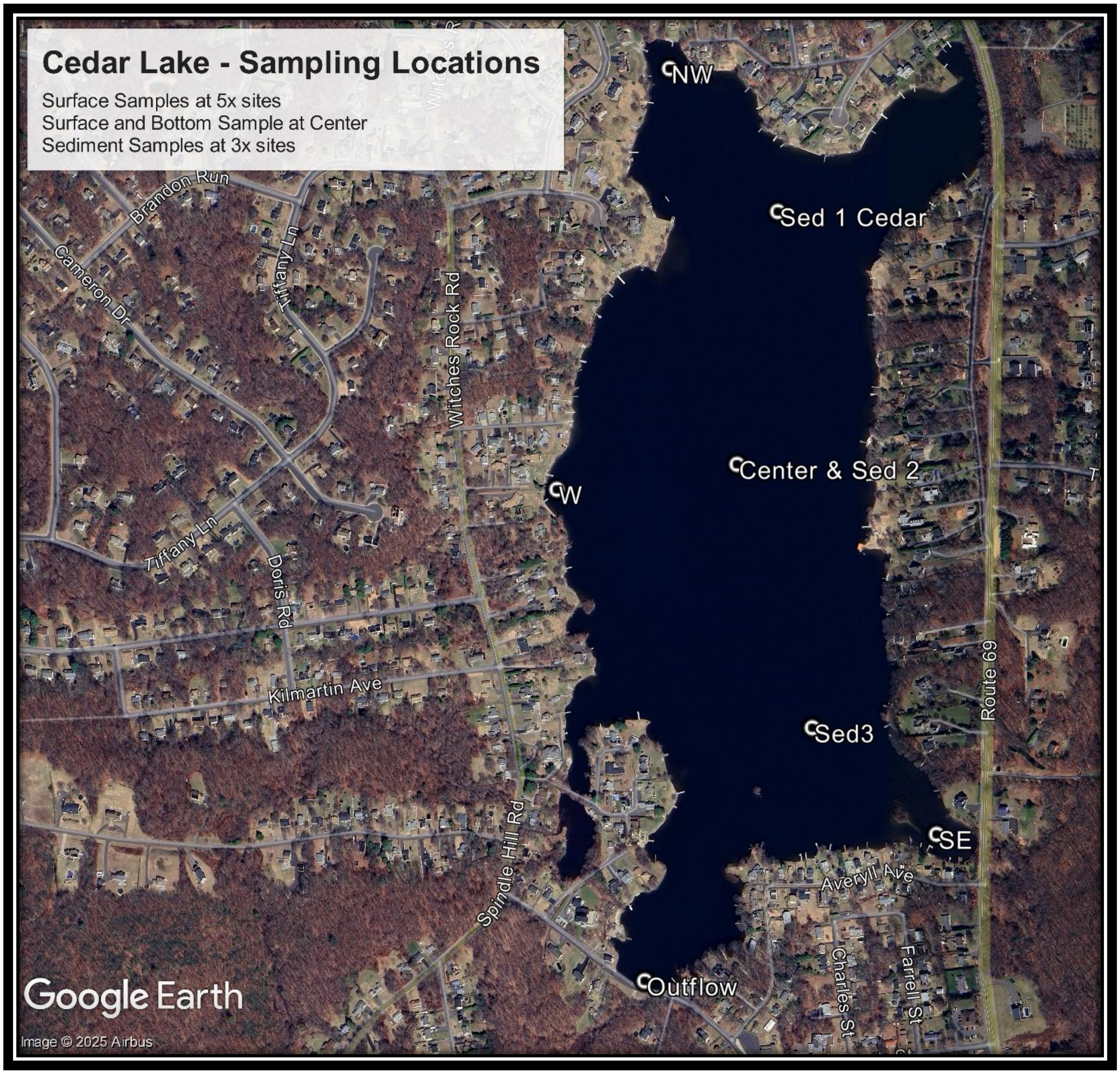
Phosphorus/Algae Evaluation
8/25/2025

Cedar Lake in Bristol, CT has had periodic concerns with water quality. A one-time whole lake evaluation of water quality parameters was conducted on 8/25/2025 which included testing of several different parameters to evaluate water quality, nutrients, and algal species/density. Also sampled was the lake sediment to evaluate the amount of phosphorus present and potentially releasable.

Water quality is fair on average, but blooms of algae have been noted annually with generally poor clarity through much of the warmer months. We wanted to determine what the current phosphorus levels were within the water column and sediment and see if it is at a level that is fueling algae blooms. If poor water clarity is caused by algae here, we wanted to know the dominant species, if there should be cause for concern, and what the best mitigation measures would be.

Since aquatic environments are typically Phosphorus limited, any “extra” phosphorus in a lake can cause algae to grow in excess. In rough numbers, a single pound of phosphorus can grow about 500lbs of algae, so any reduction can have noticeable effects. Phosphorus pollution can come from external loading sources like stream inflows and culvert pipes. These are point-source additions and generally are impacted from activities out in the watershed. Non-point-source pollution examples would be runoff from adjacent land/lawns/beaches which are influenced by activity typically closer to the water’s edge. For some lakes and ponds, these external loading sources are the major contributor and things like reducing fertilizer use, fixing faulty septic systems, goose remediation, and stormwater infrastructure improvements can be done to lessen what is added to the lake each year. Other lakes phosphorus issues come mainly from the lake bottom itself.

To evaluate how much and where phosphorus may be of issue here, six sites were selected in various coves, the lake center (surface & bottom), and the lake outflow to be tested. If Total Phosphorus was drastically different at any one site, that could indicate point-source or localized non-point-source pollution in that area. This also could suggest further testing may be needed in those areas. Surface water samples for Total Phosphorus were uniform throughout all sites during this late August evaluation so no phosphorus input hotspots are suspected at this time. However, this was a dry time of year and phosphorus does tend to build up terrestrially in times of little/no rain. Testing may show more fluctuation in TP throughout the lake after a rain event.



8/25/25 – Sampling locations

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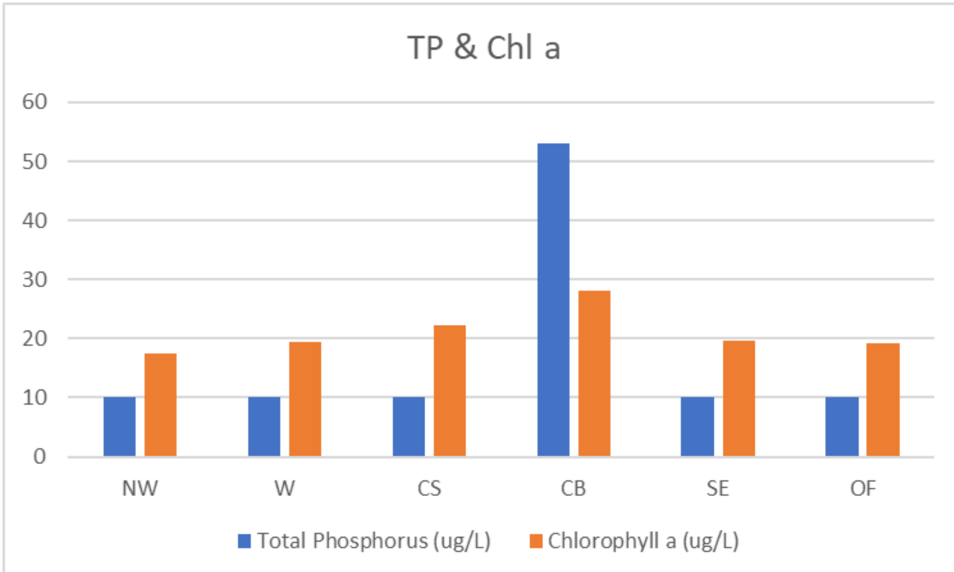
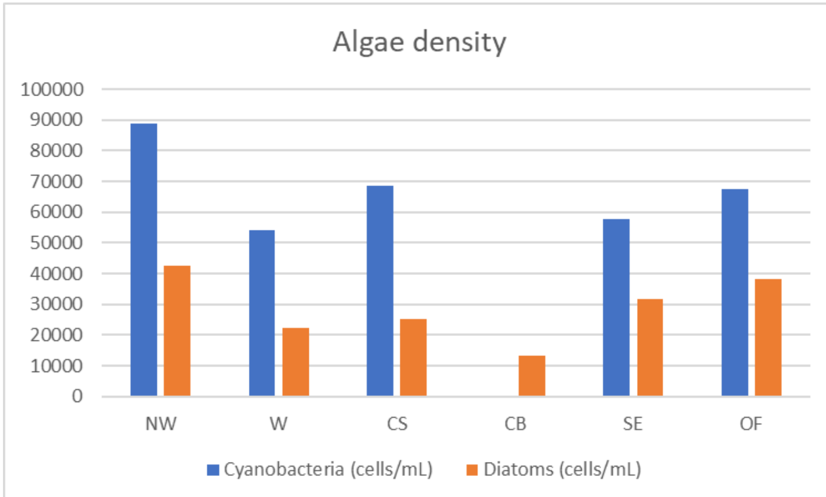


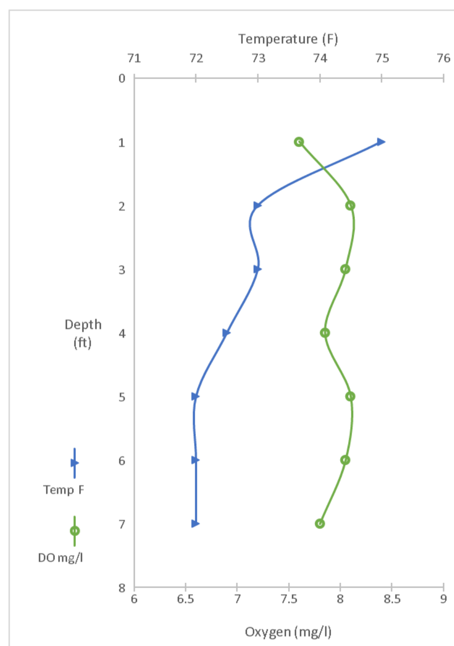
8-25-25 Cedar Lake TP/Chl a Sampling Results

The above chart compares how TP at various locations around the lake influences how much Chlorophyll a is found in the water at those sites. Generally, >TP=>Chl a. However, the TP test results from all surface locations was found to be at relatively low levels (<10ug/L). This could be explained by the moderate-dense Cyanobacterial bloom that was occurring at the time of testing. This is because as algae grow and reproduce, they accumulate Phosphorus within their cells, lowering what would be reported in a lab test within the water. Algae ID/Enumeration samples showed an average of 67,320 cells/ml of Cyanobacteria throughout the lake. Cyanobacteria do not always show up on a Chl a test as they predominantly rely on different pigments (phycocyanin etc.). The graph below shows that despite low surface TP, a sizable population of Cyanos were present and thriving.



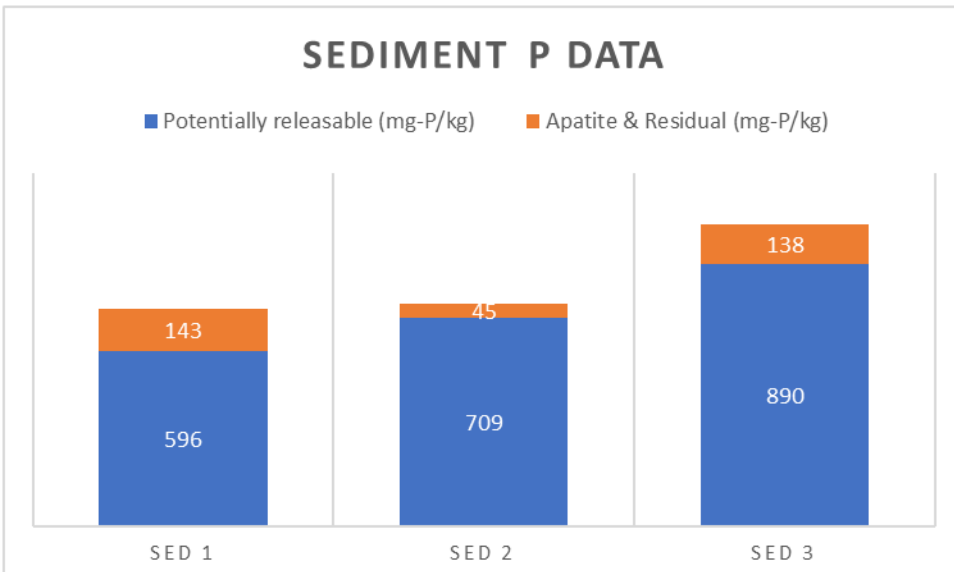
8-25-25 Cedar Lake Bloom Density Sampling Results

At the time of testing, the lake was found to be well mixed as the below temp/DO profile shows. In deeper lakes, typically the top water and bottom water separate and do not mix through the summer due to a temperature gradient top to bottom. This is not a good/bad lake quality, but can help us interpret the data correctly. There are pros/cons of the lake stratifying but neither is better/worse. The temp/DO graph shows that there is very little change in either parameter as you go deeper down the water column. A stratified temp/DO profile would show a sharp change in both parameters a few meters down with water becoming drastically colder and very low in DO at deeper depths. Another possibility is that the lake is polymictic, meaning it might stratify and remix multiple times throughout the summer. To find out if that is the case, a similar temp/DO profile would need to be done several times per season or a continuous monitor installed. Dissolved Oxygen here is sufficient to sustain aquatic life throughout the water column as >5mg/l can be used as the lower limit for many species and our testing was all >6.5mg/l.



8-25-25 Temp DO Sampling Results

With a relatively shallow maximum depth, Cedar Lake likely does not stratify or only does so periodically through the summer months. Even in this well mixed state, the bottom water sample showed drastically higher (5x) amounts of TP at the bottom than on the surface. This is evidence that Phosphorus is actively being released from the sediment and then used up by algae/cyanos in the presence of light. This sediment release of phosphorus is called internal-loading and is the major driver of algae/poor water quality in many lakes. Direct testing of lake sediment in three locations also confirms a significant amount of phosphorus is found within the sediment. The graph below breaks down the sediment bound phosphorus into two categories. One is the potentially releasable portion and the other is the portion that is more tightly bound and not easily releasable.



8-25-25 Cedar Lake Sediment Sampling Results

The vast majority of phosphorus within the lake sediment is releasable and is doing so based on the bottom water test results.

Possible mitigation measures for excess in-lake phosphorus being released from the bottom sediment usually includes various aeration system options aimed at adding oxygen to the sediment/water interface to stop the chemical reaction which liberates phosphorus from the sediment. Since Cedar Lake is already relatively well mixed, this option is not currently advised. If further DO testing is done and reveals that the lake stratifies/mixes multiple times through the Summer (Polymictic), aeration options could be revisited.

A more appropriate option for Cedar Lake would be in-lake phosphorus sequestration. This involves the addition of a phosphorus binder (Aluminum or Lanthanum) which takes releasable phosphorus from the sediment and moves it to the non-releasable portion. If enough releasable phosphorus is sequestered, then water quality should improve and algae blooms reduced.

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Cyanobacteria are especially adept at blooming in the presence of excess phosphorus as many species can biologically fix their own nitrogen which is the other main nutrient required for algae/plant growth. If phosphorus is reduced, this will bring the TP:TN ratio more inline which will also push the algae species back towards more beneficial green algae species and reduce the toxic Cyanobacteria's competitive advantage here.

Lanthanum based phosphorus sequestration products work similarly to the older Aluminum based products (Alum) with a few advantages. Lanthanum based products require much less product to be applied to the lake and less labor to achieve the same results. The bond between Lanthanum and phosphorus is also stronger and is not expected to be rereleased over time. Aluminum based products can rerelease phosphorus under a wider range of conditions. Based on this sediment testing, full remediation of the lake sediment would be in the seven-figure range. However, we do not need to target 100% of the releasable phosphorus to reduce the possibility and density of cyanobacterial blooms. Furthermore, it would both be prudent and likely easier to fund by targeting a smaller portion of the phosphorus here annually. After a few applications, sediment testing can be repeated to see the progress and shift of sediment bound phosphorus from releasable to the non-releasable portion. Please reach out to me to discuss a more specific estimate for this work.

Based on this year's water testing, water quality is being severely impacted by Cyanobacteria. These algae species can be dangerous to people, pets, and the lake ecosystem. It is suggested to advocate for residents within the Cedar Lake watershed to reduce fertilizer use, especially if it contains any amount of phosphorus. Septic systems should be regularly maintained and geese discouraged from staying/nesting throughout the season. Stormwater systems within the watershed can be evaluated to see if improvement is needed. In-lake sediment bound phosphorus management is suggested as well as an annual citizen-based water quality monitoring effort. For a relatively low cost ($100-200) a Secchi disc or two can be purchased by the association and volunteers taught how to use it and record weekly data. This type of data would be helpful in evaluating the lakes condition with respect to planktonic algae and phosphorus level for a relatively low cost. Similarly, a DO meter could be purchased and used throughout the summer to determine if Cedar Lake is polymictic or if it stays relatively well mixed all summer. These could also be the basis to compare water quality improvements here over time if a phosphorus management plan is pursued.

Please feel free to reach out to me with any questions regarding this summary.

Nicholas McMahon - 11/4/2025
Aquatic & Fisheries Biologist
The Pond and Lake Connection
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Sample ID	Sample Location	Test	Method	Results	Sampling Date / Time
CTM67570-1	NW	Turbidity (NTU)	EPA 180.1	4.6	08/25/2025
		Conductivity (µS/cm)	EPA 120.1	265.9	
		Free Reactive Phosphorus (µg/L)	EPA 365.3	<5	
		Chlorophyll a (µg/L)	EPA 445	17.4	
		Total Phosphorus (µg/L)	EPA 365.3	<10	
		Alkalinity (mg/L as CaCO3)	EPA 310.2	24.3	
		Total Hardness (mg/L as CaCO3)	EPA 130.2	28.5	
		Total Nitrate (mg/L) and Nitrite (mg/L)	Campbell et al 2004	<0.02	
		Nitrite (mg/L)	Campbell et al 2004	<0.02	
		Nitrate (mg/L)	calculated	<0.02	
		Total Kjeldahl Nitrogen (mg/L)	EPA 351.2	0.19	
		Total Nitrogen (mg/L)	calculated	0.19	
		pH	EPA 150.1	7.4	
CTM67573-1	Center Bottom	Turbidity (NTU)	EPA 180.1	6.2	08/25/2025
		Conductivity (µS/cm)	EPA 120.1	262.6	
		Free Reactive Phosphorus (µg/L)	EPA 365.3	10.5	
		Chlorophyll a (µg/L)	EPA 445	28	
		Total Phosphorus (µg/L)	EPA 365.3	53	
		Alkalinity (mg/L as CaCO3)	EPA 310.2	20	
		Total Hardness (mg/L as CaCO3)	EPA 130.2	32.8	
		Total Nitrate (mg/L) and Nitrite (mg/L)	Campbell et al 2004	<0.02	
		Nitrite (mg/L)	Campbell et al 2004	<0.02	
		Nitrate (mg/L)	calculated	<0.02	
		Total Kjeldahl Nitrogen (mg/L)	EPA 351.2	0.29	
		Total Nitrogen (mg/L)	calculated	0.29	
		pH	EPA 150.1	7.2	
CTM67572-1	Center Surface	Turbidity (NTU)	EPA 180.1	4.4	08/25/2025
		Conductivity (µS/cm)	EPA 120.1	264.7	
		Free Reactive Phosphorus (µg/L)	EPA 365.3	<5	
		Chlorophyll a (µg/L)	EPA 445	22.3	
		Total Phosphorus (µg/L)	EPA 365.3	<10	
		Alkalinity (mg/L as CaCO3)	EPA 310.2	22	
		Total Hardness (mg/L as CaCO3)	EPA 130.2	30.8	
		Total Nitrate (mg/L) and Nitrite (mg/L)	Campbell et al 2004	<0.02	
		Nitrite (mg/L)	Campbell et al 2004	<0.02	
		Nitrate (mg/L)	calculated	<0.02	
		Total Kjeldahl Nitrogen (mg/L)	EPA 351.2	0.27	
		Total Nitrogen (mg/L)	calculated	0.27	
		pH	EPA 150.1	7.4	

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CTM67575-1	Outflow	Turbidity (NTU)	EPA 180.1	4.4	08/25/2025
		Conductivity (µS/cm)	EPA 120.1	269.8	
		Free Reactive Phosphorus (µg/L)	EPA 365.3	5.3	
		Chlorophyll a (µg/L)	EPA 445	19.1	
		Total Phosphorus (µg/L)	EPA 365.3	<10	
		Alkalinity (mg/L as CaCO3)	EPA 310.2	23.1	
		Total Hardness (mg/L as CaCO3)	EPA 130.2	32.8	
		Total Nitrate (mg/L) and Nitrite (mg/L)	Campbell et al 2004	<0.02	
		Nitrite (mg/L)	Campbell et al 2004	<0.02	
		Nitrate (mg/L)	calculated	<0.02	
		Total Kjeldahl Nitrogen (mg/L)	EPA 351.2	0.33	
		Total Nitrogen (mg/L)	calculated	0.33	
		pH	EPA 150.1	7.4	
CTM67574-1	SE	Turbidity (NTU)	EPA 180.1	4.6	08/25/2025
		Conductivity (µS/cm)	EPA 120.1	264.6	
		Free Reactive Phosphorus (µg/L)	EPA 365.3	<5	
		Chlorophyll a (µg/L)	EPA 445	19.6	
		Total Phosphorus (µg/L)	EPA 365.3	<10	
		Alkalinity (mg/L as CaCO3)	EPA 310.2	23.2	
		Total Hardness (mg/L as CaCO3)	EPA 130.2	28.6	
		Total Nitrate (mg/L) and Nitrite (mg/L)	Campbell et al 2004	<0.02	
		Nitrite (mg/L)	Campbell et al 2004	<0.02	
		Nitrate (mg/L)	calculated	<0.02	
		Total Kjeldahl Nitrogen (mg/L)	EPA 351.2	0.27	
		Total Nitrogen (mg/L)	calculated	0.27	
		pH	EPA 150.1	7.4	
CTM67571-1	W	Turbidity (NTU)	EPA 180.1	4.5	08/25/2025
		Conductivity (µS/cm)	EPA 120.1	264.2	
		Free Reactive Phosphorus (µg/L)	EPA 365.3	<5	
		Chlorophyll a (µg/L)	EPA 445	19.5	
		Total Phosphorus (µg/L)	EPA 365.3	<10	
		Alkalinity (mg/L as CaCO3)	EPA 310.2	24.2	
		Total Hardness (mg/L as CaCO3)	EPA 130.2	29.5	
		Total Nitrate (mg/L) and Nitrite (mg/L)	Campbell et al 2004	<0.02	
		Nitrite (mg/L)	Campbell et al 2004	<0.02	
		Nitrate (mg/L)	calculated	<0.02	
		Total Kjeldahl Nitrogen (mg/L)	EPA 351.2	<0.1	
		Total Nitrogen (mg/L)	calculated	0	
		pH	EPA 150.1	7.4	

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Water Quality Analysis Explanation

These water quality parameters are essential to document the condition of a water body and design custom treatment prescriptions to achieve desired management objectives.

pH: Measure of how acidic or basic the water is (pH 7 is considered neutral).

<6 Notably Acidic | 6 - 9 Standard for Typical Freshwaters | >9 Notably Basic

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Hardness: Measure of the concentration of divalent cations, primarily consisting of calcium and magnesium in typical freshwaters. *0-60 mg/L as $CaCO_3$ soft; 61-120 moderately hard; 121-180 hard; > 181 very hard*

Alkalinity- Measure of the buffering capacity of water, primarily consisting of carbonate, bicarbonate and hydroxide in typical freshwaters. Waters with lower levels are more susceptible to pH shifts.
50 mg/L as $CaCO_3$ low buffered; 51-100 moderately buffered; 101-200 buffered; > 200 high buffered.

Conductivity- Measure of the waters ability to transfer an electrical current, increases with more dissolved ions. *50 uS/cm relatively low concentration may not provide sufficient dissolved ions for ecosystem health; 50-1500 typical freshwaters; > 1500 may be stressful to some freshwater organisms, though not uncommon in many areas.*

Phosphorus: Essential nutrient often correlating to growth of algae in freshwaters.

Total Phosphorus (TP) is the measure of all phosphorus in a sample as measured by persulfate strong digestion and includes: inorganic, oxidizable organic and polyphosphates. This includes what is readily available, potential to become available and stable forms.
12 µg/L oligotrophic; 12-24 µg/L mesotrophic; 25-96 µg/L eutrophic; > 96 µg/L hypereutrophic

Free Reactive Phosphorus (FRP) is the measure of inorganic dissolved reactive phosphorus. (PO_4^{-3}, HPO_4^{-2}, etc.). This form is readily available in the water column for algae growth.

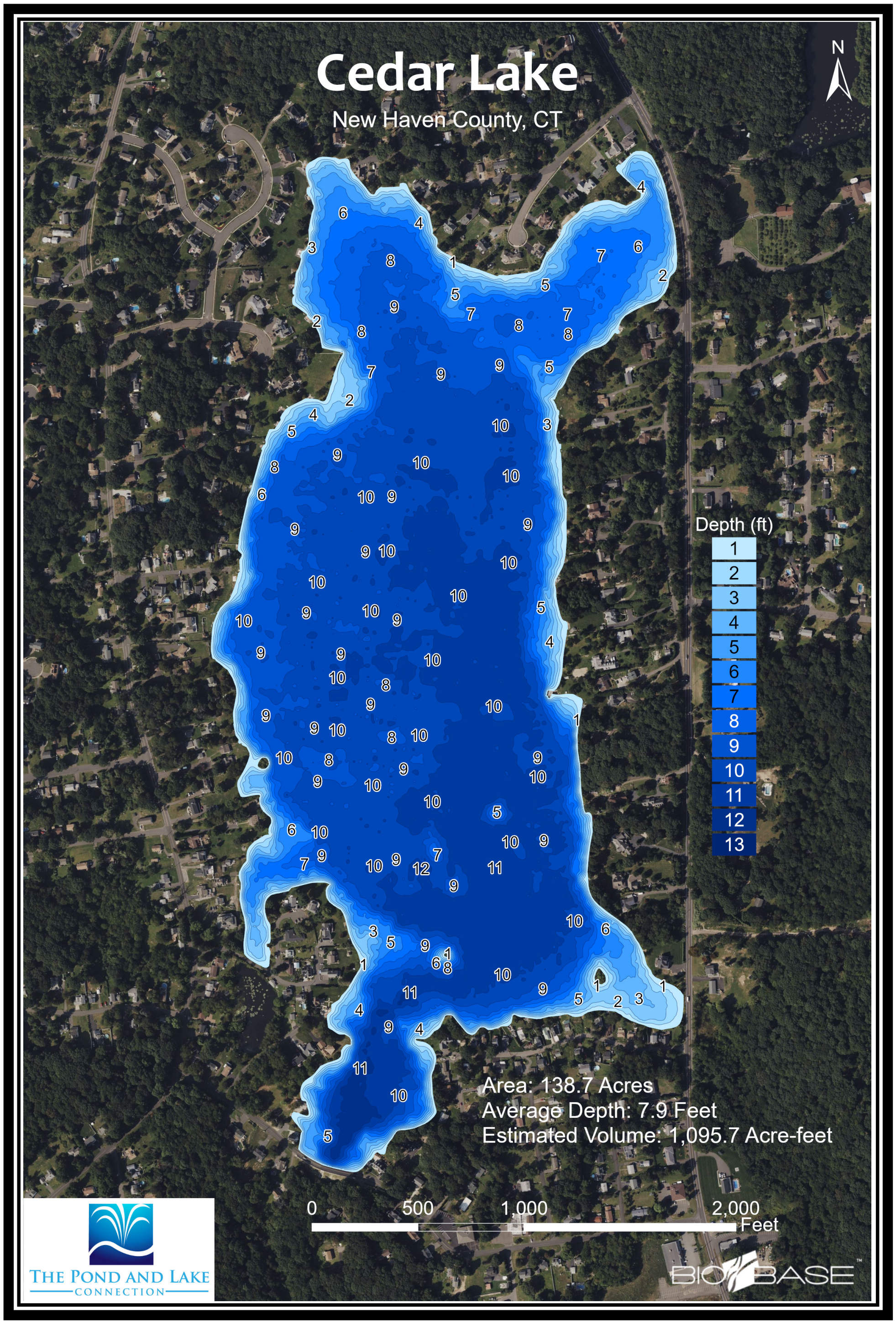
Nitrogen: Essential nutrient that can enhance growth of algae.

Total N is all nitrogen in the sample (organic N^+ and Ammonia) determined by the sum of the measurements for Total Kjeldahl Nitrogen (TKN) and ionic forms.

Nitrites and Nitrates are the sum of total oxidized nitrogen, often readily free for algae uptake.
1 mg/L typical freshwater; 1-10 potentially harmful; >10 possible toxicity, above many regulated guidelines

Chlorophyll a: primary light-harvesting pigment found in algae and a measure of the algal productivity and water quality in a system. *0-2.6µg/L oligotrophic; 2.7-20 µg/L mesotrophic; 21-56 µg/L eutrophic; > 56 µg/L hypereutrophic*

Turbidity- Measurement of water clarity. Suspended particulates (algae, clay, silt, dead organic matter) are the common constituents impacting turbidity.
<10 NTU drinking water standards and typical trout waters; 10-50 NTU moderate; > 50 NTU potential impact to aquatic life.



2025 Cedar Lake Bathymetric Map