2022 WATER QUALITY MONITORING REPORT
Echo Lake (MIDAS 5814) – Mount Vernon, ME

Background

Echo Lake (Crotched Pond) has a surface area of 1,109 acres and is located in the towns of Fayette, Mount Vernon, and Readfield in Kennebec County, ME. Echo Lake has a maximum depth of 34 m (111 ft) and an average depth of 7 m (22 ft). The direct watershed area draining to the pond is roughly 8 square miles, however the lake has a large upstream/indirect watershed of 35 square miles that includes the upstream drainages of Taylor Pond, Minnehonk Lake, David Pond, Parker Pond, Flying Pond, and several other smaller ponds and tributaries flowing into each of the above. Water from Echo Lake flows to a single outlet located at the south end of the southwest basin, where it flows South into Lovejoy Pond.

Water quality data have been collected from Echo Lake since 1976 by Maine DEP and other state agencies, volunteers monitors certified through Lake Stewards of Maine, and more recently, 30 Mile River Watershed Association (30 Mile).

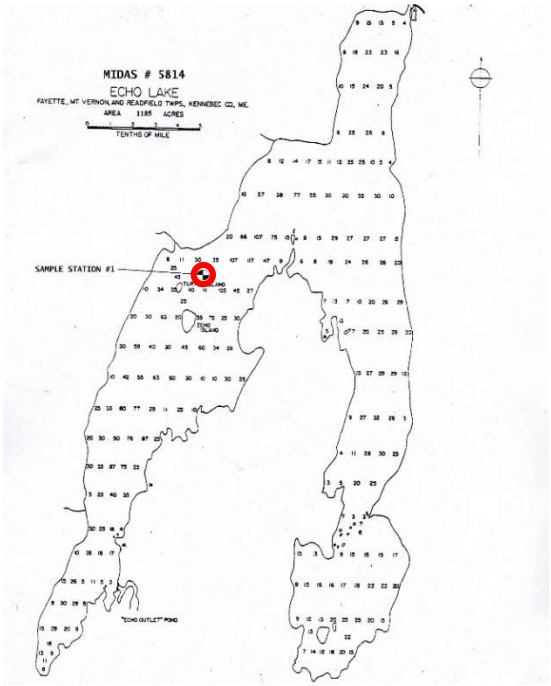

Figure 1. Station 01, Echo Lake, Mount Vernon & Readfield, ME.

Monitoring in 2022

In 2022, 30 Mile River visited Echo Lake three (3) times to collect secchi disk transparency (SDT), dissolved oxygen and temperature profiles, and a water samples that were later analyzed for Total Phosphorus (TP) and Chlorophyll-a at the health and Environmental Testing Laboratory (HETL) in Augusta, ME. Monitoring on Echo Lake takes place at the deepest spot in the lake - aka Station 01 (Figure 1). Echo Lake Association (ELA) member, a certified volunteer water quality comnitor, Mr. Gary Phillip, collected an additional eight (8) SDT readings between June and October in 2022, which are also presented in this report.

Secchi Disk Transparency (Water Clarity)

Secchi disk transparency (SDT) is an indicator of water clarity. To measure water clarity, a black and white disk is lowered into the water and the reading is taken at the depth at which it is no longer visible. Factors that affect water clarity include

Water Clarity (m)	
2022 Water Clarity Average	7.4
Historical SDT Average	6.6
Maine Lakes SDT Average	4.8

algal growth, zooplankton densities, natural water color, and suspended silt, sediment, or other particulates suspended in the water column.

Water clarity readings in 2022 ranged from 6.4 m (June 24th) to 8.2 m (October 5th) with an annual average of 7.4 m. 14 total readings were collected in Echo Lake over eight (8) monitoring days in 2022 (Figure 2).

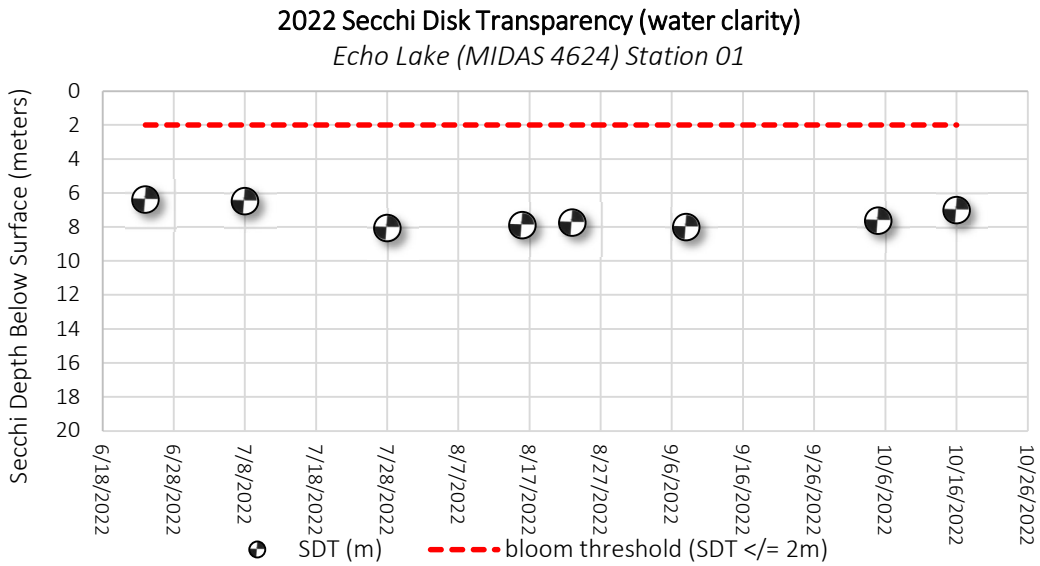

Figure 2. Secchi Disk Transparency (SDT) readings collected in Echo Lake in 2022

Since 1976, SDT has ranged between 4.0 m (1998) and 8.9 m (2018) with an overall historical average of 6.6 m. Water clarity in 2022 was above average when compared to Secchi readings collected since 1976 (Figure 3).

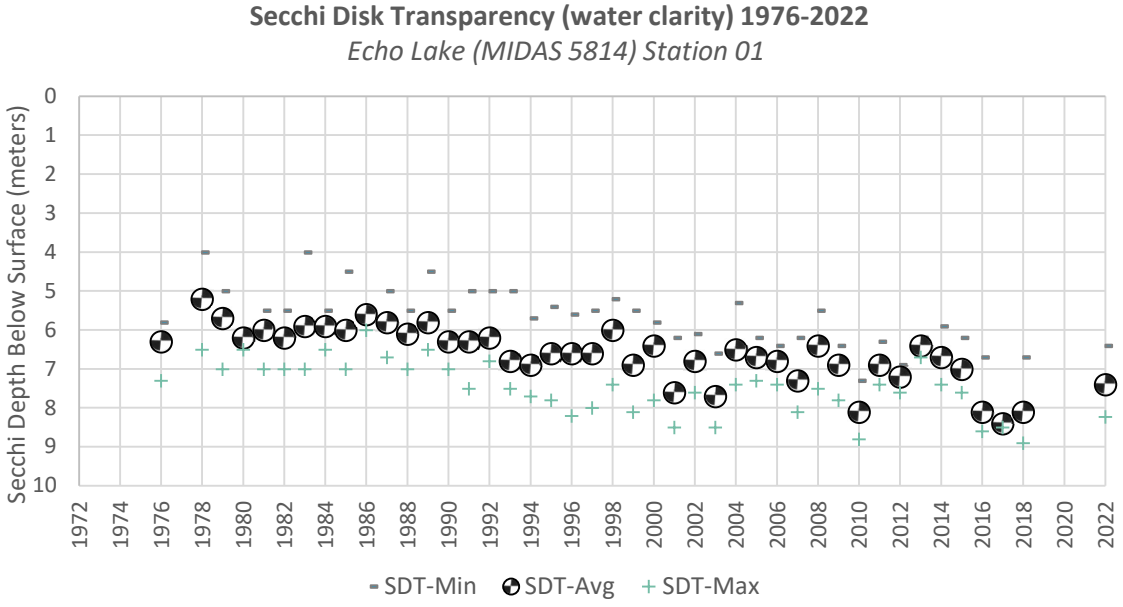

Figure 3. Annual minimum, average, and maximum Secchi Disk Transparency (SDT) readings in Echo Lake, 1976-2022

Total Phosphorus (TP)

Total Phosphorus (ppb)	
2022 TP Average	6
Historical TP Average	6
Maine Lakes TP Average	12

Phosphorus is the nutrient that most influences the growth of algae in lakes. Because its natural occurrence in lake water is very small, phosphorus "limits" the growth of algae in lake ecosystems. Even small increases in phosphorus in lake water can cause substantial increases in algal growth, which hinders not only the overall health of the lake system, but also the economic, recreational, and aesthetic values. Tracking in-lake phosphorus levels over time is another way of monitoring change in lake water quality trends. Generally speaking, in-lake phosphorus concentrations less than 10 ppb are ideal. Lakes with in-lake phosphorus concentrations of ~13 ppb or more are known to sustain algal blooms, and blooms become more frequent as average concentrations approach 20 ppb.

TP samples have been collected from the upper waters of the lake (epilimnion) since 1976 during 11 of the past 45 years. Annual average phosphorus concentrations have ranged from 4 ppb (1979 & 1985) to 9 ppb (1988) with an overall historical average of 6 ppb. The result of the three (3) epilimnetic core samples collected in 2022 were 4 ppb (July 28th), 8 ppb (August 22nd), and 7 ppb (October 5th) for an average of 6 ppb (Figure 4).

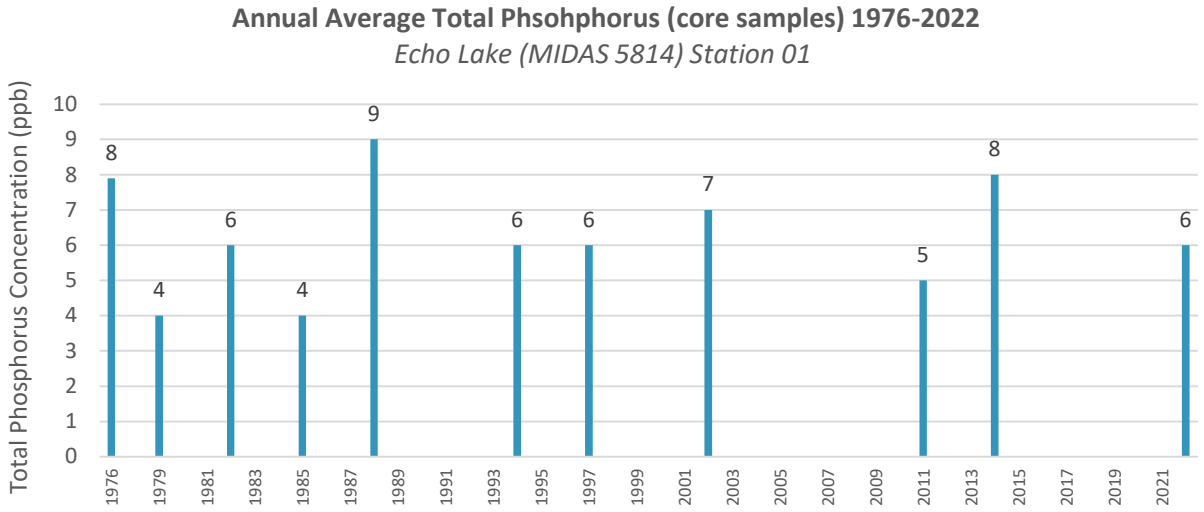

Figure 4. Annual Average Total Phosphorus data (epilimnetic core samples) collected 1976-2022, Station 1.

In 2022, one (1) sample was collected from the bottom of Echo Lake using a Kemmerer grab sampler; this type of sample is known as a "bottom grab". Bottom grabs are collected when anoxia is encountered anywhere in the dissolved oxygen profile and help us determine if there is active phosphorus release from bottom sediments exposed to anoxic conditions. Laboratory results from the single bottom grab sample collected in October 202 was 15 ppb (Figure 5).

Historically, bottom grab samples were collected during six (6) years throughout the 45-year monitoring record (1979, 1982, 1985, 1988, 2002, and 2022). The historical annual average bottom grab TP concentration ranges from 4 ppb (1979) to 15 ppb (2022) with a historical average of 6.1 ppb.

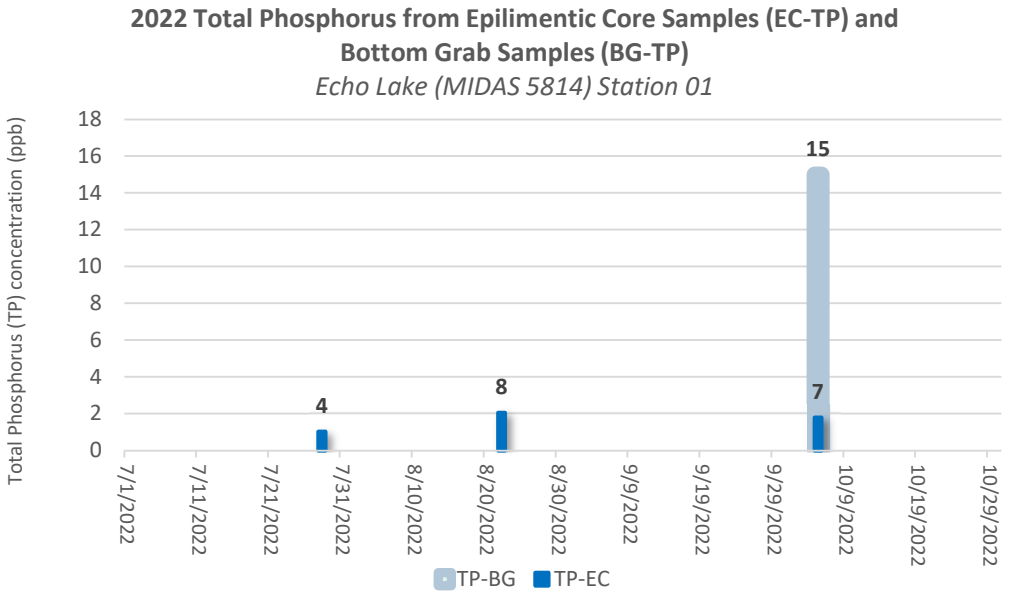

Figure 5. 2022 TP core sample and bottom grab sample results from Echo Lake.

Chlorophyll-a (Chl-a)

Chlorophyll is found in plants, including algae, and is used to convert sunlight into energy. Measuring the concentration of Chlorophyll in lake water helps us estimate the algae population in the lake. Chlorophyll was measured three (3) times in 2022.

Chl-a (ppb)	
2022 Chl-a Average	2.7
2022 Peak Chl-a	3.0
Historical Chl-a Average	2.4
Maine Lakes' Chl-a Average	5.4

Chl-a samples have been collected from the upper waters of the lake (epilimnion) since 1976 during eight (8) of the past 45 years. Annual average chl-a concentrations have ranged from 1.4 ppb (1997) to 10 ppb (1976) with an overall historical average of 2.4 ppb. The results from the three (3) epilimnetic core samples collected in 2022 were 3 ppb on July 28th and August 22nd and 2 ppb on October 5th.

Dissolved Oxygen (DO) and Temperature

Dissolved oxygen (DO) is a critical indicator of the health of the lake system. DO is produced through photosynthesis, consumed during respiration and decomposition, and is influenced by wind, wave action, weather events, and lake productivity. A good supply of oxygen is essential for fish and other aquatic species, with most fish species requiring a DO concentration of 5 mg/L or more. As lakes become more biologically productive in the summer, oxygen can decline as decomposition occurs in deep areas of the lake. Loss of oxygen may indicate a stressed and changing ecosystem. Documenting the pattern and extent of oxygen loss in deep areas of the lake across many monitoring seasons is important to understanding the current lake condition and the variability between the years or

through a single season. This is particularly concerning for lakes that may be more vulnerable for internal phosphorus loading due to unique sediment chemistries.[1]

Three (3) DO and temperature profiles were collected in Echo Lake in 2022. DO <5 mg/L was documented first in July at 35 meters but grew to include waters as shallow as 11 meters by early October. DO <2 mg/L (anoxia) was not documented at until late in the season at a depth of 30 meters in October (Figure 6). Continued collection of bi-weekly DO and temperature profiles will identify trends and changes occurring in Echo Lake in order to better understand variations in thermal stratification and the extent and severity of the low DO and anoxic zones.

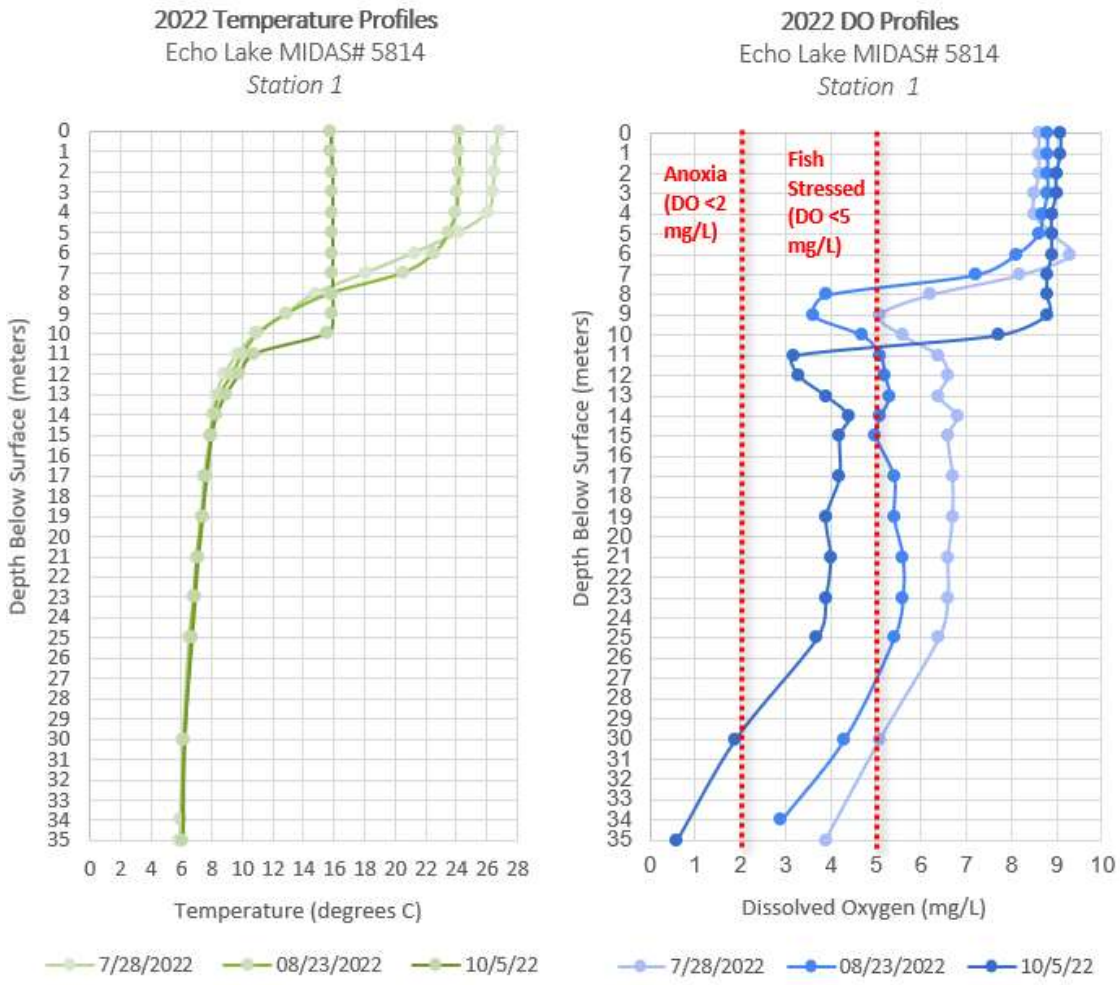

Figure 6. 2022 Dissolved Oxygen and Temperature Profiles, Station 01, Echo Lake.

[1]Echo Lake appears on Maine DEP's list of "Threatened Lakes" on the NPS Priority Watersheds List (https://www.maine.gov/dep/land/watershed/nps_priority_list/NPS%20Priority%20List%20-%20Lakes20.pdf) due to its sediment chemistry. Sediment results suggest that Echo Lake may be more vulnerable to internal phosphorus loading, a phenomenon that can occur when deep waters become anoxic (DO loss <2mg/L) resulting is phosphorus release from the bottom sediments exposed to anoxic waters.

More about the data presented in this report

2022 was 30 Mile's first year of monitoring Echo Lake. Data presented in this report includes all monitoring data collected on Echo Lake through 2018, submitted to Maine DEP by both volunteer monitors and state agencies, that has undergone a thorough QA/QC process. All data collected in 2019, 2020, and 2021 is currently in holding at Maine DEP for QA/QC and will be included in the next annual water quality report, if available at that time.

Five years of regular data collection for any given parameter will provide a baseline condition of the lake. 10 years of regular data collection is needed to meet the minimum data thresholds for determining trends over time. This effort will continue to develop a robust dataset that can help the community identify and address water quality trends.

Next Steps

Work with ELA volunteer water quality monitor, Gary Philipp, to complete a full season of baseline monitoring between May and October in 2023. This includes bi-weekly collection of Secchi disk transparency data and DO/Temperature profiles, and monthly collection of water samples that are analyzed for Total Phosphorus (TP) and Chlorophyll-a (Chl-a). Once per season, 30 Mile collects additional water samples that are analyzed for pH, Alkalinity, Conductivity, and Color.