TECHNICAL MEMORANDUM

TO: Webber Tri-WBMP Technical Advisory Committee
FROM: Jen Jespersen, Ecological Instincts
SUBJECT: **THREEMILE POND 2025 WATER QUALITY ANALYSIS**
DATE: April 1, 2026
Cc: Stephanie Taylor (KCSWCD)

INTRODUCTION

Threemile Pond is a 1,131-acre Great Pond (MIDAS #5416) located in the towns of China, Vassalboro, and Windsor, Maine. Maximum depth is reportedly 11 m with an average depth of 5 m and a flushing rate of 1 flush/yr.[1] More recent assessments put these values at 12.3 m, 5.5 m, and 1 flush/yr, respectively.[2] Both Threemile Pond, and downstream Webber Pond have a history of algal blooms in the summer months dating back to at least the 1970s and have shown a decline in water quality in recent years.

Station 1, Threemile Pond. Source: lakesofmaine.org

Ecological Instincts was tasked with conducting an analysis of 2025 water quality monitoring data for Threecornered Pond, Threemile Pond, and Webber Pond as part of the Webber, Threemile & Threecornered Ponds Tri-WBMP project. Water quality data were collected every two weeks by volunteers at Threecornered Pond between 6/1/2025 and 9/11/2025, Threemile Pond between 5/13/25 and 10/10/25, and at Webber Pond from 5/12/25 to 10/23/25.

For Threemile Pond, data collected included Secchi disk transparency (SDT), temperature and dissolved oxygen (DO) profiles at every meter through the water column, epilimnetic core samples (chlorophyll-a, pH, alkalinity, iron, total aluminum, dissolved aluminum, total Kjeldal nitrogen, and total phosphorus), total phosphorus (TP) profile grabs at every other meter from 1 m to 11 m. Data were entered by Webber Pond Association (WPA) volunteers into an online spreadsheet (Attachment 1). Water samples were collected monthly to biweekly for phytoplankton between 5/13 and 10/10 and monthly for zooplankton over the same time period, and analyzed by Water Resource Services (WRS).

The following analysis includes a summary of 2025 monitoring observations for Threemile Pond including "heat maps" showing changes in temperature, DO, and total phosphorus over the course of the 2025 monitoring season. Long-term (historical record) and short-term (10-year) trends were also examined for SDT, Chl-a, TP, pH, conductivity, color and alkalinity using available data collected between April and October. Long-term trends include all data collected between 1977-2025 while short-term trends include all data collected between 2016-2025. Additional data analysis was completed for surface water temperature, anoxic factor (AF), and minimum anoxic depth (MAD). Table 1 (below) provides an overview of the number of years of data collected by parameter over the historical time period.

[1] Lakes of Maine, Threemile Pond, Lake Information: https://www.lakesofmaine.org/data/2022_Lake_Reports/MaineLakeReport_5416_1.html

[2] Using bathymetric data collected by US EPA in 2024 and flushing rate calculated in the 2026 LLRM.

Table 1. *Threemile Pond water quality data summary by parameter, Station 1 (1977-2025).*

Parameter	# Years with Data
Secchi Disk Transparency (SDT)	49
Total Phosphorus (TP) – Epilimnetic Core	39
Total Phosphorus (TP) – Bottom Grab	42
Total Phosphorus (TP) – Surface Grab	22
Chlorophyll-a (Chl-a)	44
Dissolved Oxygen/Temperature Profiles	46
Anoxic Factor Calculations	18

2025 CONDITIONS IN THREEMILE POND

Temperature & Secchi Disk Transparency

- In 2025, **surface temperature** ranged from 16.3 °C on 5/13 to 25.8 °C on 7/9. The pond had not fully stratified at the beginning of the sampling season (5/13 & 5/29). By 6/12, the pond had stratified with a 1.6 °C drop between 3 and 4 m, and remained stratified through the summer and early fall, becoming weakly stratified in mid- to late September before full mixing by 10/10 (Figure 1). Coldwater fish generally prefer water that is <18 °C but can tolerate temperatures up to 24 °C. Surface temperature was >24 °C between 6/26 and 8/7, reaching a maximum of 25.8 °C at the surface on 7/9.
- **SDT** ranged from a maximum of 2.9 m on 6/12 to a minimum of 1.2 m on 9/23 with an average of 2 m over the course of the monitoring period (n=11). SDT measured <2 m (DEP bloom threshold) on seven of the 11 sampling dates compared to four readings >2 m which occurred early in the season between 5/13 and 6/26. SDT dropped to <2 m on 7/9 and remained at <2 m through fall turnover on 10/10 (Figure 1). Onset of SDT readings <2 m correspond with peak surface temperature and anoxia. The lowest SDT readings were recorded on 9/23 and 10/10 as the pond began to turn over. Based on 2025 SDT data, it appears that Threemile Pond experienced an algal bloom that persisted from early July through the end of the sampling period in mid-October. Based on 2025 SDT data, Threemile Pond is classified as eutrophic (nutrient rich and prone to algal blooms) with SDT readings averaging <4 m.

Dissolved Oxygen (DO)

- In 2025, DO in Threemile Pond ranged from 10.1 ppm from the surface to 3 m on 5/13 to 0 ppm at the bottom of the pond on 7/9. Low levels of DO persisted at the bottom of the pond from mid-June through mid-September (Figure 2 and Attachment 1). Coldwater fish such as brook trout begin to experience physiological stress at around 5 ppm and this can impact fish survival and even cause fish kills if there is no habitat nearby into which the fish can move.[3]
- As DO concentrations fall below 2 ppm, phosphorus begins to be released from lake sediments, with more phosphorus released at lower concentrations and during longer periods of time.[4,5] DO dropped below 2 ppm (hypoxia) at 11 m on 6/12 and below 1 ppm (anoxia) at 7 m on the 6/26.

[3] Brook trout and brown trout are stocked annually by MDIFW in Threemile Pond.

[4] LaBrie, R., Hupfer, M. and Lau, M.P., 2023. *Anaerobic duration predicts biogeochemical consequences of oxygen depletion in lakes*. Limnol. Oceanogr. Lett, 8: 666-674. https://doi.org/10.1002/lol2.10324

[5] Mortimer, H.C., 1971. *Chemical Exchanges between Sediments and Water in the Great Lakes – Speculations on the probable regulatory mechanisms*. Limnology and Oceanography, 2, https:/doi.org/10.4319/lo.1971.16.2.0387

- Anoxia persisted at depths between 6 and 7 m until late August. The depth of anoxia decreased to 10 m on 9/11. The pond was mixed by 10/10 which resulted in DO concentrations of 8.1 to 9.3 ppm throughout the water column (Figure 2).

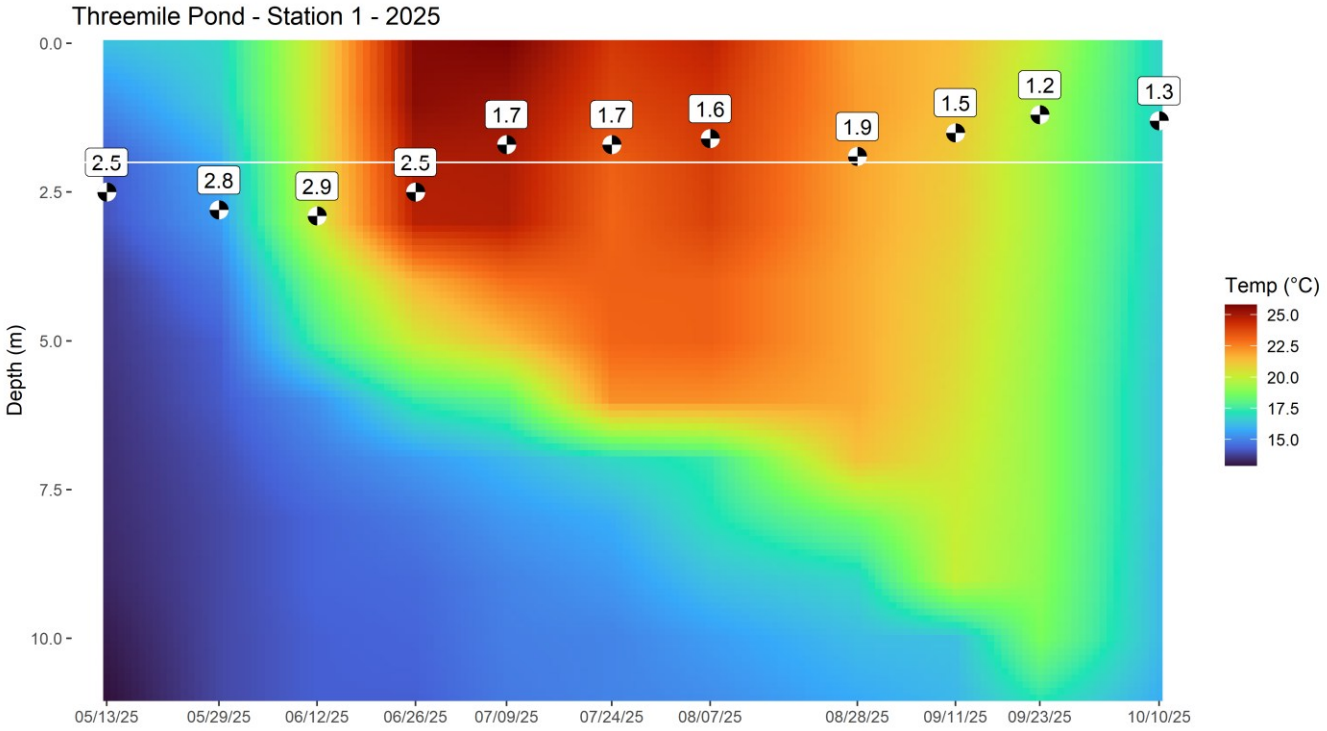


Figure 1. *Water* temperature and SDT heat map for Threemile Pond, May-October 2025. *(The horizontal white line represents the Maine DEP bloom threshold of 2 m.)*

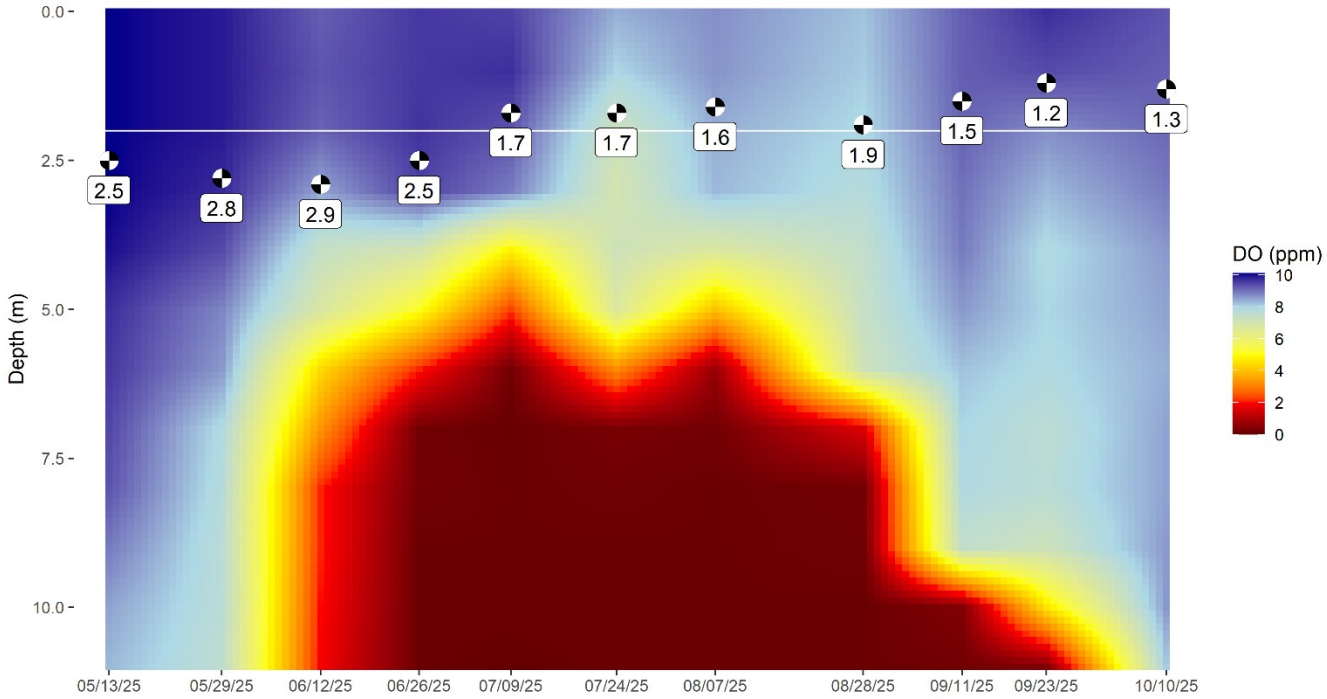


Figure 2. *DO heat map and SDT depth for Threemile Pond, May-October 2025.*

Total Phosphorus (TP) & Dissolved Oxygen (DO)

TP in surface water (1 m grab) ranged from 20 ppb on 6/26 to 34 ppb on 10/10 with an average of 26 ppb over the course of the 2025 season (Figure 3). The lowest TP value corresponds with a deeper SDT reading towards the beginning of the season, and the highest concentration corresponds with fall turnover.

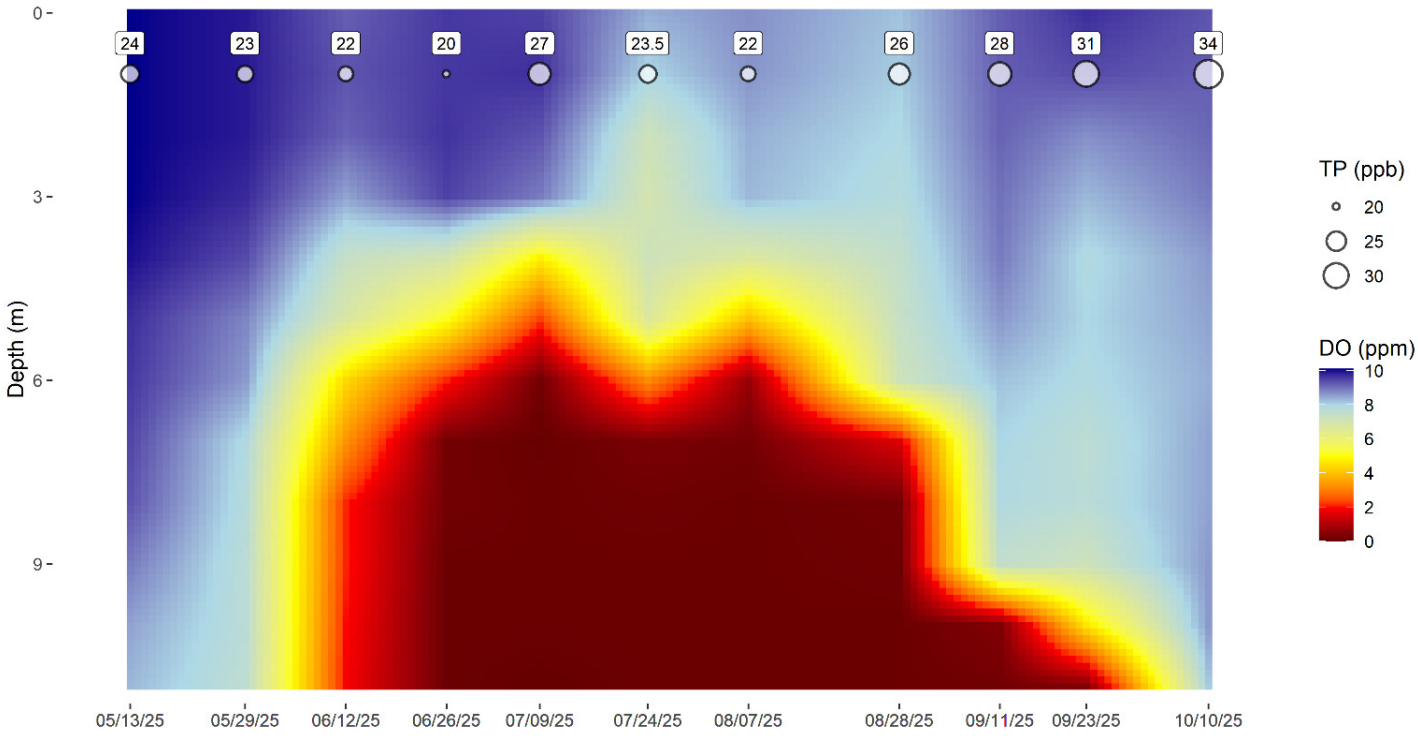


***Figure 3**. Surface TP (1 m) and DO heat map for Threemile Pond, May-October 2025.*

TP in bottom water (11 m) ranged from 27 ppb on 9/23 as the pond began to turnover to 530 ppb on 9/11 just before turnover (Figure 4).[6] The highest TP concentrations at the bottom of the pond occurred in late August and early September following the extended period of anoxia, an indication of internal phosphorus loading from the sediments during periods of anoxia, with bottom TP building in the water column as the period of anoxia increases (Figure 4). Similarly, the highest surface TP prior to turnover (31 ppb on 9/23) occurred following a significant increase in deepwater TP in the water column and the highest recorded deepwater TP on 9/11 (Figure 4, Attachment 1).

Deepwater TP started to mix into the water column on 9/11, the early stages of the pond beginning to de-stratify (surface TP reached 31 ppb), and was fully mixed into the water column at turnover on 10/10 resulting in water column TP values of 34 ppb at the surface to 49 ppb at the bottom (Figures 3 & 4). This is a clear indication of internal phosphorus loading from bottom sediments in Threemile Pond.

[6] TP data collected below 3 m on 8/7 were removed from the analysis due to sampler error. It is believed that the grab samples were improperly collected resulting in lower than expected readings based on bottom TP concentrations in the data collected before and after.

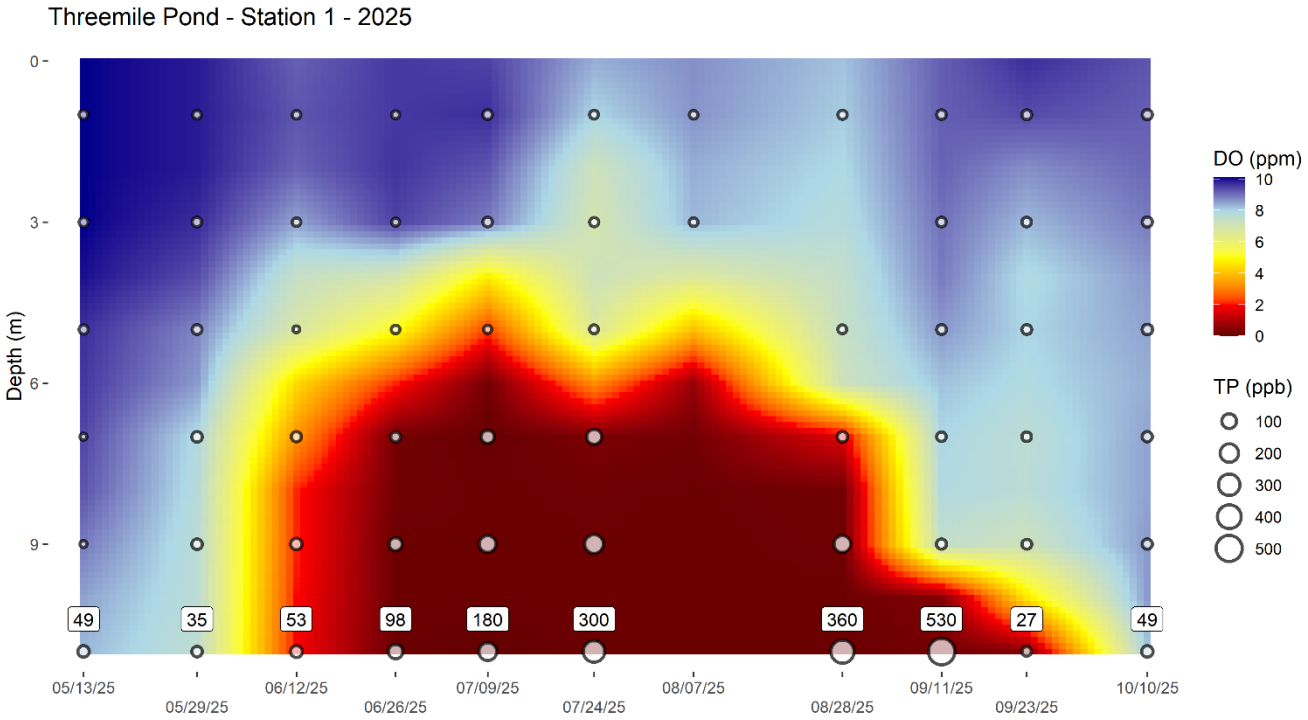


Figure 4. *TP and DO heat map for Threemile Pond, May-October 2025. (Note difference in scale for TP in Figure 3 vs. Figure 4.)*

Phosphorus Mass

2025 TP profile data were used to calculate the mass of phosphorus at discrete depth intervals in Threemile Pond between (Figure 5).

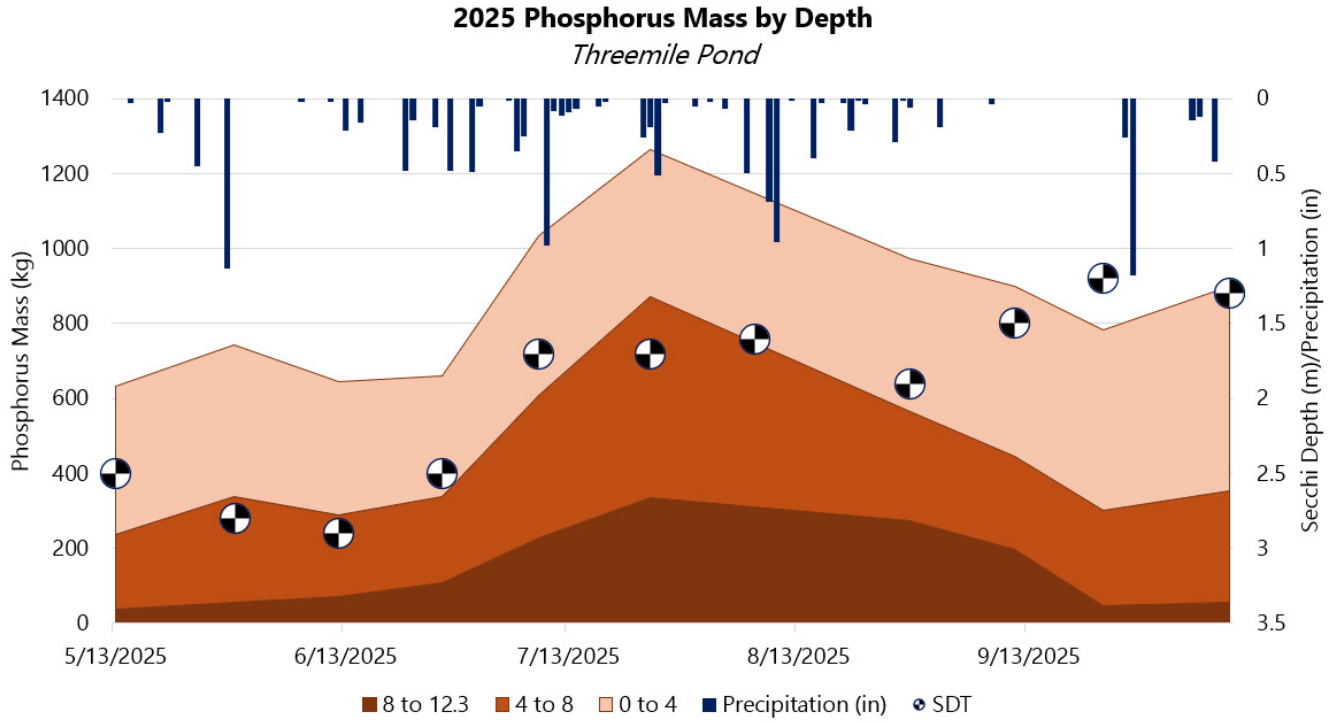


Figure 5. *Phosphorus mass by depth, precipitation, and SDT for Threemile Pond, May-October 2025.*

The water column is broken up into three vertical zones, 0-4 m, 4-8 m and 8-12.3 m based on DO profile data. It is unlikely that Threemile Pond experiences P release at depths <4 m, but the release at depths >4 m will not be uniform, based on oxygen conditions and mixing regime. There was observable accumulation of P in deeper water, primarily below 7 m in 2025.

Unlike Webber Pond, where surface layers closely mirror TP mass in bottom layers, at Threemile Pond the surface layers contain a larger mass of P in the spring (May-June) before internal loading builds substantially. This indicates that phosphorus inputs from the watershed are contributing to the overall P mass early in the year.

Since P mass is based on the volume of water and P concentration at each depth interval, depth intervals with a small volume and a high P concentration may be equivalent to a depth interval with a larger volume of water with a lower P concentration. For example, based on recent bathymetry collected by US EPA, the 0-4 m contour interval represents 61% of the total pond volume while the 8-12 m interval only accounts for 6% of the pond volume. Therefore, despite having high levels of P, the deeper contour interval accounts for a smaller portion of the total P mass. Yet, as observed in the DO/TP heat maps above, the depth interval with the smallest volume but highest P concentration plays a significant role when P mixes up into the water column, contributing to the overall mass of P in surface water layers.

Figure 5 (above) shows the rise in the overall P mass in July and August during the period of increasing anoxia at the bottom of the pond. Increasing P in water <4 m deep may be a function of loading from the watershed or uptake by algae (most notably cyanobacteria, but other algae use this mechanism as well) at the sediment-water interface with subsequent rise in the water column, bringing excess P with them.

From the low point of P mass on 5/13 (633 kg), the mass of P in Threemile Pond increased through the summer, reaching its peak on 7/24 (1265 kg) that represented a net increase of 632 kg. It is estimated that 583 kg of the total P mass in 2025 was derived from internal loading at depths >6 m.

By 9/23, the pond has almost fully mixed, resulting in the movement of deepwater phosphorus into the water column at the end of September and into mid-October. This phosphorus becomes available to algae in the surface layers, thereby increasing algae growth and resulting in low SDT (1.3 m), a high concentrations of Chl-a (49 ppb), and TP profile readings of 33-34 ppb for most of the water column (from the surface to 9 m on 10/10).

Total Kjeldahl Nitrogen

Total Kjeldal Nitrogen (TKN) was assessed from monthly epilimnetic core samples, and is comprised of particulate N forms plus ammonium N. The concentration of TKN in May and June was relatively low (0.5 ppm), and increased through the summer and fall to 1.2 ppm on 10/10. Samples were taken from a core that typically contains oxygenated water; ammonium is therefore scarce, and TKN mainly reflects particulate nitrogen associated with increased algal biomass over the course of the sampling season consistent with the increase in Chl-a and decrease in SDT (rather than elevated dissolved nitrogen inputs).

Chlorophyll-a (Chl-a), pH & Alkalinity

Chl-a concentrations in the epilimnion ranged from 4.3 ppb on 5/13 to 49 ppb on 10/10 with an average of 20.2 ppb over the course of the monitoring period. The highest Chl-a concentrations corresponds with the lowest SDT readings (9/23 – 10/10) and high values of TP in the water column during fall turnover. pH ranged

from 6.7 in September and October to 7.1 in June, with an average of 6.9. Alkalinity ranged from 15 ppm in June to 18 ppm in October, with an average of 16.3 ppm.

Phytoplankton & Zooplankton

Nine **phytoplankton** samples were collected in Threemile Pond between 5/13 and 10/10/25. Results of the phytoplankton analysis indicate that the plankton community was dominated by diatoms early in the season (May) with a shift to cyanobacteria dominance beginning 7/9 (Figure 6) corresponding with elevated surface water temperature, peak anoxia, and internal phosphorus loading. *Aphanizomenon, Microcystis,* and *Dolichospermum* exhibited the greatest densities, with *Aphanizomenon* peaking on 7/9 (24,205 cells/mL) and persisting at high densities through 8/28. *Microcystis* was most abundant in July and early September peaking on 7/24 (2,380 cells/mL). *Dolichospermum* persisted at densities >1,000 cells/mL from 7/9 through 10/10 (Attachment 2).

All three of the dominant species present in Threemile Pond in 2025 are known toxin producers (*Microcystis*, *Aphanizomenon* and *Dolichospermum*). *Planktothrix,* another known toxin producer, was only dominant in the 8/7 sample. While there were no toxin samples analyzed in 2025, Threemile Pond has experienced exceedances of both the US EPA 10-day drinking water health advisory for both bottle-fed infants and pre-school children (0.3 µg/L) and school-age children and adults (1.6 µg/L).[7]

Six monthly **zooplankton** samples were collected in Threemile Pond between 5/13 and 10/10. Results of this analysis indicate a decline in zooplankton over the summer, likely related to alewife predation. However, the biomass values and the average body length of crustaceans were not as low as often observed with large juvenile alewife populations.[8] Zooplankton densities were highest on 5/13, dominated by Rotifers (*Polyarthra*) and Cladocerans (*Bosmina*) on 5/13. In terms of biomass, *Daphnia dubia* was dominant in the spring (5/13 and 6/12) before dropping off significantly by the 7/9 sampling event.

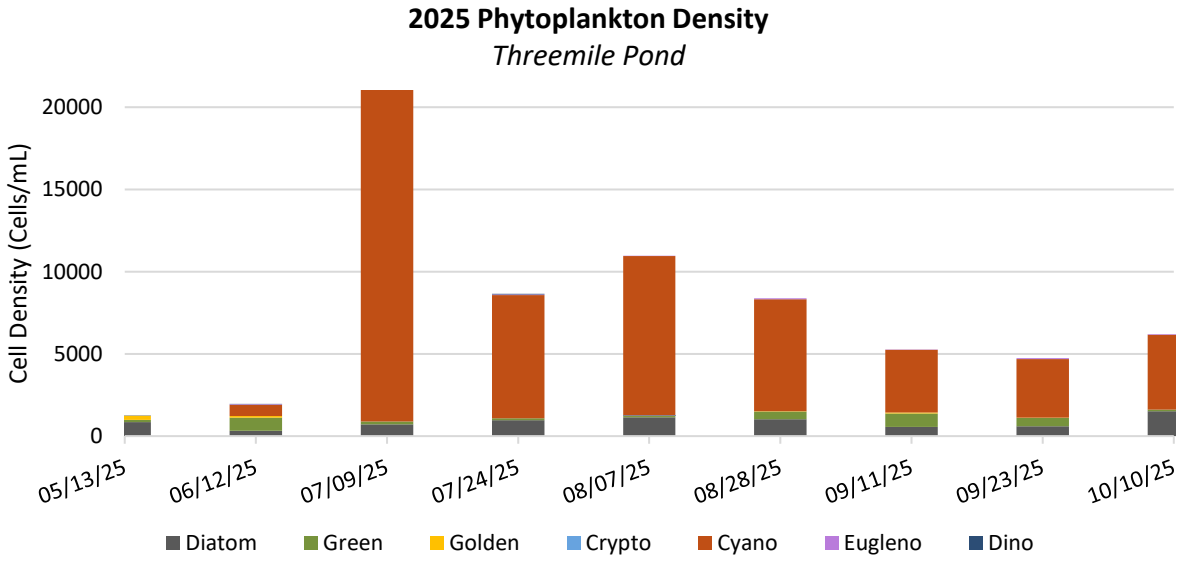


Figure 6. *Phytoplankton density in Threemile Pond, May-October 2025.*

[7] EPA, EPA Drinking Water Health Advisories for Cyanotoxins: https://www.epa.gov/habs/epa-drinking-water-health-advisories-cyanotoxins

[8] Personal communication, Ken Wagner, WRS.

Iron

Iron concentrations in the epilimnion (sampling depth range 2 – 10 m) ranged from 0.081 ppm on 7/9 to 0.170 ppm on 10/10 following turnover, increasing slightly over time after 7/9 (Figure 7). This indicates that ferric iron (Fe III) is being reduced by anaerobic bacteria. This process releases the formerly iron-bound phosphate into the hypolimnion, which is mixed into the surface water during turnover.

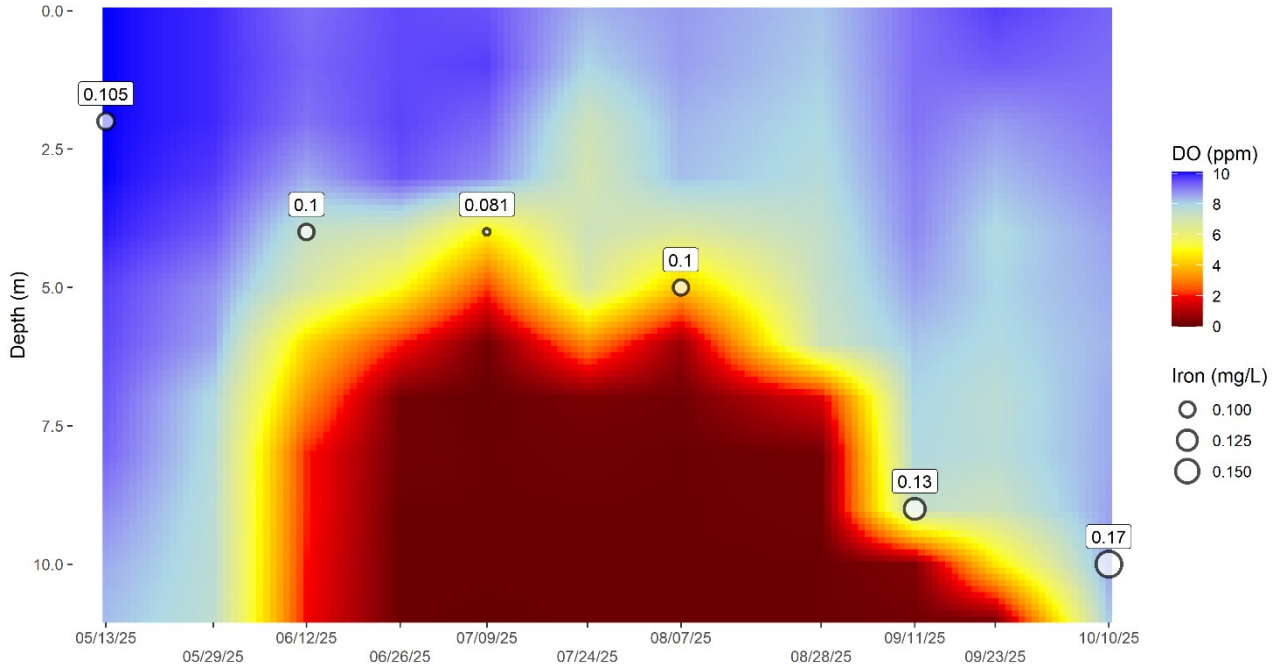


Figure 7. *Iron and DO heat map for Threemile Pond, May-October 2025.*

This can be indicated by an increase in iron in surface water. Actual iron values are not especially high, nor do they exceed the secondary drinking water standard (0.3 ppm) in any epilimnetic core sample, but the increase over time is evident and deep water values are likely to have been much higher.

Dissolved & Total Aluminum

In 2025, total aluminum concentrations in the epilimnion of Threemile Pond were variable across the monitoring period, were highest on 5/13 (0.028 ppm) before the pond was stratified, but were generally low overall. Dissolved aluminum ranged from <0.002 on 10/10 to 0.0057 ppm on 6/12, all very low values. Dissolved aluminum reacts quickly in the water column and is converted to particulate or colloidal forms. At low concentrations, total aluminum may be bound to organic matter in the water and remain in solution. The higher amounts of aluminum in the water column at the beginning of the season are most likely due to snow melt and heavy rains, as most aluminum comes from the watershed and is not subject to much release from sediment once settled.[9]

[9] *Final Aquatic Life Ambient Water Quality Criteria for Aluminum 2018.* EPA-822-R-18-001. December 2018. Online: https://www.epa.gov/sites/default/files/2018-12/documents/aluminum-final-national-recommended-awqc.pdf

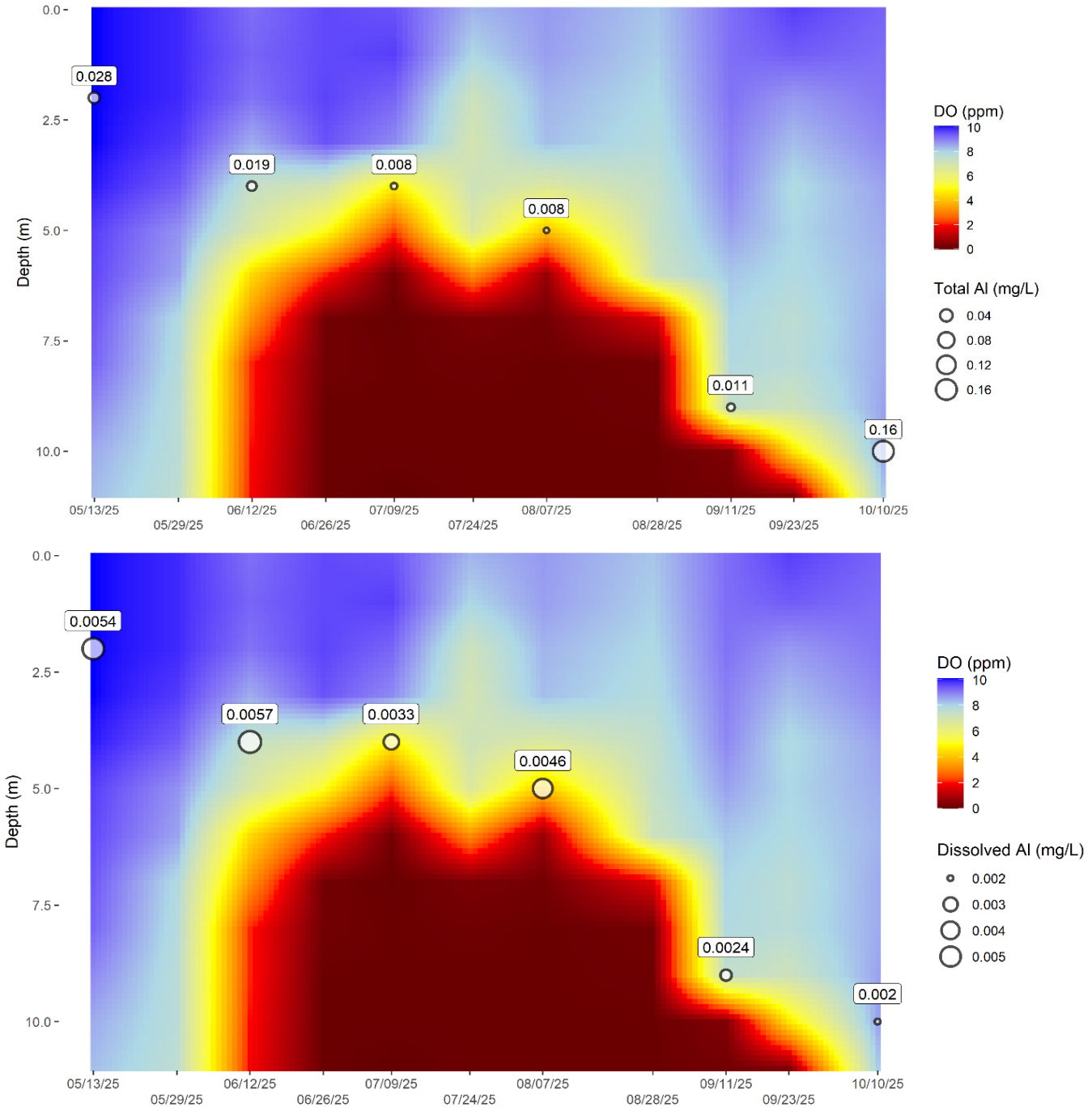


Figure 8. *Total aluminum (top) and dissolved aluminum (bottom) and DO for Threemile Pond, May-October 2025.*

WEATHER PATTERNS

Temperature

Variation in weather patterns from year to year is an important driver of annual variability in lake water quality. Higher (air and water) temperatures lead to earlier ice-out and later ice-in, resulting in longer and stronger stratification periods, which leads to increased algal growth, greater oxygen demand due to decomposition on the lake bottom, and lower oxygen near the lake bottom. Surface water temperatures in northern New England increased 1.4 °F per decade from 1984-2014, which is faster than the worldwide average, with Maine lakes warming on average by nearly 5.5 °F during this time.[10] **Average annual summer surface temperatures (April – October) increased significantly** in Threemile Pond since 1979 (Figure 9). There was no signeificant trend in the 10-year data set, however 2022 and 2023 had the highest average surface temperatures over this period.

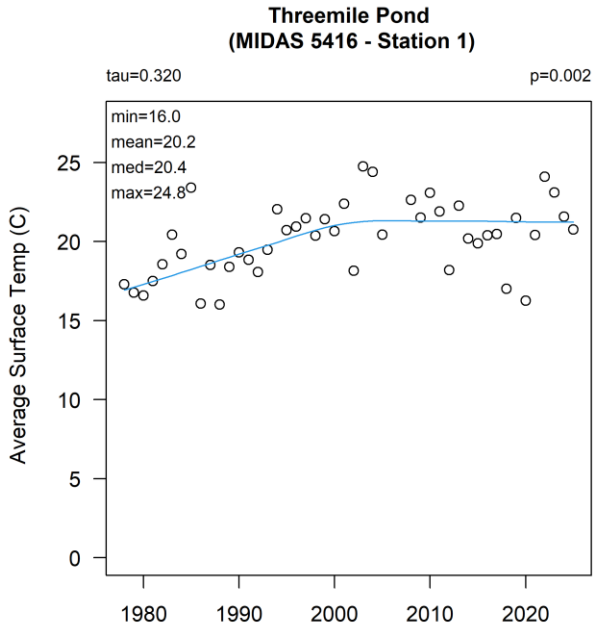


Figure 9. *Average surface temperatures (≤1 m) between April and October in Threemile Pond from 1979-2025.*

Precipitation

Increased precipitation results in an increase in the amount of runoff that lakes receive from their watersheds- meaning that drier years may result in less phosphorus getting to the lake and better water quality, and years with more precipitation may result in more phosphorus getting to the lake and poorer water quality. In lakes with a large internal load, the excess phosphorus from the watershed during wet years combined with internal loading may be enough to cause a lake-wide algal bloom.

The highest precipitation in the region over the past 10 years occurred in 2023, with 28.9 inches of rain from May-September (Figure 10). The lowest summer precipitation was in 2020 with only 10.7 inches of rain. In 2025, the total summer precipitation was relatively low at 14.5 inches, and was particularly low in July and August. In 2025, many parts of Maine were in a drought, with 60% of Maine in a severe drought as of the end of the year .[11]

[10] Maine Climate Council, 2020. *Scientific Assessment of Climate Change and Its Effects in Maine:* https://www.maine.gov/future/sites/maine.gov.future/files/inline-files/GOPIF_STS_REPORT_092320.pdf

[11] Maine Emergency Management Agency, December 19, 2025: https://www.maine.gov/mema/news/maines-drought-task-concludes-2025-drought-season-and-examines-2026-outlook-fri-12192025-1200

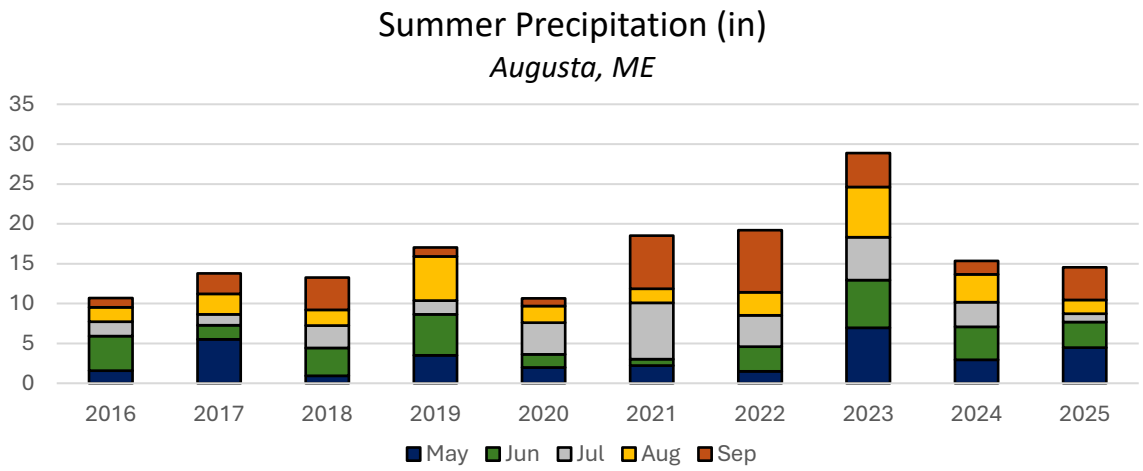


Figure 10. *Summer precipitation for Threemile Pond summed by month from 2016-2025. (Data source: NOAA NOWData, station GHCND: USC00170271 – Augusta Landfill, ME and station GHCND: USW00014605 – Augusta State Airport, ME, US (May 2025).*

Although the summer of 2025 had less precipitation, the overall trend of bigger and more frequent storms is expected to continue and could lead to an increase in the amount of phosphorus getting to the pond via increased erosion and polluted runoff.

THREEMILE POND TREND ANALYSIS

Secchi Disk Transparency (SDT)

Secchi disk transparency (SDT) data collected between 1977 and 2025 signify a **moderate and significant decline in water clarity** over the historical monitoring period (Figure 11). Average annual SDT has ranged from 1.1 m (2022) to 4.9 m (1990) over the historical sampling period with an average of 2.6 m.

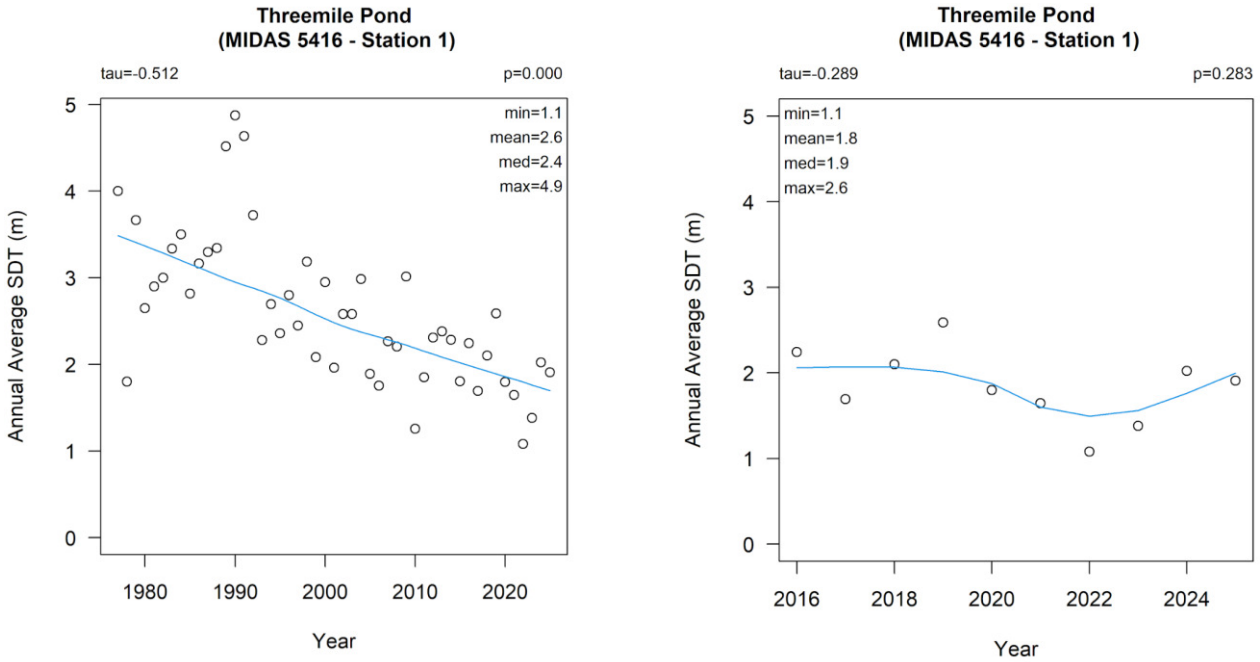


Figure 11. *Average annual SDT trend plot for Threemile Pond from 1977-2025 (left) and last 10 years (right).*

The 10-year trend in water clarity at Threemile Pond highlights the year to year variability likely due to changes in temperature, precipitation, and frequency of measurements (Figure 11). **The 10-year trend is not significant due to the high variability.** Average SDT over this period is 1.8 m.

An aluminum treatment was completed at Threemile Pond in 1989 to try and address internal loading from the sediment. As a result, water clarity improved in the pond for several years from 1989-1992 (Figure 11). Based on current assessments by WRS, treatment of a larger area of the lake bottom at a higher dose of aluminum would have inactivated phosphorus in the sediment for a longer period of time.

Chlorophyll-a (Chl-a)

Examination of Chl-a data collected from Threemile Pond between 1978-2025 indicates a **weak but significant increase in Chl-a over the historical monitoring period** (Figures 12 & 13). Due to the large variability year to year, there is **no significant change in epilimnetic Chl-a over the 10-year period** in Threemile Pond. Ongoing annual Chl-a measurements will help track long-term changes in the pond.

Annual average Chl-a has ranged from 4.6 ppb in 1990 to 60 ppb in 2022, with an average of 21.4 ppb (median= 17), and a 10-year average of 29.2 ppb (median= 26.1). The highest concentration of Chl-a at Threemile Pond was measured in August 1993 (183 ppb). Decadal trends indicate that Chl-a has increased over time and were lowest in the 1970s and highest in the 2010s (Figure 13).

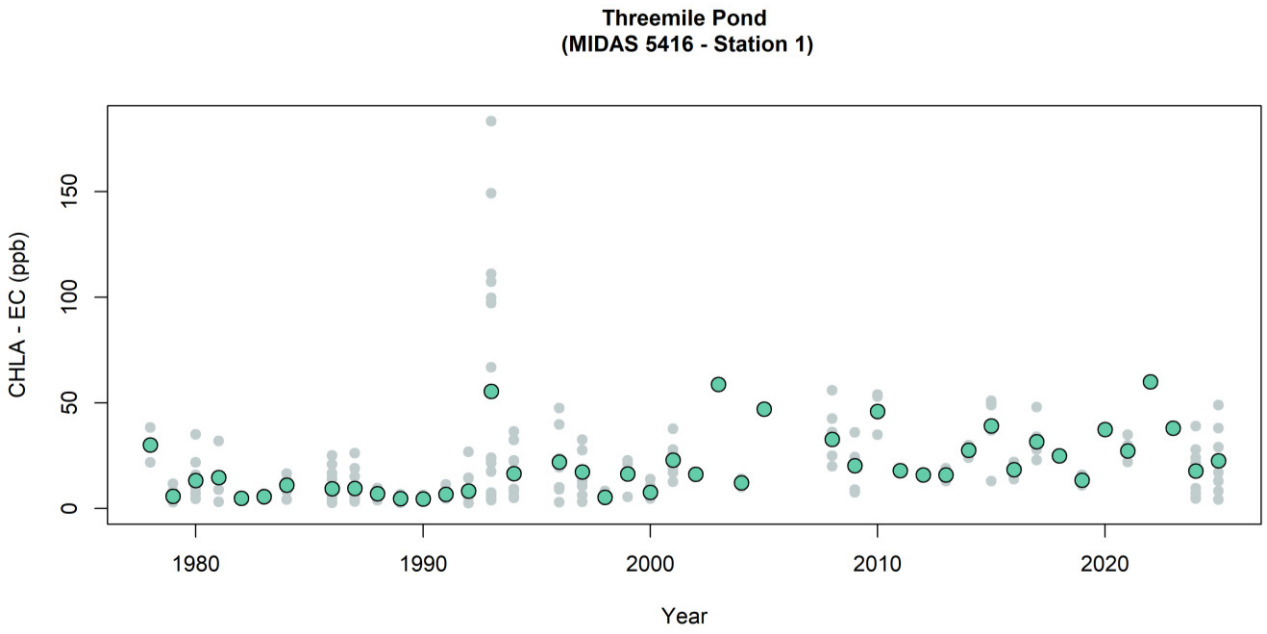


Figure 12. *Annual average Chl-a in Threemile Pond, 1978 - 2025***.**
(Green dots indicate annual average while gray dots indicate individual sampling results.)

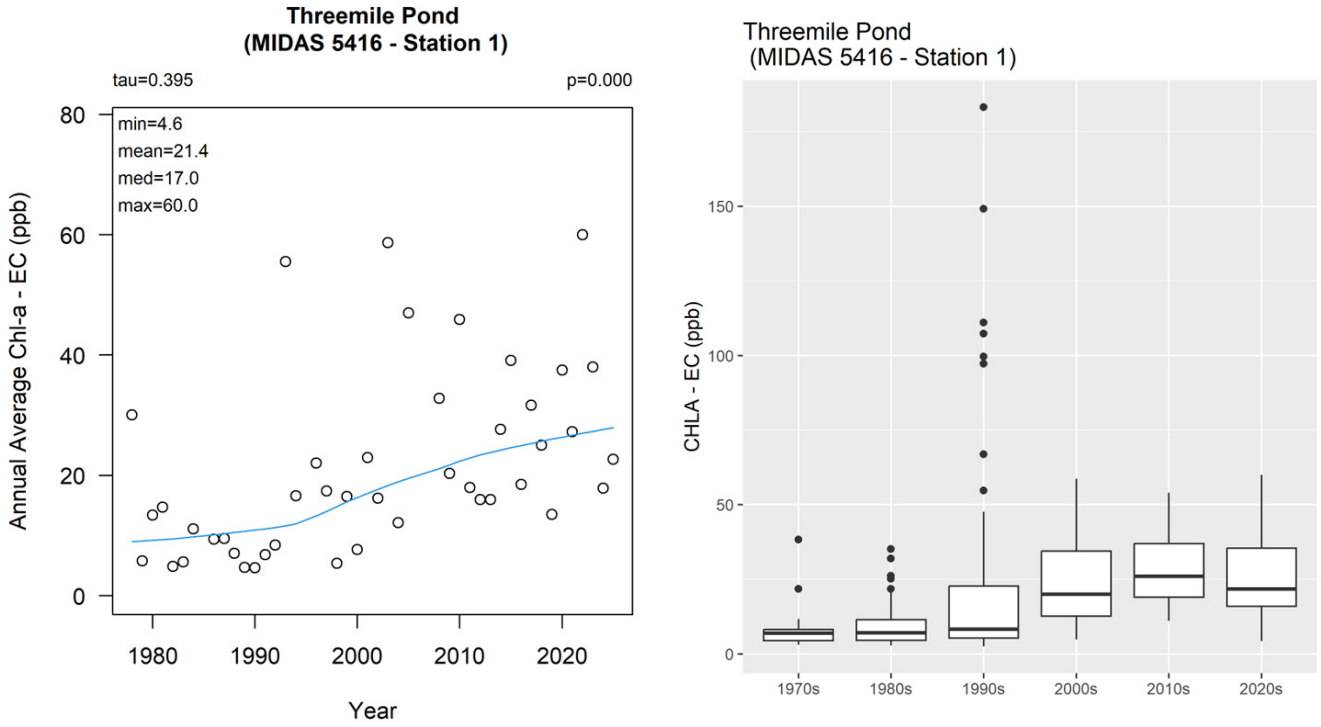


Figure 13. *Annual average Chl-a trend plot for Threemile Pond, 1978 - 2025 (left) and decadal medians (right) presented as box plots. (The median is represented by the bold line inside each box, the box represents the middle 50% of data (interquartile range or IQR), the whiskers extend to the minimum and maximum values within 1.5 times the IQR, and outliers are displayed as points beyond the whiskers.)*

Total Phosphorus (TP)

Examination of TP data collected from Threemile Pond between 1977-2025 indicates a **weak but significant increase in TP over the historical monitoring period** (Figures 14 & 15). There was not enough data to determine a trend in epilimnetic TP over the 10-year period in Threemile Pond. Ongoing annual TP measurements will help track long-term changes in the pond.

Annual average TP ranged from 14 ppb in 1989 to 45.5. ppb in 1996. The highest concentration of TP in the epilimnion was measured on July 1996 (120 ppb). Median TP from 1977-2025 (28 ppb) is lower than the 10-year median (30.5 ppb).[12] Decadal medians indicate a fairly consistent median TP across decades with a shift beginning in the 2010s to present (Figure 15).

[12] 10-year median based on five years of data between 2016-2025. There is not enough data to determine 10-year trend.

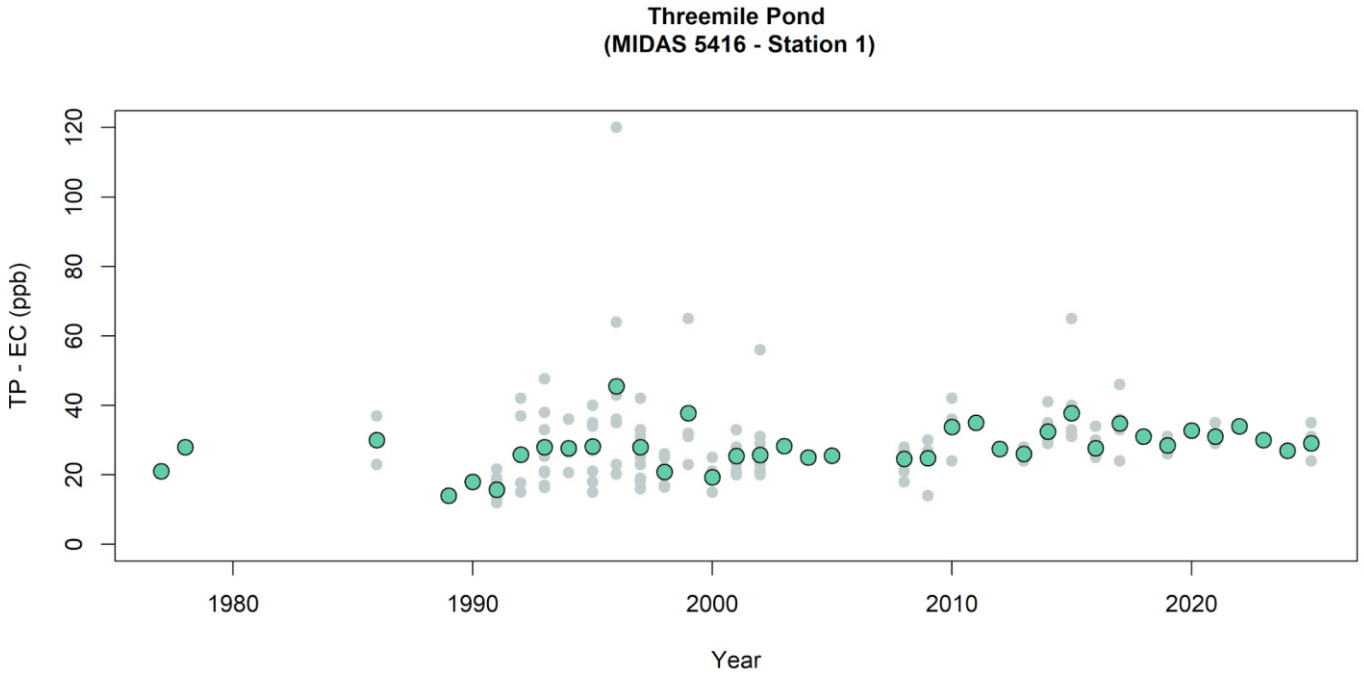


Figure 14. *Average* annual epilimnetic TP in Threemile Pond, 1977-2025. (Green dots indicate the annual average while gray dots indicate individual sampling results.)

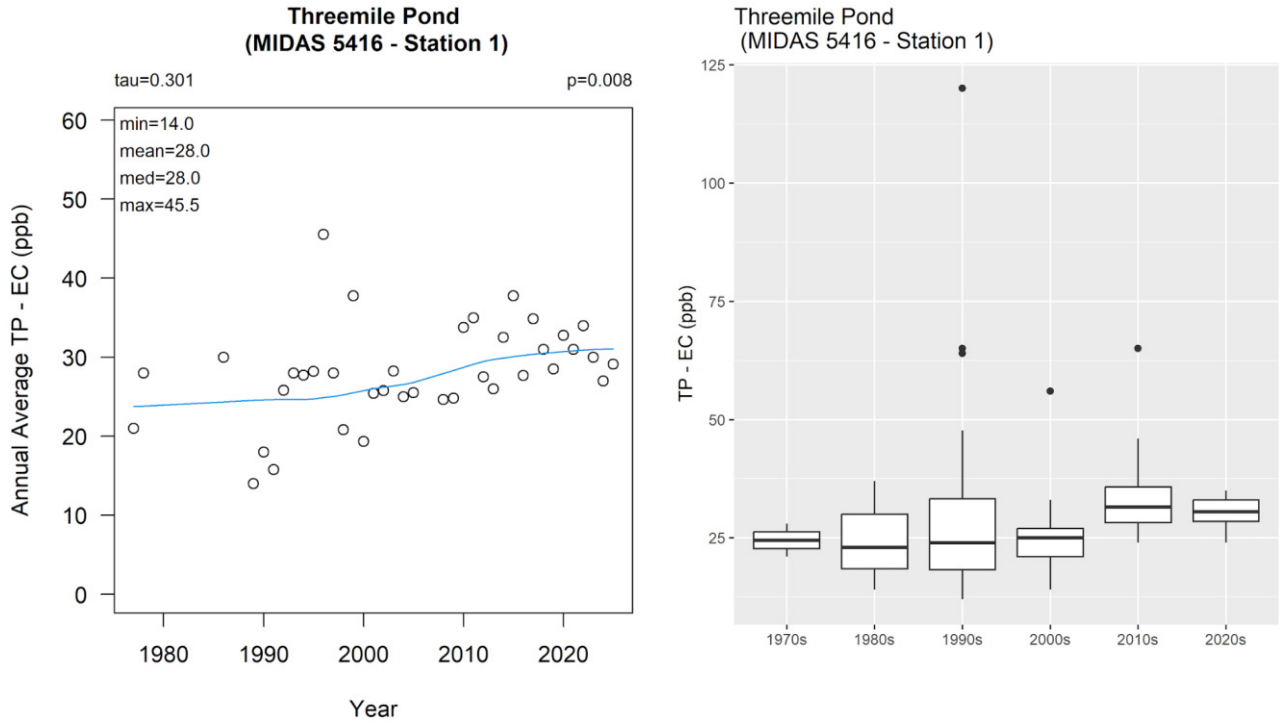


Figure 15. *Annual average epilimnetic TP trend plot for Threemile Pond, 1977 - 2025 (left) and decadal medians (right).*

Anoxic Factor (AF) & Minimum Anoxic Depth (MAD)

Anoxic factor (AF) and minimum anoxic depth (MAD) are metrics used to evaluate trends in anoxia. AF is a metric that combines the volume of anoxic water (DO <2 ppm) and the length of time that the lake is anoxic, while MAD is the shallowest depth where DO is <2 ppm. MAD is an indicator of the volume of anoxic water in lakes; the shallower the MAD, the larger the anoxic volume. DO profile measurements were used to compute AF and MAD in a given year. Larger AF values indicate worse water quality. AF values <10 are considered good while AF >30 are considered very bad.

AF was calculated for years with at least five months of data between May and October, for a total of 18 years between 1979 and 2025. AF values prior to 2002 were <10, whereas the two most recent values (2024-2025) are >10 (17.6 and 12.7, respectively). A trend analysis indicates a **significant increase in AF over the historical sampling period** (Figure 16).

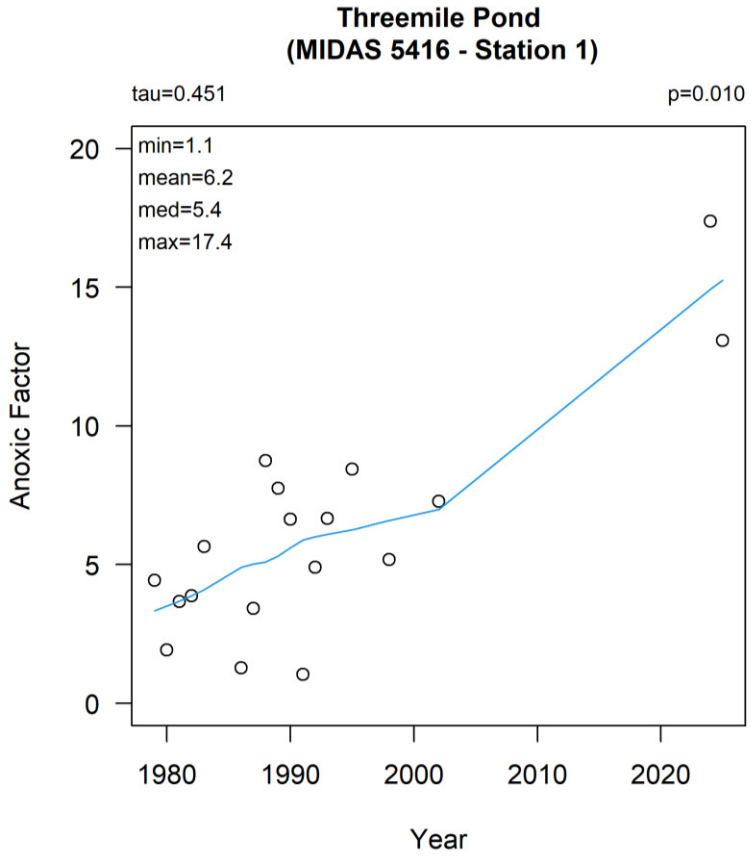


Figure 16. *Anoxic Factor calculated for Threemile Pond, 1979 - 2025.*

The MAD trend was determined using DO profile data collected between July and September 1979-2025. MAD has ranged from 5 to 9 m. Results of the Mann-Kendall analysis indicate a **significant decreasing trend in MAD** (Figure 17). This shift is likely a function of the seasonal weather patterns and longer growing seasons influencing the minimum depth of the bottom of the epilimnion, rather than solely an increase in algal production driving oxygen demand. Combined, AF and MAD trends point to an increase in the area and length of time that anoxia is occurring in Threemile Pond each year which leads to a greater area of bottom sediment exposed to anoxia now than in the past.

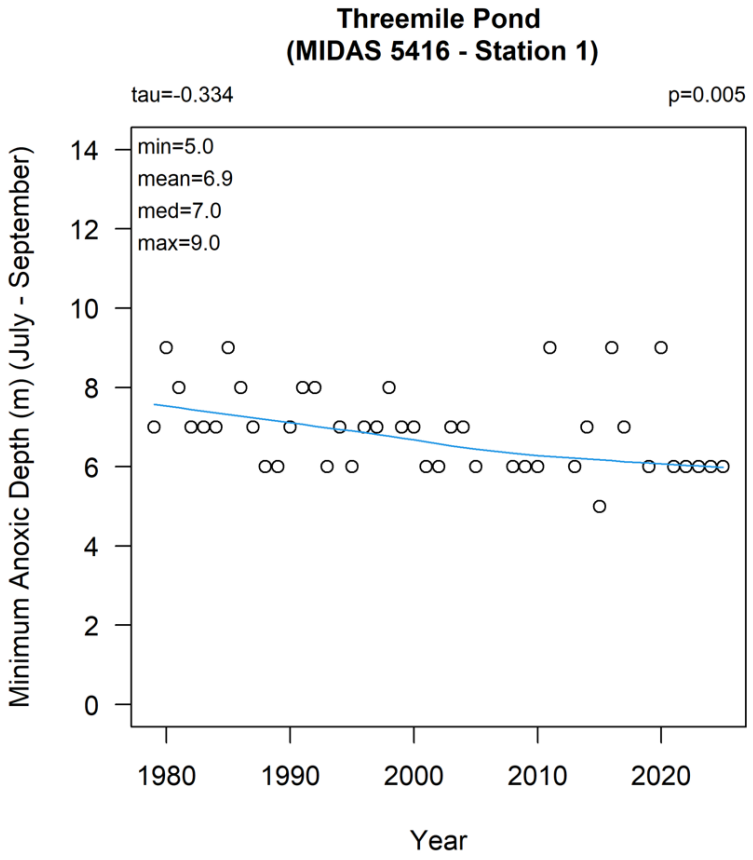


Figure 17. *Minimum* anoxic depth (MAD) for Threemile Pond, 1979 - 2025.

Other Water Chemistry

- Alkalinity- There is a **strong significant increasing trend in alkalinity** in Threemile Pond between 1996-2025. Annual averages range from 9 ppm in 1996 to 19 ppm in 2016, with an average of 14.9 ppm (Figure 18). Alkalinity measurements using methyl orange were excluded from the analysis. The trend plot shows a gradual increase from around 1995 which flattens out around 2015. Average alkalinity since 2016 is 16.3 ppm.
- pH- There is **no significant trend in annual average pH** at Threemile Pond (Figure 18). Annual average pH ranged from 6.6 in 2002 to 8.1 in 2015 with an overall average pH of 7.3 while the 10-year average is 7.2. Colorimetric samples were excluded from the analysis.
- Conductivity- Annual average conductivity in Threemile Pond shows a **strong significant increasing trend** between 1979-2019 with values ranging from 49 uS/cm in 1991 to 84 uS/cm in 2019, with an average of 67.6 uS/cm (Figure 18), and a 10-year average of 85.8. The trend in conductivity began to shift upward around 1998 and accelerated from 2010 to the present. These results are consistent with increasing conductivity statewide associated with increases in road salt usage and is also consistent with the increase in alkalinity.
- Color- There are **no significant trends in average annual color** in Threemile Pond between 2003-2019 (n=9). Values ranged from 8 SPU to 32 SPU with an historical average of 14.1 SPU (Figure 18), and a 10-year average of 11.2 SPU. Only true color data were used for the analysis.

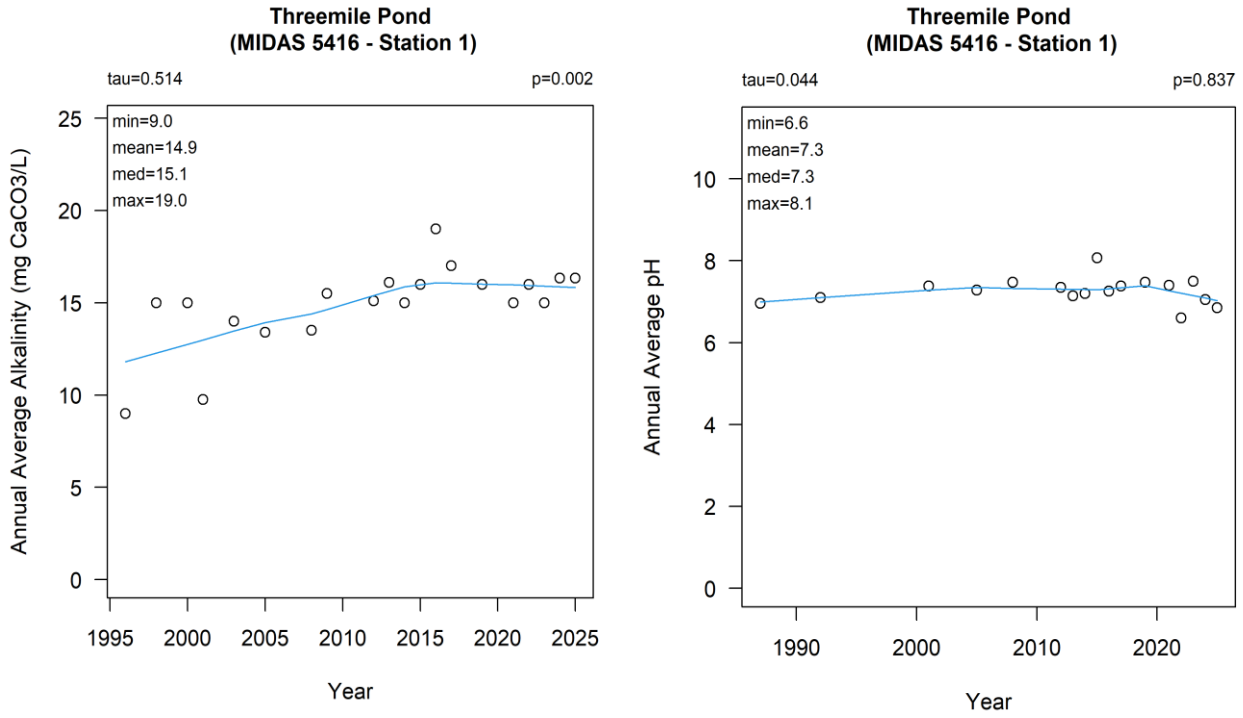


Figure 18. *Annual average alkalinity (left) and pH (right) trend plots for Threemile Pond.*

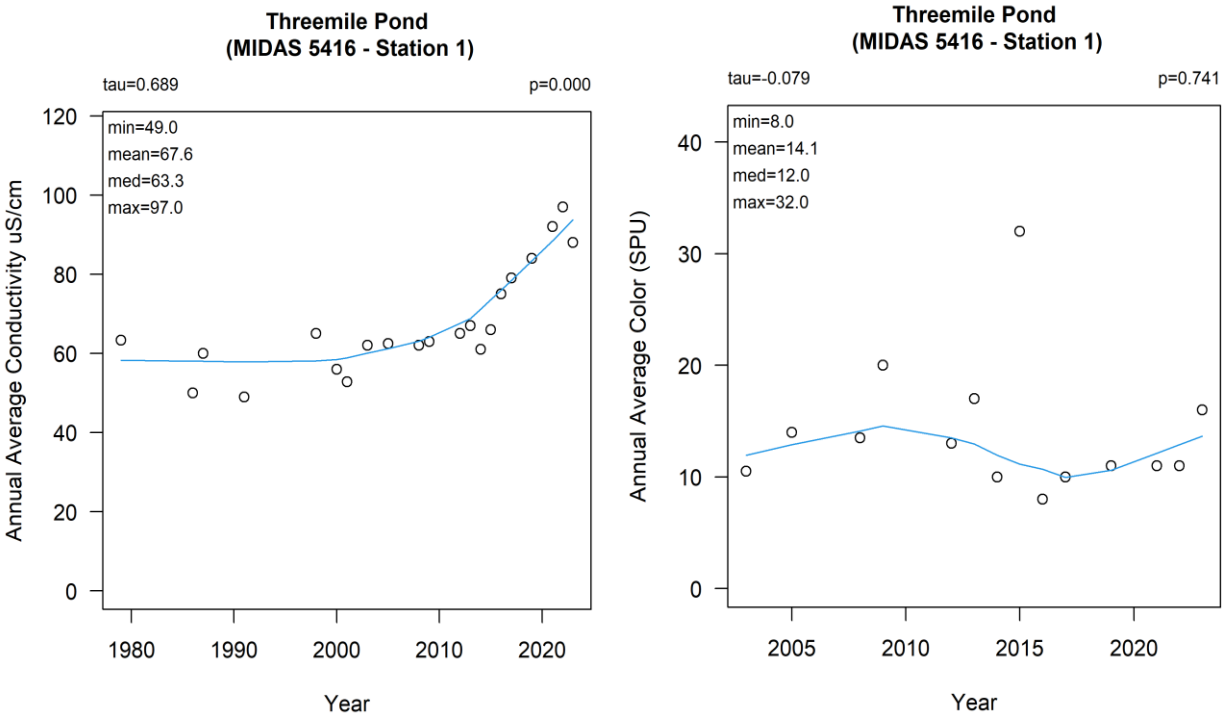


Figure 19. *Annual average conductivity (left) and color (right) trend plots for Threemile Pond.*

SUMMARY- THREEMILE POND

A review of 2025 monitoring data and historical water quality trends for Threemile Pond confirm that Threemile Pond is an impaired lake and does not meet state water quality standards as a result of SDT readings <2 m and the presence of nuisance algal blooms. Low SDT readings, and high TP and Chl-a indicate that Threemile Pond is a eutrophic lake. Threemile Pond has been impacted by excess phosphorus in the water column as a result of runoff from the watershed and internal phosphorus loading from the sediments.

- **Surface temperatures** were high enough to negatively impact coldwater fish from the surface to 3 m from approximately mid-June to early August with the highest surface temperature in early July 2025.
- Seven out of 11 **SDT** readings in 2025 were <2 m (DEP bloom threshold), with SDT <2 m persisting from early July to fall turnover. Low SDT corresponds with high TP and Chl-a, with the lowest SDT readings associated with turnover in October.
- **Dissolved oxygen** was less <2 ppm as shallow as 6 m in 2025, with persistent anoxia at depths between 6 and 7 m and deeper from late June to late August/early September. Anoxia at the bottom of the pond results in the release of iron-bound phosphorus from sediments into the water column. This phosphorus also provides a food source for cyanobacteria that carry phosphorus higher up into the water column.
- In 2025, **TP** accumulated in the hypolimnion during stratification and was mixed into the water column during fall turnover, resulting in surface concentrations exceeding 30 ppb.
- The highest **TP** concentrations occur during peak deep-water anoxia and during fall turnover, when phosphorus accumulated from internal loading is mixed throughout the water column.
- **Epilimnetic TP** in Threemile Pond in 2025 averaged 28 ppb. Numerical guidelines for trophic state in Maine indicate that lakes with TP values >20 ppb, like Threemile Pond, are classified as eutrophic.
- An estimated 583 kg of phosphorus was released from bottom sediments as a result of internal loading in 2025. **P mass** estimates suggest that Threemile Pond receives phosphorus inputs from the watershed in early spring but the increases seen over the course of the summer are a result of internal loading.
- The highest **Chl-a** concentrations in Threemile Pond in 2025 correspond with the lowest SDT readings and high TP associated with fall turnover.
- While **cyanobacteria** out in open water occurred in moderate concentrations during the summer of 2025, the most abundant species were all known toxin producers.

The historical trend analysis for Threemile Pond utilized close to fifty years of available water quality data collected between 1977-2025. The analysis found that water quality has significantly declined in Threemile Pond over the historical monitoring period based on multiple parameters including SDT, Chl-a, TP, AF, MAD, surface temperature and conductivity, while alkalinity increased over this period. There was no trend in color or pH (Table 2).

- **Surface temperature** in Threemile Pond has **increased significantly** since 1979 (no trend 2016-2025).
- **Water clarity** (SDT) trends show a **significant decrease** in Threemile Pond since 1977. Average (mean) SDT over the past 10 years is 1.8 m compared to the historical average of 2.6 m. Numerical guidelines for trophic state in Maine indicate that lakes with SDT values <4 m are eutrophic (nutrient rich and prone to algal blooms).

Table 2. *Summary of historical and 10-year water quality trends for Threemile Pond, Station 1.*

Timeframe	Water Clarity (m)	Chl-a (ppb)	Total P (ppb)	AF	MAD	Surface Temp	Alkalinity	Conductivity	Color	pH
Historical Trend (1977-2025)	↓	↑	↑	↑	↓	↑	↑	↑	No trend	No trend
10-Year Trend (2016-2025)	No trend	No trend	No trend	n/a	No trend	No Trend	No trend	No trend	n/a	No trend

- **Chl-a** data from Threemile Pond indicate a **significant increase** in Chl-a between 1978-2025. Decadal medians show Chl-a has increased each decade between the 1970s and 2010s with a median of 17 ppb over the historical monitoring period, and 26.1 ppb over the past 10 years. Numerical guidelines for trophic state in Maine indicate that lakes with Chl-a values >7 ppb are eutrophic.
- **Epilimnetic TP** data from Threemile Pond indicate a **significant increase** in TP between 1977 and 2025. There is no significant trend in the 10-year data and there is wide variation in TP concentrations year to year. Median TP over the last 10 years is 30.5 ppb, compared to 28 ppb over the historical monitoring period. Numerical guidelines for trophic state in Maine indicate that lakes with TP values >20 ppb are eutrophic.
- **Anoxic factor** (AF) has **increased significantly** and the **minimum anoxic depth** (MAD) has **decreased significantly** in Threemile Pond since the 1970s. AF values in 2024 and 2025 were the highest on record, exceeding 10 for the first time since 1979. This indicates that the length of time that pond is experiencing anoxia has increased which leads to an increase in internal loading. The decrease in MAD indicates that more sediment area at the bottom of the pond is exposed to internal loading than in the past. MAD over the past 10 years is 6 m, however it has been as low as 5 m in some years.
- Examination of other **water chemistry** data for Threemile Pond indicates a strong significant **increase in alkalinity** and an **increase in conductivity** (consistent with lakes across Maine), similar to results at downstream Webber Pond. Average alkalinity over the last 10 years is 14.9 ppm while conductivity is 85.8 uS/cm.

An analysis of the condition classifications for Maine lakes indicates that Threemile Pond is classified as a "Coastal deep lake."[13] Both total phosphorus and specific conductivity levels in the pond fall within the **altered** condition class (Table 3), meaning that measures of both TP and conductivity are well above concentrations expected for similar lakes in their geographic region. Altered lakes are described as lakes within watersheds that are most anthropogenically disturbed and reflect diminished lake condition.

When compared to the numerical guidelines for evaluation of trophic state in Maine, Threemile Pond is considered **eutrophic** (Table 4). Eutrophic lakes have elevated nutrient levels and are highly productive, and tend to have elevated plant and algae growth. Threemile Pond is considered eutrophic for SDT, Chl-a, and TP.

[13] Deeds et al. (2020): *A hydrogeomorphic and condition classification for Maine, USA, lakes*, Lake and Reservoir Management. Online: https://doi.org/10.1080/10402381.2020.1728597

Table 3. *Coastal Deep Lake Type: Water Quality Parameter Ranges for Threemile Pond, Station 1.*

Threemile Pond	*Condition Classes**			*10-Year Average*
Parameter	**Reference**	**Intermediate**	**Altered**	
Specific Conductivity (µS/cm)	< 34.2	34.2 – 66.3	≥ 66.3	**85.8**
Total Phosphorus - Epilimnion Core (ppb)	< 8.3	8.3 – 13.4	≥ 13.4	**30.5**

*The reference, intermediate, and altered values for each condition class shown above do not include standard errors. Refer to Deeds, et al., 2020 for additional information on the threshold values for each lake type.

** 10-year average (2016-2025) for Threemile Pond, Station 1.

Table 4. *Ten-year (2016-2025) and historic averages (1977-2025) for primary trophic state parameters in Threemile Pond compared to numerical guidelines for evaluation of trophic status in Maine.*

	Threemile Pond 10-Yr Average* (& Historical Avg)	ME DEP Trophic Status Indicators[14]			Threemile Pond Classification (2016-2025)
		Oligotrophic	Mesotrophic	Eutrophic	
SDT (m)	**1.8** (2.6)	**> 8**	**4 – 8**	**< 4**	**Eutrophic**
Chlorophyll-a (ppb)	**26.1** (17.0)	**< 1.5**	**1.5 – 7**	**> 7**	**Eutrophic**
Total Phosphorus (ppb)	**30.5** (28.0)	**< 4.5**	**4.5 – 20**	**> 20**	**Eutrophic**

*SDT is summarized as the mean of annual averages; Chl-a and TP are summarized as the median of annual averages.

FUTURE MONITORING- THREEMILE POND

An assessment of existing water quality monitoring data in Threemile Pond was completed as part of the water quality analysis (1977-2025). Ongoing and consistent annual monitoring efforts conducted by certified volunteers is needed over the next 10 years in order to continue tracking annual changes in water quality as improvements are made to address watershed runoff and internal loading. Future monitoring should include, at a minimum:

- Continue bi-weekly volunteer in-lake water quality monitoring for SDT, DO/Temp (April-October);
- Collect annual in-lake chemistry data including at a minimum epicore TP and Chl-a, and TP bottom grabs monthly (June-Sept) with additional profile grabs through the water column as budget allows;
- Collect annual in-lake conductivity data (minimum late summer sample), and from tributaries that flow under Route 3 (e.g., spring runoff and summer baseflow).

[14] Maine DEP (2022). *Integrated Water Quality Monitoring and Assessment Report.* Maine Department of Environmental Protection. https://www.epa.gov/system/files/documents/2022-06/2018-2022-me-integrated-report.pdf.

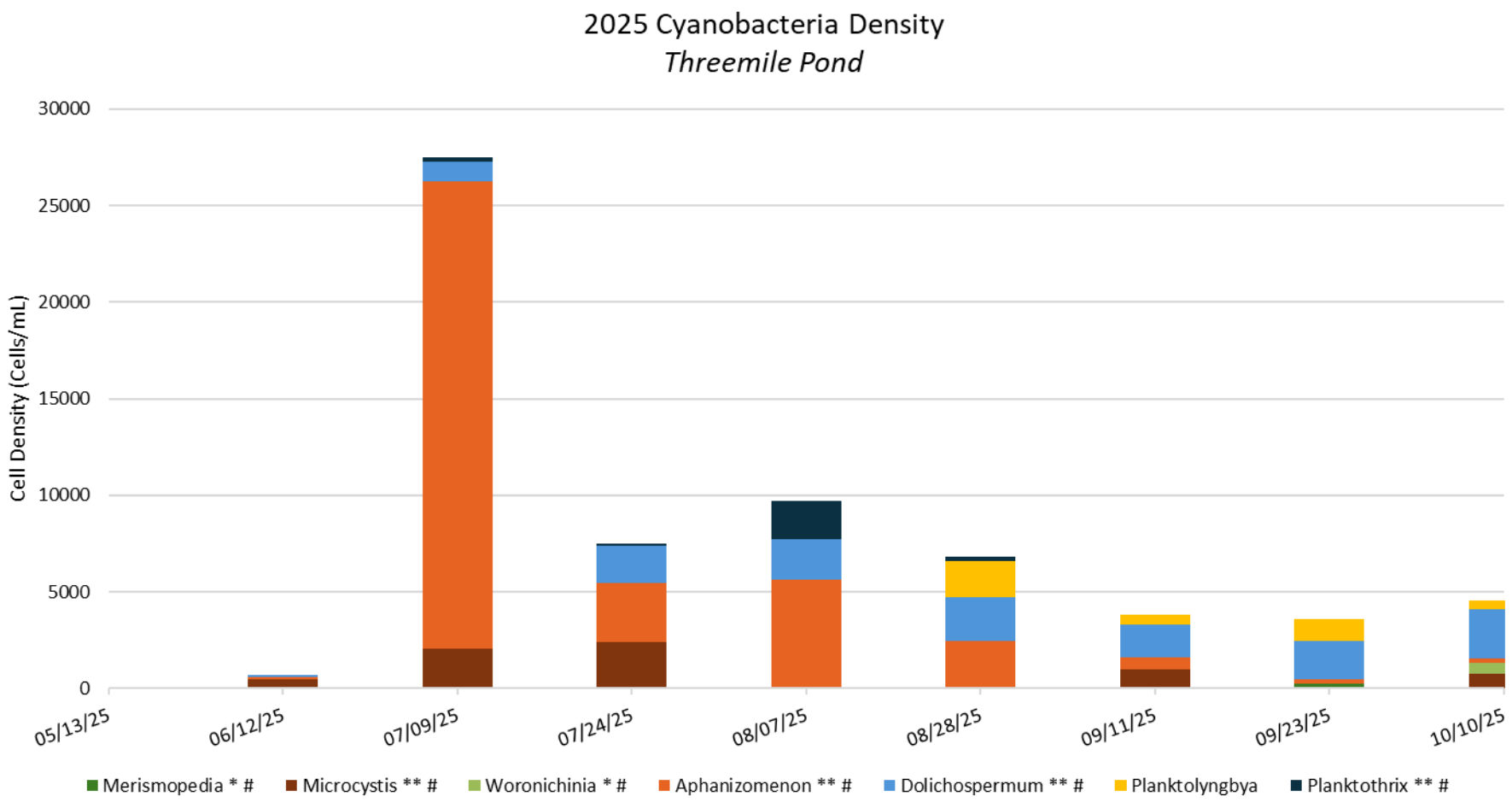
- Install a permanent monitoring buoy at Station 1 to collect continuous DO/Temp data to track duration of anoxia and minimum anoxic depth throughout the year.
- Collect DO/Temp profiles at shallower locations at least twice annually to help understand spatial differences in DO across the pond.
- Collect monthly plankton samples through the summer to create a baseline of the plankton community; collect weekly phytoplankton samples during bloom periods and zooplankton samples quarterly in late May and August, or composited monthly to get 3-4 samples/year to build a baseline.
- Record annual ice-on and ice-off dates.

Attachment 1. 2025 Threemile Pond In-Lake Sampling Results.

2025 Threemile Pond (5416) Data Spreadsheet													
Station 1 SDT,Core, Chl-a, pH/ Alk, Iron, Al, TP Results													
Station 1		**5/13/2025**	**5/29/2025**	**6/12/2025**	**6/26/2025**	**7/9/2025**	**7/24/2025**	**8/7/2025**	**8/28/2025**	**9/11/2025**	**9/23/2025**	**10/10/2025**	**Avg.**
SDT (<2 m)	**m**	2.5	2.8	2.9	2.5	**1.7**	**1.7**	**1.6**	**1.9**	**1.5**	**1.2**	**1.3**	**2.0**
Core Depth	**m**	2	10	4	4	4	6	5	6	9	10	10	**6.4**
Chl-a	**ug/L**	4.3	8.4	8.4	13	22	17	17	17	29	38	49	**20.2**
pH	**pH**	6.9		7.1		6.9		6.8		6.7		6.7	**6.9**
Alk	**mg/L**	16		15		16		16		17		18	**16.3**
Fe	**mg/L**	0.105		0.100		0.081		0.100		0.130		0.170	**0.114**
Total Al	**mg/L**	0.028		0.019		0.0084		0.0078		0.011		0.016	**0.0150**
Dissolved Al	**mg/L**	0.0054		0.0057		0.0033		0.0046		0.0024		< .002	**0.0043**
TKN	**mg/L**	0.5		0.5		0.6		0.9		0.7		1.2	**0.7**
TP Epicore	**mg/L**	31				24	29	24	24	29	*	35	**28**
TP Profiles (ppb)	**1 m**	24	23	22	20	27	24	22	26	28	31	34	**26**
	3 m	26	28	23	20	27	26	23	*	29	29	34	**30**
	5 m	25	31	19	22	21	24	*	24	30	30	35	**26**
	7 m	19	35	32	30	70	110	*	37	27	28	33	**40**
	9 m	19	36	47	69	150	210	*	150	33	31	34	**73**
	11 m	49	35	53	98	180	300	*	360	530	27	49	**155**
Avg TP (ppb)		**27**	**31**	**33**	**43**	**79**	**116**	**23**	**119**	**113**	**29**	**37**	

Station 1 Temperature (T) in °C and Dissolved Oxygen (DO) in mg/L																						
Station 1	**Date**	**5/13/2025**		**5/29/2025**		**6/12/2025**		**6/26/2025**		**7/9/2025**		**7/24/2025**		**8/7/2025**		**8/28/2025**		**9/11/2025**		**9/23/2025**		**10/10/2025**		**Avg DO**
	Depth (m)	**T**	**DO**	**T**	**DO**	**T**	**DO**	**T**	**DO**	**T**	**DO**	**T**	**DO**	**T**	**DO**	**T**	**DO**	**T**	**DO**	**T**	**DO**	**T**	**DO**	
	0	16.3	10.1	16.8	9.9	20.5	9.2	25.6	9.6	25.8	9.5	24,1	8.4	24.6	8.7	22.0	8.2	21.4	9.2	19.9	9.7	16.8	9.3	9.3
	1	15.2	10.1	16.6	9.9	20.5	9.3	25.5	9.6	25.2	9.7	23.8	8.0	24.2	8.7	22.1	8.1	21.3	9.2	19.5	9.4	16.8	9.2	9.2
	2	14.2	10.1	15.8	9.9	20.4	9.2	24.9	9.7	24.9	9.3	23.2	7.2	24.0	8.4	21.9	8.0	21.1	9.2	19.4	8.7	16.8	9.1	8.1
	3	14.1	10.1	15.5	9.8	20.2	8.5	24.7	9.5	24.8	8.9	23.1	7.0	23.9	8.3	21.9	7.8	21.0	9.0	19.4	8.3	16.8	8.9	8.7
	4	13.7	10.0	14.8	9.4	18.6	7.4	21.6	7.0	22.9	4.8	23.2	7.2	23.2	6.7	21.8	7.5	20.8	8.9	19.3	7.9	16.6	8.6	7.8
	5	13.6	9.7	14.3	8.8	17.6	6.8	20.2	5.1	21.4	2.3	23.1	6.7	23.2	4.0	21.8	7.4	20.7	8.6	19.2	8	16.5	8.5	6.9
Anoxic DO ≤ 2	**6**	13.5	9.6	14.2	8.6	15.3	4.4	17.4	2.1	18.1	0.2	22.3	3.2	22.3	0.7	21.8	7.2	20.6	8.2	19.1	7.9	16.4	8.4	5.5
	7	13.5	9.5	14.0	7.9	14.8	3.3	15.5	0.2	16.1	0.1	16.9	0.3	17.4	0.2	21.3	1.6	20.3	8.0	19.1	7.7	16.4	8.5	4.3
	8	13.4	9.3	13.9	7.8	14.4	2.1	14.8	0.2	15.4	0.1	15.9	0.2	17.1	0.1	18.5	0.2	20.1	7.9	19.1	7.7	16.3	8.5	4.0
	9	13.3	8.9	13.9	7.7	14.4	2.1	14.5	0.1	15.0	0.1	15.4	0.1	16.3	0.1	16.9	0.2	20.0	7.5	19.0	7.2	16.2	8.6	3.9
	10	13.1	8.5	13.9	7.7	14.3	2.0	14.4	0.1	14.9	0.1	15.0	0.1	15.5	0.1	16.2	0.1	16.3	0.4	18.7	4.5	16.2	8.6	2.9
	11	12.9	8.3	13.9	7.6	14.3	1.9	14.3	0.1	14.8	0.0	15.0	0.1	15.2	0.1	15.8	0.1	16.1	0.2	17.3	0.4	15.9	8.1	2.4

Attachment 2. Cyanobacteria Density in Threemile Pond, May-October 2025.



** indicates potentially toxic*

*** indicates likely toxic*

 # indicates taste and odor producer

Attachment 3. Historical (1977-2025) and 10-year (2016-2025) Trend Analysis Results for Threemile Pond, Station 1.

Water Quality Parameter	Average Annual Water Quality	Historical (1977-2025)	10-Year (2016-2025)
Water Clarity (m) Historical 10-year	**2.6** **1.8**		No Trend
Chlorophyll A* (ppb) Historical 10-year	**17.0** **26.1**		No Trend
Total Phosphorus* (Epilimnetic core) (ppb) Historical 10-year	**28.0** **30.5**		No Trend
Anoxic Factor Historical	**6.2**		n/a
MAD (m) Historical 10-year	**5.0** **6.0**		No Trend
Surface Temp (C) Historical 10-year	**20.2** **20.6**		No Trend
Alkalinity (ppm) Historical 10-year	**14.9** **16.3**		No Trend
Conductivity (uS/cm) Historical 10-year	**67.6** **85.8**		No Trend
Color (SPU) Historical 10-year	**14.1** **11.2**	No Trend	n/a
pH Historical 10-year	**7.3** **7.2**	No Trend	No Trend

** median*