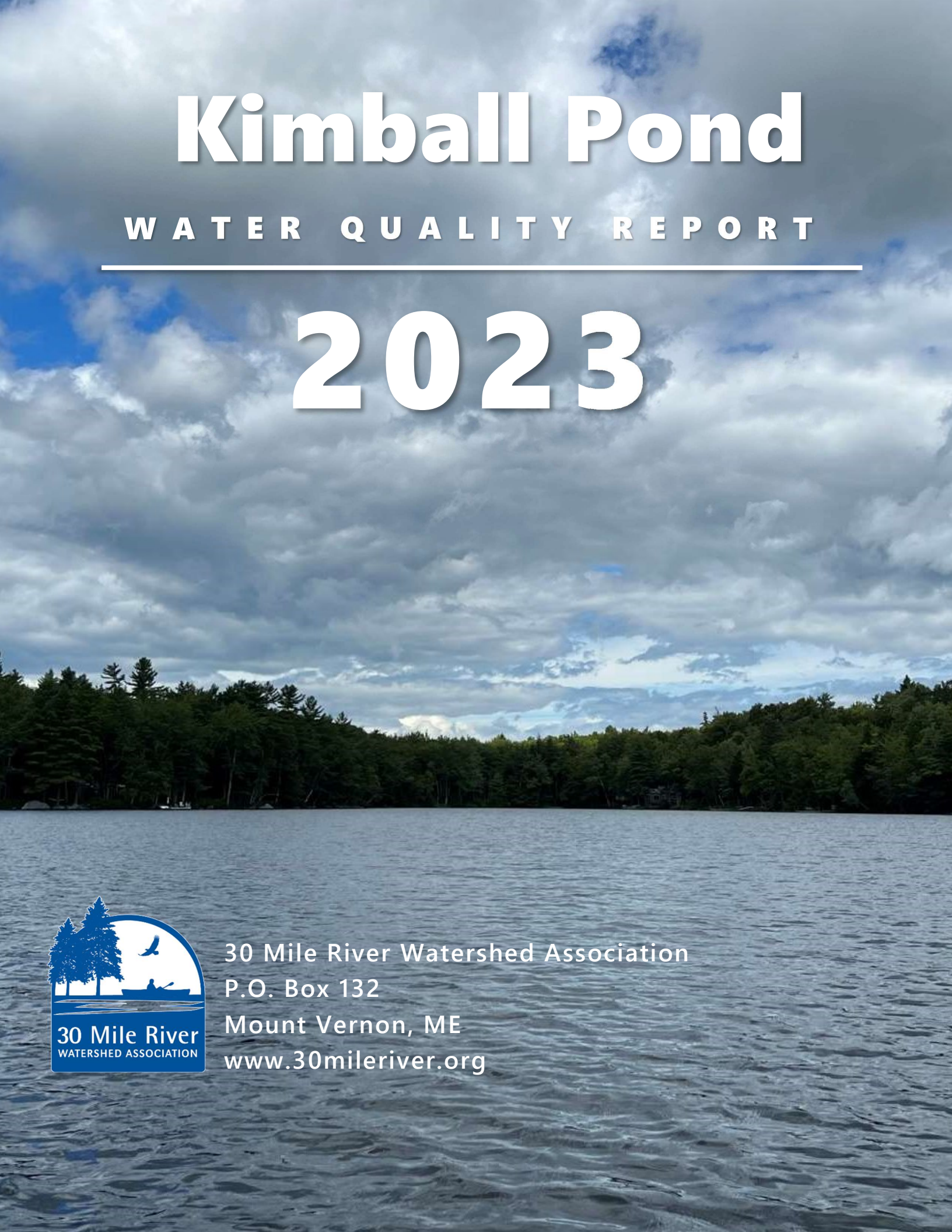


Kimball Pond

WATER QUALITY REPORT

2023

30 Mile River Watershed Association
P.O. Box 132
Mount Vernon, ME
www.30mileriver.org

2023 Kimball Pond Water Quality Report

TABLE OF CONTENTS

2023 Water Quality Summary 2

Overview 3

Water Quality Monitoring in 2023 3

Secchi Disk Transparency (Water Clarity) 4

Dissolved Oxygen and Temperature 5

Total Phosphorus (TP) 7

Chlorophyll (Chl-a) 9

pH 9

True Color 9

Conductivity 10

Alkalinity 10

Discussion 11

Next Steps 11

TABLE OF FIGURES

Figure 1. Station 01, Kimball Pond, Fayette, Maine. 3

Figure 2. 2023 Secchi Disk Transparency (water clarity), Station 01 4

Figure 3. Historical Secchi Disk Transparency (water clarity), Station 01, 1983-2023 5

Figure 4. Thermal stratification in a deep lake 5

Figure 5. 2023 Dissolved Oxygen and Temperature Profiles, Station 01 6

Figure 6. Annual Average TP data (epilimnetic core samples) collected 1976-2023, Station 01. ... 7

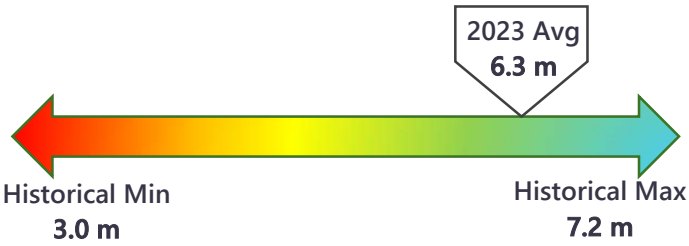
Figure 7. 2023 TP epilimnetic core samples (EC) and TP bottom grab samples (BG) results 8

2023 Water Quality Summary[1]

Monitoring on Kimball Pond occurred monthly July through September in 2023 by Whitney Baker and Silas Mohlar of 30 Mile River Watershed Association (30 Mile).

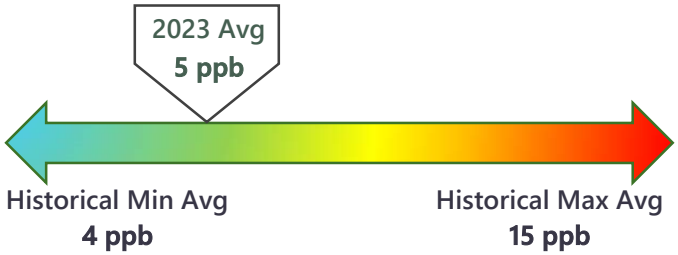
Water clarity readings in 2023 ranged from 6.1 meters (September 12th) to 6.4 meters (August 14th) with an annual average of 6.3 meters. Three (3) total readings were collected over three monitoring days in 2023.

Water Clarity (m)	
2023 Water Clarity Average	6.3
Historical SDT Average	5.6
Maine Lakes SDT Average	4.8



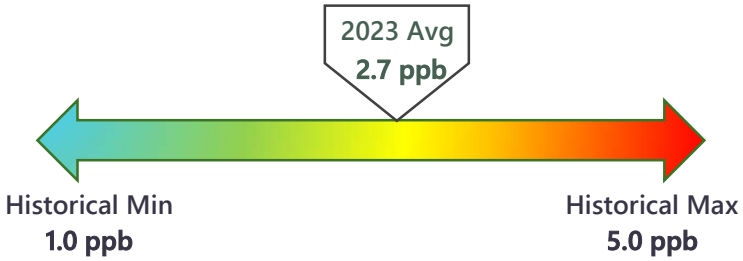
Three (3) samples were collected and analyzed for **Total Phosphorus**. Laboratory results ranged from 4 ppb (parts per billion) to 5 ppb with an average of 5 ppb.

Total Phosphorus (ppb)	
2023 TP Average	5
Historical TP Average	7
Maine Lakes TP Average	12



Chlorophyll was measured three (3) times in 2023. Results ranged from 1 ppb (August 14th) to 5 ppb (September 12th) with an annual average of 2.7 ppb.

Chlorophyll-a (ppb)	
2023 Chl-a Average	2.7
2023 Peak Chl-a	5
Historical Chl-a Average	3
Maine Lakes Chl-a Average	5.4



Three (3) **Dissolved Oxygen (DO)** profiles were collected in 2023. Anoxia (DO <2 ppm) was encountered in waters 6 meters and deeper during profile collected in 2023.

[1] Scale bars illustrate the range of data collected for each parameter over the historical monitoring record for general comparison with the 2023 monitoring results. The blue end represents the historical minimum (best), and the red end represents the historical maximum (worst) of all monitoring data collected.

Overview

Kimball Pond is a small 55-acre pond located in the towns of New Sharon and Vienna in Kennebec County, ME. Kimball Pond has a maximum depth of 6 m (19 ft) and an average depth of just 3 m (10 ft). The watershed area draining to the pond is roughly 0.2 square miles and includes the smaller drainages of several small intermittent and perennial streams and drainages that flow into the pond and form the headwaters of the 30 Mile River watershed. Water from Kimball Pond flows to a single outlet, Mill Stream, located at the south end of the pond. Mill stream flows south to Mill Pond and continues south into Flying Pond.

Water quality data have been collected in Kimball Pond since 1983 by Maine DEP, volunteers monitors certified through Lake Stewards of Maine, and more recently, 30 Mile River Watershed Association.

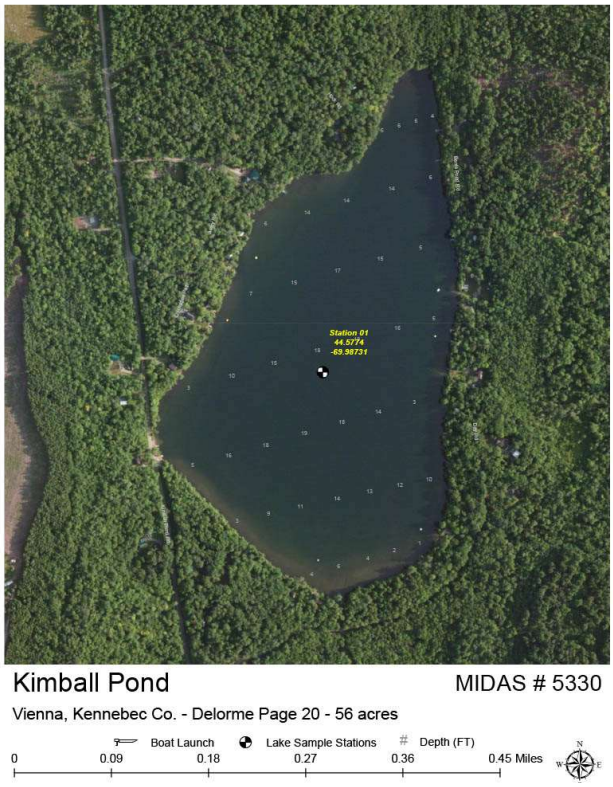


Figure 1. Station 01, Kimball Pond, Fayette, Maine.

Water Quality Monitoring in 2023

In 2023, 30 Mile River staff Whitney Baker and Silas Mohlar visited Kimball Pond three (3) times throughout the season to collect a secchi disk transparency (SDT), dissolved oxygen and temperature profile, and a water sample that was later analyzed for Total Phosphorus (TP) and Chlorophyll-a at the state lab in Augusta, ME. Monitoring on Kimball Pond takes place at the deepest spot in the lake - aka Station 01 (Figure 1).

Silas Mohlar, 30 Mile, collects water samples on Kimball Pond in 2023.

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 algal growth, zooplankton densities, natural water color, and suspended silt or sediment particles.

Water Clarity (m)	
2023 Water Clarity Average	6.3
Historical SDT Average	5.6
Maine Lakes SDT Average	4.8

Water clarity readings in 2023 ranged from 6.1 meters (September 12th) to 6.4 meters (August 14th) with an annual average of 6.3 meters. Three (3) readings were collected in 2023 in total over three monitoring days in 2023 (Figure 2).

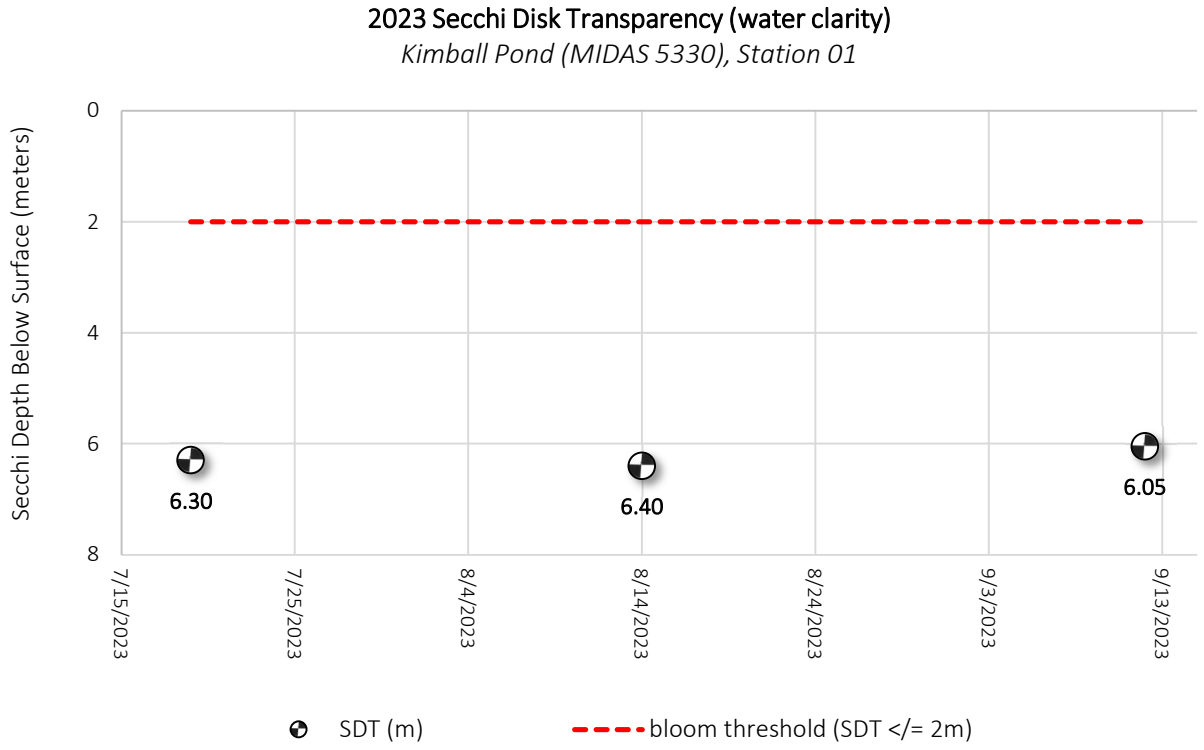


Figure 2. 2023 Secchi Disk Transparency (water clarity), Station 01

SDT data has been collected during 31 years since monitoring began in 1983. SDT readings in Kimball Pond have ranged from 3.0 m (2020) to 7.2 m (2020) with an historical annual average of 5.6 m (Figure 3). It is important to note that water clarity readings in Kimball Pond can sometimes be physically restricted by the depth of the lake. Ocassionally, the Secchi disk will touch the bottom of the lake while still visible. One of the three secchi readings in 2023 reached the lake bottom while still visible.

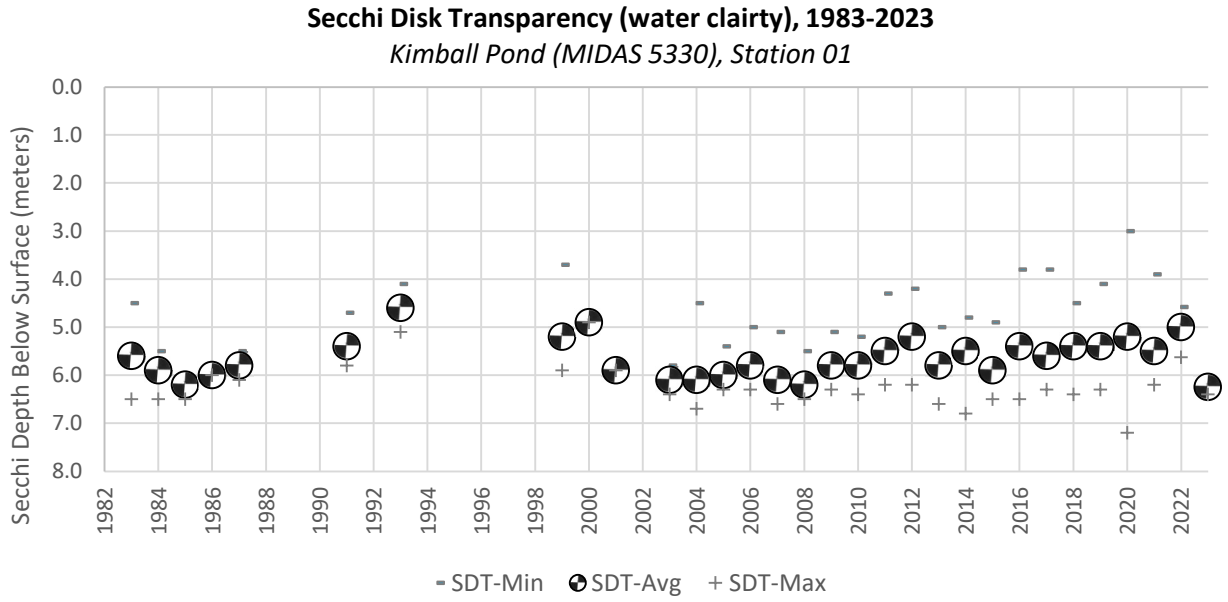


Figure 3. Historical Secchi Disk Transparency (water clarity), Station 01, 1983-2023

Dissolved Oxygen 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. Anoxia (no oxygen) occurs when DO falls below 2 mg/L. As lake water is warmed during the summer, deep lakes will form three distinct temperature layers. There is a warm layer at the surface (epilimnion), a thin transitional layer (metalimnion), and a deep cold layer (hypolimnion). The change in water temperature and density at the metalimnion acts as a physical barrier that prevents mixing of the upper and lower layers for several months during the warm summer months.

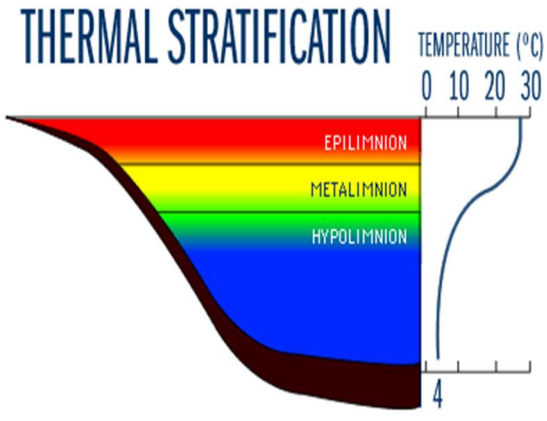


Figure 4. Thermal stratification in a deep lake. Image source: www.waterontheweb.org.

As the lake becomes more biologically productive in the summer, oxygen can decline in the hypolimnion as decomposition occurs in deep areas of the lake. Though some oxygen loss in deep lakes is considered normal, excessive loss of oxygen may indicate a stressed and changing ecosystem. Understanding the pattern and extent of oxygen loss in deep areas of Kimball Pond is important to understanding changes between years and throughout a single season, and is

particular concerning for lakes that may be more vulnerable for internal phosphorus loading due to unique sediment chemistries.[2]

Shallow lakes may experience brief or periodic occurrences of thermal stratification throughout the open water season, but most often shallow lakes are homothermous, with somewhat consistent temperature and dissolved oxygen levels from the lake surface to the lake bottom. Kimball Pond is considered a homothermous lake, which is typical of lakes of similar depth as wind events can facilitate water mixing and easily disrupt thermal stratification and redistributes oxygen throughout the water column.

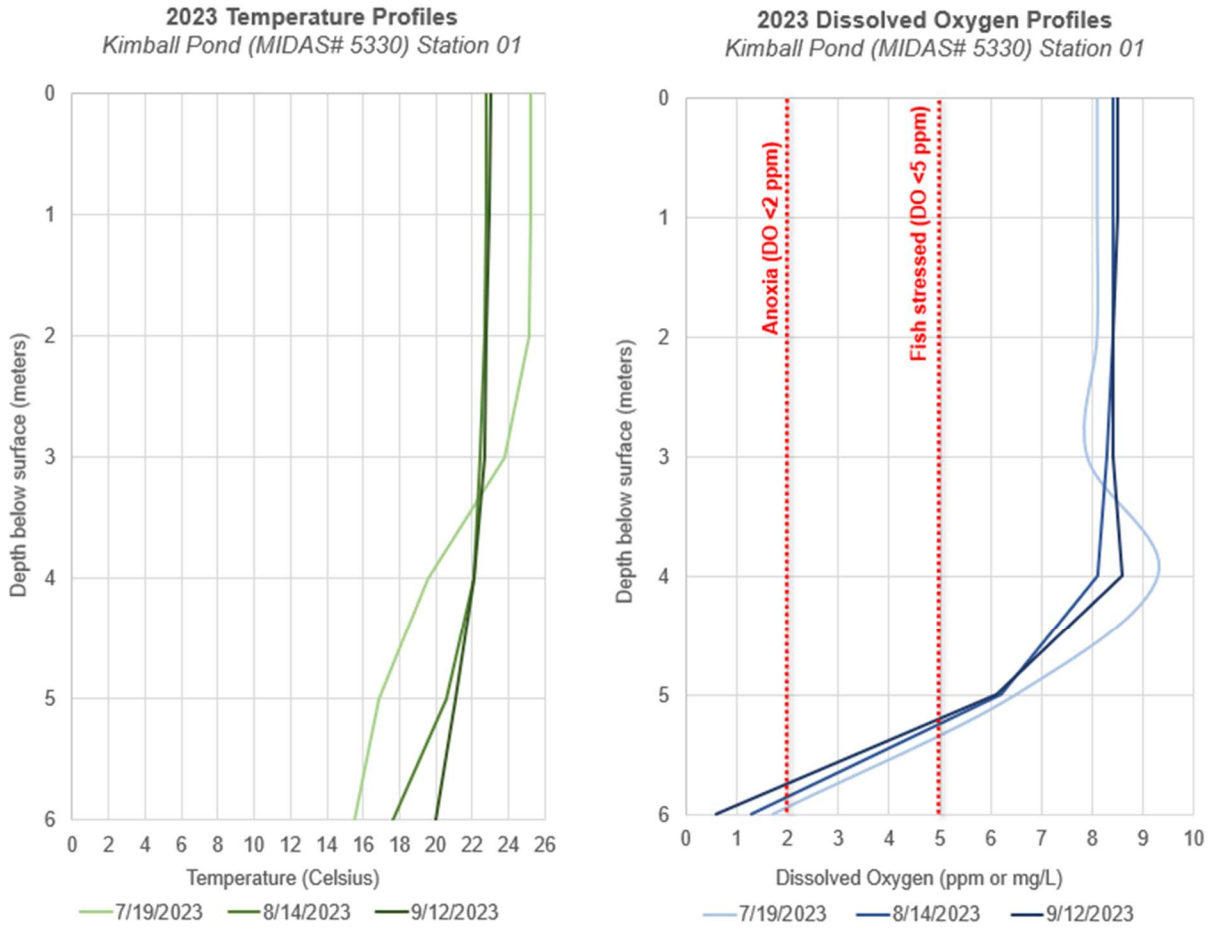


Figure 5. 2023 Dissolved Oxygen and Temperature Profiles, Station 01

However, in 2023 DO <2 mg/L (anoxia) was documented in waters 6 meters and deeper all three profiles collected in July, August, and September. One DO profile collected in 2022 (August) also documented anoxia in waters 6 meters and deeper. 2022 and 2023 were the first years anoxia

[2]Some lakes in Maine may be more vulnerable than others to internal phosphorus loading, a phenomenon that can occur when deep waters become anoxic (DO loss <2 mg/L) resulting in phosphorus release from the bottom sediments exposed to anoxic waters.

was ever documented at the bottom of Kimball Pond. However, DO profile data is somewhat limited with only 12 years of data collection since 1983. Continued and consistent monitoring will provide greater understanding of DO trends in Kimball Pond (Figure 5).

Water surface temperatures through the monitoring season ranged from 16.4 C (61.5 F) to 27.2 C (81.0 F) with an average surface water temperature of 22.9 C (73.3 F) between June and September. Continued collection of bi-weekly DO and temperature profiles will identify trends and changes occurring in Pocasset Lake in order to better understand variations in thermal stratification and the extent and severity of the low DO and anoxia throughout the monitoring season.

Total Phosphorus (TP)

Total Phosphorus (ppb)	
2023 TP Average	5
Historical TP Average	8
Maine Lakes TP Average	12

Phosphorus is the nutrient that most influences the growth of algae in lakes. Because its natural occurrence in lakes is very small, phosphorus "limits" the growth of algae in lake ecosystems. Small increases in phosphorus in lake water can cause substantial increases in algal growth, hindering lake health as well as the economic, recreational, and aesthetic value of the lake. Tracking in-lake phosphorus levels over time is another way of monitoring change in lake water quality trends.

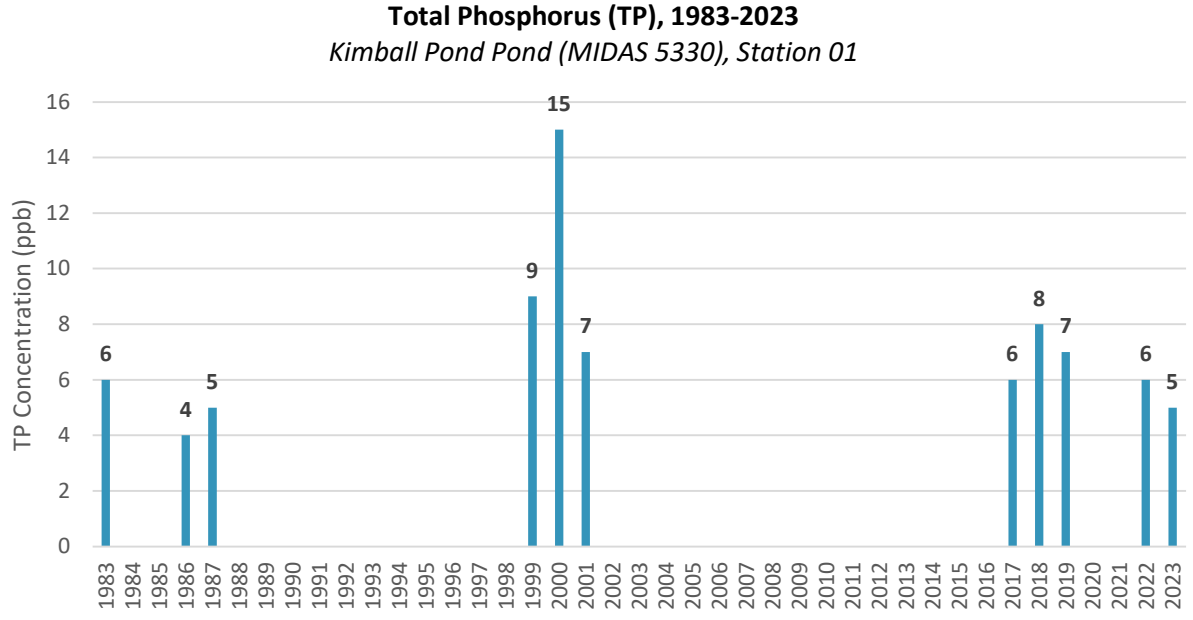


Figure 6. Annual Average Total Phosphorus data (epilimnetic core samples) collected 1983-2023, Station 01.

Two (2) samples were collected from the surface of Kimball Pond in 2023 using an integrated core sampler (referred to as "epilimnetic core samples") and analyzed for Total Phosphorus (TP). Samples were collected monthly between July and August. Laboratory results for epilimnetic core samples collected in 2023 ranged from 4 ppb to 5 ppb with an annual average of 5 ppb.

Generally speaking, in-lake phosphorus concentrations (epilimnetic samples) less than 10 ppb are ideal. Lakes with in-lake phosphorus concentrations of ~13 ppb or more are able to sustain algal blooms, and blooms become frequent as in-lake average concentrations approach 20 ppb. TP data has been collected from Kimball Pond during only 11 years since 1983. Historically, the annual average phosphorus concentration in Kimball ranges from 4 ppb (1986) to 15 ppb (2000) with a historical average of 7 ppb (Figure 6).

In 2023, three (3) samples were collected from the bottom of Kimball Pond 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 for bottom grab samples collected in 2023 were 7 ppb (7/19/23), 7 ppb (8/14/23), and 13 ppb (9/13/23) with an annual average of 9 ppb (Figure 7).

Historically, bottom grab samples have only been collected in 2022 and 2023. Annual averages were 5 ppb (2022) and 9 ppb (2023) respectively.

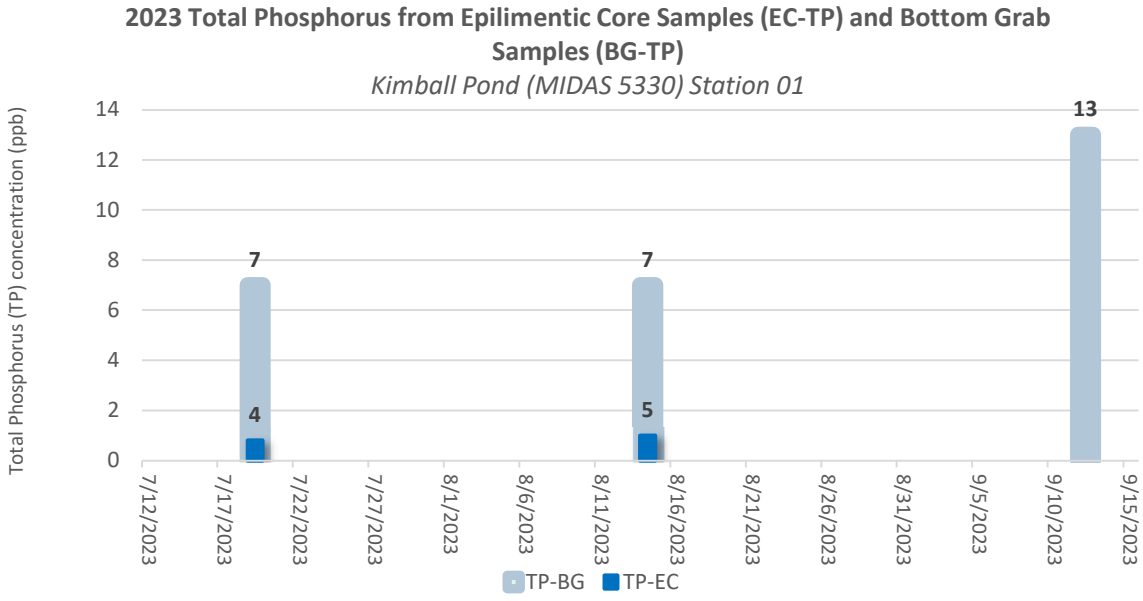


Figure 7. 2023 TP epilimnetic core samples (EC) and TP bottom grab samples (BG) results.

Chlorophyll (Chl-a)

Chl-a (ppb)	
2023 Chl-a Average	2.7
2023 Peak Chl-a	5.0
Historical Chl-a Average	3.0
Maine Lakes Chl-a Average	5.4

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 2023. Results ranged from 1 ppb to 5 ppb, with a 2023 annual average of 2.7 ppb.

Historically, chl-a data have been collected during nine (9) years between 1983-2023, ranging between 1 ppb (2023) and 5 ppb (2023) with a historical annual average of 3.0 ppb. The highest chl-a concentration documented in Kimball Pond was recorded in 2023.

pH

pH	
2023 pH	7
Historical pH Average	7
Maine Lakes Average	6.44

pH helps determine which plant and animal species can live in the lake, and it governs biochemical processes that take place. The pH scale ranges from 0-14, with 7 being neutral. Water is increasingly acidic below 7, and increasingly alkaline above 7. A one unit change in pH represents a tenfold change in acidity or alkalinity. The pH scale is the inverse log of the hydrogen ion concentration.

One sample taken on August 14th was analyzed for pH and had a result of 7. Historically, pH has only been analyzed during eight (8) years since 1983, with a historical annual average of result of 7.

True Color

Color (PCU)	
2023 Color	10
Historical Color Average	18
Maine Lakes Color Average	20.7

Water color refers to the concentration of natural dissolved organic acids. This includes natural tannins and lignins dissolved in the water, often resulting in "tea" or "root beer" colored water in very colored lakes. “True Color” is measured in Platinum Cobalt Units (PCU) after all particulates (including algae cells) have been filtered out of the sample. Colored lakes (>25 PCU) can have reduced transparency readings and increased phosphorus values. However, this does not mean the lakes produce more algae. The color simply reduces the transparency such that the reading is not a good measure of algal biomass. Chlorophyll-a (Chl-a) is the best indicator of algal productivity in colored lakes and should be used if possible.

One sample taken on August 14th was analyzed for true color and had a result of 10 PCU. Historically, color has only been analyzed during four (4) years starting in 2006 and has ranged between 5 PCU (2018) and 10 PCU (2023) with a historical average annual result of 7 PCU.

Conductivity

Conductivity (µMHOS/cm)	
2023 Conductivity	23
Historical Conductivity Average	20
Maine Lakes Conductivity Average	51

Conductivity measures the ability of water to carry electrical current and is directly related to the dissolved ions (charged particles) present in the water. Fishery biologists can use conductivity values to calculate fish yield estimates because conductivity will generally increase if there is an increase of pollutants entering the lake or pond. Stormwater runoff from developed areas and roadways is the most common pollutant in Maine lakes that can raise conductivity values. Conductivity is measured in micromhos per centimeter (µMHOS/cm).

One sample taken on August 14th was analyzed for conductivity and had a result of 23 µMHOS/cm. Historically, conductivity has been analyzed nine (9) years since 1986 and has ranged between 16 µMHOS/cm (1986) and 25 µMHOS/cm (2018) with a historical annual average of 20 µMHOS/cm.

Alkalinity

Alkalinity (mg/L)	
2023 Alkalinity	4
Historical Alkalinity Average	3
Maine Lakes Alkalinity Average	12

Alkalinity is also referred to as "buffering capacity." It is a measure primarily of naturally available bicarbonate, carbonate, and hydroxide ions in the water and is measured in milligrams per liter (mg/L). Measuring alkalinity is important to determining a lake's ability to neutralize acidic pollution from rainfall or snowmelt. Lakes with alkalinity values >20 mg/L are considered well buffered against pH changes over time. Lakes with low or zero alkalinity may have more variation in pH levels that can sometimes result in damage to aquatic life.

One sample taken on August 14th was analyzed for alkalinity and had a result of 4 mg/L. Historically, alkalinity has been analyzed nine (9) years since 1983 and has ranged from 1.8 mg/L (1986) to 6 mg/L (2000) with a historical annual average of 3 mg/L.

Discussion

2023 was 30 Mile's fifth year of monitoring Kimball Pond after a two-year hiatus following the Covid pandemic and changes in staffing. Data presented in this report includes all monitoring data collected on Kimball Pond through 2022, submitted to Maine DEP by both volunteer monitors and state agencies, that has undergone a thorough QA/QC process. 2023 data presented here is from 30 Mile only.

Despite the unprecedented rain storms we received in the spring and summer of 2023, water clarity, and epilimnetic phosphorus and chlorophyll results were average in 2023. It is possible that runoff entering the lake from the surrounding landscape during the intense rain events this spring increased the levels of organic carbon in the pond (evident by an elevated True Color concentration). Lakes and ponds will process excess carbon through the decomposition process that occurs at the lake bottom which requires oxygen.

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.

Near real-time data for Kimball Pond's clarity (Secchi depth), and dissolved oxygen and temperature profiles can be found online at https://30mileriver.org/kimball-pond/, along with a link to the historical dataset and depth map.

Next Steps

1. Continue annual baseline monitoring to document seasonal and annual variability across all parameters, and better document changes and trends over time.

2. Deliver LakeSmart programming to the landowners on Kimball Pond, to provide education about polluted stormwater runoff and the effects of watershed development on lake water quality. For more information about this awesome program visit: https://www.lakes.me/lakesmart. To request a free LakeSmart evaluation from 30 Mile staff visit: https://30mileriver.org/lakesmart/