Minnehonk Lake

WATER QUALITY REPORT

2021

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

2021 Minnehonk Lake Water Quality Report

TABLE OF CONTENTS

2021 Water Quality Summary 1

Overview 1

Water Quality Monitoring in 2021 2

Secchi Disk Transparency (Water Clarity) 3

Dissolved Oxygen and Temperature 3

Total Phosphorus 5

Chlorophyll 7

Discussion 8

Next Steps 8

TABLE OF FIGURES

Figure 1. Minnehonk Lake Monitoring Stations. 2

Figure 2. 2021 Secchi Disk Transparency, Station 1 3

Figure 3. Average annual secchi disk transparency (water clarity), Station 1, 1976-2021 4

Figure 4. 2021 Dissolved Oxygen and Temperature Profiles, Station 1 5

Figure 5. Annual Average Total Phosphorus data collected 1976-2021, Station 1. 7

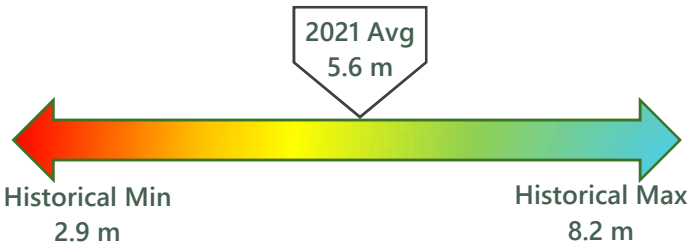
Figure 6. Annual average and peak annual chlorophyll concentrations, 1974-2021, Station 1 7

2021 Water Quality Summary[1]

Monitoring on Minnehonk Lake occurred on 10 dates between May and September 2021 by Whitney Baker of 30 Mile River Watershed Association (30 Mile) and local volunteers.

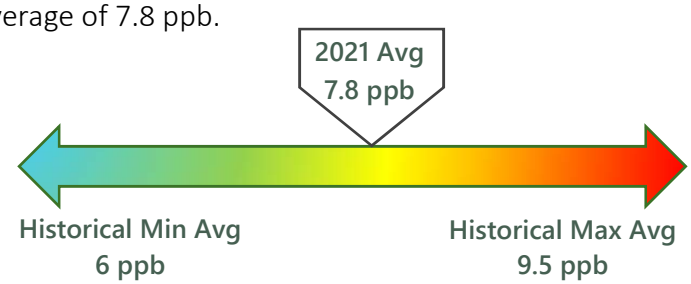
Water clarity readings in 2021 ranged from 4.65 meters (June 10th) to 6.32 meters (August 5th) with an annual average of 5.64 meters. 13 readings were collected in 2021 in total.

Water Clarity (m)	
2021 Water Clarity Average	5.6
Historical SDT Average	5.6
Maine Lakes SDT Average	4.8



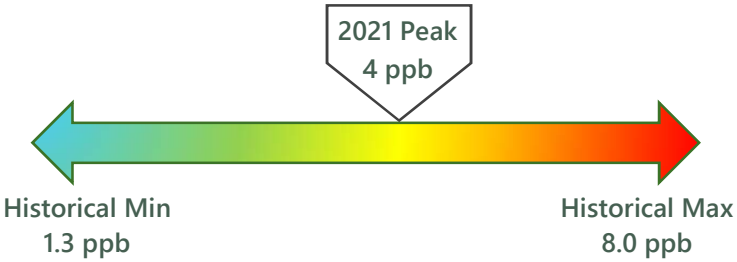
Five (5) samples were collected and analyzed for **Total Phosphorus**. Laboratory results ranged from 7 ppb (parts per billion) to 9 ppb with an average of 7.8 ppb.

Total Phosphorus (ppb)	
2021 TP Average	7.8
Historical TP Average	7.6
Maine Lakes TP Average	12



Chlorophyll was measured five (5) times in 2021. Results ranged from 2 ppb (August 5th) to 4 ppb (June 10th, July 7th, and August 31st) with an annual average of 3.4 ppb.

Chlorophyll-a (ppb)	
2021 Chl-a Average	3.4
2021 Peak Chl-a	4.0
Historical Chl-a Average	3.0
Maine Lakes Chl-a Average	5.4



Ten (10) **Dissolved Oxygen (DO)** profiles were collected in 2021. Anoxia (DO <2 ppm) was first encountered in deep waters at a depth of 21 meters in late August, and grew slightly to include waters 19 meters and deeper in early October. Oxygen loss in deep waters is typical in the summer months in Minnehonk Lake. This anoxia zone commonly occurs in the bottom 2-6 meters each year, and in recent years has reached a depth as shallow as 17 meters (2018 and 2020).

[1] Scale bars illustrate the range of data collected for each parameter over the historical monitoring record for general comparison with the 2021 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

Minnehonk Lake is located in the town of Mount Vernon in Kennebec County, Maine and has a direct watershed area of 1.7 square miles. Its indirect upstream watershed is quite large (14 square miles) and includes the upstream drainages of Flying Pond, Boody Pond, Kimball Pond, Mill Pond, and Black Pond. Minnehonk Lake has a single outlet, Hopkins Stream, located at the south end of the lake that flows south to Hopkins Pond and Taylor Pond, also in Mount Vernon.

Minnehonk Lake is a relatively deep lake with a maximum depth of 22 m (73 ft) and an average depth of just 9 m (30 ft). The lake has a small surface area covering approximately 99 acres and can be accessed via a public launch located on Route 41 at the north end of the lake in Mount Vernon Village.

Figure 1. Minnehonk Lake Monitoring Stations.

Water Quality Monitoring in 2021

Water quality monitoring on Minnehonk Lake takes place at the deepest spot in the lake (Maine DEP Station 1), also known as the "deep spot", and is just over 22 meters deep (Figure 1). Monitoring in 2021 was completed by Whitney Baker of 30 Mile River Watershed Association (30 Mile) and local volunteers. A special thanks to the 2021 volunteers:

2021 water quality volunteer, Greg Cauldwell.

Greg Cauldwell
Tom Ward

Water quality data was collected on 10 dates between May and October. Parameters include Secchi disk transparency, dissolved oxygen and temperature, phosphorus, chlorophyll, and advanced chemistry parameters (pH, Alkalinity, Color, and Conductivity).

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)	
2021 Water Clarity Average	5.3
Historical SDT Average	4.7
Maine Lakes SDT Average	4.8

Water clarity readings in 2021 ranged from 4.65 meters (June 10th) to 6.32 meters (August 5th) with an annual average of 5.64 meters. 13 total readings were collected over 10 monitoring days in 2021 (Figure 2).

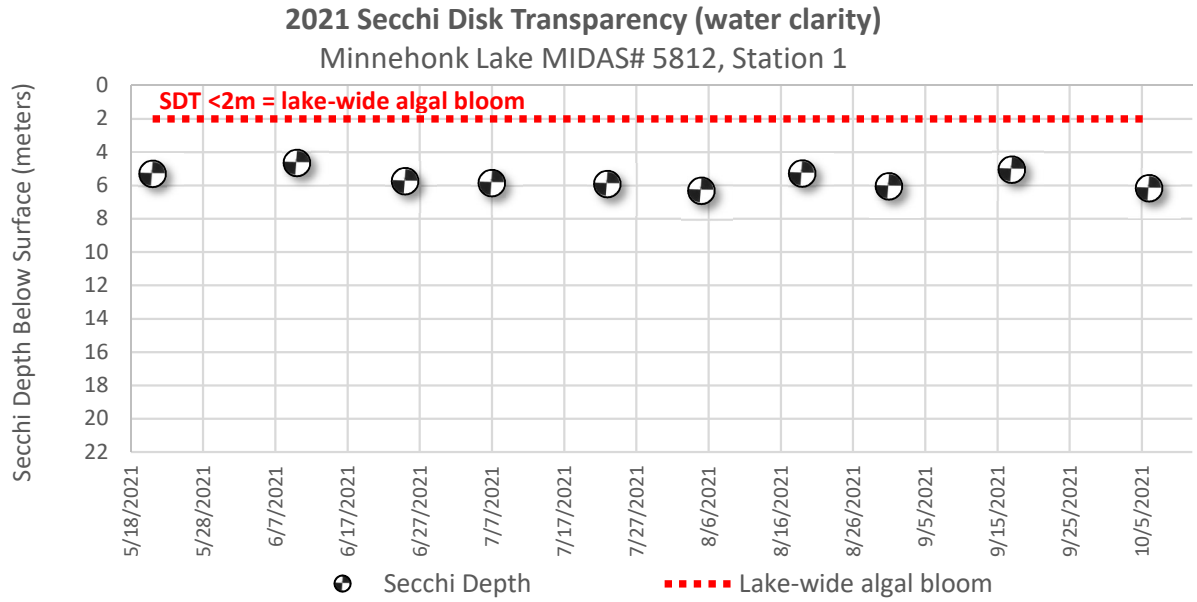


Figure 2. 2021 Secchi Disk Transparency, Station 1

SDT data has been collected on Minnehonk Lake during 23 years over the hisotircal monitoring period spanning the past 47 years starting in 1974. Secchi readings have ranged from 2.9 m (1976) to 8.2 m (2017) with an average annual reading of 5.6 m (Figure 3).

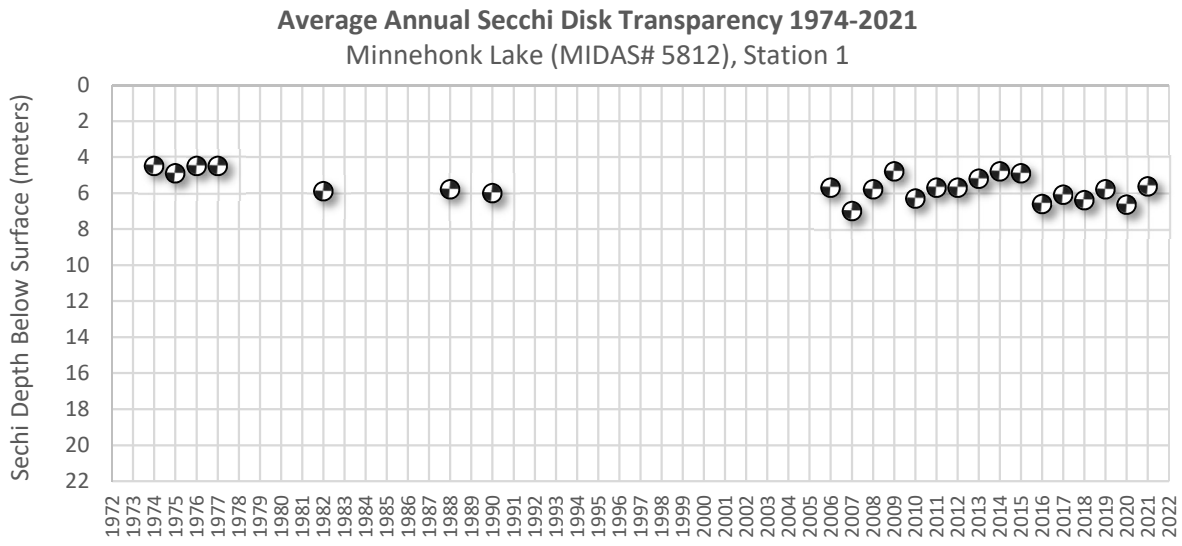


Figure 3. Average annual secchi disk transparency (water clarity), Station 1, 1976-2021

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 ppm (parts per million) 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. Understanding the pattern and extent of oxygen loss in deep areas of the lake is important to understanding changes between the years and through a single season, and is particular concerning for lakes that may be more vulnerable for internal phosphorus loading due to unique sediment chemistries.[2]

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) that becomes isolated from the surface and oxygen resupply. In Minnehonk Lake, oxygen loss in the hypolimnion is common in late summer and early fall, and is not uncommon in deep lakes in Maine.

Ten (10) DO and temperature profiles were collected in 2021. DO patterns were above average in Minnehonk Lake. DO <5 ppm was documented first in late July in only the deepest 2 meters of the lake, but grew to include waters as shallow as 7 meters by early October. DO <2 ppm (anoxia) was

[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 ppm) resulting in phosphorus release from the bottom sediments exposed to anoxic waters.

first documented at a depth of 21 meters in late August, and grew slightly to a depth of 19 meters in early October (Figure 4).

Oxygen depletion in deep areas of the lake is not uncommon in Minnehonk Lake in the summertime. Looking at dissolved oxygen profiles collected over the historical monitoring period starting in 1976, anoxia typically develops in late summer, affecting the bottom 2-6 meters of the lake. In recent years, anoxia has reached a depth as shallow as 17 meters (2018 and 2020).

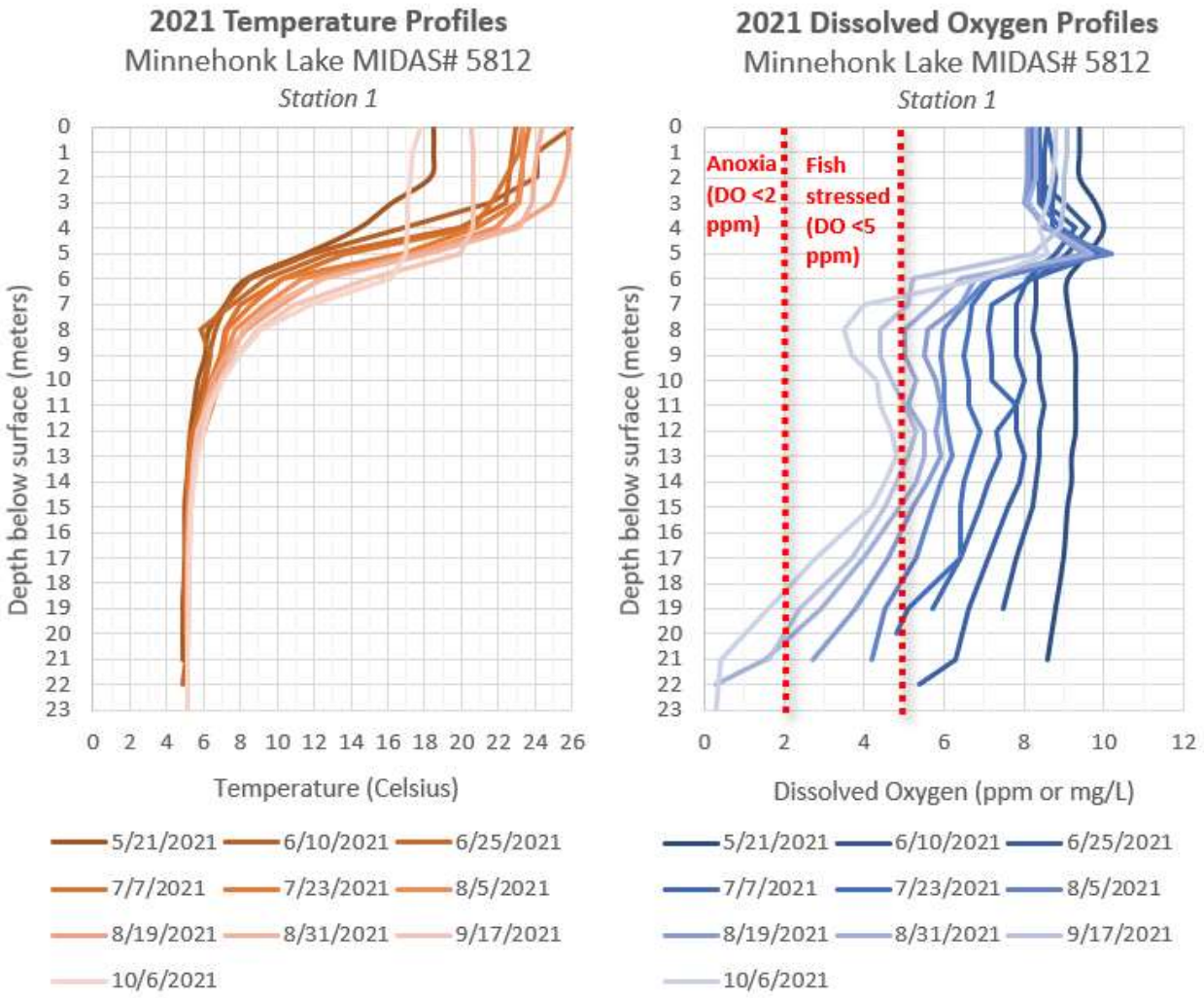


Figure 4. 2021 Dissolved Oxygen and Temperature Profiles, Station 1

Water surface temperatures through the monitoring season ranged from 20.5 C (69 F) to 26.0 C (79 F) with an average surface water temperature of 23.7 C (75 F) between June and September. Continued collection of bi-weekly DO and temperature profiles will identify trends and changes occurring in Minnehonk Lake in order to better understand variations in thermal stratification and the extent and severity of the low DO and anoxic zones throughout the monitoring season.

Total Phosphorus

Total Phosphorus (ppb)	
2021 TP Average	7.8
Historical TP Average	7.6
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.

Seven (7) samples were collected by 30 Mile staff this year and analyzed for Total Phosphorus (TP). Samples were collected monthly between June and October. Five (5) of the phosphorus samples were collected using an integrated core sampler and are referred to as "epilimnetic core samples". Laboratory results for epilimnetic core samples collected in 2021 ranged from 7 ppb to 9 ppb with an annual average of 7.8 ppb.

Generally speaking, in-lake phosphorus concentrations (epilimnetic samples) less than 10-12 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. Historically, the annual average in-lake phosphorus concentration in Minnehonk Lake ranges from 6 ppb (2007) to 9.5 ppb (2020) with an average historical average of 7.6 ppb (Figure 5).

In 2021, two (2) samples were collected from the bottom of Minnehonk 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 for bottom grab samples collected in 2021 were 22 ppb (August 31st) and 31 ppb (October 6th).

Historically, bottom grab samples were collected in 9 years throughout the 47-year monitoring record (2021, 2019, 2018, 2017, 2016, 2012, 1982, 1977, and 1976). The historical annual average bottom grab TP concentration ranges from 7 ppb (1977) to 34 ppb (2018) with a historical average of 19 ppb.

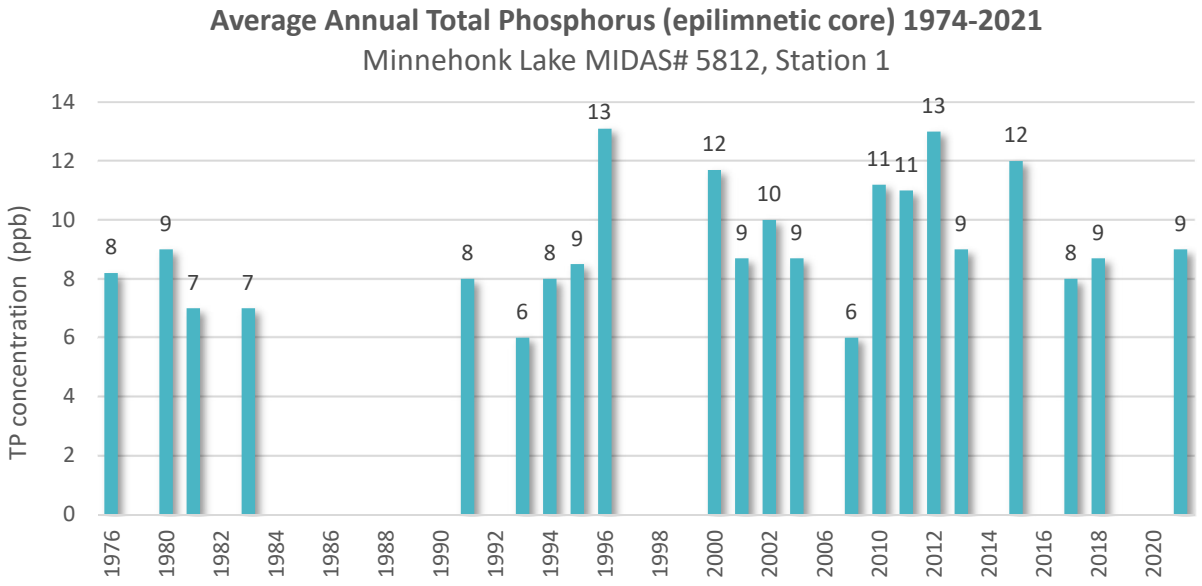


Figure 5. Annual Average Total Phosphorus data (epilimnetic core samples) collected 1976-2021, Station 1.

Chlorophyll

Chlorophyll is found in plants (including algae), and is used to convert sunlight into energy. Because algae photosynthesize, they contain chlorophyll. Measuring the concentration of Chlorophyll in lake water helps us estimate the algae population in the lake.

Chl-a (ppb)	
2021 Chl-a Average	3.4
2021 Peak Chl-a	4.0
Historical Chl-a Average	3.0
Maine Lakes Chl-a Average	5.4

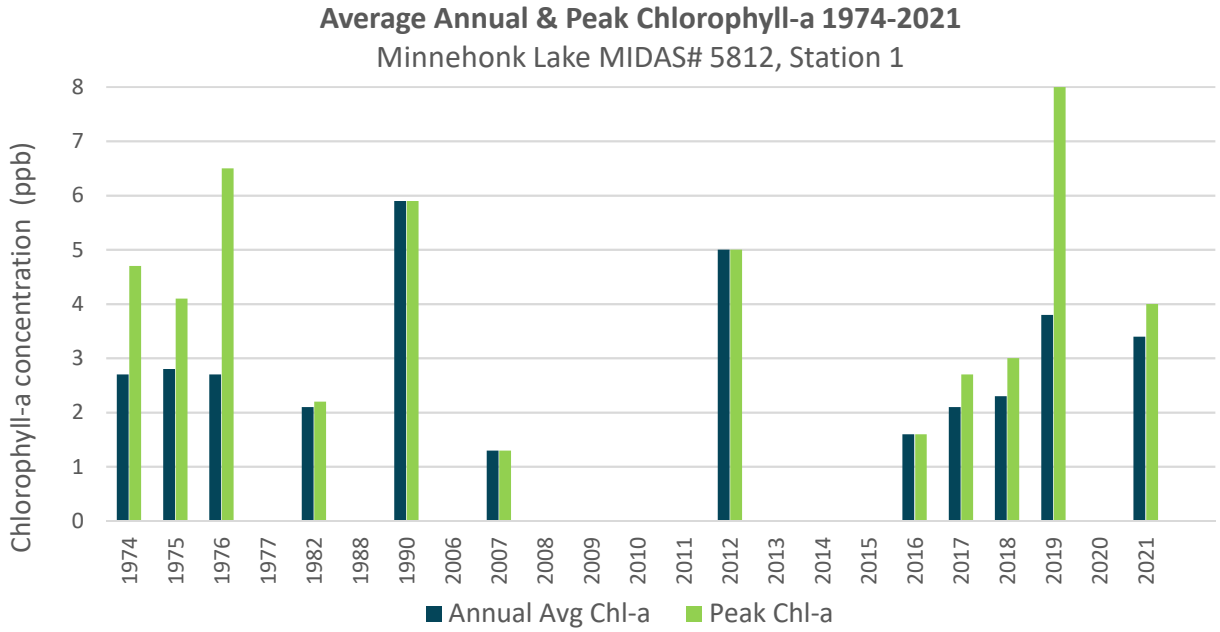


Figure 7. Annual average and peak annual chlorophyll concentrations, 1974-2021, Station 1

Chlorophyll was measured five (5) times in 2021. Results ranged from 2 ppb to 4 ppb, with a 2021 annual average of 3.4 ppb. Historical monitoring data collected between 1974-2021 ranged from 1.3 ppb (1975, 1976, and 2007) to 8.0 ppb (2019) with a historical annual average of 3.0 ppb (Figure 6).

Discussion

2021 was 30 Mile's sixth year of monitoring Minnehonk Lake. Historical data presented in this report includes all monitoring data collected on Minnehonk Lake through 2018, submitted by 30 Mile, volunteer monitors, and state agencies, that has undergone a thorough QA/QC process at Maine DEP. 2019, 2020, and 2021 data included in this report is from 30 Mile only. Data submitted from other monitors or agencies over the past three years is currently in holding at Maine DEP for QA/QC and will be included in next year's water quality report if published at that time.

Five years of consecutive data collection for any given parameter will provide the baseline condition of the Pond. 10 years of consecutive data collection is needed to meet the minimum data thresholds for determining trends over time. 30 Mile's monitoring program will continue to develop a robust dataset that can help our community identify and address water quality concerns in Minnehonk Lake.

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

Next Steps

1. Continue **bi-weekly baseline monitoring** between May and October each year to monitor seasonal and annual variability across all parameters, and better document changes and trends over time.

2. Develop a **LakeSmart team** on Minnehonk Lake, providing education to shorefront property owners about polluted stormwater runoff, phosphorus, and the affects that watershed development can have on lake water quality.

3. Work with 30 Mile to **review the list of priority sites identified during the 2013 watershed survey** and determine next steps to address remaining sites through LakeSmart and 30 Mile's YCC and Technical Assistance Programs.