Flying Pond

WATER QUALITY REPORT

2021

30 Mile River Watershed Association
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2021 Flying Pond Water Quality Report

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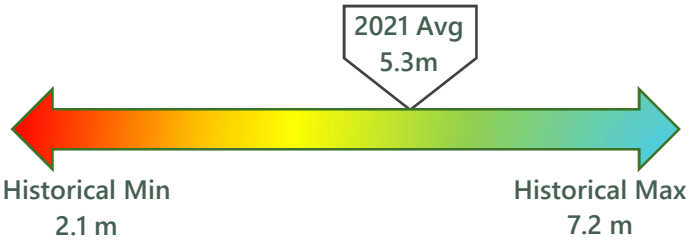
2021 Water Quality Summary[1]

Monitoring on Flying Pond occurred on 10 dates between June and September 2021 by Whitney Baker of 30 Mile River Watershed Association (30 Mile) and volunteers from the Flying Pond Improvement Association (FPIA).

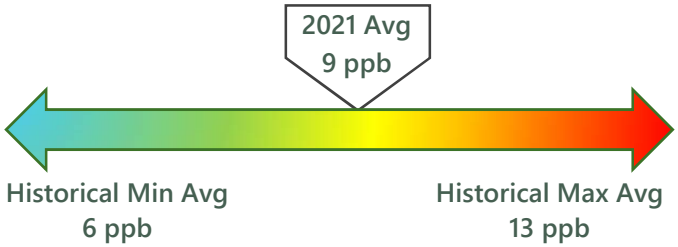
Water clarity readings in 2021 ranged from 2.95 meters (June 10th) to 6.00 meters (August 31st) with an annual average of 5.32 meters. 12 readings were collected in 2021 in total.

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



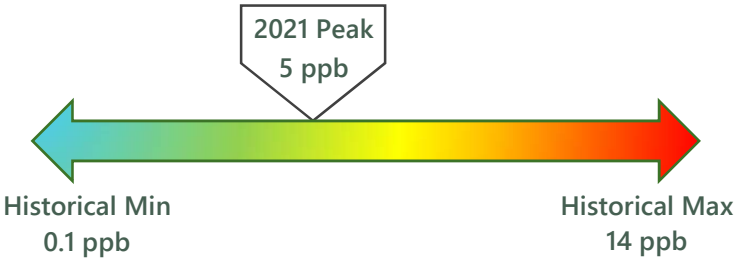
Five (5) samples were collected and analyzed for **Total Phosphorus**. Laboratory results ranged from 6 ppb (parts per billion) to 13 ppb with an average of 9 ppb.

Total Phosphorus (ppb)	
2021 TP Average	9
Historical TP Average	9
Maine Lakes TP Average	12



Chlorophyll was measured five (5) times in 2021. Results ranged from 3 ppb (August 31st) to 5 ppb (July 7th, Augusta 6th, and September 28th) with an annual average of 4.4 ppb.

Chlorophyll-a (ppb)	
2021 Chl-a Average	3.1
2021 Peak Chl-a	5.0
Historical Chl-a Average	3.1
Maine Lakes Chl-a Average	5.4



Nine (9) **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 July, but this zone of anoxia grew to include waters as shallow as 7 meters deep in September. 2021 documented the shallowest recorded depth of anoxia on the historical DO monitoring record for Flying Pond, which includes DO data collected sporadically since 1991.

[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

Flying Pond is located in the towns of Vienna and Mount Vernon in Kennebec County, Maine and has a total watershed area of 14 square miles, which includes the upstream drainages of Boody Pond, Kimball Pond, Mill Pond, and Black Pond. Flying Pond has a single outlet, located east of Russ Point, that flows south to Minnehonk Lake in Mount Vernon.

Flying Pond is a relatively deep lake with a maximum depth of 24m (80 ft) and an average depth of just 8m (25 ft). The lake has a surface area covering approximately 403 acres and can be accessed via a public launch located on the eastern shoreline on Route 41, just north of Demariano Road.

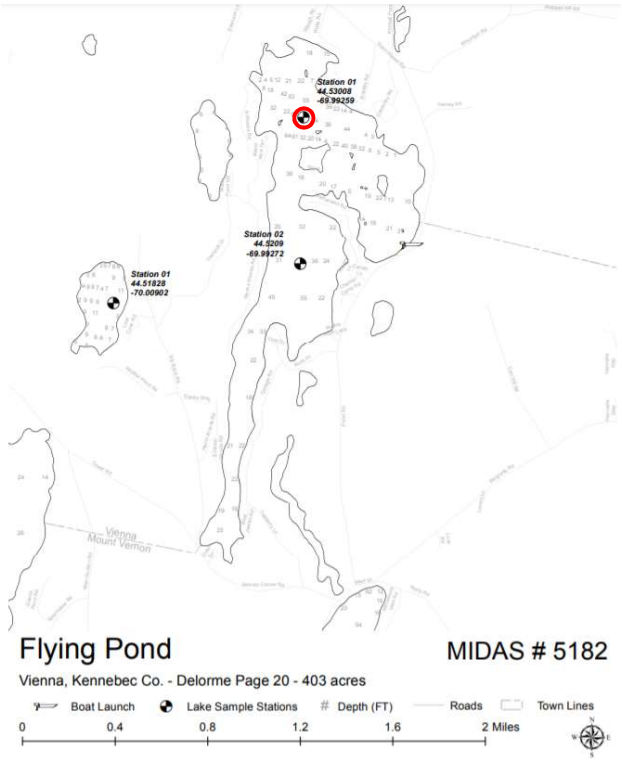


Figure 1. Flying Pond Monitoring Stations.

Water Quality Monitoring in 2021

Water quality monitoring on Flying Pond takes place at the deepest spot in the lake (Maine DEP Station 1), also known as the "deep spot", located on the north side of Big Island. Station 1 is just over 24 meters (80 ft) deep (Figure 1). Monitoring in 2021 was completed by Whitney Baker of 30 Mile River Watershed Association (30 Mile) and volunteers from the Flying Pond Improvement Association (FPIA). A special Thanks to the 2021 volunteers:

2021 water quality volunteer, Len Roe.

Debbie & Len Roe
Gary Cortelyou & Family
Dave Gifford & Family
Randy & Wendy Oakley

Water quality data was collected on 10 dates between June and September. 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 2.95 meters (June 10th) to 6.00 meters (August 31st) with an annual average of 5.32 meters. 12 total readings were collected over 10 monitoring days in 2021 (Figure 2).

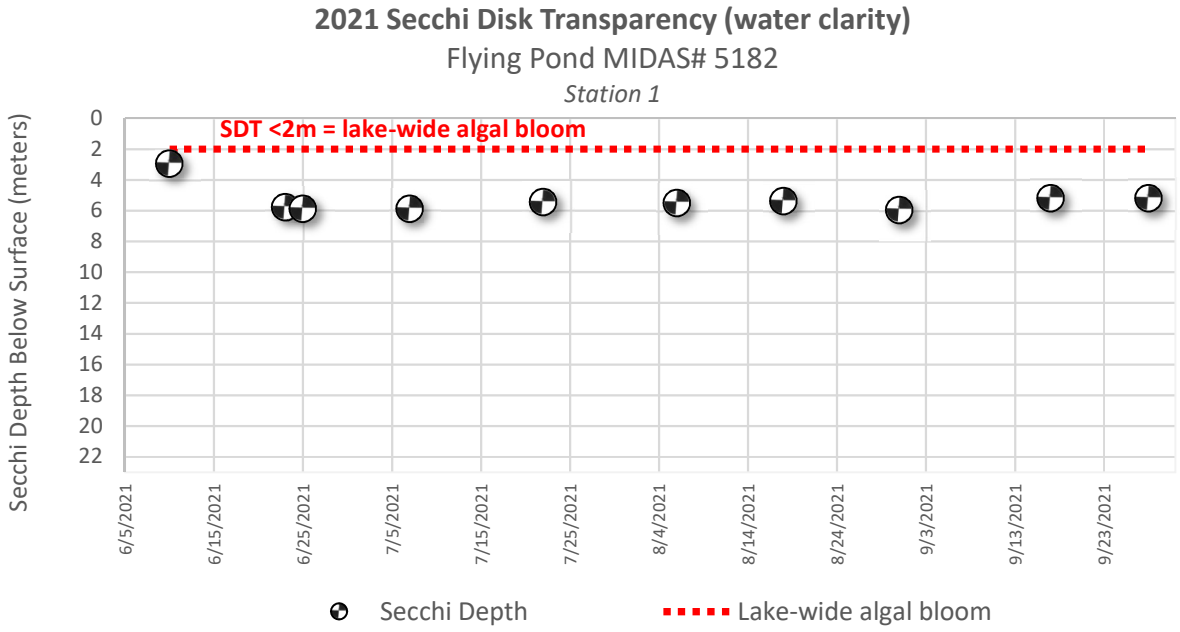


Figure 2. 2021 Secchi Disk Transparency, Station 1

The shallow clarity reading of 2.95 m, taken on June 10th, is an outlier in the 2021 dataset. However, this reading coincides with the highest total phosphorus sample collected in 2021 (See total phosohorus summary on page 6). While reduced water clarity readings are rare on Flying Pond, SDT readings between 2-3 meters deep have been documented (most often occuring in spring) in 7 years throughout the historical data record that includes 37 years of monitoring data collected since 1976. Hisotrically, SDT readings have ranged from 2.1 m (1989) to 7.2 m (2017) with an average annual reading of 4.7 m. (Figure 3).

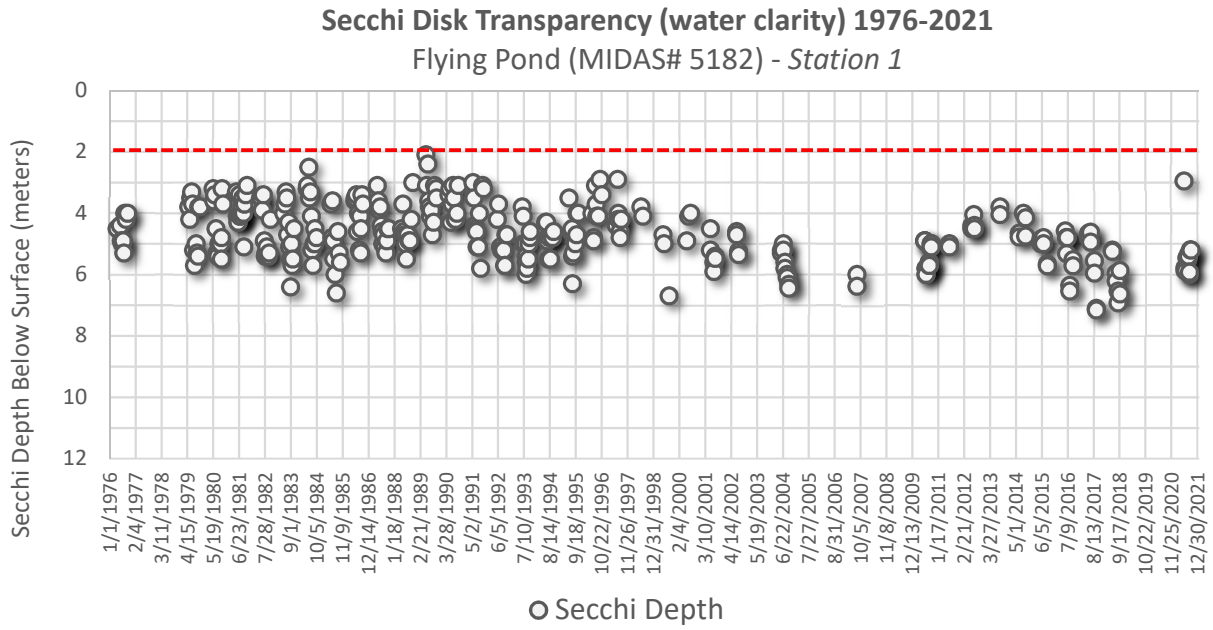


Figure 3. Historical Secchi Disk Transparency, Station 1, 1976-2021

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 Flying Pond 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 lake sediment chemistry.[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 Flying Pond, severe oxygen loss in the hypolimnion is common in late summer through early fall.

[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.

Nine (9) DO and temperature profiles were collected in 2021. DO <5 ppm was documented in every profile collected in 2021 and first encountered in deep waters only (waters 23 meters and deeper) in June, but grew to include all water 5 meters and deeper by mid-August. DO <2 ppm (anoxia) was first documented at a depth of 21 meters in late July, but the zone of anoxic water grew to include waters 7 meters and deeper in September. By the end of September, the entire hypolimnion of Flying Pond was anoxic (Figure 4). 2021 documented the shallowest recorded depth of anoxia on the historical monitoring record for Flying Pond which includes DO data collected sporadically since 1991.

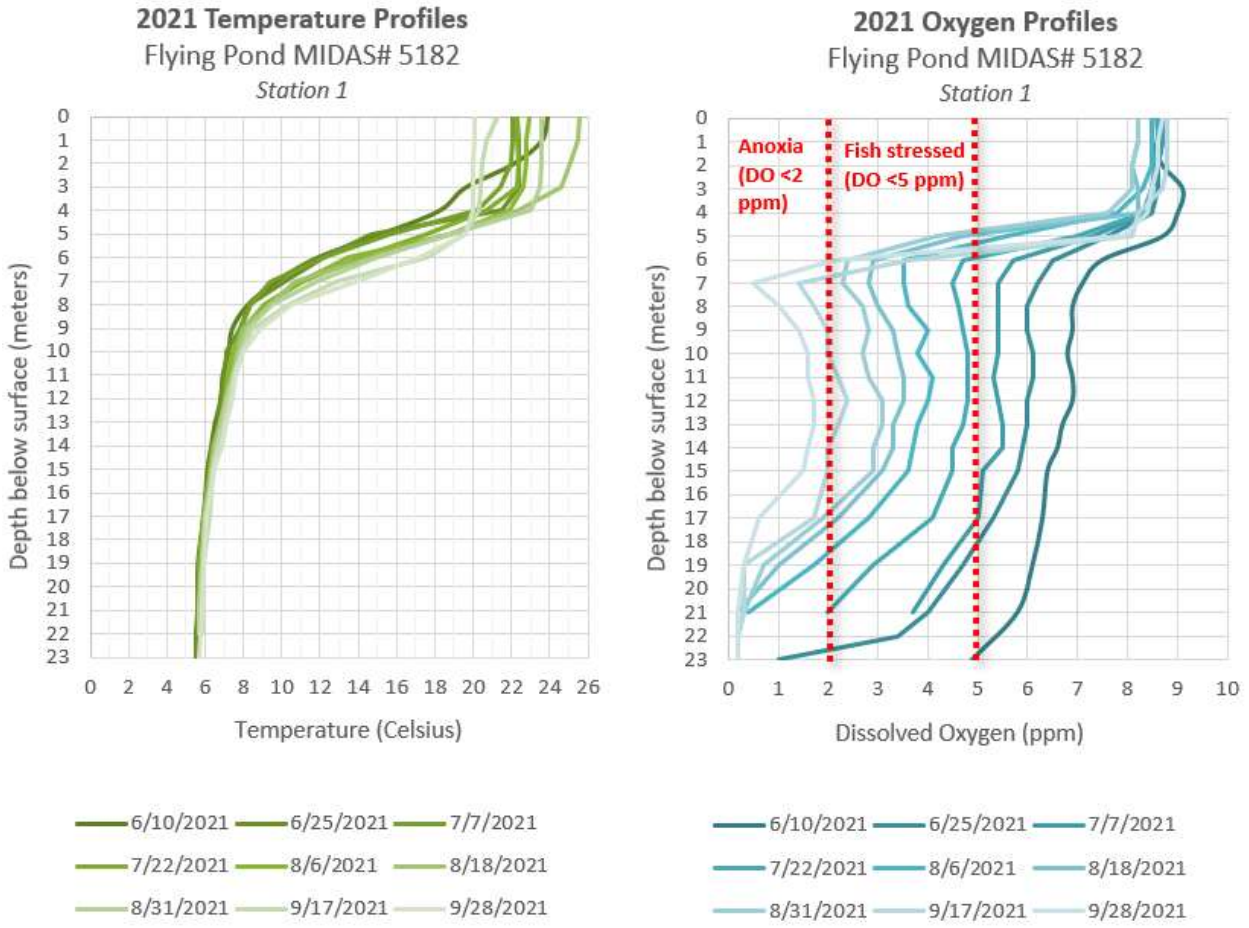


Figure 4. 2021 Dissolved Oxygen and Temperature Profiles, Station 1

Oxygen depletion in the deep areas of the lake is not uncommon in Flying Pond and is why the pond is only marginally suited to support cold-water fish species that rely on deep, cold-water refuge in the summer months with an adequate oxygen supply. Past stockings of salmon and lake

trout have not produced a quality fishery in Flying Pond[3], however Maine Department of Inland Fisheries & Wildlife currently stocks brown trout, brook trout, and landlocked salmon.[4]

Water surface temperatures through the monitoring season ranged from 20.1 C (68 F) to 25.6 C (78 F) with an average surface water temperature of 22.7 C (73 F) between June and September. Continued collection of bi-weekly DO and temperature profiles will identify trends and changes occurring in Flying Pond 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 (TP)

Total Phosphorus (ppb)	
2021 TP Average	9
Historical TP Average	9
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.

Eight (8) samples were collected by 30 Mile staff this year and analyzed for Total Phosphorus (TP). Samples were collected monthly between June and September. Five (5) of the phosphorus samples were collected from the top layer of Flying Pond using an integrated core sampler and are referred to as "epilimnetic core samples". Laboratory results for epilimnetic core samples collected in 2021 ranged from 6 ppb (August 31st) to 13 ppb (June 10th) with an average of 9 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 Flying Pond ranges from 6 ppb (1993 and 2007) to 13 ppb (1996 and 2012) with a historical average of 9 ppb (Figure 5).

In 2021, three (3) samples were collected from the bottom of Flying 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

[3] Maine Department of Inland Fisheries & Wildlife. Lake Survey Maps – Flying Pond. Accessed online: https://www.maine.gov/ifw/docs/lake-survey-maps/kennebec/flying_pond_vienna.pdf.

[4] Maine Department of Inland Fisheries & Wildlife. Annual Fish Stocking Reports. Accessed online: https://www.maine.gov/ifw/fishing-boating/fishing/fishing-resources/fish-stocking-report.html.

bottom grab samples collected in 2021 were 25 ppb (August 6th), 23 ppb (August 31st), and 33 ppb (September 28th) with an annual average of 27 ppb.

Historically, bottom grab samples were collected during 9 years throughout the 45-year monitoring record (2018, 2013, 2001, 1996, 1995, 1994, 1983, 1981, and 1980). The historical annual average bottom grab TP concentration ranges from 7 ppb (1983) to 27 ppb (2021).

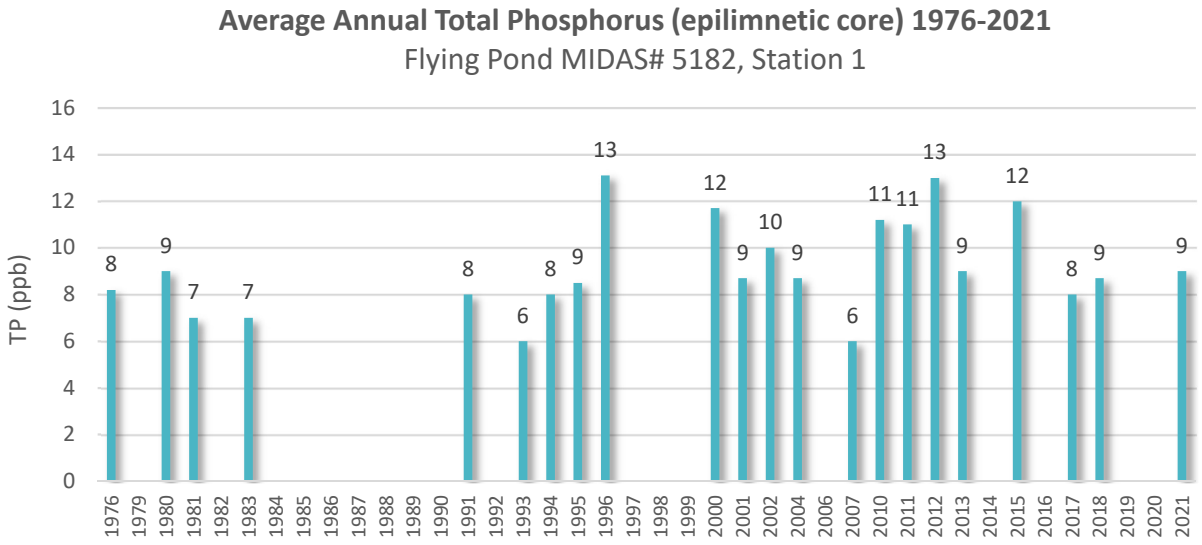


Figure 5. Annual Average Total Phosphorus data (epilimnetic core samples) collected 1976-2021, Station 1.

Chlorophyll (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.

Chl-a (ppb)	
2021 Chl-a Average	4.4
2021 Peak Chl-a	5.0
Historical Chl-a Average	3.1
Maine Lakes Chl-a Average	5.4

Chlorophyll was measured five (5) times in 2021. Results ranged from 3 ppb to 5 ppb, with a 2021 annual average of 4.4 ppb. Historical monitoring data collected between 1976-2021 ranged from 0.1 ppb (1996) to 14 ppb (2010) with a historical annual average of 3.1 ppb (Figure 6).

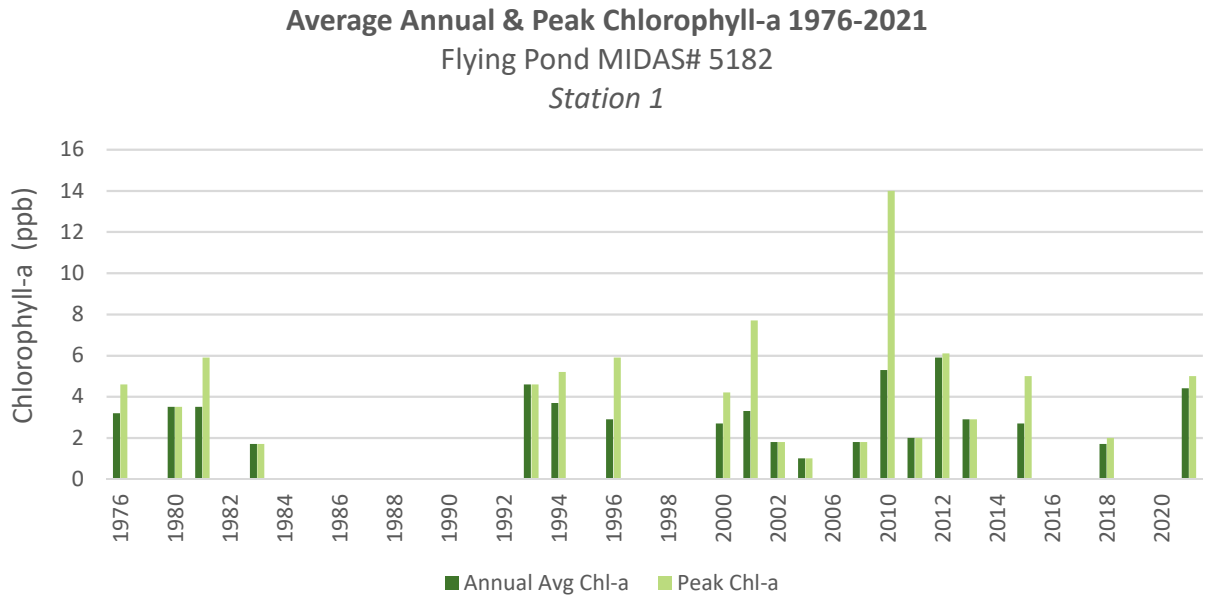


Figure 6. Annual average and peak chlorophyll-a, station 1, 1976-2021

Discussion

2021 was 30 Mile's first year of monitoring Flying Pond. Historical data presented in this report includes all monitoring data collected on Flying Pond through 2018, submitted by both volunteer monitors and state agencies, that has undergone a thorough QA/QC process at Maine DEP. Data collected in 2019 and 2020 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.

New monitoring staff at 30 Mile did not start until June 2021, so we do not have May data. Typically, baseline monitoring begins in May, and we plan to do so on Flying Pond in 2022. This will better document early spring conditions – the time of year we saw high phosphorus readings and reduced water clarity in 2021. Continued bi-weekly monitoring will also be crucial in understanding the extent and severity of low DO and anoxia in Flying Pond over 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. This effort will continue to develop a robust dataset that can help our community identify and address water quality concerns in Flying Pond.

Near real-time data for Flying Pond's clarity (secchi depth), and dissolved oxygen and temperature profiles can be found online at https://30mileriver.org/flying-pond/, 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. Continue to deliver LakeSmart programming on Flying Pond, 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 2014 watershed survey and determine next steps to address remaining sites through LakeSmart and 30 Mile's YCC Programs.