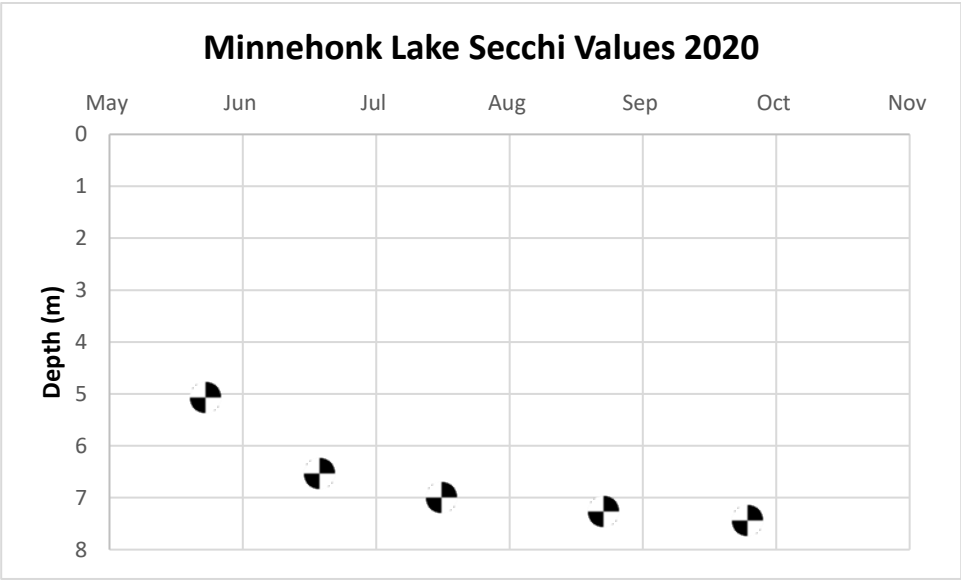
Overview

Minnehonk Lake is a 99-acre lake located in Mount Vernon, Maine with a mean depth of 30 feet and a maximum depth of 73 feet. In 2020, 30 Mile monitored Minnehonk Lake once a month from May through September, for a total of 5 visits throughout the summer. On each visit we collected **water clarity** readings and **dissolved oxygen/temperature** profiles. Twice during the late summer, water samples were collected and tested for **phosphorus** concentrations. Sampling visits this summer were performed less frequently than a typical season due to constraints of the Covid-19 pandemic, but the focus remained to keep eyes on the water - collecting the quality data necessary for monitoring water quality trends.

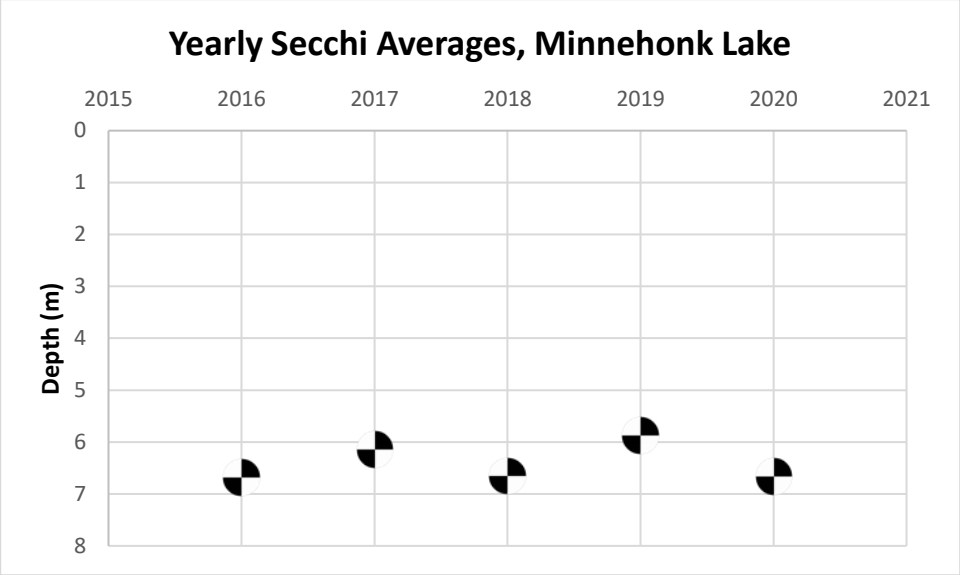
Water Clarity

Secchi disk transparency (SDT) is an indicator of water clarity. A black and white disk is lowered in the water and the reading is taken at the depth at which it is no longer visible. Factors that affect transparency include algal growth, zooplankton, natural water color, and suspended silt or sediment particles.



In 2020 the average reading was 5.87m (19.3 ft), the maximum: 7.44m (24.4 ft) and the minimum: 5.06m (16.6 ft). Minnehonk Lake has a maximum depth of around 23m.

These Secchi readings are better than the 2019 average of 5.87 meters, but consistent with clarity readings observed by 30 Mile Watershed over the last 5 years. The graph below shows the similarities of this year's readings with those in 2016 and 2018.



Dissolved Oxygen and Temperature

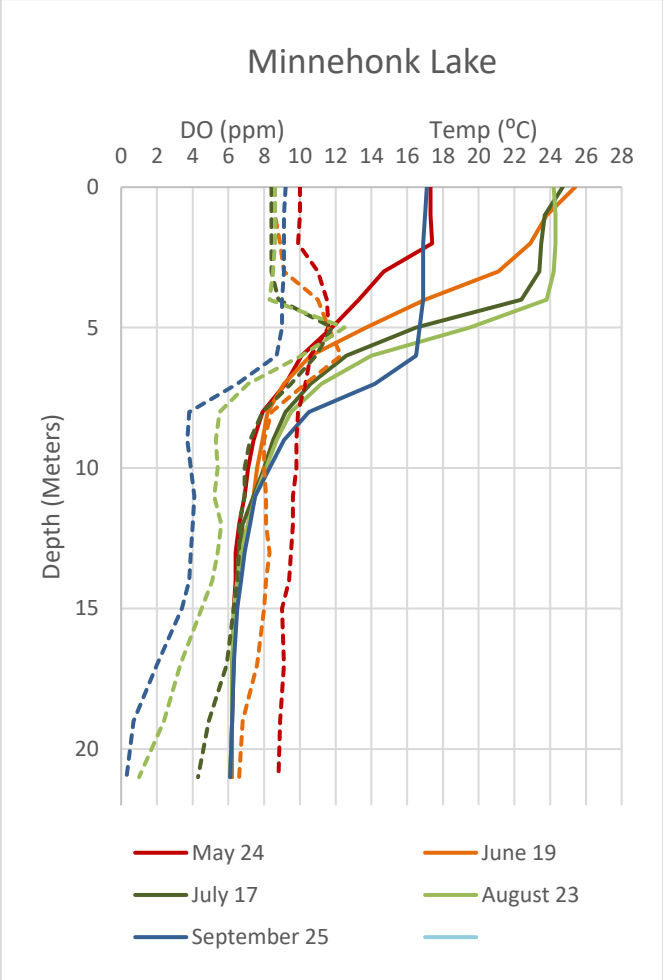
As lake water is warmed during the summer months, many of Maine's lakes form three distinct temperature layers. There is a warm layer at the surface (epilimnion), a thin transitional layer (thermocline), and a deep cold layer (hypolimnion). As the temperature profile to the right demonstrates, Minnehonk is a lake that forms distinct layers - with warm water near the surface and colder water beneath.

Water temperature and dissolved oxygen are generally measured together as the amount of oxygen that can dissolve into water changes with temperature. During the height of the summer, the water temperature 10m below the surface is nearly 40 degrees F colder than the surface. This gradient of temperatures traps the movement of water and oxygen between layers. Decomposition of organic material on the lake bottom consumes oxygen and depletes the oxygen supply in the hypolimnion.

When oxygen levels are below 2 ppm at the bottom of the lake, it is considered "anoxic" and there is a greater likelihood that iron-bound phosphorus stored in bottom sediments will be released back into the lake. When anoxic conditions occur at or near the bottom sediments, it triggers a chemical reaction that releases phosphorus from the sediment, that was formerly bound to iron in the soil, back into the water column. This is referred to as "internal loading"

as it differs from phosphorus that enters the lake from external sources in the form of runoff from the surrounding watershed.

In 2020, oxygen levels at the bottom dipped below 2 ppm in August and September. This is similar to trends observed in 2018 and 2019 with oxygen levels dropping late in the August or September. It is a good sign that the oxygen does not deplete until late in the summer, but also needs further monitoring to understand trends in Minnehonk Lake. There is no doubt that a warming climate will lead to warmer lakes.



Phosphorus

Phosphorus is an important parameter to measure as it is the nutrient that most influences the growth of algae in lakes. Phosphorus is found in soil, fertilizers, and animal waste among other sources, and enters lakes and streams during rain events that erode bare soils and flow over the landscape transporting sediments (and phosphorus) as stormwater runoff into a water body. Our goal is to limit the phosphorus entering a water body, and thus limit algal growth. It only takes small increases of phosphorus in a lake to cause substantial increases in algal growth. Algal blooms are harmful to fish and other organisms because they use up the available oxygen in a lake. Algal blooms also cause risks to human health and can decrease the economic, recreational, and aesthetic value of a lake and the properties around it.

It is important to note that extreme weather events associated with climate change typically produce higher volumes and velocity of stormwater runoff. This increases the likelihood that sediment and nutrients (primarily phosphorus) will be transported to lakes and cause substantial increases in the concentration of algae in lake water over a relatively short period of time.

The phosphorus concentrations recorded in Minnehonk Lake in 2020 were 9 ppb in July and 10 ppb (parts per billion) in September. These observations are higher than the average phosphorus level in 2019 of 7.8 ppb, and the historical average of 7.3 ppb. This is not the first time levels have been as high as 9 ppb, but the two high phosphorus concentrations observed

this summer suggest that phosphorus loading may pose a threat to the health of Minnehonk and should continue to be monitored closely.

Monitoring of Minnehonk in 2020

2020 was our fifth year of monitoring Minnehonk's water quality. We began monitoring in late May and continued through the end of September, once per month. This was an abbreviated monitoring schedule, but still produced a thorough sample of this summer's conditions to be included in the growing dataset of water quality parameters that we are monitoring. The last five years has seen the most frequent water monitoring in Minnehonk Lake's history in our effort to provide a greater understanding of the lake's dynamic processes. This effort 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's clarity (Secchi depth), dissolved oxygen and temperature can be found online at http://30mileriver.org/programs/water-quality-monitoring/minnehonk-lake/, along with a link to historical data.

Need for Sustained, Longer-Term Monitoring

Based on the limited historical data, the Maine DEP rates the overall water quality of Minnehonk as average. It is important to note that although there are no red flags yet, we have only four years of complete, consistent data on clarity, dissolved oxygen, temperature, phosphorus and chlorophyll. According to Maine DEP water quality staff, we will need ten years of data at our current monitoring schedule before we will have enough information to identify any trends. Therefore, our **continual and consistent monitoring of Minnehonk is critical**ly **important** in order for us to identify negative trends in water quality.

The **annual cost of water quality monitoring of Minnehonk Lake is $3,500**. This includes staff time, lab fees, travel, and supplies over the six-month monitoring season. While some of the start-up cost of water quality monitoring of Minnehonk as well as other lakes in the 30 Mile River Watershed received from funding from foundation grants, the **ongoing cost of water quality monitoring of Minnehonk must be supported by donors to 30 Mile, including the Greater Minnehonk Lake Association.**