Keeping An Eye On the Lake for Almost 50 Years

This document gives an overview of water quality trends observed in 48 years of data collected by the Lake Waramaug Task Force and its consulting limnologists. It includes background information and graphs about two important water quality metrics: water clarity and total phosphorus.

Part A: Secchi Disk

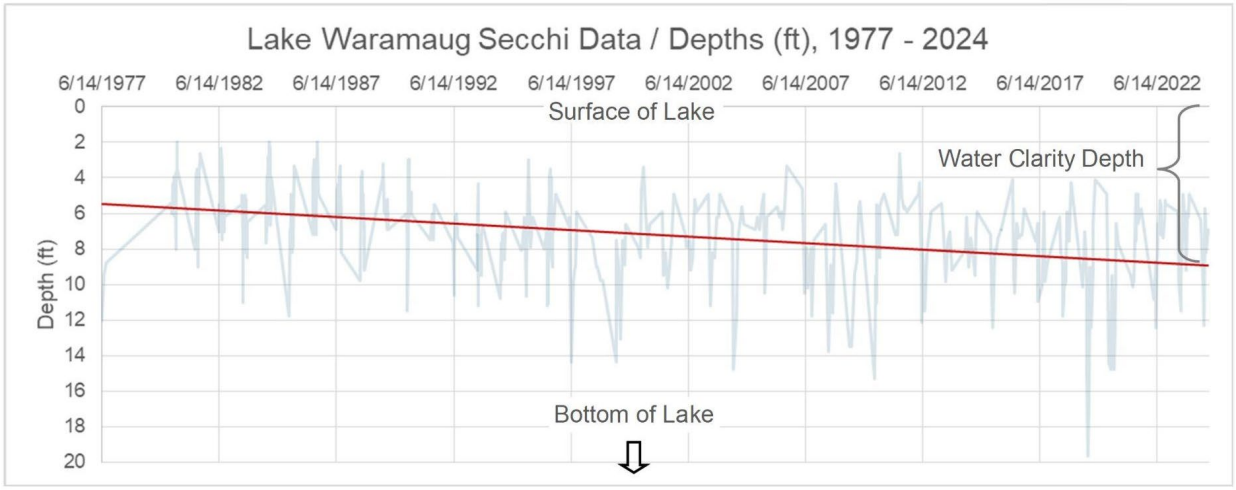
What is water clarity?

Water clarity is both an aesthetic condition and an ecologically important factor determining how deeply sunlight can penetrate into the water column. Clarity is affected by various physical, chemical and biological factors such as the amount of suspended solids and phytoplankton. More material and organisms suspended in the water column will result in decreased clarity. Decreased water clarity can be an indicator of compromised water quality. Conversely, greater water clarity usually indicates favorable water quality conditions.

How do we measure water clarity in a lake?

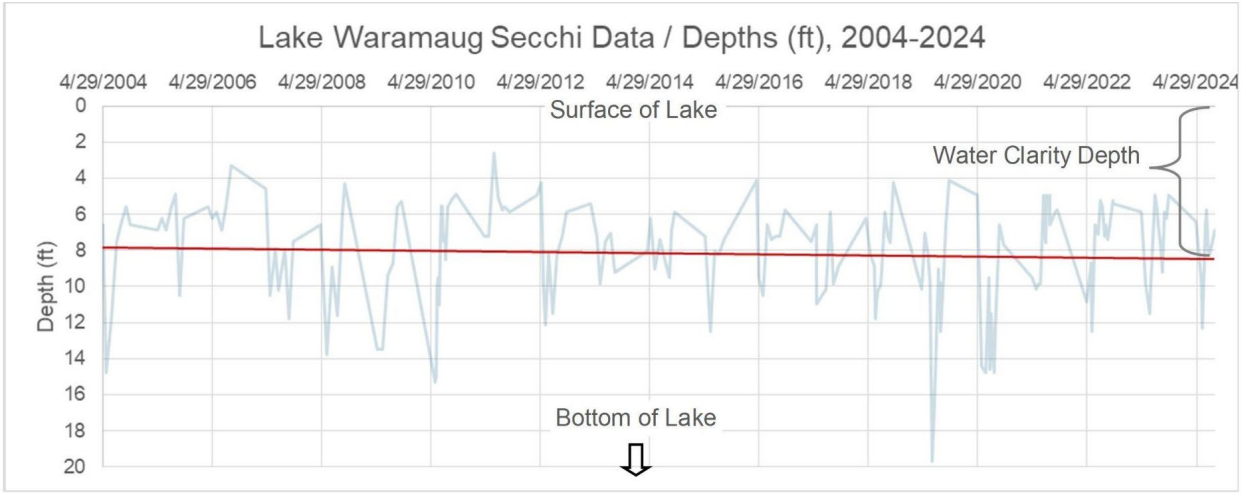
The Secchi disk tool was created in 1865 to assess turbidity (the cloudiness) of water. 160 years later, this disk still offers the most efficient way to measure clarity and track trends and changes over the decades. It is a very simple, yet effective, visual sampling technique used throughout the lake management and scientific community. The Task Force has been collecting Secchi measurements / clarity depth data on Lake Waramaug for almost 50 years (see below for clarity trend graphs). To take a clarity depth reading, we simply lower a Secchi disk into the water on a depth-metered tape. The depth at which the disc is no longer visible is considered the Secchi disk depth, and corresponds to water clarity. The consistent manner in which these readings have been taken at Waramaug provide us with a foundational water quality metric required to accurately track water quality trends over the years and decades. See graph set below.

Secchi Clarity Graphs



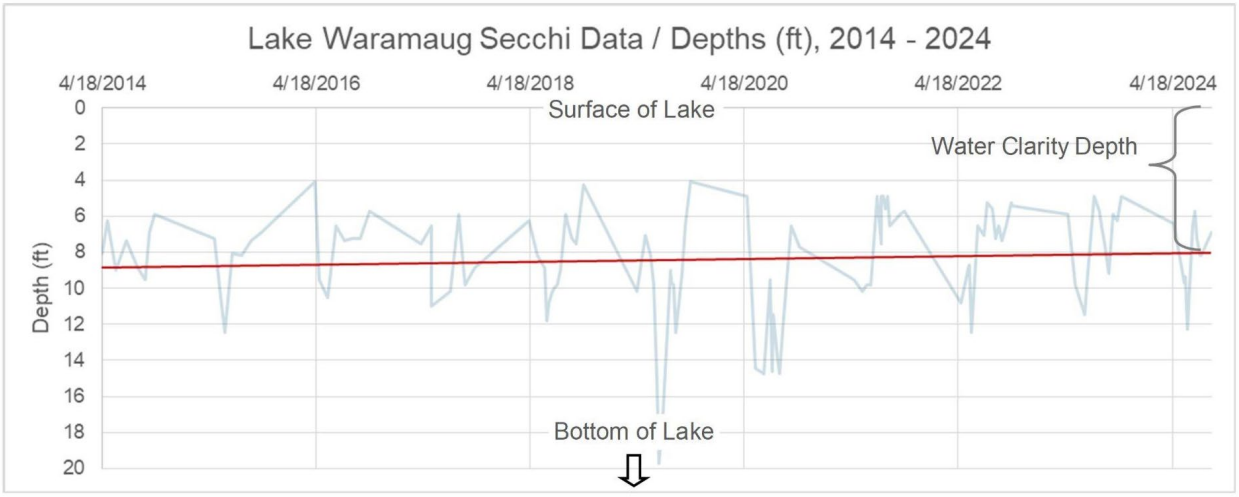
Graph 1: Secchi Data For Lake Waramaug 1977 - 2024

In this graph, and the three additional Secchi data graphs that follow, the surface of the lake is at a depth of zero feet (top of the y-axis) ranging to a depth of 20 feet, with the x-axis representing the time period of interest progressing from left to right. The downward slope of the trend line (in red) indicates that Secchi depths (or water clarity) have increased (improved) over the entire timespan of data collected. The downward slope in the trend line indicates an increasing water clarity trend, which suggests an overall trend of better water quality over the graph's timespan. The faint jagged blue line in the background indicates the lake Secchi disk readings used to calculate the trend line.



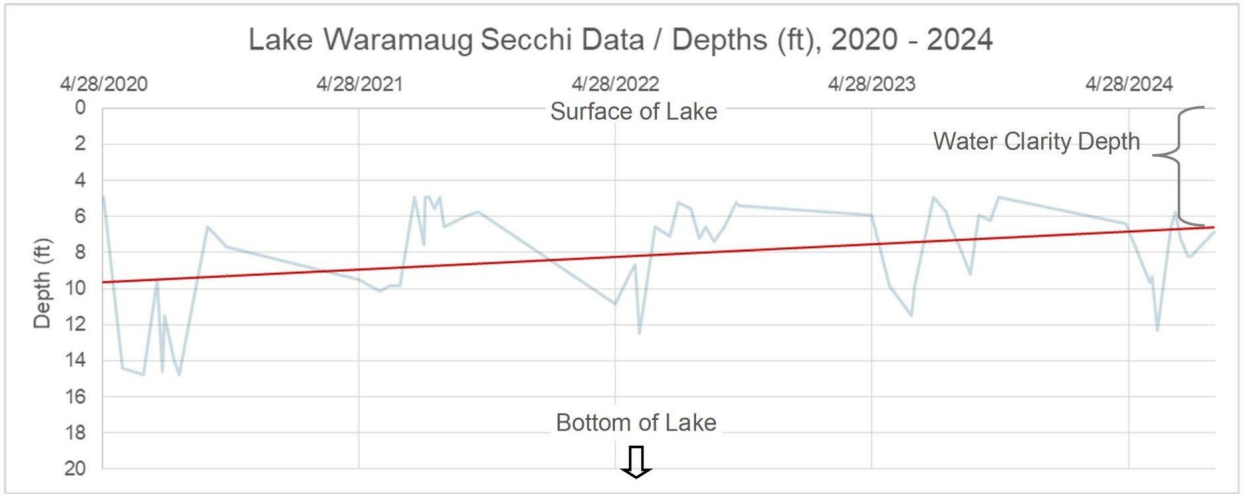
Graph 2: Secchi Data For Lake Waramaug 2004 - 2024

In Graph 2, the same graph design notes apply as detailed for Graph 1; however, Graph 2 looks at the past 20 years of collected clarity data. Graph 2 shows that for the last 20 years lake clarity improvements have occurred, but at a rate much less pronounced as compared to Graph 1.



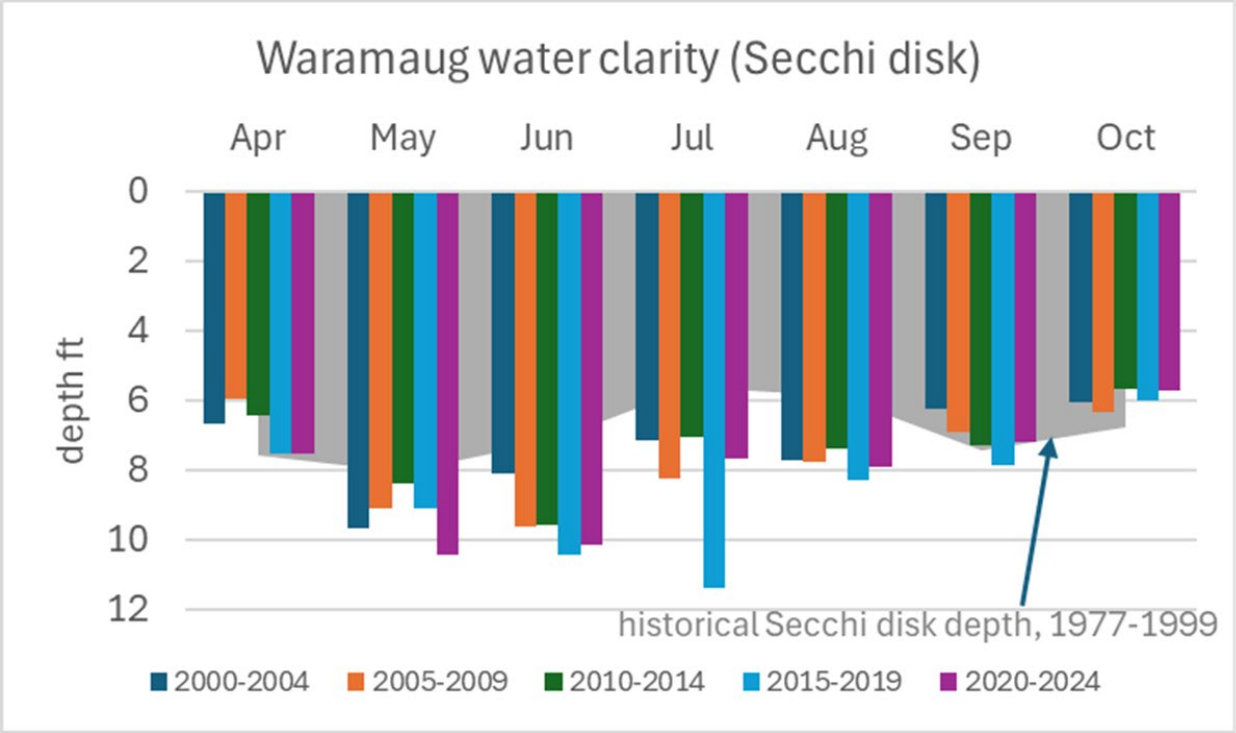
Graph 3: Secchi Data For Lake Waramaug 2014 - 2024

In Graph 3, the same graph design notes apply as detailed for Graph 1; however, Graph 3 looks at the past 10 years of collected clarity data. When we look at the last 10-year period, there is a slight decrease in clarity.



Graph 4: Secchi Data For Lake Waramaug 2020 - 2024

In Graph 4, the same graph design notes apply as detailed for Graph 1. However, Graph 4 looks at the past 5 years of collected clarity data. When we look at the last 5 years, there is a decrease in clarity overall. It is important to note that 2019 and 2020 were two of the best years of clarity (deepest Secchi disc measurements) that the Task Force has ever recorded.



Graph 5: Monthly Secchi Data For Lake Waramaug

Using the same data, Graph 5 displays the seasonal variation of lake water clarity, with monthly averaged Secchi disk depths. Each color bar represents a specific 5-year average of data spanning the last 25 years. So this graph also shows seasonal changes in water clarity through time. The historical Secchi data (1977 - 1999) is indicated by the grey background for comparison. It is statistically different from the latest 25 years of data, especially in the summer months (June-August).

Part B: Surface Phosphorus

What is phosphorus? Why do we care about it?

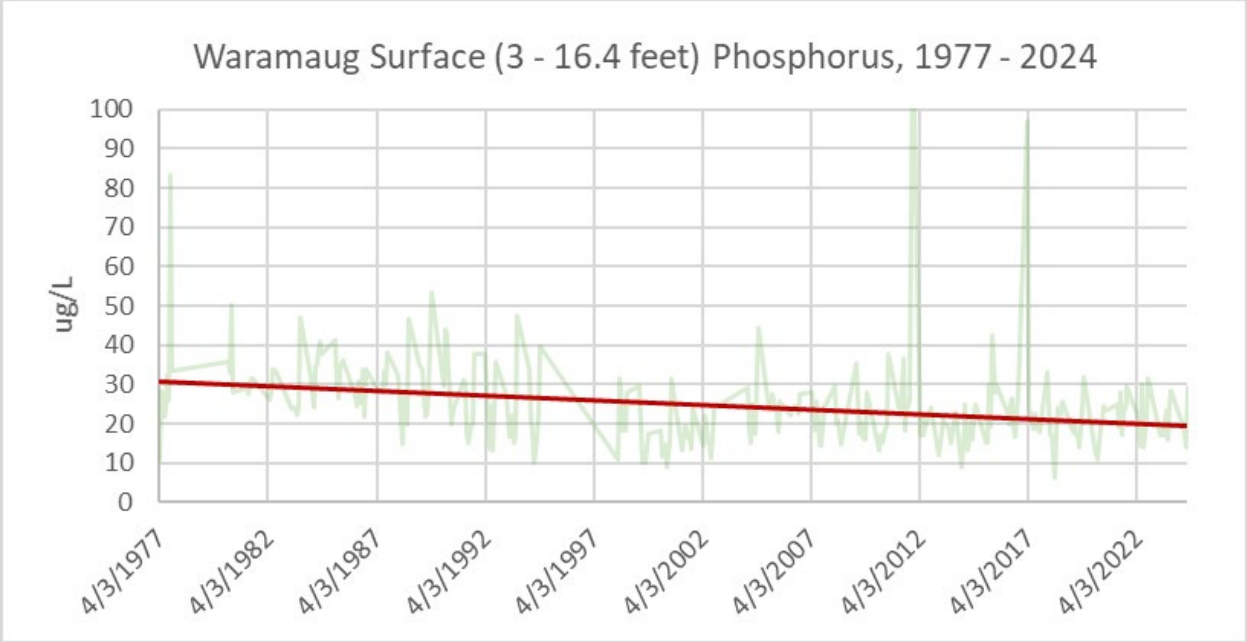
In freshwater systems, phosphorus is the limiting nutrient for growth of aquatic plants and phytoplankton. Phytoplankton include cyanobacteria, the organisms responsible for toxic blooms. Anthropogenic sources of phosphorus enrichment include fertilizer, runoff from roads and homes, erosion of sediment on construction sites, leaking septic systems, and more. Another potentially major source of phosphorus in lake water results from “internal loading”: Lake bottom sediments are typically rich in phosphorus, but this potential nutrient supply usually only mobilizes from the bottom up into the water column under certain seasonal conditions (typically occurring in peak to late summer). Increased phosphorus concentration from the watershed and lake sediment creates potential for cyanobacteria growth and blooms.

Monitoring in-lake phosphorus is key to tackling negative trends in water quality. To ensure that cyanobacteria do not bloom, it is important to keep the total phosphorus concentration at or below 20 ug/L (or 20 parts per billion) in the surface layers of the lake. The Task Force actively works to decrease the risk of cyanobacteria blooms in the lake, as these blooms can be toxic to pets and humans, degrade the natural environment, and potentially harm the local economy.

Much of the work the Task Force does in Waramaug and its watershed is intended to reduce the amount of phosphorus entering the lake. This includes all our efforts to keep phosphorus trapped in the lower layers of the lake.

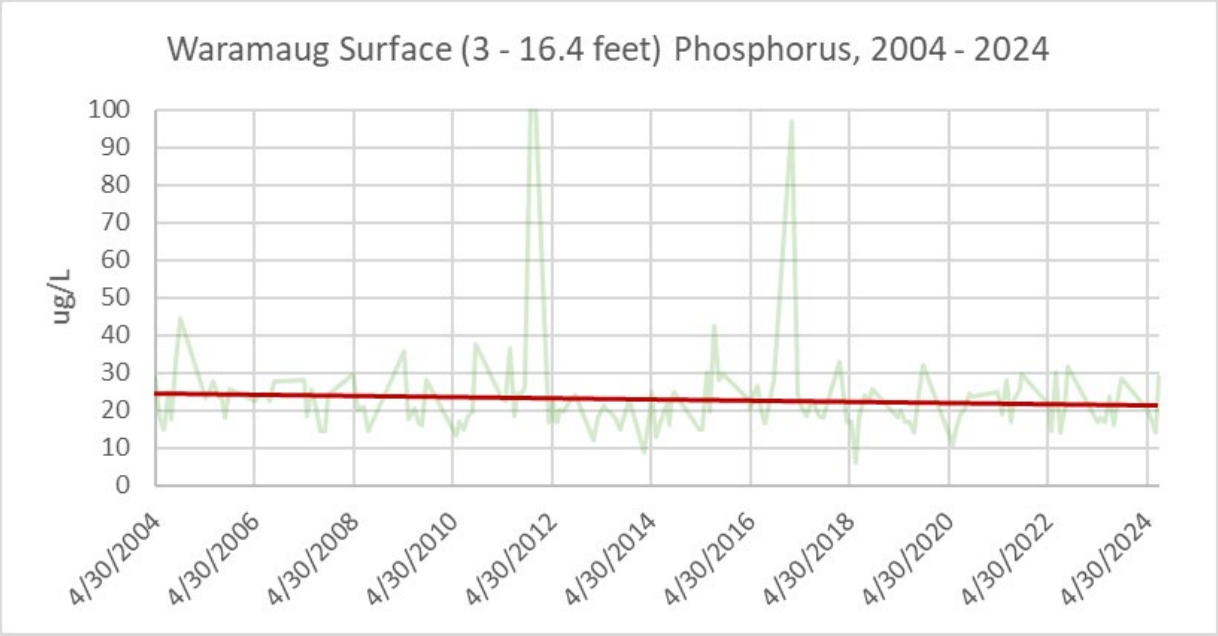
How do we monitor phosphorus?
The Task Force monitors in-lake phosphorus concentrations by taking water samples at least every month throughout the spring, summer and the first half of the fall. We use a device called a Van Dorn Vertical Water Sampler that collects surface water phosphorus samples at various depths down the water column. In Waramaug, discrete phosphorus samples are collected at 3, 16, 30 and 36 foot depths.

Phosphorus Graphs



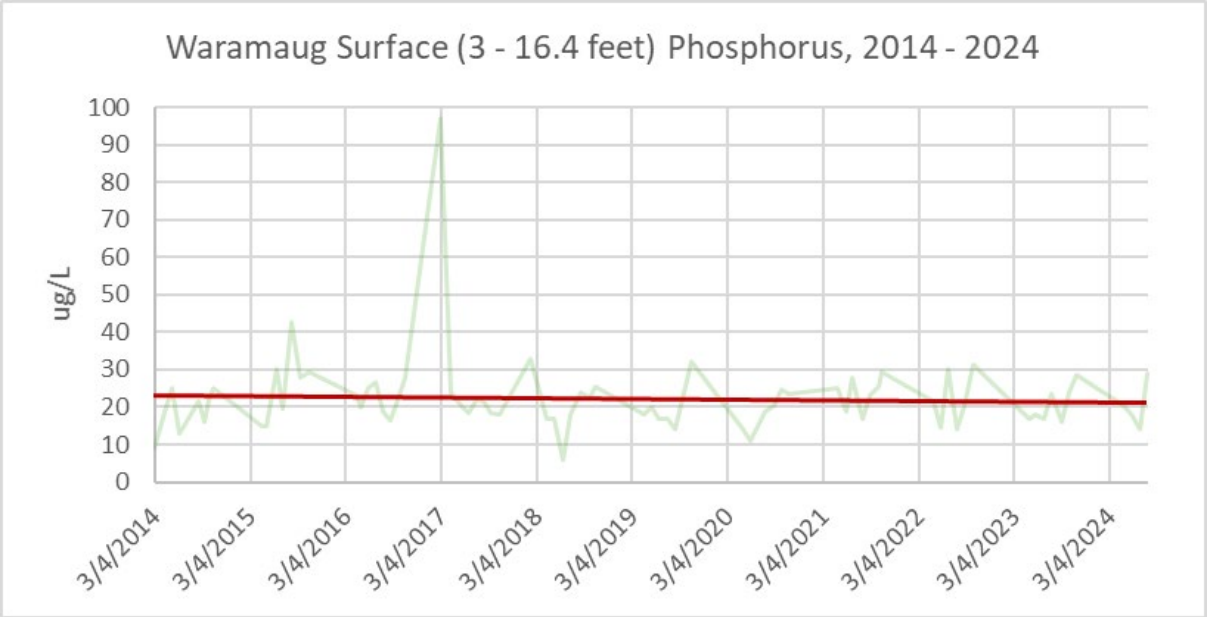
Graph 6: Phosphorus Data For Lake Waramaug 1977 - 2024

In this graph, and the three additional phosphorus data graphs that follow, the surface water phosphorus concentration is represented by the y-axis ranging from 0 to 100 ug/l (or parts per billion). The x-axis represents the time period of interest progressing from left to right. The downward slope of the trend line (in red) indicates that phosphorus concentrations have been decreasing (improving) over the entire timespan of data collected. The faint jagged green element in the background is a line graph illustrating all the in-lake phosphorus data used to calculate the trend line. A downward slope in the trend line indicates an improving water quality trend.



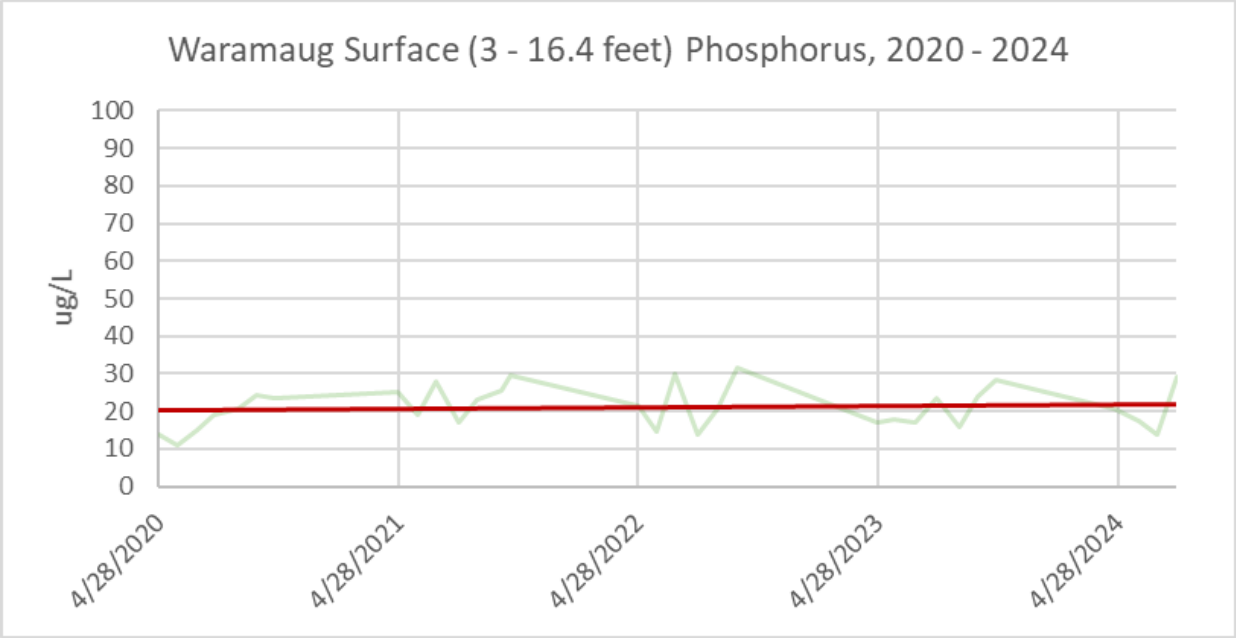
Graph 7: Phosphorus Data For Lake Waramaug 2004 - 2024

In Graph 7, the same graph design notes apply as detailed for Graph 6. However, Graph 7 looks at the past 20 years of collected surface phosphorus data. Graph 7 shows a very slight decrease (improvement) in surface phosphorus concentration over the last 20 years.



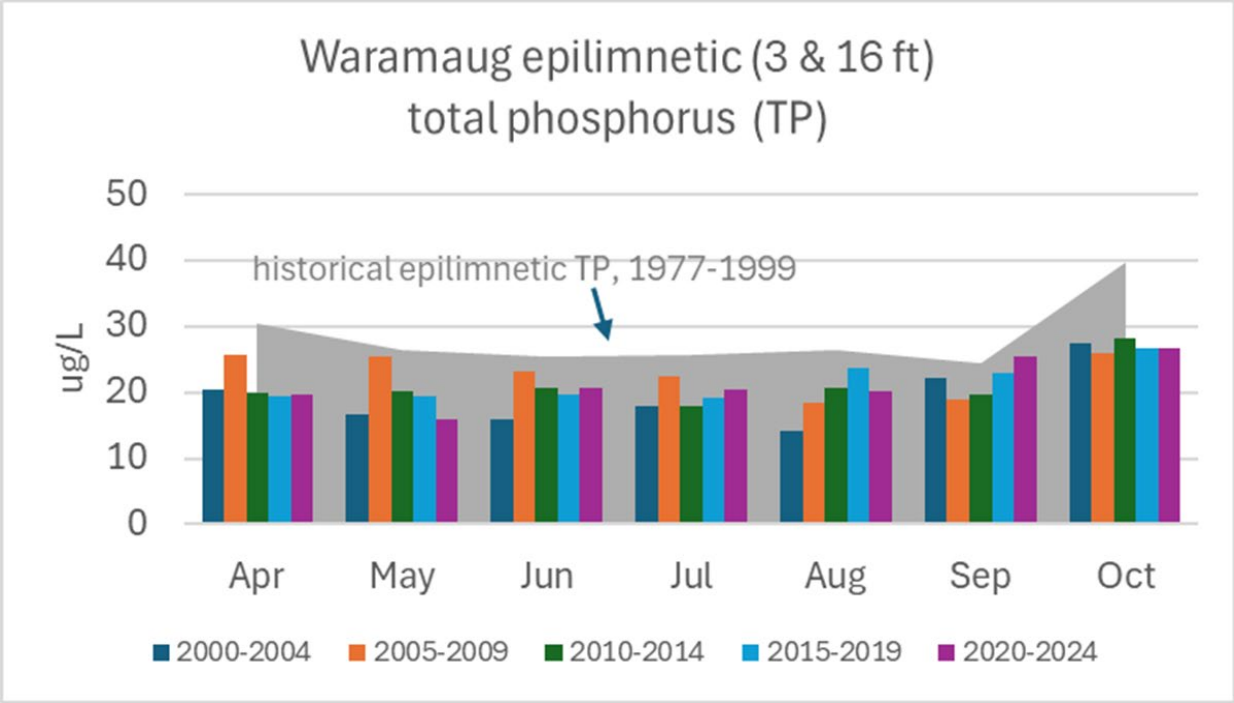
Graph 8: Phosphorus Data For Lake Waramaug 2014 - 2024

In Graph 8, the same graph design notes apply as detailed for Graph 6; however, Graph 8 looks at the past 10 years of collected surface phosphorus data. The 10-year phosphorus concentrations indicate that we have virtually plateaued near the critical phosphorus concentration threshold of 20 ug/L (or 20 parts per billion).



Graph 9: Phosphorus Data For Lake Waramaug 2020 - 2024

In this graph, the same graph design notes apply as detailed for Graph 6; however, Graph 9 looks at the past 5 years of collected surface phosphorus data. Graph 9 shows a slight increase in the lake's surface phosphorus concentration, hovering around the critical phosphorus concentration threshold of 20 ug/L (or 20 parts per billion).



Graph 10: Monthly Phosphorus Data For Lake Waramaug

Phosphorus concentrations in the epilimnion (surface water at a depth of 3 - 16.4 feet) changes seasonally, similar to water clarity. Each set of 5 bars above have been grouped by month, and each color represents a specific 5-year average of data we collected over the last 25 years. The historical surface water phosphorus concentration data (1977 - 1999) can be seen as the grey background for comparison, and it is statistically different from the latest 25-year span.

Conclusion

For almost 50 years, the Task Force, the three towns, and the entire lake community have worked together to restore Lake Waramaug to a clear and clean condition. Significant improvements in water quality have occurred during this period, as reflected in the above charts and commentary. Though overall averages demonstrate improvement, interannual trends within the last 5-10 years have either plateaued or slightly reversed. It is unfortunately impossible to ascribe those trends to any one cause, be it natural variability, recreational activity, climate change, weather events, property development. The Task Force will continue to work with the towns, the community, and its expert consultants to protect these gains by whatever means possible.