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2025 Rainbow Lake Water Quality Report

Gratiot County, Michigan

Introduction

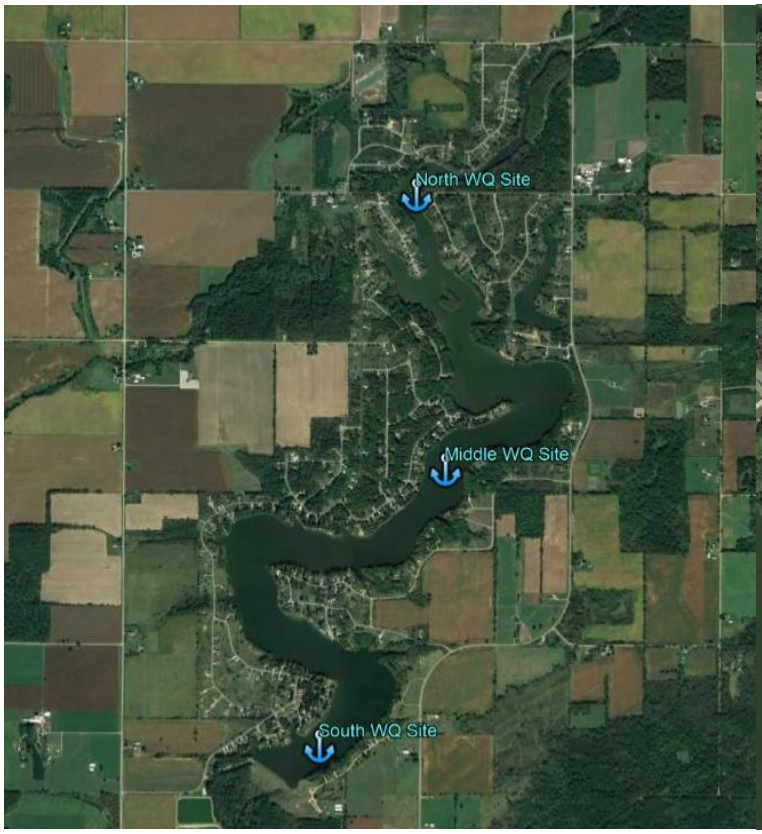
The goal of this testing program was to monitor various water quality parameters of the lake, compare results to historical data, and identify any potential risks to the health of Rainbow Lake. Water samples were taken at three different locations and tested for 12 different parameters. Tests were conducted using a Hanna Nutrient Specific Calorimeter, a YSI ProDSS Multiparameter Water Quality Meter, and a Hach DR1900 spectrophotometer. Test results were compared to the historical data in "2024 Rainbow Lake Water Quality Report" by LakePro, Inc.

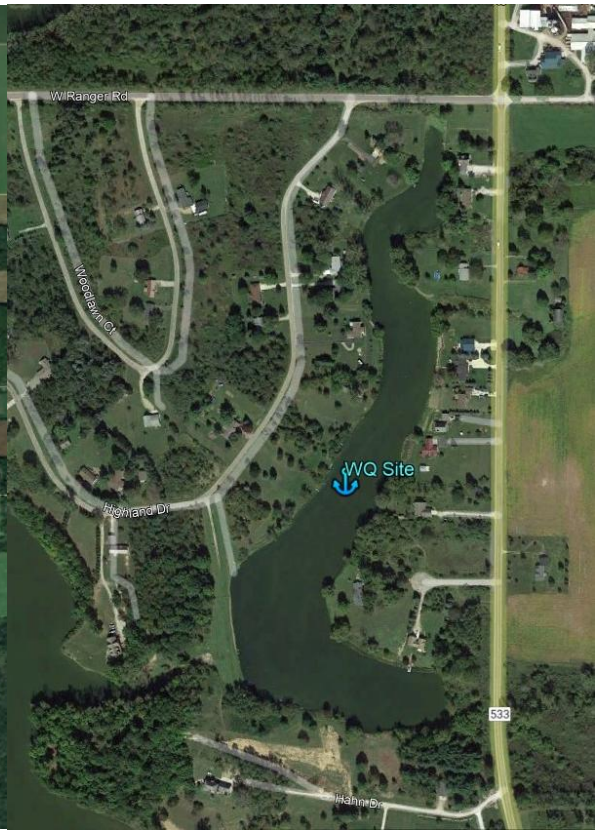
Testing Dates

Field tests and water samples were taken on May 16th, 2025, and September 26th, 2025. Laboratory tests were completed on October 6th, 2025. This report describes conditions at the times the samples were taken. Historical testing dates are at the end of this report.

Water Quality Sampling Sites

The following maps show the water quality sampling locations on both Big and Little Rainbow Lakes.





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Discussion

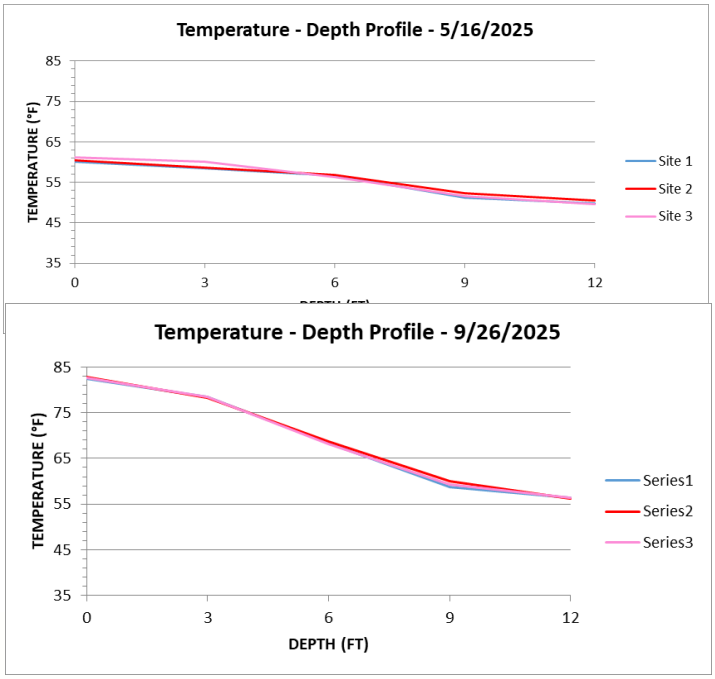
We performed the tests in early and late summer to capture the water quality at the start of the season and during the stress of warm water conditions. Each testing event captured a snapshot of the water quality when the sample was pulled. Water quality parameters can change from morning to night, day to day, and year to year. The discussion below focused on the results listed above.

This year's testing results indicated that Rainbow Lake continues to exhibit some nutrient enrichment (Total Phos., Nitrates, Chlorophyll-a), consistent with previous findings. Also, the water clarity was below the target range, similar to historical results. We did see a slight increase in water clarity, however. Moreover, the water chemistry parameters have all maintained relatively stable levels within the desired target ranges.

This was the eleventh year that LakePro/TIGRIS tested the lake water. This historical data has enabled us to distinguish between parameters that exhibit natural variations and those that demonstrate consistent trends. With each successive year of testing, we can enhance the precision of our trend analysis even further.

The **Temperature** was similar to last year in the spring; however, temperatures in the summer were higher than those recorded last year. Cooler water can hold more oxygen, so lower surface temperatures are better for the lake.

We also measured temperature at different depths to create a **depth profile**. This data shows how the temperature changed with depth and whether or not a thermocline was present in the lake. The graph below shows the data we collected this year. A thermocline was not present in the water this Spring. In the Summer, we noted a thermocline between 6 and 9 foot depths.



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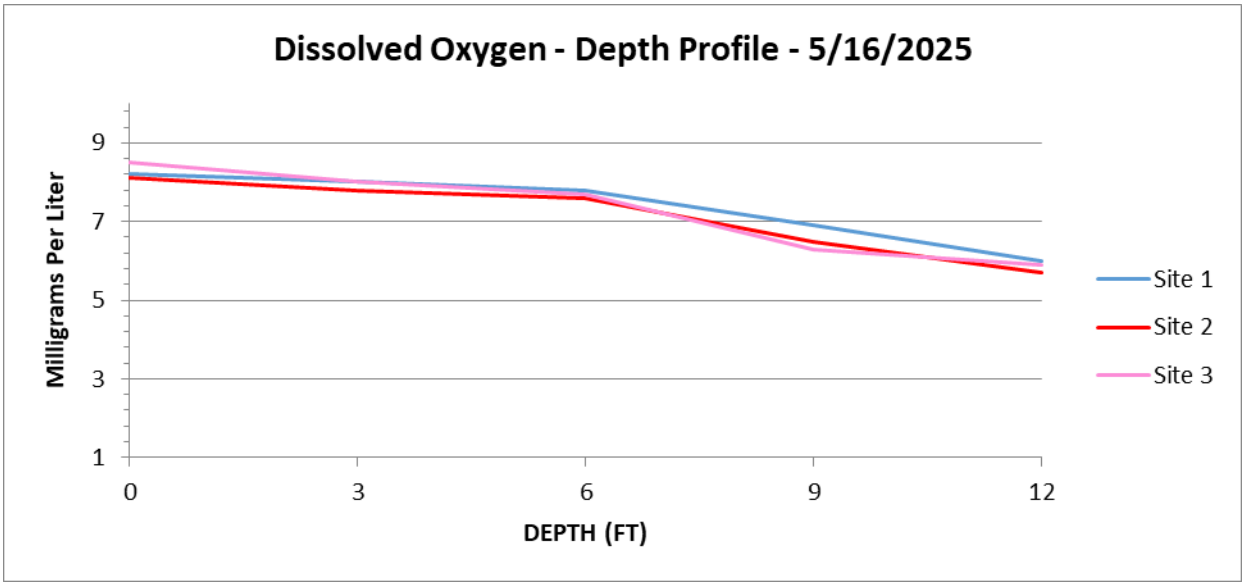
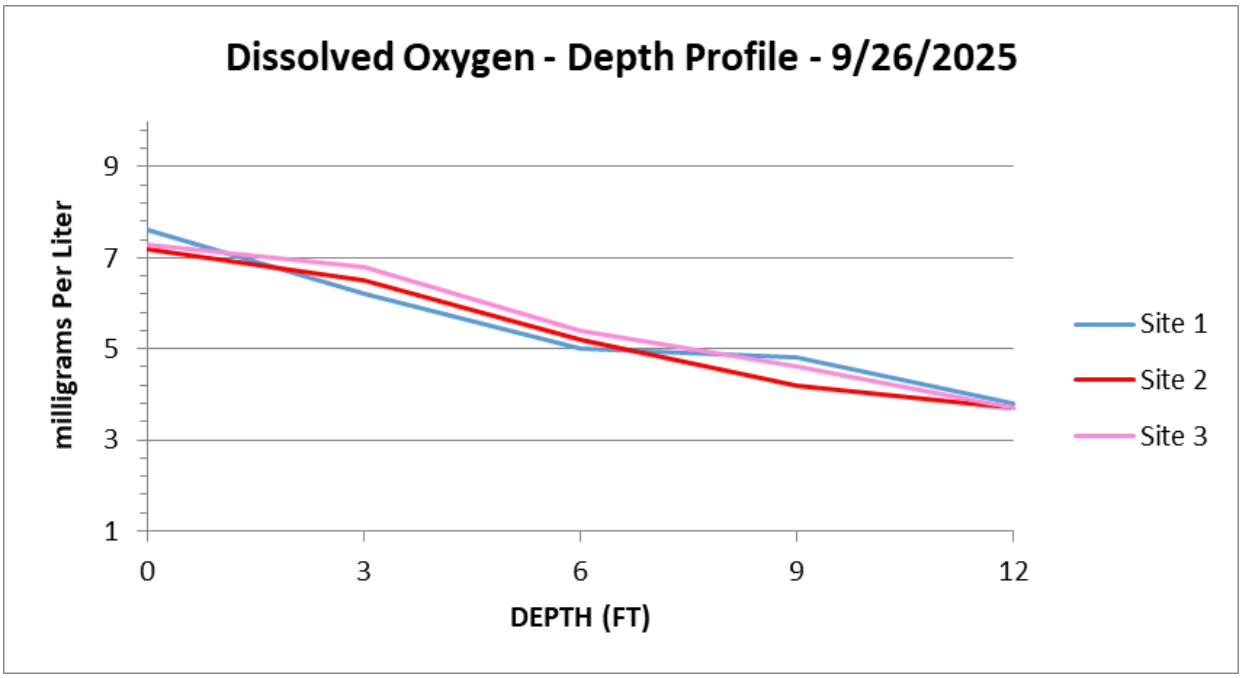
During both tests, the **Dissolved Oxygen** concentrations were at sufficient levels to support a healthy fishery. We also measured dissolved oxygen at different depths to create a **depth profile**. This data shows how the oxygen concentration changed with depth. The graph depicted below illustrates the data we gathered this summer. In both sampling instances, we observed a decline in dissolved oxygen levels from the lake's surface to its bottom. Importantly, the results from both tests indicated that there was an ample supply of oxygen to sustain a thriving fishery across the entire water column.





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During the spring tests, the **Total Phosphorus** concentrations were above the target range. These concentrations stayed relatively steady throughout the summer. Total Phosphorus is lost to dilution, flushing, and plant uptake. Additionally, we conducted tests for o-Phosphate, the form of phosphorus essential for plant growth. It's noteworthy that the levels of Phosphate fell within the designated target range during both testing sessions, with a decrease observed from the initial to the subsequent sampling.

Another major nutrient, **Nitrate,** was above the target range but consistent the past four years. Since 2022, we have measured Nitrates at a lower concentration than the average prior to 2022. The concentrations increased over the summer, most likely due to runoff from precipitation and other non-point source factors. The target range for natural, freshwater lakes is less than 1 ppm (1,000 ppb). The EPA's standard for drinking water is 10 ppm (10,000 ppb). During the spring and summer test, all sites were below the drinking water limit. Swimming restrictions in this case are not needed, and recreational activities are safe to participate in.

Chlorophyll, which is tested to quantify plant production, was within the target range during the April test. By August, the chlorophyll increased, showing the lake supported abundant plant and algae growth. High chlorophyll levels in a body of water can indicate an overabundance of algae and phytoplankton, and while these organisms are essential for the aquatic food web, excessive chlorophyll can lead to environmental issues

Transparency was below the target range at all sites and during both tests. The low clarity was caused mostly by turbidity. With the low transparency, swimmers and boaters should use caution because they may not accurately judge depth or see underwater obstructions.

In order to better understand the relationship between nutrients, plant production, and clarity, limnologists use Trophic State Indices (TSI) to score each category and examine the relationship between them. In general, lower scores indicate a less productive lake. This summer's TSIs for Rainbow Lake were:

Category	Water Quality Parameter	Trophic State Index (season average)	Classifciation
Nutrients	Total Phosphorus	71.4	Hypereutrophic
Plant Production	Chlorophyll	51.9	Mesotrophic
Clarity	Transparency	68.9	Eutrophic

The TSI for total phosphorus classified the lake as hypereutrophic, or highly productive, based on the availability of nutrients to fuel plant growth. The TSI for chlorophyll was lower than the nutrient index, showing that the plants did not grow to the levels predicted by the nutrient concentrations. Finally, the TSI for transparency showed that the clarity was worse than predicted by the plant production. This was most likely due to the turbidity caused by sediment turbation, runoff, stormwater inlets, shoreline degradation, or animal waste.

pH decreased on average from last year but still happily remained within the target range. pH is a broad indicator of lake health that can show changes based on rainfall, dissolved oxygen, groundwater inputs, and pollution. This parameter must stay within the target range.

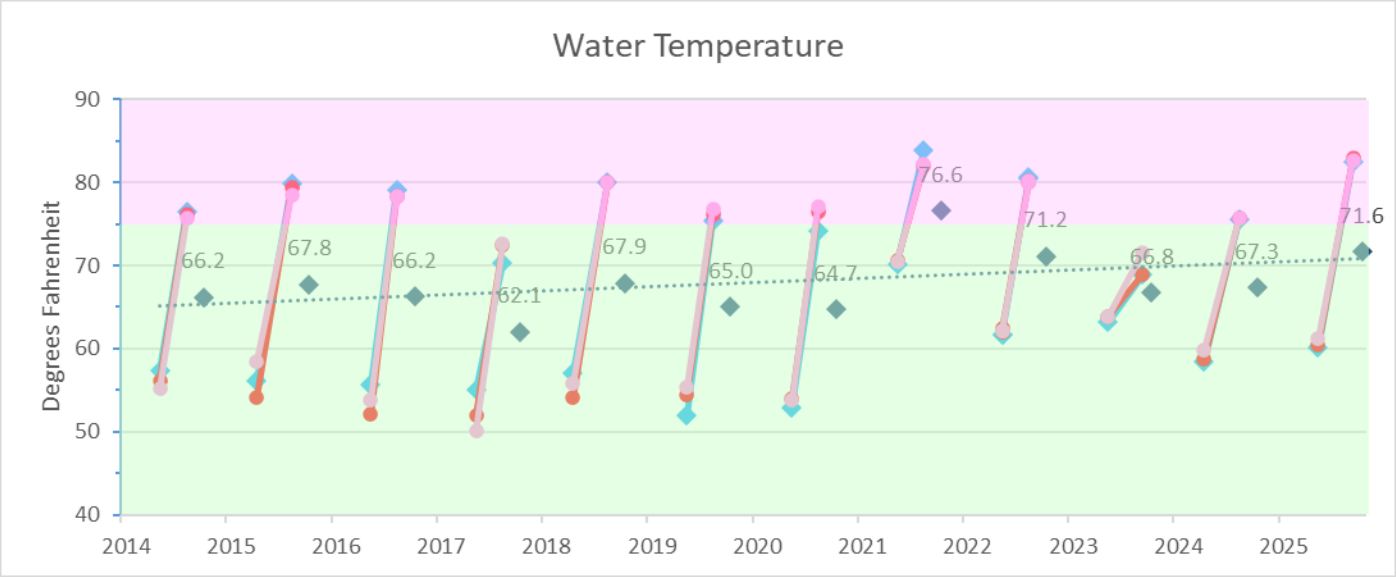
The **Total Dissolved Solids** and **Conductivity** both slightly decreased from last year, showing the lake flushed more substances than it retained. The results were still within the target ranges.

The **Alkalinity** was at very healthy concentrations during both tests. Calcium carbonate is the main constituent of these parameters. Calcium carbonate enters the lake with groundwater that coursed along limestone deposits. The carbonate ions buffer against shifts in the pH caused by other substances, so having sufficient alkalinity was beneficial to the lake.

The **Salinity** was at normal levels in the water and showed a slight decrease from last year. These results were consistent with the decreases of TDS and Conductivity.

Long-Term Trends

LakePro began testing the water quality of Rainbow Lake in 2014. 2025 was the Eleventh year of testing, which allowed us to compare annual averages. Each successive year of water quality data will provide more insight into how the lake changed on a long-term scale.



Target Range: Less than 75°F

The lake temperature has not changed significantly over the testing history. The lake temperature was affected by the dates selected for testing and the particular weather of each year.

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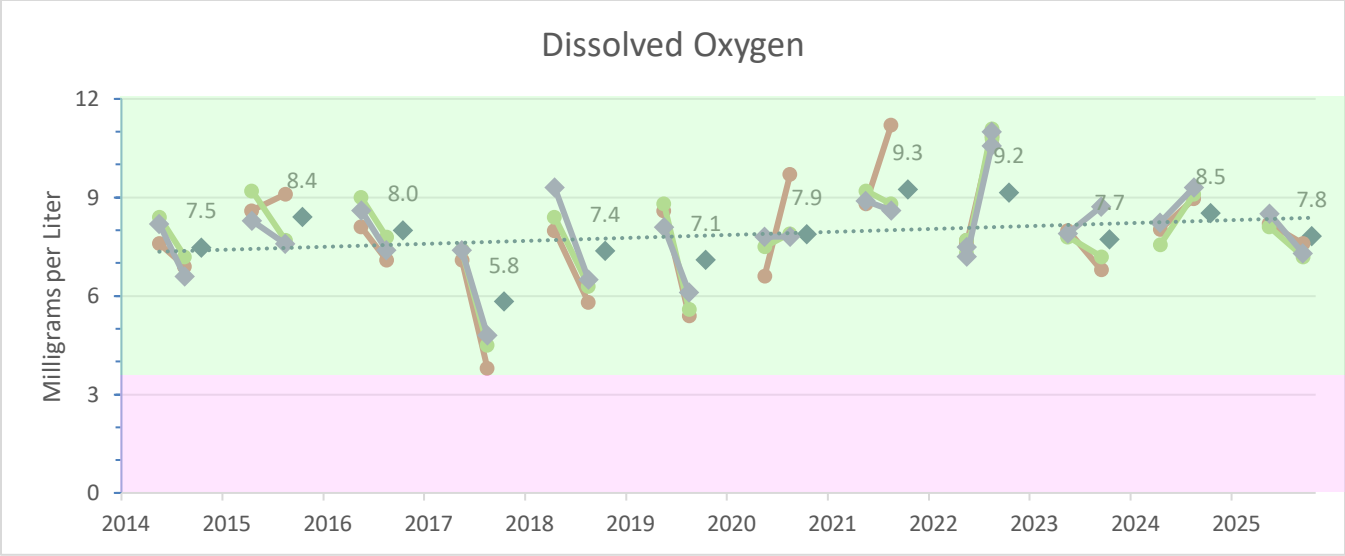
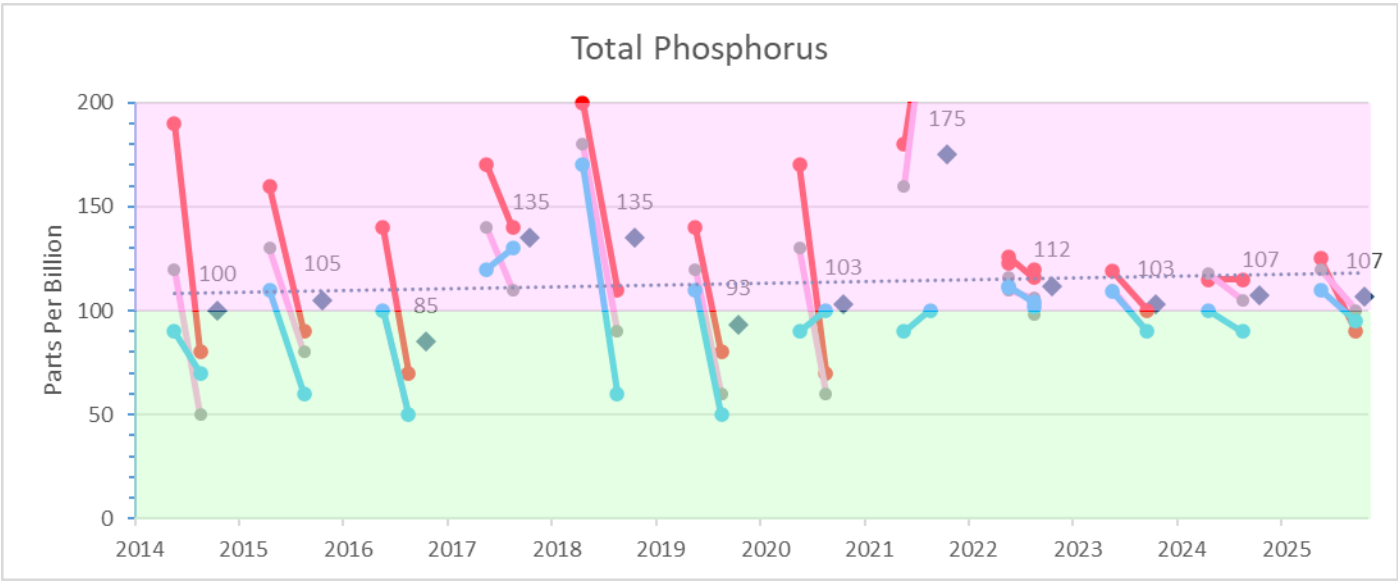


Target Range: 4.0 – 12.0 mg/L

The dissolved oxygen increased slightly over the testing history, but remains within the target range. This could be due to eutrophication of the lake.



Target Range: 0 – 100 ppb

The total phosphorus concentration showed a slight upward trend over the testing history. Additional phosphorus can enter the lake with runoff, from Pine Creek, or by leaching from the bottom sediment during periods of low oxygen. This year and last year have showed a slight incline.

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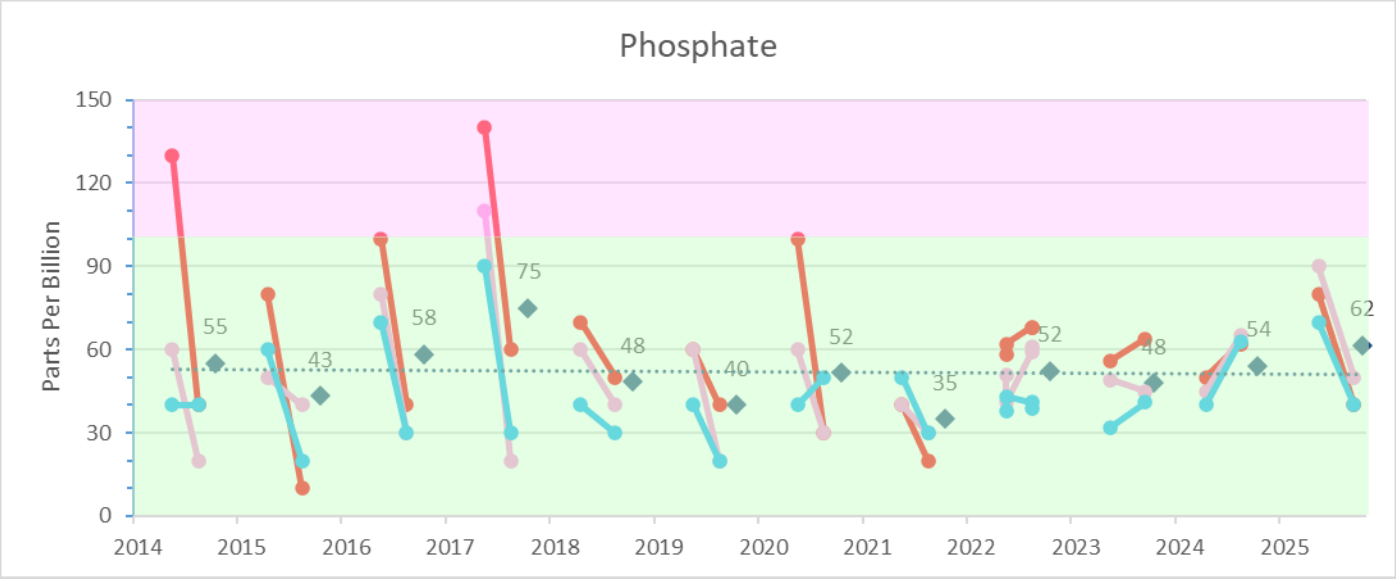
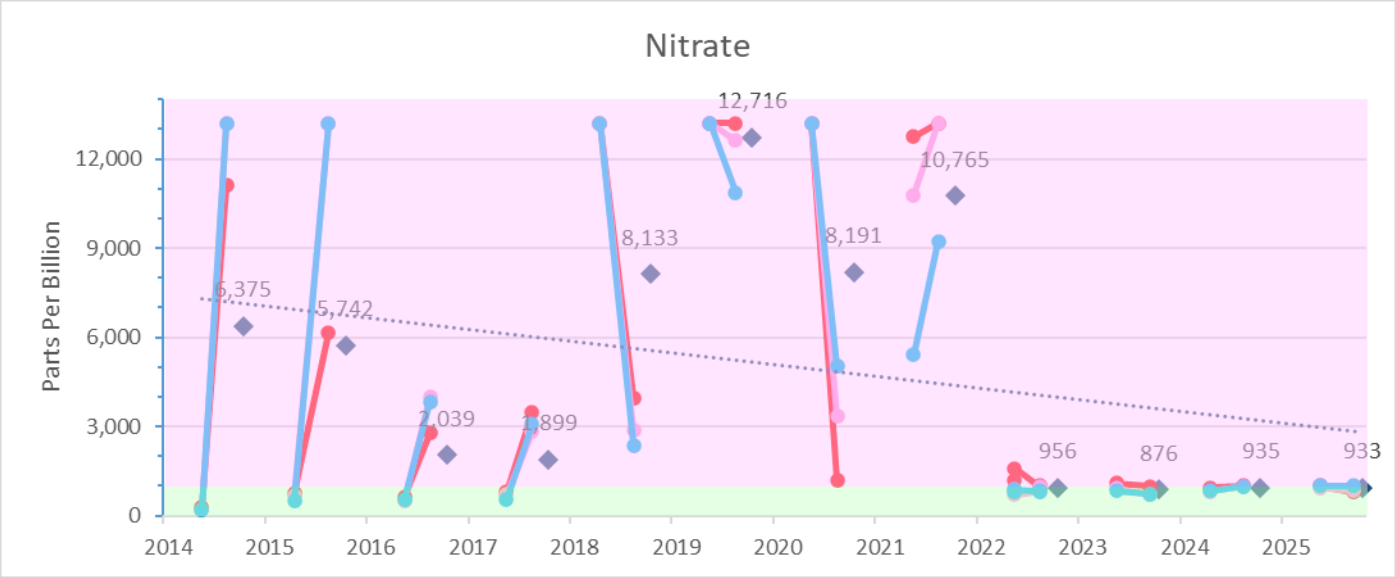


Target Range: 0 – 100 ppb

Although there was an increase in total phosphorus, the trend for o-phosphate exhibited a slight decline throughout our testing history. This could be attributed to increased plant uptake of o-phosphate or a shift towards other forms of phosphorus in the ecosystem. The overall trend seems to be leveling off, and our averages increase validity with each year of testing.



Target Range: 0 – 1,000 ppb

Nitrate showed an upward trend over the testing history. The excess nitrates in the past have posed a public health risk however, the last four years have showed a healthy decrease. The excess nitrate could also lead to nuisance algae and plant growth, kept in check by the phosphate concentration and low water clarity.

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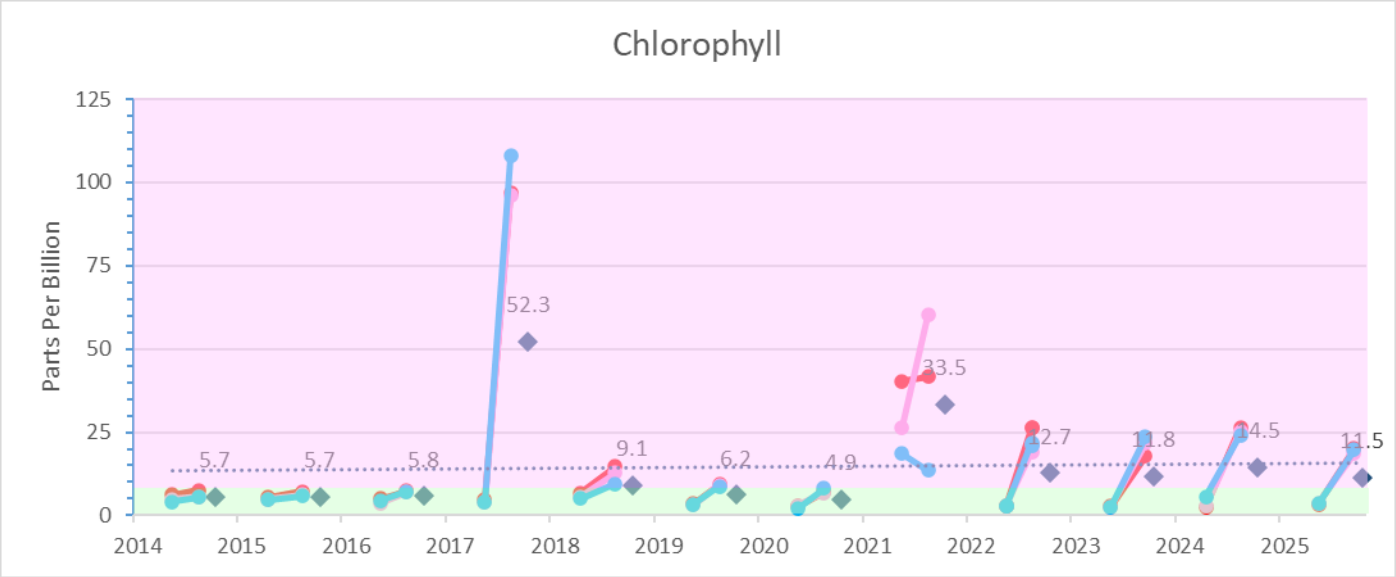
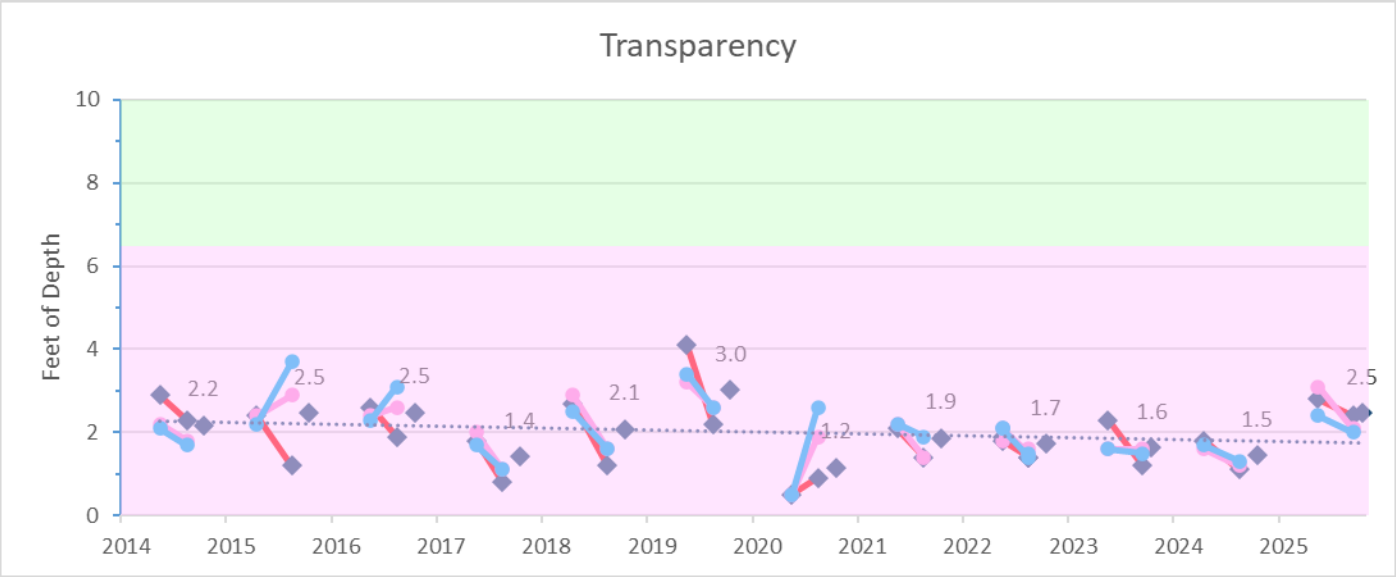


Target Range: 0 – 7.3 ppb

Despite the lake-wide algal bloom observed in 2017, chlorophyll-a concentrations have remained relatively stable over the monitoring period. Persistently low water clarity likely limits light penetration within the water column, which in turn constrains excessive algal and submerged plant growth. While chlorophyll levels indicate ongoing algal presence, the lack of increased concentrations over time suggests that algal productivity has remained relatively consistent rather than progressively worsening.



Target Range: More than 6.5 feet

The Transparency showed a slight downward trend, a continuing trend since 2020. The transparency of Rainbow Lake is primarily affected by the turbidity of the water. In 2025, we noted the highest reading in the past few years.

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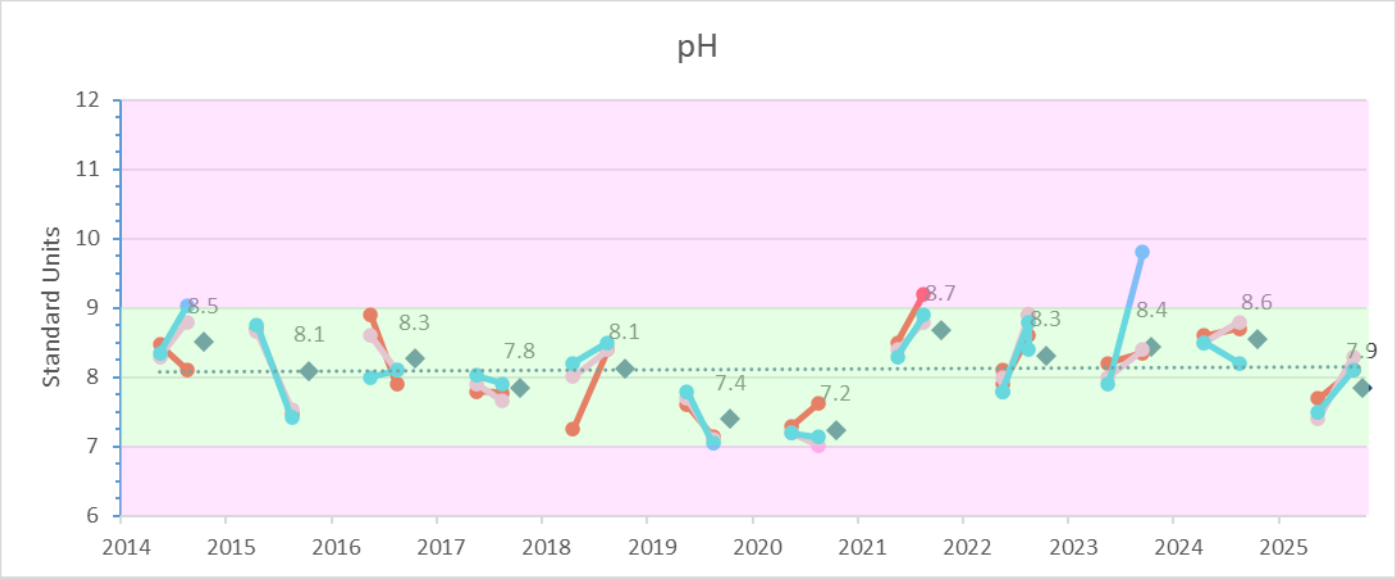
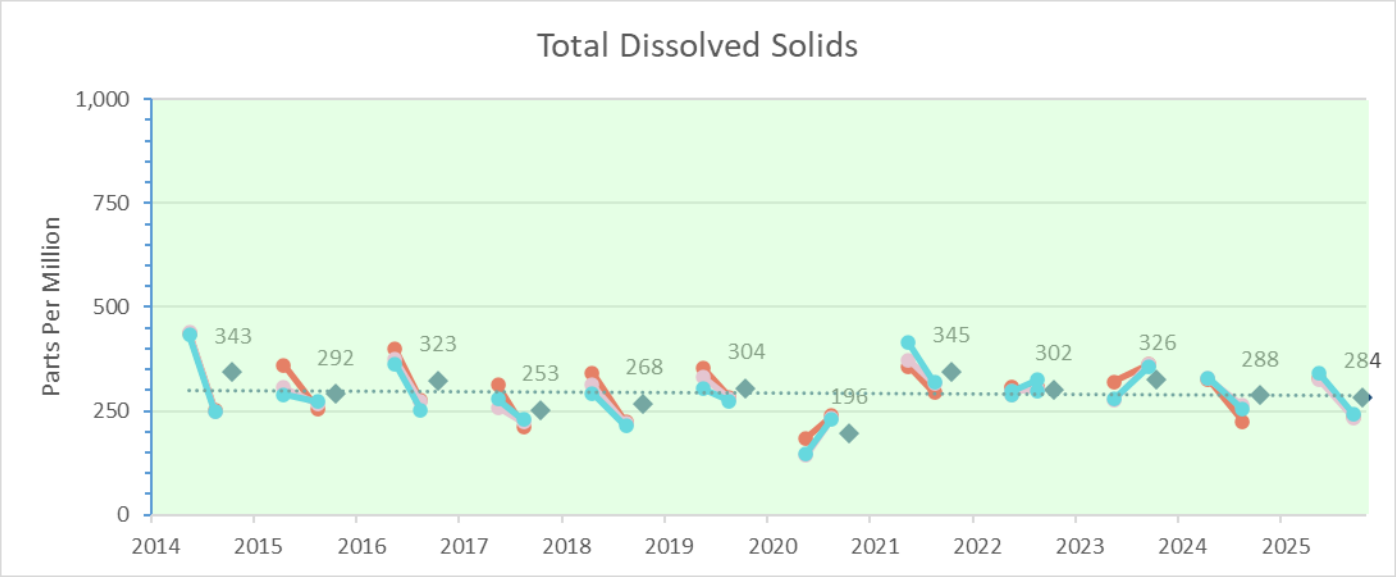


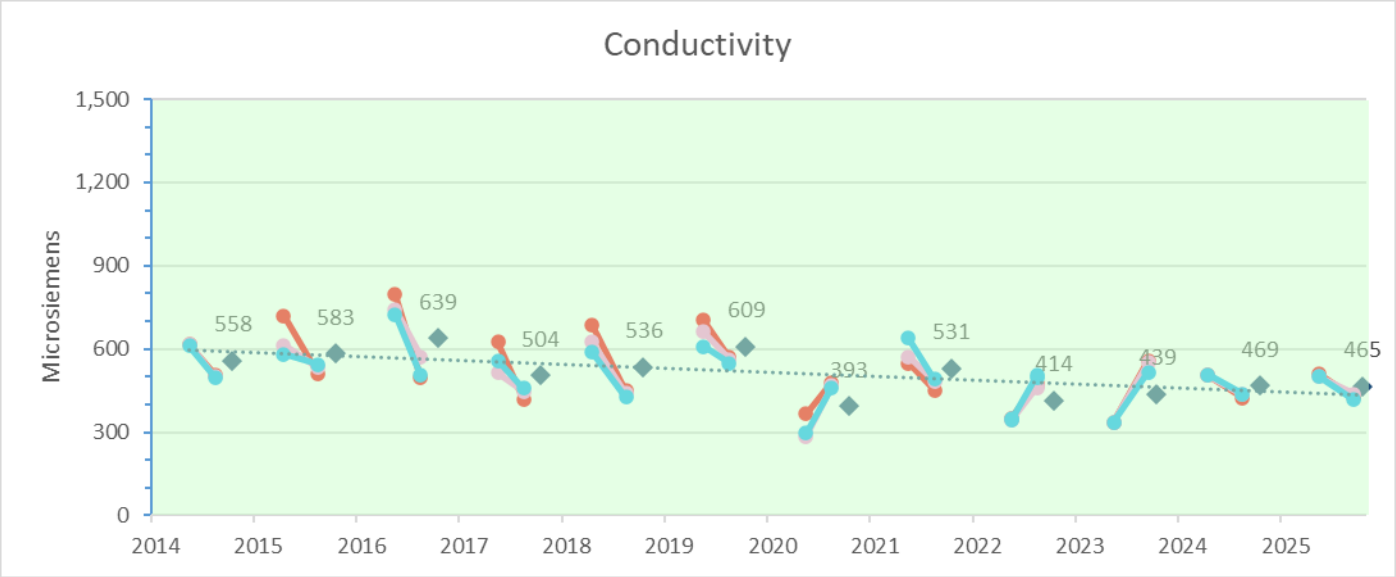
Target Range: 7.0 – 9.0

A modest downward trend in pH was observed over the monitoring period, though all results remained within acceptable target ranges. Seasonal and interannual pH variability is influenced by precipitation, groundwater contributions, and biological activity, with this year's average slightly lower than the previous year.



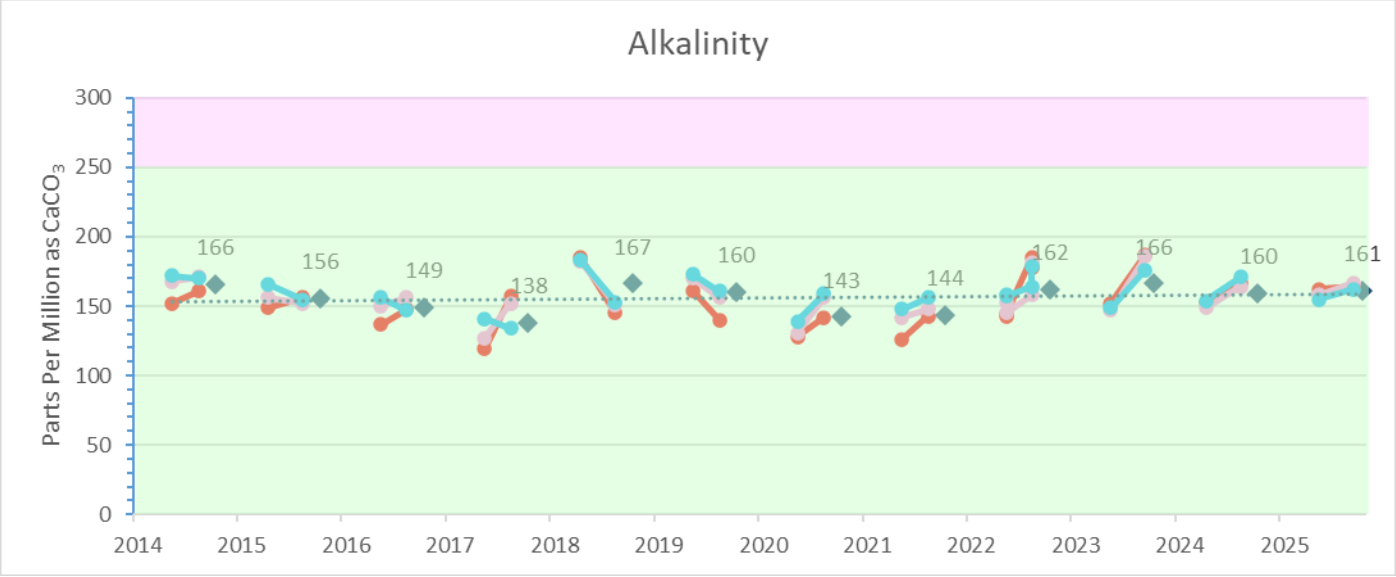
Target Range: 0 – 1,000 ppm

The TDS decreased slightly over the testing history, showing the lake lost substances at a slow rate. This is a positive for the lake that we look to continue in future years.



Target Range: 0 – 1,500 µS

Conductivity is closely related to total dissolved solids (TDS) and reflects the concentration of ionic compounds in the water that enable electrical conductivity. Conductivity has shown a slight decrease over the monitoring period, consistent with the TDS results observed this year. These parameters are interrelated and typically change in tandem.



Target Range: 0 – 250 ppm

Alkalinity has not changed significantly over the monitoring history and functions as a critical buffering mechanism, reducing pH variability in response to external inputs such as acidic precipitation and seasonal pH declines.

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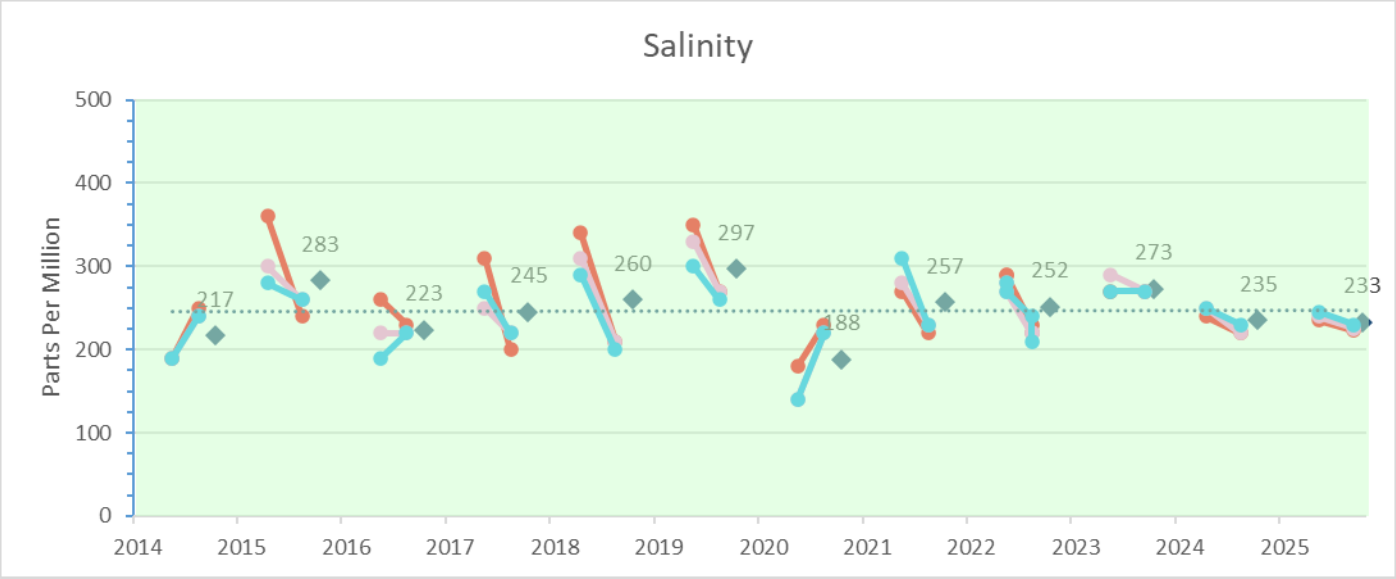

Target Range: 0 – 500 ppm
Salinity levels fluctuated throughout the monitoring period but have not shown a significant long-term change, consistent with observed alkalinity trends, despite a slight decrease in total dissolved solids (TDS).

Little Rainbow Values

Parameter	May 16th, 2025	Sept. 26th, 2025	Target Range
Temperature	60.8 ˚F	82.7 ˚F	Less than 75 ˚F
Dissolved Oxygen	8.3 mg/L	7.4 mg/L	4.0 – 12.0 mg/L
Total Phosphorus	118 ppb	95 ppb	0 – 100 ppb
Phosphate	80 ppb	43 ppb	0 – 100 ppb
Nitrate	990 ppb	877 ppb	0 – 1,000 ppb
pH	7.5	8.2	7.0 – 9.0 S.U.
Total Dissolved Solids	332 ppm	236 ppm	0 – 1,000 ppm
Conductivity	503 µS	427 µS	0 – 1,500 µS
Transparency	2.8 feet	2.2 feet	6.5 feet or above
Chlorophyll-a	3.5 ppb	19.5 ppb	0-7.3 ppb
Phycocyanin	1.5 RFU	0.9 RFU	0.0 – 5.0 RFU
Alkalinity	158 ppm	164 ppm	0 – 250 ppm
Total Salinity	240 ppm	226 ppm	0 – 500 ppm

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Conclusion

Rainbow Lake continues to experience two primary water quality challenges: elevated total phosphorus levels, along with high late-summer chlorophyll-a concentrations and persistently low water transparency. Reduced clarity is largely influenced by the lake's morphology and watershed characteristics. Given these factors, significant long-term improvements in transparency are unlikely, as suspended sediment and elevated algal biomass—particularly in late summer—remain dominant contributors.

Elevated nutrient concentrations continue to support late-season algal blooms, which periodically give the lake a green appearance due to planktonic algae. Although concentrations were lower than those observed last year, nitrate levels remain an important parameter to monitor. As such, the management recommendations provided in last year's report remain applicable and are included again below to support continued nutrient reduction efforts.

Over the past four years, nitrate concentrations have shown signs of stabilization and now remain within a safer range, posing reduced risk to recreational users, pets, and children. To maintain this positive trend, continued seasonal water quality monitoring is recommended. Ongoing data collection, combined with the expanding multi-year dataset for Rainbow Lake, will support more proactive and predictive lake management decisions moving forward.

Overall, the remaining water quality parameters measured this year were favorable and consistent with expectations for a lake of this type. While the size and influence of the watershed present ongoing challenges, sustained efforts to reduce external nutrient inputs will help improve overall water quality and better align it with the lake's otherwise positive characteristics.

Completed and Certified by: _____ Date: October 27th, 2025

Michael Smith
Operations Manager