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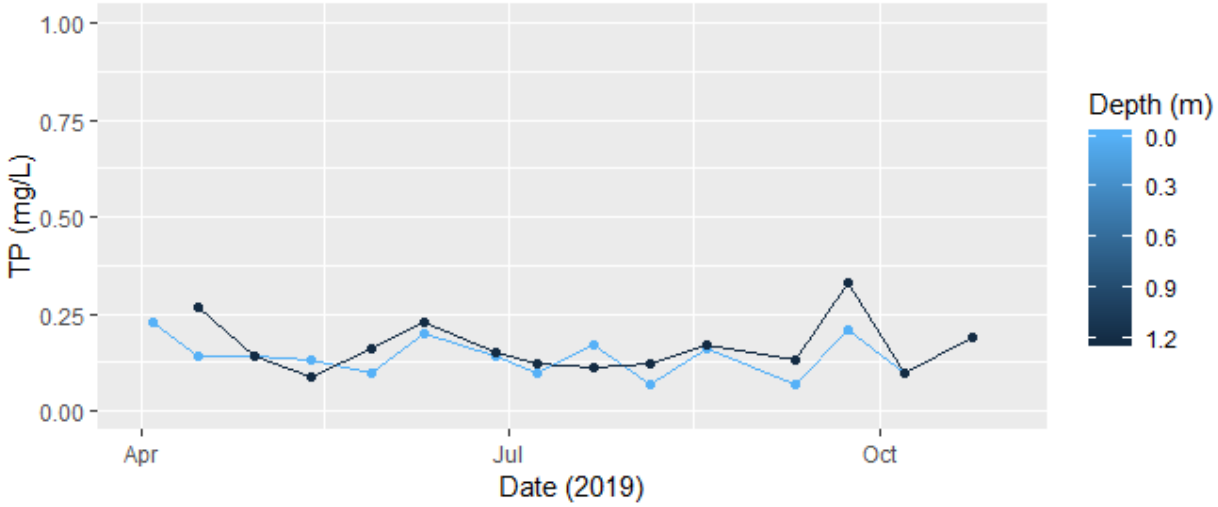
Attn: Noah Czech, City of St. Cloud
From: Stormwater Research Group, St. Anthony Falls Laboratory (SAFL), University of Minnesota
Re: Summary of Collected Data from Pond 52 in St. Cloud, Minnesota during 2020
Date: December 28th, 2020

The following is a summary and brief analysis of the collected data from Pond 52 in St. Cloud, Minnesota that the Stormwater Research Group (PI: John Gulliver) has examined. This summary primarily discusses comparisons between data from the 2020 and 2019 field seasons. Descriptions of the data available preceding the 2019 field season were included in the summary memo dated January 6th, 2020.



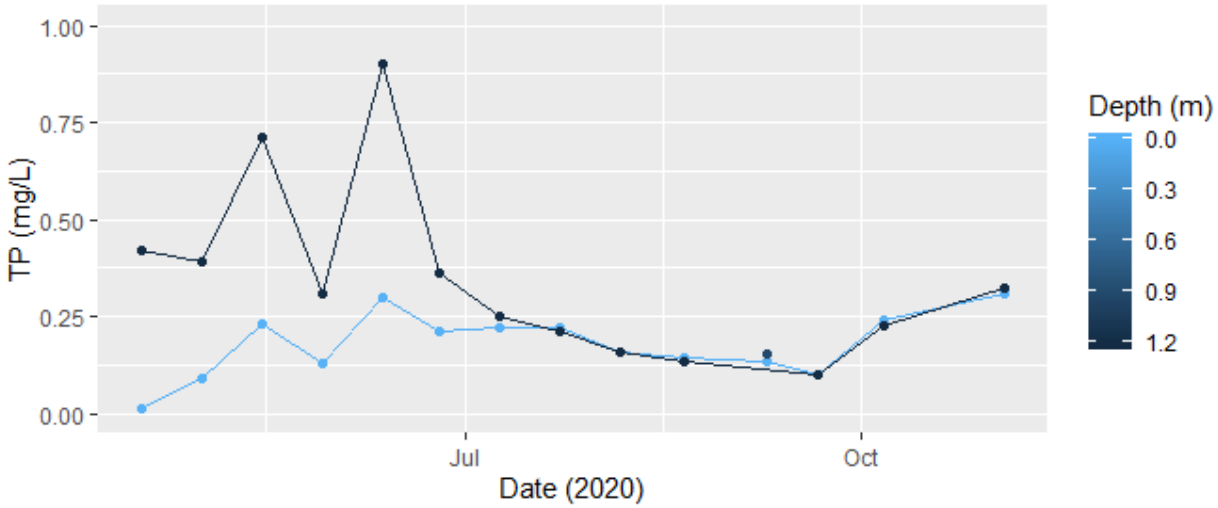


Figure 1. Concentrations of total phosphorus (TP) in the 2020 monitoring season were similar to those from the 2019 monitoring season. Occasional high hypolimnion (bottom of the water column) TP concentrations could be due to sediment accidentally captured along with the water samples or due to sediment phosphorus release.

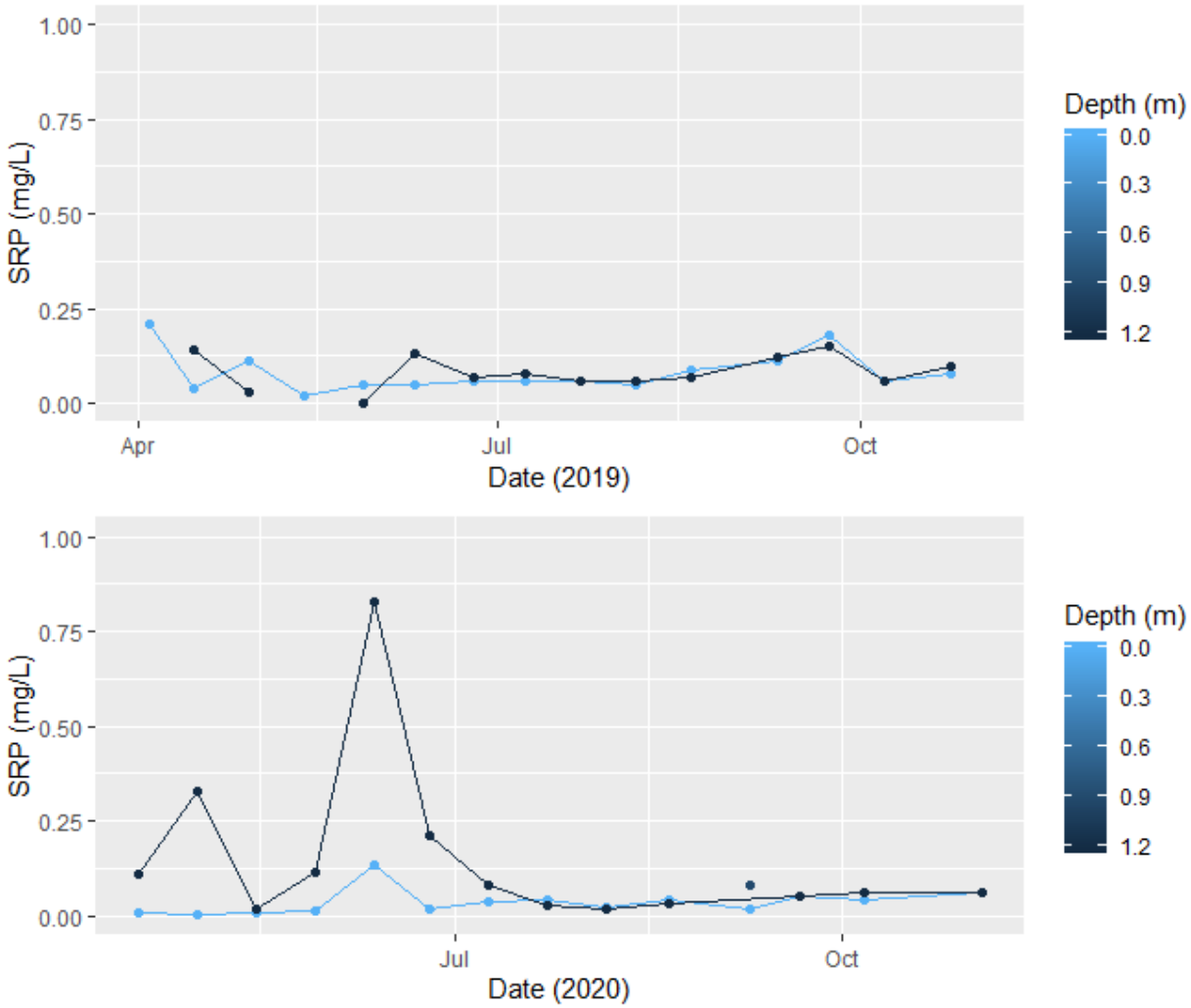


Figure 2. Concentrations of soluble reactive phosphorus (SRP) in the 2020 monitoring season were similar to those from the 2019 monitoring season. A notable exception was during the warmest summer months when SRP concentrations were briefly elevated.

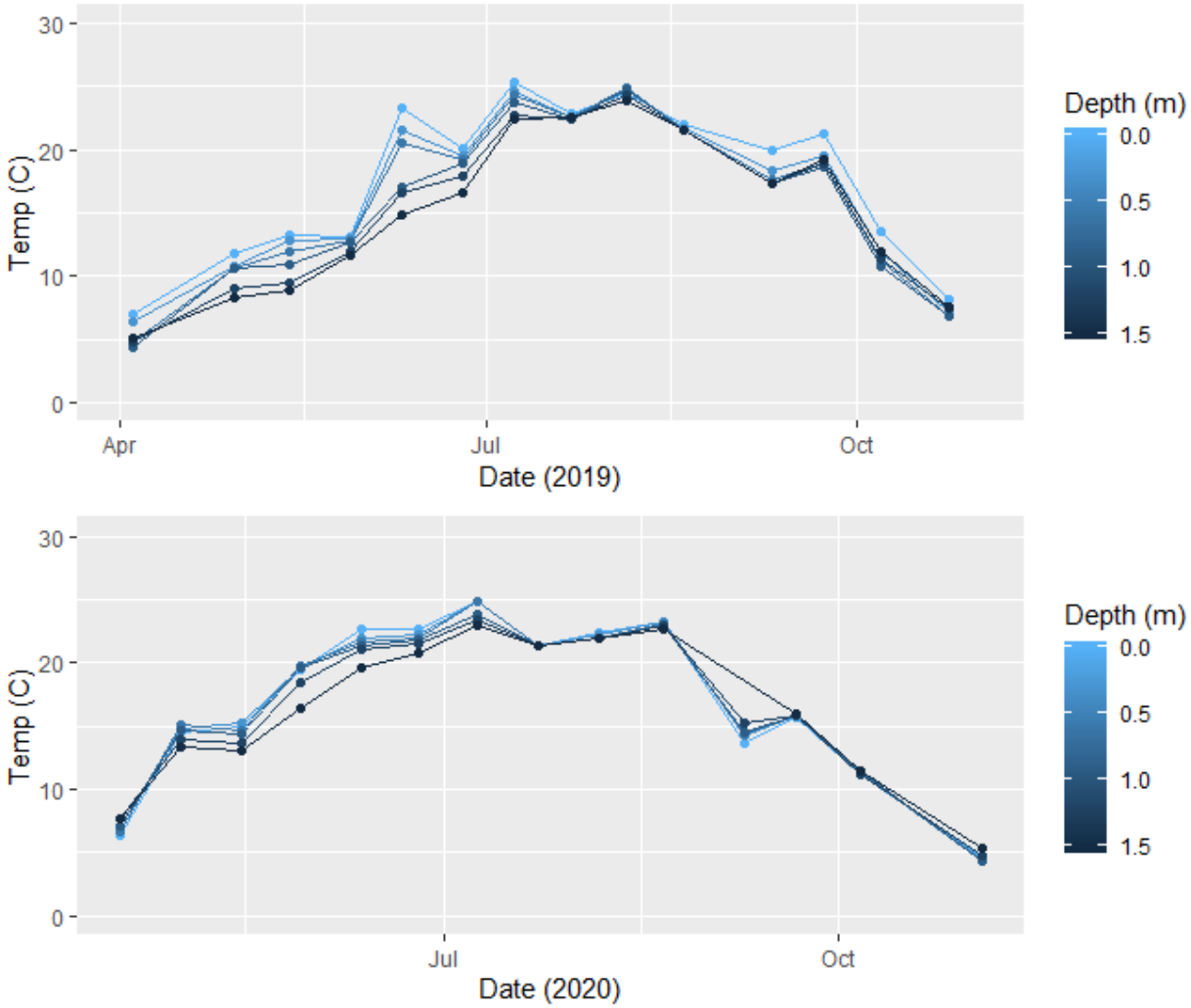


Figure 3. Temperature differences across water depths were minor in both years, but thermal stratification appears to have been slightly weaker during 2020.

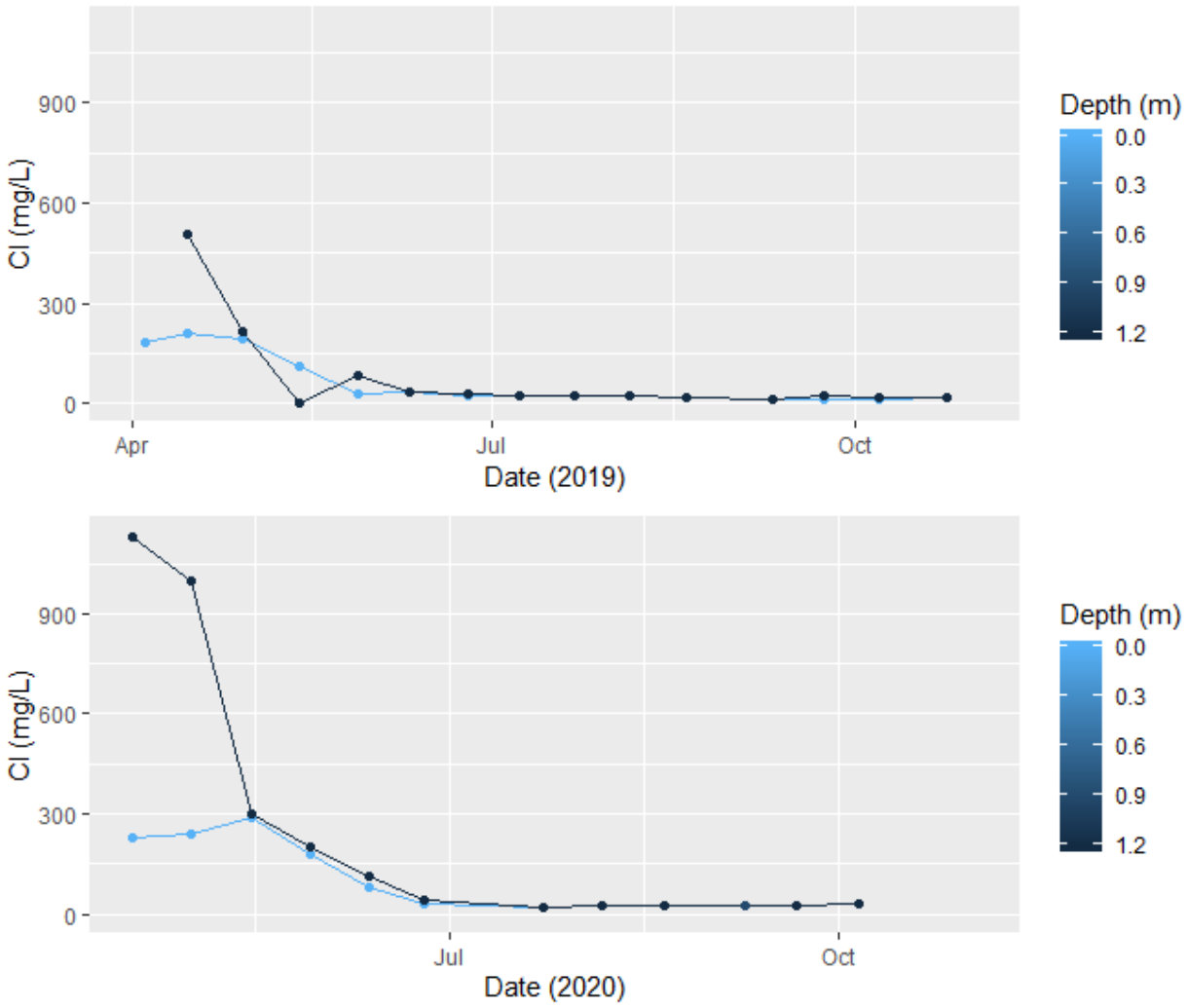


Figure 4. Chloride concentrations appear to have accumulated following snowmelt in the spring and lingered into the summer.

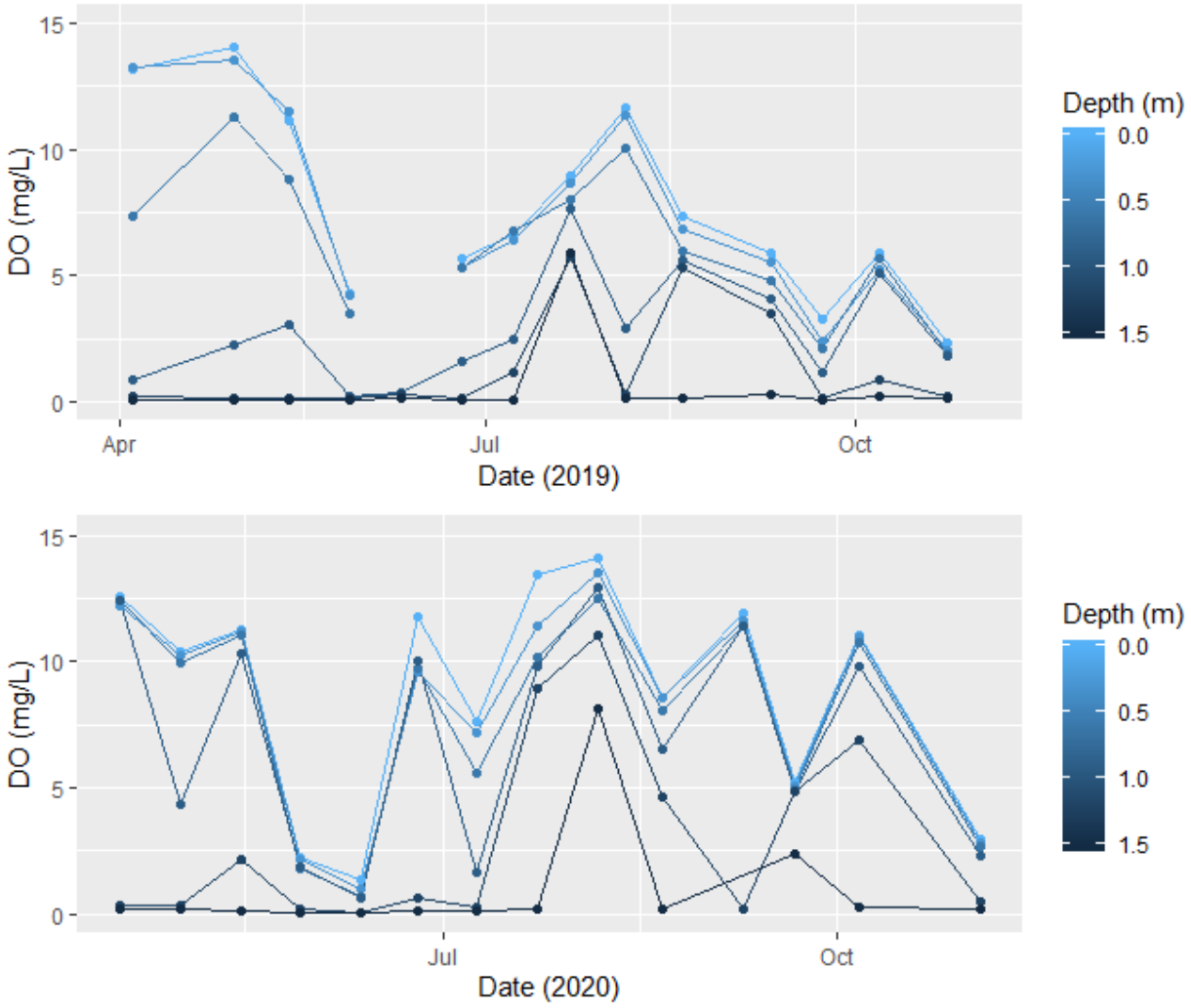


Figure 5. Dissolved oxygen (DO) concentrations at the bottom of the pond were frequently low. The remainder of the water column typically had high DO concentrations with a few exceptions. Low DO in the upper water column during the spring may have been influenced by lower than average rainfall during this time in the year (see Figure 6).

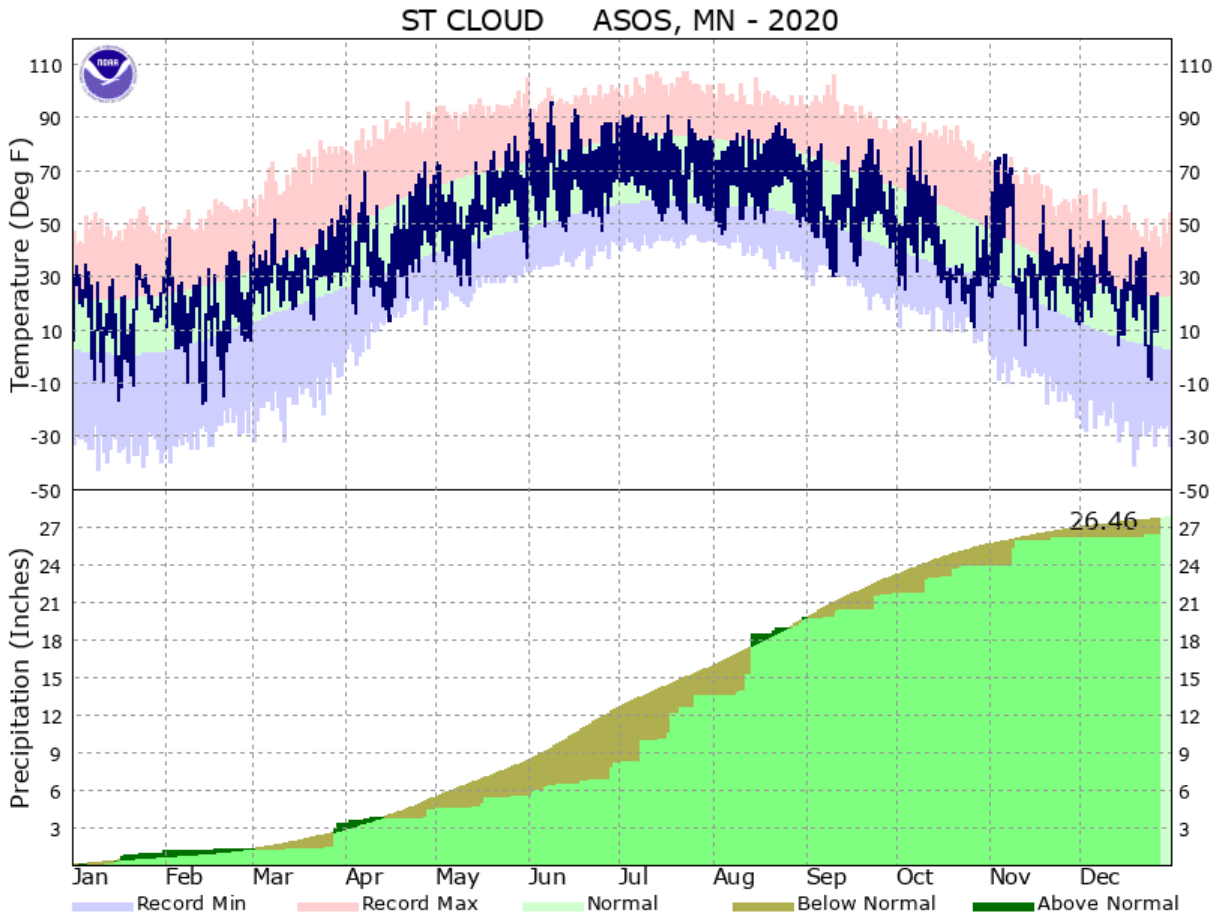


Figure 6. Temperature and precipitation observations for St. Cloud, MN in 2020. Source: NOAA, retrieved from https://www.weather.gov/images/mpx/Climate/STC/KSTC2020plot.png.

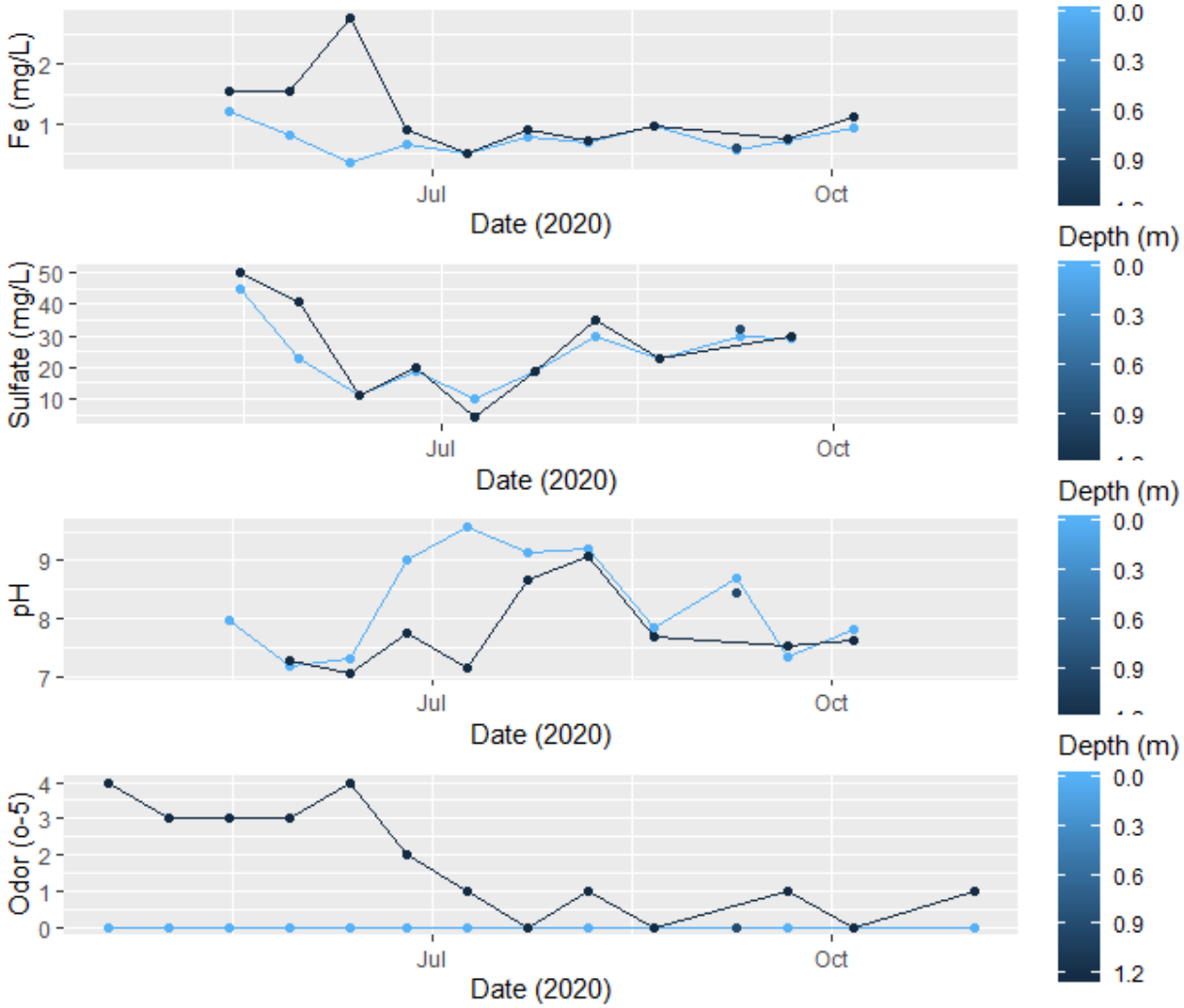


Figure 7. The additional water quality parameters of iron (Fe), sulfate, and pH were monitored in the 2020 field season. Observations of foul odors were also noted. Elevated Fe and SRP concentrations during the period of hypolimnetic anoxia in the first part of the year could have resulted from iron mineral dissolution that caused phosphorus and ferrous iron to release. Observations of foul odors are often used to identify the presence of hydrogen sulfide (H2S). Here, odor intensity appears to correlate strongly with the high Fe and low sulfate concentrations. Depressed sulfate levels under anoxia suggest sulfide production in the pond. Changes in pH can occur due to chemical mechanisms and biological activity including pH increase due to photosynthesis during the growing season.

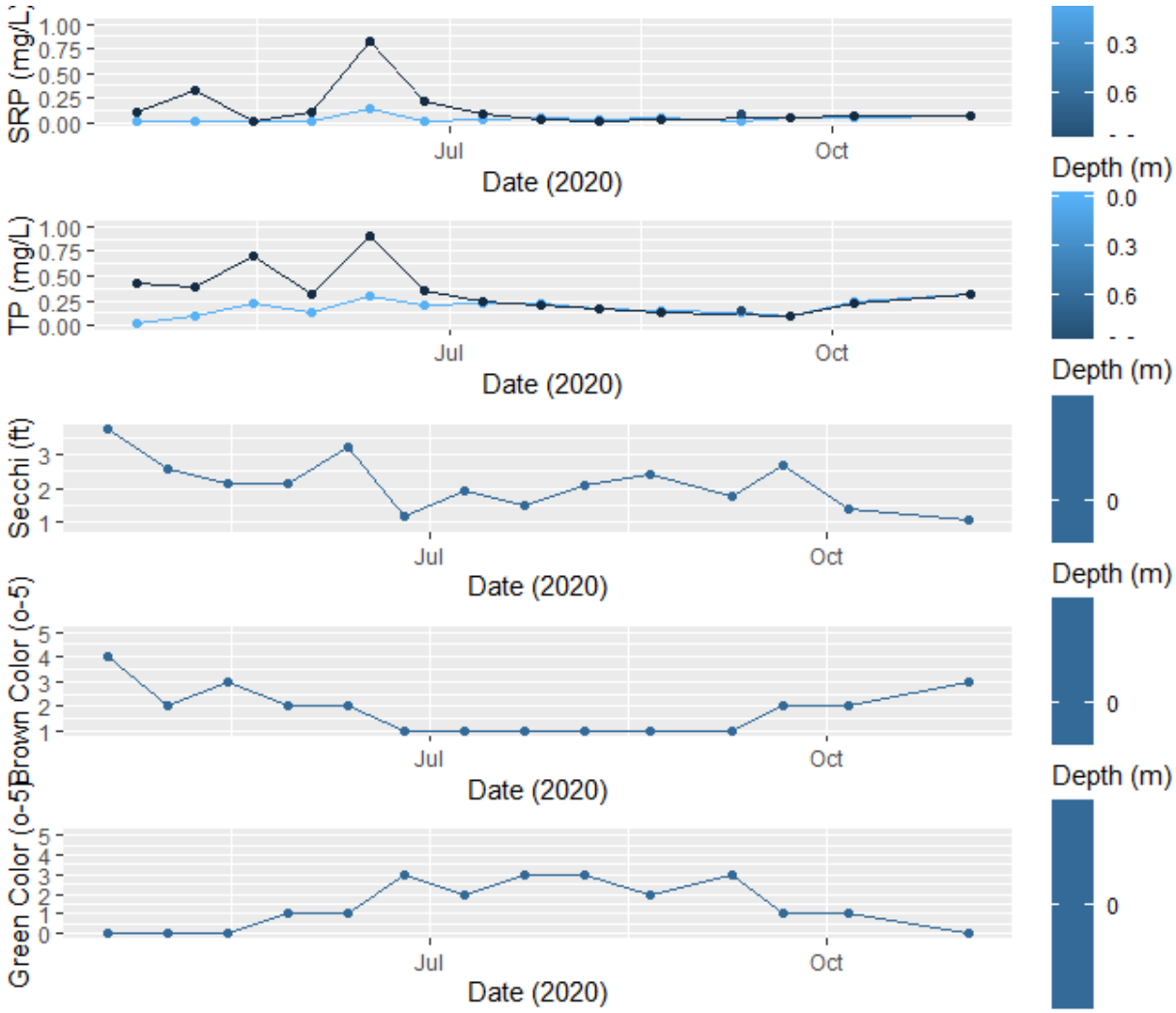


Figure 8. Additional observations related to water color and clarity were recorded. The color of the pond water appears to have shifted from primarily brown in the spring to green in the summer and back to brown in the fall. When compared with Secchi depth measurements, it appears that water clarity was greatest at the beginning of the year and decreased thereafter. Water clarity dropped markedly around the time of the SRP and TP concentration spikes, which could be evidence of increased turbidity in the pond. High turbidity could indicate high sediment and phosphorus concentrations entering the pond, but it could also be evidence of biological growth (phytoplankton or cyanobacteria) that dramatically increased in response to the higher phosphorus. The biological growth theory could be supported by the shift in water color from brown to green during this same period.

Recommendations

The TP and SRP concentrations were in the moderate range in the 2020 season. Briefly elevated TP and SRP concentrations in 2020 corresponded to elevated Fe concentrations and low DO concentrations. Fe concentrations were not monitored in 2019, but no elevated SRP concentrations

were measured during the period of anoxia. It is possible that a second application of iron filings may become necessary if the pond phosphorus concentrations continue to increase in the next season to treat the existing and additional phosphorus load that has accumulated in the pond. Collecting and analyzing the pond sediments prior to and following a second iron filings application would enable chemical changes in the sediment phosphorus pool to be investigated. With respect to pond sampling, additional water quality analysis of chlorophyll-a and total suspended solids could enhance our understanding of what processes are occurring within the pond.