Assessment of Lake Glenville Water Quality
June 2020
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Summary
The North Carolina Department of Environmental Quality's Division of Water Resources (DWR) conducts lake and reservoir assessments every 5 years. The Little Tennessee River Basin, which includes Lake Glenville, was assessed in Summer 2019 and a summary of the data are presented in this report. Temporal trends were also examined by comparing data from the 2014 and 2019 reports. Overall water quality, as evidenced by data collected by DWR in 2019, continues to be supportive of the state's Class C water quality standards for recreational fishing, swimming, and boating. Lake Glenville continues to exhibit very low biological productivity due to its low nutrient concentrations.

Methods
Lake monitoring and sample collection activities were performed by DWR field staff in accordance with the Intensive Survey Unit Standard Operating Procedures Manual. Lake Glenville was sampled with other lakes and reservoirs in the Little Tennessee River Basin during the growing season from May through September, 2019. Data were assessed in relation to the state's Class C water quality standards for chlorophyll-a, dissolved oxygen, water temperature, and turbidity. Secchi depth and percent dissolved oxygen saturation were also measured to calculate the trophic or nutrient-enriched status of the lake.

Results
Dissolved Oxygen and Dissolved Oxygen Saturation: Dissolved oxygen (DO) concentrations continue to suggest that Lake Glenville has the capacity to effectively assimilate organic matter and nutrients to support aquatic life. DO concentrations at all sampling stations and dates measured well above the State of North Carolina's aquatic life standard of 6 mg/L for Trout Waters (Figure 1). The sufficient DO concentrations observed in the lake suggest that nutrient concentrations are not negatively impacting nutrient cycling or ecosystem function. Additionally, the average DO concentration increased between 2014 and 2019 (Figure 2).

Figure 1. Average dissolved oxygen concentrations, 2019

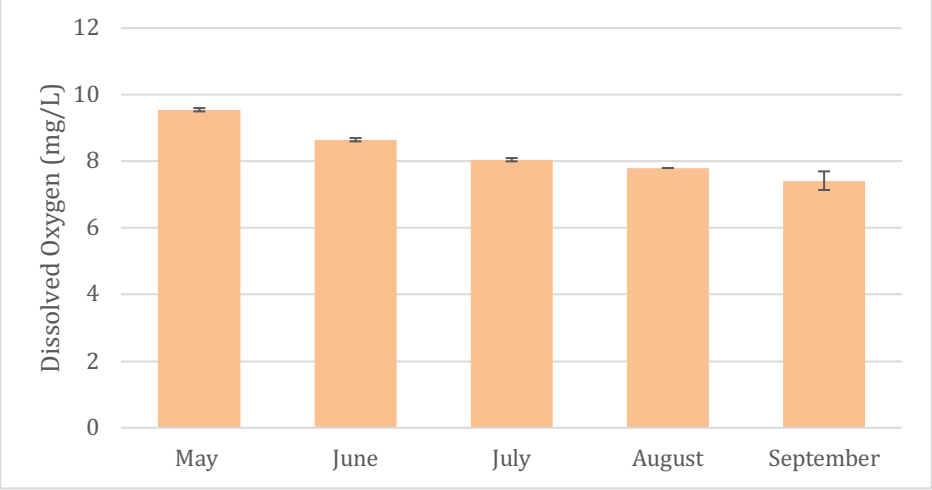
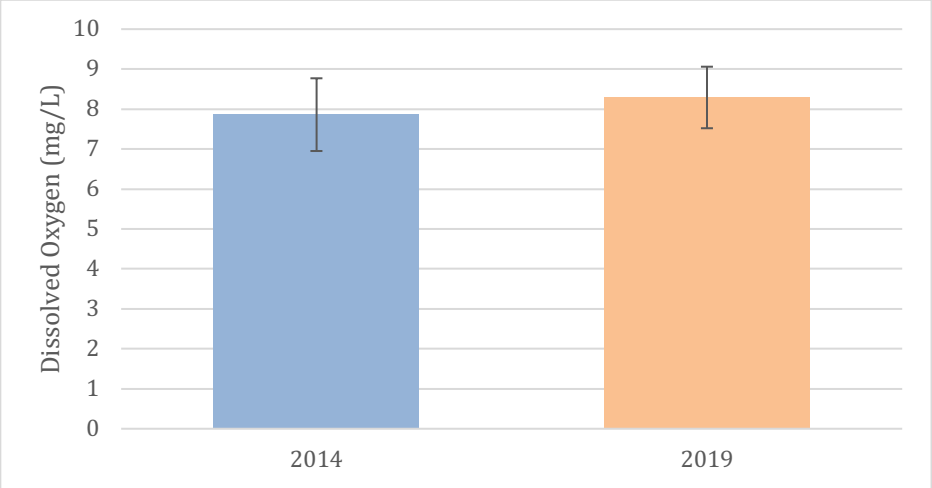


Figure 2. Average dissolved oxygen concentrations, 2014 and 2019



Dissolved oxygen saturation (% SAT) describes the capacity of water to absorb oxygen gas. % SAT is inversely proportional to temperature; as temperature increases, the water's capacity for oxygen will decrease. Observed % SAT measurements by month follow a similar pattern as that of dissolved oxygen concentrations (Figure 3) and % SAT were higher in 2019 than in 2014 (Figure 4) indicating the ability of the lake to support nutrient cycling and ecosystem function.

Figure 3. Average % SAT, 2019

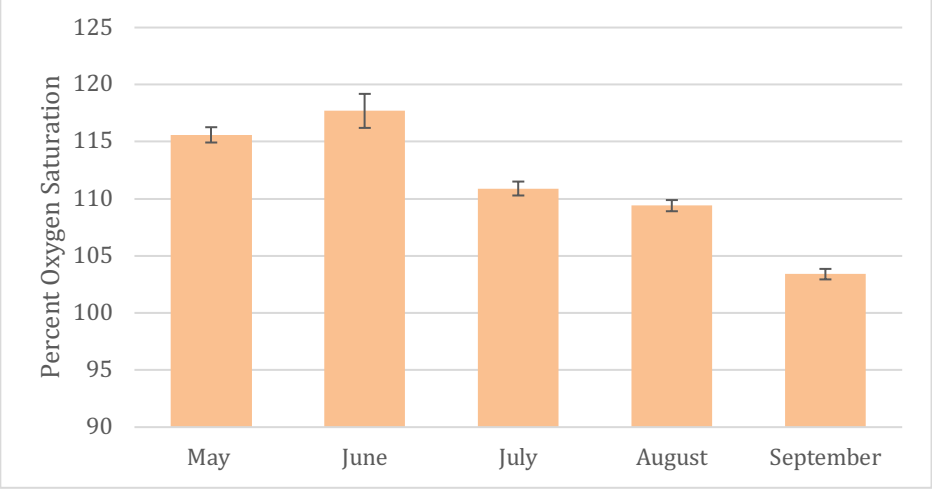
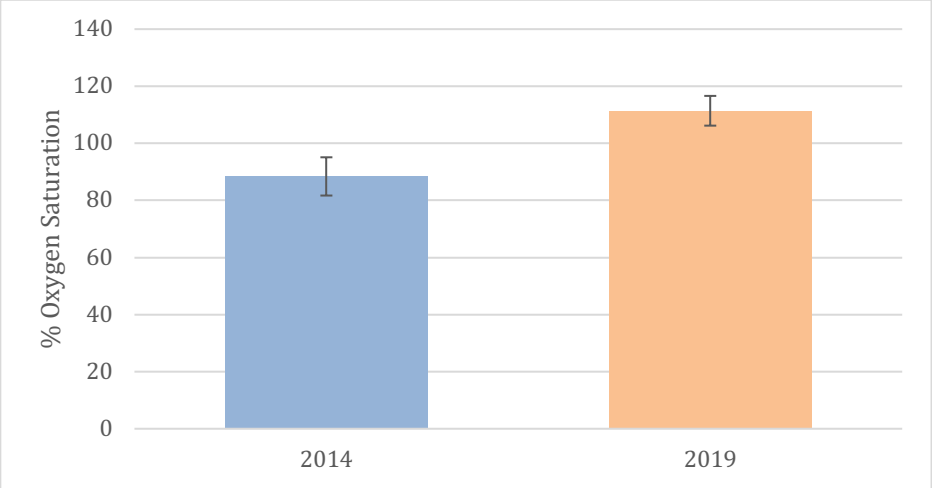


Figure 4. Average % SAT, 2014 and 2019



Water Temperature: Average water temperatures increased across the summer months in 2019 (Figure 5) which is expected given weather conditions. Weather conditions were elevated in July and August, and September was unusually warm. Increased water temperatures can contribute to decreased dissolved oxygen concentrations but it does not appear that warmer water temperatures in 2019 compared to 2014 (Figure 6) negatively affected DO concentrations, as DO concentrations increased from 2014 to 2019.

Figure 5. Average water temperatures, 2019

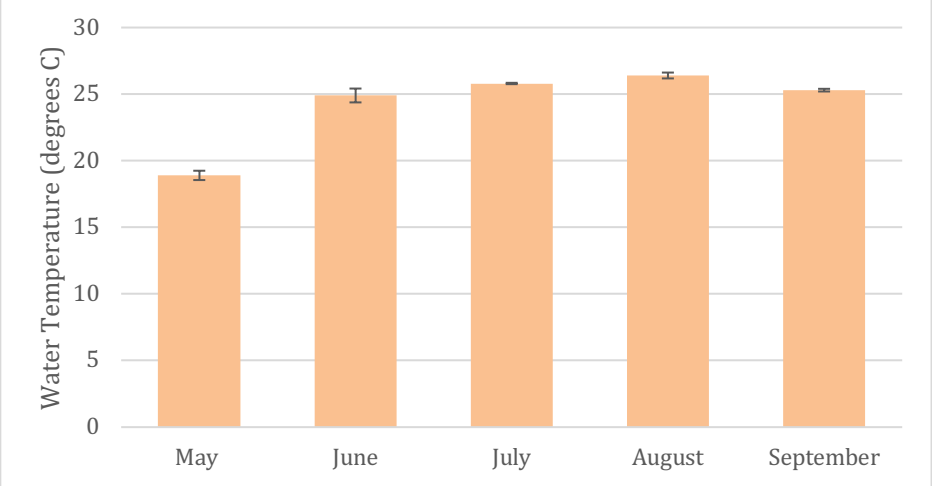
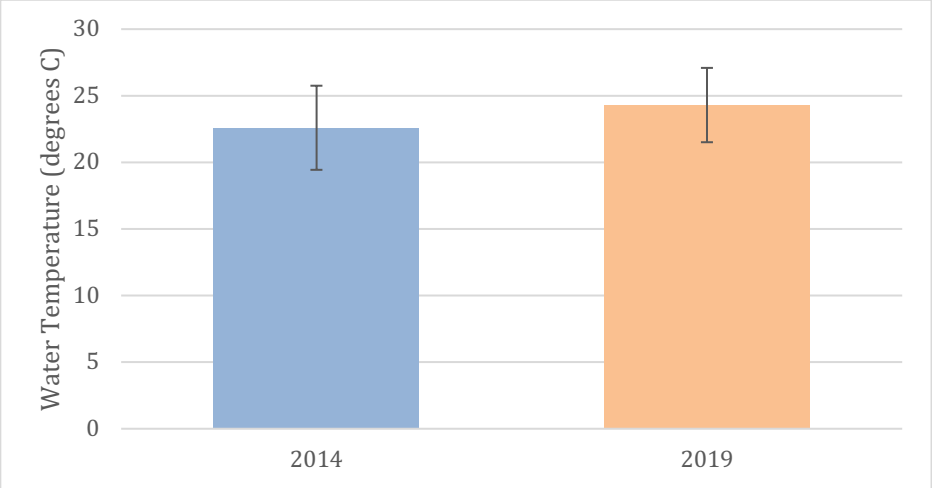


Figure 6. Average water temperatures, 2014 and 2019



pH: pH expresses the relative acidity or alkalinity of a water. The ambient water quality standard for pH is between 6.0 and 9.0 and all monitored stations and dates were observed to have pH readings within that acceptable range (Figure 7) The annual average pH readings were also consistent from 2014 to 2019 (Figure 8).

Figure 7. Average water pH, 2019

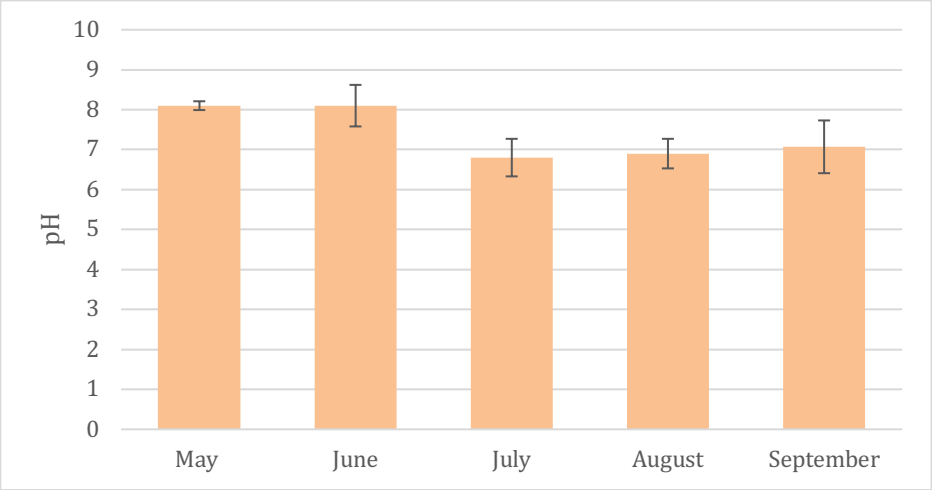
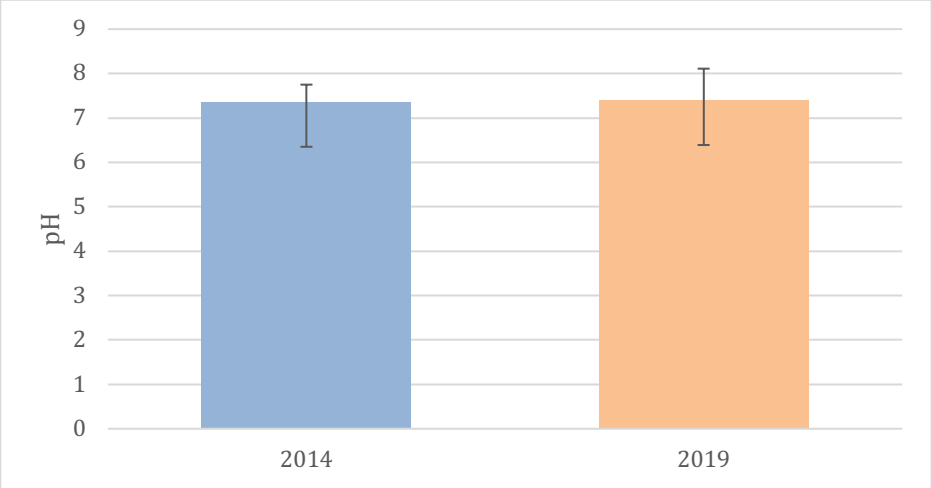


Figure 8. Average water pH, 2014 and 2019



Conductivity: Conductivity is a measure of the ability of water to conduct an electrical current and conductivity increases as water becomes more mineralized. The observed conductivity concentrations increased slightly across sampling dates in 2019 (Figure 9) but the 2019 average conductivity concentration is lower than that observed in 2014 (Figure 10). The decreased average conductivity concentrations from 2014 to 2019 correspond to decreases in turbidity and total solids concentrations. This suggests that reduced runoff and eroded soil introductions into the lake contributed to lower conductivity concentrations in 2019.

Figure 9. Average conductivity concentrations, 2019

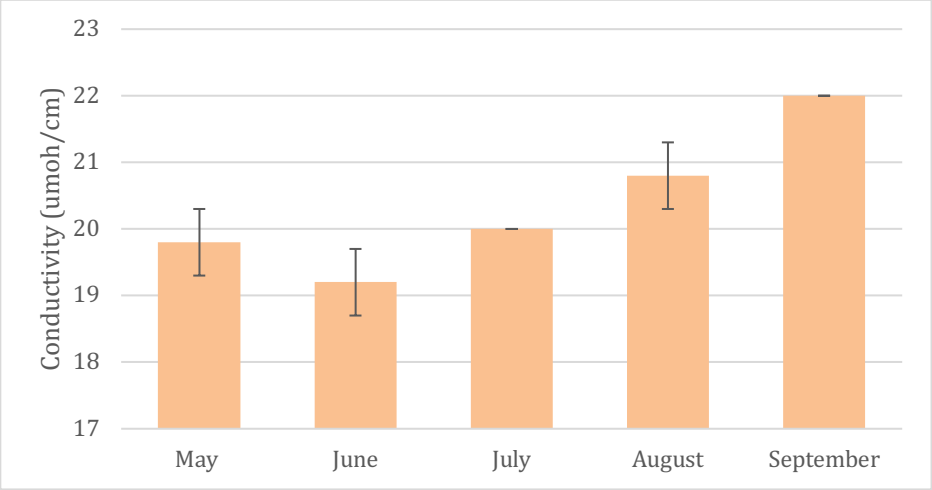
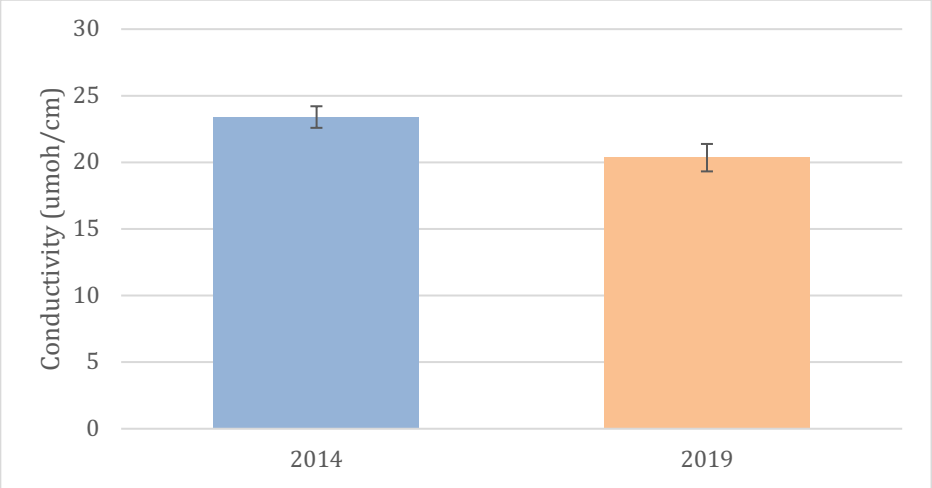


Figure 10. Average conductivity concentrations, 2014 and 2019



Secchi Depth: Secchi depth is a measure of water transparency expressed in meters. It is used in combination with chlorophyll-a and nutrient concentrations to determine the North Carolina Trophic State Index (NCTSI) to determine a lake's biological productivity. Average Secchi depths increased between May and September in 2019 (Figure 11) and follow monthly patterns consistent with those observed in previous 5-year lake assessments conducted by DWR. The average Secchi depth decreased slightly from 2014 to 2019 (Figure 12) but the decrease was not statistically significant.

Figure 11. Average Secchi depths, 2019

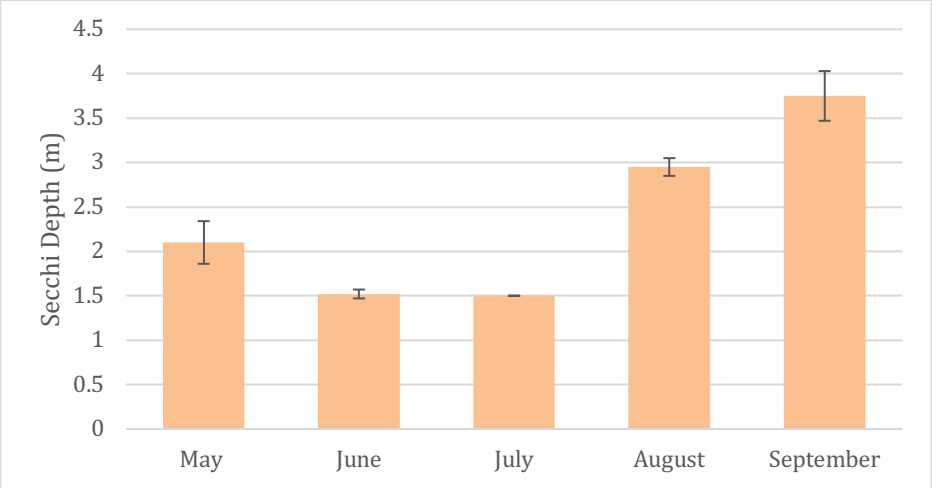
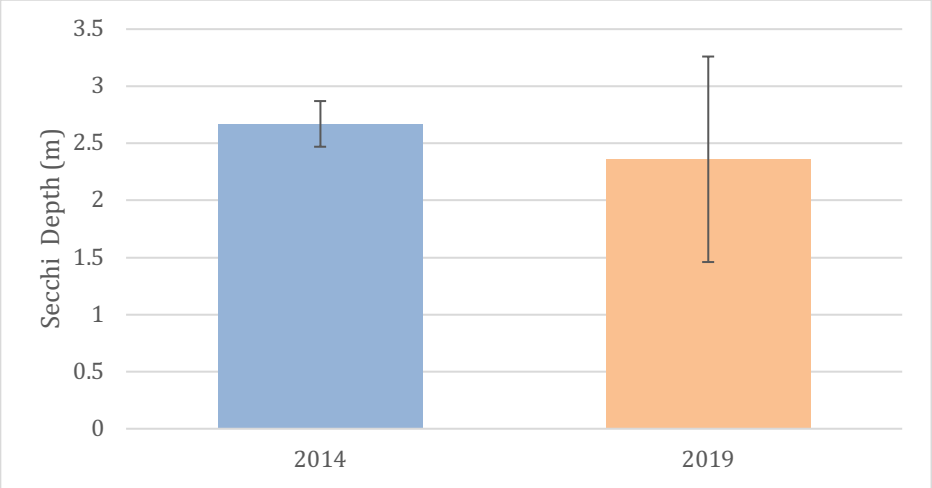


Figure 12. Average Secchi depths, 2014 and 2019.



Total Kjeldahl Nitrogen (TKN) and Total Organic Nitrogen (TON): TKN is the sum of organic nitrogen and ammonia in a water body. High TKN typically results from sewage and manure discharges into water bodies. TON is a significant nitrogen reservoir in the aquatic system during the summer months and its concentration can be related to lake productivity. Neither TKN or TON concentrations were measured in June or July, but both parameters show similar trends across the summer months in 2019 (Figures 13 and 14). TKN concentrations remained unchanged from 2014 to 2019 (Figure 15) and TON concentrations decreased from 2014 to 2019 (Figure 16). TON is used in the NCTSI calculation of lake productivity, and these nutrient results continue to demonstrate the oligotrophic (low biological productivity) of Lake Glenville.

Figure 13. Average total Kjeldahl nitrogen concentrations, 2019

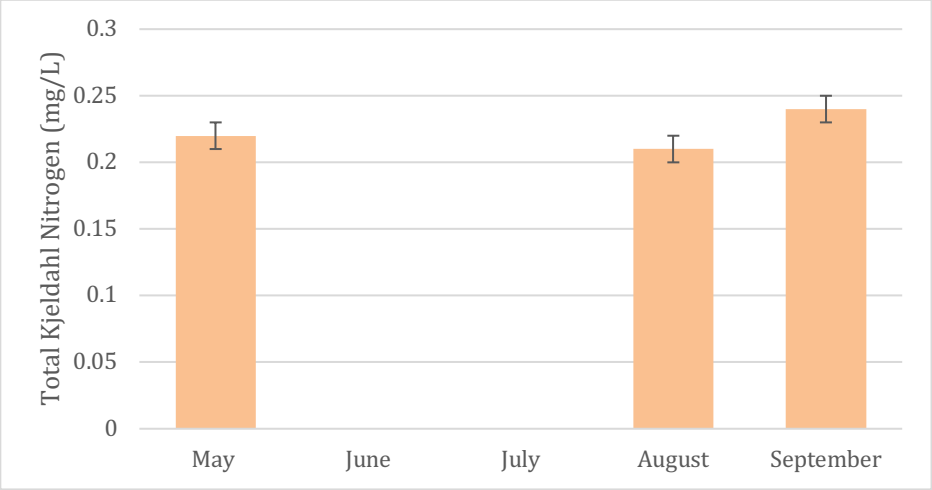


Figure 14. Average total organic nitrogen concentrations, 2019

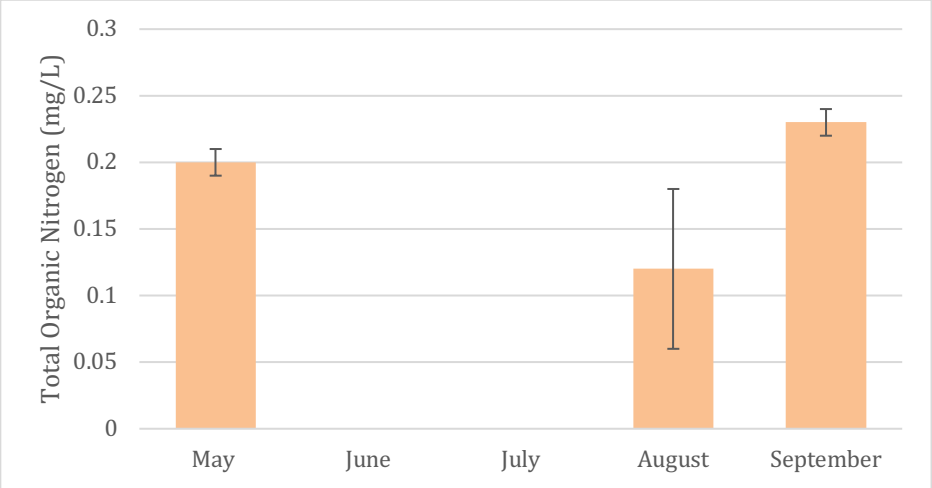


Figure 15. Average total Kjeldahl nitrogen concentrations, 2014 and 2019

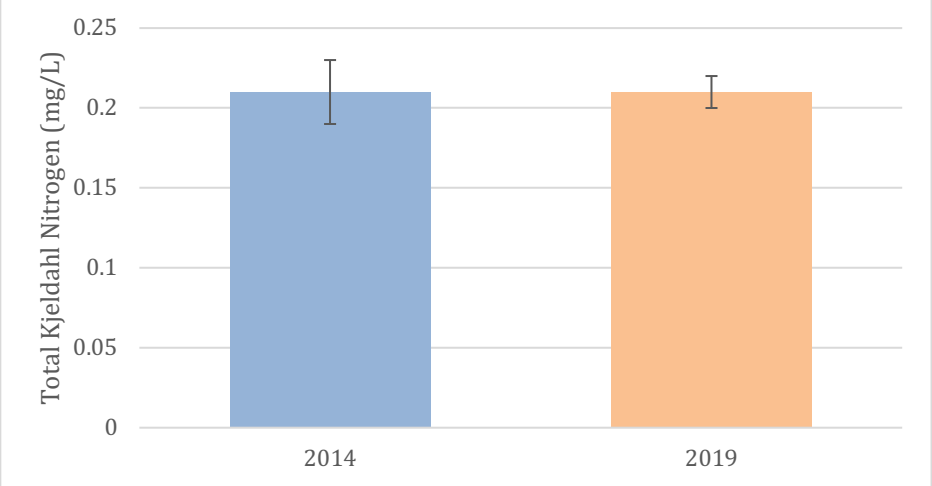
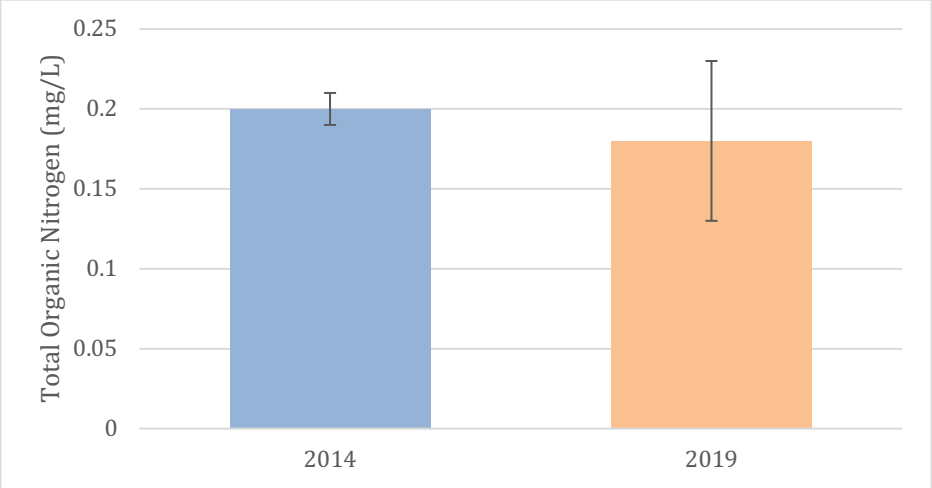


Figure 16. Average total organic nitrogen concentrations, 2014 and 2019



Chlorophyll-a: Chlorophyll-a is an algal pigment that is used as an approximate measure of biomass and is used in the calculation of NCTSI. The chlorophyll-a concentration in June exceeded the NC water quality standard of 15µg/L for a waterbody designated as a Trout Water (Figure 17). The elevated chlorophyll-a concentrations in June corresponds to the reduced Secchi depths observed during the same month. The chlorophyll-a concentrations in 2019 were higher than those observed in 2014 (Figure 18). However, biomass in Lake Glenville continues to be low and does not appear to be negatively affecting DO and % SAT concentrations.

Figure 17. Average chlorophyll-a concentrations, 2019

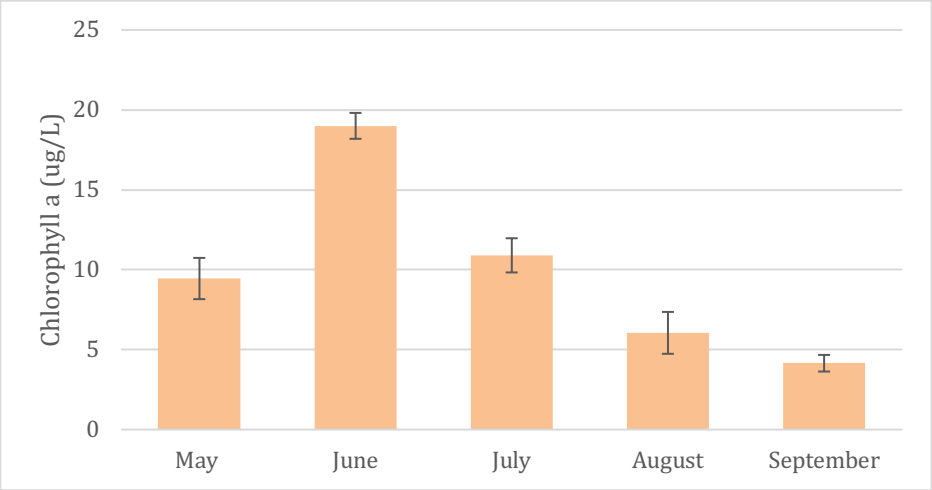
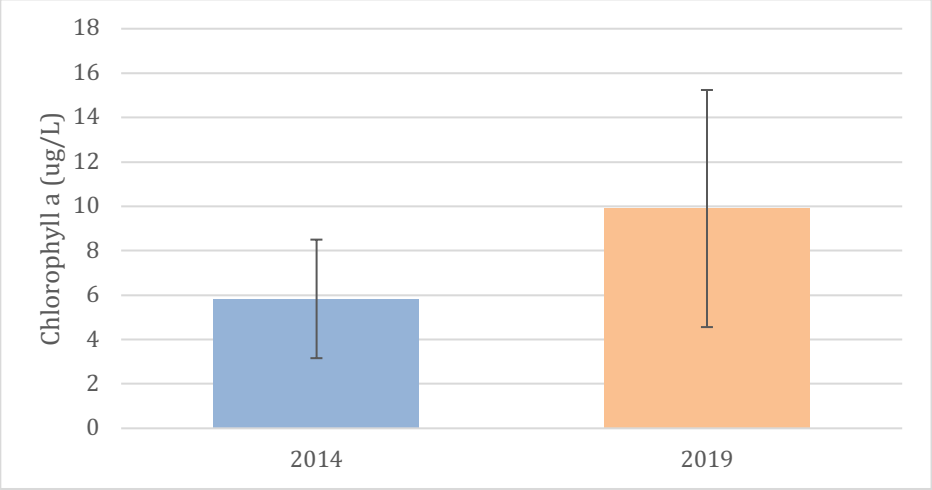


Figure 18. Average chlorophyll-a concentrations, 2014 and 2019.



Total Solids and Turbidity: Total solids is a measure of the suspended and dissolved solids that are present in water. Although total solids concentrations increased in August (Figure 19), they did not appear to significantly influence water clarity as August Secchi depth measurements were higher than in previous months. The average total solids concentrations were also lower in 2019 than in 2014 (Figure 20).

Figure 19. Average total solids concentrations, 2019

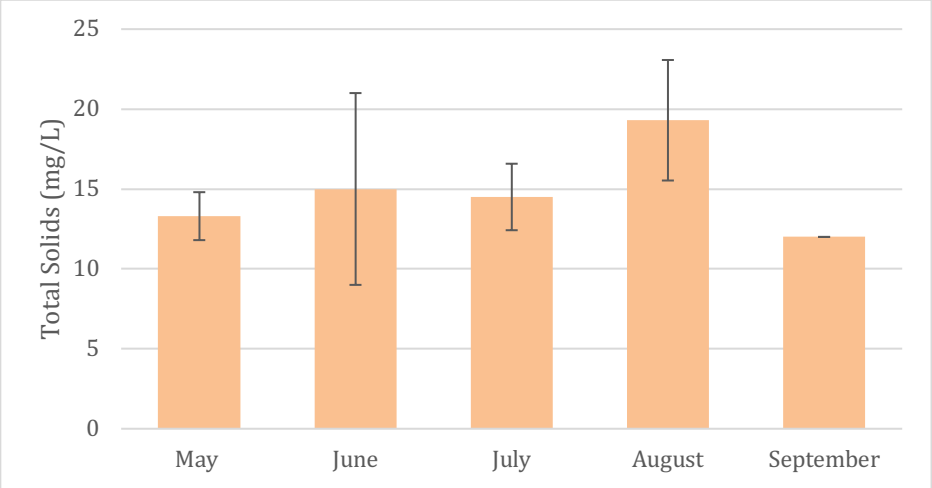
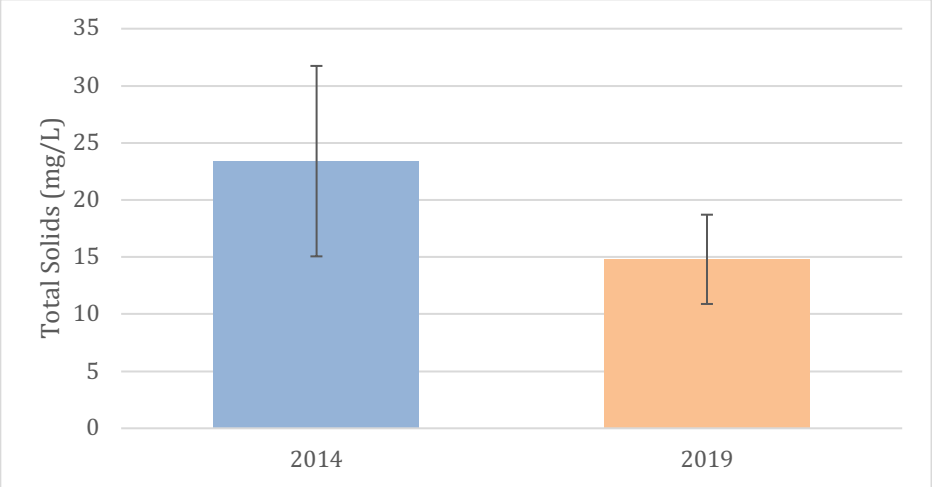


Figure 20. Average total solids concentrations, 2014 and 2019



Turbidity is a measure of the ability of light to pass through a volume of water and is considered to be an indirect measure of total solids. The NC water quality standard for turbidity in Trout Waters is 10 NTU and turbidity measurements at all stations and dates during were well are below the 10 NTU trout-designated water standard (Figure 21). The average turbidity measurement in 2019 is also significantly lower than that observed in 2014 (Figure 22).

Figure 21. Average turbidity, 2019

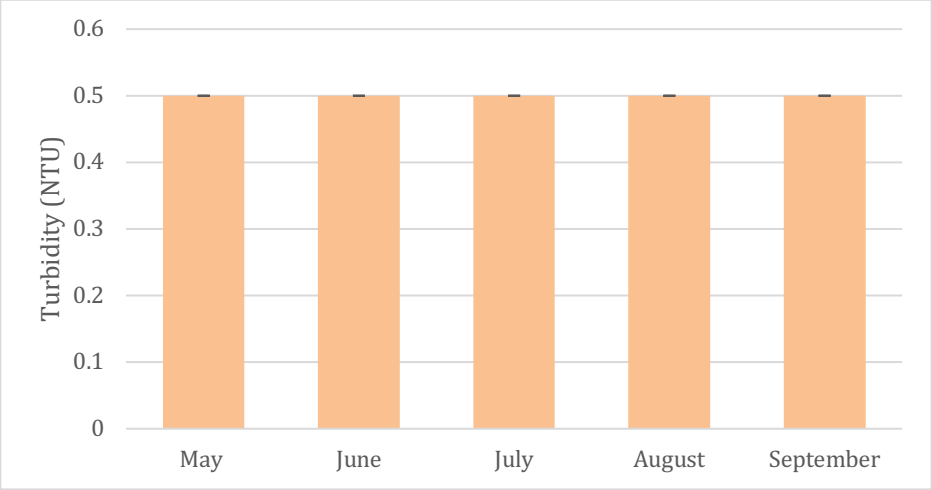
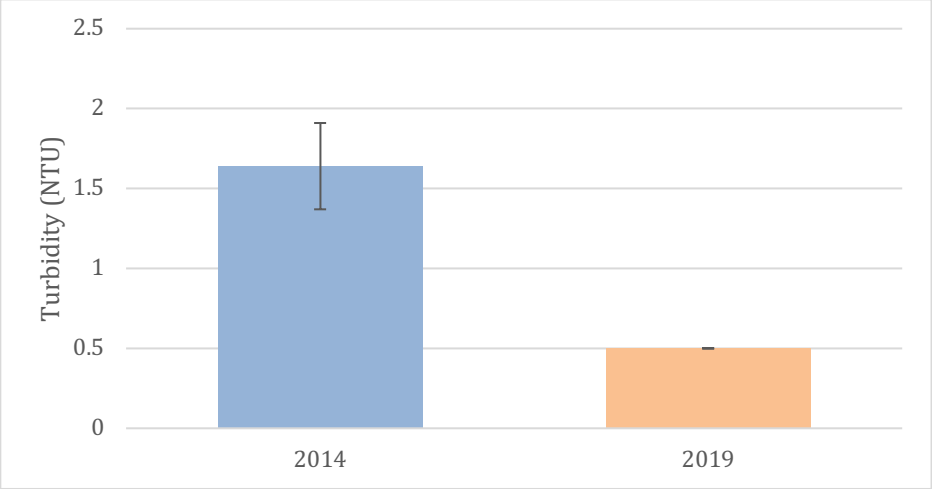


Figure 22. Average turbidity, 2014 and 2019



Conclusions

Results presented in the "Lake and Reservoir Assessments – Little Tennessee River Basin" report published by the DWR in 2019 demonstrate that Lake Glenville is supportive of the state's Class C water quality standards for recreational fishing, swimming, and boating. Lake Glenville continues to exhibit very low biological productivity due to its low nutrient concentrations. Measurements for dissolved oxygen, percent dissolved oxygen saturation, conductivity, total organic nitrogen, total solids, and turbidity all improved over 2014 measurements as presented by the DWR. Lake Glenville continues to be oligotrophic and have very low biological productivity, consistent with other lakes and reservoirs in the river basin, including Nantahala Lake, Bear Creek Reservoir, Cedar Cliff Reservoir, Fontana Lake, Lake Cheoah, Santeetlah Lake and Calderwood Lake.

References

NC DEQ. May 19, 2020 Lake and Reservoir Assessments – Little Tennessee River Basin. *Intensive Survey Branch, Water Sciences Section, Division of Water Resources, North Carolina Department of Environmental Quality*

NC DEQ. February 27, 2015 Lake and Reservoir Assessments – Little Tennessee River Basin. *Intensive Survey Branch, Water Sciences Section, Division of Water Resources, North Carolina Department of Environmental Quality*