

Carr Creek Lake (CFK) Water Quality Summary

Summary of 2020 Water Quality Results

Carr Creek Lake had one exceedance of KY's water quality criteria for temperature at the tailwater (CFK10000). Total phosphorus (TP) levels at all sample locations exceeded the USEPA nutrient criteria, while only two total nitrogen samples exceeded USEPA criteria. TSI for the three indices classified the lake as oligotrophic, mesotrophic, or hypereutrophic, indicating varying levels of biological activity potential. Finally, our sampling showed there were no samples with cyanobacteria cell counts over 100,000 cells/mL at the time of the sampling event. While cell counts were not indicative of HABs at the time of sampling, and the TSI categories were variable, the high TP levels indicates the potential for HAB development in the lake.

2020 Activities

In 2020, one sampling event was conducted at Carr Creek Lake. Field data and chemical samples were collected at all 11 sample locations (Figure 1). Chlorophyll and phytoplankton were collected at 4 sites, and zooplankton samples were collected at the damsite (CFK20001).

Additionally, temperature and dissolved oxygen (DO) profiles were collected by the project staff at the damsite and tailwater approximately every two weeks from early May through late December.

Exceedances of KY State Water Quality Criteria

There was one exceedance event of KY state water quality criteria for temperature at the tailwater on January 15th. There were no other exceedances of KY state WQ criteria.

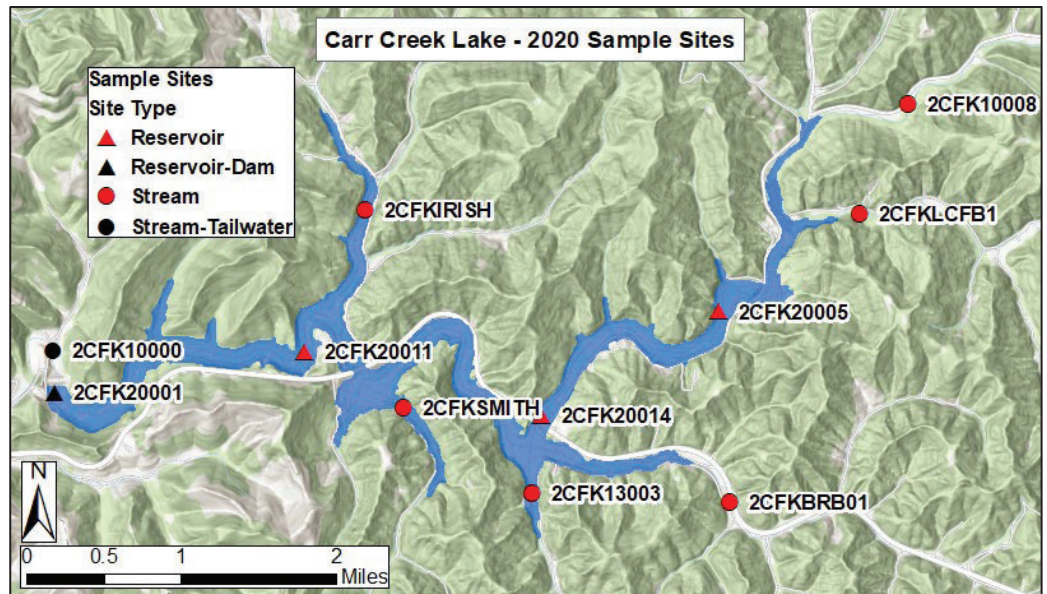


Figure 1. Water quality sampling locations for Carr Creek Lake in 2020.

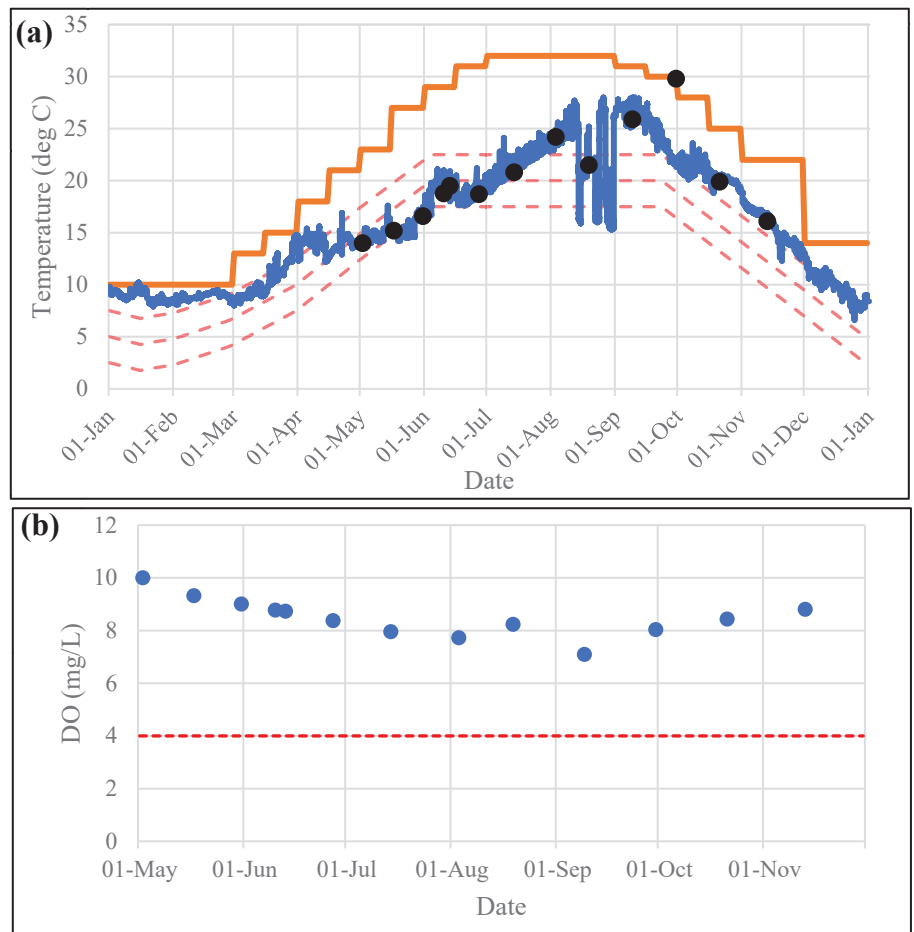


Figure 2. Carr Creek Lake tailwater temperature and DO data. (a) Tailwater temperature data collected by project staff in 2020 is represented by the black dots. The blue line represents USGS gage data (provisional) from a gage downstream from the project. The temperature guide curve is represented by the dashed red lines, and the orange line represents the KY water quality criteria for temperature. (b) Tailwater dissolved oxygen data collected in 2020 is represented by the blue dots. The KY water quality criteria for DO is represented by the dashed red line.

Tailwater Temperature and DO Conditions

Tailwater data was compared to KY state water quality criteria for temperature and to the Louisville District's temperature guide curve for Carr Creek Lake (Figure 2a). According to the provisional USGS data, tailwater temperature exceeded the state criteria for temperature on January 15. During this time, the reservoir was de-stratified; therefore, nothing could be done operationally to prevent this exceedance. Also, tailwater temperatures fell outside the guide curve January through February and most of the time August through early December. The WQ Program will use these findings to inform future operational decisions to improve performance of downstream temperature management wherever possible. Tailwater dissolved oxygen levels (Figure 2b) did not exceed state criteria at any time throughout the year.

Nutrient Analyses

Nutrient data, including total nitrogen (TN) and total phosphorus (TP) data, were collected at all sample sites in 2020. The 2020 TP and TN values were compared to historical data from 2012 through 2019 (Figure 3). The TP and TN values at each site were compared to their respective USEPA recommended criteria. Nutrient levels are an area of concern because elevated nutrients can lead to high biological activity, especially with respect to HABs.

Total Phosphorus

2020 TP values at all sites were higher than historical medians and were above the top of the distribution of historical values for each location. Also, 2020 TP levels at all sites were above the USEPA recommended nutrient criteria for the respective locations.

Total Nitrogen

2020 TN values at all sites were lower than historical medians and were at or

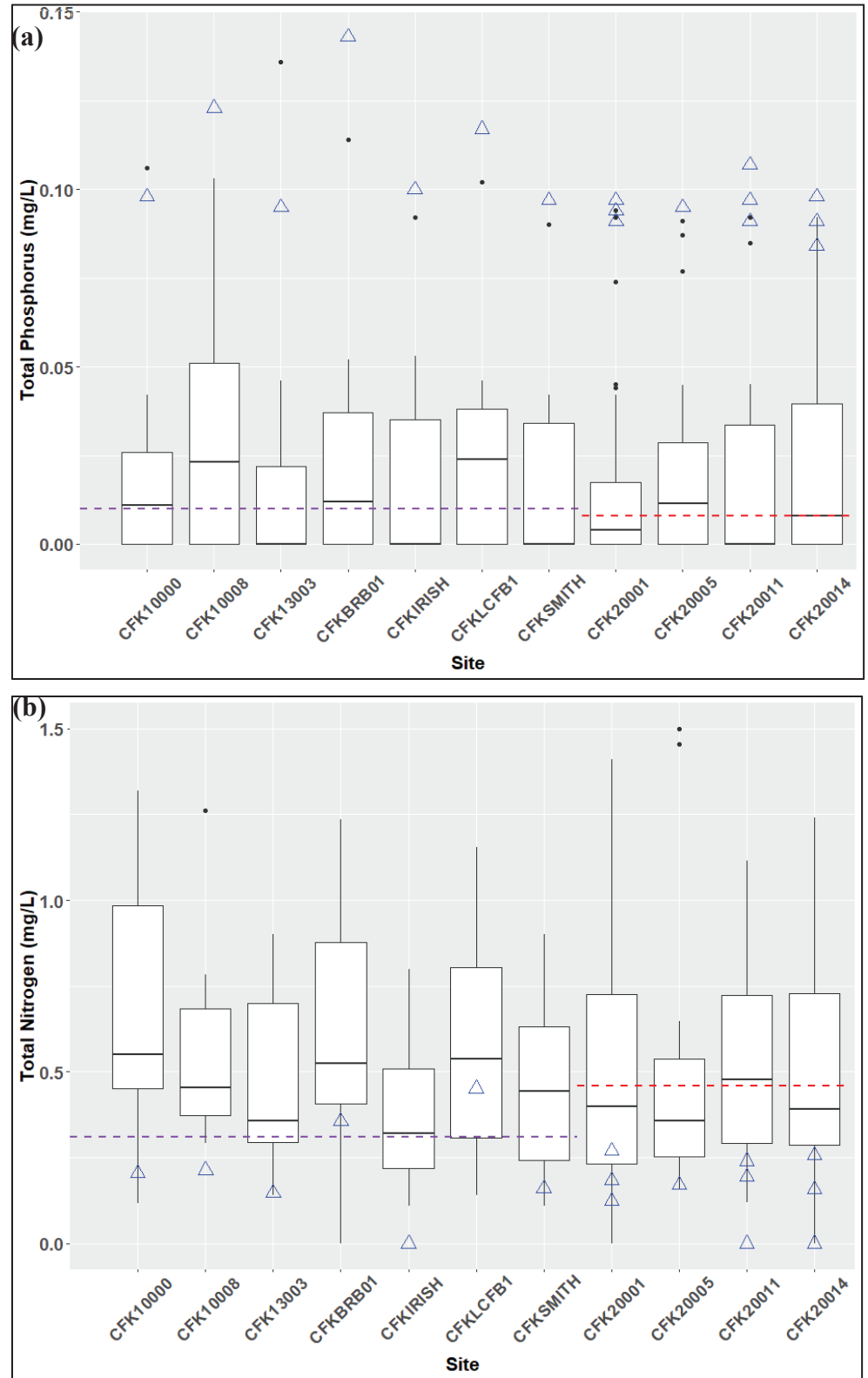


Figure 3. Comparison of 2020 Carr Creek Lake nutrient data to historical samples and nutrient criteria. Boxplots represent data collected in 2012-2019 and blue triangles represent 2020 data. Purple and red dotted lines represent USEPA recommended nutrient criteria for streams and reservoirs, respectively. (a) Comparison of total phosphorus data. (b) Comparison of total nitrogen data. Two outliers (values range from 1.654 to 3.79 mg/L) were excluded to make plot easier to interpret.

below the distribution of historical values for each location. 2020 TN values in only two samples exceeded the USEPA recommended nutrient criteria.

Cyanobacteria Data, HABs, and Trophic State Index (TSI)

Cyanobacteria Data

13 phytoplankton samples were collected from various depths at 4 sites. Total cyanobacteria cell counts did not exceed 100,000 cells/mL (guideline value for moderate health risk from the World Health Organization’s Guidelines for Safe Recreational Water Environments [2003]) at Carr Creek Lake. These results indicate Carr Creek Lake did not have cell count levels potentially indicative of a HAB at the time of sampling.

Harmful Algal Bloom (HAB) Response

The KY Division of Water (KDOW) is the lead agency for HAB response in Kentucky. KDOW did not issue any advisories for HABs at Carr Creek Lake in 2020.

TSI

The trophic state indices for Secchi depth [TSI(SD)], chlorophyll-*a* [TSI(CHL)], and total phosphorus [TSI(TP)] were calculated for four reservoir sites at Carr Creek Lake (Table 1). The mean categories of all three indices ranged from oligotrophic to hypereutrophic, indicating varying levels of biological activity potential.

Table 1. Summary of calculate trophic state indices at Carr Creek Lake.

	Mean Score (range)	Mean Category
TSI(SD)	47 (44-50)	Mesotrophic
TSI(CHL)	32 (32-32)	Oligotrophic
TSI(TP)	69 (69-70)	Hypereutrophic