

Green River Lake (GRR) Water Quality Summary

Summary of 2020 Water Quality Results

Green River Lake had three exceedances of KY's water quality criteria for temperature at the tailwater (GRR10000). Total phosphorus and total nitrogen levels at most sample locations exceeded the USEPA nutrient criteria. TSI for the three indices classified the lake as moderately eutrophic or eutrophic, indicating moderate to high levels of biological activity potential. Finally, our sampling showed there was one sample with cyanobacteria cell counts over 100,000 cells/mL at the time of sampling. The elevated nutrient levels and moderately eutrophic/eutrophic TSI classification indicate there is a high potential for HAB development in the lake.

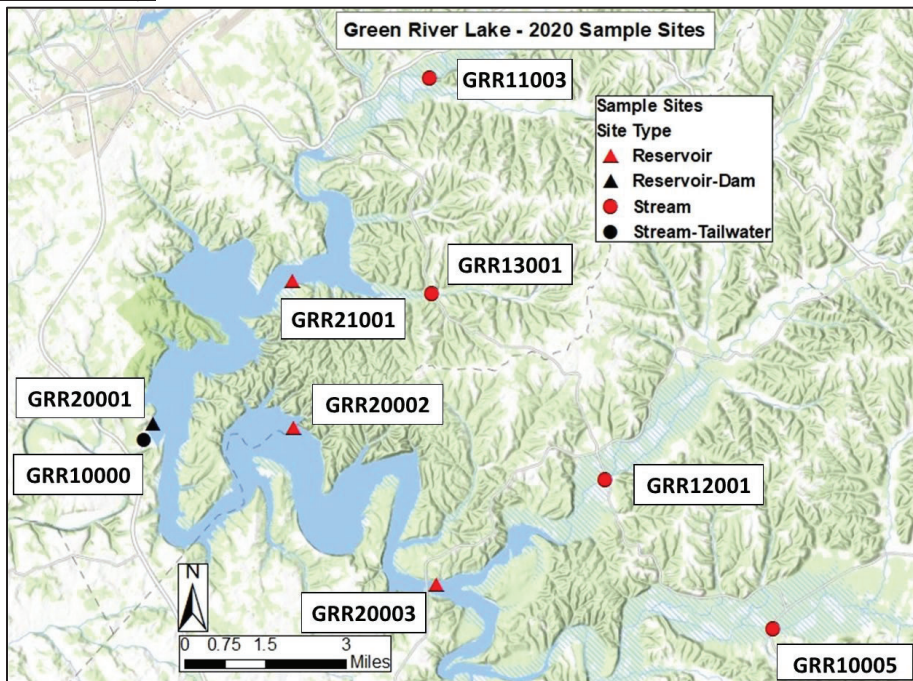


Figure 1. Water quality sampling locations for Green River Lake in 2020.

2020 Activities

In 2020, one sampling event was conducted at Green River Lake. Field data and chemical samples were collected at nine sample locations (Figure 1). Chlorophyll and phytoplankton were collected at four sites, and zooplankton samples were collected at the damsite (GRR20001).

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 early December.

Exceedances of KY State Water Quality Criteria

There were three exceedance events of KY state water quality criteria for temperature at the tailwater. There were no other exceedances of KY state WQ criteria.

Tailwater Temperature and DO Conditions

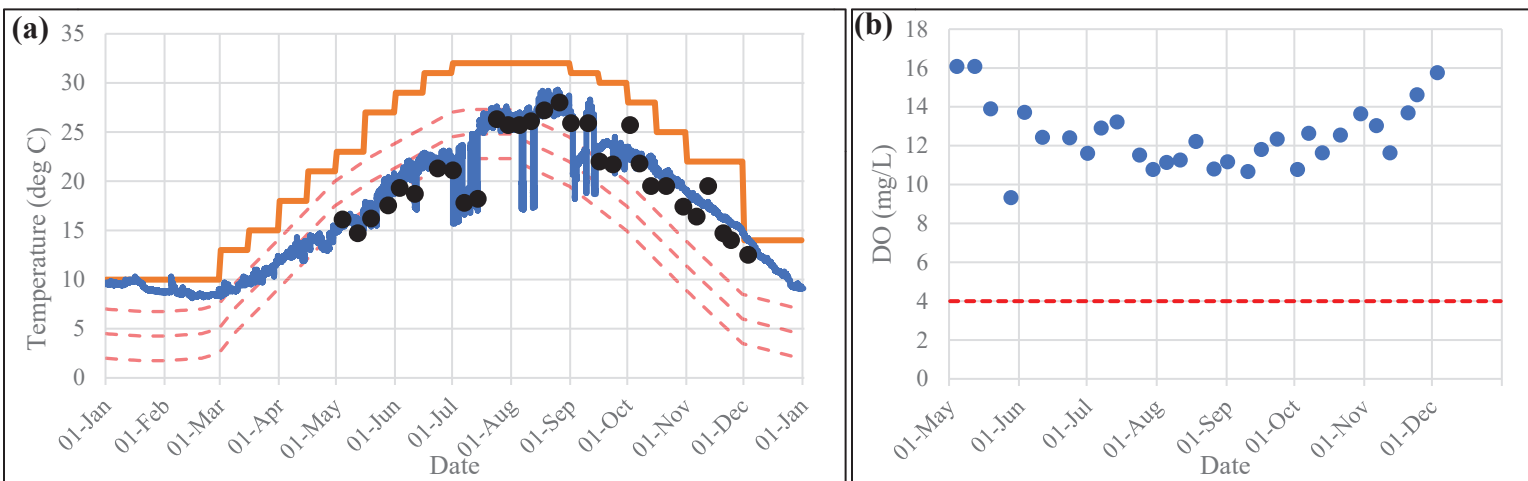


Figure 2. Green River Lake tailwater temperature and DO data. (a) Tailwater temperature data collected by project staff in 2020 is represented by the black dots. The blue line represents USGS gage data (provisional) from a gage downstream from the project. The temperature guide curve is represented by the dashed red lines, and the orange line represents the KY water quality criteria for temperature. (b) Tailwater DO 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 data was compared to KY state water quality criteria for temperature and to the Louisville District's temperature guide curve for Green River Lake (Figure 2a). According to the provisional USGS data, tailwater temperature exceeded the state criteria for temperature: January 16-17, February 4, and December 1-3. During these times, the reservoir was de-stratified; therefore, nothing could be done operationally to prevent these exceedances. Also, tailwater temperatures fell outside the guide curve early January through early March, early to mid-July, and mid-August through the end of the year. 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 stream sites were higher than historical medians and distributions. 2020 TP values at reservoir sites were near historical medians. Also, 2020 TP levels at all sites were above the USEPA recommended nutrient criteria for the respective locations.

Total Nitrogen

2020 TN values at most sites were near historical medians and distributions. 15 out of 17 TN values in 2020 exceeded the USEPA recommended nutrient criteria.

Cyanobacteria Data, HABs, and Trophic State Index

Cyanobacteria Data

15 phytoplankton samples were collected from various depths at 4 sites. Total

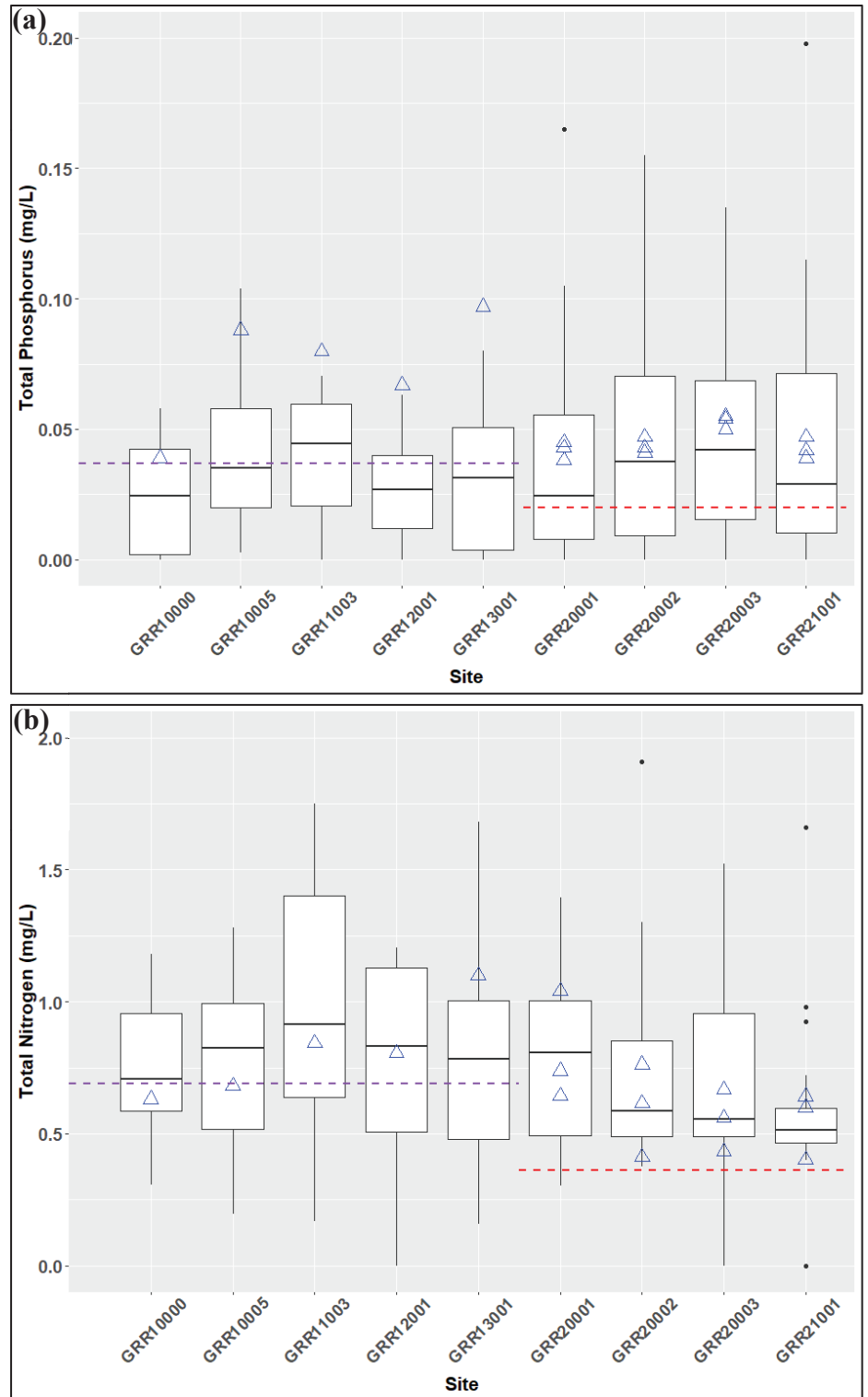


Figure 3. Comparison of 2020 Green River Lake nutrient data to historical samples and nutrient criteria. Boxplots represent data collected in 2012-2019 and blue triangles represent 2020 data. Purple and red dotted lines represent USEPA recommended nutrient criteria for streams and reservoirs, respectively. (a) Comparison of total phosphorus data. Four outliers (values ranging from 0.246 to 0.359 mg/L) were excluded to make plot easier to interpret. (b) Comparison of total nitrogen data. One outlier (value = 4.54 mg/L) was excluded to make plot easier to interpret.

cyanobacteria cell counts exceeded 100,000 cells/mL (guideline value for moderate health risk from the World Health Organization’s Guidelines for Safe Recreational Water Environments [2003]) in one sample. These results indicate Green River 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 Green River 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 Green River Lake (Table 1). The mean categories of all three indices ranged from moderately eutrophic to eutrophic, indicating moderate to high levels of biological activity potential.

Table 1. Summary of calculated trophic state indices at Green River Lake.

	Mean Score (range)	Mean Category (Range)
TSI(SD)	53 (51-56)	Moderately Eutrophic (Moderately Eutrophic-Eutrophic)
TSI(CHL)	55 (53-59)	Moderately Eutrophic (Moderately Eutrophic-Eutrophic)
TSI(TP)	59 (57-61)	Eutrophic