

Cagles Mill Lake (CMR) Water Quality Summary

Summary of 2020 Water Quality Results

Cagles Mill Lake had no exceedances of Indiana’s water quality criteria at the tailwater (CMR10000). Total phosphorus and total nitrogen levels at all sample locations exceeded the USEPA nutrient criteria. The mean TSI categories for all three indices ranged from eutrophic to hypereutrophic, indicating a very high level of biological activity. Finally, our sampling showed cyanobacteria cell counts over 100,000 cells/mL in 10 out of 13 samples at the time of sampling. The elevated nutrient levels and eutrophic/hypereutrophic TSI classification indicate there is a high potential for HAB development in the lake.

2020 Activities

In 2020, one sampling event was conducted at Cagles Mill Lake. Field data and chemical samples were collected at all sites (Figure 1). Chlorophyll and phytoplankton were collected at four sites, and zooplankton samples were collected at the damsite (CMR20001).

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

Exceedances of IN State Water Quality Criteria

There were no exceedances of Indiana state water quality criteria at the tailwater.

Tailwater Temperature and DO Conditions

Tailwater data was compared to IN state water quality criteria for temperature and to the Louisville District’s temperature guide curve for Cagles Mill Lake (Figure 2a). Tailwater temperature did not exceed

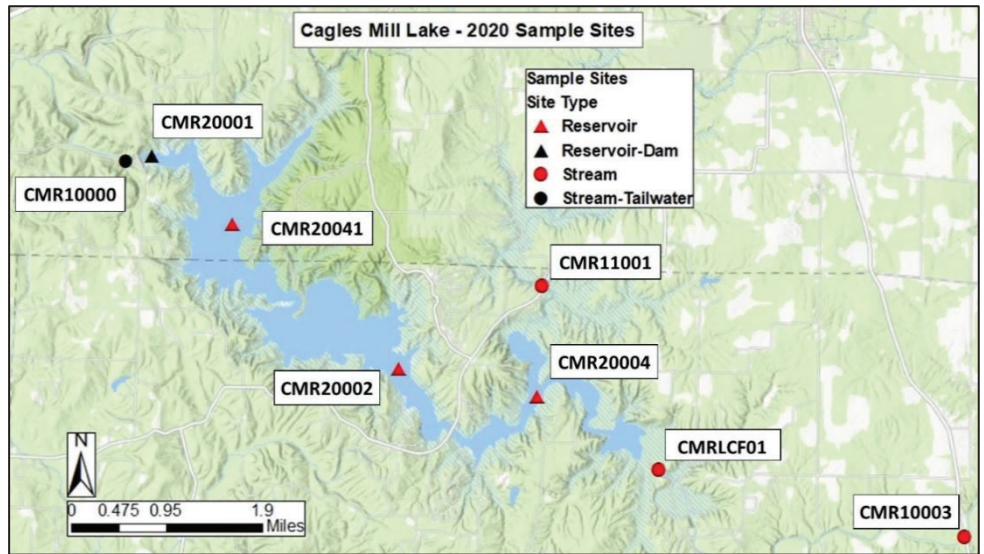


Figure 1. Water quality sampling locations for Cagles Mill Lake in 2020.

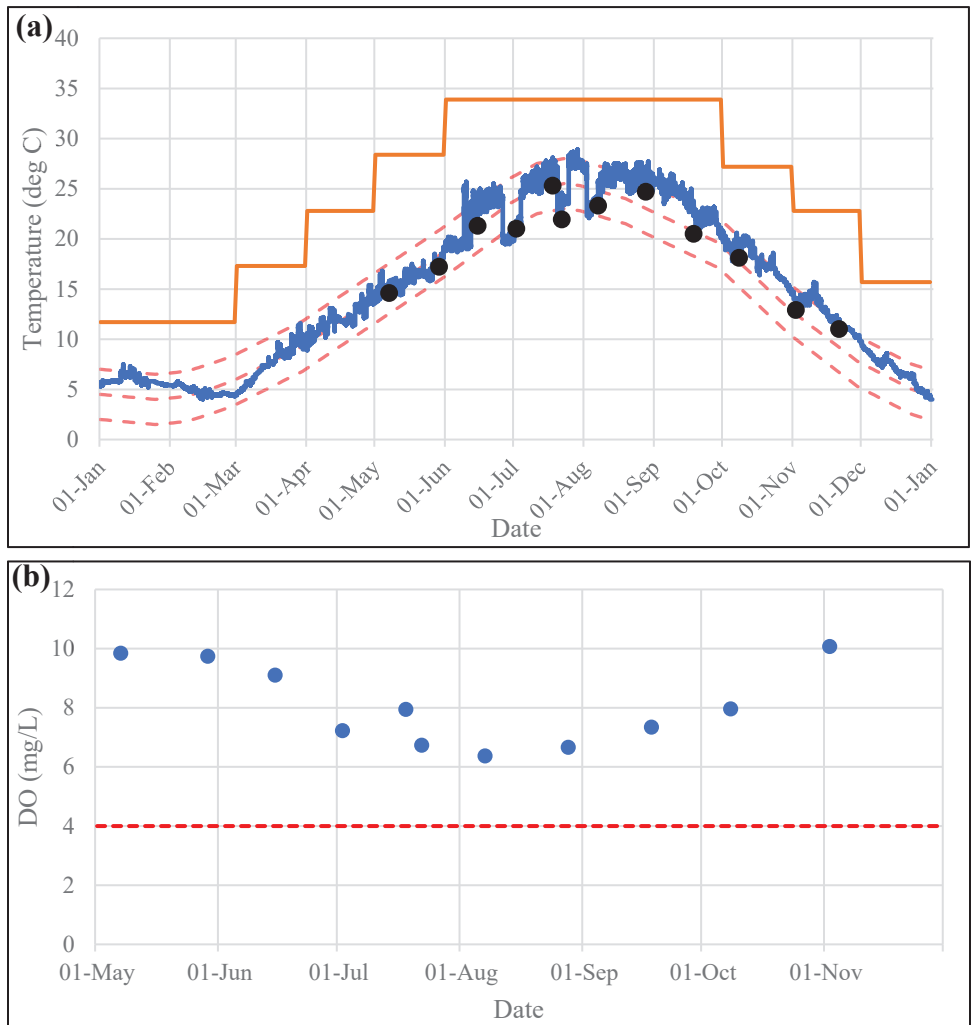


Figure 2. Cagles Mill Lake tailwater temperature and DO data. (a) Tailwater temperature data collected by project staff in 2020 is represented by the black dots. The blue line represents USGS gage data (provisional) from a gage downstream from the project. The temperature guide curve is represented by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

the state criteria for temperature at any time; however, tailwater temperatures fell outside the guide curve for brief periods of time intermittently throughout the year (mostly minor deviations from the guide curve). 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 at Cagles Mill Lake were above the historical medians and the USEPA recommended nutrient criteria.

Total Nitrogen

2020 TN values at Cagles Mill Lake were near or below the historical medians at all but two sites. Also, 2020 TN levels at all sites were above the USEPA recommended nutrient criteria for the respective locations.

Cyanobacteria Data, HABs, and Trophic State Index

Cyanobacteria Data

13 phytoplankton samples were collected at various depths from 4 sites. Total 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 10 out of 13 samples collected from 3 sites. None of these samples

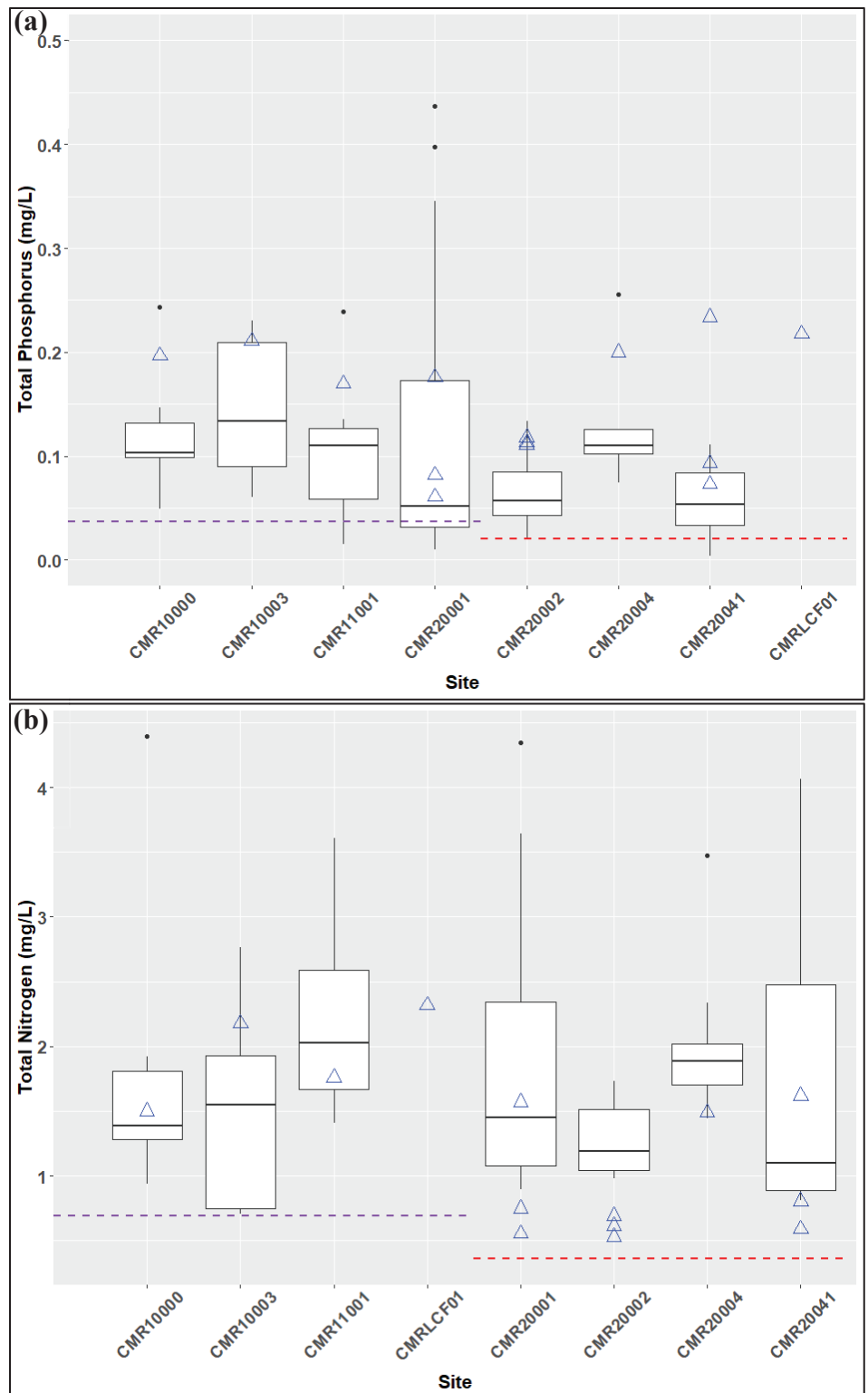


Figure 3. Comparison of 2020 Cagles Mill Lake nutrient data to historical samples and nutrient criteria. Boxplots represent data collected in 2012-2019 and blue triangles represent 2020 data. Purple and red dotted lines represent USEPA recommended nutrient criteria for streams and reservoirs, respectively. (a) Comparison of total phosphorus data. Four outliers (values ranging from 0.427-0.465 mg/L) were excluded to make graph easier to interpret. (b) Comparison of total nitrogen data.

exceeded 1,000,000 cells/mL. These results indicate Cagles Mill Lake had cell count levels potentially indicative of a HAB at the time of sampling.

Harmful Algal Bloom (HAB) Response

Indiana Department of Environmental Management (IDEM) is the lead agency for HAB response in Indiana. IDEM samples Cagles Mill Lake Beach biweekly during the recreation season and issues appropriate HAB alert level based on the results. IDEM issued HAB Advisory alert levels at the Cagles Mill Lake Beach from 5/22/20 through 5/29/20 and from 7/2/20 through 9/4/20. The Advisory alert level indicates that cell counts were over 100,000 cells/mL, but toxin levels did not meet thresholds for the Caution or Closed alert levels. At an Advisory alert level, the following precautions apply: swimming and boating permitted; avoid contact with algae; don't drink the water; and shower after you swim.

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 Cagles Mill Lake (Table 1). The mean categories of all three indices ranged from eutrophic to hypereutrophic, indicating a very high level of biological activity.

Table 1. Summary of calculated trophic state indices at Cagles Mill Lake.

	Mean Score (range)	Mean Category (Range)
TSI(SD)	68 (63-81)	Hypereutrophic (Eutrophic-Hypereutrophic)
TSI(CHL)	65 (51-76)	Eutrophic (Moderately Eutrophic-Hypereutrophic)
TSI(TP)	71 (63-81)	Hypereutrophic (Eutrophic-Hypereutrophic)