

Hillsdale Lake Water Quality Summary

2010-2019

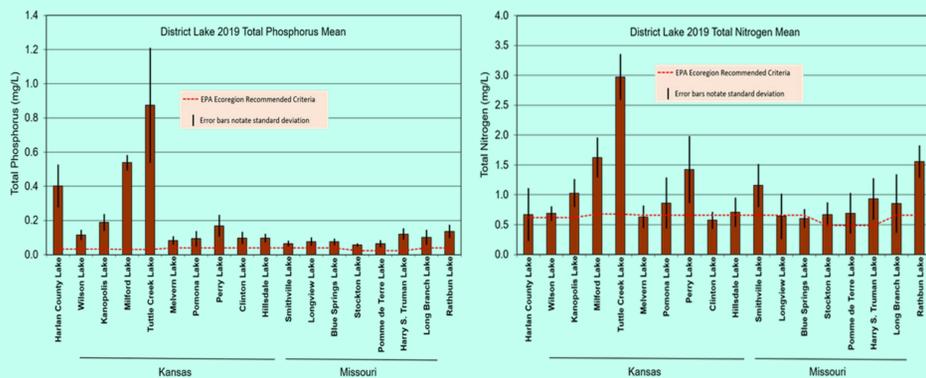


Hillsdale Lake:

- Built on Big Bull Creek 29.1 km (18.2 miles) upstream of the confluence of Marais des Cygnes River
- **Watershed** = 144 sq miles (92,160 Acres)
- **Capacity:**
 - Flood Control: 83,000 Acre Feet (AF); 7,413 surface acres (SA)
 - Multipurpose: 76,300 AF; 4,575 SA; 51 miles of shoreline
- **Operating project purposes:** flood control, water quality, recreation, fish and wildlife, and water supply.
- **Avg. annual inflow (2010-2019)**=88,375 AF; **2019 inflow**=195,822 AF
- **Water Quality** at Hillsdale Lake is beginning to show increasing populations of blue-green algae species or cyanobacteria. However, dominant species are not typically toxin producers. Water quality was beneficial to authorized purposes for Hillsdale Lake in 2019.

Nutrient Enrichment

Nutrients (i.e. phosphorus and nitrogen) are essential for aquatic life and are the primary factor driving fish and aquatic plant growth rates and productivity. Excess nutrients from urban, agricultural or natural sources increases the natural aging or eutrophication process in lakes. This can alter plant and aquatic life in lakes and water bodies, cause algal blooms, create low dissolved oxygen that affect fish survival, and lead to taste and odor issues in drinking water. Hillsdale Lake is on the draft 2020 KS 303(d) list of impaired waters due to eutrophication. EPA and KDHE are working with water quality partners and landowners to focus watershed conservation efforts on priority or target areas in the watershed to reduce nutrient and sediment runoff. This approach is designed to improve water quality and reduce designated impairments at Hillsdale Lake. In 2019, Hillsdale Lake annual averages for total phosphorus (0.09 mg/L) and total nitrogen (0.7 mg/L) were less than respective USACE Kansas City District lake averages while exceeding EPA Ecoregion recommended criteria as shown in graph below. Error bars in the graphs below illustrate the variation observed in monthly sample results from each site during 2019 sampling year.

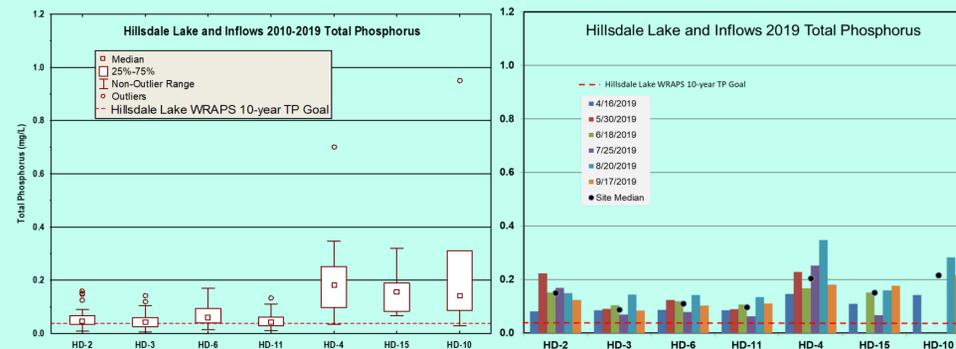


The **US Army Corps of Engineers (USACE)** Water Quality Program collects monthly water samples at Hillsdale Lake* from April through September. These figures present data collected between 2010-2019 from inflow sites (HD-4, HD-10, HD-15), three lake sites (HD-3, HD-6, HD-11) and the outflow (HD-2) below the dam. Thirty-four chemical, physical and biological parameters are measured to evaluate water quality. USACE uses this data to describe water quality history, conditions and changes from the inflow streams, within the main lake, and outflow focusing on eutrophication, nutrients, sediment, herbicides, metals, and contaminants.

*Note: The term "lake" is substituted for technically correct "reservoir" throughout this document for consistency.

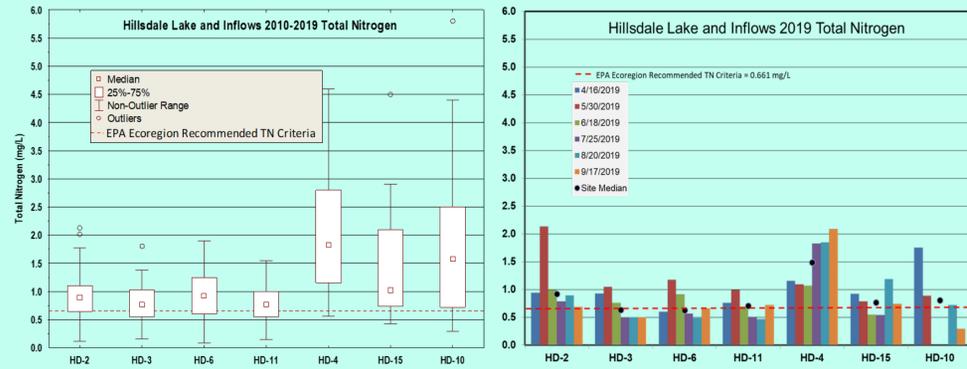
Total Phosphorus

Total phosphorus (TP) median values from 2019 Hillsdale Lake samples exceeded EPA Ecoregion recommended criteria (0.04 mg/L) and WRAPS 10-year goals (0.032 mg/L). Median TP of samples from 2019 inflows (HD-4, HD-10, HD-15) were all less than 75% quartile of 10-year average from respective Hillsdale sites since 2010. TP median concentrations from lake sites in 2019 all exceeded the 75% quartile of 10-year TP data. Inflow into Hillsdale was 2.2 times higher than the 10-year average while lake surface elevation was also exceptionally high, combined with reduced outflows during the sample season. This creates a high phosphorus loading situation where more TP is entering the lake than is exiting. Lake sites are in the moderate to high range of biological productivity (eutrophic) leading to high algae populations and rapid fish growth.



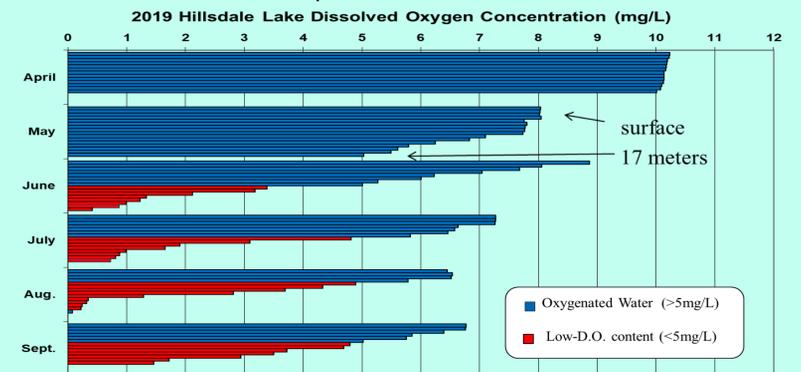
Total Nitrogen

Hillsdale Lake typically ranks below District lake average for total nitrogen (TN) in most years, including 2019. The water year for 2019 was a considered a flood year as lake surface elevation was more than 13' above conservation pool during the growing season. After an initial pulse of nitrogen from runoff, considerable de-nitrification through chemical and organic processes from June through September. Median TN values in 2019 were similar to 10-year medians at all respective sites including inflows. Median TN at the dam (HD-3) was below EPA Ecoregion recommended criteria in 2019. TN is a combination of inorganic forms which are available for plant/algae growth and the organic forms of nitrogen not immediately available. Bio-available forms of nitrogen were below laboratory detection limits in 50% of lake samples in 2019. Nitrogen compounds change forms frequently as atmospheric and terrestrial sources move into and through the aquatic environment.



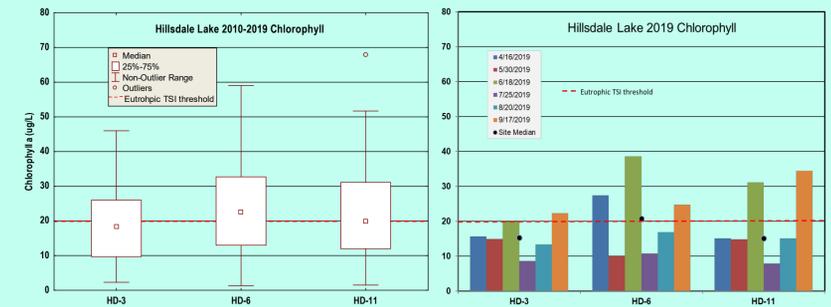
Dissolved Oxygen

Dissolved oxygen (D.O.) is an important factor in aquatic species location, growth, and ultimately survival in lakes. Some lakes undergo a process called stratification or develop layers based on temperature and oxygen. This process begins in late spring, remains throughout the summer, and breaks apart (i.e. de-stratifies or 'turns over') in the fall. The figure below shows dissolved oxygen measured in the water column in one-meter intervals (e.g. each row in each month represents one meter of depth) from April through September at the dam (HD-3). Hillsdale Lake typically stratifies during summer months and low oxygen concentration (<5 mg/L) can stress fish. In 2019, Hillsdale Lake stratification was evident in June through August. In the critical August period, only the top 4 meters of Hillsdale Lake had sufficient oxygen to provide optimal conditions for fish survival and growth. Signs of fish stress or fish kill was not reported.



Algae

Algae and green plants are the base of the food chain in aquatic food webs and convert nutrients and CO₂ through photosynthesis into biomass for all aquatic life. Chlorophyll is a measure of the active green pigment present in beneficial algae and harmful blue-green algae (cyanobacteria) active in this process. Chlorophyll is a critical measurement as it relates the plant nutrients (phosphorus and nitrogen), to biological productivity and trophic state related to algae (good and bad), aquatic invertebrate production, and fish growth. Median chlorophyll at all sites in 2019 were similar to 10-year medians, respectively. Summer chlorophyll values at HD-3 were in the mesotrophic or moderate level according to Carlson's Trophic State Index (Carlson, 1977). The mesotrophic level of production benefits the aquatic food web.



Water Quality Concerns:

- Eutrophication
- Dissolved Oxygen



US Army Corps of Engineers
Environmental Resources Section
Kansas City, MO