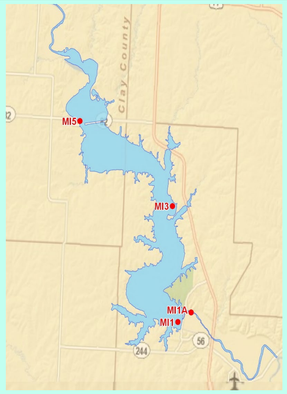
Milford Lake Water Quality Summary

2010-2019

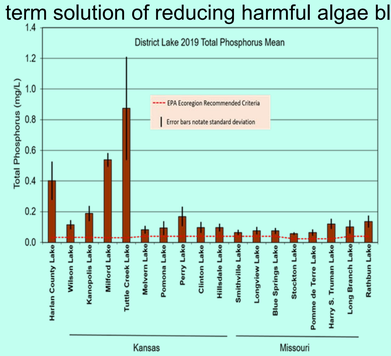
Milford Lake

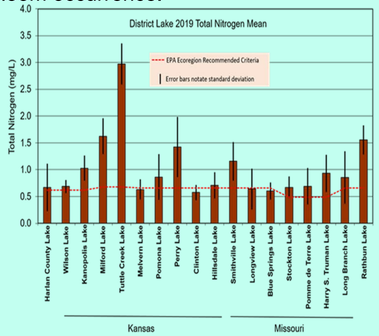


- Built on Republican River reaching full pool in 1967.
- **Watershed** = 17,388 square miles; 11,130,000 Surface Acres (SA)
- **Capacity**:
  - Flood Control: 756,669 Acre-feet (AF); 32,979 SA
  - Multipurpose: 388,816 AF; 15,709 SA; 163 miles of shoreline
  - 10-year avg. annual inflow=713,427 AF
  - 2019 inflow=2,004,214AF
- **Operating project purposes**: Flood control, water supply, water quality, navigation, recreation, and fish and wildlife conservation.
- **Water Quality** at Milford Lake in 2019 was beneficial to operating purposes listed above and measured parameters did not exceed KS State WQ Standards for designated uses. No harmful algae blooms were observed in 2019. High surface elevations and physical considerations limited swim beach access in 2019. Water quality generally improves as nutrients, herbicides and sediments are removed by settling, dilution, and biological processes as water moves from inflow streams to the dam.

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 defining lake productivity. In 2019, Milford had the second highest total phosphorus concentrations of all District lakes at the upper lake sites and the dam. Excess nutrients from urban, agricultural or natural sources increases the natural aging or eutrophication process and cause algal blooms, create low dissolved oxygen affecting fish survival, and lead to taste and odor issues in drinking water. Milford Lake is categorized as a hypereutrophic lake due to excessive phosphorus and extreme algae concentrations. Milford Lake experienced algal blooms with toxins present from 2011-2017 leading to significant recreational impacts ranging from health watch to lake closure. Blooms have been greatly reduced or non-factor in the last two years. Excessively high nutrient concentrations and history of harmful algae blooms have landed Milford Lake on the 2020 Kansas 303(d) list of impaired waters for eutrophication and low dissolved oxygen. Nine inflow stream(s) sections upstream from Milford Lake are also listed for nutrient related water quality impairments. State and federal agencies are working with water quality partners, landowners and Milford Lake Watershed Restoration and Protection Strategy (WRAPS) group to improve water quality at Milford Lake. WRAPS directs funding critical to implementing best management practices for target areas in the watershed to improve inflow water quality and reduce phosphorus loads. In 2018, Kansas Water Office (KWO) was awarded $2.88 million through the Natural Resources Conservation Service (NRCS) Regional Conservation Partnership Program (RCPP) to fund these water quality initiatives within the Milford Lake Watershed. This is a critical step in implementing the only widely recognized, long-term solution of reducing harmful algae bloom occurrence.



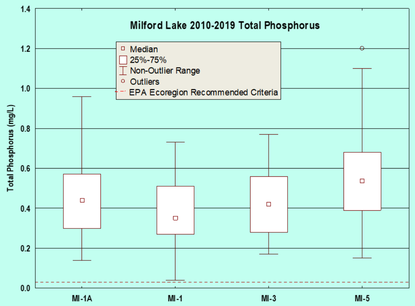


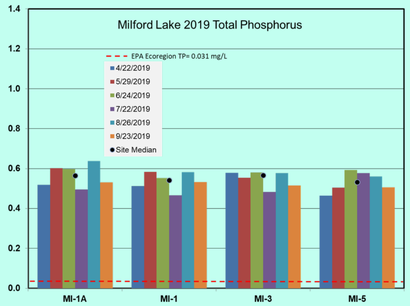
The US Army Corps of Engineers (USACE) Water Quality Program collects monthly water samples at Milford Lake* and inflows from April through September. These figures present data collected between 2010-2019 from three lake sites (MI-1, MI-3, MI-5) and the outflow (MI-1A). Thirty-four chemical, physical and biological parameters are measured to evaluate water quality. USACE use this data to describe conditions and changes from the inflows through the 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.

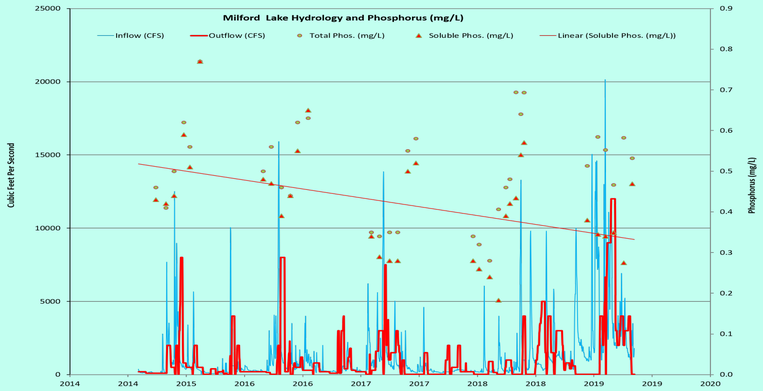
Phosphorus

Physical conditions and excessive nutrients in Milford Lake have caused significant toxic blue-green algae blooms in 2011, 2014-2017. Total phosphorus medians from lake sites in 2019 were 4 times greater than Carlson's hypereutrophic threshold and 10-20 times higher than EPA Ecoregion recommended criteria of 0.031 mg/L. Median total phosphorus from 2019 samples at lower lake sites MI-1 and MI-3 exceeded the 75% quartile of the 10-year TP data. Release of soluble phosphorus as orthophosphate from bed sediments (internal loading), was not apparent in 2019 due to large inflows and flood elevations driving the phosphorus cycle. Extreme phosphorus levels in Milford Lake are nearly 5x higher than average for District Lakes as shown in TP graph in left column.



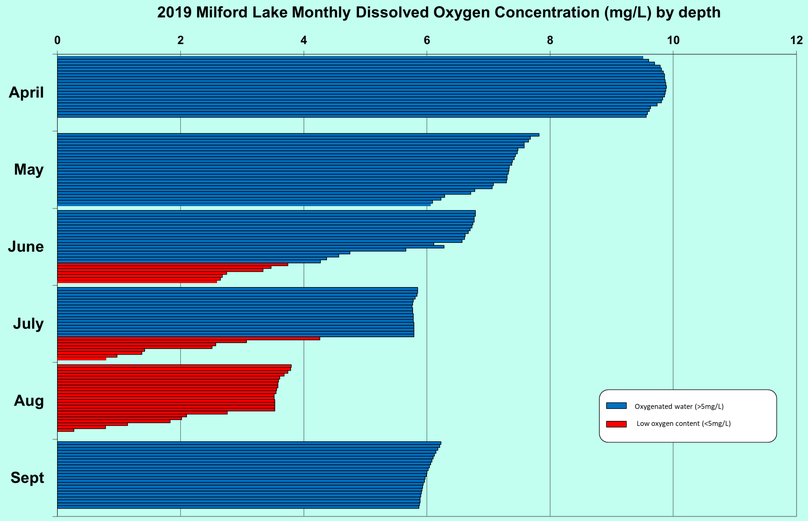


The phosphorus problem, specifically excess biologically available orthophosphate, fuels harmful algae blooms that have become a regular occurrence leading to significant impacts to recreation. Water releases from Milford May-July to meet Lake Level Management Plan targets appear to reduce phosphorus levels and reduce algae bloom conditions during those months. Flood releases at the end of the summer in 2019. graphed with red line, also moved phosphorus out of the lake and dissipated algae populations as they were forming. Median soluble phosphorus in 2017 and 2019 were well below the 5-year trend line. Concentration of total phosphorus related to organic forms incorporated in algae blooms and soluble forms released from sediments increase exponentially when discharge at outflow is reduced in late summer months.



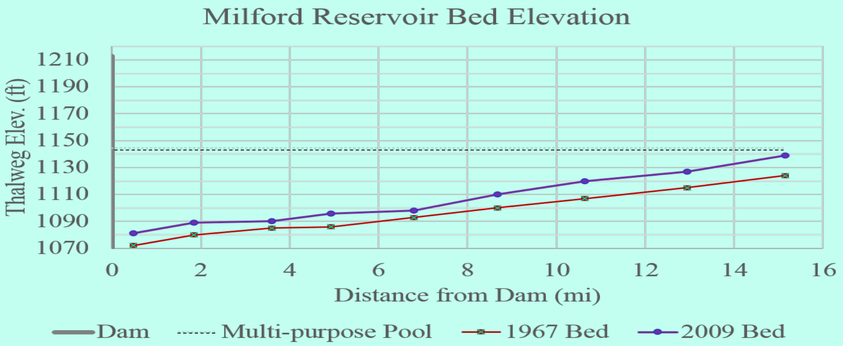
Dissolved Oxygen

Dissolved oxygen (D.O.) is a factor in aquatic species location, growth, and ultimately survival in lakes. In 2019, Milford Lake experienced strong thermal stratification. August inflows exceeded 100,000 cubic feet per second leading to increased biochemical oxygen demand and low D.O. at all depths at lake sites during August sampling. Oxygen consumption from algae decomposition can greatly reduce dissolved oxygen levels, but oxygen related fish kills have not been documented.



Sedimentation

The sedimentation rate in the multi-purpose pool of Milford Lake was 1,007 ac-ft/year from 1967 to 2009, which is 42% less than anticipated during the design of the dam and relatively lower than nearby reservoirs. Sediment accumulation decreases available water storage volume, depth, and surface area of the lake. The loss of depth in the main channel of the Republican River in Milford Lake ranges from 5 to 15 ft.



Water Quality Concerns:

- Eutrophication
- Nutrients
- Harmful algae blooms
- Sediment inputs

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