

April 2019

Alkaline Lake

(46.65672 N, -99.56475 W)

Kidder County

- Alkaline Lake is a popular natural lake in south-central North Dakota (Figure 1). See map at (<https://gf.nd.gov/gnf/maps/fishing/lakecontours/alkalinekidder2005.pdf>)
- There is one paved, public boat ramp on the southwest side of Alkaline Lake.
- The Alkaline Lake watershed is about 100,000 acres of mostly grassland/pasture and agricultural land. The most common crops grown are soybeans, spring wheat and non-alfalfa hay (Table 1).
- Alkaline Lake is a Class II fishery, which are “capable of supporting natural reproduction and growth of cool water fishes (e.g., northern pike and walleye) and associated aquatic biota.”
- Alkaline Lake is managed for walleye, with fingerlings stocked annually. Yellow perch and northern pike were also found during the last sample by the ND Game and Fish.
- Alkaline Lake was previously assessed in 2005-2006.

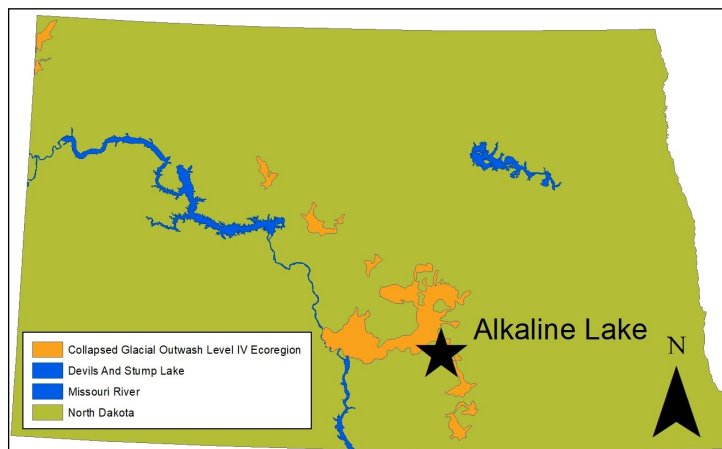


Figure 1. Location of Alkaline Lake within the state

Table 1. Percentage of land cover in the watershed and near the lake (NASS, 2015). Value listed of crop type represents percentage of total production.

Land Cover Type	% in Watershed	% within 500 meters
Grassland/Pasture	50.6%	39.2%
Agriculture	33.2%	38.6%
Soybeans	44.0%	40.2%
Spring Wheat	18.0%	10.2%
Other Hay/Non-Alfalfa	16.1%	18.6%
Open Water	9.6%	13.6%
Wetlands	3.9%	5.2%
Developed	2.7%	3.4%
Forest	< 0.1%	NA

Temperature and Dissolved Oxygen

- Alkaline Lake occasionally stratifies, with warm, well-oxygenated water at the top of the water column, and cold, low-oxygen water near the bottom.
- There was no thermal stratification in 2016. Temperature change in the water column was 1.69 degrees Celsius (°C), 0.12°C and 0.14°C in May, July and September, respectively.
- All samples showed most of the lake as well-oxygenated.

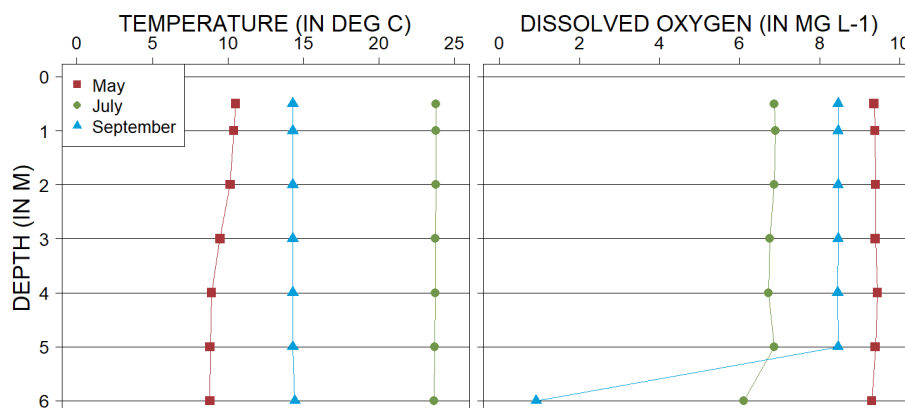


Figure 2. 2016 profiles of temperature (left) and dissolved oxygen (right) in milligrams per liter ($mg L^{-1}$)

Trophic State Indices

- Trophic state is a measure used by scientists to assess the condition (where lower scores indicate better water quality) of a lake using three common measures: total phosphorus (TP), Secchi disk transparency and chlorophyll-a concentration.
- Alkaline Lake is a eutrophic lake (Figure 3) that has relatively high nutrient concentrations but moderate algal growth.
- Current trophic state is similar to historical indices.
- There have been no confirmed *harmful* algal (cyanobacteria) blooms at Alkaline Lake.

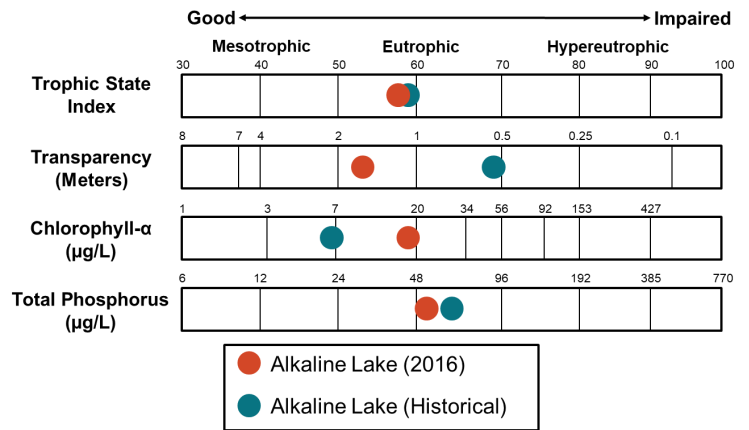


Figure 3. Trophic state indices for 2016 and historical samples

Nutrients

- Median concentration of total nitrogen (TN) in 2016 was less than the historical median but greater than the median for the Collapsed Glacial Outwash Level IV Ecoregion (hereafter, Glacial Outwash) where Alkaline Lake is located (Figure 4).
- Median concentration of dissolved TN was slightly less than TN.
- Median TP concentration in 2016 was slightly less than the historical median and the median for the Glacial Outwash (Figure 4).
- Median concentration of dissolved phosphorus was slightly less than TP.
- Ammonia was detected twice in Alkaline Lake in 2016, while there were no detections of nitrate plus nitrite.

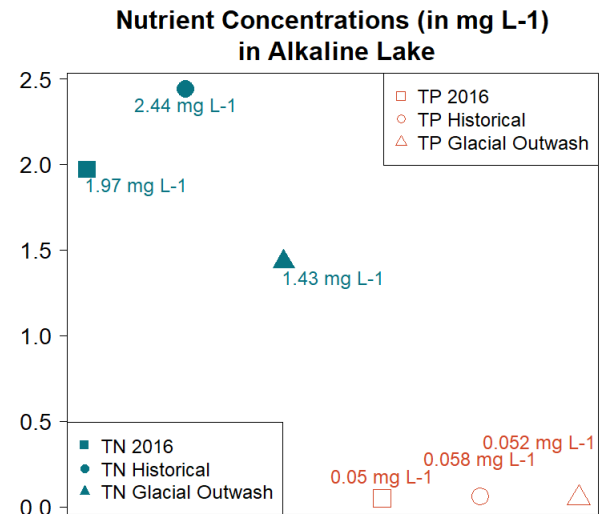


Figure 4. Median concentrations of TN and TP in mg L⁻¹ compared to regional medians

Water Chemistry

Table 2. Median concentrations of selected constituents for 2016 and historical samples and from all Glacial Outwash lakes.

Measure	2016 Median	Historical Median	Ecoregion Median
Alkalinity	608 mg L ⁻¹	733 mg L ⁻¹	466 mg L ⁻¹
Bicarbonate (HCO ₃ ⁻)	612 mg L ⁻¹	656 mg L ⁻¹	464 mg L ⁻¹
Calcium (Ca ²⁺)	21.8 mg L ⁻¹	15.0 mg L ⁻¹	25.3 mg L ⁻¹
Carbonate (CO ₃ ²⁻)	66 mg L ⁻¹	112 mg L ⁻¹	58 mg L ⁻¹
Conductivity	3,330 µS cm ⁻¹	4,210 µS cm ⁻¹	1,770 µS cm ⁻¹
Dissolved Solids	2,340 mg L ⁻¹	3,215 mg L ⁻¹	1,240 mg L ⁻¹
Magnesium (Mg ²⁺)	122 mg L ⁻¹	142 mg L ⁻¹	88 mg L ⁻¹
Sodium (Na ⁺)	589 mg L ⁻¹	871 mg L ⁻¹	163 mg L ⁻¹
Sulfate (SO ₄ ²⁻)	1,090 mg L ⁻¹	1,505 mg L ⁻¹	554 mg L ⁻¹

- Sulfate is the dominant anion in Alkaline Lake, while sodium is the dominant cation (Figure 5).
- Median concentrations of most cations and anions are less than the historical median for the lake and less than the median for the Glacial Outwash.

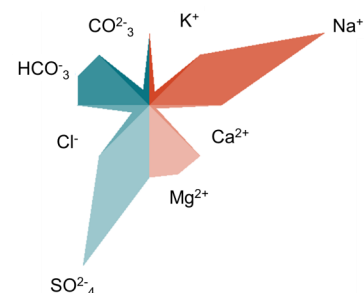


Figure 5. Maucha diagram showing ionic balance based on 2016 data