

April 2019

## Blue Lake

(47.54687 N, -100.75950 W)

### McLean County

- Blue Lake is a large, natural lake in central North Dakota (Figure 1).
- There is no public boat access at Blue Lake.
- The Blue Lake watershed is about 42,000 acres of mostly grassland/pasture and agricultural land. The most common crops grown are spring wheat, soybeans and canola (Table 1).
- Blue Lake is not defined in the state's water quality standards.
- Blue Lake is not managed as a fishery by the North Dakota Game and Fish, but the lake is connected to Brush Lake during times of high water allowing passage of game fish.
- Blue Lake was previously assessed in 1993 and 2009.

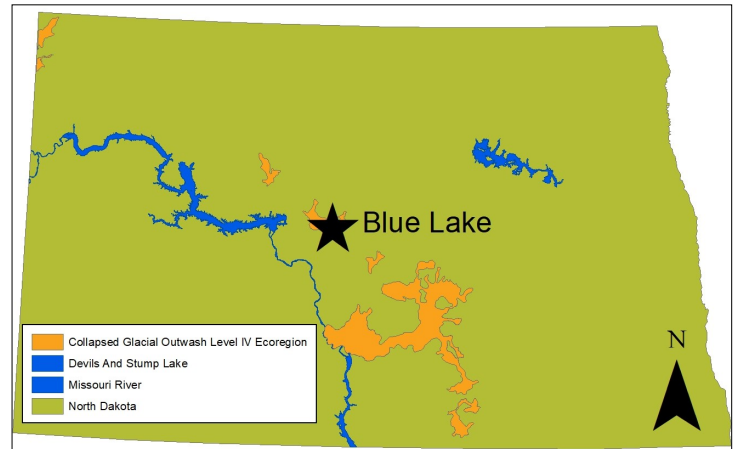


Figure 1. Location of Blue Lake within the state

Table 1. Percentage of land cover in the watershed and near the lake (NASS, 2017). Value listed of crop type represents percentage of total production.

Land Cover Type	% in Watershed	% within 500 meters
Grassland/Pasture	48.6%	61.0%
Agriculture	35.4%	11.7%
Spring Wheat	35.8%	8.3%
Soybeans	29.9%	10.0%
Canola	10.4%	65.9%
Open Water	6.5%	13.3%
Wetlands	4.9%	5.4%
Developed	4.3%	8.5%
Forest	0.4%	< 0.1%

## Temperature and Dissolved Oxygen

- Blue Lake rarely stratifies in the summer, with the lake being well-mixed most of the year.
- There was no thermal stratification in during any sample in 2018. Temperature change in the water column was 0.55 degrees Celcius (°C), 0.05°C and 0.08°C in May, July and September, respectively.
- All samples showed the lake as well-oxygenated.

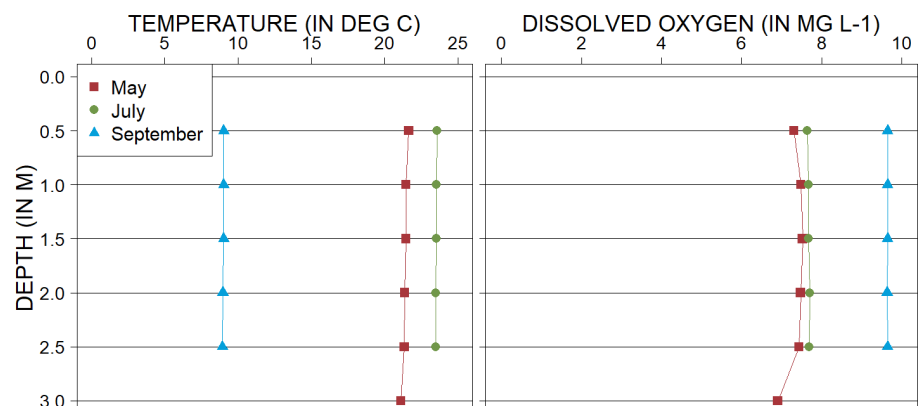


Figure 2. 2018 profiles of temperature (left) and dissolved oxygen (right) in milligrams per liter ( $mg L^{-1}$ )

## 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.
- Blue Lake is a eutrophic lake (Figure 3) that has moderate nutrient concentrations but low algal growth.
- Current trophic state is similar to historical indices, though there are large differences between phosphorus and chlorophyll scores.
- There have been no confirmed **harmful** algal (cyanobacteria) blooms at Blue Lake.

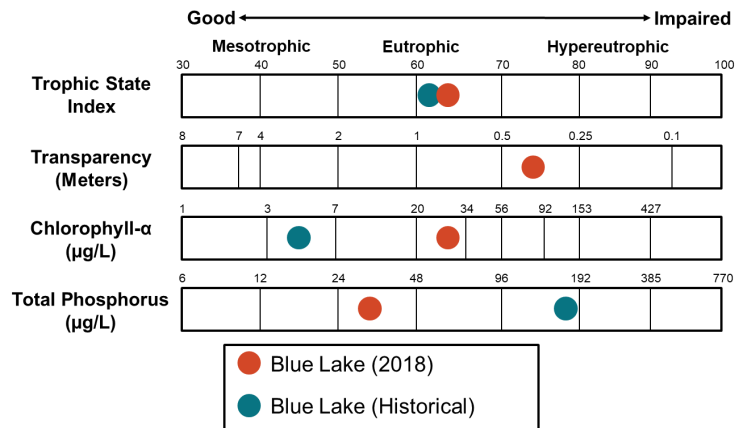


Figure 3. Trophic state indices for 2018 and historical samples

## Nutrients

- Median concentration of total nitrogen (TN) was lower in 2018 compared to the historical median but greater than the median for the Collapsed Glacial Outwash Level IV Ecoregion (hereafter, Glacial Outwash) where Blue Lake is located (Figure 4).
- Median concentration of dissolved TN was much less than TN.
- Median TP concentration was lower in 2018 compared to historical concentrations and the median for the Glacial Outwash (Figure 4).
- Median concentration of dissolved phosphorus was slightly less than TP.
- Ammonia and nitrate plus nitrite were not detected in Blue Lake in 2018.

**Nutrient Concentrations (in mg L<sup>-1</sup>) in Blue Lake**

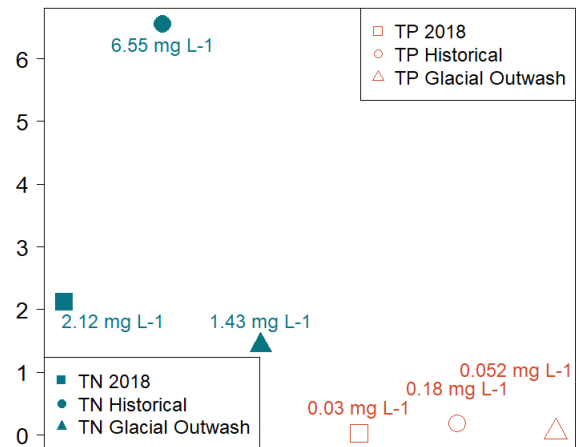


Figure 4. Median concentrations of TN and TP in mg L<sup>-1</sup> compared to regional medians

## Water Chemistry

**Table 2.** Median concentrations of selected constituents for 2018 and historical samples and from all Glacial Outwash lakes.

Measure	2018 Median	Historical Median	Ecoregion Median
Alkalinity	857 mg L <sup>-1</sup>	4,075 mg L <sup>-1</sup>	466 mg L <sup>-1</sup>
Bicarbonate (HCO <sub>3</sub> <sup>-</sup> )	726 mg L <sup>-1</sup>	2,385 mg L <sup>-1</sup>	464 mg L <sup>-1</sup>
Calcium (Ca <sup>2+</sup> )	6.8 mg L <sup>-1</sup>	5.0 mg L <sup>-1</sup>	25.3 mg L <sup>-1</sup>
Carbonate (CO <sub>3</sub> <sup>2-</sup> )	166 mg L <sup>-1</sup>	1,250 mg L <sup>-1</sup>	58 mg L <sup>-1</sup>
Conductivity	2,400 µS cm <sup>-1</sup>	10,850 µS cm <sup>-1</sup>	1,770 µS cm <sup>-1</sup>
Dissolved Solids	1,640 mg L <sup>-1</sup>	9,065 mg L <sup>-1</sup>	1,240 mg L <sup>-1</sup>
Magnesium (Mg <sup>2+</sup> )	109 mg L <sup>-1</sup>	163 mg L <sup>-1</sup>	88 mg L <sup>-1</sup>
Sodium (Na <sup>+</sup> )	436 mg L <sup>-1</sup>	2,835 mg L <sup>-1</sup>	163 mg L <sup>-1</sup>
Sulfate (SO <sub>4</sub> <sup>2-</sup> )	522 mg L <sup>-1</sup>	3,230 mg L <sup>-1</sup>	554 mg L <sup>-1</sup>

- Bicarbonate and sulfate are co-dominant anion in Blue 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 but greater than the median for the Glacial Outwash.

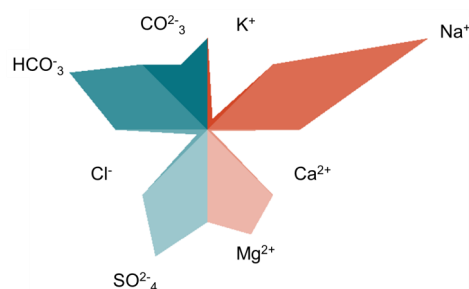


Figure 5. Maucha diagram showing ionic balance based on