NORTH Dakota | Environmental Quality

Be Legendary.™

Contact: Watershed Management Program

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March 2019

Lake Josephine

(47.18244 N, -100.00146 W)

Kidder County

- Lake Josephine is a large lake in central North Dakota (Figure 1). See map at (https://gf.nd.gov/gnf/maps/fishing/lakecontours/josephine2004.pdf).
- Lake Josephine is accessible by one public boat ramp on the south end of the lake.
- The Lake Josephine watershed is about 25,000 acres of mostly grassland/pasture, agricultural land and wetlands. The most common crops grown are spring wheat, soybeans and non-alfalfa hay (Table 1).
- Lake Josephine is a Class II fishery, which means it is "capable of supporting natural reproduction and growth of cool water fishes (e.g., northern pike and walleye) and associated aquatic biota."
- The lake is primarily managed for walleye, with fingerlings stocked annually. Northern pike and yellow perch are also found in the lake.
- Lake Josephine was previously assessed in 2005-2006.

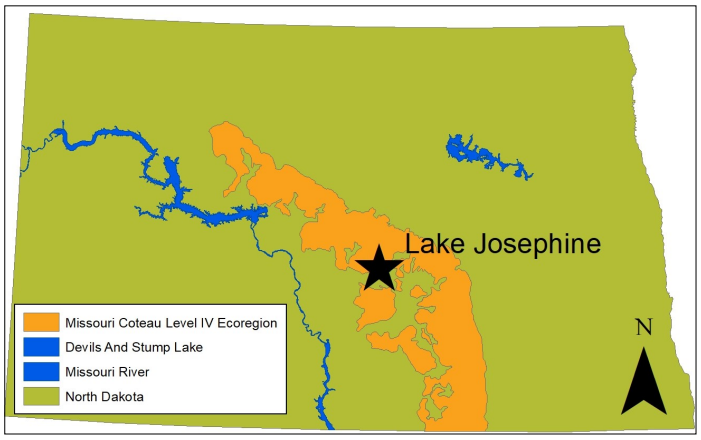

Figure 1. *Location of Lake Josephine within the state*

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	53.0%	69.2%
Agriculture	25.6%	16.3%
Soybeans	*35.7%*	*5.8%*
Spring Wheat	*26.7%*	*0.4%*
Other Hay/Non-Alfalfa	*19.7%*	*81.1%*
Open Water	15.4%	8.0%
Wetlands	3.4%	3.5%
Developed	2.6%	3.1%
Forest	0.1%	NA

Temperature and Dissolved Oxygen

- Lake Josephine rarely stratifies in the summer, with the majority of the water column typically well-oxygenated
- There was no thermal stratification recorded in 2018. Temperature change in the water column was 0.74 degrees Celsius (ºC), 0.03ºC and 0.02ºC in May, July and September, respectively (Figure 2).
- All samples in 2018 showed the lake as well-oxygenated.

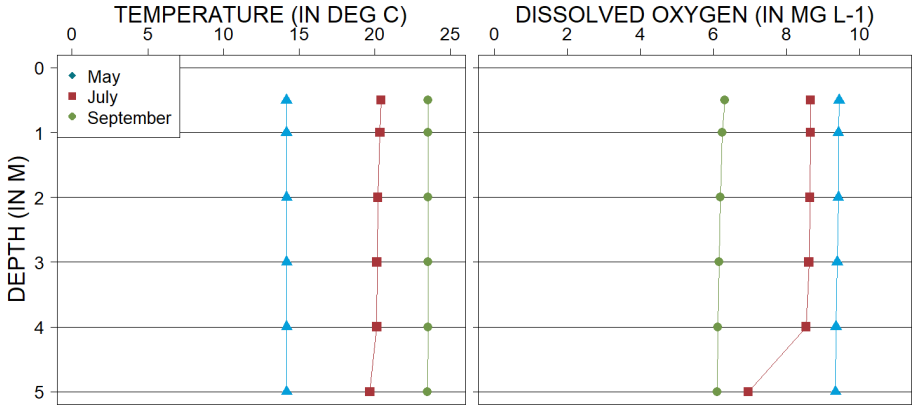

Figure 2. *2018 profiles of temperature (left) and dissolved oxygen (right) in milligrams per liter (mg L^{-1})*

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.
- Lake Josephine is a eutrophic lake (Figure 3) that has relatively moderate nutrient concentrations and moderate algal growth.
- Trophic state has improved compared to historical indices.
- There have been no confirmed ***harmful*** algal (cyanobacteria) blooms at Lake Josephine, but NDDoH has investigated several reports.

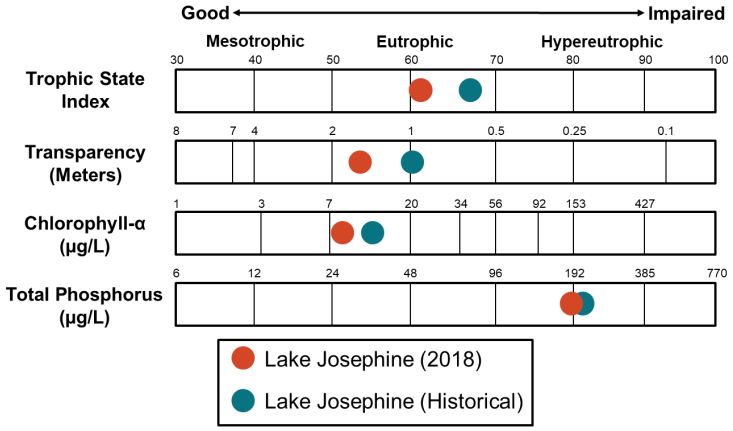

Figure 3. *Trophic state indices for 2018 and historical samples*

Nutrients

- Median concentration of total nitrogen (TN) was less in 2018 compared to the historical median but greater than the median for the Missouri Coteau Level IV Ecoregion (hereafter, Missouri Coteau) where Lake Josephine 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 but greater than the median for the Missouri Coteau (Figure 4).
- Median concentration of dissolved phosphorus was similar to TP.
- Ammonia and nitrate plus nitrite were detected in most samples in 2018, but were found in relatively low concentrations.

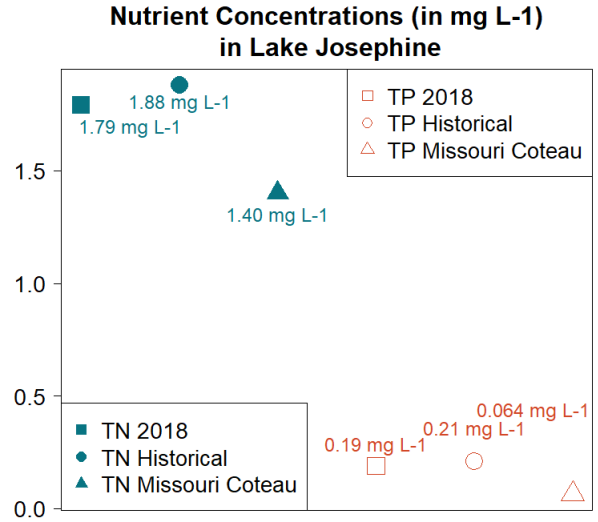

Figure 4. *Median concentrations of TN and TP in mg L^{-1} compared to regional medians*

Water Chemistry

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

Measure	2018 Median	Historical Median	Ecoregion Median
Alkalinity	555 mg L^{-1}	647 mg L^{-1}	274 mg L^{-1}
Bicarbonate (HCO^-_3)	572 mg L^{-1}	643 mg L^{-1}	289 mg L^{-1}
Calcium (Ca^{2+})	30.5 mg L^{-1}	32.6 mg L^{-1}	39.8 mg L^{-1}
Carbonate (CO^{2-}_3)	55 mg L^{-1}	74 mg L^{-1}	21 mg L^{-1}
Conductivity	1,940 µS cm^{-1}	2,025 µS cm^{-1}	1,010 µS cm^{-1}
Dissolved Solids	1,320 mg L^{-1}	1,385 mg L^{-1}	642 mg L^{-1}
Magnesium (Mg^{2+})	85.9 mg L^{-1}	77.6 mg L^{-1}	72.4 mg L^{-1}
Sodium (Na^+)	308 mg L^{-1}	318 mg L^{-1}	62 mg L^{-1}
Sulfate (SO^{2-}_4)	504 mg L^{-1}	514 mg L^{-1}	239 mg L^{-1}

- Bicarbonate and sulfate are co-dominant anions in Lake Josephine, while sodium is the dominant cation (with magnesium being relatively high also) (Figure 5).
- Median concentrations of most cations and anions are lower than the historical median for the lake but greater than the median concentration for the Missouri Coteau.

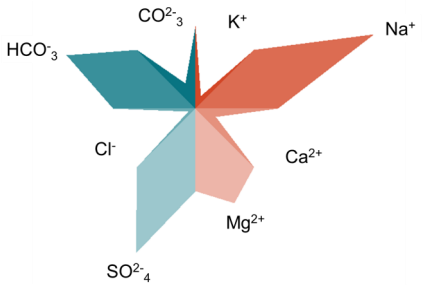

Figure 5. *Maucha diagram showing ionic balance based on 2018 data*