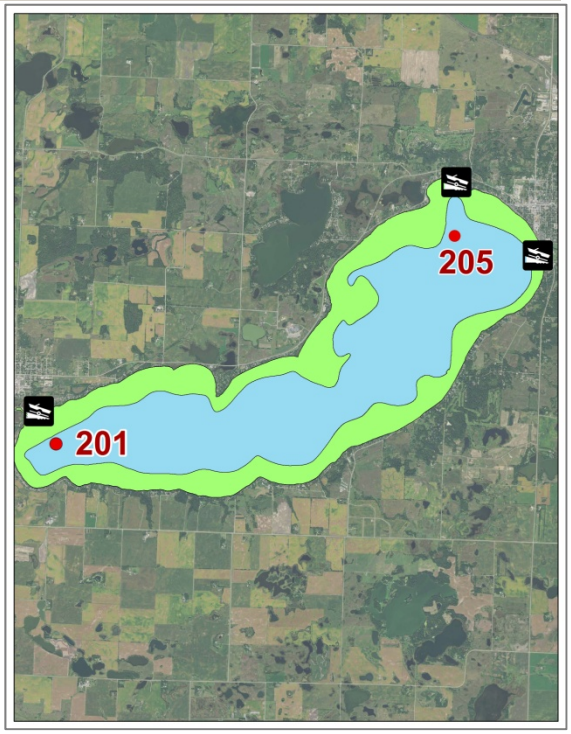
# Lake Minnewaska

# Pope County

## Summary

Lake Minnewaska is a moderately deep eutrophic lake. Algae concentration results (chlorophyll a) show that the lake experiences some algae blooms every summer. In the past two years (2015-2016), the transparency has increased and the amount of algae in the water has decreased. This could be due to zebra mussels filtering the water column. Lake Minnewaska has a good amount of historical water quality monitoring data, which makes a lake evaluation like this possible. Monitoring should continue to enable future water quality analyses.




## Lake Vitals

| | |
|---|---|
| MN Lake ID: | 61-0130-00 |
| Ecoregion: | North Central Hardwood Forest |
| Major Watershed: | Chippewa River |
| Surface area (acres): | 8050.3 |
| Littoral area (acres): | 3290.9 |
| % Littoral area: | 40.9% |
| Max depth: | 32(ft) 9.8(m) |
| Aquatic Invasive Species: | Zebra Mussels, Eurasian Milfoil |

## Water Quality Characteristics

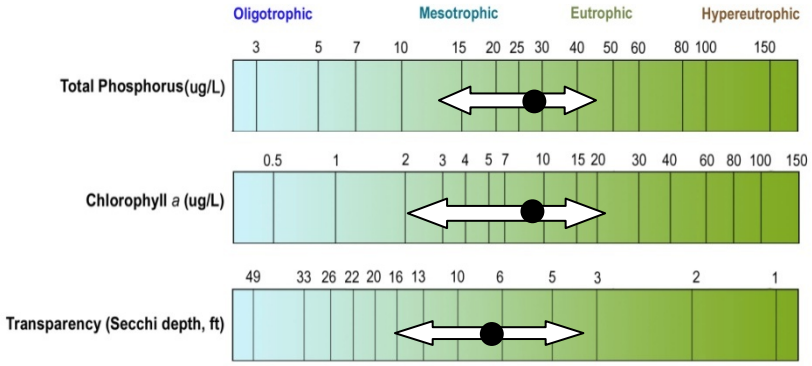
Years monitored: 1996 - 2016

| Parameters | West | East |
|---|---|---|
| Total Phosphorus Mean (ug/L): | 28.8 | 28.8 |
| Total Phosphorus Min (ug/L): | 12.0 | 14.0 |
| Total Phosphorus Max (ug/L): | 65.0 | 65.0 |
| Number of Observations: | 98 | 98 |
| Chlorophyll-a Mean (ug/L): | 8.5 | 8.8 |
| Chlorophyll-a Min (ug/L): | <1 | <1 |
| Chlorophyll-a Max (ug/L): | 28.0 | 34.0 |
| Number of Observations: | 86 | 86 |
| Secchi Depth Mean (ft): | 9.4 | 8.7 |
| Secchi Depth Min (ft): | 4.5 | 3.5 |
| Secchi Depth Max (ft): | 23.0 | 19.0 |
| Number of Observations: | 97 | 98 |

### Trophic State Index

Trophic State: Eutrophic (50)

The figure below shows the minimum and maximum values with the arrows and the mean with the black dot (site 201).




## Ecoregion Comparisons

(Primary site only. Comparisons are based on interquartile range, 25th - 75th percentile, for ecoregion reference lakes)

| | |
|---|---|
| Ecoregion: | North Central Hardwood Forest |
| Total Phosphorus: | Within Expected Range |
| Chlorophyll-a: | Within Expected Range |
| Secchi Depth: | Within Expected Range |

# Trend Analysis Report

In assessing water quality, agencies and other lake data users want to know if the amount of algae has been changing over time. Scientists test hypotheses using statistics, and the hypothesis used in a trend analysis is that no trend exists. In other words, we begin with the assumption that there is no trend. We collect data and use statistics to determine the probability of collecting our data if this hypothesis of no trend is indeed true. The output from a statistical test is called the probability value (or p-value for short) of collecting data given the hypothesis of no trend is true. The smaller this probability value, the more likely the null hypothesis of no trend can be rejected. The MPCA has set the acceptable p-value to be less than 10%. In other words, if $p < 0.10$ we reject the hypothesis of no trend and accept that a trend likely exists. Another way to think of this is to say that there is in reality an existing trend, there is a 90% chance we would have collected the data we collected and that a 10% chance that the trend is a random result of the data. For detecting trends, a minimum of 8-10 years of data with four or more readings per season are recommended by the MPCA. Where data does not cover at least eight years or where there are only few samples within a year, trends can be misidentified because there can be different wet years and dry years, water levels, weather, and etc., that affect the water quality naturally.

Lake Minnewaska had enough data to perform a trend analysis for all three parameters (Table 1). The data was analyzed using the Mann Kendall Trend Analysis.

Table 1. Trend analysis for Lake Minnewaska .

| Lake Site | Parameter | Date Range | Trend | Probability |
|---|---|---|---|---|
| West | Total Phosphorus | 1996-2016 | Improving | 99% |
| West | Chlorophyll *a* | 1993-2013 | No trend | |
| West | Chlorophyll *a* | 1993-2016 | Improving | 95% |
| West | Transparency | 1996-2013 | Decreasing | 99.9% |
| West | Transparency | 1996-2016 | No Trend | - |
| East | Total Phosphorus | 1996-2016 | Improving | 95% |
| East | Chlorophyll *a* | 1996-2016 | Improving | 90% |
| East | Transparency | 1996-2013 | Decreasing | 95% |
| East | Transparency | 1996-2016 | No Trend | - |

Lake Minnewaska data are showing some changes in the lake's condition. There is evidence of a declining transparency trend from 1996-2013, but no trend from 1996-2016 (Figure 11). Zebra mussels were discovered in Lake Minnewaska in 2012. Usually they take about two years to start impacting water clarity, so it could be that the zebra mussels have improved water transparency in Lake Minnewaska in 2015-2016. The chlorophylla has also decreased in 2015-2016, which could be due to Zebra mussels (Figure 12). Monitoring should continue so that these trends can be tracked in future years. Due to Zebra mussels, the transparency and algae will not follow phosphorus levels anymore.