

Big Rice Lake 11-0073-00 CASS COUNTY

Summary



Big Rice Lake is located in Cass County, five miles south of Remer, MN. With a surface area of 2,030 acres, it is in the upper 10% of lakes in Minnesota in terms of its size.

Big Rice Lake is located in the Mississippi River – Grand Rapids Major Watershed. It receives water from Big Thunder Lake through its southern inlet. Big Rice Lake drains into various lakes in Itasca and Aitkin counties.

The shallow nature of the lake would suggest that it does not behave like a typical lake of its size in northern Minnesota. It is better described as a marsh. The entire lake can be considered littoral (shallow enough for sunlight to reach the bottom and plants to grow), and one could expect a dense and diverse aquatic plant community. DNR vegetation surveys indicate that much of the lake contains emergent vegetation including waterlilies, wild rice, bulrush and cattails. Most of the land around Big Rice Lake is governmentally owned.

Data is limited for Big Rice Lake; however, due to the wetland complex it is a part of, and the lack of development around the lake, it is not considered a high priority for a monitoring program.

Vitals

MN Lake ID:	11-0073-00
County:	Cass
Ecoregion:	Northern Lakes and Forest
Major Drainage Basin:	Upper Mississippi River
Latitude/Longitude:	46.989152/-93.933105
Water Body Type:	P
Monitored Sites (Primary):	101
Monitored Sites (Secondary):	None
Invasive species present:	none documented

Physical Characteristics

Surface area (acres):	2,030
Littoral area (acres):	2,030
% Littoral area:	100%
Max depth (ft):	3 - 5
Mean depth (ft):	NA
Lakeshed size (acres):	9,048
Lakeshed:lake area ratio	4.5:1
Inlets	2
Outlets	1
Accesses	2

Data Availability

Transparency data



Transparency data exist only from 2008.

Chemical data



Total phosphorus and chlorophyll a data were collected by the DNR as one data point in each 1990, 2004 and 2007, and from the MPCA as 5 data points in 2008.

Inlet/Outlet data



No inlet or outlet data exist for Big Rice Lake.

Recommendations

For recommendations see page 8.

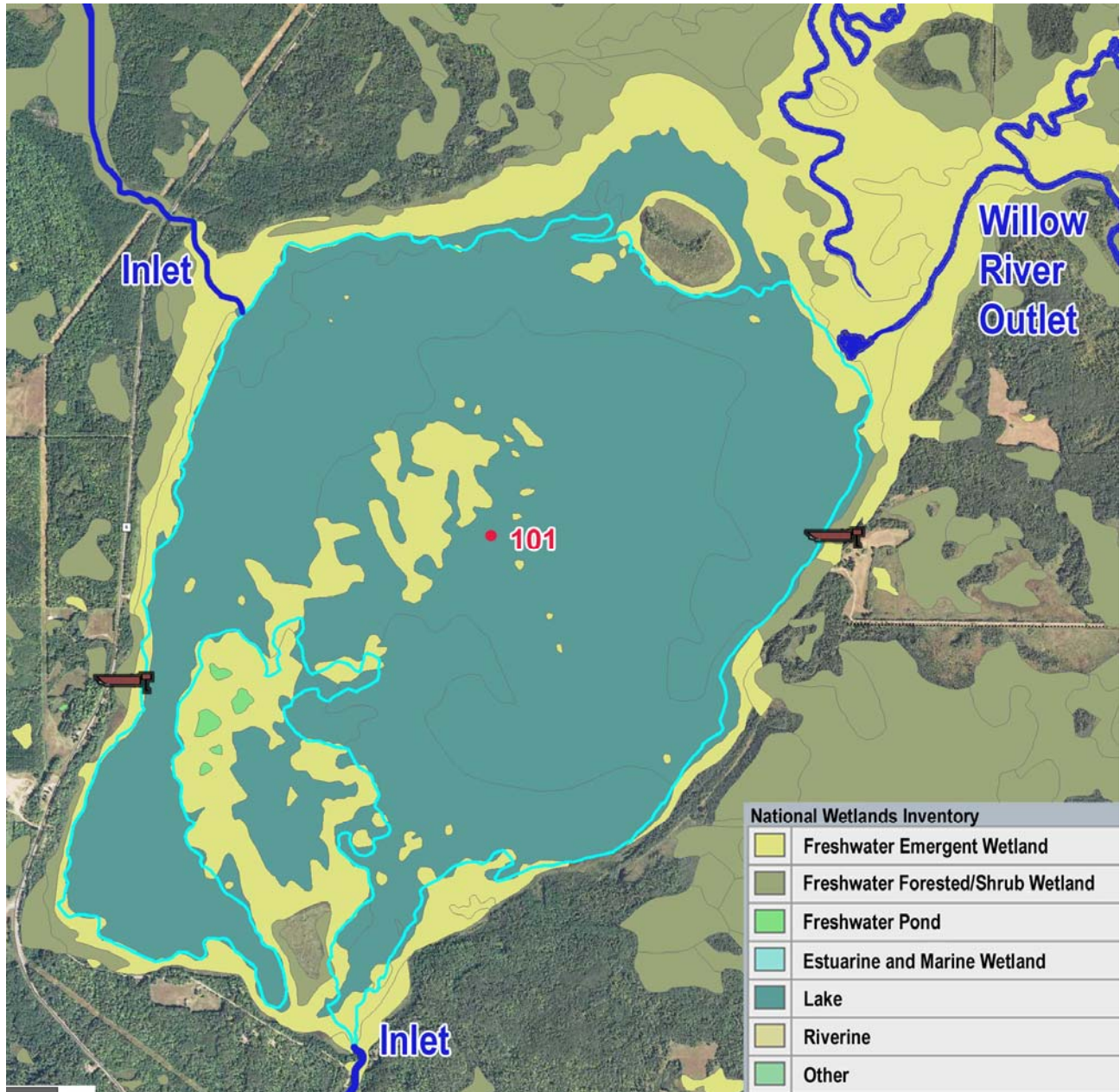


Figure 1. Map of Big Rice Lake with aerial land use and wetlands inventory. The entire lake is littoral, which means it is shallow enough for plants to grow.

Lake Site	Depth (ft)	Monitoring Programs
101* Primary Site	3	MPCA: 2008; DNR: 1990, 2004, 2007

The information below describes available chemical data for Big Rice Lake through 2008. The data set is limited, and all parameters are means for just 1990, 2004, 2007-2008 data.

Minnesota is divided into seven ecoregions based on land use, vegetation, precipitation and geology. The MPCA has developed a way to determine the "average range" of water quality expected for lakes in each ecoregion. For more information on ecoregions and expected water quality ranges, see page 7.

Parameter	Mean	Ecoregion Range ¹	Impaired Waters Standard ²	Interpretation
Total phosphorus (ug/L)	23	14 - 27	> 35	Due to the shallow nature of the lake (max depth 3-5 ft), it is not beneficial to compare Big Rice Lake to the Ecoregion averages for total phosphorus and secchi depth.
³ Chlorophyll a (ug/L)	2.5	4 - 10	> 12	
Chlorophyll a max (ug/L)	6.4	<15		
Secchi depth (ft)	3	7.5 - 15	< 4.5	
Dissolved oxygen	<i>see page 6</i>			Big Rice Lake is shallow and polymictic (mixes all summer).
Total Kieldahl Nitrogen (mg/L)	0.6	0.4 - 0.75		Indicates insufficient nitrogen to support summer nitrogen-induced algae blooms.
Alkalinity (mg/L)	136	40 - 140		Big Rice Lake is a medium hard water lake. Big Rice Lake alkalinity indicates a low sensitivity to acid rain and a good buffering capacity.
Color (Pt-Co Units)	27	10 - 35		Indicates semi-clear water with some tannins (brown stain), which are common in wetlands.
pH	7.7	7.2 - 8.3		Within the average ecoregion range. Lake water pH less than 6.5 can affect fish spawning and the solubility of metals in the water.
Chloride (mg/L)	3.2	0.6 - 1.2		Slightly higher than the ecoregion average, but still considered low level.
Total Suspended Solids (mg/L)	2.7	<1 - 2		Indicates clear water and low suspended solids.
Conductivity (umhos/cm)	237	50 - 250		Conductivity is within the expected range for the ecoregion.
Total Nitrogen :Total Phosphorus	45:1	25:1 – 35:1		Indicates the lake is phosphorus limited, which means that algae growth is limited by the amount of phosphorus in the lake.

Data Source: DNR Fisheries Surveys 1990, 2004, 2007; MPCA 2008; Chippewa National Forest 1999, 2003

¹The ecoregion range is the 25th-75th percentile of summer means from ecoregion reference lakes

²For further information regarding the Impaired Waters Assessment program, refer to <http://www.pca.state.mn.us/water/tmdl/index.html>

³Chlorophyll a measurements have been corrected for pheophytin

Units: 1 mg/L (ppm) = 1,000 ug/L (ppb)

Water Quality Characteristics - Historical Means

Years monitored: 1990, 2004, 2007, 2008

Parameters	Site 101
Total Phosphorus (ug/L):	16
Total Phosphorus Min:	7
Total Phosphorus Max:	33
Number of Observations:	8
Chlorophyll a Mean (ug/L):	3
Chlorophyll a Min:	1
Chlorophyll a Max:	6
Number of Observations:	7
Secchi Depth Mean (ft):	3
Secchi Depth Min:	2
Secchi Depth Max:	4
Number of Observations:	5

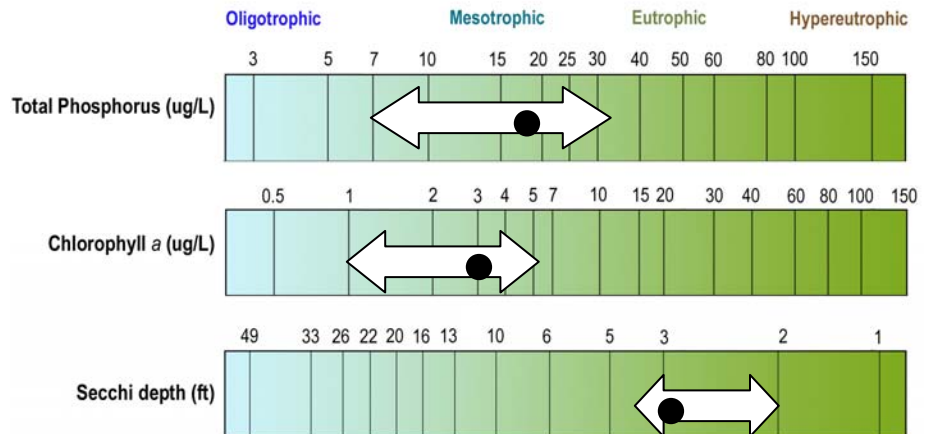


Figure 2. Big Rice Lake total phosphorus, chlorophyll a and transparency historical ranges. The arrow represents the range and the black dot represents the historical mean. Figure adapted after Moore and Thornton, [Ed.]. 1988. Lake and Reservoir Restoration Guidance Manual. (Doc. No. EPA 440/5-88-002)

Transparency (Secchi Depth)

Transparency is how easily light can pass through a substance. In lakes it is how deep sunlight penetrates through the water. Plants and algae need sunlight to grow, so they are only able to grow in areas of lakes where the sun penetrates. Water transparency depends on the amount of particles in the water. An increase in particulates results in a decrease in transparency.

Big Rice Lake Secchi data is not representative of the lake water quality since it was clear down to the bottom of the lake. The maximum depth at the sample site was 3 feet and the secchi depth was also 3 feet. Using total phosphorus and chlorophyll a data to characterize the lake will be more representative of in-lake conditions.

User Perceptions

User perceptions do not apply to Big Rice Lake because the lake is not used for recreational activities such as swimming.

Total Phosphorus

Big Rice Lake is phosphorus limited, which means that algae and aquatic plant growth is dependent upon available phosphorus.

Total phosphorus was evaluated in Big Rice Lake by the DNR in 1990, 2004 and 2007, but the data consist of just one data point for each year. In 2008, the MPCA monitored the lake and collected a full season of data points (Fig 3). The data indicate very consistent phosphorus levels from the beginning of the summer to the end.

Since Big Rice Lake is shallow and is surrounded by wetland, it probably doesn't need to be monitored each year because there shouldn't be much change in water quality.

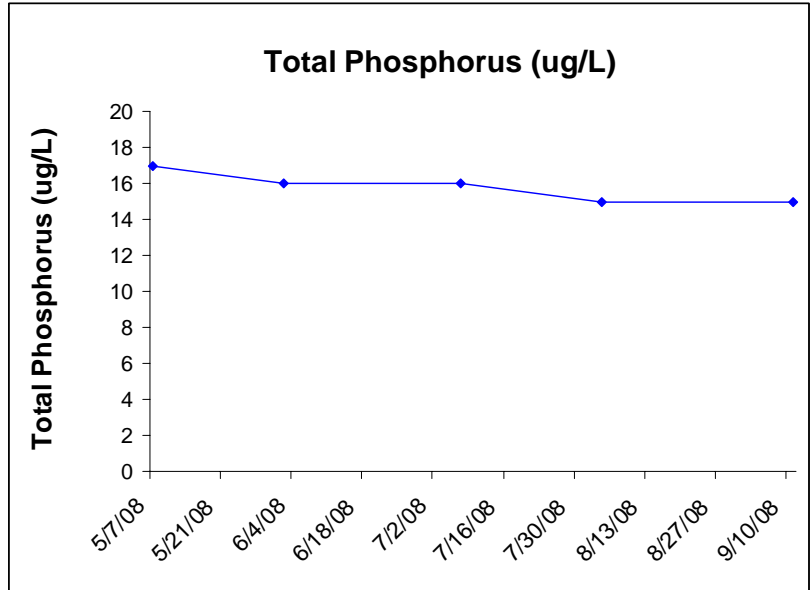


Figure 3. Historical total phosphorus concentrations (ug/L) for Big Rice Lake (data set from 2008).

Chlorophyll *a*

Chlorophyll *a* is the pigment that makes plants and algae green. Chlorophyll *a* is tested in lakes to determine the algae concentration or how "green" the water is.

Chlorophyll *a* concentrations greater than 10 ug/L are perceived as a mild algae bloom, while concentrations greater than 20 ug/L are perceived as a nuisance.

Big Rice Lake was monitored by the DNR in 2004 and 2007, but the data consist of just one data point for each year. In 2008, the MPCA monitored the lake and collected a full season of data points (Fig 4). Chlorophyll *a* concentrations remained relatively consistent throughout the season and remained below 10 ug/L, indicating clear water most of the summer.

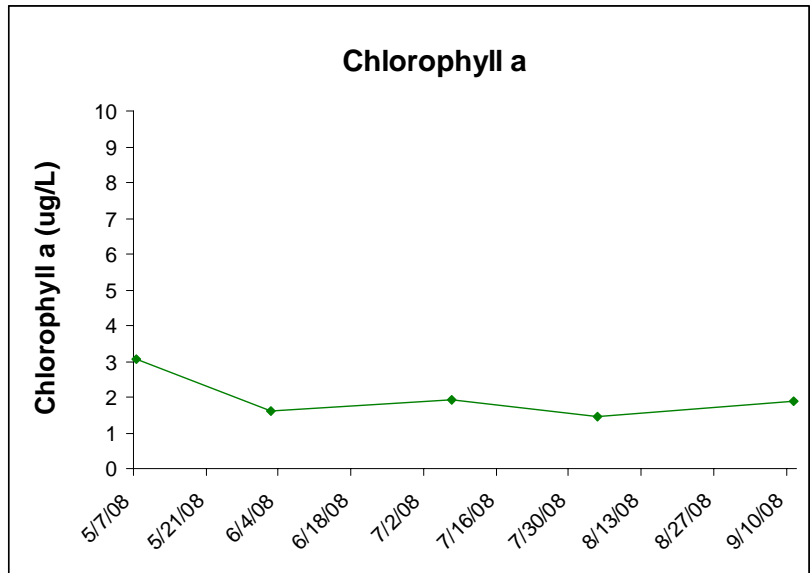


Figure 4. Chlorophyll *a* concentrations (ug/L) for Big Rice Lake (data set from 2008).

Dissolved Oxygen

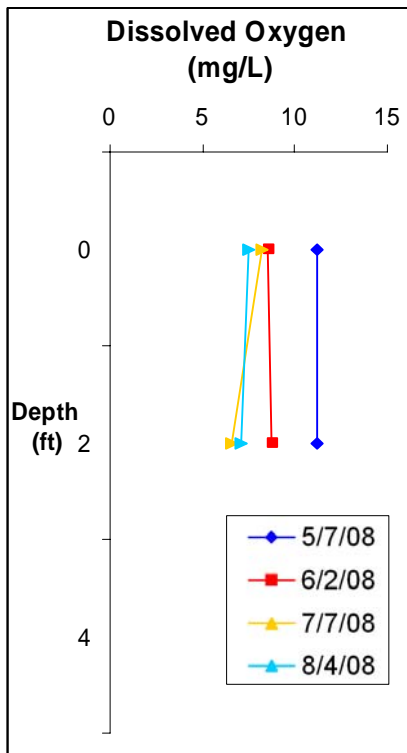


Figure 5. Dissolved oxygen profile for Big Rice Lake in 2008.

Dissolved Oxygen (DO) is the amount of oxygen dissolved in lake water. Oxygen is necessary for all living organisms to survive, except for some bacteria. Living organisms breathe in oxygen that is dissolved in the water. Dissolved oxygen levels of <5 mg/L are typically avoided by game fish.

Big Rice Lake is a very shallow lake, with a maximum depth of 3-5 feet. Due to its shallow nature, the lake is polymictic (mixes often throughout the summer). Any windy day will be enough to cause the lake to mix.

The dissolved oxygen data collected by the MPCA in 2008 show that the lake remains oxygenated throughout the water column all summer (Figure 5).

Additionally, due to its shallow nature the lake experiences winterkill. The DNR reported that due to the winterkill situation and shallow depth, it is suspected that many of the fish that spend the summer in Big Rice Lake move into the Willow River and also upstream to the pugholes during the fall and winter months. During the early spring months many fish return to Big Rice Lake.

Trend Analysis

For detecting trends, a minimum of 8-10 years of data with 4 or more readings per season are recommended. Minimum confidence accepted by the MPCA is 90%. This means that there is a 90% chance that the data are showing a true trend and a 10% chance that the trend is a random result of the data. Only short-term trends can be determined with just a few years of data, because there can be different wet years and dry years, water levels, weather, etc, that affect the water quality naturally.

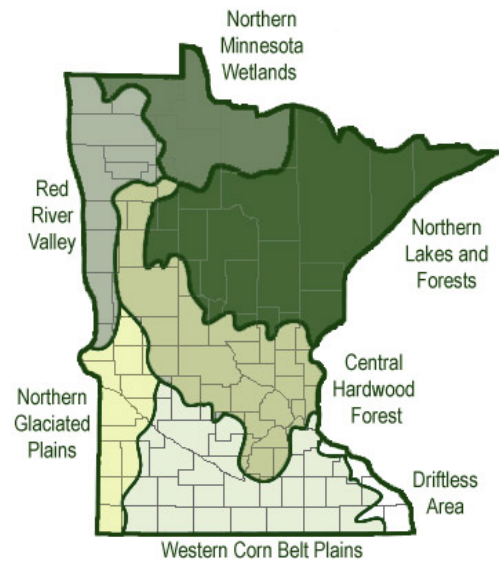
There is not enough historical data to perform trend analysis for transparency, total phosphorus or chlorophyll a on Big Rice Lake.

Trophic State Index

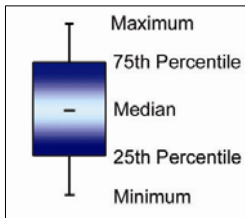
The Trophic State Index is not useful for describing Big Rice Lake. The shallow nature of the lake (max depth 3-5 feet) would suggest that it does not behave like a typical lake of its size in northern Minnesota. In shallow lakes there are different dynamics occurring than deep lakes, and total phosphorus, chlorophyll a and secchi depth are not as closely related.

Ecoregion Comparisons

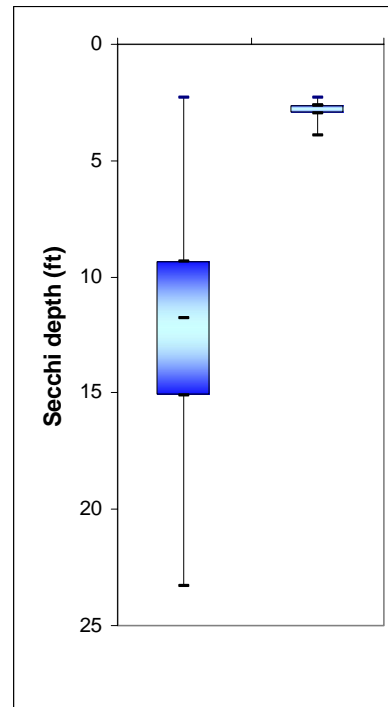
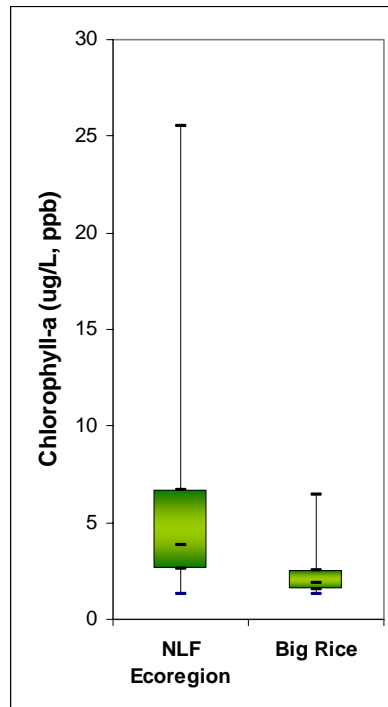
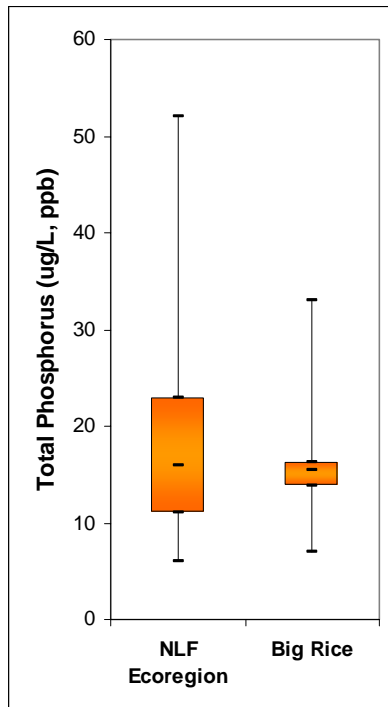
Minnesota is divided into seven ecoregions based on land use, vegetation, precipitation and geology. The MPCA has developed a way to determine the "average range" of water quality expected for lakes in each ecoregion. From 1985-1988, the MPCA evaluated the lake water quality for reference lakes. These reference lakes are not considered pristine, but are considered to have little human impact and therefore are representative of the typical lakes within the ecoregion. The "average range" refers to the 25th - 75th percentile range for data within each ecoregion. For the purpose of this graphical representation, the means of the reference lake data sets were used.



Big Rice Lake is in the Northern Lakes and Forests (NLF) Ecoregion. The total phosphorus and chlorophyll a for Big Rice Lake are within the expected ecoregion ranges (Figures 6a-c).



The transparency is lower than the ecoregion average (Figure 6c); however, the secchi disk was always seen clear to the bottom of the lake, so the transparency is not a good indicator of water quality in Big Rice Lake.



↑ increased algae
↓ crystal clear

Figures 6a-c. Big Rice Lake ranges compared to Northern Lakes and Forest Ecoregion ranges. The Big Rice Lake total phosphorus, chlorophyll a, and secchi depth ranges are from 5 data points collected in May-September of 2008.

Inlet/Outlet Data Assessment

No inlet or outlet data exist for Big Rice Lake.

Assessment/Findings Recommendations

Transparency

Transparency is not a good indicator of water quality in Big Rice Lake because the secchi disk can be seen clear to the bottom of the lake.

Impaired Waters Assessment 303(d) List

There are two main types of Impaired Waters Assessment for lakes: eutrophication (phosphorus) for aquatic recreation and mercury in fish tissue for aquatic consumption. Big Rice Lake is not listed as impaired for mercury in fish tissue.

As of the date of this report, the Big Rice Lake data set is insufficient for Impaired Waters Assessment for eutrophication. A data set of 10 data points each of total phosphorus, chlorophyll *a*, and secchi depth over a two-year period in the past 10 years is required for eutrophication assessment. Scheduling one more year of chemical data collection before 2016 would complete this assessment data set (see standards on page 3).

Aquatic Recreational Use Assessment 305(b)

In the 2008 MPCA Aquatic Use Assessment (305(b)), Big Rice Lake did not have enough data to be included this assessment.

Organizational contacts and reference sites

Chippewa National Forest	200 Ash Avenue NW, Cass Lake, MN 56633 (218) 335-8600 http://www.fs.fed.us/r9/forests/chippewa/
Cass County Environmental Services Department	303 Minnesota Avenue W, P.O. Box 3000, Walker, MN 56484 (218) 547-7241 http://www.co.cass.mn.us/esd/home_esd.html
DNR Fisheries Office	7316 State Hwy 371 NW, Walker, MN 56484 (218) 547-1683 http://www.dnr.state.mn.us/lakefind/index.html
Regional Minnesota Pollution Control Agency Office	7678 College Road, Suite 105, Baxter, MN 56425 (218) 828-2492 http://www.pca.state.mn.us
Regional Board of Soil and Water Resources Office	1601 Minnesota Drive, Brainerd, MN 56401 (218) 828-2383 http://www.bwsr.state.mn.us