

Steamboat Lake 11-0504-00 CASS COUNTY

Summary



Steamboat Lake is located eight miles south of Cass Lake, MN in Cass County. It covers 1,756 acres, which places it in the upper 10% of lakes in Minnesota in terms of size.

Steamboat Lake lies in the northwest corner of the Leech Lake River Watershed and receives flow from inlets on the west and north sides of the lake. Steamboat River flows east through Steamboat Lake and then flows under State Highway 371 and into Steamboat Bay Lake. Steamboat River continues south and empties into Steamboat Bay of Leech Lake. The Leech Lake River exits Leech Lake on the east side and eventually joins the Mississippi River.

Water quality data have been collected on Steamboat Lake since 2004. These data show that the lake is mesotrophic (page 8). Mesotrophic lakes are characterized by clear water most of the summer and occasional algal blooms in late summer.

The Steamboat Lake Association is relatively new. The Association is involved in water quality monitoring and is a member of the Association of Cass County Lakes.

Vitals

MN Lake ID:	11-0504-00
County:	Cass
Ecoregion:	Northern Lakes and Forest
Major Drainage Basin:	Upper Mississippi River
Latitude/Longitude:	47.265252 / -94.65683
Water Body Type:	Public
Monitored Sites (Primary):	201
Monitored Sites (Secondary):	202

Invasive species present: none documented

Physical Characteristics

Surface area (acres):	1,756
Littoral area (acres):	532
% Littoral area:	30%
Max depth (ft):	93 (m): 28.3
Mean depth (ft):	NA
Lakeshed size (acres):	7,867
Lakeshed : lake area ratio	4.5:1
Inlets	2
Outlets	1
Accesses	1 public

Data Availability

Transparency data



Secchi readings have been collected from 2004 to 2008 through the MPCA CLMP program.

Chemical data



Two Total Phosphorus and Chlorophyll a data points exist from 1993 and 1997 DNR Fisheries surveys.

Inlet/Outlet data



No inlet or outlet data exist for Steamboat Lake.

Recommendations

For recommendations refer to page 10.

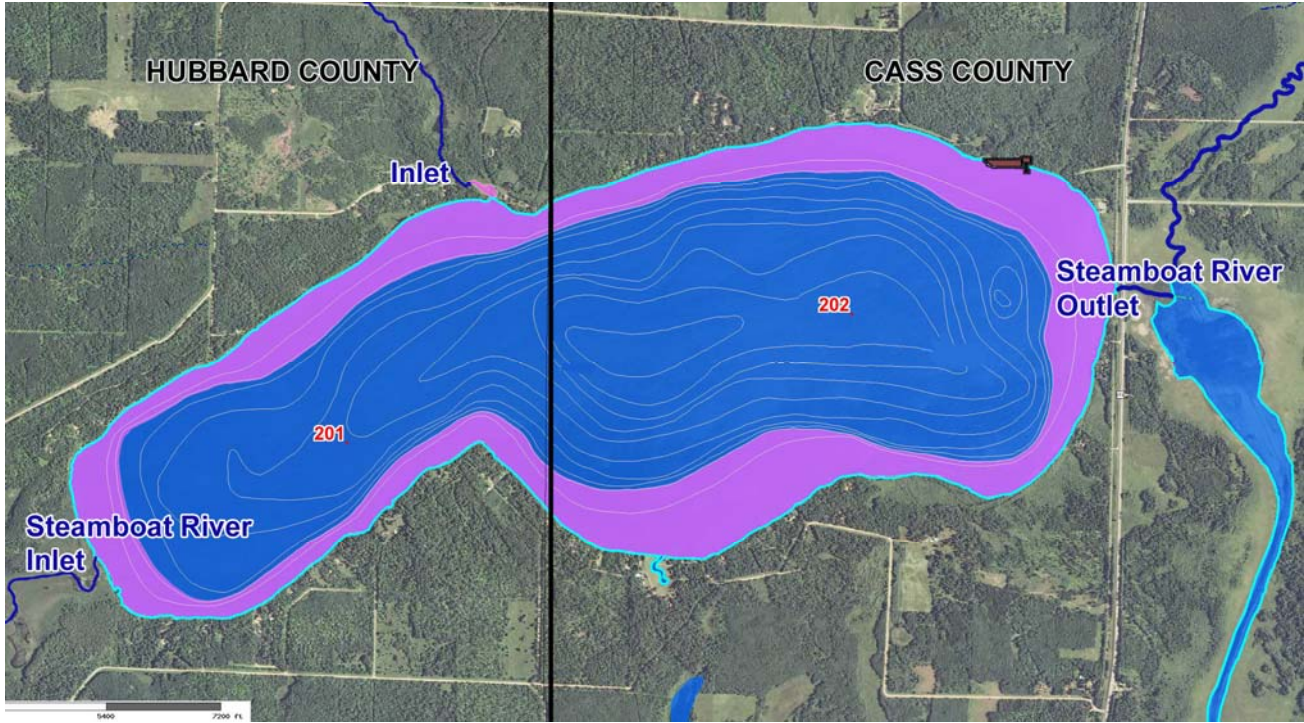


Figure 1. Map of Steamboat Lake illustrating bathymetry, lake sample site locations, stream inlets and outlets and aerial land use. The pink shaded areas in the lake illustrate the littoral zone, where the sunlight can usually reach the lake bottom allowing aquatic plants to grow.

Lake Site	Depth (ft)	Monitoring Programs
201* Primary Site	57	CLMP: 2004 - 2008
202	80	CLMP: 2006 - 2008

The information below describes available chemical data for Steamboat Lake through 2008. The data set is limited, and all parameters are means from 1993 and 1997 DNR Fisheries surveys.

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 9.

Parameter	Mean	Ecoregion Range¹	Impaired Waters Standard²	Interpretation
Total phosphorus (ug/L)	25	14 - 27	> 35	Results are within the expected range for the ecoregion. For more information about Impaired Waters Assessment, see page 10.
Chlorophyll a (ug/L) ³	7.2	4 - 10	> 12	
Chlorophyll a max (ug/L)	8.7	<15		
Secchi depth (ft)	11.6	7.5 - 15	< 4.5	
Dissolved oxygen	--			Data non-existent.
Total Kieldahl Nitrogen (mg/L)	--	0.4 - 0.75		Data non-existent.
Alkalinity (mg/L)	166	40 - 140		Indicates a low sensitivity to acid rain and a good buffering capacity.
Color (Pt-Co Units)	--	10 - 35		Data non-existent.
pH	8.5	7.2 - 8.3		Characteristic of a hard water lake. Lake water pH less than 6.5 can affect fish spawning and the solubility of metals in the water.
Chloride (mg/L)	--	0.6 - 1.2		Data non-existent.
Total Suspended Solids (mg/L)	--	<1 - 2		Data non-existent.
Conductivity (umhos/cm)	321	50 - 250		Above the ecoregion average. High conductivity indicates high dissolved solids, which can come from watershed or human sources.
Total Nitrogen :Total Phosphorus	--	25:1 – 35:1		Data non-existent.

Data Source: 1993 & 1997 DNR Fisheries Surveys

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: 1993, 1997, 2004, 2006-2007

Parameters	Primary		DNR Site*
	Site 201	Site 202	
Total Phosphorus Mean (ug/L):			25
Total Phosphorus Min:			22
Total Phosphorus Max:			28
Number of Observations:			2
Chlorophyll a Mean (ug/L):			7.2
Chlorophyll-a Min:			5.7
Chlorophyll-a Max:			8.7
Number of Observations:			2
Secchi Depth Mean (ug/L):	11.6	13.3	
Secchi Depth Min:	6.5	10.0	
Secchi Depth Max:	16.5	18.0	
Number of Observations:	47	24	

*The DNR data consists of two data points from 7/26/1993 and 7/21/1997, so they are not representative of the lake condition during the entire ice-free season.

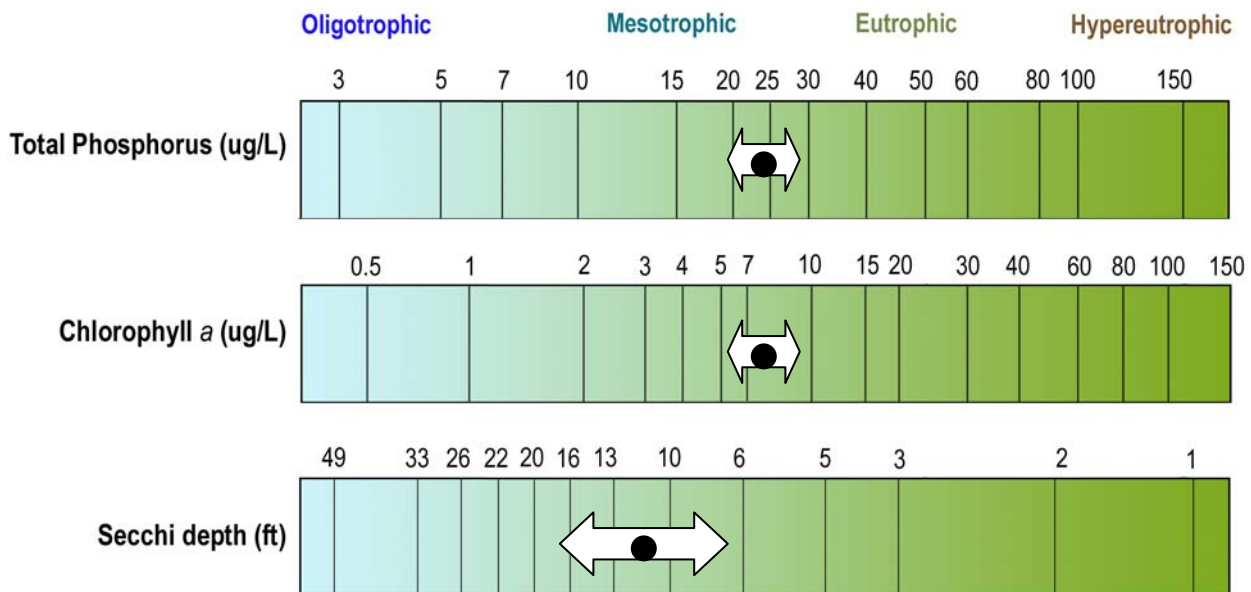


Figure 2. Steamboat Lake total phosphorus, chlorophyll a and transparency historical ranges. The arrow represents the range and the black dot represents the historical mean. Figure adapted after Moore and Thornton, [Ed.]. 1988. Lake and Reservoir Restoration Guidance Manual. (Doc. No. EPA 440/5-88-002)

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.

The transparency varies year to year due to changes in weather, precipitation, lake use, flooding, temperature, lake levels, etc. The annual mean transparency for Steamboat Lake ranges from 9.8 to 12.2 feet. Figure 3 shows the annual means compared to the long-term mean. 2007 had the highest mean transparency and 2005 had the lowest mean transparency.

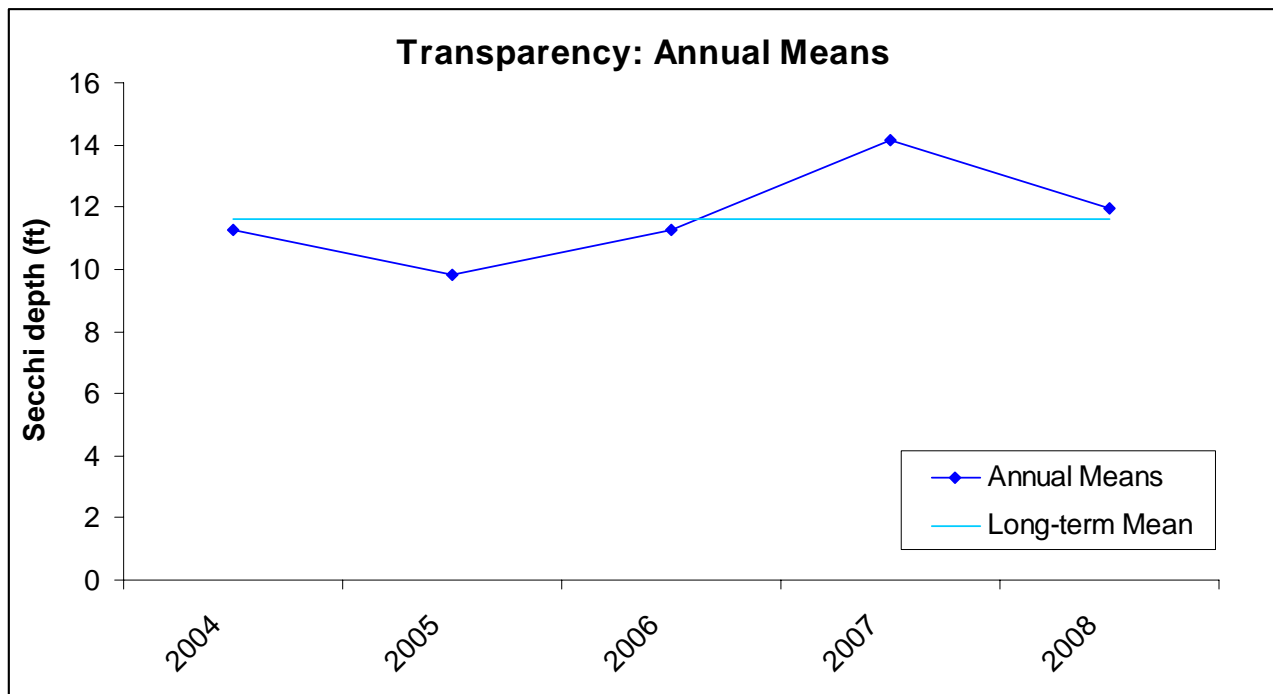


Figure 3. Annual mean transparency for site 201.

Steamboat Lake transparency ranges from 7.5 to 18.0 ft. Figure 4 shows the seasonal transparency dynamics. The transparency remains relatively consistent throughout the summer. The transparency in some lakes vary throughout the summer while others stay constant. The dynamics are related to algae population patterns, precipitation and lake turnover.

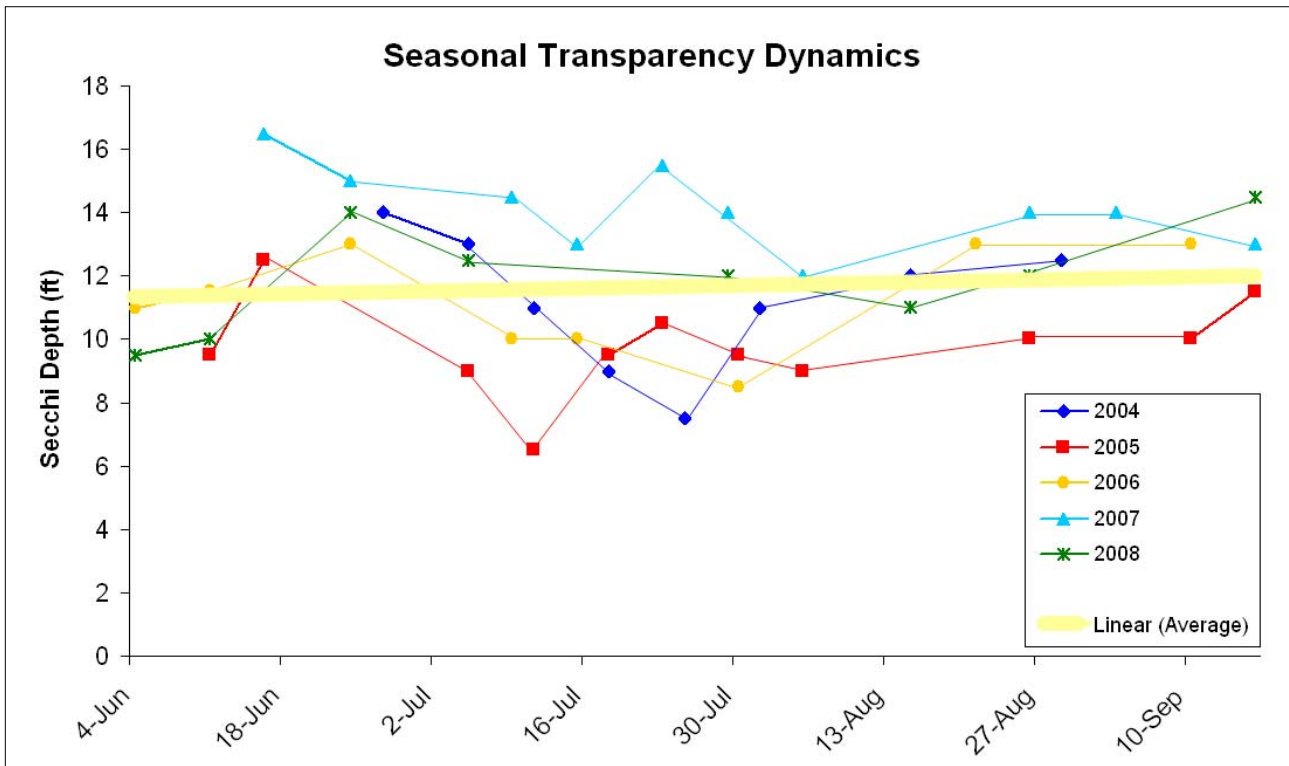


Figure 4. Seasonal transparency dynamics and year-to-year comparison (Primary Site 201).

User Perceptions

When volunteers collect secchi depth readings, they record their perceptions of the water based on the physical appearance and the recreational suitability. These perceptions can be compared to water quality parameters to see how the lake "user" would experience the lake at that time. Looking at transparency data, as the secchi depth decreases the perception of the lake's physical appearance rating decreases. Steamboat Lake was rated as being "not quite crystal clear " 75% of the time between 2004-2007 (Figure 5).

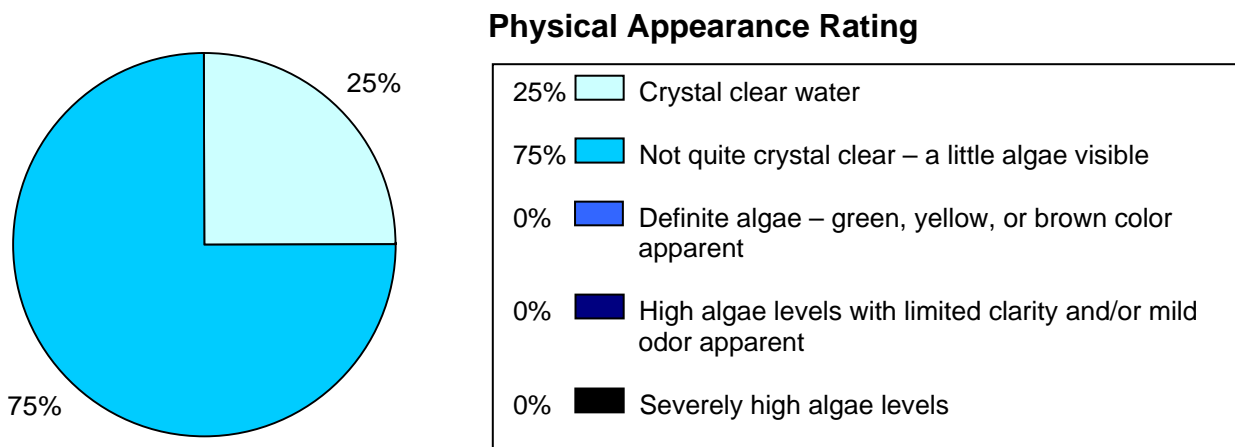


Figure 5. Physical appearance rating, as rated by the volunteer monitor (2004-2007).

As the secchi depth decreases, the perception of recreational suitability of the lake decreases. Steamboat Lake was rated as being "beautiful" 100% of the time from 2004-2007 (Figure 6).

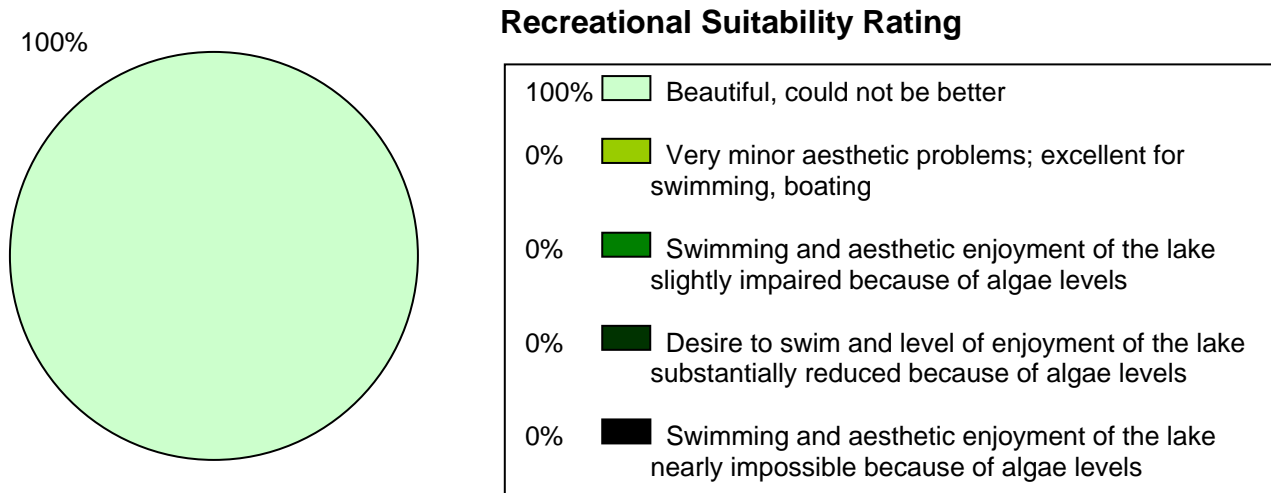


Figure 6. Recreational suitability rating, as rated by the volunteer monitor (2004-2007).

Total Phosphorus

Steamboat Lake is most likely phosphorus limited, which means that algae and aquatic plant growth is dependent upon available phosphorus.

Total phosphorus was evaluated in Steamboat Lake in 1993 and 1997; however, there is only one data point from each year (see page 4). The data indicate that Steamboat Lake is mesotrophic. Phosphorus should continue to be monitored to track any future changes in water quality.

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.

Chlorophyll *a* was evaluated in Steamboat Lake in 1993 and 1997; however, there is only one data point from each year. Both data points were below 10 ug/L, indicating clear water and no large algae bloom (see page 4). Chlorophyll *a* should continue to be monitored to track changes in water quality.

Dissolved Oxygen

There is no dissolved oxygen data for Steamboat Lake. Monitoring dissolved oxygen in future years would describe dynamics occurring in the water column and the habitat quality for game fish.

Trend Analysis

For detecting trends, a minimum of 8-10 years of data with 4 or more readings per season are recommended. There is not enough historical data to perform trend analysis for transparency, total phosphorus or chlorophyll a on Steamboat Lake. In another 2 years, short-term trend analysis will be possible.

Trophic State Index

Phosphorus (nutrients), chlorophyll a (algae concentration) and Secchi depth (transparency) are related. As phosphorus increases, there is more food available for algae, resulting in increased algal concentrations. When algal concentrations increase, the water becomes less transparent and the Secchi depth decreases.

The results from these three measurements cover different units and ranges and thus cannot be directly compared to each other or averaged. In order to standardize these three measurements to make them directly comparable, we convert them to a trophic state index (TSI).

The TSI for transparency indicates that Steamboat Lake is mesotrophic (Figure 7). There is insufficient data to determine the TSI for phosphorus and chlorophyll a.

Mesotrophic lakes (TSI 40-50) are characterized by moderately clear water most of the summer. "Meso" means middle or mid; therefore, mesotrophic means a medium amount of productivity. Mesotrophic lakes are commonly found in central Minnesota and have clear water with some algal blooms in late summer.

Steamboat Secchi

Trophic State Index	
TSI Total Phosphorus	Insufficient data
TSI Chlorophyll-a	Insufficient data
TSI Secchi	41
TSI Mean	Insufficient data
Trophic State:	Mesotrophic

Numbers represent the mean TSI for each parameter.

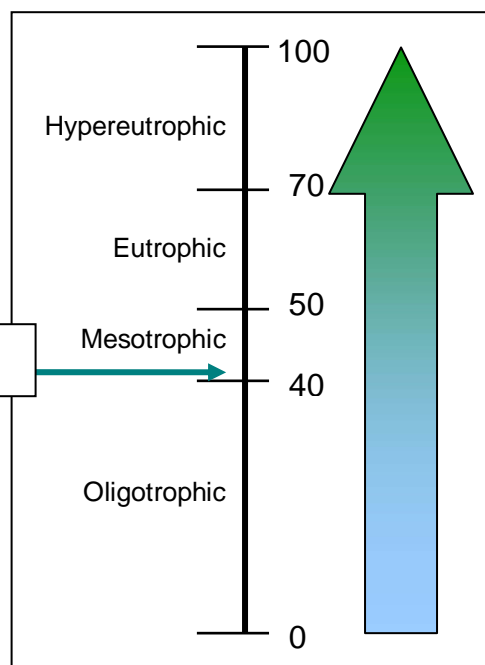


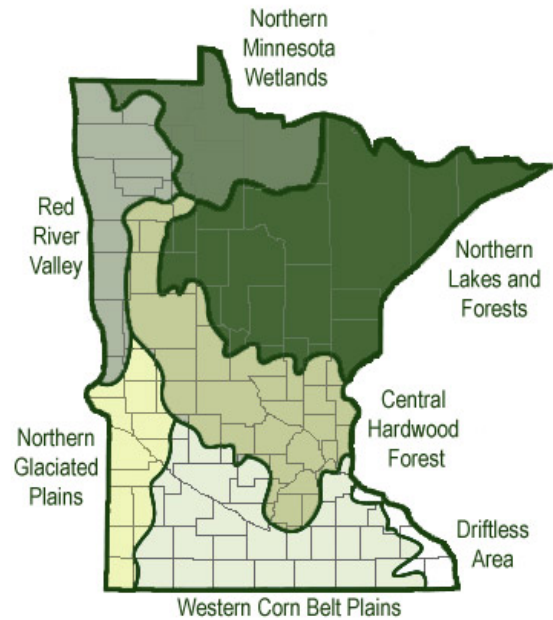
Figure 7. Trophic state index chart with corresponding trophic status.

TSI	Attributes	Fisheries & Recreation
<30	Oligotrophy: Clear water, oxygen throughout the year at the bottom of the lake, very deep cold water.	Trout fisheries dominate.
30-40	Bottom of shallower lakes may become anoxic (no oxygen).	Trout fisheries in deep lakes only. Walleye, Tullibee present.
40-50	Mesotrophy: Water moderately clear most of the summer. May be "greener" in late summer.	No oxygen at the bottom of the lake results in loss of trout. Walleye may predominate.
50-60	Eutrophy: Algae and aquatic plant problems possible. "Green" water most of the year.	Warm-water fisheries only. Bass may dominate.
60-70	Blue-green algae dominate, algal scums and aquatic plant problems.	Dense algae and aquatic plants. Low water clarity may discourage swimming and boating.
70-80	Hypereutrophy: Dense algae and aquatic plants.	Water is not suitable for recreation.
>80	Algal scums, few aquatic plants.	Rough fish (carp) dominate; summer fish kills possible.

Source: Carlson, R.E. 1997. A trophic state index for lakes. *Limnology and Oceanography*. 22:361-369.

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.



Steamboat Lake is in the Northern Lakes and Forests Ecoregion. The mean transparency (secchi depth) for Steamboat Lake is within the expected ecoregion range (Figure 8).

There is insufficient total phosphorus and chlorophyll a data for Steamboat Lake to determine how it fits into the ecoregion ranges.

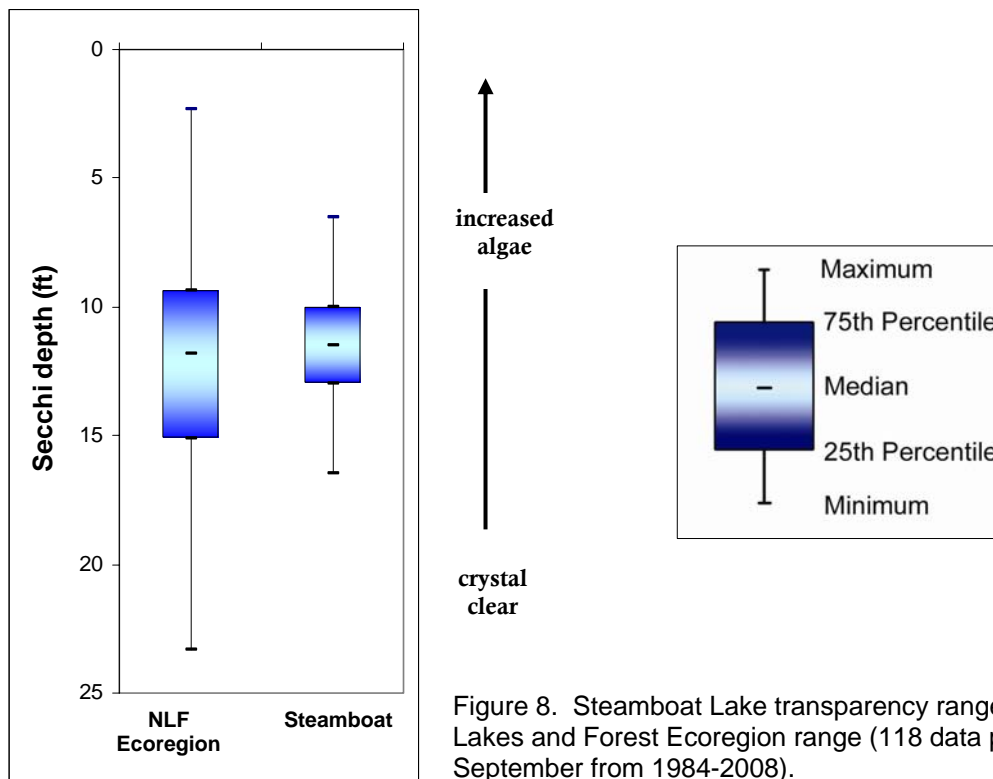


Figure 8. Steamboat Lake transparency ranges compared to Northern Lakes and Forest Ecoregion range (118 data points collected in May-September from 1984-2008).

Inlet/Outlet Data Assessment

No inlet or outlet data exist for Steamboat Lake.

Assessment/Findings Recommendations

Transparency

Transparency monitoring at sites 201 and 202 should be continued annually. It is important to continue transparency monitoring weekly or at least bimonthly every year to enable year-to-year comparisons and trend analyses.

Impaired Waters Assessment 303(d) List

There are two main types of Impaired Waters Assessment for lakes: eutrophication (excess phosphorus) for aquatic recreation and mercury in fish tissue for aquatic consumption. Steamboat Lake was listed as impaired for mercury in fish tissue in the 2008 Impaired Waters List. It is not part of the statewide mercury TMDL. Steamboat Lake is not considered impaired for eutrophication; however it does not have sufficient data for assessment. Ten data points of each total phosphorus, chlorophyll *a* and secchi depth over a two-year period are required for assessment.

Aquatic Recreational Use Assessment 305(b)

In the 2008 MPCA Aquatic Use Assessment (305(b)) Steamboat Lake was classified as having insufficient data.

Inlet/Outlet Assessment

Because of the limited inlet/outlet data, a mass balance project should be considered. This study answers questions about nutrient loading into the lake and nutrient budget within the lake.

Organizational contacts and reference sites

Steamboat Lake Association

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