Eagle Lake 29-0256-00 HUBBARD COUNTY

Lake Water Quality

Summary

Eagle Lake is located about nine miles north of Park Rapids, Minnesota. It covers 411 acres and has a long, narrow shape.

Eagle Lake has one inlet and one outlet, which classifies it as a drainage lake. The inlet enters on the north side of the lake from Island Lake. The outlet flows out of the south end into Potato Lake. From Potato Lake, the Potato River joins the Fish Hook River, which eventually joins the Shell River and then the Crow Wing River.

Water quality data have been collected on Eagle Lake since 1991 (Table 3). These data show that the lake is mesotrophic, which is characterized by moderately clear water throughout the summer and excellent recreational opportunities.

The Eagle Lake Association is involved in many activities, including water quality monitoring. They are also a member of the Hubbard Coalition of Lake Associations (COLA).

Table 1. Eagle Lake location and key physical characteristics.

Location Data		Physical Characteristics	
MN Lake ID:	29-0256-00	Surface area (acres):	411
County:	Hubbard	Littoral area (acres):	164
Ecoregion:	Northern Lakes & Forests	% Littoral area:	40%
Major Drainage Basin:	Upper Mississippi River	Max depth (ft), (m):	77, 23.5
Latitude/Longitude:	47.03000000 / -95.09972222	Inlets:	1
Invasive Species:	None	Outlets:	1
		Public Accesses:	1

Table 2: Availability of data and an observation of the quantity of sample points.

Data Availability

Transparency data		Excellent data set through the Citizens Lake Monitoring Program.
Chemical data		Excellent data set through the RMB Lab Lakes Program.
Inlet/Outlet data		No inlet or outlet data exist for this lake.

Recommendations **For recommendations refer to page 18.**

Lake Map

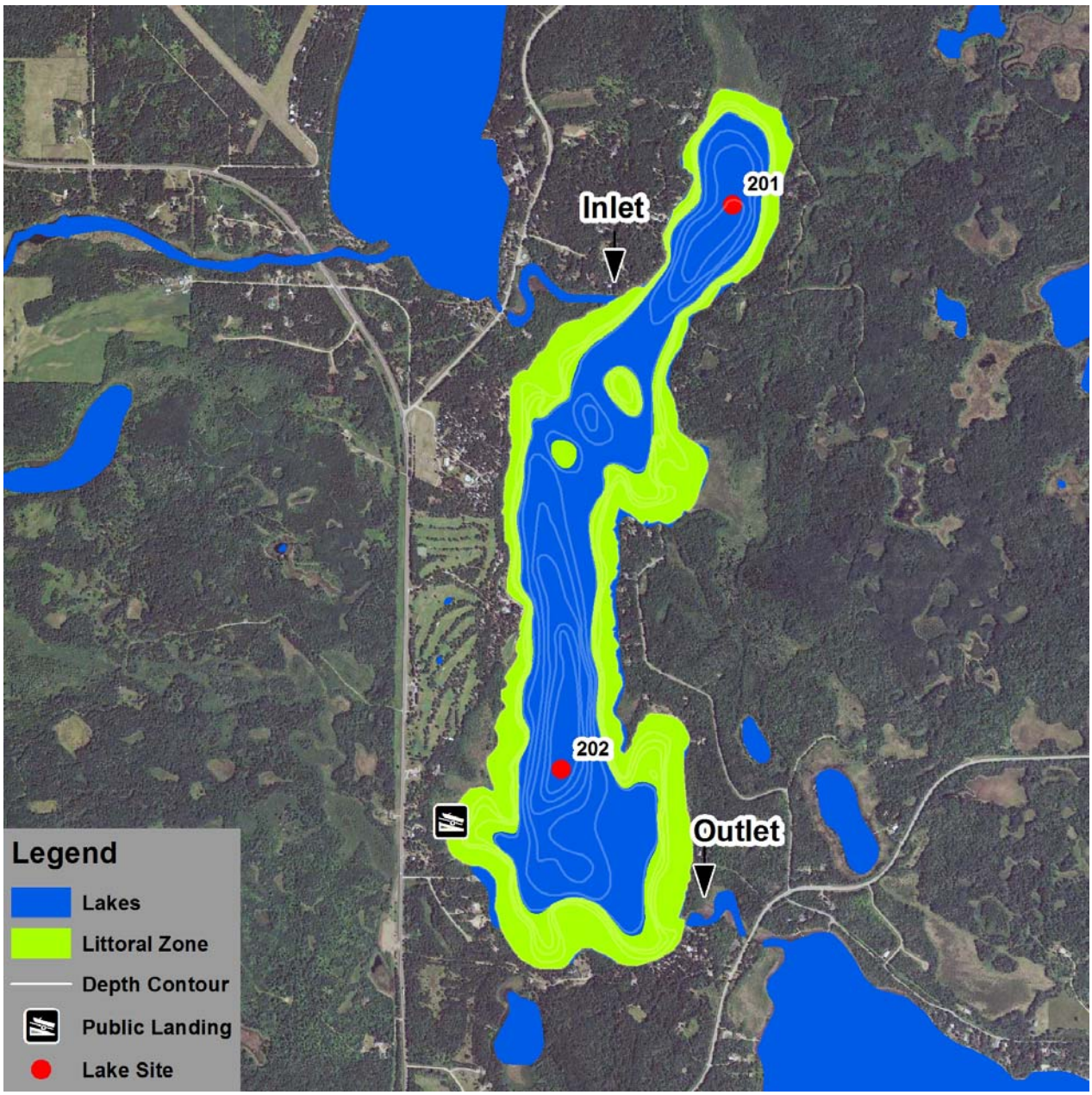


Figure 1. Map of Eagle Lake with 2010 aerial imagery and illustrations of sample site locations, inlets and outlets, and public access points. The light green areas in the lake illustrate the littoral zone, where the sunlight can usually reach the lake bottom allowing aquatic plants to grow.

Table 3. Monitoring programs and associated monitoring sites. Monitoring programs include the Citizens Lake Monitoring Program (CLMP) and RMB Environmental Laboratories Lakes Program (RMBEL).

Lake Site	Depth (ft)	Monitoring Programs
201	50	CLMP: 1991-2010
202	77	CLMP: 1993, 1997-2011; RMBEL: 1997-2011

Water Quality Characteristics - Historical Means and Ranges

Table 4. Water quality means and ranges for primary sites.

Parameters	Primary Site 202	Site 201
Total Phosphorus Mean (ug/L):	**19**	
Total Phosphorus Min:	5	
Total Phosphorus Max:	37	
Number of Observations:	72	
Chlorophyll *a* Mean (ug/L):	**7**	
Chlorophyll-a Min:	1	
Chlorophyll-a Max:	18	
Number of Observations:	71	
Secchi Depth Mean (ft):	**10.3**	**9.8**
Secchi Depth Min:	6.0	6.5
Secchi Depth Max:	27.0	17.5
Number of Observations:	203	175

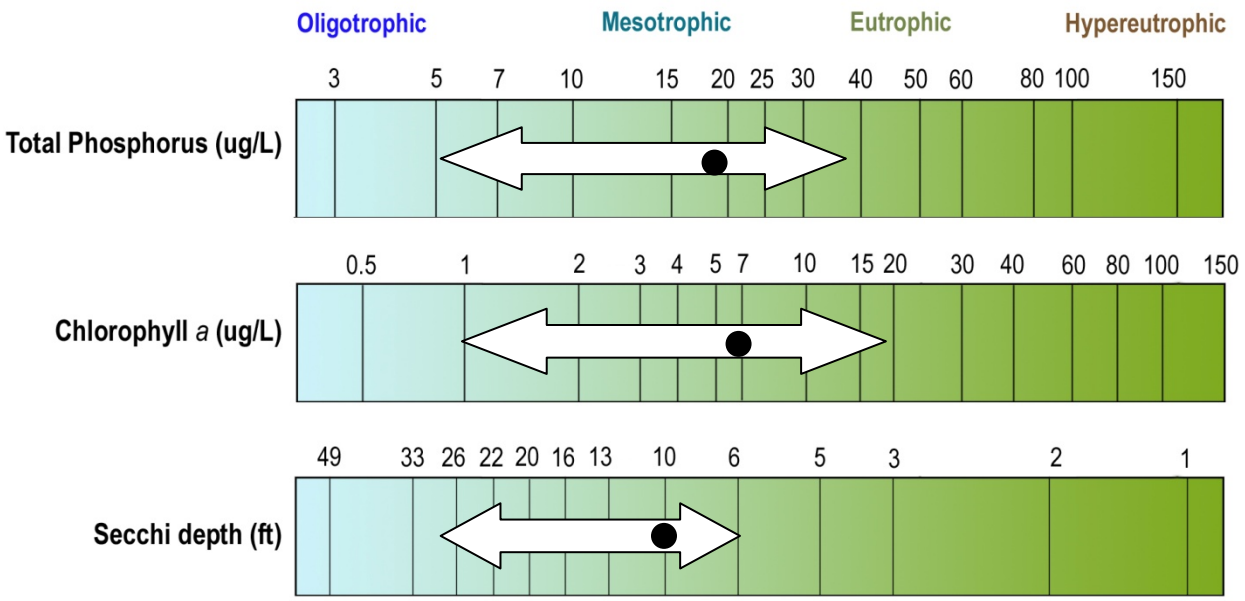


Figure 2. Eagle Lake total phosphorus, chlorophyll *a* and transparency historical ranges. The arrow represents the range and the black dot represents the historical mean (Primary Site 202). Figure adapted after Moore and Thornton, [Ed.]. 1988. Lake and Reservoir Restoration Guidance Manual. (Doc. No. 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 Eagle Lake ranges from 7.6 – 13.9 ft (Figure 3). Transparency is almost identical every year at sites 201 and 202 except for in 2000. This shows that water quality conditions are very similar between the north and south ends of the lake. Transparency monitoring should be continued at both sites to track water quality in Eagle Lake.

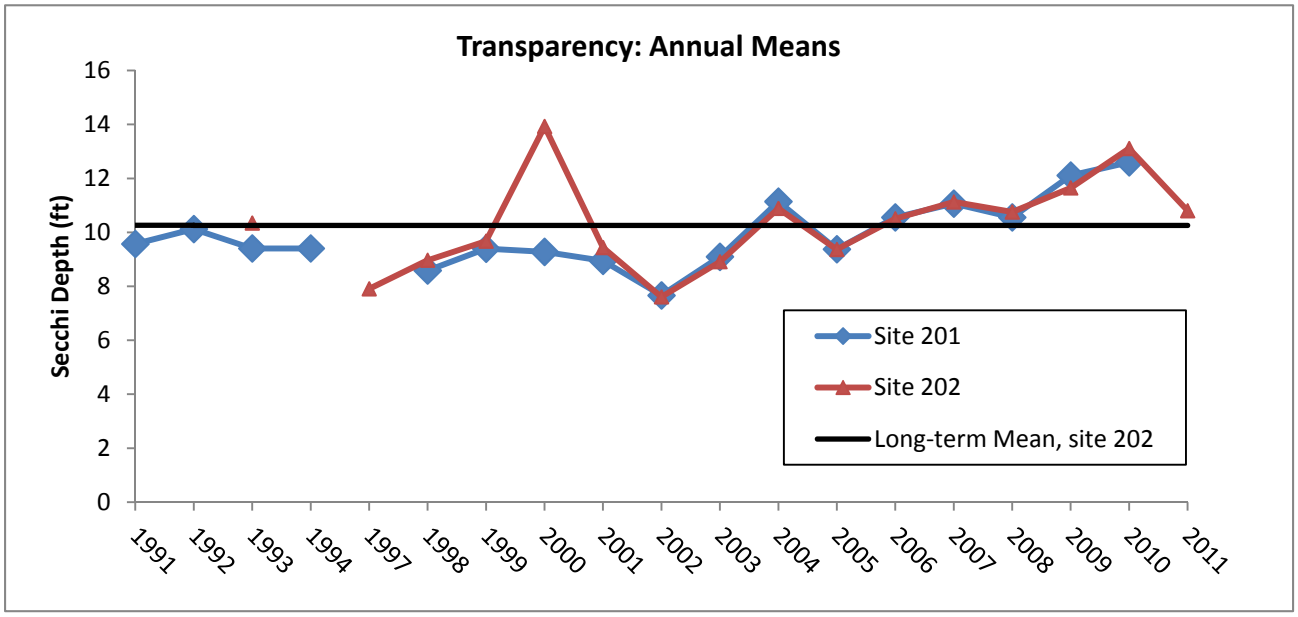


Figure 3. Annual mean transparency for sites 201 and 202.

Eagle Lake transparency ranges from 10 to 27 feet throughout the summer. Figure 4 shows the seasonal transparency dynamics. The transparency does not change much throughout the summer for Eagle Lake. The maximum Secchi reading is usually obtained in early summer. Eagle Lake transparency is high in May and June and declines slightly through August. The transparency then rebounds in October after fall turnover. The dynamics have to do with algae and zooplankton population dynamics, and lake turnover.

It is important for lake residents to understand the seasonal transparency dynamics in their lake so they are not worried about why their transparency is lower in August than it is in June. It is typical for a lake to vary in transparency throughout the summer

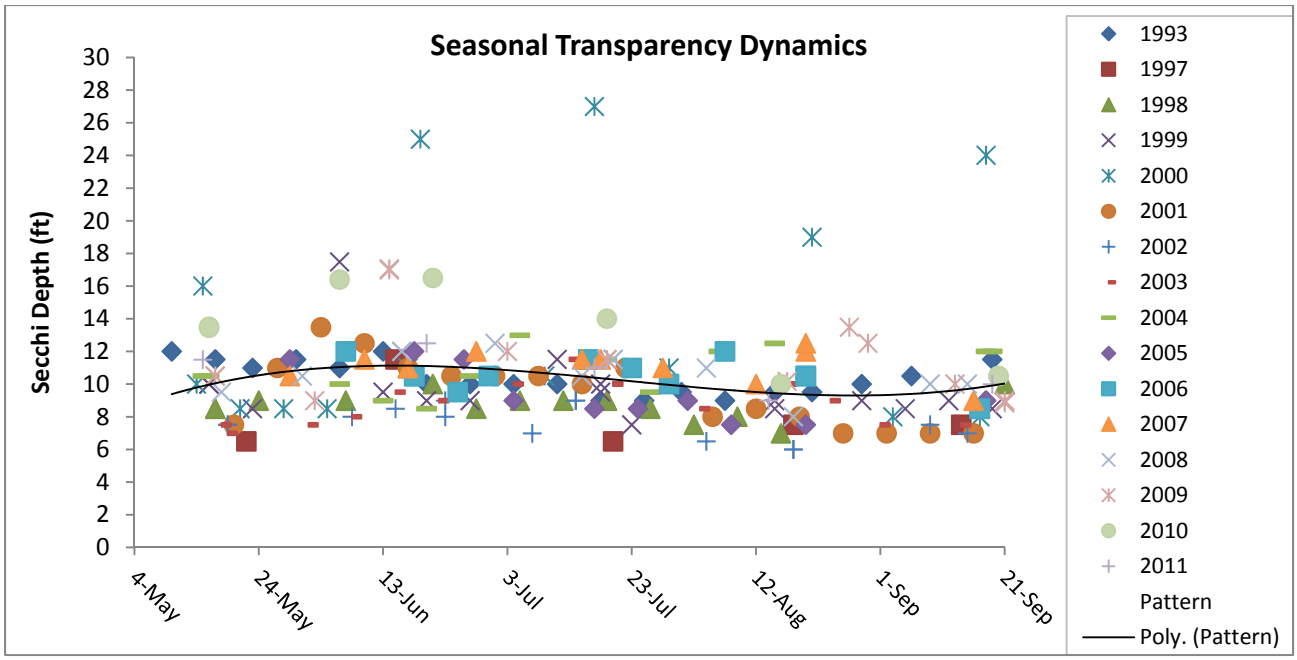


Figure 4. Seasonal transparency dynamics and year-to-year comparison (site 202). The black line represents the pattern in the data.

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. Eagle Lake was rated as being "not quite crystal clear" 90% of the time between 1991-2011 (Figure 5).

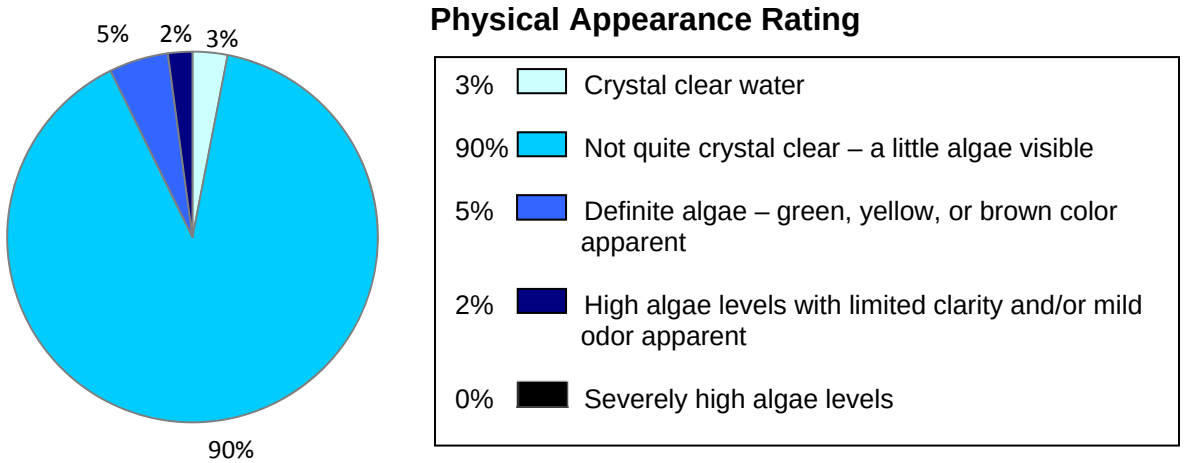


Figure 5. Physical appearance rating, as rated by the volunteer monitor.

As the secchi depth decreases, the perception of recreational suitability of the lake decreases. Eagle Lake was rated as being "beautiful" 11% of the time from 1991-2011.

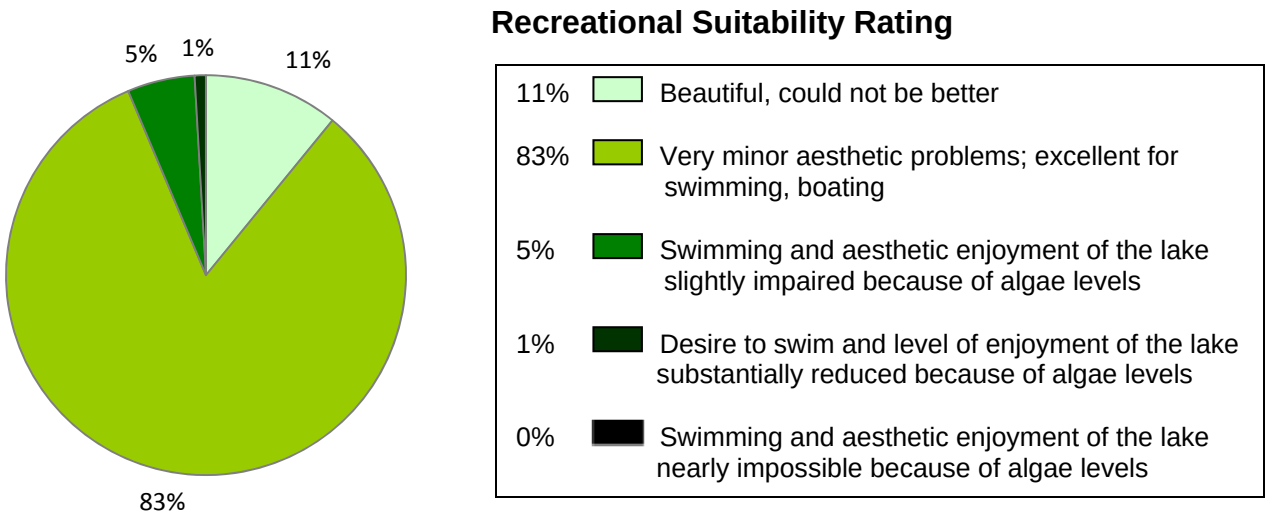


Figure 6. Recreational suitability rating, as rated by the volunteer monitor.

Total Phosphorus

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

Total phosphorus was evaluated in Eagle Lake in 1997-2011. Most of the data points fall into the mesotrophic range (Figure 7).

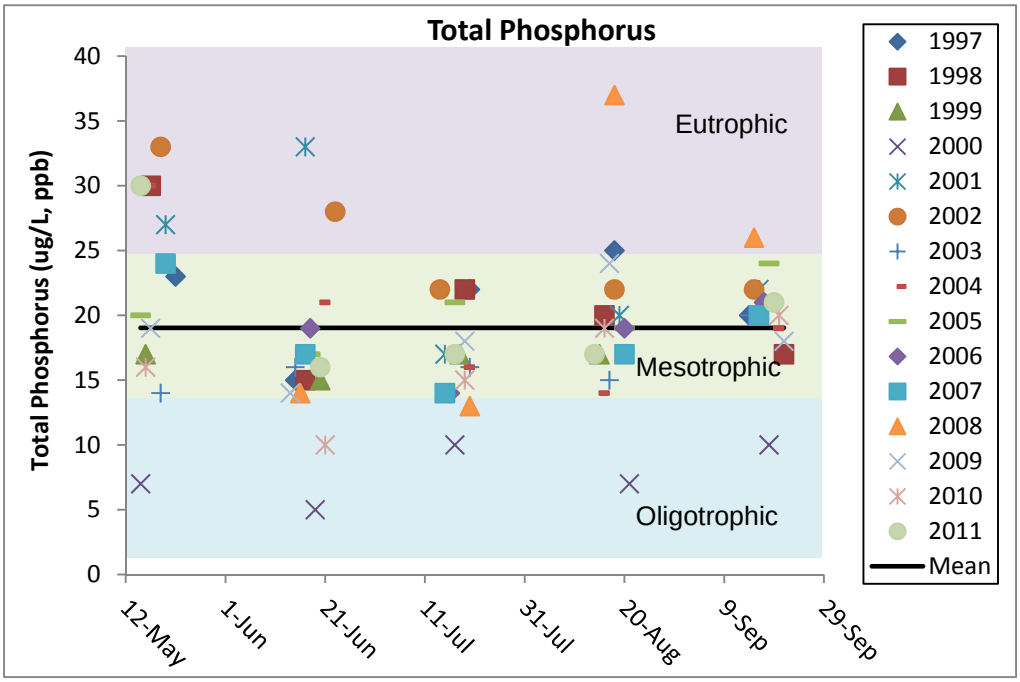


Figure 7. Historical total phosphorus concentrations (ug/L) at site 202 for Eagle Lake.

There are a large range of phosphorus concentrations in Eagle Lake. Some years, such as 2000, are very low, while other years, such as 2002, are high. Eagle Lake has a very large watershed (218 times larger than the lakeshed), and it could be that precipitation and conditions in the watershed are responsible for the phosphorus dynamics in the lake. The transparency is inversely related to the total phosphorus in Eagle Lake. For example, in 2000 when the phosphorus readings were abnormally low, the transparency readings were very high.

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.

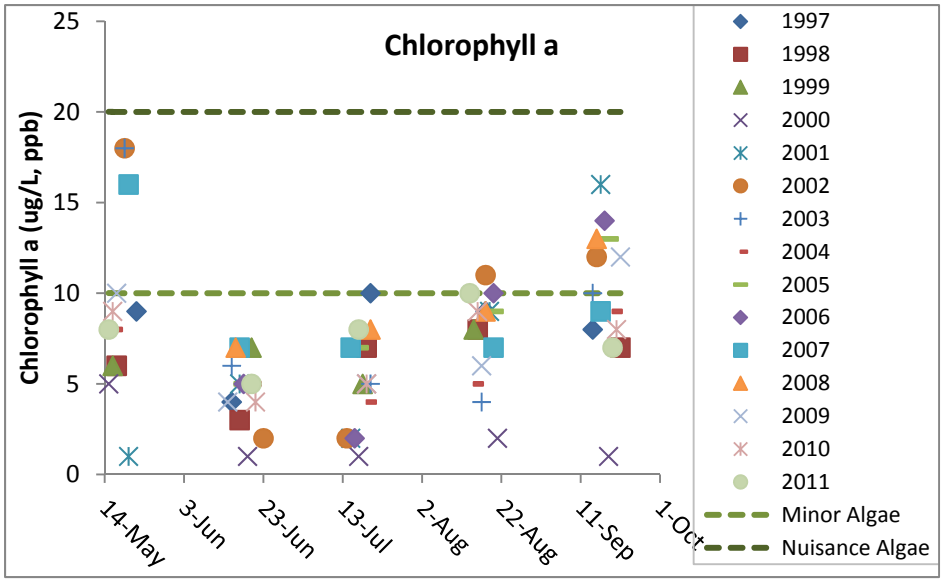
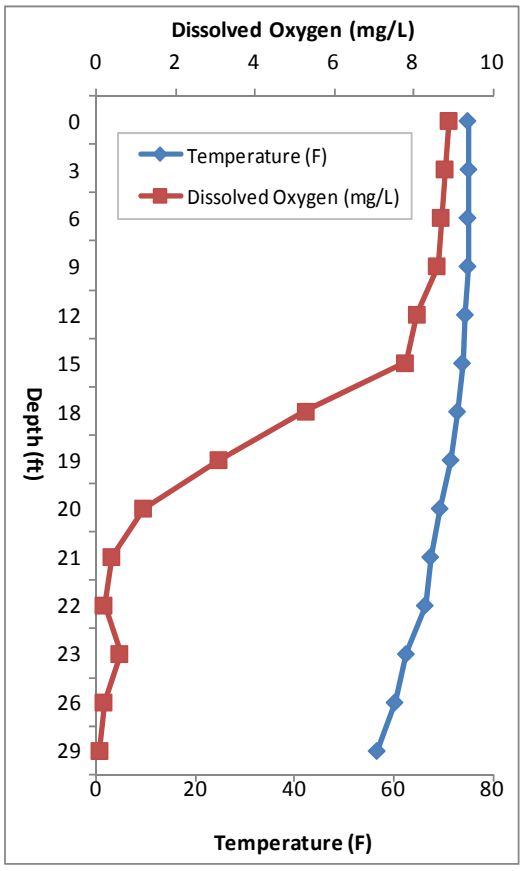


Figure 8. Chlorophyll *a* concentrations (ug/L) for Eagle Lake.

Chlorophyll *a* was evaluated in Eagle Lake in 1997-2011 (Figure 8). Chlorophyll *a* concentrations reached 10 ug/L most years, indicating minor algae blooms in August-September.

Dissolved Oxygen



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 fisheries.

Eagle Lake is a moderately deep lake, with a maximum depth of 77 ft. Dissolved oxygen profiles from 2007 indicate that Eagle Lake stratifies in the summer (Figure 9). The thermocline occurs at 15-19 feet, and below the thermocline the oxygen is depleted. This means that no gamefish will be present below about 20 feet in mid-summer, which is typical for a lake of this size and depth.

Figure 9. Dissolved oxygen and temperature profile for Eagle Lake on 7/23/2007.

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 mean TSI for Eagle Lake falls into the mesotrophic range (Figure 10). There is good agreement between the TSI for phosphorus and chlorophyll *a*, indicating that these variables are strongly related (Table 5). The TSI for transparency is lower, which could be due to the fact that there is a lot more transparency data than phosphorus or chlorophyll *a*. Other reason could include large algae particles dominating the algal community, or zooplankton grazers selectively eliminating the smaller algal cells.

Mesotrophic lakes (TSI 40-50) are characterized by moderately clear water most of the summer (Figure 10). "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 algal blooms in late summer. They are also good for walleye fishing.

Table 5. Trophic State Index.

Trophic State Index	Site 204
TSI Total Phosphorus	47
TSI Chlorophyll-a	50
TSI Secchi	43
TSI Mean	46
Trophic State:	Mesotrophic

Numbers represent the mean TSI for each parameter.

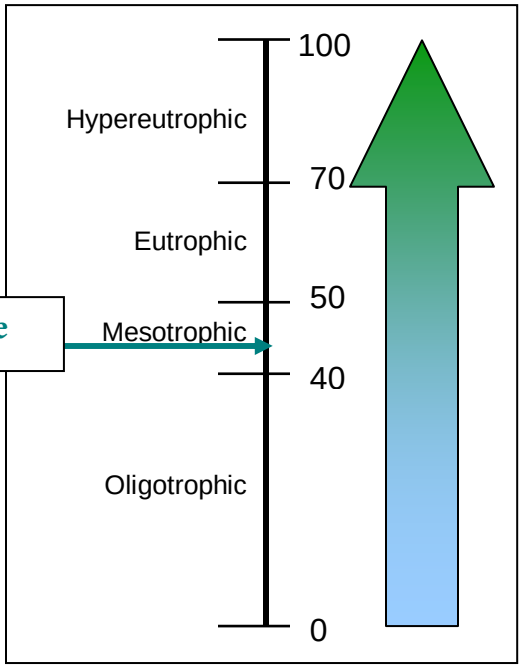


Figure 10. Trophic state index chart with corresponding trophic status.

Table 6. Trophic states and corresponding lake and fishery conditions.

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, Cisco 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.

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 enough historical data to perform trend analysis for total phosphorus, chlorophyll *a,* and transparency on Eagle Lake (Table 7). The data was analyzed using the Mann Kendall Trend Analysis.

Table 7. Trend analysis for Eagle Lake.

Lake Site	Parameter	Date Range	Trend	Probability
202	Transparency	1997-2011	Improving	95%
202	Total Phosphorus	1997-2011	No trend	-
202	Chlorophyll a	1997-2011	No trend	-

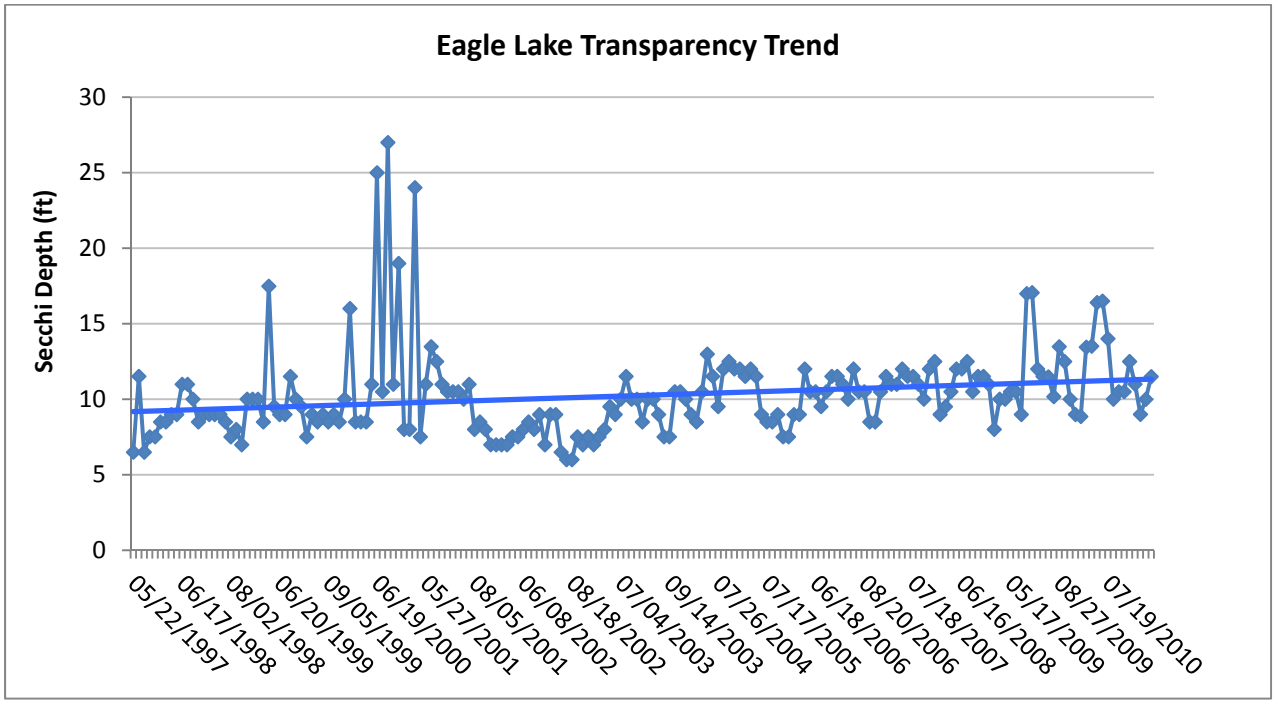


Figure 11. Long-term transparency trend for site 202 in Eagle Lake.

Site 202 shows a statistically significant improving trend in transparency from 1997-2011 (Figure 11). There is no detectable trend for phosphorus or chlorophyll a. Monitoring should continue at site 202 so that this trend can be tracked in future years.

Ecoregion Comparisons

Minnesota is divided into 7 ecoregions based on land use, vegetation, precipitation and geology (Figure 12). 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.

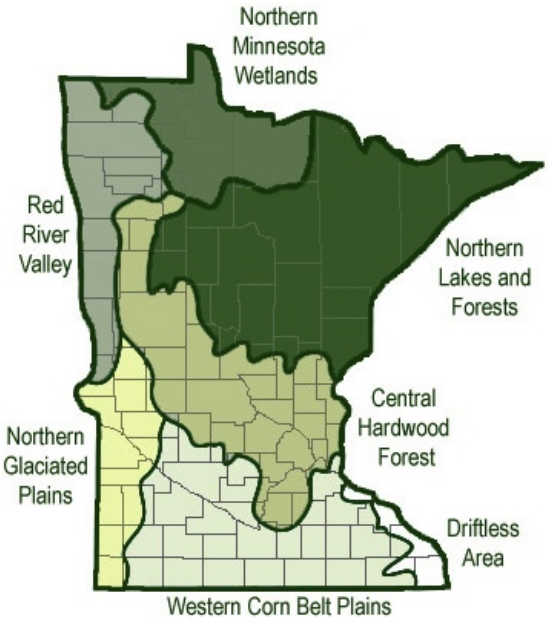
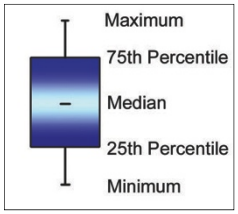
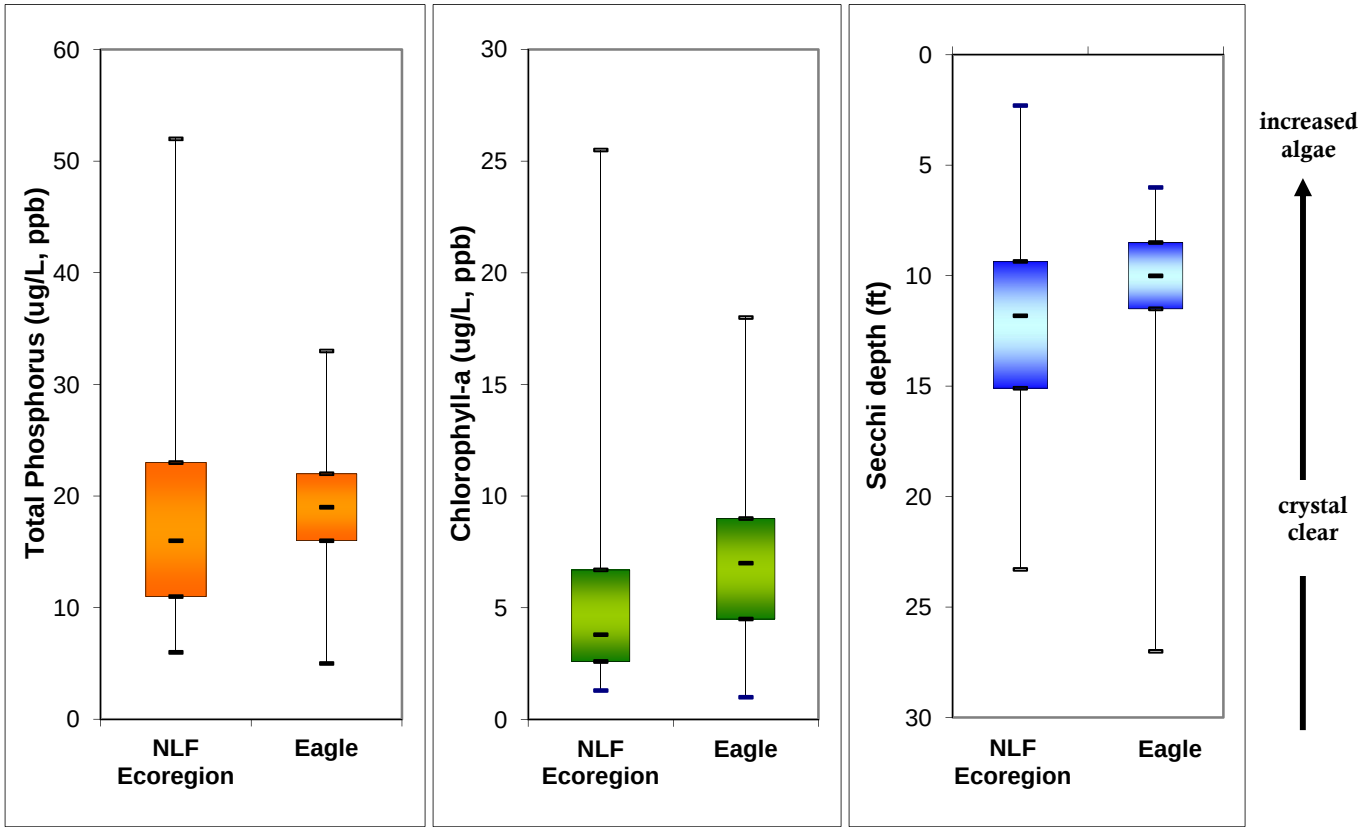


Figure 12. Map of Minnesota with the seven ecoregions.

Eagle Lake is in the Northern Lakes and Forests Ecoregion. The means for phosphorus, chlorophyll a and transparency are within the ecoregion ranges (Fig 13).





Figures 13a-c. Eagle Lake ranges compared to Northern Lakes and Forest Ecoregion ranges. The Eagle Lake total phosphorus and chlorophyll *a* ranges are from 72 data points collected in May-September of 1997-2011. The Eagle Lake Secchi depth range is from 203 data points collected in May-September from 1997-2011.

Lakeshed Data and Interpretations

Lakeshed

Understanding a lakeshed requires an understanding of basic hydrology. A watershed is defined as all land and water surface area that contribute excess water to a defined point. The MN DNR has delineated three basic scales of watersheds (from large to small): 1) basins, 2) major watersheds, and 3) minor watersheds.

The **Crow Wing River Major Watershed** is one of the watersheds that make up the Upper Mississippi River Basin, which drains south to the Gulf of Mexico (Figure 14). This major watershed is made up of 136 minor watersheds. Eagle Lake is located in **minor watershed** 12013 (Figure 15).

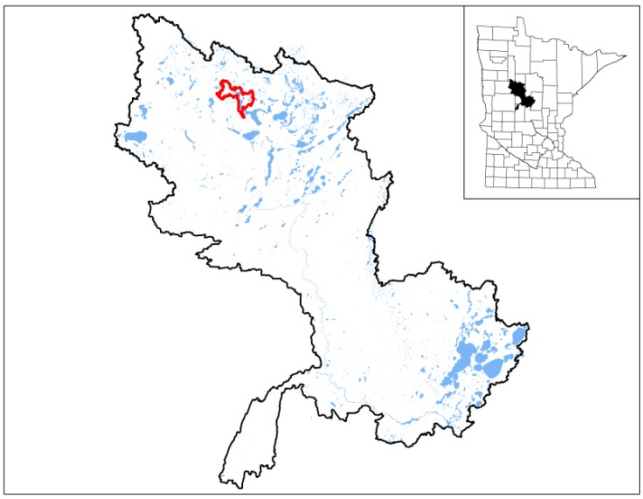


Figure 14. Crow Wing River Watershed.

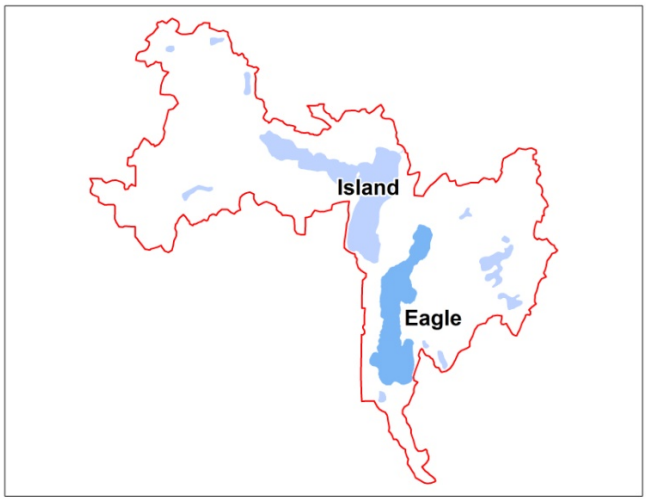


Figure 15. Minor Watershed 12013

The MN DNR also has evaluated catchments for each individual lake with greater than 100 acres surface area. These lakesheds (catchments) are the "building blocks" for the larger scale watersheds. Eagle Lake falls within the **Eagle Lake (1201300) lakeshed** (Figure 16). Though very useful for displaying the land and water that contribute directly to a lake, lakesheds are not always true watersheds because they may not show the water flowing into a lake from upstream streams or rivers. While some lakes may have only one or two upstream lakesheds draining into them, others may be connected to a large number of lakesheds, reflecting a larger drainage area via stream or river networks. For further discussion of Eagle Lake's full watershed, containing all the lakesheds upstream of Eagle Lake lakeshed, see page 6. The data interpretation of the Eagle Lake lakeshed includes only the immediate lakeshed, as this area is the land surface that flows directly into Eagle Lake.

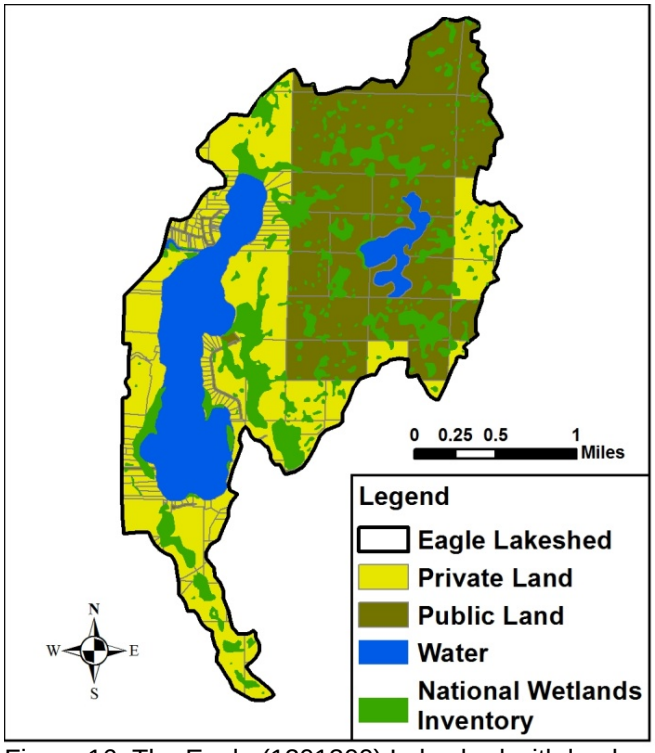


Figure 16. The Eagle (1201300) Lakeshed with land ownership, lakes, wetlands, and rivers illustrated.

The lakeshed vitals table identifies where to

focus organizational and management efforts for each lake (Table 8). Criteria were developed using limnological concepts to determine the effect to lake water quality.

KEY
Possibly detrimental to the lake
Warrants attention
Beneficial to the lake

Table 8. Lakeshed vitals for Eagle Lake.

Lakeshed Vitals		Rating
Lake Area	424 acres	descriptive
Littoral Zone Area	164 acres	descriptive
Lake Max Depth	76.9 ft.	descriptive
Lake Mean Depth	21.7 ft.	
Water Residence Time	NA	NA
Miles of Stream	0.4	descriptive
Inlets	1 – Hay Creek	
Outlets	1 – Hay Creek	
Major Watershed	12 - Crow Wing River	descriptive
Minor Watershed	12013	descriptive
Lakeshed	1201300	descriptive
Ecoregion	Northern Lakes and Forest	descriptive
Total Lakeshed to Lake Area Ratio (total lakeshed includes lake area)	7:1	
Standard Watershed to Lake Basin Ratio (standard watershed includes lake areas)	218:1	
Wetland Coverage	16%	
Aquatic Invasive Species	None	
Public Drainage Ditches	None	
Public Lake Accesses	1	
Miles of Shoreline	5.7	descriptive
Shoreline Development Index	1.99	
Public Land : Private Land (excludes water)	1:1	
Development Classification	Recreational Development	
Miles of Road	7.3	descriptive
Municipalities in lakeshed	None	
Forestry Practices	2002 Hubbard County Forest Resources Management Plan	
Feedlots	None	
Sewage Management	Individual waste treatment systems (last lake-wide county inspection - 2007)	
Lake Management Plan	Healthy Lakes & Rivers Partnership program, 2005	
Lake Vegetation Survey/Plan	None	

Land Cover / Land Use

The activities that occur on the land within the lakeshed can greatly impact a lake. Land use planning helps ensure the use of land resources in an organized fashion so that the needs of the present and future generations can be best addressed. The basic purpose of land use planning is to ensure that each area of land will be used in a manner that provides maximum social benefits without degradation of the land resource.

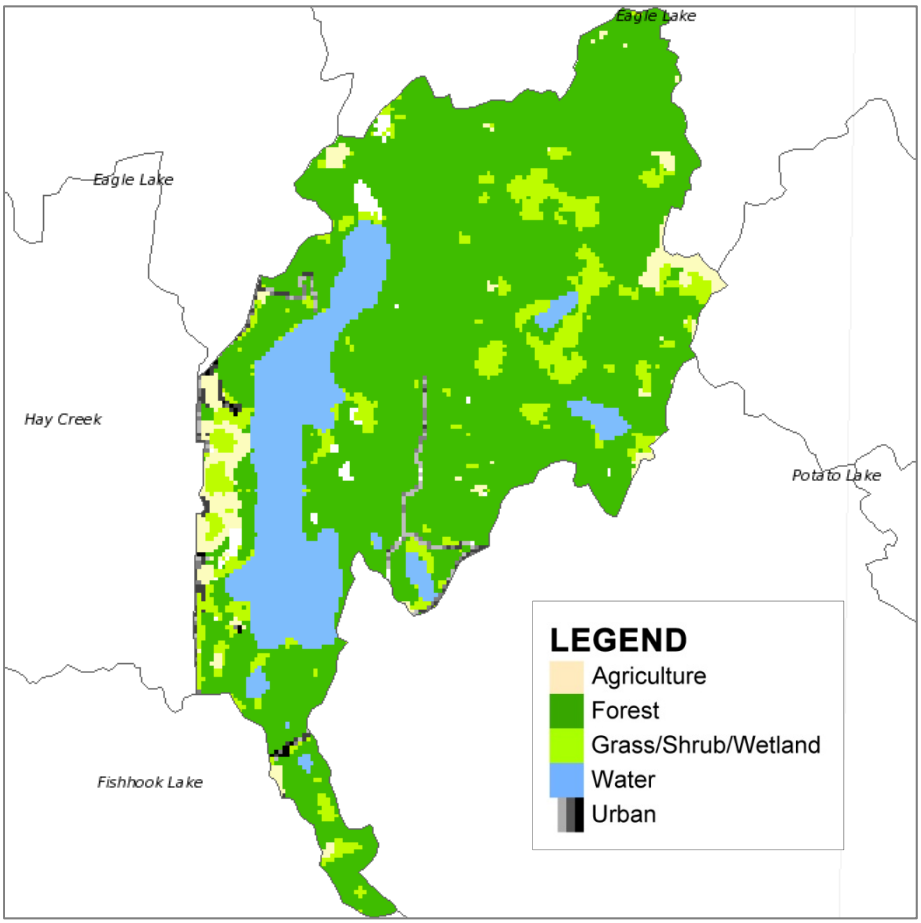


Figure 17. Eagle Lake (1201300) lakeshed land cover (http://land.umn.edu).

Changes in land use, and ultimately land cover, impact the hydrology of a lakeshed. Land cover is also directly related to the land's ability to absorb and store water rather than cause it to flow overland (gathering nutrients and sediment as it moves) towards the lowest point, typically the lake. Impervious intensity describes the land's inability to absorb water, the higher the % impervious intensity the more area that water cannot penetrate in to the soils. Monitoring the changes in land use can assist in future planning procedures to address the needs of future generations.

Phosphorus export, which is the main cause of lake eutrophication, depends on the type of land cover occurring in the lakeshed. Figure 17 depicts the land cover in Eagle Lake's lakeshed.

The University of Minnesota has online records of land cover statistics from years 1990 and 2000 (http://land.umn.edu). This data is somewhat outdated, but it is the most recent comparable data available. Table 10 describes Eagle Lake's lakeshed land cover statistics and percent change from 1990 to 2000. Due to the many factors that influence demographics, one cannot determine with certainty the projected statistics over the next 10, 20, 30+ years, but one can see the transition within the lakeshed from agriculture, grass/shrub/wetland, and water acreages to forest and urban acreages. The largest change in percentage is the decrease in water cover (19%); however, in acreage, forest cover has increased the most (129 acres). In addition, the impervious intensity has increased, but the percentage is somewhat misleading. Impervious intensity increased 175%, but it only went from 4 acres in 1990 to 11 acres in 2000. Any increase in impervious intensity has implications for storm water runoff into the lake.

Table 9. Eagle Lake's lakeshed land cover statistics and % change from 1990 to 2000 (http://land.umn.edu).

	1990		2000		% Change
Land Cover	**Acres**	**Percent**	**Acres**	**Percent**	**1990 to 2000**
Agriculture	133	4.28	116	3.73	12.8% Decrease
Forest	2066	66.5	2195	70.65	6.2% Increase
Grass/Shrub/Wetland	326	10.49	309	9.95	5.2% Decrease
Water	542	17.44	439	14.13	19% Decrease
Urban	43	1.38	51	1.64	18.6% Increase
Impervious Intensity %					
0	3081	0	3058	0	0.7% Decrease
1-10	10	0	16	0.03	60% Increase
11-25	7	0.03	12	0.06	71.4% Increase
26-40	4	0.03	10	0.1	150% Increase
41-60	2	0.03	5	0.1	150% Increase
61-80	0	0	3	0.06	300% Increase
81-100	0	0	0	0	No Change
Total Area	3107		3107		
Total Impervious Area (Percent Impervious Area Excludes Water Area)	4	0.16	11	0.41	175% Increase

Demographics

Eagle Lake is classified as a recreational development lake. Recreational development lakes usually have between 60 and 225 acres of water per mile of shoreline, between 3 and 25 dwellings per mile of shoreline, and are more than 15 feet deep.

The Minnesota Department of Administration Geographic and Demographic Analysis Division extrapolated future population in 5-year increments out to 2035. Compared to Hubbard County as a whole, Arago Township has a lower extrapolated growth projection (Figure 18).

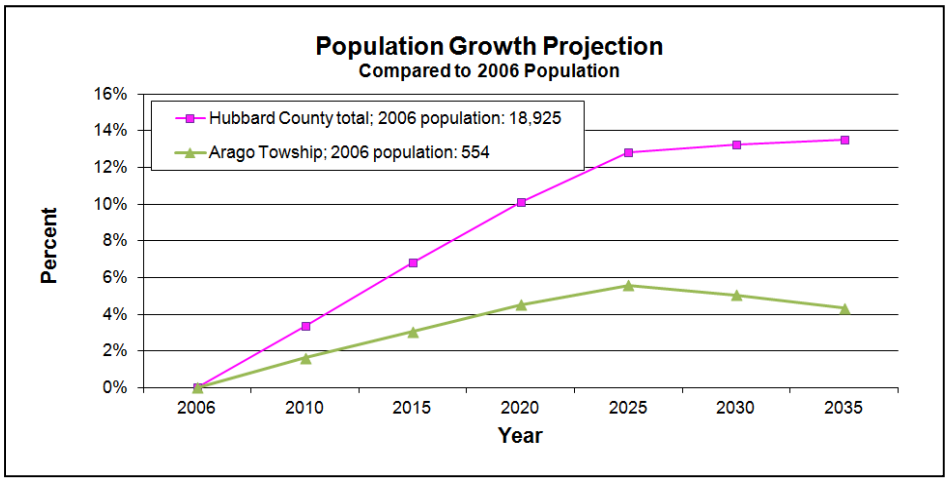


Figure 18. Population growth projection for Arago Township and Hubbard County. (source: http://www.demography.state.mn.us/resource.html?Id=19332)

Eagle Lake Lakeshed Water Quality Protection Strategy

Each lakeshed has a different makeup of public and private lands. Looking in more detail at the makeup of these lands can give insight on where to focus protection efforts. The protected lands (easements, wetlands, public land) are the future water quality infrastructure for the lake. Developed land and agriculture have the highest phosphorus runoff coefficients, so this land should be minimized for water quality protection.

The majority of the land within Eagle Lake's lakeshed is made up of private forested uplands (Table 10). This land can be the focus of development and protection efforts in the lakeshed.

Table 10. Percent land use in private versus publicly owned land with corresponding phosphorus loading and protection/restoration ideas (Sources: Minnesota DNR GAP Stewardship data, National Wetlands Inventory, and the 2006 National Land Cover Dataset).

	Private (42%)					16%	Public (42%)		
	Developed	**Agriculture**	**Forested Uplands**	**Other**	**Wetlands**	**Open Water**	**County**	**State**	**Federal**
Land Use (%)	1.3%	2.4%	26.9%	2.7%	8.7%	16%	42%	0.08%	.0008%
Runoff Coefficient Lbs of phosphorus/acre/ year	0.45 – 1.5	0.26 – 0.9	0.09		0.09		0.09	0.09	0.09
Estimated Phosphorus Loading Acreage x runoff coefficient	17 – 58	19 – 66	75		24		118	0.2	0.002
Description	Focused on Shoreland	Cropland	Focus of develop-ment and protection efforts	Open, pasture, grass-land, shrub-land	Protected				
Potential Phase 3 Discussion Items	Shoreline restoration	Restore wetlands; CRP	Forest stewardship planning, 3rd party certification, SFIA, local woodland cooperatives		Protected by Wetland Conservation Act		County Tax Forfeit Lands	State Forest	National Forest

DNR Fisheries approach for lake protection and restoration

Credit: Peter Jacobson and Michael Duval, Minnesota DNR Fisheries

In an effort to prioritize protection and restoration efforts of fishery lakes, the MN DNR has developed a ranking system by separating lakes into two categories, those needing protection and those needing restoration. Modeling by the DNR Fisheries Research Unit suggests that total phosphorus concentrations increase significantly over natural concentrations in lakes that have watershed with disturbance greater than 25%. Therefore, lakes with watersheds that have less than 25% disturbance need protection and lakes with more than 25% disturbance need restoration (Table 11). Watershed disturbance was defined as having urban, agricultural and mining land uses. Watershed protection is defined as publicly owned land or conservation easement.

Table 11. Suggested approaches for watershed protection and restoration of DNR-managed fish lakes in Minnesota.

Watershed Disturbance (%)	Watershed Protected (%)	Management Type	Comments
< 25%	> 75%	Vigilance	Sufficiently protected -- Water quality supports healthy and diverse native fish communities. Keep public lands protected.
	< 75%	Protection	Excellent candidates for protection -- Water quality can be maintained in a range that supports healthy and diverse native fish communities. Disturbed lands should be limited to less than 25%.
25-60%	n/a	Full Restoration	Realistic chance for full restoration of water quality and improve quality of fish communities. Disturbed land percentage should be reduced and BMPs implemented.
> 60%	n/a	Partial Restoration	Restoration will be very expensive and probably will not achieve water quality conditions necessary to sustain healthy fish communities. Restoration opportunities must be critically evaluated to assure feasible positive outcomes.

The next step was to prioritize lakes within each of these management categories. DNR Fisheries identified high value fishery lakes, such as cisco refuge lakes. Ciscos (*Coregonus artedi)* can be an early indicator of eutrophication in a lake because they require cold hypolimnetic temperatures and high dissolved oxygen levels. These watersheds with low disturbance and high value fishery lakes are excellent candidates for priority protection measures, especially those that are related to forestry and minimizing the effects of landscape disturbance.

Eagle Lake was classified with having 58.9% of the watershed protected and 4.1% of the watershed disturbed (Figure 19). Therefore, Eagle Lake should have a protection focus. Goals for the lake should be to limit any increase in disturbed land use.

Figure 20 displays the upstream lakesheds that contribute water to the lakeshed of interest. All of the land and water area in this figure has the potential to contribute water to Eagle Lake, whether through direct overland flow or through a creek or river. Most of the upstream lakesheds are either sufficiently protected (dark green) or are excellent candidates for protection (light green). Goals for this lakeshed should be to limit any increase in disturbed land use and implement Best Management Practices.

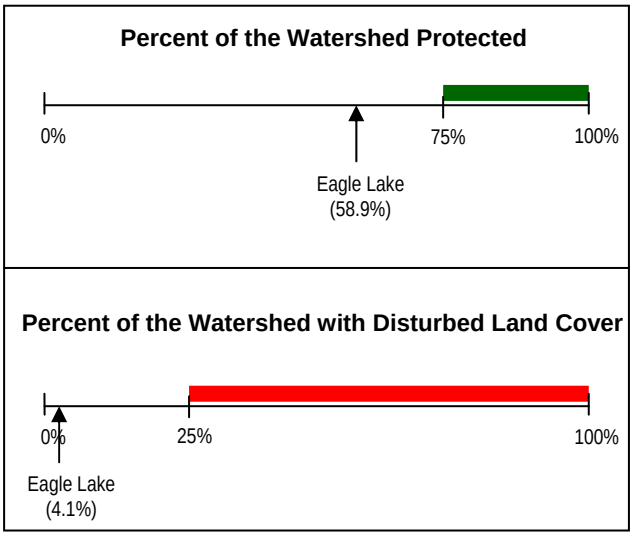


Figure 19. Eagle Lake lakeshed's percentage of watershed protected and disturbed.

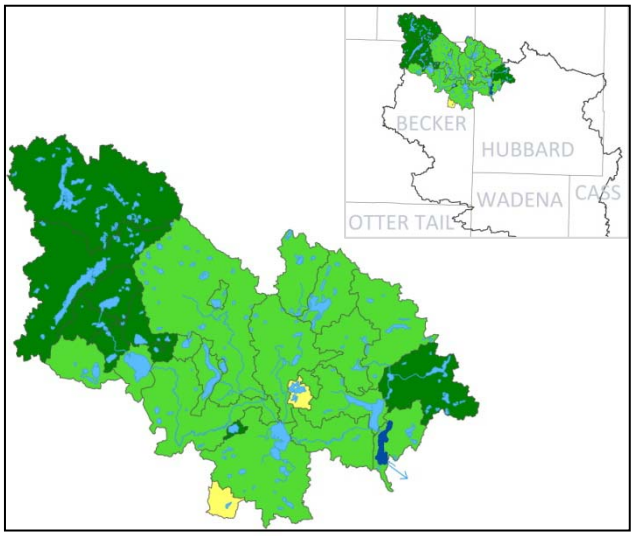


Figure 20. Upstream lakesheds that contribute water to the Eagle Lake lakeshed. Color-coded based on management focus (Table 3).

Eagle, Status of the Fishery (as of 07/23/2007)

Eagle Lake is located in Hubbard County, seven miles north of Park Rapids. Eagle Lake has a surface area of 411 acres and a maximum depth of 77 feet. There is a public access located on the west shore of the lake. Eagle Lake is part of the Island, Eagle, Potato chain of lakes, with connections to Island Lake upstream and Potato Lake downstream. Boating access in the river connecting these lakes is possible with a small to medium size boats. Eagle is a popular fishing lake, and provides angling opportunities for walleye, northern pike, and panfish.

The Minnesota Dept. of Natural Resources (DNR) has classified Minnesota's lakes into 43 different types based on physical, chemical, and other characteristics. Eagle Lake is in lake class 25. Other area lakes in this same classification include Bad Axe, Belle Taine, West Crooked, Big and Little Mantrap, Ojibway, Little Sand, and Spider.

Eagle Lake is well known for its walleye fishery and is a popular fishing spot, especially early in the season. Walleye abundance (7.4 walleye/gillnet) was up from past surveys and above the current management goal of (3 walleye/gillnet). The 2007 gillnet catch rate of 7.4 walleye/net is the highest for all surveys conducted on Eagle since 1961. Walleye abundance in past surveys has generally fluctuated around the current management goal. Sampled walleye had an average length and weight of 14.7 inches and 1.3 pounds. Eagle Lake is stocked with walleye fingerlings during odd numbered years. Yellow perch, an important forage species for walleye, were sampled in high numbers. Yellow perch were small in size, with few perch an acceptable size for angling.

Northern pike were sampled in high numbers (8.2 pike/gillnet), at the upper end of the range "typical" for this lake class. The 2002 survey had similar pike abundance, while earlier surveys sampled pike in low to moderate numbers. Sampled northern pike had an average length and weight of 22.1 inches and 2.6 pounds, with pike measured up to 32.7 inches. Eagle Lake, as well as surrounding lakes, have seen an increase in northern pike numbers in recent years. Higher than normal water levels in Hubbard County in the late 1990's and early 2000's have provided excellent spawning conditions for northern pike. While dominated by small pike, Eagle Lake can produce a few large fish. Important forage species such as Cisco (tullibee), white sucker, and shorthead redhorse are present providing the right conditions for growing large pike.

While not known as a panfish lake, Eagle does support fishing opportunities for black crappie and bluegill. Black crappie were sampled in low numbers, similar to past surveys. Anglers can expect to find black crappie in the 10-12 inch size range. The bluegill population in Eagle Lake has been increasing. Bluegill were sampled in moderate numbers (26.1 bluegill/trapnet), within the range "typical" for this lake class. Bluegill abundance in surveys prior to 2000 was low, well below the range "typical" for this lake class. Anglers can expect to find bluegill in the 6-8 inch size range.

Other species sampled in moderate numbers included pumpkinseed, rock bass, shorthead redhorse, yellow bullhead, brown bullhead, and black bullhead. Largemouth bass are present in low numbers when compared to other area lakes.

See the link below for specific information on gillnet surveys, stocking information, and fish consumption guidelines. http://www.dnr.state.mn.us/lakefind/showreport.html?downum=29025600

Key Findings / Recommendations

Monitoring Recommendations
Transparency monitoring at site 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. Phosphorus and chlorophyll a monitoring should continue, as the budget allows, to track future water quality trends.

Overall Conclusions
Overall, Eagle Lake is in good shape. It is a mesotrophic lake (TSI=46) that falls within the expected ecoregion ranges of water quality for the area. It has an improving trend in transparency from 1997 to 2011. Forty-two percent (42%) of the lakeshed is public land, and 58.9% of the watershed protected while only 4.1% of the lakeshed is disturbed.

There are a large range of phosphorus concentrations in Eagle Lake. Some years, such as 2000, are very low, while other years, such as 2002, are high (Figure 7). Eagle Lake has a very large watershed (218 times larger than the lakeshed), and it could be that precipitation and conditions in the watershed are responsible for the phosphorus dynamics in the lake. In 2002 there were 6 more inches of spring and summer precipitation in the Eagle Lake area than in 2000. In addition, the year 2000 had 3.5 inches less spring and summer precipitation than 1998-1999 (www.climate.umn.edu).

Priority Impacts to the lake
Eagle Lake has a high watershed to lake area ratio (218:1), which means that there is a lot of area draining into the lake; however the overall immediate lakeshed is well protected. Development is concentrated on the western side of Eagle Lake; however, a new road section on the eastern side may signal development in this section. Increased development, including 2nd tier development, brings along increased impervious surface, runoff, and septic system impacts to the lake.

The current development on the west side of the lake is high density with three resorts and a golf course. The inlet on the northwest side is developed as well. These areas could benefit from the implementation of best management practices to mitigate the negative impact development can have on water quality.

Best Management Practices Recommendations
The management focus for Eagle Lake should be to protect the current water quality. Protection efforts should be focused on managing and/or decreasing the impact caused by additional development, including second tier development, and impervious surface area. Project ideas include protecting land with conservation easements, enforcing county shoreline ordinances, smart development, shoreline restoration and buffers, rain gardens, and septic system maintenance.

Targeted placement of best management practices can increase their cost effectiveness. Individual parcel assessment of percent impervious cover and proximity to a river or the shoreline is one way to rank priority. Flow analysis using GIS software could also pinpoint locations where water accumulates into a swale or depression.

Organizational contacts and reference sites

Eagle Lake Association	No contact information available
DNR Fisheries Office	301 South Grove Avenue, Park Rapids, MN 56470 218-732-4153 parkrapids.fisheries@state.mn.us http://www.dnr.state.mn.us/areas/fisheries/parkrapids/index.html
Regional Minnesota Pollution Control Agency Office	714 Lake Ave., Suite 220, Detroit Lakes, MN 56501 218-847-1519, 1-800-657-3864 http://www.pca.state.mn.us/yhiz3e0
Hubbard County Soil and Water Conservation District	212 1/2 2nd St W, Park Rapids MN 56470 218-732-0121 http://www.hubbardswcd.org/