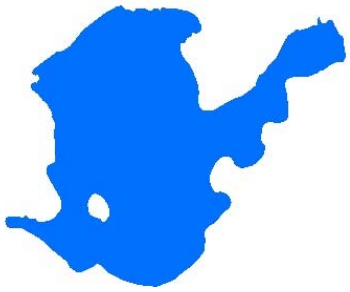
Bear Lake 09-0034-00 Carlton County



Bear Lake is located 0.5 miles southeast of Barnum, MN in Carlton County. It is a small lake covering 90 acres (Table 1).

Bear Lake has two minor inlets and one outlet, which classify it as a drainage lake. Water enters Bear Lake from groundwater streams in the south and northeast and flows out through Cub lake to the Moose Horn River. Since the inlet streams are intermittent, there is likely some groundwater interaction as well.

Water quality data have been collected on Bear Lake from 1996-2001 and from 2009-2016 (Tables 2 & 3). These data show that the lake is mesotrophic (TSI = 49) with moderately clear water conditions most of the summer.

There is a joint Lake Association on Bear, Eddy, Hanging Horn and Little Hanging Horn lakes. They have an organized golf tournament and are involved in lake monitoring and education.

Table 1. Bear Lake location and key physical characteristics.

Location Data		Physical Characteristics	
MN Lake ID:	09-0034-00	Surface area (acres):	90.4
County:	Carlton County	Littoral area (acres):	62.5
Ecoregion:	Northern Lakes and Forests	% Littoral area:	69.1%
Major Watershed:	Kettle River	Max depth (ft), (m):	31, 9.45
Latitude/Longitude:	46.497713, -92.677686	Inlets:	2
Invasive Species:	Eurasian Watermilfoil	Outlets:	1
		Public Accesses:	1

Table 2. Availability of primary data types for Bear Lake.

Data Availability		
Transparency data		Good
Chemical data		Good – multiple years, but with gaps between the years
Inlet/Outlet data	--	Not necessary
Recommendations		For recommendations refer to page 15.

Lake Map

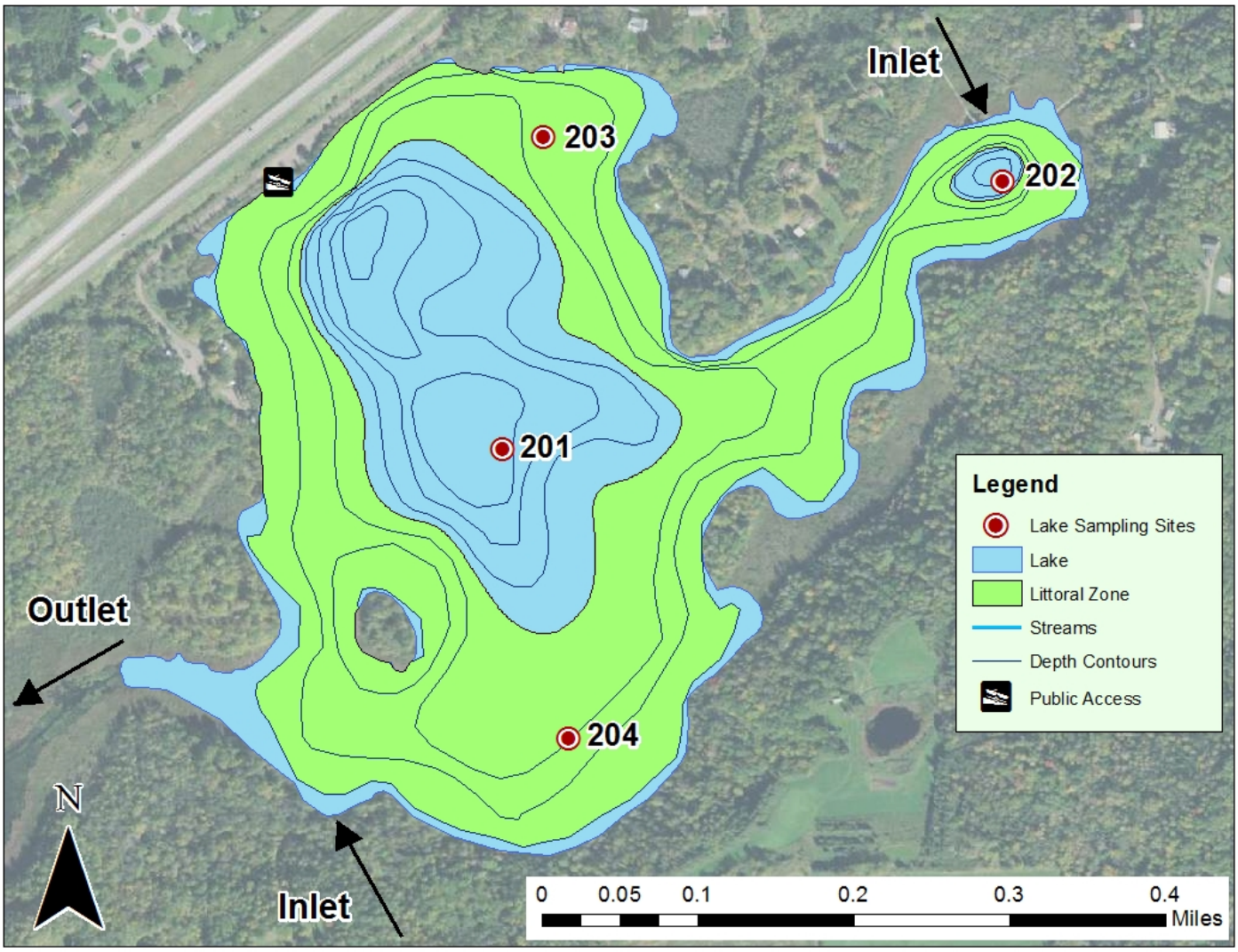


Figure 1. Map of Bear Lake with 2010 aerial imagery and illustrations of lake depth contour lines, sample site locations, inlets and outlets, and public access points. The light green areas in the lake illustrate the littoral zone, where the sunlight can usually reach the lake bottom, allowing aquatic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

Table 3. Monitoring programs and associated monitoring sites. Monitoring programs include the Citizen Lake Monitoring Program (CLMP), Mississippi River-Grand Rapids Carlton SWCD (SWCD), and MPCA Lake Monitoring Program (MPCA).

Lake Site	Depth (ft)	Monitoring Programs
201* Primary site	30	CLMP: 1996-2000, 2010-2016; SWCD: 2009-2010, 2016; MPCA: 1982, 1997
202	25	CLMP: 2000-2001
203	15	CLMP: 2001
204	15	CLMP: 2001

Average Water Quality Statistics & Comparisons

The information below describes available chemical data for Bear Lake through 2017 (Table 4). Data for total phosphorus, chlorophyll *a*, and Secchi depth are from the primary site 201.

Minnesota is divided into 7 ecoregions based on land use, vegetation, precipitation and geology. The Minnesota Pollution Control Agency (MPCA) has developed a way to determine the "average range" of water quality expected for lakes in each ecoregion[1] (Table 4). Bear Lake is in the Northern Lakes and Forests Ecoregion (Figure 2).

The MPCA has developed Impaired Waters Standards for lakes in each ecoregion to determine if a lake is impaired for excess phosphorus/eutrophication (Table 4). Lakes that are over the impaired waters standards are placed on the state's Impaired Waters List[2].

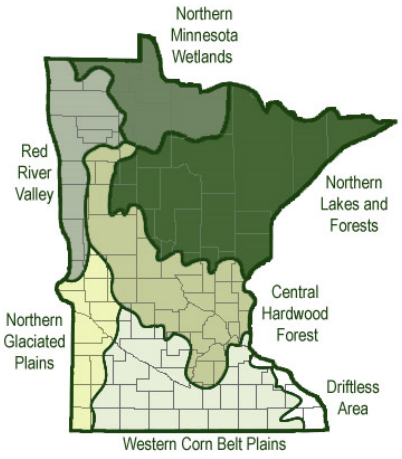


Figure 2. Minnesota ecoregions.

Table 4. Water quality means compared to ecoregion ranges and impaired waters standard.

Parameter	Mean	Ecoregion Range[1]	Impaired Waters Standard[2]	Interpretation
Total phosphorus (ug/L)	25.2	14 – 27	> 30	Results are within the expected range for the Northern Lakes and Forests Ecoregion and the lake is not impaired for excess phosphorus.
[3]Chlorophyll *a* (ug/L)	7.2	4 – 10	> 9	
Chlorophyll *a* max (ug/L)	21.9	< 15		
Secchi depth (ft)	9.2	8 – 15	< 6.5	
Dissolved oxygen	*See page 8*			Dissolved oxygen depth profiles show that the lake mixes in spring and fall (dimictic).
Total Kjeldahl Nitrogen (mg/L)	0.62	<0.4 – 0.75		Indicates insufficient nitrogen to support summer nitrogen-induced algae blooms.
Alkalinity (mg/L)	57.8	40 – 140		Indicates a low sensitivity to acid rain and a good buffering capacity.
Color (Pt-Co Units)	26	10 – 35		Indicates mostly clear water with some tannins (brown stain).
pH	8.8	7.2 – 8.3		Indicates 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)	29.1	0.6 – 1.2		Above the expected range for the ecoregion and could be due to the proximity of the city of Barnum the I35 Freeway and road salts.
Total Suspended Solids (mg/L)	3.5	<1 – 2		Above the expected range for the ecoregion, but still considered low level.
Specific Conductance (umhos/cm)	186.7	50 – 250		Within the expected range for the ecoregion.
TN:TP Ratio	24.6:1	25:1 - 35:1		Shows the lake is phosphorus limited.

[1]The ecoregion range is the 25th-75th percentile of summer means from ecoregion reference lakes: https://www.pca.state.mn.us/quick-links/eda-guide-typical-minnesota-water-quality-conditions
[2]For further information regarding the Impaired Waters Assessment program, refer to http://www.pca.state.mn.us/water/tmdl/index.html
[3]Chlorophyll *a* measurements have been corrected for pheophytin
Units: 1 mg/L (ppm) = 1,000 ug/L (ppb)

Water Quality Characteristics - Historical Means and Ranges

Table 5. Water quality means and ranges for primary sites.

Parameters	Primary Site 201	Site 202	Site 203	Site 204
Total Phosphorus Mean (ug/L):	25			
Total Phosphorus Min:	8			
Total Phosphorus Max:	43			
Number of Observations:	22			
Chlorophyll *a* Mean (ug/L):	7			
Chlorophyll-a Min:	1			
Chlorophyll-a Max:	22			
Number of Observations:	23			
Secchi Depth Mean (ft):	9.2	5.8	7.5	7.2
Secchi Depth Min:	2.0	3.0	5.5	5.5
Secchi Depth Max:	15.0	7.5	10.0	10.5
Number of Observations:	168	6	5	5

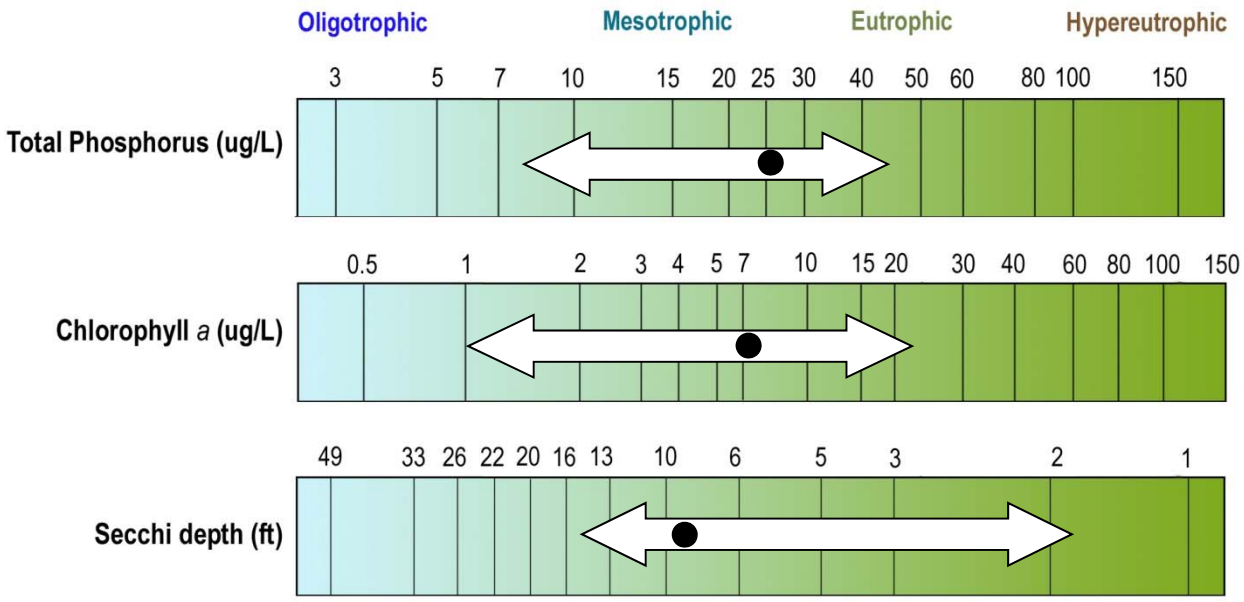


Figure 3. Bear Lake total phosphorus, chlorophyll a and transparency historical ranges. The arrow represents the range and the black dot represents the historical mean (Primary Site 201). Figure adapted after Moore and Thornton, [Ed.]. 1988. Lake and Reservoir Restoration Guidance Manual. (Doc. No. EPA 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 number 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 in Bear Lake ranges from 6.6 to 11.1 feet (Figure 4). The annual means hover up and down around the long-term mean. For trend analysis, see page 10. Transparency monitoring should be continued annually at site 201 in order to track water quality changes.

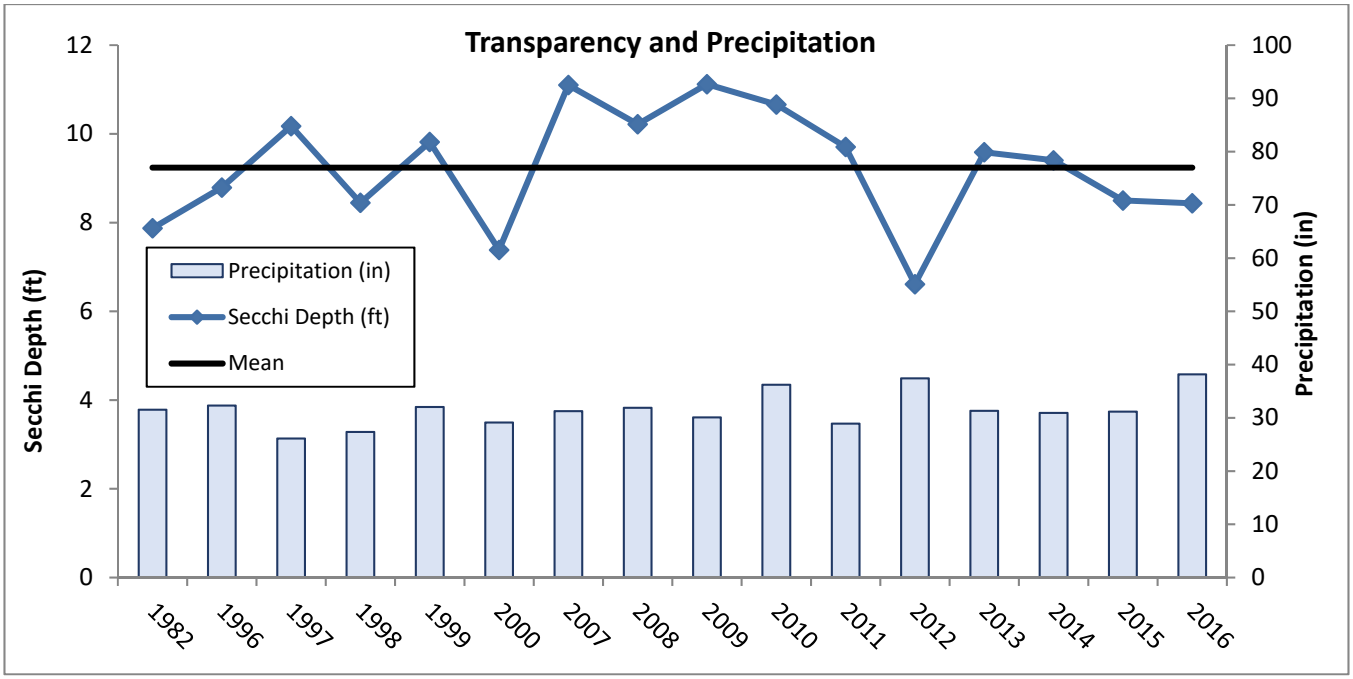


Figure 4. Annual mean transparency compared to long-term mean transparency

Bear Lake transparency ranges from 2.0 to 15.0 ft at the primary site (Table 5). Figure 5 shows the seasonal transparency dynamics. The maximum Secchi reading is usually obtained in early summer. Bear Lake transparency is high in May and June, and then declines through August. This transparency dynamic is typical of a Minnesota lake. 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 that 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.

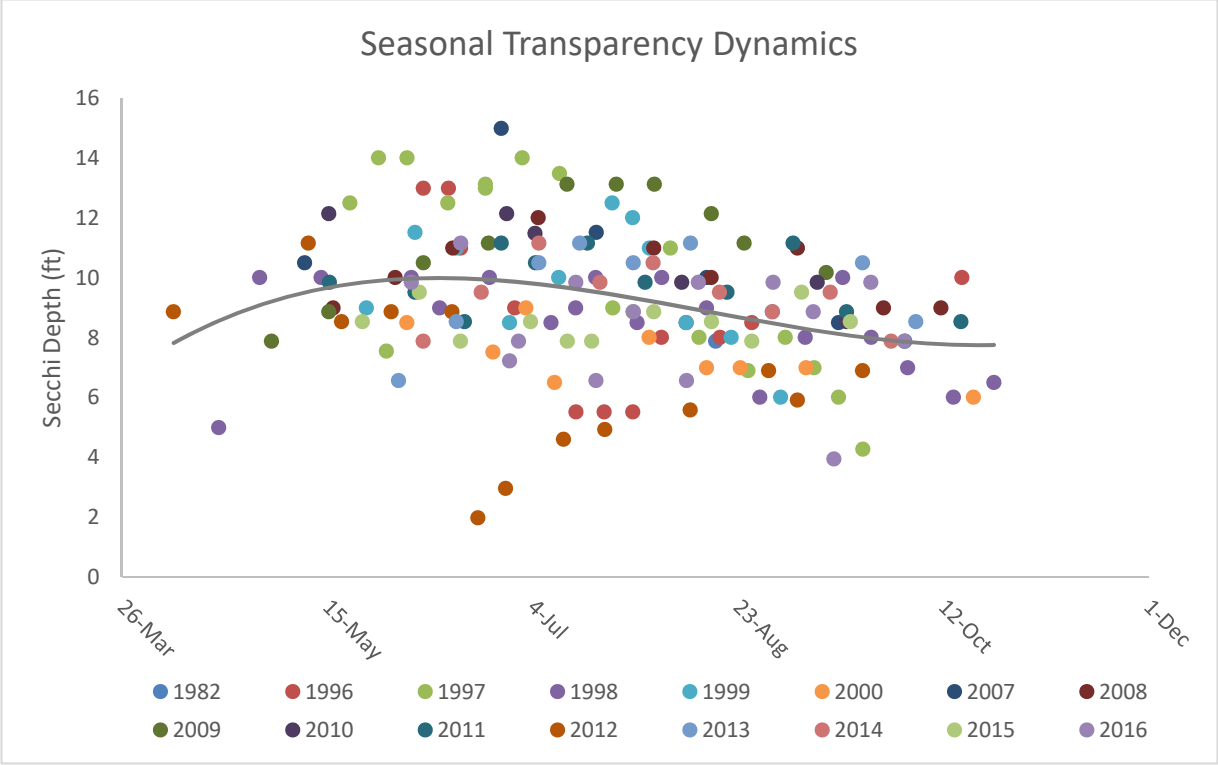


Figure 5. Seasonal transparency dynamics and year to year comparison (Primary Site 201). The gray line represents the pattern in the data.

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 and recreational suitability decreases (Figures 6-7).

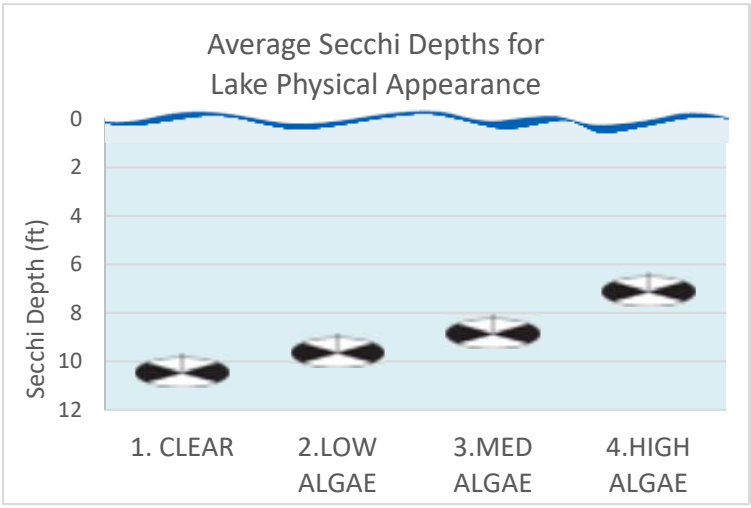


Figure 7. Average Secchi depth (ft) for each lake physical appearance rating.

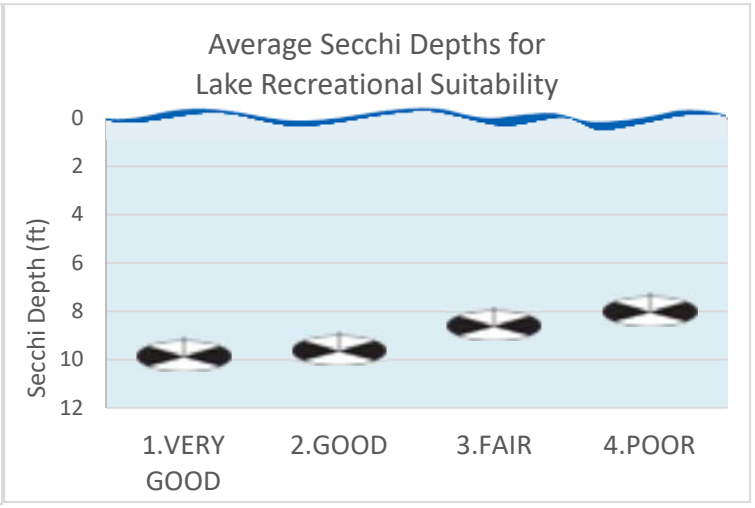


Figure 6. Average Secchi depth (ft) for each lake recreational suitability rating.

Algae

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 Bear Lake at site 201 in 1982, 1997, 2009-2010, and 2016 (Figure 8). Chlorophyll *a* concentrations went above 10 ug/L in 2010 and 2016, indicating minor algae blooms. Chlorophyll *a* concentrations were above 20 ug/L in 1997, indicating a major algae bloom. There was not much variation over the years monitored and chlorophyll *a* concentrations are usually highest in late summer.

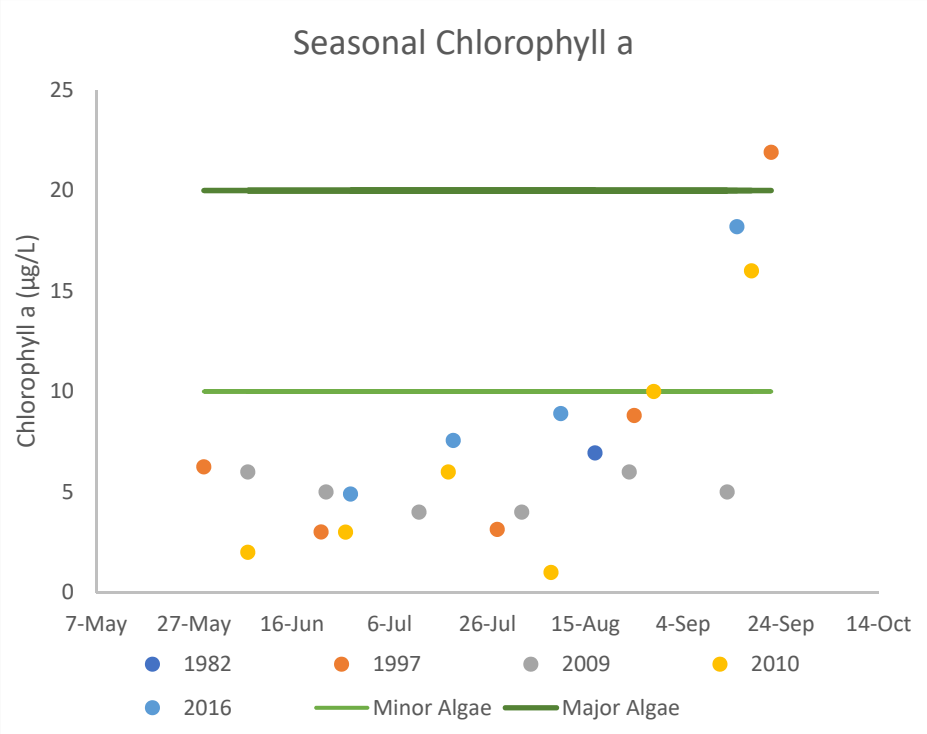


Figure 8. Chlorophyll a concentrations (ug/L) for Bear Lake at site 201.

Phosphorus

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

Total phosphorus was evaluated in Bear Lake in 1997, 2009-2010, and 2016. The data do not indicate much seasonal variability. The majority of the data points fall into the mesotrophic or eutrophic ranges (Figure 9).

Phosphorus should continue to be monitored to track any future changes in water quality.

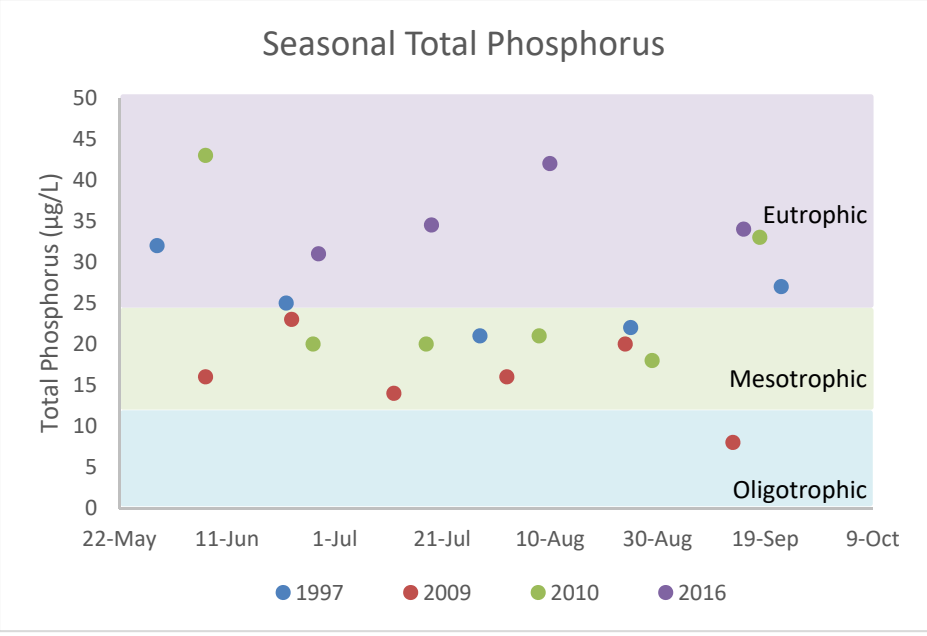
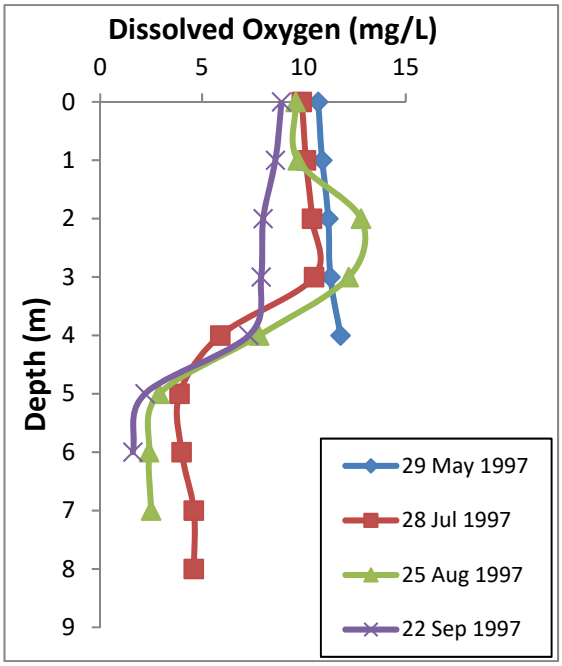


Figure 9. Historical total phosphorus concentrations (ug/L) for Bear Lake site 201.

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.

Bear Lake is a moderately shallow lake, with a maximum depth of 31 feet. Dissolved oxygen profiles from data collected in 1997 at site 201 show stratification developing during the summer (Figure 10). The thermocline in 1997 was around 3 meters (10 feet). Dissolved oxygen was below 5 mg/L in August and September meaning gamefish will likely be scarce in the deeper water at that time.

Figure 10. Representative dissolved oxygen profiles from 1997 in Bear Lake.

Trophic State Index (TSI)

TSI is a standard measure or means for calculating the trophic status or productivity of a lake. More specifically, it is the total weight of living algae (algae biomass) in a waterbody at a specific location and time. Three variables, chlorophyll a, Secchi depth, and total phosphorus, independently estimate algal biomass.

If all three TSI numbers are within a few points of each other, they are strongly related. If they are different, there are other dynamics influencing the lake's productivity, and TSI mean should not be reported for the lake. Bear Lake falls into the mesotrophic range (Tables 6, 7).

Table 6. Trophic State Index for Bear Lake.

Trophic State Index	
TSI Phosphorus	51
TSI Chlorophyll-a	50
TSI Secchi	45
TSI Mean	49
Trophic State:	Mesotrophic

Numbers represent the mean TSI for each parameter.

Table 7. Trophic state index attributes and their corresponding fisheries and recreation characteristics.

Bear Lake

Eutrophication

TSI	Attributes	Fisheries & Recreation
<30	**Oligotrophy:** Clear water, oxygen throughout the year at the bottom of the lake, deep cold water.	Trout fisheries dominate.
30-40	Bottom 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.

Bear Lake had enough data to perform a trend analysis on transparency (Table 8). The data was analyzed using the Mann Kendall Trend Analysis.

Table 8. Trend analysis for Bear Lake.

Lake Site	Parameter	Date Range	Trend
201	Total Phosphorus	1997-2016	No significant trend
201	Chlorophyll *a*	1982-2016	No significant trend
201	Transparency	2007-2016	No significant trend

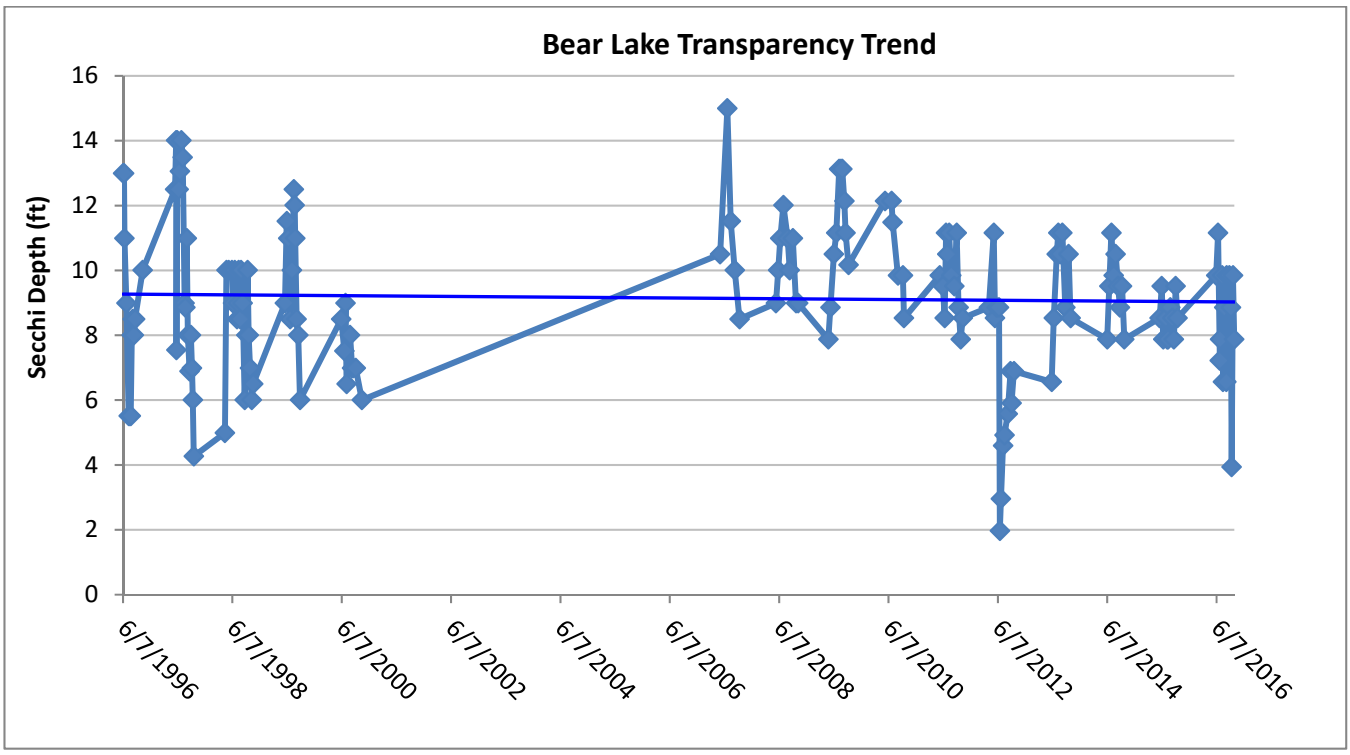


Figure 11. Transparency (feet) trend for site 201 from 1996-2016.

Bear Lake shows insufficient evidence for a transparency trend (Figure 11). There was a large gap in data between 2000-2006. Since then, 2012 had much lower transparency than average, but it improved again after 2012. See the recommendations section for more explanation (page 15). Transparency monitoring should continue so that this trend can be tracked in future years.

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 Kettle River Major Watershed is one of the watersheds that make up the St. Croix River Basin, which drains south to the Gulf of Mexico (Figure 12).

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. Bear Lake falls within lakeshed 3502400 (Figure 12). 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.

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 based on their lakeshed, 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 9). Watershed disturbance was defined as having urban, agricultural and mining land uses. Watershed protection is defined as publicly owned land, public surface waters, wetlands, or conservation easement.

Table 9. 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. Forest stewardship planning, harvest coordination to reduce hydrology impacts and forest conservation easements are some potential tools that can protect these high value resources for the long term.

Bear Lake's lakeshed is classified with having 52% of the watershed protected and 13% of the watershed disturbed (Figure 13). Therefore, this lakeshed should have a protection focus. Goals for the lake should be to limit any increase in disturbed land use and to maintain current protection levels. Bear Lake is a headwaters lakeshed, which means that no other lakesheds flow into it (Figure 12).

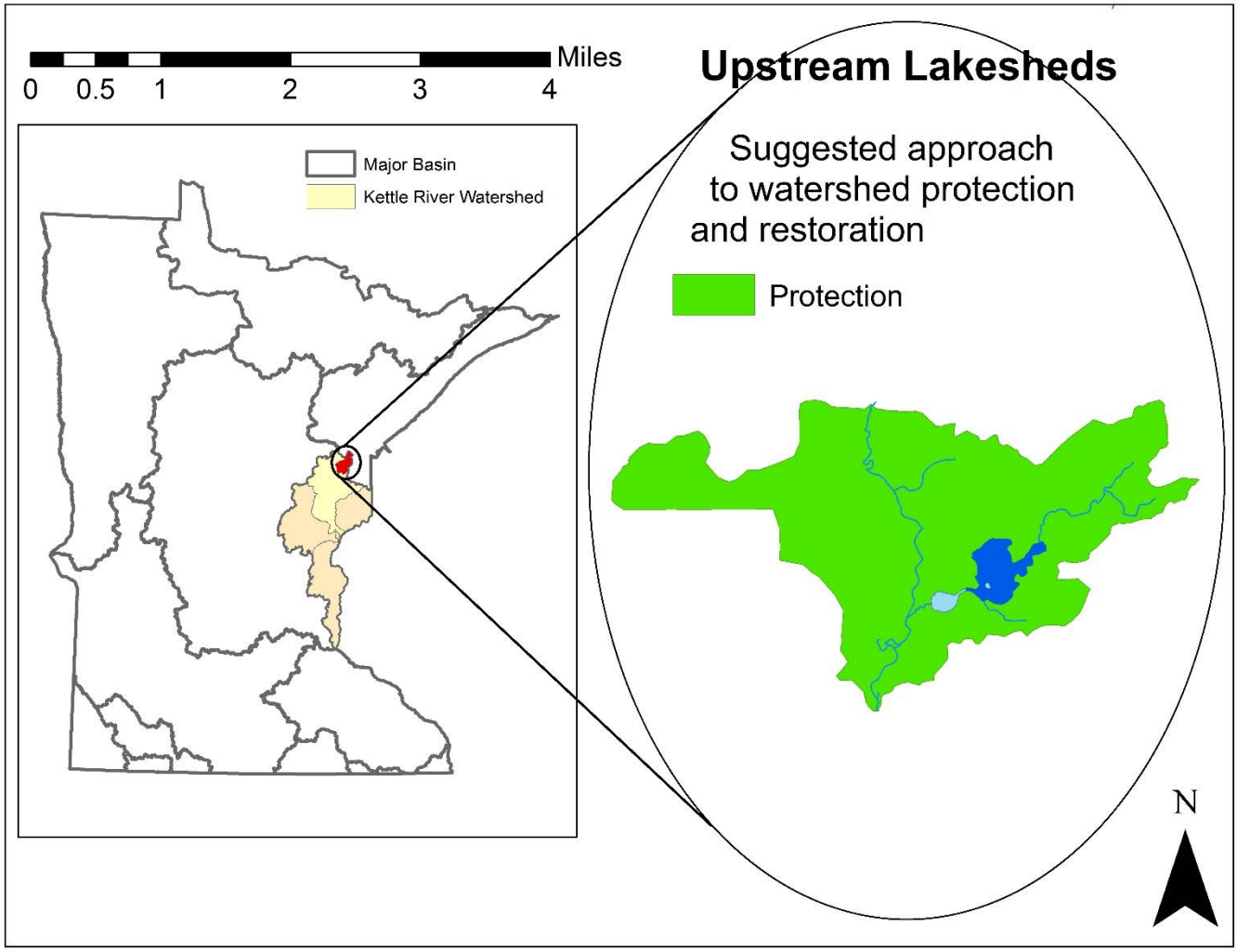


Figure 12. Kettle River major watershed and MN basins (left), and Bear Lake lakeshed and upstream catchments with protection suggestions (right).

Land use and Ownership

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.

Over half (52%) of the Bear Lake lakeshed is protected (Figure 13). This total includes water, wetlands, and publicly owned land. There is one parcel along the lakeshore which has conservation potential. It is private land over 20 acres which is less than 50% developed or agriculture.

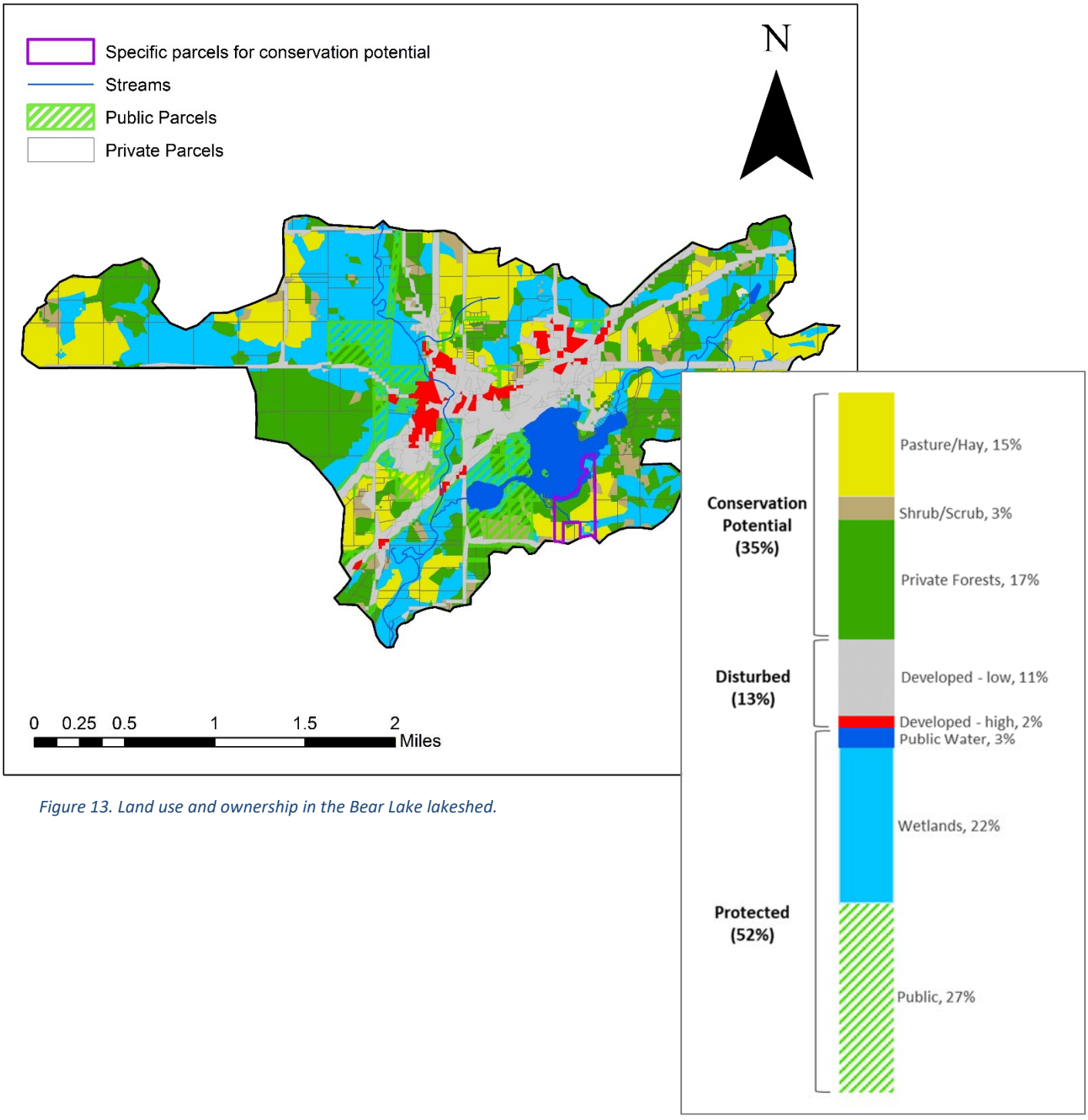


Figure 13. Land use and ownership in the Bear Lake lakeshed.

The lakeshed vitals table identifies where to focus organizational and management efforts for each lake (Table 10). 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 10. Bear Lake lakeshed vitals table.

Lakeshed Vitals		Rating
Lake Area	90.4 acres	descriptive
Littoral Zone Area	62.5 acres	descriptive
Lake Max Depth	31 ft.	descriptive
Lake Mean Depth	11 ft.	
Water Residence Time	NA	Not available
Miles of Stream	6.7	descriptive
Inlets	2	
Outlets	1	
Major Watershed	35 – Kettle River	descriptive
Minor Watershed	35024	descriptive
Lakeshed	3502400	descriptive
Ecoregion	Northern Lakes and Forest	descriptive
Total Lakeshed to Lake Area Ratio (total lakeshed includes lake area)	34:1	
Standard Watershed to Lake Basin Ratio (standard watershed includes lake areas)	34:1	
Wetland Coverage	26.3%	
Aquatic Invasive Species	Eurasian Watermilfoil	
Public Drainage Ditches	None	
Public Lake Accesses	1	
Miles of Shoreline	2.61	descriptive
Shoreline Development Index	1.59	
Public Land to Private Land Ratio	0.2:1	
Development Classification	Recreational Development	
Miles of Road	23.0	descriptive
Municipalities in lakeshed	Barnum	
Forestry Practices	None	
Feedlots	None	
Sewage Management	Compliance inspections are required for subsurface sewage treatment systems at point-of-sale or permit application in shoreland areas.	
Lake Management Plan	None	
Lake Vegetation Survey/Plan	DNR, 2016	

Bear Lake, Status of the Fishery (DNR, 8/3/2015)

A standard survey was conducted on Bear Lake during the summer of 2015 to update information about fish populations. Walleye is the primary management species for Bear Lake and fingerlings are stocked during even numbered years. Walleye abundance of 1.0 per gillnet lift was average compared to other Minnesota lakes of similar type. Walleye average length was large at 20.1 inches. Two year-classes were represented, and both corresponded to stocked year-classes.

Angling opportunities for Largemouth Bass are notable in Bear Lake with fish up to 20.6 inches sampled. The Largemouth Bass electrofishing catch rate was 29.0 fish per hour, which is average compared to other Duluth Area Largemouth Bass populations. Mean length of sampled bass was good at 14.6 inches.

Panfish population density was average compared to other similar Minnesota lakes. Black Crappie average length was 6.8 inches but only 10% exceeded eight inches. Bluegill averaged 6.3 inches with some quality fish available up to 8.5 inches. Yellow Perch were scarce and small.

Northern Pike abundance of 7.0 per gillnet lift was above average compared to other Minnesota lakes of similar type. Mean length was 22.8 inches and over 50% of the fish captured exceeded 24 inches long.

Eurasion water milfoil was identified in Bear Lake during this survey. The infestation was well established and was very thick in the immediate vicinity of the public access, among other areas. The lake has been designated as infested waters and signs were posted to notify those using the public water access. Designation of the lake as an infested water prohibits the transport of water and harvest of bait. Extreme care must be exercised by thoroughly cleaning boats and trailers when leaving the lake to avoid spreading the aquatic invasive species to other waterbodies.

Development pressure is increasing around the shorelines and within the watersheds of many Minnesota lakes. This development can degrade water quality and impact valuable shoreline habitat. Native shoreline vegetation provides habitat for fish and wildlife, filters harmful nutrients, and protects against shoreline erosion. Lakeshore owners can minimize their impact on the shoreline and maintain a more natural setting while actually decreasing annual maintenance. For more information on how to accomplish this, contact the nearest Area Fisheries office or go to the following website: www.dnr.state.mn.us/shorelandmgmt

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=09003400

Key Findings and Recommendations

Monitoring Recommendations
Transparency monitoring at site 201 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 at site 201, as the budget allows, to track future water quality trends.

Overall Conclusions
Bear Lake is a mesotrophic lake (TSI = 49) with insufficient evidence of a long-term trend in water clarity. The total phosphorus, chlorophyll *a* and transparency ranges are within the ecoregion ranges (Table 4).

Over half of the Bear Lakeshed is protected (52%), which includes public ownership, wetlands, and open water, and 17% of the lakeshed land area is forested. Only 13% of the lakeshed is disturbed, which includes high and low levels of development (Figure 13).

The city of Barnum and Interstate 35 are adjacent to Bear Lake. Chloride concentration in the lake was monitored in 1997 and 2016 and is higher than expected for the region (Table 4). The chloride is still under the state standard though; the state standard is 207 mg/L and Bear Lake is 29 mg/L. This higher chloride could be due to road salt use in Barnum and on I35. More information about chloride monitoring and guidelines can be found at the Minnesota Pollution Control Agency's website here: https://www.pca.state.mn.us/water/chloride-salts. Stormwater from the city and Interstate 35 could be diverted to a sediment basin before running into Bear Lake to protect the lake from chloride runoff.

Phosphorus Loading and Priority Impacts
Bear Lake is at an advantage because the lake is a headwaters lake, which means no additional water flows into this lake from upstream lakes or rivers. The inlets to the lake are intermittent and groundwater and/or wetland fed. (Figure 1). This means that the land practices around Bear Lake and in it's lakeshed are the main impacts to the lake (Figure 13).

Bear Lake has insufficient evidence for a strong trend in transparency from 2007-2016 (Table 8, Figure 11), but the graph shows much lower than average transparency in 2012. Water level monitoring shows an increase of five feet over the ordinary high water mark in 2012, which could have caused the lower transparency (Figure 14). High water can cause shoreline erosion and cause decreased water transparency. Maintaining wetlands in the lakeshed help with water storage and can decrease the impact from high water events.

Table 11. Watershed characteristics.

Lakeshed to Lake Area Ratio (lakeshed includes lake area)	34:1
Watershed to Lake Area Ratio (watershed includes lake areas)	34:1
Number of Upstream Lakes	0
Headwaters Lake?	Yes
Inlets / Outlets	2 / 1
Water Residence Time	NA

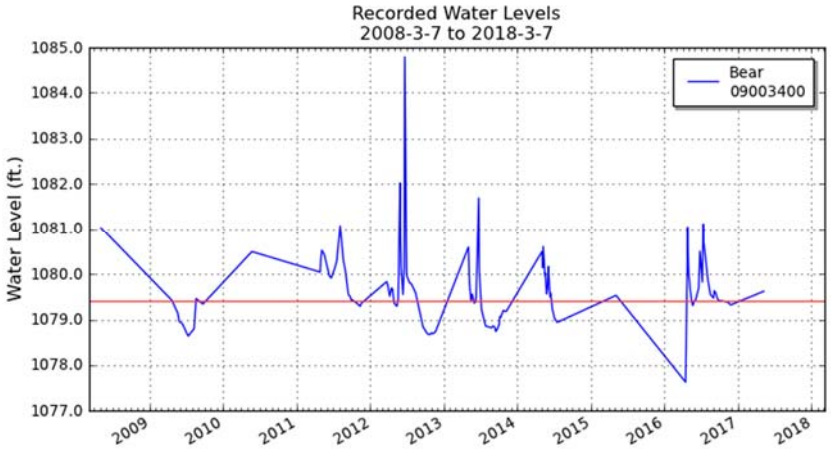


Figure 14. Monitored water levels in Bear Lake, Source: MN DNR Lakefinder.

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

Bear Lake Goals

1. Protection Focus: minimize disturbed land uses and maintain protected lands
2. Manage phosphorus loading from **nearshore**, Table 12
3. Focused BMPs per land type: Table 12

Table 12. Best Management Practices Table specific to Bear Lake (refer to Figure 13 for locations).

Category	Land use type	Conservation project ideas	Results	Who	Contact for help
Conservation Potential Land (35%)	private forests (17%, 528 acres)	Forest stewardship planning, 3rd party certification, SFIA, local woodland cooperatives	Conserve and protect current forest cover	• Individual Property Owners	Carlton SWCD (218) 384-3891 https://carltonswcd.org/
	pasture/hay (15%, 466 acres)	Conservation Reserve Program (CRP), maintain vegetative cover, plant trees, conservation easements, grassed waterways, ditch buffers, maintain/restore wetlands.	Reduce water runoff and soil erosion, better water storage	• Individual Property Owners	Natural Resources Conservation Service 123-4567-8910, info@swcd.org
Disturbed Land (13%)	developed, low intensity (11%, 144 acres)	Shoreline buffers, rain gardens	Reduce water runoff and shoreline erosion.	• Individual Property Owners	Carlton SWCD (218) 384-3891 https://carltonswcd.org/
	developed, high intensity (2%, 26 acres)	Sediment basins, rain gardens, shoreline buffers, stormwater retention.	Reduce water runoff into streams and lakes.	• Individual Property Owners • Cities • Lake Associations	Carlton SWCD (218) 384-3891 https://carltonswcd.org/

The publicly owned land at the lake's outlet is a good location for land protection (Figure 13). Although the impervious surface from the city of Barnum and I35 can't be removed, runoff from it can be managed so that it doesn't impact water quality. See table 12 for project ideas.

The current lakeshore homeowners can lessen their negative impact on water quality by installing or maintaining the existing trees on their properties. Forested uplands contribute significantly less phosphorus (lbs/acre/year) than developed land cover (Table 12).

One sixth of the lakeshed is privately owned forested uplands (Table 12). Forested uplands can be managed with Forest Stewardship Planning, 3rd party certification, SFIA, and local woodland cooperatives. Contact the Soil and Watershed Conservation District for options for managing private forests.

The lakeshed still has a couple of large undeveloped shoreline parcels (Figure 13). Because a lot of undeveloped private land still exists, there is a great potential for protecting this land with conservation easements and aquatic management areas (AMAs). Conservation easements can be set up easily and with little cost with help from organizations such as the Board of Soil and Water Resources and the Minnesota Land Trust. AMAs can be set up through the local DNR fisheries office.

Native aquatic plants stabilize the lake's sediments and tie up phosphorus in their tissues. When aquatic plants are uprooted from a shallow lake, the lake bottom is disturbed, and the phosphorus in the water column gets used by algae instead of plants. This contributes to "greener" water and more algae blooms. Protecting native aquatic plant beds will ensure a healthy lake and healthy fishery. If a swimming area is necessary in front of people's docks, clear only a small area of plants. Clearing a whole 100 foot frontage is not necessary and can contribute to additional algae blooms.

Table 13. Organizational contacts and reference sites

Organizational contacts and reference sites

Hanging Horn Lakeshore Management Association	P.O. Box 192 Barnum, MN 55707
DNR Fisheries Office	5351 North Shore Drive, Duluth, MN 55804 218-302-3264, duluth.fisheries@state.mn.us
Regional Minnesota Pollution Control Agency Office	525 Lake Avenue South, Suite 400, Duluth, MN 55802 218-723-4660 https://www.pca.state.mn.us/about-mpca/duluth-office
Carlton County Soil and Water Conservation District	808 3rd St, Carlton, MN 55718 (218) 384-3891, https://carltonswcd.org/
Carlton County	301 Walnut Ave, Carlton, MN 55718 http://carltoncountymn.govoffice3.com/