

Potato Lake 29-0243-00 HUBBARD COUNTY

Lake Water Quality

Summary



Potato Lake is located about six miles north of Park Rapids, Minnesota. It covers 2,100 acres and has a horseshoe shape.

Potato Lake has two main inlets and one outlet, which classifies it as a drainage lake. The main inlet enters from Eagle Lake to the northwest. The second inlet flows in from Blue Lake. A third intermittent inlet enters on the north side of the lake from a wetland. The outlet, the Potato River, flows out of the south end of the lake and into Fish Hook Lake. From there it joins the Fish Hook River and eventually the Crow Wing River.

Water quality data have been collected on Potato Lake since 1990 (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 Potato Lake Association was incorporated in 1987 and is very active. They are involved in many activities, including water quality monitoring, lake level monitoring, fishery management input to the DNR, advocating for healthy lakeshore development, aquatic invasive species education, loon nesting projects, shoreland surveys, education, and newsletter distribution. They are also a member of the Hubbard County Coalition of Lake Associations (COLA).

Table 1. Potato Lake location and key physical characteristics.

| Location Data | | Physical Characteristics | |
|-----------------------|----------------------------|--------------------------|----------|
| MN Lake ID: | 29-0243-00 | Surface area (acres): | 2100 |
| County: | Hubbard | Littoral area (acres): | 426 |
| Ecoregion: | Northern Lakes & Forests | % Littoral area: | 20% |
| Major Drainage Basin: | Upper Mississippi River | Max depth (ft), (m): | 87, 26.5 |
| Latitude/Longitude: | 47.00083333 / -95.05586111 | Inlets: | 2 |
| Invasive Species: | None as of 2011 | Outlets: | 1 |
| | | Public Accesses: | 2 |

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

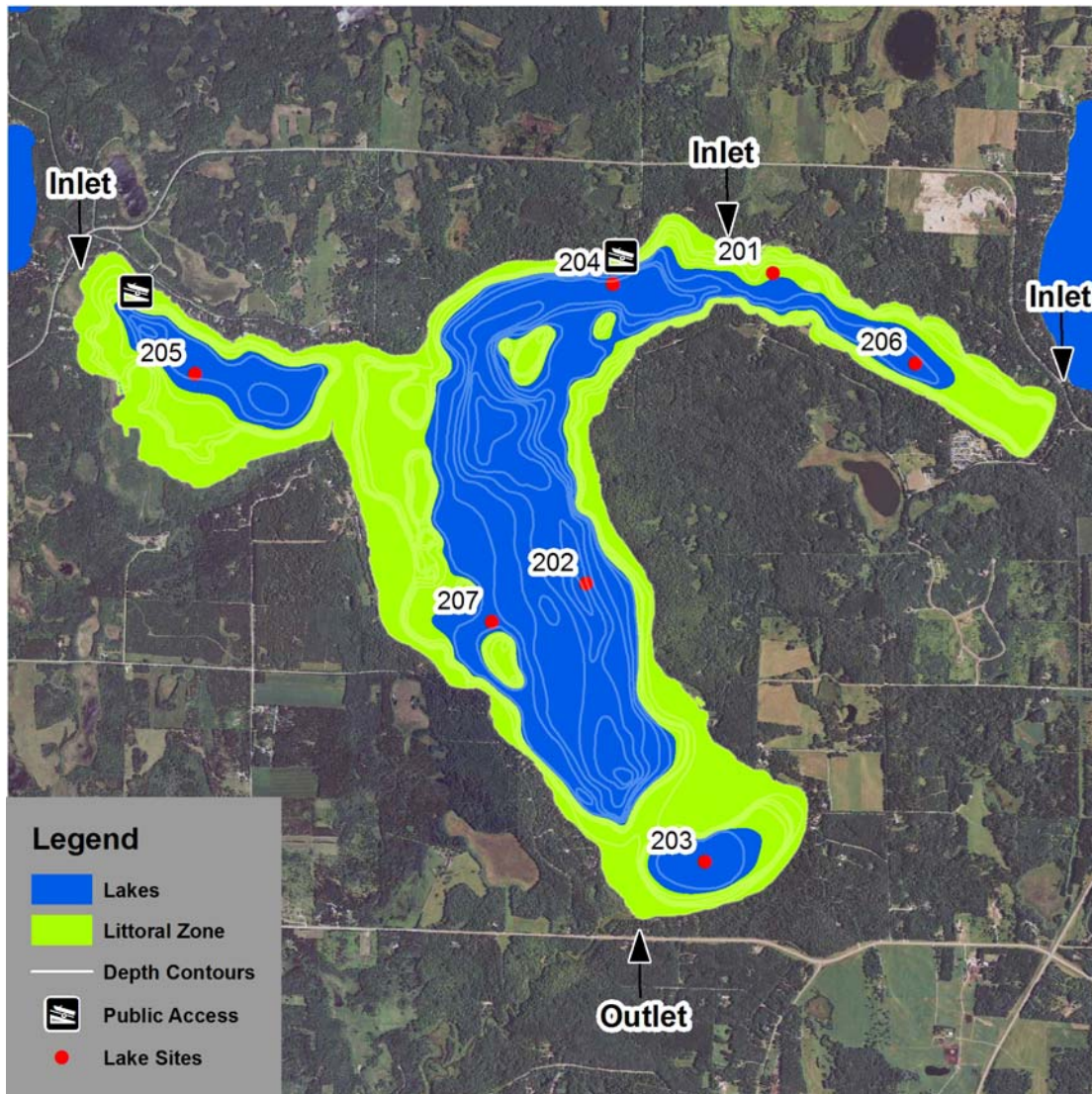


Figure 1. Map of Potato Lake with 2010 aerial imagery and illustrations of sample site locations, inlets and outlets, and public access points. The light green areas in the lake illustrate the littoral zone, where the sunlight can usually reach the lake bottom allowing aquatic plants to grow.

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 | 25 | CLMP: 1990-1992 |
| 202*primary site | 80 | CLMP: 1990-2012; RMBEL: 1997-2012 |
| 203 | 37 | CLMP: 1994-2010 |
| 204 | 50 | CLMP: 1994-2010 |
| 205 | 30 | CLMP: 1994-2010 |
| 206 | 30 | CLMP: 1994-2010 |
| 207 | 30 | CLMP: 1995-1999 |

Water Quality Characteristics - Historical Means and Ranges

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

| Parameters | Primary | | | | | | |
|--------------------------------------|-------------|------------|-------------|-------------|-------------|-------------|------------|
| | Site 202 | Site 201 | Site 203 | Site 204 | Site 205 | Site 206 | Site 207 |
| Total Phosphorus Mean (ug/L): | 15 | | | | | | |
| Total Phosphorus Min: | 5 | | | | | | |
| Total Phosphorus Max: | 40 | | | | | | |
| Number of Observations: | 103 | | | | | | |
| Chlorophyll a Mean (ug/L): | 5 | | | | | | |
| Chlorophyll-a Min: | 1 | | | | | | |
| Chlorophyll-a Max: | 23 | | | | | | |
| Number of Observations: | 103 | | | | | | |
| Secchi Depth Mean (ft): | 11.1 | 9.2 | 10.8 | 11.6 | 10.6 | 10.4 | 9.6 |
| Secchi Depth Min: | 4.5 | 7.0 | 4.5 | 5.5 | 6.5 | 5.0 | 5.0 |
| Secchi Depth Max: | 20.0 | 12.0 | 18.4 | 20.0 | 16.1 | 19.5 | 14.5 |
| Number of Observations: | 429 | 39 | 300 | 319 | 294 | 225 | 79 |

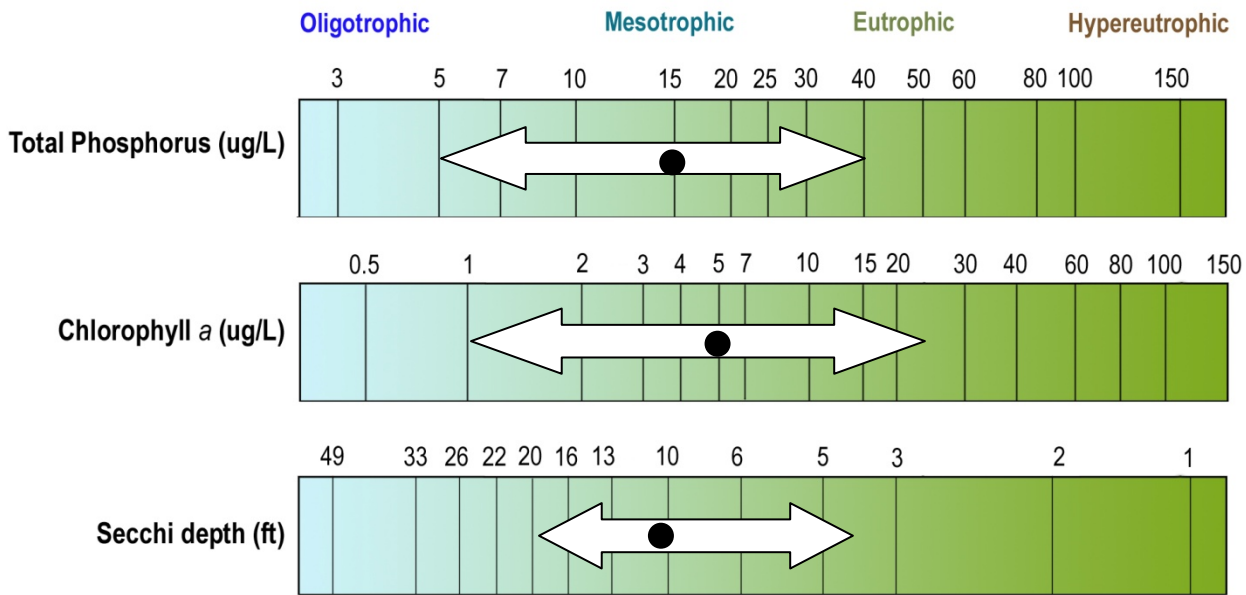


Figure 2. Potato Lake total phosphorus, chlorophyll a and transparency historical ranges. The arrow represents the range and the black dot represents the historical mean (Primary Site 202). Figure adapted after Moore and Thornton, [Ed.]. 1988. Lake and Reservoir Restoration Guidance Manual. (Doc. No. 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 means for Potato Lake range from 7.7-13.9 ft (Figure 3). Transparency is consistently highest at site 204. This could be because site 204 is flushed well by the inlet near it. Overall, the transparency is fairly uniform across the lake. Transparency monitoring should be continued at all sites to track water quality in Potato Lake.

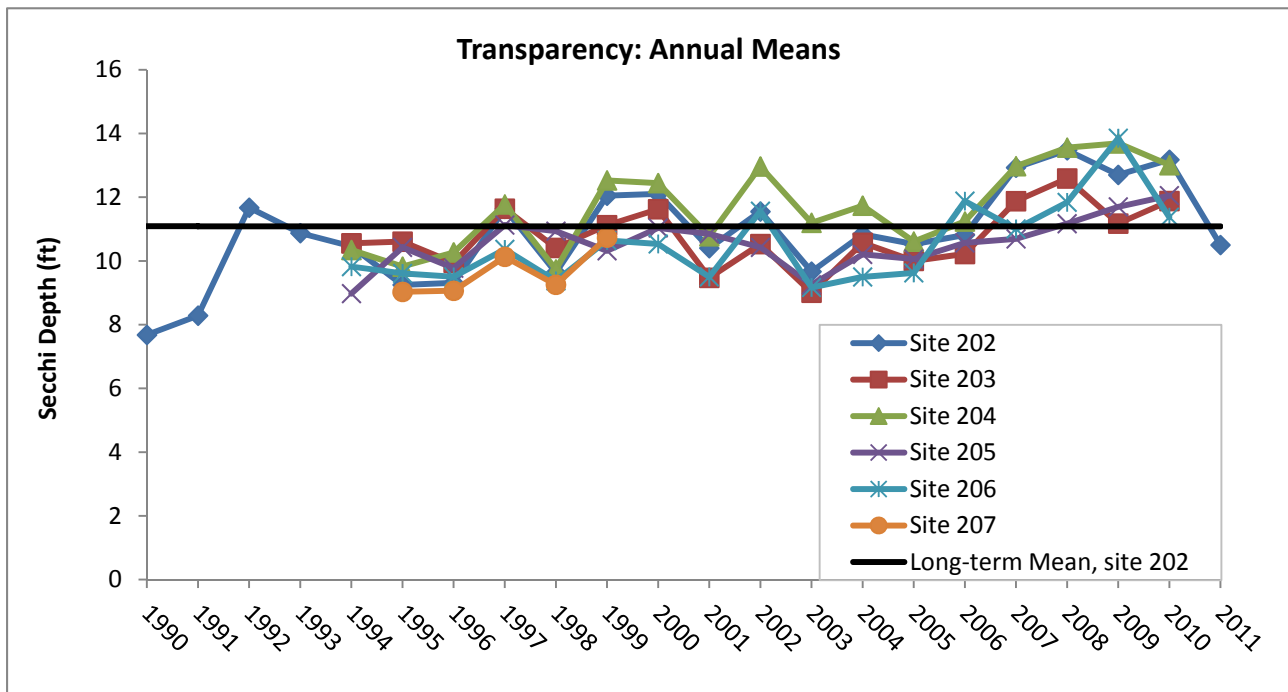


Figure 3. Annual mean transparency for all sites.

Potato Lake transparency ranges from 4.5 to 20 feet throughout the summer (Table 5). Figure 4 shows the seasonal transparency dynamics. The maximum Secchi reading is usually obtained in early summer. Potato 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

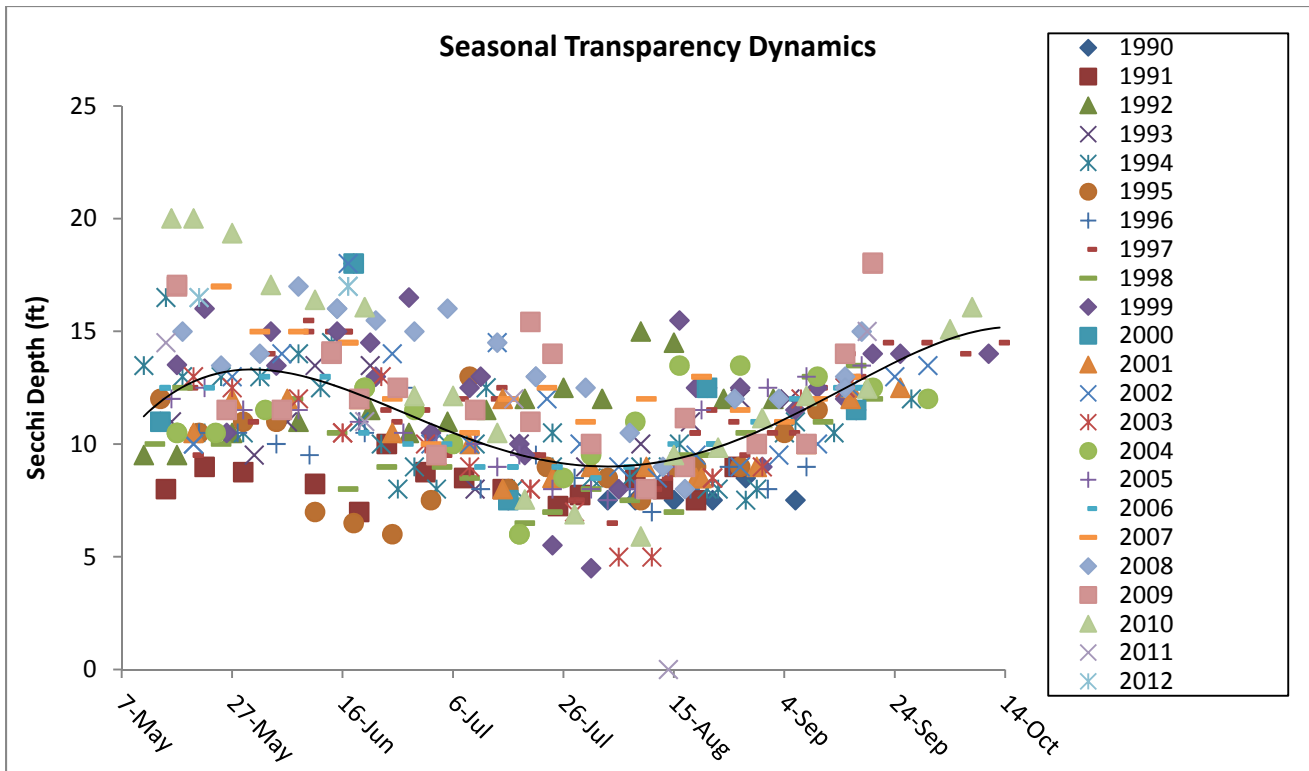


Figure 4. Seasonal transparency dynamics and year-to-year comparison (site 204). The black line represents the pattern in the data.

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. Potato Lake was rated as being "not quite crystal clear" 78% of the time between 1991-2011 (Figure 5).

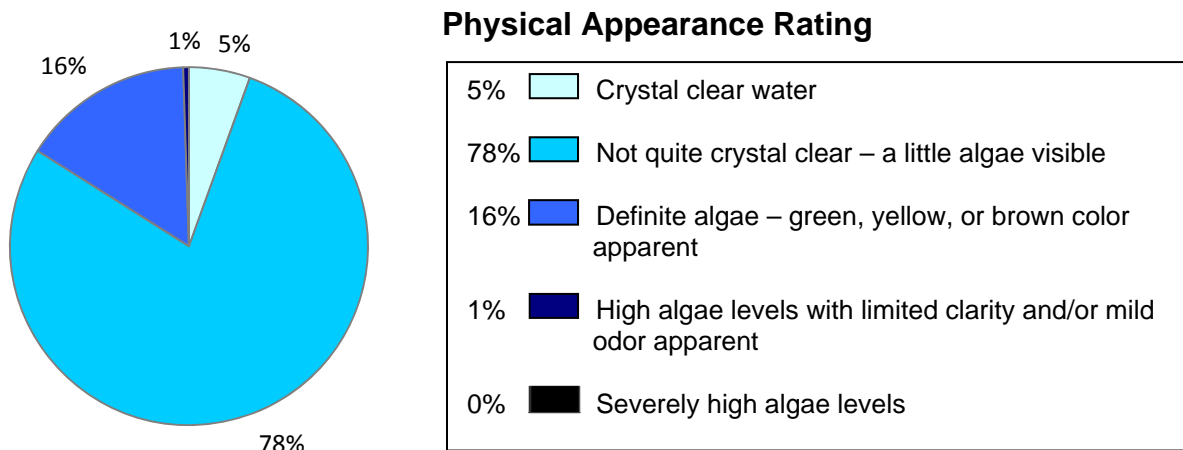


Figure 5. Physical appearance rating, as rated by the volunteer monitor.

As the secchi depth decreases, the perception of recreational suitability of the lake decreases. Potato Lake was rated as having “very minor aesthetic problems” 82% of the time from 1991-2011.

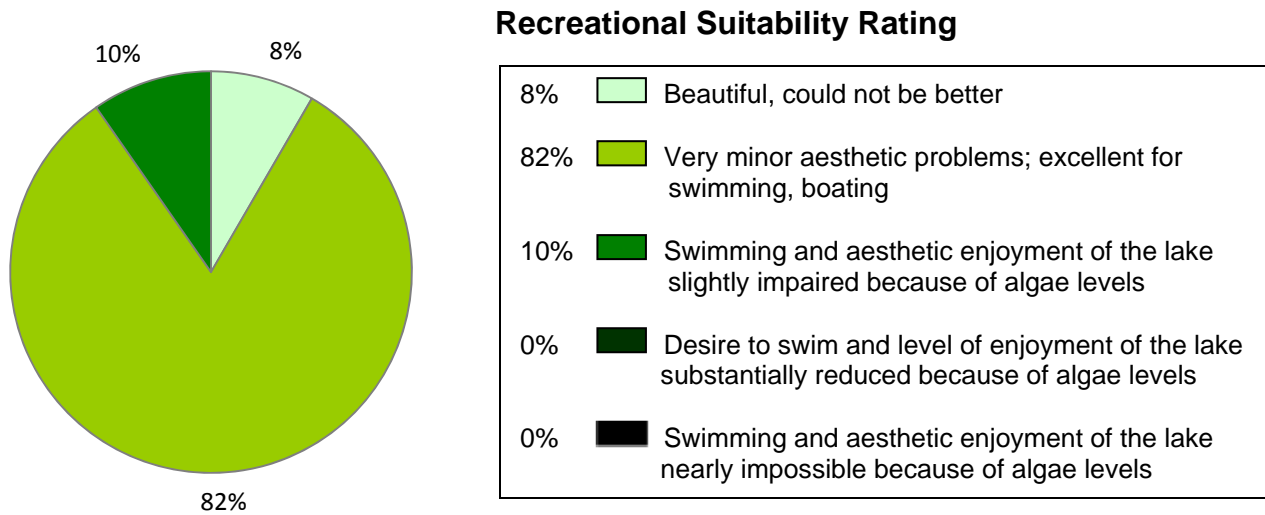


Figure 6. Recreational suitability rating, as rated by the volunteer monitor.

Total Phosphorus

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

Total phosphorus was evaluated in Potato Lake in 1997-2011. Most of the data points fall into the mesotrophic range (Figure 7). There is not much seasonal variation in phosphorus concentration for Potato Lake, although the phosphorus is slightly higher in the spring and fall, which could be due to turnover.

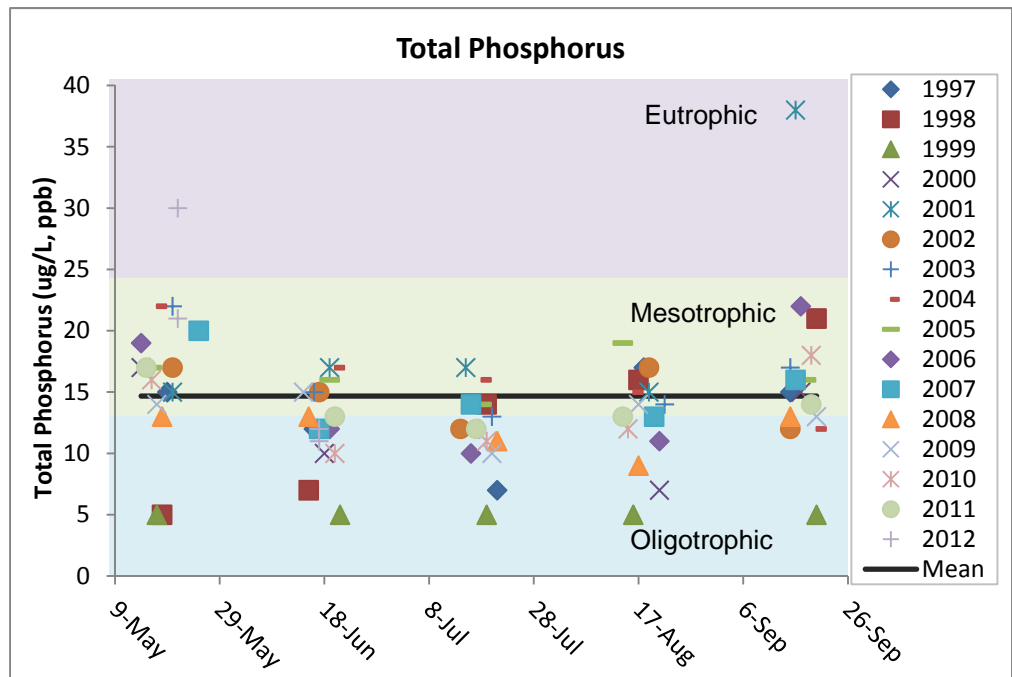


Figure 7. Historical total phosphorus concentrations (ug/L) at site 202 for Potato Lake.

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 Potato Lake in 1997-2011 (Figure 8). Chlorophyll *a* concentrations remained below 10 ug/L on most dates, indicating clear water all summer and no nuisance algae blooms.

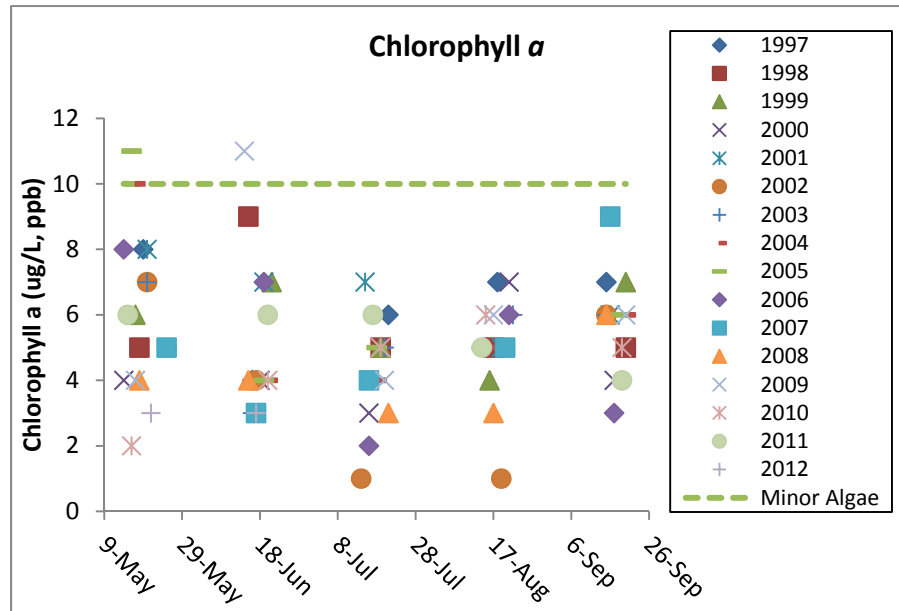
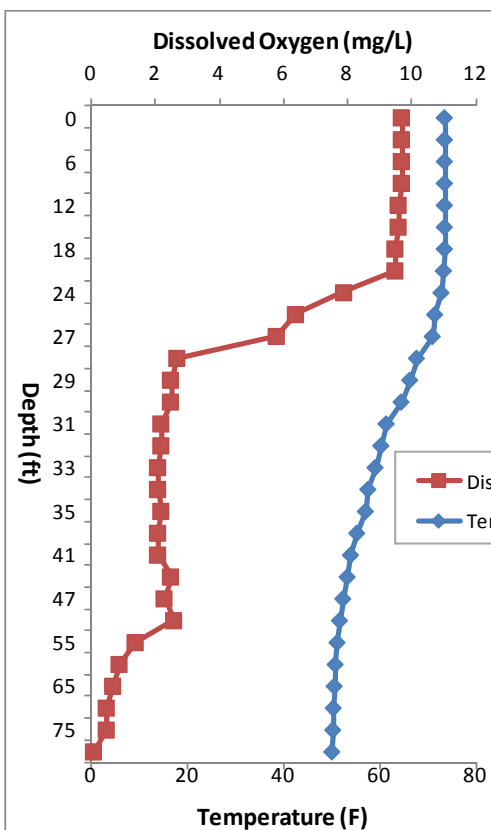


Figure 8. Chlorophyll *a* concentrations (ug/L) for Potato Lake.

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.

Potato Lake is a relatively deep lake, with a maximum depth of 87 feet. Dissolved oxygen profiles from 2010 indicate that Potato Lake stratifies in the summer (Figure 9). The thermocline occurs around 28 feet, and below that depth the oxygen drops below 5 mg/L. This means that game fish will be scarce below this depth in mid-summer.

Figure 9. Dissolved oxygen and temperature profile for Potato Lake on 7/19/2010, MN DNR.

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 Potato Lake falls into the mesotrophic range (Figure 10). There is good agreement between the TSI for phosphorus, chlorophyll a and transparency, indicating that these variables are strongly related (Table 6).

Mesotrophic lakes (TSI 40-50) are characterized by moderately clear water most of the summer (Table 7). "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 6. Trophic State Index.

| Trophic State Index | Site 204 |
|----------------------|-------------|
| TSI Total Phosphorus | 43 |
| TSI Chlorophyll-a | 46 |
| TSI Secchi | 42 |
| TSI Mean | 44 |
| Trophic State: | Mesotrophic |

Numbers represent the mean TSI for each parameter.

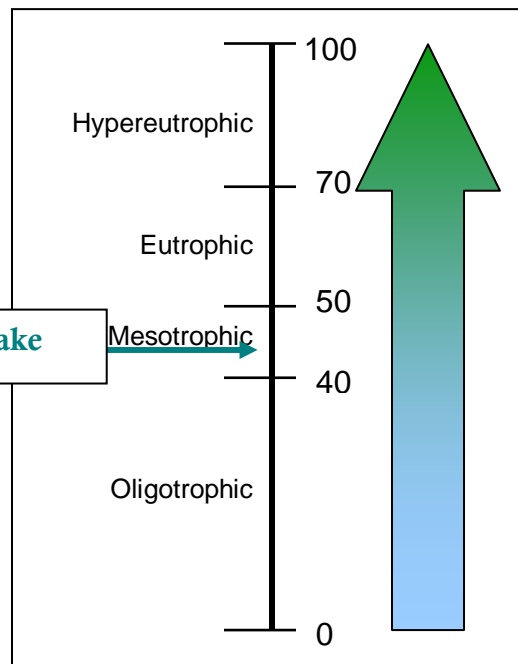


Figure 10. Trophic state index chart with corresponding trophic status.

Table 7. 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 Potato Lake (Table 8). The data was analyzed using the Mann Kendall Trend Analysis.

Table 8. Trend analysis for Potato Lake.

| Lake Site | Parameter | Date Range | Trend | Probability |
|-----------|----------------------|------------|-----------|-------------|
| 202 | Transparency | 1990-2011 | Improving | 95% |
| 202 | Total Phosphorus | 1997-2011 | No trend | - |
| 202 | Chlorophyll <i>a</i> | 1997-2011 | No trend | - |

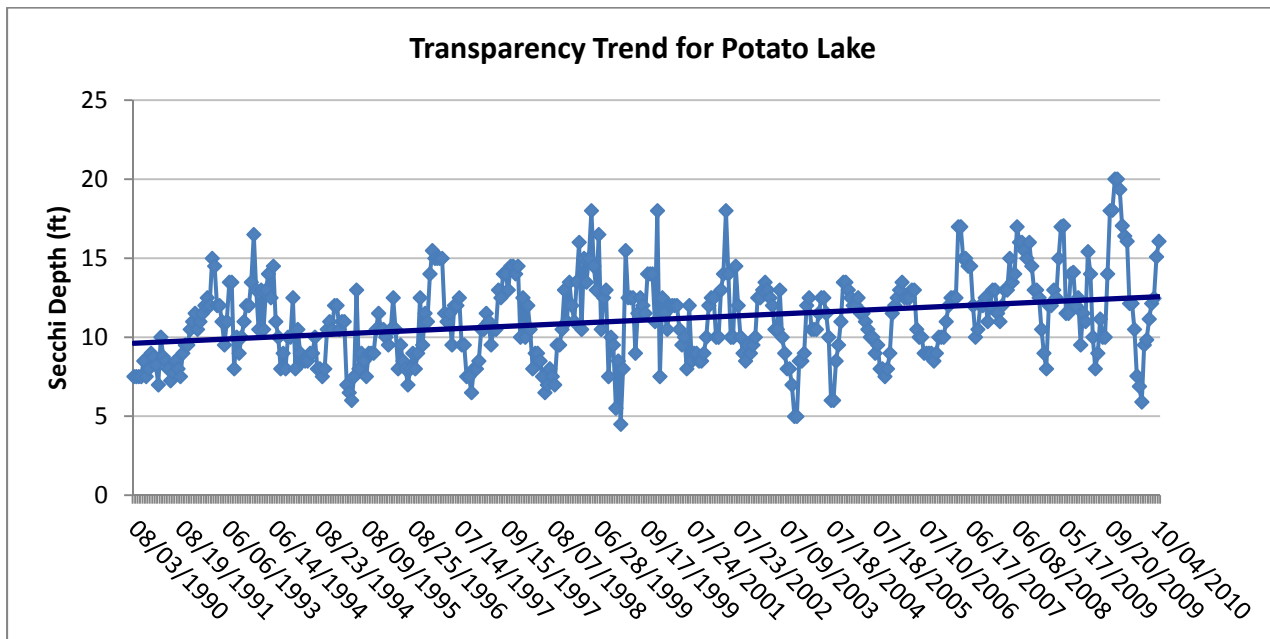


Figure 11. Long-term transparency trend for site 202 in Potato Lake.

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.

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

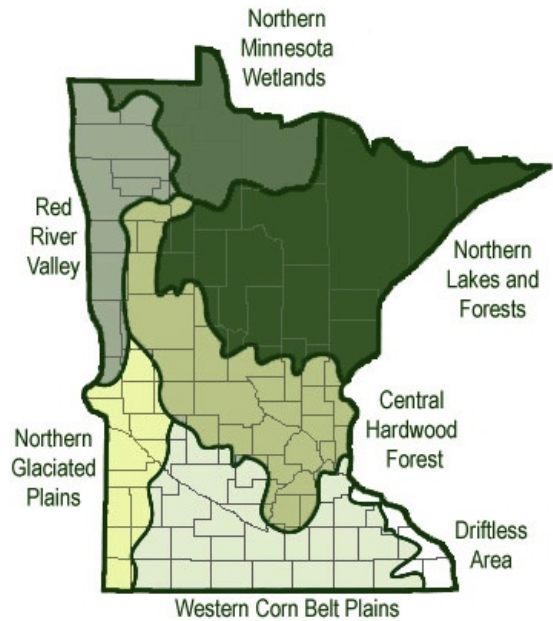
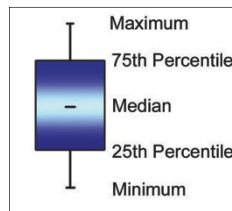
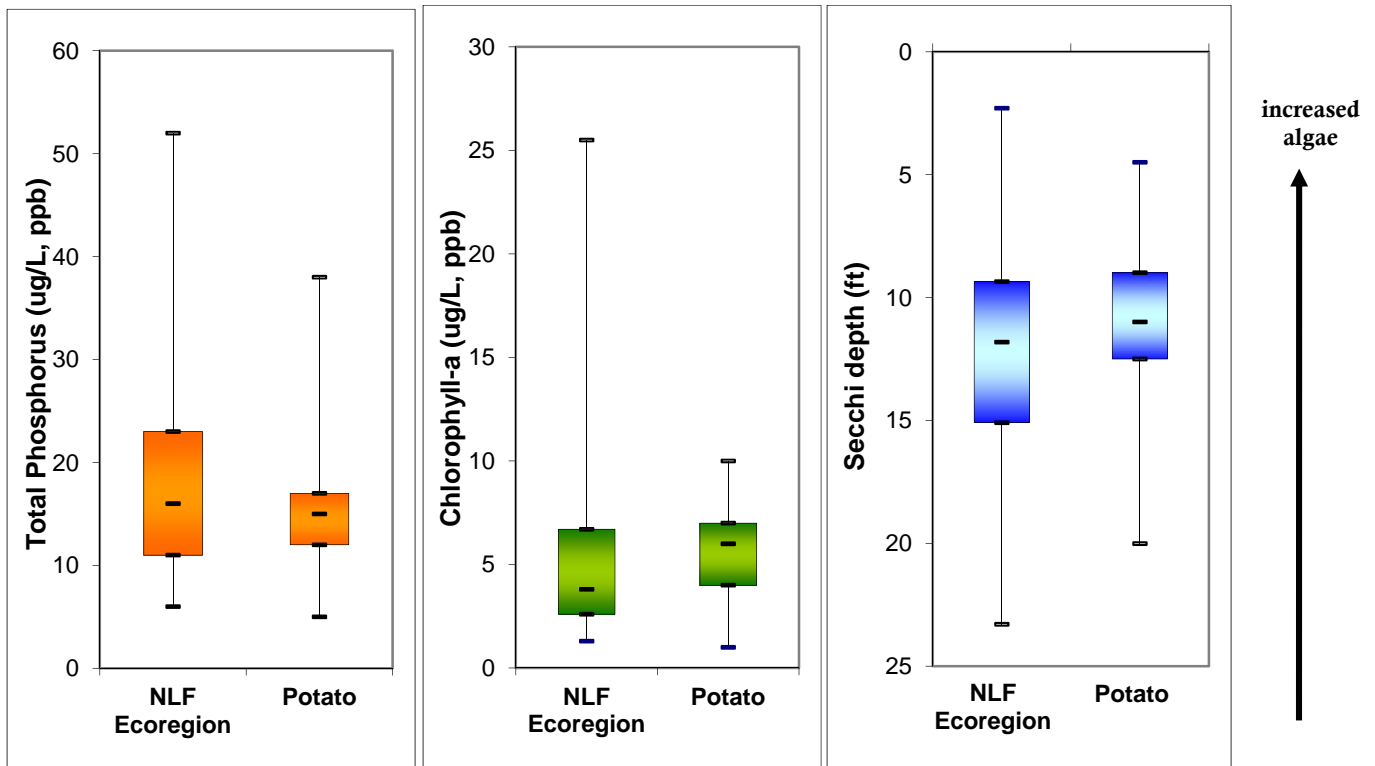


Figure 12. Map of Minnesota with the seven ecoregions.



Figures 13a-c. Potato Lake ranges compared to Northern Lakes and Forest Ecoregion ranges. The Potato Lake total phosphorus and chlorophyll a ranges are from 80 data points collected in May-September of 1997-2011. The Potato Lake Secchi depth range is from 434 data points collected in May-September from 1987-2011.

Lakeshed Data and Interpretations

Lakeshed

Understanding a lakeshed requires the understanding of basic hydrology. A watershed is the area of land that drains into a surface water body such as a stream, river, or lake and contributes to the recharge of groundwater. There are three categories of watersheds: 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 begins at Itasca State Park and drains south towards the Gulf of Mexico (Figure 14). This major watershed is made up of 136 minor watersheds. Potato Lake is located within **minor watershed 12014** (Figure 15)

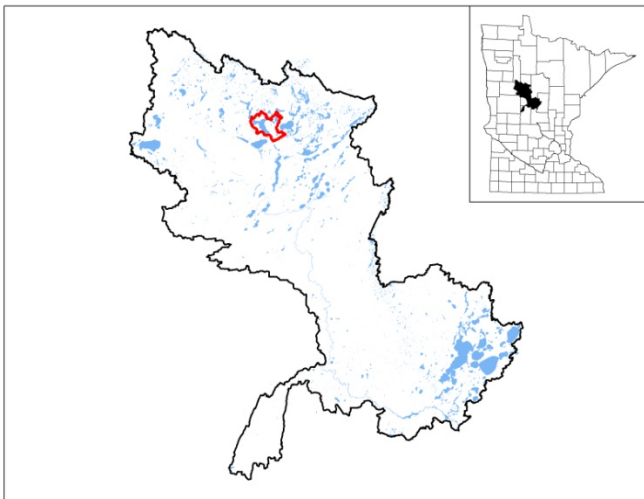


Figure 14. Crow Wing River Major Watershed.



Figure 15. Minor Watershed 12014.

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. Potato Lake falls within lakeshed number **1201400** (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

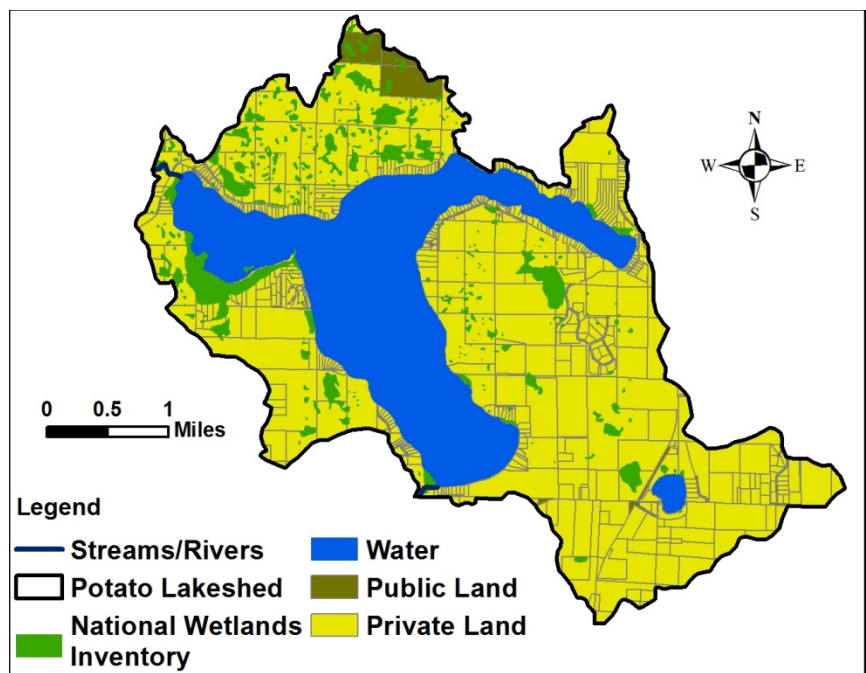


Figure 16. Potato Lake Lakeshed (1201400) with land ownership, lakes, wetlands, and rivers illustrated.

Potato Lake's full watershed, containing all the lakesheds upstream of Potato Lake lakeshed, see page 16. The data interpretation of the Potato Lake lakeshed is only the immediate lakeshed as this area is the land surface that flows directly into Potato Lake.

The lakeshed vitals table identifies where to focus organizational and management efforts for each lake (Table 9). 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 9. Lakeshed vitals for Potato Lake.

| Lakeshed Vitals | | Rating |
|--|--|---|
| Lake Area | 2096 acres | descriptive |
| Littoral Zone Area | 426 acres | descriptive |
| Lake Max Depth | 86.9 ft. | descriptive |
| Lake Mean Depth | 27.2 ft. |  |
| Water Residence Time | NA | NA |
| Miles of Stream | 0.49 | descriptive |
| Inlets | 2 |  |
| Outlets | 1 |  |
| Major Watershed | 12 - Crow Wing River | descriptive |
| Minor Watershed | 12014 | descriptive |
| Lakeshed | 1201400 | descriptive |
| Ecoregion | Northern Lakes and Forest | descriptive |
| Total Lakeshed to Lake Area Ratio <small>(total lakeshed includes lake area)</small> | 4:1 |  |
| Standard Watershed to Lake Basin Ratio <small>(standard watershed includes lake areas)</small> | 53:1 |  |
| Wetland Coverage | 7% |  |
| Aquatic Invasive Species | None |  |
| Public Drainage Ditches | None |  |
| Public Lake Accesses | 2 |  |
| Miles of Shoreline | 14.7 | descriptive |
| Shoreline Development Index | 2.31 |  |
| Public Land : Private Land <small>(excludes water)</small> | 0.03:1 |  |
| Development Classification | Recreational Development |  |
| Miles of Road | 29.3 | 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 - 1997) |  |
| Lake Management Plan | Healthy Lakes & Rivers Partnership program, 2005 |  |
| Lake Vegetation Survey/Plan | 2007-2009 Aquatic Plant Inventory |  |

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.

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 Potato 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 Potato 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 increase in urban cover (21.1%); however, in acreage, forest cover has increased the most (199 acres). In addition, the impervious intensity has increased, which has implications for storm water runoff into the lake. The increase in impervious intensity is consistent with the increase in urban acreage.

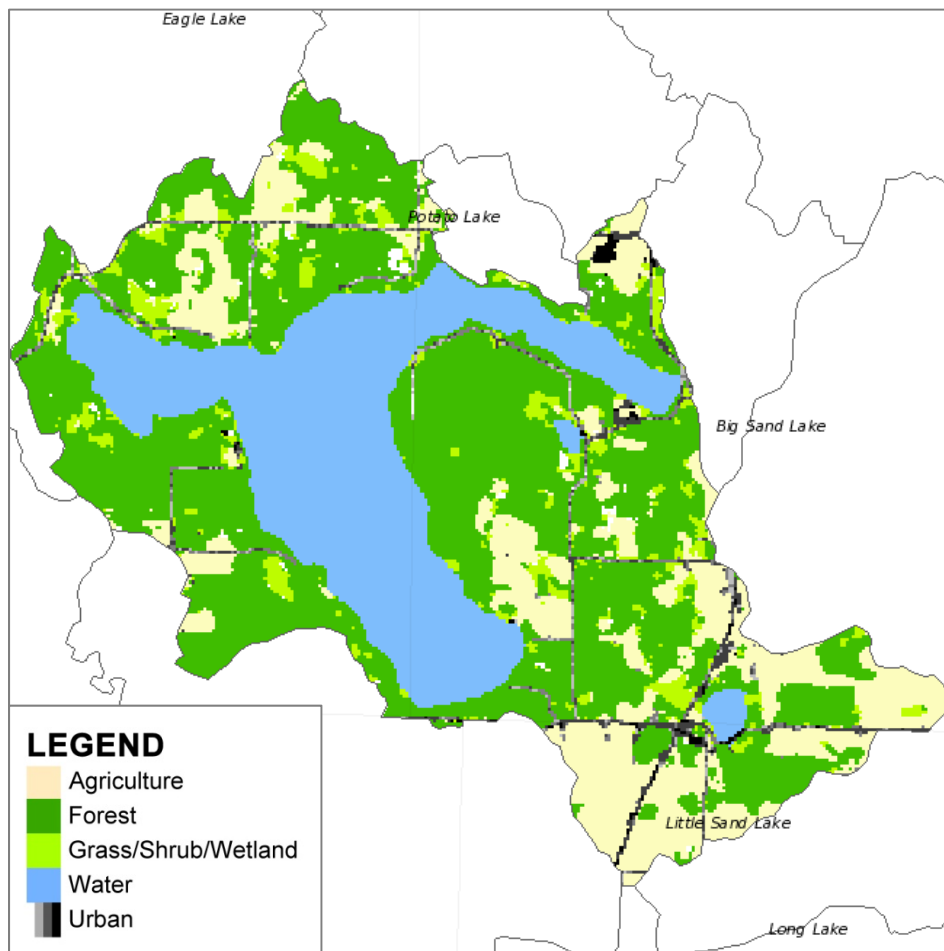


Figure 17. The Potato Lake (1201400) lakeshed land cover (<http://land.umn.edu>).

Table 10. Potato Lake's lakeshed land cover statistics and % change from 1990 to 2000 (<http://land.umn.edu>).

| Land Cover | 1990 | | 2000 | | % Change 1990 to 2000 |
|---------------------|-------|---------|-------|---------|--------------------------|
| | Acres | Percent | Acres | Percent | |
| Agriculture | 1662 | 19.69 | 1544 | 18.29 | 7.1% Decrease |
| Grass/Shrub/Wetland | 526 | 6.23 | 461 | 5.46 | 12.4% Decrease |
| Forest | 3750 | 44.42 | 3949 | 46.78 | 5.3% Increase |
| Water | 2185 | 25.88 | 2103 | 24.91 | 3.8% Decrease |
| Urban | 313 | 3.71 | 379 | 4.49 | 21.1% Increase |

Impervious Intensity %

| | | | | | |
|--------|------|-------|------|-------|-----------------|
| 0 | 8172 | 96.82 | 8068 | 95.59 | 1.3% Decrease |
| 1-10 | 74 | 0.88 | 73 | 0.86 | 1.4% Decrease |
| 11-25 | 83 | 0.98 | 114 | 1.35 | 37.3% Increase |
| 26-40 | 56 | 0.66 | 75 | 0.89 | 33.9% Increase |
| 41-60 | 46 | 0.55 | 73 | 0.86 | 58.7% Increase |
| 61-80 | 9 | 0.11 | 24 | 0.28 | 166.7% Increase |
| 81-100 | 1 | 0.01 | 14 | 0.17 | 1300% Increase |

| | | | | | |
|--|------|------|------|------|----------------|
| Total Area | 8442 | | 8442 | | |
| Total Impervious Area (Percent Impervious Area Excludes Water Area) | 65 | 1.04 | 115 | 1.81 | 76.9% Increase |

Demographics

Potato 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, Lake Emma Township has a higher extrapolated growth projection (Figure 18). On the other hand, Arago Township has a lower extrapolated growth projection.

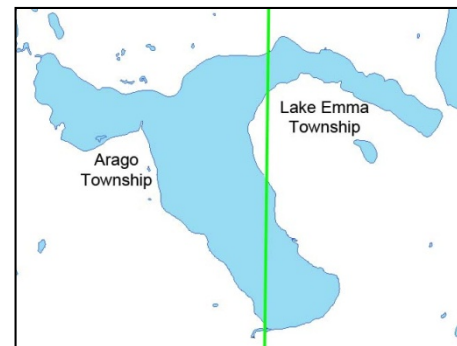
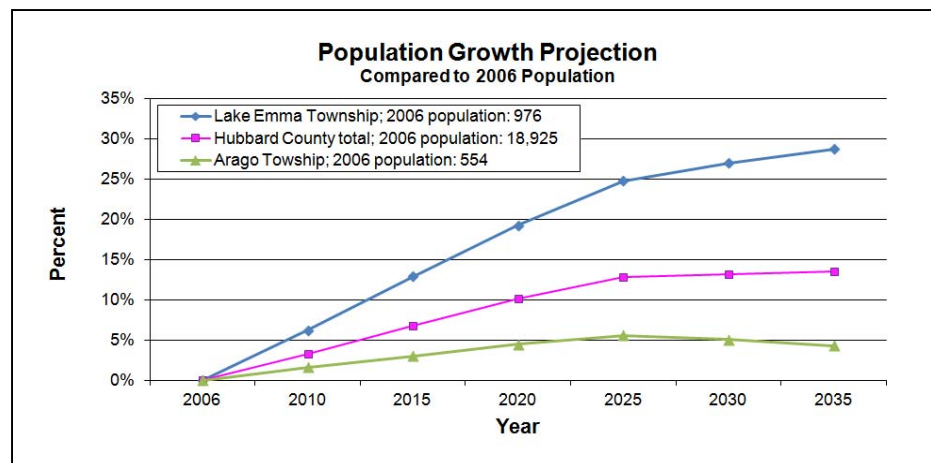


Figure 18. Population growth projection for Lake Emma and Arago Township and Hubbard County. (source: <http://www.demography.state.mn.us/resource.html?id=19332>)



Potato 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 Potato Lake's lakeshed is made up of private forested uplands (Table 11). This land can be the focus of development and protection efforts in the lakeshed. Roads, which have a runoff coefficient closer to developed land, comprise 1/4 of public land.

Table 11. 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 (72.2%) | | | | | 25.3% | Public (2.5%) | | |
|--|-----------------------|-----------------------|---|-------------------------------------|---------------------------------------|-------------------|--------------------------|--------------|-----------------|
| | Developed | Agriculture | Forested Uplands | Other | Wetlands | Open Water 25% | County | State | Federal |
| Land Use (%) | 3.5% | 12.8% | 45.8% | 3.5% | 6.6% | | | 2.5% | .01% |
| Runoff Coefficient <small>Lbs of phosphorus/acre/year</small> | 0.45 – 1.5 | 0.26 – 0.9 | 0.09 | | 0.09 | | | | |
| Estimated Phosphorus Loading <small>Acreage x runoff coefficient</small> | 132 – 438 | 281 – 973 | 348 | | 50 | | | | |
| Description | Focused on Shoreland | Cropland | Focus of development and protection efforts | Open, pasture, grassland, shrubland | Protected | | | | |
| Potential Phase 3 Discussion Items | Shoreline restoration | Restore wetlands; CRP | Forest stewardship planning, 3 rd 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 12). Watershed disturbance was defined as having urban, agricultural and mining land uses. Watershed protection is defined as publicly owned land or conservation easement.

Table 12. 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 artedii*) 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.

Potato Lake was classified with having 2.0% of the watershed protected and 17.6% of the watershed disturbed (Figure 19). Therefore, Potato Lake should have a protection focus. This lake is approaching that threshold of 25% of land disturbance within the watershed. 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 Potato Lake, whether through direct overland flow or through a creek or river. The watershed should have a protection focus as well.

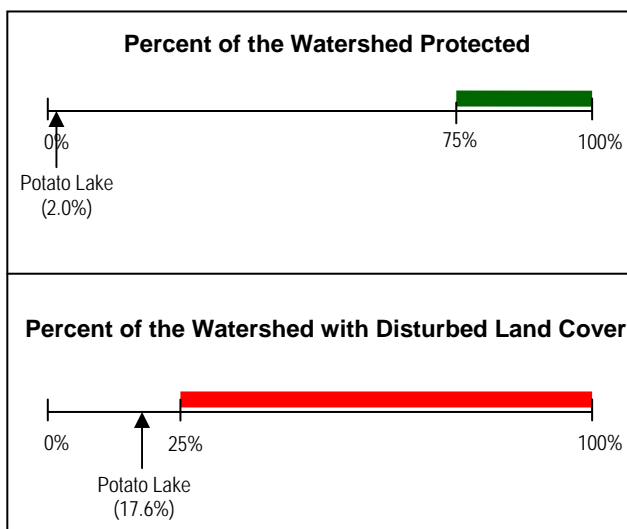


Figure 19. Potato Lake lakeshed's percentage of watershed protected and disturbed.

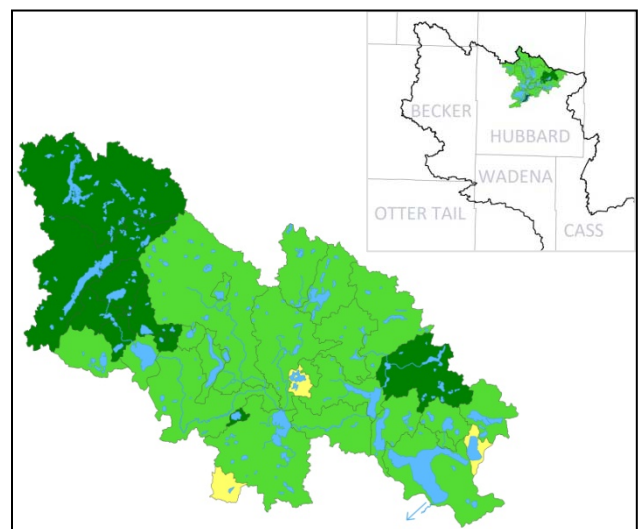


Figure 20. Upstream lakesheds that contribute water to the Potato Lake lakeshed. Color-coded based on management focus (Table 3).

Potato, Status of the Fishery (as of 08/03/2005)

Potato Lake is located seven miles north of Park Rapids in Hubbard County. Potato Lake has a surface area of 2,100 acres and a maximum depth of 95 feet. A state-owned public access is located on the north shore and a county access is located on the west "arm" of the lake. Boating access is also available from the river connecting to Eagle Lake. There is a fixed crest dam at the outlet that prevents boat travel downstream. The fixed crest dam was installed in 2004 and the design of the dam now allows for fish passage. Potato Lake is a very popular fishing lake in the Park Rapids area. Potato Lake is well known for its walleye population, but also provides angling opportunities for northern pike, smallmouth bass, and panfish.

The Minnesota Department of Natural Resources (DNR) has classified Minnesota's lakes into 43 different types based on physical, chemical, and other characteristics. Potato Lake is in lake class 25. Other area lakes in this same classification include: Big Sand, Lower Bottle, Kabekona, and Long.

Walleye abundance was down, with the gillnet catch rate of 5.2 walleye/gillnet below the current management goal of 6.0 walleye/gillnet. Walleye gillnet catch rates since the late 1970's have been similar, generally fluctuating within the range "typical" for this lake class and around the current management goal. Sampled walleye had an average length and weight of 18.1 inches and 2.4 pounds, with fish measured up to 30.4 inches. While Potato Lake has excellent water quality and walleye spawning substrate, contribution from natural reproduction has been very sporadic in recent years. Recent surveys have shown that walleye fingerling stocking is contributing heavily to the walleye population in Potato Lake. The DNR has identified Potato Lake as a "Core" walleye lake that would benefit from increased walleye stocking. Potato Lake is a good candidate for increased walleye stocking due to its popularity as a walleye fishery and for having a good forage base of yellow perch and tullibee (Cisco) that helps in the survival of stocked walleye fingerlings. Starting in the fall of 2005 the walleye fingerling stocking rate on Potato was increased.

Northern pike were sampled in moderate numbers (6.4 pike/gillnet), within the range "typical" for this lake class. Northern pike abundance in past surveys has fluctuated from low to moderate numbers. Sampled northern pike had an average length and weight of 22.1 inches and 2.7 pounds. The proportion of larger pike (> 28.0 inches) sampled, was low when compared to other area lakes.

Potato Lake supports both a smallmouth bass and largemouth bass fishery. Smallmouth bass are abundant in the rock and gravel bars of the main basin, while largemouth are less abundant, but are found in the bulrush stands and submerged aquatic vegetation beds of the west and east arms. Anglers have reported that the smallmouth bass population has been increasing since the late 1980's.

The panfish fishery in Potato is probably known more for its quality than quantity. Black crappie were sampled in low numbers, similar to past surveys. Anglers have reported catching nice-size crappie early in the spring. Bluegill abundance (27.6 bluegill/trapnet) was up from past surveys. Bluegill have been sampled in low numbers in past surveys, below the range "typical" for this lake class. Bluegill in the 6-7 inch size range were common.

Other species sampled included high numbers of rock bass and moderate numbers of white sucker, shorthead redhorse, and yellow bullhead. Brown bullhead were sampled in low numbers.

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=29024300>

Key Findings / Recommendations

Monitoring Recommendations

Transparency monitoring at sites 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, Potato Lake is in great shape as far as water quality. It is a mesotrophic lake (TSI=43) with an improving water quality trend in transparency from 1990-2011.

Two and a half percent (2.5%) of the lakeshed is in public ownership, and 2% of the watershed is protected, while 17.6% of the watershed is disturbed (Figure 6). Even though the lakeshed is not well protected by public land or easements, it has a good amount of forest cover (46%) in private ownership and several large, undisturbed tracts of shoreline.

It is often difficult to determine the reason for an improving water quality trend. It could be due to the septic system upgrades completed in 1997. Big Sand, Little Sand, and Emma Lakes, which are adjacent to Potato Lake, also have improving trends. It could be that this area is very sandy and has very good drainage.

Priority Impacts to the Lake

Because the watershed is not well protected, there is a potential for future changes in land use that could impact the lake. Watershed protection includes public land and conservation easements. In addition, because Potato Lake is a good water resource and fishery, there is a high degree of development pressure. From 1990-2000, the impervious surface increased by 77% (50 acres) (Table 1). The population in the Lake Emma Township is projected to grow another 25% in the next 10 years.

Best Management Practices Recommendations

The management focus for Potato 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, rain gardens, and septic system maintenance. The large tracts of undeveloped land would be excellent areas for conservation easements or aquatic management areas.

Organizational contacts and reference sites

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|---|--|
| Potato Lake Association | http://www.minnesotawaters.org/group/potato/welcome |
| 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/ |