Lake Management Plan

for

Wall Lake

Wall Lake Association

Sept 2016

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Section 1: Overview

Executive Summary:

In late 2015, the Wall Lake Association was invited to participate in the Healthy Lakes and Rivers Partnership program along with three other Lake Associations in Otter Tail County. Under the coordination of Jen Kader (Freshwater Society) and Don Hickman (Initiative Foundation), and with strong support from Darrin Newman (East Otter Tail Soil and Water Conservation District) representatives attended a 1-1/2 days of training on lake ecology, strategic planning and communications on May 2016.

The Wall Lake Association was represented at the Healthy Lakes and Rivers Partnership training sessions by: John Carlson, Alwayne Draeger, Darlene Draeger, Jackie Hendrickson, Lanny Hendrickson, Mike Rudh, LuAnn Rudh, John Whartnaby and Jannine Whartnaby.

Following the training sessions, each lake association held an inclusive community planning/visioning session designed to identify key community concerns, assets, opportunities, and priorities. The Wall Lake Association held this planning session on June 11 2016, facilitated by Jen Kader, Freshwater Society. Approximately 45 people were in attendance, with about 50 percent of the participants describing themselves as year round residents.

Taking what was learned at the Vision/Planning session, this action plan was create to identify the goals of the Wall Lake community as a part of the overall Wall Lake Management Plan. This document will help prioritize goals, guide citizen action and engagement in the priority action areas. As goals and priorities are accomplished or it's discovered that alternative strategies are needed, it is the intent to update the plan so that it continues to serve as a useful guide to future leaders.

The following Wall Lake community priorities have been identified:

1. To preserve and protect water quality for current and future generations (maintain or improve water quality trends).
2. Educate Wall lake users on water and boating safety
3. Preserve and protect wildlife on and around Wall Lake
4. Build a strong association with increased involvement

While state agencies and local units of government have a vital role and responsibility in managing surface waters and other natural resources, the Wall Lake Management Plan is intended to be an assessment of what we as citizens can influence, what our desired outcomes are, and how we will participate in shaping our own destiny.

We thank the Legislative-Citizen Commission on Minnesota Resources who, through the Environment and Natural Resources Trust Fund, made this round of the program possible.

Section 2: Plan Detail

History and purpose of Wall Lake Association

Wall Lake (MN Lake ID: #56-0658-00) is located 5 miles east of Fergus Falls, MN in Otter Tail County. It covers 683 acres and has a maximum depth area of 34 ft. Wall Lake is part of the Otter Tail River Watershed which is composed primarily of agricultural land interspersed with hardwood woodlots. The lake has a larger north basin and a smaller south basin, which are separated by a shallow sandbar. The maximum depth of Wall Lake is 34 feet; however, 33% of the lake is less than 15 feet in depth. Secchi disk readings range from 5' to 14'.

Wall Lake is classified as a general development lake. It receives water through an inlet on the southeast side of the north basin, which drains the area east of the lake, and the lake drains through an outlet on the west side of the north basin, which flows a short distance to the Otter Tail River.

Water quality data have been collected on Wall Lake since 1986. These data show that the lake is mesotrophic (TSI 40-50), which is characteristic of moderately clear water throughout the summer and excellent recreational opportunities.

The Wall Lake Association was incorporated in 1980 to deal with water quality issues. The Wall Lake Association is also a member of the Otter Tail COLA. There are approximately 235 residents around Wall Lake with approximately 50% being year round. Currently, about 50% of this group are Wall Lake Association members.

Volunteers within the Wall Lake Community conduct the monthly water sampling, Secchi disk testing for the Minnesota Pollution Agency and once a year Loon counting on the lake.

The Association pays for the COLA membership, which includes once a month water sampling from May through September. Other projects include T-shirt fundraising and holding directors and annual meetings. The Association would like to grow in the areas of community education on water quality and water safety. They would also like to increase promotion of native restoration buffers throughout the Wall Lake community and gain more knowledge on fishing regulations and whether this is a fit for Wall Lake.

In 2012, the East Otter Tail County Soil and Water Conservation conducted a lake assessment of Wall Lake through RMB Laboratories, and the subsequent report is cited frequently as a source of information. This report is what follows next.

RMB Environmental Laboratories Report

Lake Map

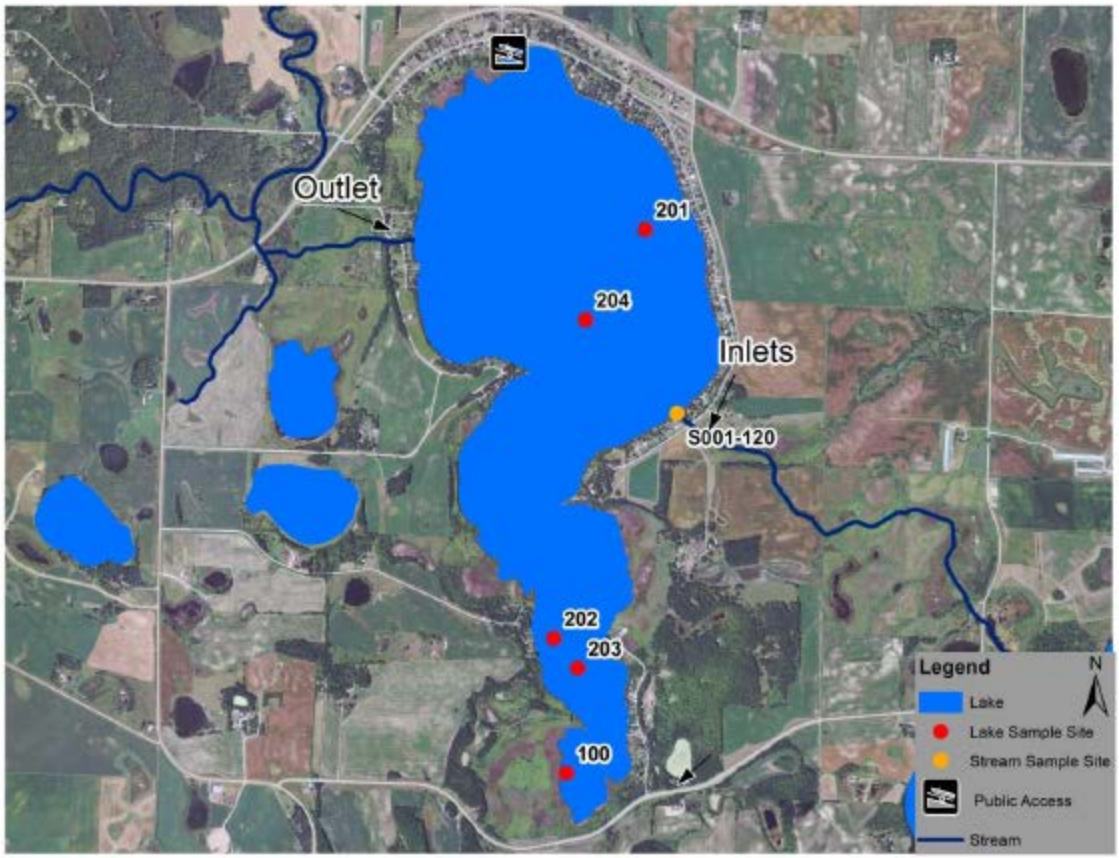


Figure 1. Map of Wall Lake with 2010 aerial imagery and illustrations of lake depth contour lines, sample site locations, inlets and outlets, and public access points. The light green areas in the lake illustrate the littoral zone, where the sunlight can usually reach the lake bottom allowing aquatic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

Table 3. Monitoring programs and associated monitoring sites. Monitoring programs include the Citizens Lake Monitoring Program (CLMP), the Minnesota Pollution Control Agency (MPCA) and the RMB Environmental Laboratories Lakes Program (RMBEL).

Lake Site	Depth (ft)	Monitoring Programs
201	20	CLMP: 1985–1995
202	25	CLMP: 1985–1986; MPCA: 1980, 1987, 1995
203	27	CLMP: 1987–1995, 2001–2010
204*primary site	27	CLMP: 1996–2011; RMBEL: 1996–2000, 2005–2011

Average Water Quality Statistics

The information below describes available chemical data for the primary site (204) of Wall Lake through 2011. The data set is limited, and all parameters with the exception of total phosphorus, chlorophyll *a* and Secchi depth, are means for just 1980, 1987 and 1995 data.

Minnesota is divided into 7 ecoregions based on land use, vegetation, precipitation, and geology. The MPCA has developed a way to determine the average range of water quality expected for lakes in each ecoregion. For more information on ecoregions and expected water quality ranges, see page 11.

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)	30	23 – 50	> 40	Results are within the expected range for the ecoregion.
[3]Chlorophyll *a* (ug/L)	9	5 – 22	> 14	
Chlorophyll *a* max (ug/L)	20	7 – 37		
Secchi depth (ft)	9.2	4.9 – 10.5	< 7.0	
Dissolved oxygen	*Polymictic* See page 8			Dissolved oxygen depth profiles show that the lake mixes periodically throughout the summer.
Total Kjeldahl Nitrogen (mg/L)	1.0	<0.60 – 1.2		Indicates insufficient nitrogen to support summer nitrogen-induced algae blooms.
Alkalinity (mg/L)	208	75 – 150		Indicates a low sensitivity to acid rain and a good buffering capacity.
Color (Pt-Co Units)	13	10 – 20		Indicates clear water with little to no tannins (brown stain).
pH	8.4	8.6 – 8.8		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)	8.0	4 – 10		On the high end of the expected range for the ecoregion.
Total Suspended Solids (mg/L)	4	2 – 6		Within the expected range for the ecoregion. Indicates low suspended solids and clear water.
Specific Conductance (umhos/cm)	512	300 – 400		Higher than the expected range for the ecoregion, and indicates high runoff.
Total Nitrogen :Total Phosphorus	35:1	25:1 – 35:1		Indicates the lake is phosphorus limited, which means that algae growth is limited by the amount of phosphorus in the lake.

[1]The ecoregion range is the 25th–75th percentile of summer means from ecoregion reference lakes
[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 204	203	201
Total Phosphorus Mean (ug/L):	30		
Total Phosphorus Min:	10		
Total Phosphorus Max:	108		
Number of Observations:	64		
Chlorophyll *a* Mean (ug/L):	9		
Chlorophyll-a Min:	0.5		
Chlorophyll-a Max:	20		
Number of Observations:	64		
Secchi Depth Mean (ft):	9.2	9.8	9.5
Secchi Depth Min:	4	4	4.5
Secchi Depth Max:	27	25	25
Number of Observations:	146	187	122

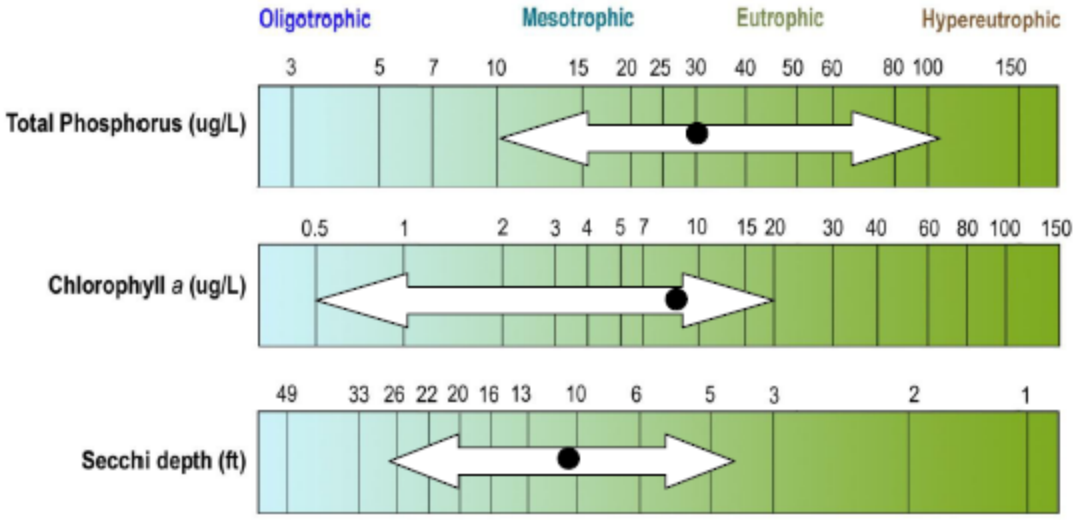


Figure 2. Wall Lake total phosphorus, chlorophyll *a*, and transparency historical ranges. The arrow represents the range and the black dot represents the historical mean (Primary Site 204). Figure adapted after Moore and Thornton, [Ed.]. 1988. Lake and Reservoir Restoration Guidance Manual. (Doc. No. 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 annually due to changes in weather, precipitation, lake use, flooding, temperature, lake levels, etc.

For all three transparency monitoring sites, the mean ranges from 9.2 to 9.8 feet. The transparency throughout the lake appears to be relatively uniform, with all three sites showing almost identical annual means each year (Figure 3). The highs and lows illustrate the year-to-year variability in transparency.

The transparency at site 201 was better than the long-term average in 1987, 1989, and 1992–1994. Transparency at site 203 was better than the long-term average in 1987, 1989–1990, 1992–1994, and 2001–2006. At primary site 204, the transparency was better than the long-term average in 1996, 1998–2000, 2002–2004, 2006, and 2008. Monitoring should be continued annually at sites 203 and 204 in order to track water quality changes.

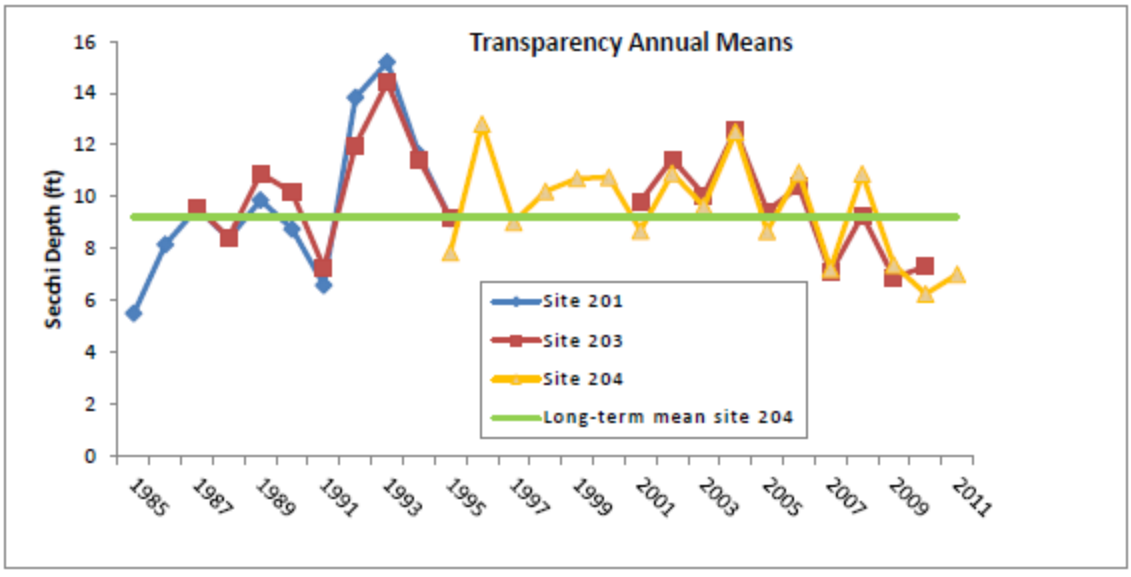


Figure 3. Annual mean transparency compared to long-term mean transparency, sites 201, 203, and 204.

Wall Lake transparency ranges from 4 to 27 feet at the primary site (204). Figure 4 shows the seasonal transparency dynamics. The maximum Secchi reading is usually obtained in early summer; correlating with the high visibility seen in May and June, which then declines through August. The transparency then rebounds in October after fall turnover. This transparency dynamic is typical of a northern Minnesota lake, and is influenced by the 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 throughout the summer.

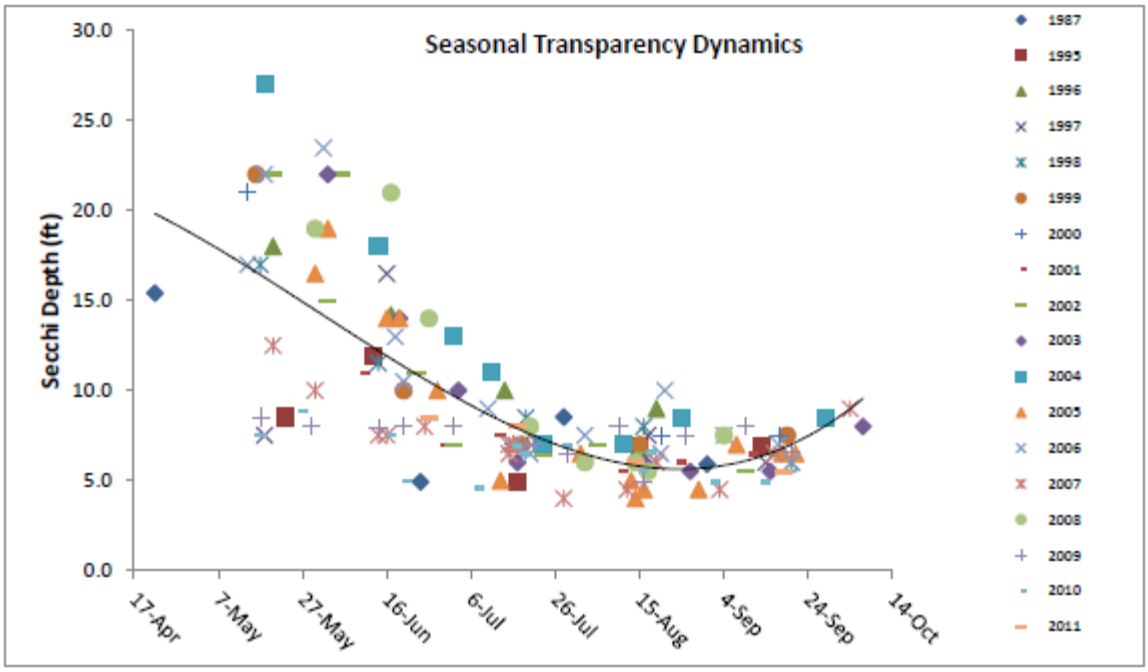


Figure 4. Seasonal transparency dynamics and year-to-year comparison (Primary Site 204). The black line represents the seasonal pattern.

User Perceptions

When volunteers collect Secchi depth readings, they record their observations 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. Wall Lake was rated as being crystal clear 26% of the time in 1987, 1995, and 2001–2011 (Figure 5).

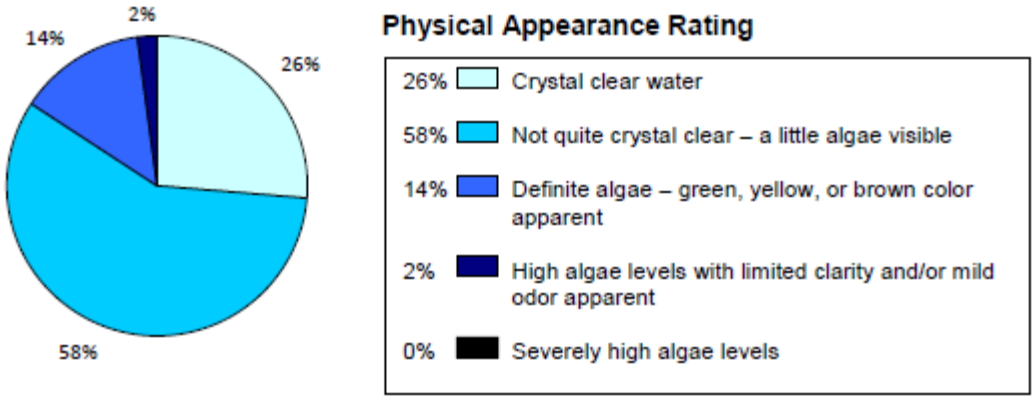


Figure 5. Physical appearance rating, as rated by the volunteer monitor (1987, 1995, and 2001–2011).

As the Secchi depth decreases, the perception of recreational suitability of the lake decreases. Wall Lake was rated as being beautiful 34% of the time in 1987, 1995, and 2001–2011.

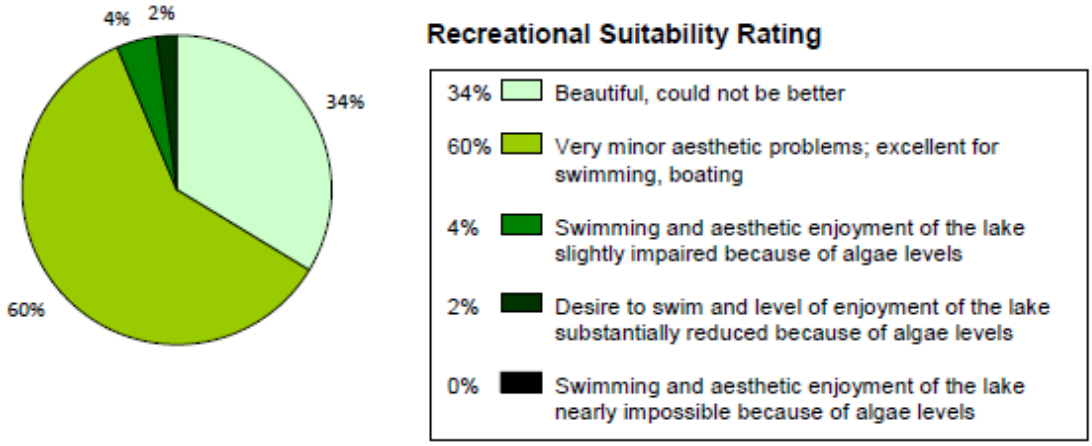


Figure 6. Recreational suitability rating, as rated by the volunteer monitor (1987, 1995, and 2001–2010).

Total Phosphorus

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

Total phosphorus was evaluated in Wall Lake in 1987, 1995–2000, and 2005–2011 (Figure 7). The majority of the data fall into the mesotrophic and eutrophic ranges. The phosphorus concentrations appear to increase as summer persists. This could indicate internal loading, which would also be consistent with Wall Lake's depth.

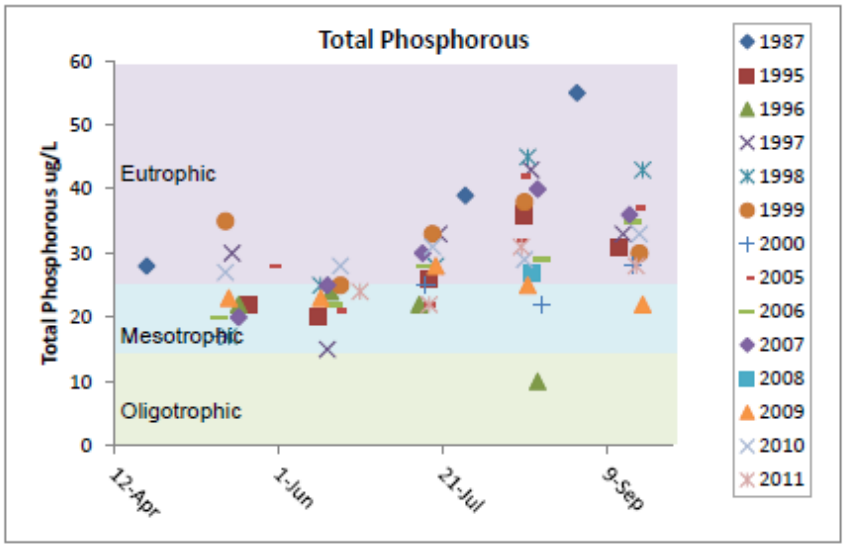


Figure 7. Historical total phosphorus concentrations (ug/L) for Wall Lake.

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. It is tested in lakes to determine the algae concentration or how green the water is.

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

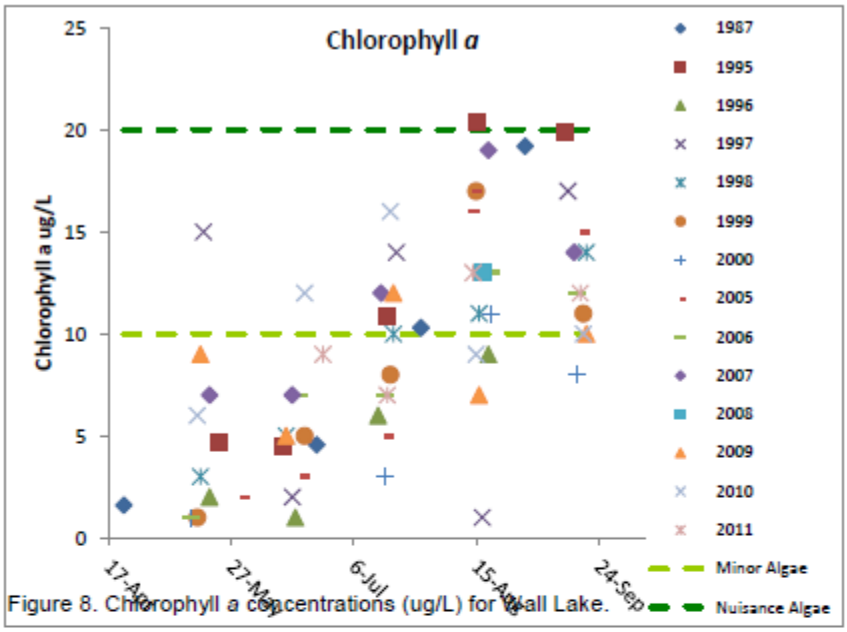
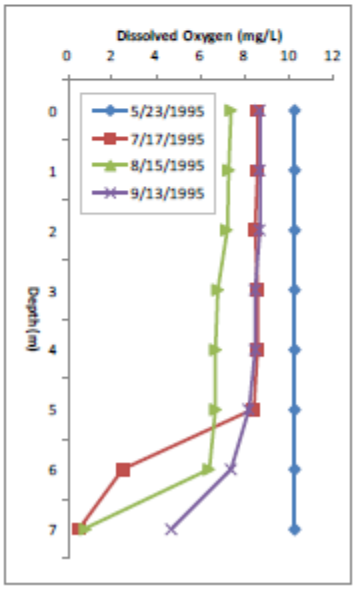


Figure 8. Chlorophyll *a* concentrations (ug/L) for Wall Lake.

Chlorophyll *a* was evaluated in Wall Lake in 1987, 1995–2000, and 2005–2011. Concentrations increase as the summer persisted, which is consistent with the increase in phosphorus (Figure 7). The data also show that the lake experiences algae blooms August through September every year.

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.

Wall Lake is a relatively shallow lake, with a maximum depth of 34 feet. Dissolved oxygen profiles from 1995 indicate that the lake weakly stratifies in the summer, characteristic of a shallow lake. A windy day can mix the water column causing phosphorus from the anoxic lake bottom to re-suspend in the water. This phenomenon is known as internal loading.

Figure 9. Dissolved oxygen profile for Wall Lake in 1995 at site 204.

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 or averaged. In order to standardize these measurements to make them comparable, we convert them to a trophic state index (TSI).

The mean TSI for Wall Lake falls in the eutrophic range (Figure 10). There is good agreement between the TSI for phosphorus and chlorophyll *a*, indicating that these variables are strongly related (Table 6). The TSI for transparency is lower than the other two parameters. This could be due to zooplankton grazing on the smaller algae cells, large algae particles dominating the algal community, or loss of rooted vegetation.

Eutrophic lakes (TSI 50–70) are characteristic of green water most of the summer. "Eu" means true and the root "trophy" means nutrients therefore, eutrophic literally means true nutrients or truly nutrient rich (phosphorus). These lakes are usually shallow with abundant aquatic plants and algae, and are located near fertile soils (Table 7).

Table 6. Trophic State Index for site 204.

Trophic State Index	Site 204
TSI Total Phosphorus	53
TSI Chlorophyll *a*	52
TSI Secchi	45
TSI Mean	50
Trophic State:	Eutrophic

Numbers represent the mean TSI for each parameter.

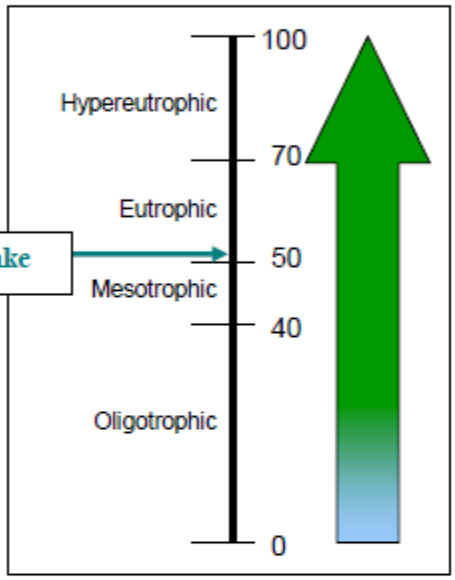


Figure 10. Trophic state index chart with corresponding trophic status.

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

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 moisture 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 Wall Lake (Table 8, Figure 11). The data was analyzed using the Mann Kendall Trend Analysis.

Table 8. Trend analysis for Wall Lake.

Lake Site	Parameter	Date Range	Trend
204	Transparency	1995–2011	No trend
204	Chlorophyll a	1996–2000, 2005–2011	Insufficient data due to gap between 2000 and 2005
204	Total Phosphorus	1996–2000, 2005–2011	Insufficient data due to gap between 2000 and 2005

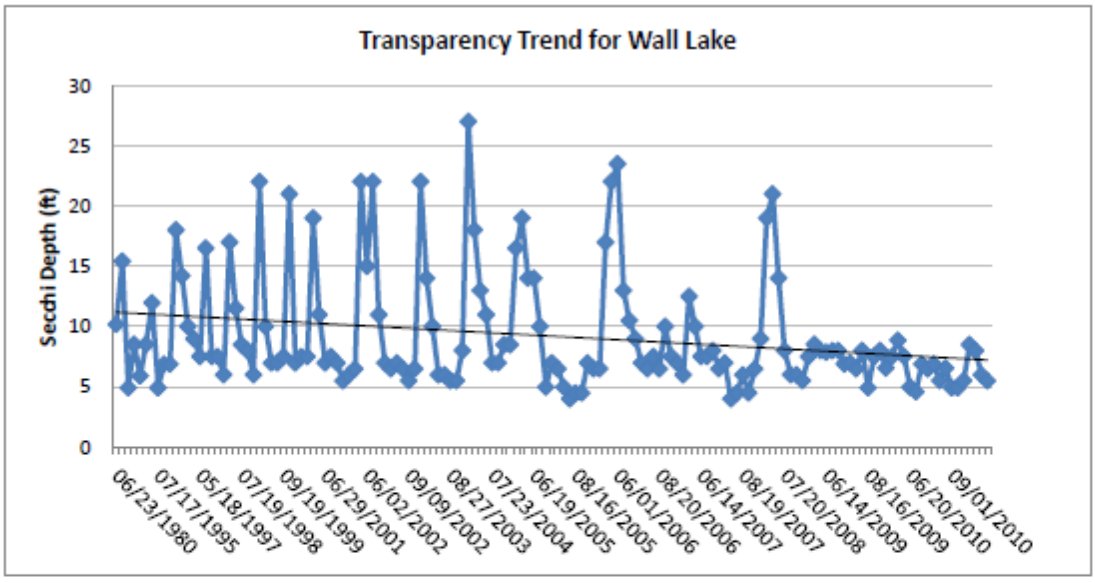


Figure 11. Transparency (ft) trend for site 204 from 1980–2011.

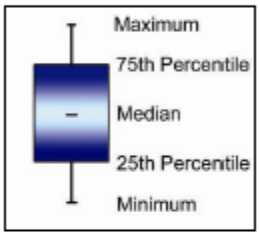
Wall Lake data show no significant trends in water quality; however, the transparency spring maximums haven't occurred since 2008. This could indicate the start of a decline in transparency. Monitoring should continue so that this trend can be tracked in future years.

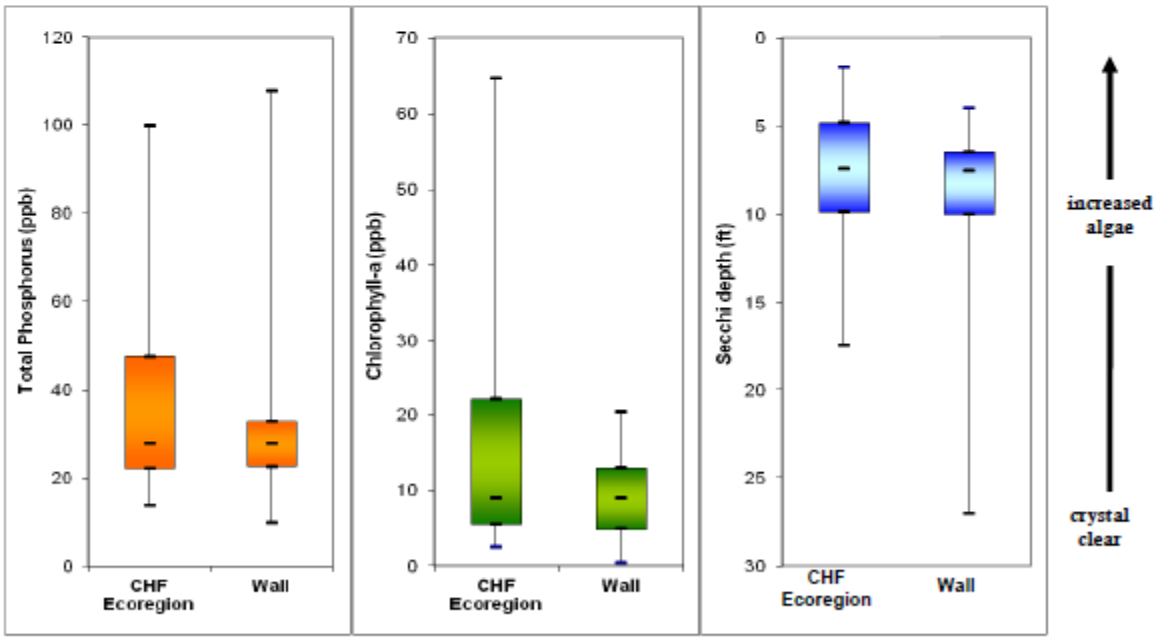
Ecoregion Comparisons

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 lakes are not considered pristine, but 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. Minnesota Ecoregions.

Wall Lake is in the Central Hardwood Forests Ecoregion. The mean total phosphorus, chlorophyll *a*, and transparency (Secchi depth) for Wall are all within the expected ecoregion ranges (Figure 13).





Figures 13a-c. Wall Lake ranges compared to Central Hardwood Forest Ecoregion ranges. The Wall Lake total phosphorus and chlorophyll *a* ranges are from 64 data points collected in May-September of 1980, 1987, 1995–2000, and 2005–2011. The Wall Lake Secchi depth range is from 147 data points collected in May-September of 1980, 1987, and 1995–2011.

Lakeshed Data and Interpretations

Lakeshed

Understanding a lakeshed requires knowledge 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 **Otter Tail River Major Watershed** is one of the watersheds that make up the Red River Basin, which drains north to Lake Winnipeg (Figure 14). This major watershed is made up of 106 minor watersheds. Wall Lake is located in **minor watershed 56061** (Figure 15).

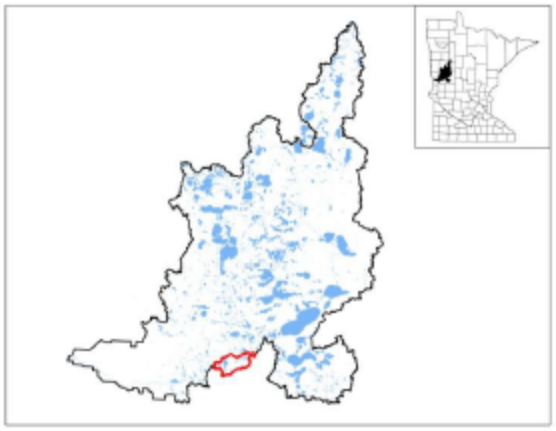


Figure 14. Otter Tail River Watershed.

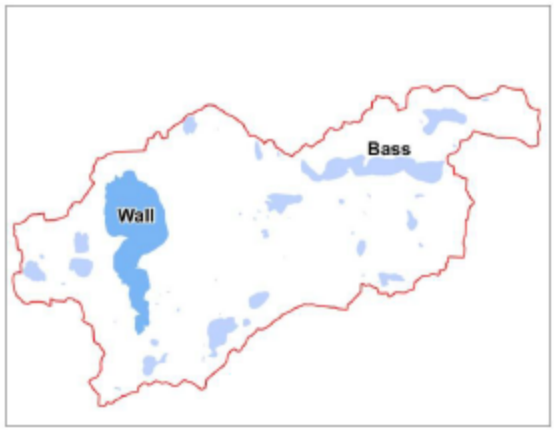


Figure 15. Minor Watershed 56061.

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. Wall Lake falls within **lakeshed 5606104** (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 many, reflecting

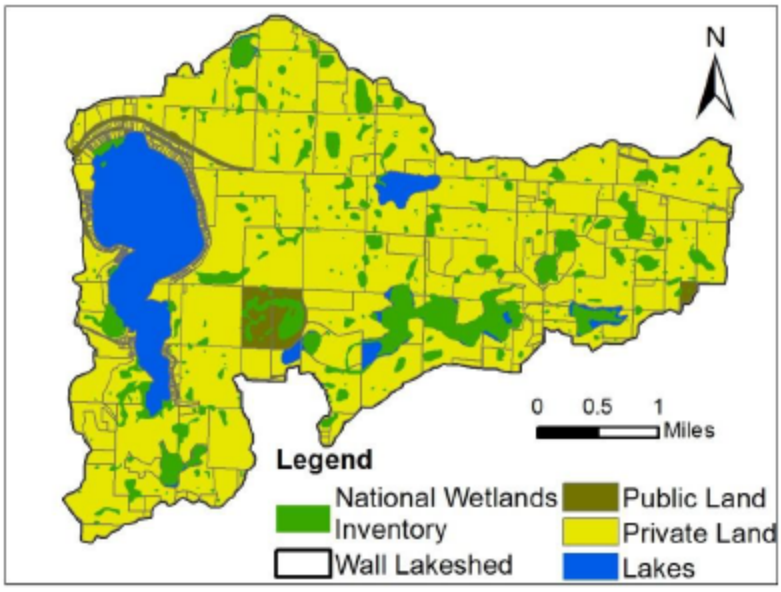


Figure 16. Wall lakeshed (5606104) with land ownership, lakes, and wetlands illustrated.

a larger drainage area via stream or river networks. For further information, see page 17. The data interpretation of the Wall lakeshed includes only the immediate lakeshed, this is the land surface that flows directly into the 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

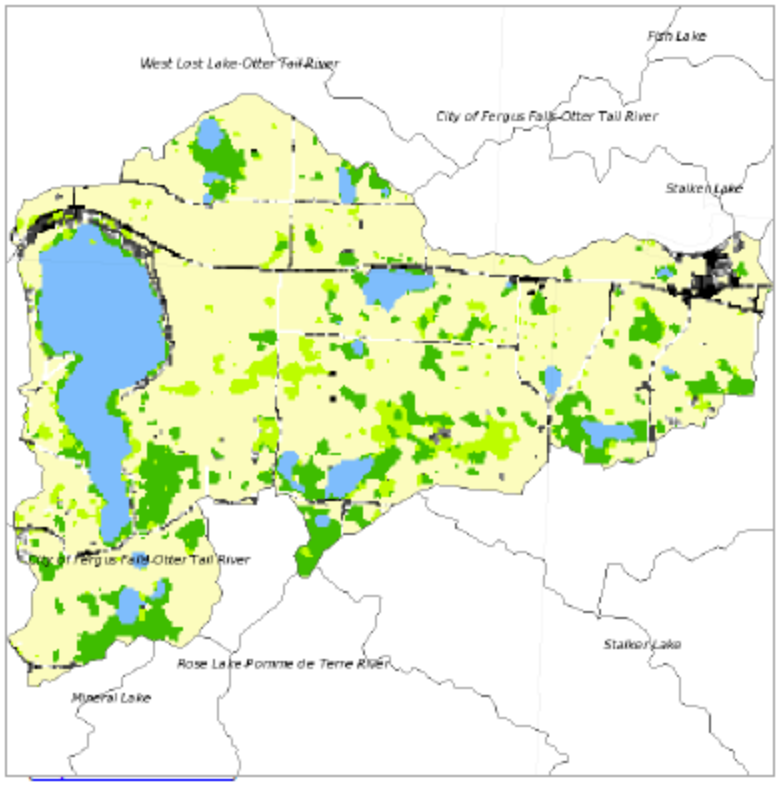
- Possibly detrimental to the lake
- Warrants attention
- Beneficial to the lake

Table 9. Lakeshed vitals for Wall Lake.

Lakeshed Vitals		Rating
Lake Area	727.7 acres	descriptive
Littoral Zone Area	229 acres	descriptive
Lake Max Depth	34 ft	descriptive
Lake Mean Depth	NA	NA
Water Residence Time	NA	NA
Miles of Stream	1.8	descriptive
Inlets	1	
Outlets	1	
Major Watershed	56-Otter Tail River	descriptive
Minor Watershed	56061	descriptive
Lakeshed	5606104	descriptive
Ecoregion	North Central Hardwood Forests	descriptive
Total Lakeshed to Lake Area Ratio (total lakeshed includes lake area)	11:1	
Standard Watershed to Lake Basin Ratio (standard watershed includes lake areas)	14:1	
Wetland Coverage	12.8%	
Aquatic Invasive Species	None as of 2011	
Public Drainage Ditches	None	
Public Lake Accesses	2	
Miles of Shoreline	6.9	descriptive
Shoreline Development Index	1.8	
Public Land to Private Land Ratio	0.04:1	
Development Classification	General Development	
Miles of Road	29.0	descriptive
Municipalities in lakeshed	Underwood	
Forestry Practices	No county forest plan	
Feedlots	2	
Sewage Management	Individual waste treatment systems (last county-wide inspection in 2009)	
Lake Management Plan	None	
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 the needs of present and future generations can be best addressed. The purpose of land use planning is to ensure 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 lands 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 lands 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 Wall lakeshed.

The University of Minnesota has online records of land cover statistics from years 1990 and 2000 (http://land.umn.edu). Although this data is 11 years old, it is the only data set available to compare over a decade of time. Table 10 describes Wall lakeshed's land cover statistics and percent change from 1990 to 2000. Due to 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 and grass/shrub/wetland, to forest and urban acreages. The largest change in percentage is the increase in forest cover (116%). 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.

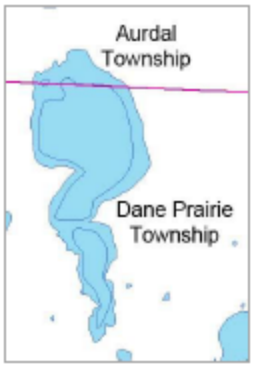
Table 10. Wall lakeshed's land cover statistics and % change from 1990 to 2000 (http://land.umn.edu).

	1990		2000		% Change
Land Cover	Acres	Percent	Acres	Percent	1990 to 2000
Agriculture	5594	68.39	5164	63.13	7.7% Decrease
Grass/Shrub/Wetland	764	9.34	469	5.73	38.6% Decrease
Forest	459	5.61	992	12.13	116.1% Increase
Water	944	11.54	976	11.93	3.4% Increase
Urban	422	5.16	581	7.1	37.7% Increase
Impervious Intensity %					
0	7853	96.03	7753	94.8	1.3% Decrease
1–10	46	0.56	57	0.7	23.9% Increase
11–25	81	0.99	92	1.12	13.6% Increase
26–40	86	1.05	95	1.16	10.5% Increase
41–60	71	0.87	95	1.16	33.8% Increase
61–80	32	0.39	56	0.68	75% Increase
81–100	8	0.1	30	0.37	275% Increase
Total Area	8180		8180		
Total Impervious Area (Percent Impervious Area Excludes Water Area)	110	1.52	163	2.26	48.2% Increase

Demographics

Wall Lake is classified as a general development lake. This type of lake usually has more than 225 acres of water per mile of shoreline, 25 dwellings per mile of shoreline, and is more than 15 feet deep.

The Minnesota Department of Administration Geographic and Demographic Analysis Division has extrapolated the future population of the area, in 5-year increments, out to 2035. Compared to Otter Tail County as a whole, Aurdal Township has a higher extrapolated growth projection, whereas Dane Prairie Township's is much lower (Figure 18).



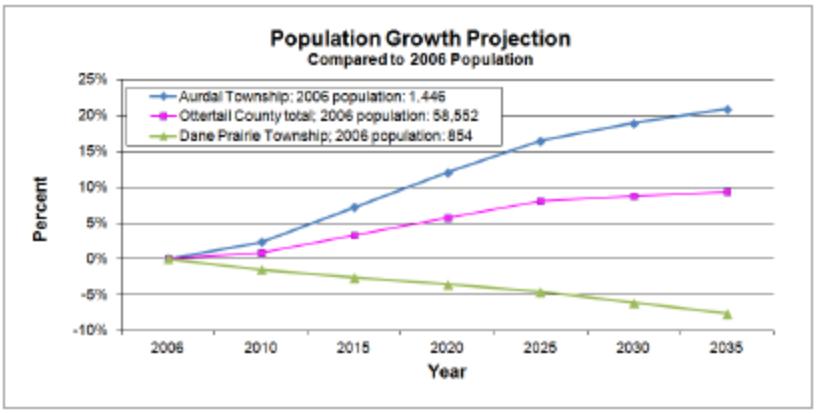


Figure 18. Population growth projection for Aurdal and Dane Prairie Township and Otter Tail County. (source: http://www.demography.state.mn.us/resource.html?Id=19332)

Wall Lake Lakeshed Water Quality Protection Strategy

Each lakeshed has a unique combination 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, and 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 Wall lakeshed is utilized for agricultural purposes (Table 11). These areas can be the focus of development and protection efforts in the lakeshed.

Table 11. Land ownership, land use/land cover, estimated phosphorus loading, and ideas for protection and restoration in Wall Lake lakeshed (Sources: Otter Tail County parcel data, National Wetlands Inventory, and the 2006 National Land Cover Dataset).

	Private (82%)					15%	Public (3%)		
	Developed	Agriculture	Forested Uplands	Other	Wetlands	Open Water	County	State	Federal
Land Use (%)	6.0%	54.0%	10.2%	2.4%	11.8%	15%	1.1%	0.02%	1.9%
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	221–738	1155–3998	75		87		9	<1	15
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% 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 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.

Wall Lake is classified with having 19.7% of the watershed protected and 67.0% disturbed (Figure 19), indicating that the lake should have a partial restoration focus. Goals should 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 Wall Lake, whether through direct overland flow or through a creek or river. One of the 3 upstream lakesheds has the same management focus (partial restoration).

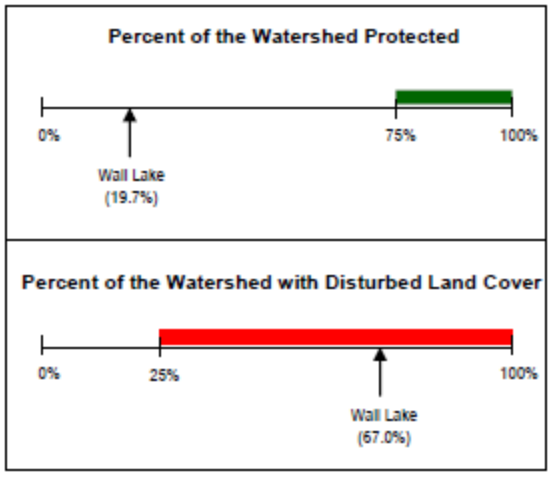


Figure 19. Wall lakeshed's percentage of watershed protected and disturbed.

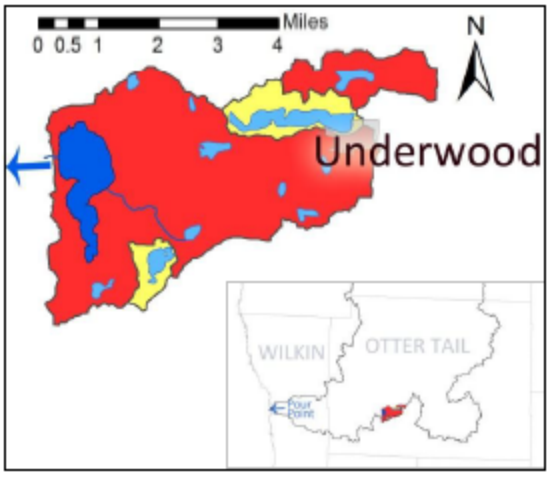


Figure 20. Upstream lakesheds that contribute water to the Wall lakeshed. Color-coded based on management focus (Table 12).

Wall Lake, Status of the Fishery (as of 07/20/2009)

Wall Lake is a 683-acre located in southwestern Otter Tail County approximately five miles east of Fergus Falls, MN, and is part of the Otter Tail River Watershed. A non-navigable outlet is located along the west shoreline of the lake, and serves as a tributary to the Otter Tail River. The immediate watershed is composed primarily of agricultural land interspersed with hardwood woodlots. The maximum depth of the lake is 34 feet; however, 33% is less than 15 feet in depth. The Secchi disk reading during the 2009 lake survey was 4.9 feet, slightly lower than previous readings ranging from 5.0 to 9.0 feet. Wall Lake experiences periodic plankton/algae blooms during the summer months which can influence Secchi disk readings.

A majority of the shoreline of Wall Lake has been developed, consisting primarily of homes and cottages. A DNR-owned public water access is located along the north shoreline, with a privately-owned access located at a campground along to the east. The shoal water substrates consist primarily of sand and gravel. Large stands of hardstem bulrush are prevalent throughout the lake. Emergent aquatic plants such as these provide valuable fish and wildlife habitat, and are critical for maintaining good water quality. They protect shorelines and lake bottoms, absorbing and breaking down pollutants, and provide spawning areas for fish such as northern pike, largemouth bass, and panfish. They also serve as an important nursery area for all species of fish. Because of their ecological value, emergent plants may not be removed without a DNR permit.

With a close proximity to Fergus Falls, Wall Lake has become a popular angling lake. It can be ecologically classified as a bass-panfish lake; this is reflected in the assemblage of the fish community. Northern pike, largemouth bass, and bluegill are the dominant game species. The prolificacy of these species can be attributed to the abundance of suitable spawning habitat. The northern pike test-net catch rate was equivalent to the lower limit of the expected range for similar lakes. Age data indicate that reproduction is consistently good. Pike ranged in length from 15.1 to 30.0 inches with an average length and weight of 22.2 inches and 2.5 pounds, reaching an average length of 22.3 inches at four years. The walleye test-net catch rate was within the expected range for similar lakes. Age data indicate that several viable year classes are present. Walleye ranged in length from 7.3 to 25.4 inches with an average length and weight of 15.8 inches and 1.7 pounds. Individuals reach an average length of 15.1 inches at four years of age. Data collected from a spring electrofishing assessment indicate that a balanced largemouth bass population also exists. Age data indicate that largemouth bass reproduction is consistently good, ranging in length from 3.0 to 18.5 inches with an average length and weight of 13.7 inches and 1.5 pounds. Bass reach an average length of 12.2 inches at four years of age. The bluegill test-net catch rate exceeded the expected range for similar lakes. The 2003 year class is very strong and should provide good angling for several years. Thirty-eight percent of the bluegill sample was 7.0 inches or greater in length, with individuals reaching an average length of 6.9 inches at six years.

Anglers can maintain the quality of fishing by practicing selective harvest. This management practice encourages the release of medium to large-size fish while allowing the harvest of more abundant, smaller fish for table fare. Releasing the medium to large fish will ensure the lake has enough spawning-age fish annually, providing anglers with more opportunities to catch large fish in the future.

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=56065800

Key Findings / Recommendations

Monitoring Recommendations

Transparency monitoring at site 204 should be continued annually. It is important to continue monitoring weekly, or at least bimonthly, every year to enable annual comparisons and trend analyses. To track future water quality trends, phosphorus and chlorophyll *a* monitoring should continue as the budget allows.

Overall Conclusions

Wall Lake is currently in fair shape regarding water quality, however, the lakeshed needs restoration from disturbed land uses. Wall Lake is a eutrophic lake (TSI=50) with no significant water quality trends. Three percent (3%) of the lakeshed is in public ownership, and 20% is protected, while 67% is disturbed (Figure 19).

Wall Lake has a very dynamic seasonal transparency pattern. It averages a high of 15 feet in May and a low of 6 feet in August. August through September, the lake experiences algae blooms that can reach nuisance levels. Since 2008, the May readings have not exceeded 10 feet, which could indicate the start of a declining trend.

The forested acreage around the lake increased by 116% (533 acres) from 1990–2000. This buffer better protects the lake from runoff in the lakeshed.

A lake-wide septic system check of the oldest systems was completed by Otter Tail County in 2009. The septic systems around Wall Lake should be up to date and working properly.

A surface runoff potential analysis with maps is located on the following pages. The last map in this sequence illustrates the very high runoff potential (red) from developed areas around the lake.

Priority Impacts to the lake

In close proximity to Fergus Falls, there is a high degree of development pressure on Wall Lake. The first tier is mostly developed, whereas the second tier is developed along the north and east sides. From 1990–2000, the urban area in the lakeshed increased by 38% (159 acres) and the impervious area increased by 48% (53 acres) (Table 9). There are also many paved, impervious, roads around the lake (Table 9). The conversion of previously farmed land to housing and second tier development along the lakeshore is a cause for concern. Storm water runoff from impervious surfaces located on developed shoreline properties and roads can add nutrients and chloride (salt) to the lake. The chloride levels and specific conductance in the lake are relatively high, indicating high runoff. Because it is fairly shallow, Wall Lake lacks the large amounts of water necessary to dilute runoff from impervious surface and turf lawns.

Agricultural land use in the lakeshed is high (54%), classifying the area as a partial restoration (Table 10, Figure 20). When the agricultural land extends to the developed shoreline, there is not a sufficient buffer from runoff. The agricultural uses include pasture/hay, cultivated crops, and animal feedlots. There is also agriculture along the stream inlet to the lake.

Due to the shallow nature of the lake and the amount of nutrients in it, it is possible that internal loading is occurring. The dissolved oxygen data show the lake mixes periodically in the summer (Figure 9). Internal loading is when the phosphorus in the lake sediment re-suspends into the water column, feeding algae and plants. Phosphorus re-suspends when large boat motors churn up sediment, when the lake is calm it loosely stratifies, and then windy days mixes the water again

Best Management Practices Recommendations
The management focus for Wall Lake should protect the water quality, and restore the lakeshed. Restoration efforts should focus 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.

Partnering with farmers to implement conservation farming practices, restore wetlands, increase lake and stream shoreline buffers, and place priority parcels into land retirement programs can decrease the impacts of agriculture in the lakeshed.

If the majority of phosphorus in the lake stems from internal loading, an alum treatment could be applied to hold phosphorus in the sediments, preventing its re-suspension into the water column.

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 phosphorus in the water column is utilized by algae rather than plants. This contributes to greener water and additional algae blooms. Protecting native aquatic plant beds will ensure a healthy lake and fishery.

Project Implementation
The best management practices above can be implemented by a variety of entities. Some possibilities are listed below.

Individual property owners
- Shoreline restoration
- Rain gardens
- Aquatic plant bed protection (only remove a small area for swimming)

Lake Associations
- Lake condition monitoring
- Internal loading monitoring
- Ground truthing – visual inspection upstream on stream inlets
- Shoreline inventory study by a consultant

Soil and Water Conservation District (SWCD) and Natural Resources Conservation Service (NRCS)
- Shoreline restoration
- Stream buffers
- Work with farmers to
    - Restore wetlands
    - Implement conservation farming practices
    - Participate in land retirement programs such as Conservation Reserve Program

Organizational Contacts and Reference Sites

Wall Lake Association	http://walllakeassociation.blogspot.com/
DNR Fisheries Office	1509 1st Avenue North, Fergus Falls, MN 56537 218-739-7576 fergusfalls.fisheries@state.mn.us http://www.dnr.state.mn.us/areas/fisheries/fergusfalls/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
Otter Tail Soil and Water Conservation District	506 Western Ave N, Fergus Falls, MN 56537 218-739-1308 ext.3 http://www.eotswcd.org/

Aquatic Vegetation

Rooted aquatic plants are a natural part of most lake communities and provide many benefits to fish, wildlife and people. They are one of the primary producers in the aquatic food chain, converting the basic chemical nutrients in the water and soil into plant matter that becomes feed for other aquatic and terrestrial life.

In-lake aquatic vegetation for Wall Lake are very important to the fishery and general health of the lake. The areas of hardstem bulrush and narrow leaved cattail are abundant and provide habitat for the fish species as well as filtration of nutrients as they enter the lake. The pondweeds are important food for fish and habitat for various insects and invertebrates that become food for other species of fish. These areas should be protected and the vegetation preserved. Some of the vegetation creates quite a nuisance for boaters and general recreation.

Aquatic plants have many other important functions, including:

-improving water quality by trapping nutrients;
-Protecting shorelines and lake bottoms by decreasing wave action; and
-improving aesthetics by adding to the biodiversity of the lakeshore.

While aquatic plants perform these important functions, they can also interfere with various uses of the lake if their growth is profuse. Control of aquatic plants is appropriate when reasonable access to and the use of the water is impeded.

Partnering with the Otter Tail SWCD office when creating shoreline buffers will allow us to make sure that native vegetation is used in shoreline buffers.

Types of aquatic vegetation that the DNR have observed at Wall Lake include:

Submersed Plants (Plants with most leaves growing beneath the water surface)

Coontail
Northern Watermilfoil
Whorled Watermilfoil
Sea Naiad
Fries' Pondweed
Pondweed
Widgeon Grass
Common Sago Pondweed
Greater bladderwort
Horned pondweed

Free-floating Plants (Plants that float freely on the water surface)

Turion-forming Duckweed
Greater Duckweed

Emergent Plants (Plants with leaves extending above the water surface)

Small's Spikerush
Broad-leaved Arrowhead
Hard-stem bulrush
Narrow-leaved cat-tail

Shoreline Plants (Plants associated with the wetland habitat)

Swamp milkweed
Bur-Marigold; Beggar-Tick
Two-stamened Sedge
False Cyperus sedge
Bulb-bearing water-hemlock
Jewelweed,Spotted touch-me-not
Northern bugleweed
Swamp Candles, Loosestrife
Tufted loosestrife
Reed canary grass
Dock; Sorrel
Willow
Marsh skullcap

Wildlife

The "Blue Book," *Developing a Lake Management Plan* notes that:

> "Minnesota's lakes are home to many species of wildlife. From our famous loons and bald eagles to muskrats, otters, and frogs, wildlife is an important part of our relationship with lakes. In fact, Minnesota's abundant wildlife can be attributed largely to our wealth of surface water. From small marshes to large lakes, these waters are essential to the survival of wildlife.
>
> The most important wildlife habitat begins at the shoreline. The more natural the shoreline, with trees, shrubs and herbaceous vegetation, the more likely that wildlife will be there. Just as important is the shallow water zone close to shore. Cattail, bulrush, and wild rice along the shoreline provide both feeding and nesting areas for wildlife. Loons, black terns and red-necked grebes are important Minnesota birds that are particularly affected by destruction of this vegetation. Underwater vegetation is also important to wildlife for many portions of their life cycle, including breeding and rearing of their young."

The MN DNR also recognizes the unique importance of shallow lakes:

> "Minnesota's diverse wildlife populations are influenced in large part by our state's abundant water resources. While all lakes support wildlife needs, it is the shallow water zone, characterized by aquatic plants and generally less than 15 feet deep, that provides the most important wildlife habitat."

The primary agency charged with the management of Minnesota's wildlife is the Department of Natural Resources, Division of Fish and Wildlife, Wildlife Section. For Wall Lake, the DNR Area Wildlife Manager is: Troy Richards, (218) 826-6391. The DNR Fisheries Office is located at 1509 1st Ave North, Fergus Falls MN 56537. (fergusfalls.fisheries@state.mn.us) and (http://www.dnr.state.mn.us/areas/fisheries/fergusfalls/index.html).

Loon nesting has been successful at Wall Lake. Loon counting was done on June 2016 which found a count of 22 loons to be on the lake. Bald eagles are also observed on the lake with at least 2 active nests. Various species of geese, ducks, coots, gulls and turkeys are common on the lake. Mammals noted include muskrat, beaver, fox, woodchucks, otters, mink, coyote and deer are also seen around the lake. Numerous geese in the yard of landowners can be found to be a nuisance.

Exotic Species

Wall Lake currently does not have a presence of aquatic invasive species, although it is part of the Otter Tail River watershed for which there is a zebra mussel presence.

The Aquatic Invasive Specialist for Otter Tail County is Spencer McGrew and can be contacted at the Otter Tail County Offices. The County has also developed an AIS Task Force, (http://aisfighters.net/)

Background

"Exotic" species -- organisms introduced into habitats where they are not native -- are severe world-wide agents of habitat alternation and degradation. A major cause of biological diversity loss throughout the world, they are considered "biological pollutants."

Introducing species accidentally or intentionally, from one habitat into another, is risky business. Freed from the predators, parasites, pathogens, and competitors that have kept their numbers in check, species introduced into new habitats often overrun their new home and crowd out native species. In the presence of enough food and favorable environment, their numbers will explode. Once established, exotics rarely can be eliminated.

Most species introductions are the work of humans. Some introductions, such as carp and purple loosestrife, are intentional and do unexpected damage. But many exotic introductions are accidental. The species are carried in on animals, vehicles, ships, commercial goods, produce, and even clothing. Some exotic introductions are ecologically harmless and some are beneficial. But other exotic introductions are harmful to recreation and ecosystems. They have been caused the extinction of native species -- especially those of confined habitats such as islands and aquatic ecosystems.

The recent development of fast ocean freighters has greatly increased the risk of new exotics in the Great Lakes region. Ships take on ballast water in Europe for stability during the ocean crossing. This water is pumped out when the ships pick up their loads in Great Lakes ports. Because the ships make the crossing so much faster now, and harbors are often less polluted, more exotic species are likely to survive the journey and thrive in the new waters.

Many of the plants and animals described in this guide arrived in the Great Lakes this way. But they are now being spread throughout the continent's interior in and on boats and other recreational watercraft and equipment. This guide is designed to help water recreationalists recognize these exotics and help stop their further spread.

Eurasian watermilfoil (*Myriophyllum spicatum*)

Eurasian watermilfoil was accidentally introduced to North America from Europe. Spread westward into inland lakes primarily by boats and also by waterbirds, it reached Midwestern states between the 1950s and 1980s.

In nutrient-rich lakes it can form thick underwater stands of tangled stems and vast mats of vegetation at the water's surface. In shallow areas the plant can interfere with water recreation such as boating, fishing, and swimming. The plant's floating canopy can also crowd out important native water plants.

A key factor in the plant's success is its ability to reproduce through stem fragmentation and runners. A single segment of stem and leaves can take root and form a new colony. Fragments clinging to boats and trailers can spread the plant from lake to lake. The mechanical clearing of aquatic plants for beaches, docks, and landings creates thousands of new stem fragments. Removing native vegetation crates perfect habitat for invading Eurasian watermilfoil.

Eurasian watermilfoil has difficulty becoming established in lakes with well-established populations of native plants. In some lakes the plant appears to coexist with native flora and has little impact on fish and other aquatic animals.

Likely means of spread: Milfoil may become entangled in boat propellers, or may attach to keeps and rudders of sailboats. Stems can become lodged among any watercraft apparatus or sports equipment that moves through the water, especially boat trailers.

Other Midwestern Aquatic Exotics

Curly-leaf pondweed (*Potamogeton crispus*) is an exotic plant that forms surface mats that interfere with aquatic recreation. The plant usually drops to the lake bottom by early July. Curly-leaf pondweed was the most severe nuisance aquatic plant in the Midwest until Eurasian watermilfoil appeared. It was accidentally introduced along with the common carp.

Flowering rush (*Botumus umbellatus*) is a perennial plant form Europe and Asia that was introduced in the Midwest as an ornamental plant. It grows in shallow areas of lakes as an emergent, and as a submersed form in water up to 10 feet deep. Its dense stands crowd out native species like bulrush. The emergent form has pink, umbellate-shaped flowers, and is 3 feet tall with triangular-shaped stems.

Purple loosestrife (*Lythrum salicaria*) is a wetland plant from Europe and Asia. It was introduced into the East Coast of North America in the 1800s. First spreading along roads, canals, and drainage ditches, then later distributed as an ornamental, this exotic plant is in 40 states and all Canadian border provinces.

Purple loosestrife invades marshes and lakeshores, replacing cattails and other wetland plants. The plant can form dense, impenetrable stands which are unsuitable as cover, food, or nesting sites for a wide range of native wetland animals including ducks, geese, rails, bitterns, muskrats, frogs, toads, and turtles. Many are rare and endangered wetland plants and animals and are also at risk.

Purple loosestrife thrives on disturbed, moist soils, often invading after some type of construction activity. Eradicating an established stand is difficult because of an enormous number of seeds in the soil. One adult plant can disperse 2 million seeds annually. The plant is able to re-sprout from roots and broken stems that fall to the ground or into the water.

A major reason for purple loosestrife's expansion is a lack of effective predators in North America. Several European insects that only attack purple loosestrife are being tested as a possible long-term biological control of purple loosestrife in North America.

Likely means of spread: Seeds escape from gardens and nurseries into wetlands, lakes, and rivers. Once in aquatic system, moving water and wetland animals easily spreads the seeds.

Reed Canary Grass (*Phalaris arundinacea)* is considered a major threat to natural wetlands as it out competes most native species and presents a major challenge in wetland mitigation efforts.

Planted throughout the U.S. for forage and erosion control since the 1800s, it forms large, single-species stands, with which other species cannot compete. Invasion is associated with disturbances, such as ditch building, stream channeling sedimentation and intentional planting and if cut during the growing season a second growth spurt occurs in the fall.

Rusty crayfish (*Orconectes rusticus*) are native to streams in the Ohio, Kentucky, and Tennessee region. Spread by anglers who use them as bait, rusty crayfish are prolific and can severely reduce lake and stream vegetation, depriving native fish and their prey of cover and food. They also reduce native crayfish populations.

Starry Stonewort (*Nitellopsis obtuse*) is a grass-like form of algae that are not native to North America. The plant was first confirmed in Minnesota in Lake Koronis in late August of 2015. Plant fragments were probably brought into the state on a trailered watercraft from infested waters in another state.

It is similar in appearance to native grass-like algae such as other stoneworts and musk-grass. Native stoneworts and musk-grass are both commonly found in Minnesota waters. Starry stonewort can be distinguished from other grass-like algae by the presence of star-shaped bulbils.

Starry stonewort can interfere with recreational and other uses of lakes where it can produce dense mats at the water's surface. These mats are similar to, but can be more extensive then, those produced by native vegetation. Dense starry stonewort mats may displace native aquatic plants.

Like all plants, starry stonewort may grow differently in different lakes, depending on many factors. At this time, we cannot predict how it might grow in any one Minnesota lake. It is believed to be spread from one body of water to another by the unintentional transfer of bulbils, the star-like structures produced by the plant. These fragments are most likely attached to trailered boats, personal watercraft, docks, boat lifts, anchors or any other water-related equipment that was not properly cleaned.

Zebra Mussels (*Dreissena polymorpha*) Zebra mussels and a related species, the Quagga mussel, are small, fingernail-sized animals that attach to solid surfaces in water. They can cause problems for lakeshore residents and recreationists and present a threat to the ecological integrity of lakes a rivers by potentially disrupting food chains and crowding out native species.

Zebra mussels can be a costly problem for cities and power plants when they clog water intakes. Zebra mussels also cause problems for lakeshore residents and recreationists. They can attach to boat motors and boat hulls, reducing performance and efficiency; attach to rocks, swim rafts and ladders where swimmers can cut their feet on the mussel shells; and clog irrigation intakes and other pipes.

Zebra mussels also can impact the environment of lakes and rivers where they live. They eat tiny food particles that they filter out of the water, which can reduce available food for larval fish and other animals, and cause aquatic vegetation to grow as a result of increased water clarity. Zebra mussels can also attach to and smother native mussels.

6. Land Use and zoning

The water quality of a lake or river is ultimately a reflection of the land uses within its watershed. Otter Tail County Soil and Water Conservation District recognizes the multiple areas that impact water health including residential development, agriculture and shoreline management. The Otter Tail County Local Water Plan was created by the SWCD to evaluate the multiple sources of decreasing water quality and propose programs to address those challenges. The priorities listed in the plan include:

- **Surface Water Quality**
  - To improve the water quality of surface waters in Otter Tail County by reducing or minimizing the amount and extent of contaminants entering surface waters.
  - Example Action Items: Provide technical assistance to shore land owners on water quality projects. Assist with feedlot runoff projects providing technical assistance and financial assistance when available to projects that meet criteria.

- **Ground Water Quality and Quantity**
  To improve and protect the quality and quantity of groundwater resources in Otter Tail County by minimizing or reducing the amount and extent of contaminants entering the groundwater resources, and ensuring that there will be a stable and adequate source of useable water for municipal, industrial and agricultural purposes.

- **Development Pressure**
  To protect the natural resources of Otter Tail County by reducing or minimizing the impacts of ongoing and future development within the county.

- **Soil Erosion**
  Promote best management practices that reduce soil losses through wind and water erosion to below 2T (T is a technical abbreviation for tolerable soil loss).

- **Wildlife Habitat**
  To protect and preserve wildlife habitat and wetlands from conversion to cropland and urban development, and promote the re-establishment of wildlife habitat.

- **Sustainable Agriculture**
  To assist agricultural producers in maintaining productivity through the use of conservation practices that protect and preserve our natural resources and maintain a sustainable agricultural base in the county.

- **Education Promotion**
  Promote soil and water conservation through an effective information and education program to the residents, seasonal property owners, schools, and elected officials in Otter Tail County

- **Funding/Partnering/Administration**

Provide assistance to the public through the most efficient use of public funds and administration of programs, and maintain and develop a strong working relationship with other resource agencies.

The specific impacts to a lake from various land uses vary as a function of local soils, topography, vegetation, precipitation and other factors. However, one of the most important ways that citizens can work to positively impact their local waters is through ensuring that prudent local zoning ordinances are in place.

Many zoning regulations are based upon the Shoreland Management Act and/or the Minnesota Department of Natural Resources (DNR) classification of a given lake. The DNR has classified all lakes within Minnesota as General Development (GD), Recreational Development (RD), or Natural Environmental (NE) lakes, and assigned a unique identification number to the lake for ease of reference. Counties in turn have used these classifications as a tool to establish minimum lot area (width and setbacks) that is intended to protect and preserve the character reflected in the classification. It should be noted that counties will often make local ordinances stricter than the minimum standards set by the DNR.

On any shoreland the permissible density and setbacks for virtually all new uses are determined by the lake or river classification standards established by the Department of Natural Resources. OtterTail County has three categories for defining development around area lakes: Natural Environment, General Development, and Recreational Development. Wall Lake is classified by Otter Tail County as a General Development Lake.

Natural Environment lakes are generally small, often shallow lakes with limited capacities for assimilating the impacts of development and recreational use. They often have adjacent lands with substantial constraints for development such as high water tables, exposed bedrock, and unsuitable soils. These lakes, particularly in rural areas, usually do not have much existing development or recreational use.

Recreational Development lakes are generally medium-sized lakes of varying depths and shapes with a variety of landform, soil, and ground water situations on the lands around them. They often are characterized by moderate levels of recreational use and existing development. Development consists mainly of seasonal and year-round residences and recreationally-oriented commercial uses. Many of these lakes have capacities for accommodating additional development and use.

General Development lakes are generally large, deep lakes or lakes of varying sizes and depths with high levels and mixes of existing development. These lakes often are extensively used for recreation and, except for the very large lakes, are heavily developed around the shore. Second and third tiers of development are fairly common. The larger examples in this class can accommodate additional development and use.

Below are zoning standards associated with a General Development lake. Please note that this chart does not represent all the zoning requirements that are involved with land use and property development.

	General Development (Wall Lake)	**Recreational Development**
Structure Setback from OHWL	75 ft	100 ft
Water Frontage/Lot Width	100 ft	150 ft
Lot Area*	20,000 ft^2	40,000 ft^2
Buildable Area	8,400 ft^2	8,400 ft^2
Sewage Treatment Area	2,500 ft^2	2,500 ft^2

**Setbacks are measured from the Ordinary High Water Level (OHWL)*
***excluding public road right-of-ways, bluffs, wetlands, and land below the OHWL of public waters*

Many lakes have numerous properties that are considered to have "vested rights" or were developed prior to the establishment of these restrictions. In general, these pre-existing uses are allowed to remain unless they are identified as a threat to human health or environment, or are destroyed by natural, accidental causes or in association with significant renovation.

Questions may be directed to:

Bill Kalar, Land & Resource Management Director
Phone: 218-998-8095
Email: bkalar@co.ottertail.mn.us
Location: 540 Fir Ave. W, Fergus Falls, MN 56537

7. Public water access

Research has shown that Minnesotans rely heavily upon public access sites to access lakes and rivers. A 1988 boater survey conducted by the University of Minnesota showed that three-fourths of the state's boat owners launch a boat at a public water access site at least once a year. In addition, over 80 percent of boat owners report using public water access sites for recreation activities other than boating.

The primary agency responsible for pubic water accesses in Minnesota is the Minnesota Department of Natural Resources, Trails and Waterways Unit. They are responsible for the acquisition, development and management of public water access sites. The DNR either manages them as individual units or enters into cooperative agreements with county, state, and federal agencies, as well as local units of government such as townships and municipalities. The DNR's efforts to establish and manage public water access sites are guided by Minnesota Statutes and established written DNR policy. The goal of the public water access program is free and adequate public access to all of Minnesota's lake and river

resources consistent with recreational demand and resource capabilities to provide recreation opportunities.

According to Minnesota Department of Natural Resources Fisheries Survey, there is one public access on Wall Lake.

9. Organizational Development and Communication

Wall Lake Association is a nonprofit organization under Minnesota statue with a tax exempt 501 (c) (3) status from the IRS. The affairs of the association shall be managed and directed by a board of at least five but no more than nine directors. It is the expressed intention of these by-laws that there be, as nearly as possible, one director from each of the recognized areas around the lake. These areas are as follows: 1. Aurdal, 2. Hillside North, 3. Hillside South, 4. Elks Point, 5. South East, 6. South West, 7. Wall Lake Point, 8 Club 32 and 9 Farms. The Board elects officers for a 2 year term, at the annual meeting, to be held either during the months of June or July. The ongoing business of the Wall Lake Association shall be conducted through four standing committees: Water Quality & Safety, Communication, Community Events and Membership. Communication to the members is done via email, newsletter or direct mailings. During the visioning sessions held in 2016, it was determined that community via increased Association membership is a priority.

III. Summary/Conclusion

Wall Lake Association Vision Planning Session Summary

Approximately 50 individuals participated in the interactive Community Visioning Session held at Elk's Point Lodge on June 11, 2016. Participants were asked to contribute their thoughts, concerns, and ideas regarding the future of the lake, and regarding what should happen in the next 2-3 years to achieve the goals the group identified. Over the course of just under two hours, participants contributed more than 100 comments. Based on the content of the comments, three clear categories emerged: Strong Lake Association, Water Quality, and Lake Use. Those categories, and the themes in each, are detailed below.

STRONG ASSOCIATION

Comments in this category largely fell into two buckets: internal capacity building, and communication with the larger community. The benefit with this split is that enhanced communication and education can begin soon and have a noticeable change while the longer work of building partnerships and forming relationships takes place.

- Sub-themes
    - Membership Growth
    - Stronger Partnerships
    - Access to Resources
    - Enhanced Communication and Education
- Who should be at the table
    - Agency and local government
        - DNR (including Fish and Wildlife staff)
        - SWCD
        - U.S. Fish and Wildlife
        - County
        - Troy Richards—Game warden
        - State Representative
        - Commissioners—county and township
    - Community
        - Boy Scouts
        - Other Lake Associations
        - Lakeshore owners
        - Farmers
        - Those not on the lake
        - School kids
- Next 30/60/90 days
    - (30) Meeting summary sent to property owners
    - (90) Compile data and apply for grants
    - (30, 60, 90) Educate and provide on-going communication
    - (30, 60, 90) Plan with DNR
    - (30, 60, 90) Lakewide vote
    - (30, 60, 90) Address capacity building at association meetings

WATER QUALITY

Attendees are largely in agreement that water quality is a serious concern. While the sub-themes below do not directly state this, attendees are looking for improved clarity, and a lake supportive of the many uses they enjoy. Managing nutrient loads in the lake as well as the loading coming from the lakeshed will be important to achieve this over-arching goal.

- Sub-themes
    - Education on the issues
        - Baseline data
        - Figure out the "muck" issue
        - Weed management
    - Direct and upstream runoff problems
        - Shoreline habitat
        - Incentives for good landscaping for water quality
        - Runoff from lakeshore owners (fertilizer, etc.)
        - Runoff from farmers
    - Nutrient load in the lake
        - Chemical makeup
        - Excess nutrients
        - Excess weed growth
    - Property values
- Who should be at the table
    - Farmers from within the lakeshed
    - DNR
    - Extension
    - SWCD
- Next 30/60/90 days
    - (60) Talk to DNR about weed control
    - (30, 60, 90) Education and tour of restoration projects
    - (30, 60, 90) Baseline monitoring
    - (30, 60, 90) Contact DNR/extension office i.e. cattle in lake
    - *(30, 60, 90) Work with SWCD to develop an incentive program for the installation of shoreline gardens and other measures that reduce runoff into the lake*

LAKE USE

Comments in this category largely focused on making sure that all users of the lake have a safe and enjoyable time. This area is the least robust in terms of comments given and depth of topic, but it is clearly important to attendees to make sure "going to the lake" is fun for everyone.

- Sub-themes
    - Fisheries
        - Habitat
        - Stocking and slot limits
    - Safety & Recreation-communicate with the lake users
    - Public Access

- Who should be at the table
    - US Fish and Wildlife
    - DNR
- Next 30/60/90 days
    - (30,60,90) Contact US Fish and Wildlife about Stang Lake
    - (30,60,90) Print boating safety law and guideline rules and timely email of rules from WLA
    - (30,60,90) Have a map of the lake (including sandbar and rockbar) at the access and/or campgrounds.

Prioritized Goals and Action Plan

This final chapter of the Wall Lake management plan summarizes the conclusions and priority actions we have chosen to work on at this time. Specifically, for each priority action we have down our best to answer (for each goal presented):

Goal #1: Protect Water Quality **To preserve and protect the water quality of Wall Lake for current and future generations**	Responsible	Date Completed by:	Cost
Water Quality Monitoring Lead-John C/Jackie			
-Continue the present monitoring program to establish long-term trends in lake quality	Jackie/John C	Continuous	
-Determine if MPCA has Wall Lake inlet on their project list (if so, partner on testing and outcomes)	John Carlson	Oct-16	
-Recruit a larger group to share monitoring responsibilities			
- Report multi year results of chlorophyll a, phosphorus and Secchi disk readings to Wall Lake residents	Sue N/Jackie	Newsletter	
Promote projects that will enhance water quality **Lead: Jeff W and Scott C**			
-Work with SWCD to determine where and what type of buffer or rain garden projects would be most useful	Jeff W/Scott C/Jackie		
-Educate landowners about the importance of preventing runoff into the lake and stabilizing shorelines	Sue N/Jackie	Newsletter	
-Provide information to landowners on water quality restoration projects			
--Provide all residents with "Guide to Lake Protection and Management" (Freshwater Society) booklet	Jackie H	May-17	240
--Provide interested residents with Carrol Henderson's "Landscaping for Wildlife and Water Quality" (promote via newsletter)			
--Provide information via newsletters on water quality data, testimonials, etc.		May-17	
-Support installation of projects			
--Provide incentives for installations (recommend $200 per project from WLA upon installation proof from SWCD)			
--Promote the SWCD cost sharing program for property			

owners to install rain gardens and/or native buffers.			
--Look to partner with Scout Group or Gardening Group to assist with project installations.			
Promote restoration projects			
- Schedule tour of restoration projects around Wall Lake (such as a progressive breakfast)	Jeff W		
and/or provide a "self guided brochure showing locations of restorations.			
-Launch official incentive program for landowners to manage storm water runoff	Jeff/Scott/Jackie		

Goal #2: Promote Water Safety			
To promote and educate Wall Lake users (residents and visitors) on water and boating safety on the lake			
Educate lake users on sandbar hazards			
-Create and print colored topographic map showing sandbar hazards			
-Request approval from DNR to post topographic map at the access.			
-Work with Elks Point Campground to hand out water safety information and topographic map to all campers			
Promote safe and proper boating			
-Educate residents via newsletter and annual meeting on safe boating and consequences of speed boating close to shore.	Sue N	Newsletters	
Promote water safety			
-Continue working with Elks Point Campground to have handout inventory			
-Set up informational table at Elks Point with topographic map and other water safety brochures.	John W		
-Consider having a kids boating safety class	WLA Board		
-Work with local Boy Scout group to create an informational board to mount at Elks Point.			

Goal #3: Preserve and Protect Wildlife on and around Wall Lake			
To preserve and protect habitat for healthy fish, birds and pollinators for all to enjoy for current and future generations.			
Loon Monitoring			
-Continue Loon counting and provide this information to Wall lake community via newsletter and/or annual meeting		Jun-17	
-Educate residents via newsletter on the importance of staying clear of loons while boating.	Sue N	Newsletters	
AIS Prevention and education			
-Mail AIS brochure to all residents (Otter Tail Aquatic Invasive Species ID brochure)			
-Educate residents on AIS via newsletter and annual meeting			
-Investigate if Boy Scout group is interested in creating an AIS information board to post at Elks Point			
Explore the need for possible fishing regulations			
-Survey residents to gauge their thoughts on fishing regulations	John C	Summer 2017	
-Monitor DNR fish surveys to help determine the possible need for fishing regulations	John C		
--Contact DNR Fisheries	John C	Oct-16	
Wall Lake Association to make donation to local fish club			
-Wall Lake Association to make a yearly donation to the fish club, "Carpe Diem Outdoors" to show appreciation and support of their fishing/removal of carp in Wall Lake.			
--Contact Carpe Diem Outdoors to issue check	WLA Board		
Promote the importance of Monarch butterflies and other Pollinators			
-Wall Lake Association will encourage residents to plant milkweed for Monarch butterflies via newsletter			
---Gather milkweed seeds and package	Luann R	Oct-16	
-Provide milkweed seed packets at annual meeting	Jackie H	Jun-17	
-Milkweed seed packets will be included with welcome package for new residents to the lake.			
-Encourage landowners to include pollinator-friendly plants in shoreline gardens and other restoration projects.	Sue N	Newsletters	

-Promote & teach plantings - Residents and campground	Luann R-campground kids Newsletter	June 2017	
Future Activity/Programs:			
- Continue to provide milkweed seeds to new residents			
- Continue to support local fish club			

Goal #4: Build a strong lake association and increase involvement of all members			
Work towards a membership goal of at least 75% of residents and active involvement within the lake association			
Actively advertise and promote annual meeting	John C/Jackie H		
-Send flyer or mailing advertising annual meeting		Jun-17	
-Provide breakfast and door prizes at annual meeting		Jun-17	
-Provide speaker at the meeting that will draw community interest		Jun-17	
Develop new Wall Lake resident packet			
-Develop a new resident welcome committee (Beach captain)			
-Determine what needs to be in packet			
-Get Wall Lake listing from County	Jackie H	Mar-17	$0
Continue membership in the OTC COLA			
-Assign a representative that can attend the COLA meeting	John C		
-Report COLA meeting information to all members via newsletter	John C		
Future Activity/Program			
-Promote Wall Lake Assoc			
Get updated resident list from county March of every year	Jackie H		
Continue COLA membership yearly	WLA Board		
Maintain new resident program	Jackie H		

Revisiting this plan

This plan is designed to be relevant for only 3-5 years. It will be important for the Wall Lake Association Board to have a process for updating the plan at least every 5 years. As Issues change, people change, and resources change, so this plan should change, too! It will be important to build and maintain relationships with our local resource experts

To Review the plan we should:

a. Make sure the membership and leadership remember the purpose of the plan (keeping in mind new members).
b. Review what has changed in the lake and lakeshed based on new data.
    i. Contact resource experts for updated data if not already available
    ii. Review new data for changes in status or trends
c. Review the status of the action plans
    i. Are the action plans still relevant?

2. Identify new action plans. We could possibly:
    a. Hold a community visioning session
    b. Identify new priority issues or opportunities that groups want to work on
    c. Research new funding opportunities
    d. Draft an updated /new action plan
3. Update the Wall Lake Management Plan, and approve it at an upcoming meeting!

Glossary

Aerobic: Aquatic life or chemical processes that require the presence of oxygen.

Algal bloom: An unusual or excessive abundance of algae.

Alkalinity: Capacity of a lake to neutralize acid.

Anoxic: The absence of oxygen in a water column or lake; can occur near the bottom of eutrophic lakes in the summer or under the ice in the winter.

Benthic: The bottom zone of a lake, or bottom-dwelling life forms.

Best Management Practices: A practice determined by a state agency or other authority as the most effective, practicable means of preventing or reducing pollution.

Bioaccumulation: Build-up of toxic substances in fish (or other living organism) flesh. Toxic effects may be passed on to humans eating the fish.

Biological Oxygen Demand: The amount of oxygen required by aerobic microorganisms to decompose the organic matter in sample of water. Used as a measure of the degree of water pollution.

Buffer Zone: Undisturbed vegetation that can serve as to slow down and/or retain surface water runoff, and assimilate nutrients.

Chlorophyll *a*: The green pigment in plants that is essential to photosynthesis.

Clean Water Partnership (CWP) Program: A program created by the legislature in 1990 to protect and improve ground water and surface water in Minnesota by providing financial and technical assistance to local units of government interested in controlling nonpoint source pollution.

Conservation Easement: A perpetual conservation easement is a legally binding condition placed on a deed to restrict the types of development that can occur on the subject property.

Cultural eutrophication: Accelerated "aging" of a lake as a result of human activities.

Epilimnion: Deeper lakes form three distinct layers of water during summertime weather. The epilimnion is the upper layer and is characterized by warmer and lighter water.

Eutrophication: The aging process by which lakes are fertilized with nutrients.

Eutrophic Lake: A nutrient-rich lake – usually shallow, "green" and with limited oxygen in the bottom layer of water.

Exotic Species: Any non-native species that can cause displacement of or otherwise threaten native communities.

Fall Turnover: In the autumn as surface water loses temperature they are "turned under" (sink to lower depths) by winds and changes in water density until the lake has a relatively uniform distribution of temperature.

Feedlot: A lot or building or a group of lots or buildings used for the confined feeding, breeding or holding of animals. This definition includes areas specifically designed for confinement in which manure may accumulate or any area where the concentration of animals is such that a vegetative cover cannot be maintained. Lots used to feed and raise poultry are considered to be feedlots. Pastures are not animal feedlots.

Groundwater: water found beneath the soil surface (literally between the soil particles); groundwater is often a primary source of recharge to lakes.

Hardwater: Describes a lake with relatively high levels of dissolved minerals such as calcium and magnesium.

Hypolimnion: The bottom layer of lake water during the summer months. The water in the hypolimnion is denser and much colder than the water in the upper two layers.

Impervious Surface: Pavement, asphalt, roofing materials or other surfaces through which water cannot drain. The presence of impervious surfaces can increase the rates and speed of runoff from an area, and prevents groundwater recharge.

Internal Loading: Nutrients or pollutants entering a body of water from its sediments.

Lake Management: The process of study, assessment of problems, and decisions affecting the maintenance of lakes as thriving ecosystems.

Littoral zone: The shallow areas (less than 15 feet in depth) around a lake's shoreline, usually dominated by aquatic plants. These plants produce oxygen and provide food, shelter and reproduction areas for fish & animal life.

Local Unit of Government: A unit of government at the township, city or county level.

Mesotrophic Lake: A lake that is midway in nutrient concentrations (between a eutrophic and oligotrophic lake). Characterized by periodic problems with algae blooms or problem aquatic vegetation.

Native Species: An animal or plant species that is naturally present and reproducing.

Nonpoint source: Polluted runoff – nutrients or pollution sources not discharged from a single point. Common examples include runoff from feedlots, fertilized lawns, and agricultural fields.

Nutrient: A substance that provides food or nourishment, such as usable proteins, vitamins, minerals or carbohydrates. Fertilizers, particularly phosphorus and nitrogen, are the most common nutrients that contribute to lake eutrophication and nonpoint source pollution.

Oligotrophic Lake: A relatively nutrient-poor lake, characterized by outstanding water clarity and high levels of oxygen in the deeper waters.

Nutrient: A substance that provides food or nourishment, such as usable proteins, vitamins, minerals or carbohydrates. Fertilizers, particularly phosphorus and nitrogen, are the most common nutrients that contribute to lake eutrophication and non-point source pollution.

pH: The scale by which the relative acidity or basic nature of waters are accessed,

Photosynthesis: The process by which green plants produce oxygen from sunlight, water and carbon dioxide.

Phytoplankton: Algae – the base of the lake's food chain, it also produces oxygen.

Point Sources: Specific sources of nutrient or pollution discharge to a water body, i.e., a stormwater discharge pipe.

Riparian: The natural ecosystem or community associated with river or lake shoreline.

Secchi Disc: A device measuring the depth of light penetration in water.

Sedimentation: The addition of soils to lakes, which can accelerate the "aging" process by destroying fisheries habitat, introducing soil-bound nutrients, and filling in the lake.

Spring turnover: After ice melts in the spring, warming surface water sinks to mix with deeper, colder water. At this time of year all water is the same temperature.

Thermocline: During summertime deeper lakes stratify by temperature to form three discrete layers; the middle layer of lake water in known as the thermocline.

Trophic Status: The level of growth or productivity of a lake as measured by phosphorus, content, algae abundance, and depth of light penetration.

Watershed: The surrounding land area that drains into a lake, river, or river system.

Zooplankton: Microscopic animals.

Common Biological or Chemical Abbreviations

BOD	Biological Oxygen Demand
°C	degree(s) Celsius
cfs	cubic feet per second (a common measure of rate of flow)
cfu	colony forming units (a common measure of bacterial concentrations)
chl *a*	Chlorophyll *a*
cm	centimeter
COD	Chemical Oxygen Demand
Cond	conductivity
DO	dissolved oxygen
FC	fecal coliform (bacteria)
ft	feet
IR	infrared
l	liter
m	meter
mg	milligram
ml	milliliter
NH_3-N	nitrogen as ammonia
NO_2-NO_3	nitrate-nitrogen
NTU	Nephelometric Turbidity Units, standard measure of turbidity
OP	Ortho-phosphorus
ppb	parts per billion
ppm	parts per million
SD	Standard Deviation (statistical variance)
TDS	total dissolved solids
TN	total nitrogen
TP	total phosphorus
TSI	trophic status index
TSI (C)	trophic status index (based on chlorophyll *a*)
TSI (P)	trophic status index (based on total phosphorus)
TSI (S)	trophic status index (based on secchi disc transparency)
TSS	total suspended solids
µg/l	micrograms per liter
µmhos/cm	micromhos per centimeter, the standard measure of conductivity
UV	Ultraviolet

Guide to common acronyms

State and Federal Agencies

BWSR	Board of Soil & Water
COE	U.S. Army Corps of Engineers
CRP	Conservation Reserve Program - A federal government conservation program
DNR	Department of Natural Resources
DOJ	United States Department of Justice
DOT	Department of Transportation
DTED	Department of Trade and Economic Development
EPA	U.S. Environmental Protection Agency
EQB	MN Environmental Quality Board
LCCMR	Legislative-Citizen Commission on Minnesota Resources
MDH	Minnesota Department of Health
MPCA	Minnesota Pollution Control Agency
OEA	MN Office of Environmental Assistance
OSHA	Occupational Safety and Health Administration
RIM	Reinvest In Minnesota - a State of Minnesota Conservation Program
SCS	Soil Conservation Service
SWCD	Soil & Water Conservation District
USDA	United States Department of Agriculture
USGS	United States Geological Survey
USFWS	United States Fish & Wildlife Service

Regional, watershed, community development, trade and advocacy groups

AMC	Association of Minnesota Counties
APA	American Planning Association
COLA	Coalition of Lake Associations
IF	Initiative Foundation
LMC	League of Minnesota Cities
MAT	Minnesota Association of Townships
MLA	Minnesota Lakes Association
MSBA	Minnesota School Board Association
MCIT	Minnesota Counties Insurance Trust
Mid-MnMA	Mid-Minnesota Association of Builders
MLA	Minnesota Lakes Association
MnSCU	Minnesota State Colleges and Universities
RCM	Rivers Council of Minnesota
TIF	Tax Increment Financing

Codes and Regulations

110B	The Minnesota law that regulates non-metro county water plans
ADA	American Disabilities Act
B & B	Bed and Breakfast
BOA	Board of Adjustment
Chapter 70/80	Individual Sewage Treatment Standards
CIC Plat	Common Interest Community Plat
Class V	Class Five “Injection” well; any well which receives discharge
CSAH	County State Aid Highway
CUP	Conditional Use Permit
CWA	Clean Water Act
EAW	Environmental Assessment Worksheet
EIS	Environmental Impact Statement
EOA	Equal Opportunity Act
FOIA	Freedom of Information Act
GD	General Development (lake)
GLAR	Greater Lakes Area Association of Realtors
IAQ	Indoor Air Quality
ISTS	Individual Sewage Treatment System
LMP	Lake Management Plan
LQG	Large Quantity Generator (of hazardous waste)
MAP	Minnesota Assistance Program
OHW	Ordinary High Water
PUD	Planned Unit Development
RD	Recreational Development (lake)
ROD	Record of Decision
ROW	Right-of-Way
SBC	State Building Code
SDWA	Safe Drinking Water Act
SF	Square feet
SIZ	Shoreland Impact Zone
SQG	Small Quantity Generator (of hazardous waste)
SWMP	Stormwater Management Plan
UBC	Universal Building Code