Draft Lake Management Plan

for

Lake Lida

Lake Lida Property Owners Association, August 2016

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Section 1: Overview

LETTER FROM ORGANIZATION PRESIDENT:

In late 2015, the Lake Lida Property Owners Association was invited to participate in the Initiative Foundation's 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 with strong support from Darrin Newville (East Otter Tail Soil and Water Conservation District) representatives attended a day of training on lake ecology, strategic planning and communications.

Representatives of many state and local agencies, as well as nonprofit organizations also attended the training sessions in order to offer their assistance to each group in developing a strategic Lake Management Plan.

Following the training sessions, each lake association held an inclusive community planning/visioning session designed to identify key community concerns, assets, opportunities, and priorities. Details of the public input received at this session are provided within this plan.

This document is intended to create a record of historic and existing conditions and influences on Lake Lida, and to identify the goals of the surrounding community. Ultimately it is meant to help prioritize goals, and guide citizen action and engagement in the priority action areas. While state agencies and local units of government have a vital role and responsibility in managing surface waters and other natural resources, this 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.

This Lake Management Plan is also intended to be a "living document;" as new or better information becomes available. As we accomplish our goals or discover that alternative strategies are needed, it is our intent to update this plan so that it continues to serve as a useful guide to future leaders.

In discussing lake management issues it is impossible to avoid all scientific or technical terms. We have tried to express our goals, measures of success, and other themes as simply and clearly as possible, but have included a glossary of common limnological terms at the end of the plan to assist the reader. Limnology is the state of lake conditions and behavior.

Finally, we would like to recognize the Legislative-Citizen Commission on Minnesota Resources who, through the Environment and Natural Resources Trust Fund, made this round of the program possible.

Plan Structure

The purpose of this Lake Management Plan is to provide an agreed upon set of strategies and actions Lake Lida Property Owners Association can take to address issues relating to Lake Lida, and secure its future as an amenity for the community. The plan, included in full detail in the following section, is broken out into several areas. These sections are explained below.

Section 1: Overview

This section, which you are currently in, is designed to be a stand-alone document, laying out the overarching issues Lake Lida and the POA face, the implications of these issues for the lake and group, and our next steps. The details as they relate to each section are included in full detail in the next section, but the summaries in Section 1 can be referenced by the group, shared with decision-makers, and be used as a readily-understandable guide to inform the work of Lake Lida Lake Association and against which progress can be measured.

Section 2: Plan Detail

This is the longest section of the plan, detailing the following:

- History of the group
- RMB Laboratories Report of the lake, including in-lake and lakeshed characteristics
- Maps and other data reflecting the historical, existing, and projected (as applicable) conditions for the focus areas:
    - Aquatic Vegetation
    - Wildlife
    - Exotic Species
    - Land Use and Zoning
    - Public Water Access
    - Organizational Development and Communication
- Notes from the Community Visioning Process
- Detailed Action Plans, laying out individual steps as well as overarching goals, and identifying key players both in and outside the group that will be relied on to complete the actions
- Approach for revisiting and refreshing the plan, so that it may be a living document that adapts and evolves over time as issues and knowledge of solutions change.

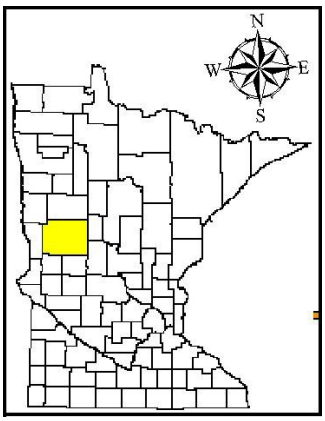
While Section 1 will include summaries of all of this information, the data and information from Section 2 is needed to provide clarification and further information when called for by partners, members, decision-makers, or others, especially as time passes.

Section 3: Appendices

This section contains any reference documents that help to further clarify any of the information in Section 2, including things like relevant articles and studies. It also contains a glossary of terms, as throughout this plan there will be a frequent use of acronyms and scientific terms that may not be familiar to all readers.

Introduction

The lakes addressed in this plan – North and South Lida and Venstrom – are located among the over 1,000 lakes in Otter Tail County. These lakes are part of the Otter Tail River Watershed, located in the Red River Basin. Glacial outwash plain provides the sandy/gravel mix of the lake basins and surrounding shorelines. Steep slopes and bluff areas are located along the eastern shoreline of both Lida Lakes, and along the west shoreline of South Lida. The watershed is predominantly made up of cultivated agriculture land with large patches of deciduous forest.



Homes are clustered around the shorelines of these lakes as seen in ***Figure One***.

These three lakes together total nearly 6500 acres. North Lida Lake, the largest of the three, is located south of Otter Tail County Highway 4 and north of State Highway 108. North Lida is connected to South Lida by a navigable culvert under Highway 108 and is also connected to Lizzie Lake by an unnavigable culvert under County Road 4. There is also a public access to the lake off of this road.

South Lake Lida is located North of County Highway 3 and South of State Highway 108. It is connected to North Lida as mentioned above as well as to Venstrom Lake by small channel (navigable only by small water craft). Almost the entire east side of the lake borders Maplewood State Park, protecting it from development and vegetation loss.

Venstrom**,** by far the smallest of the three lakes is only accessible from South Lida. Paddleboats and canoes frequent it.

Lida Lake dwellings & Park Boundary

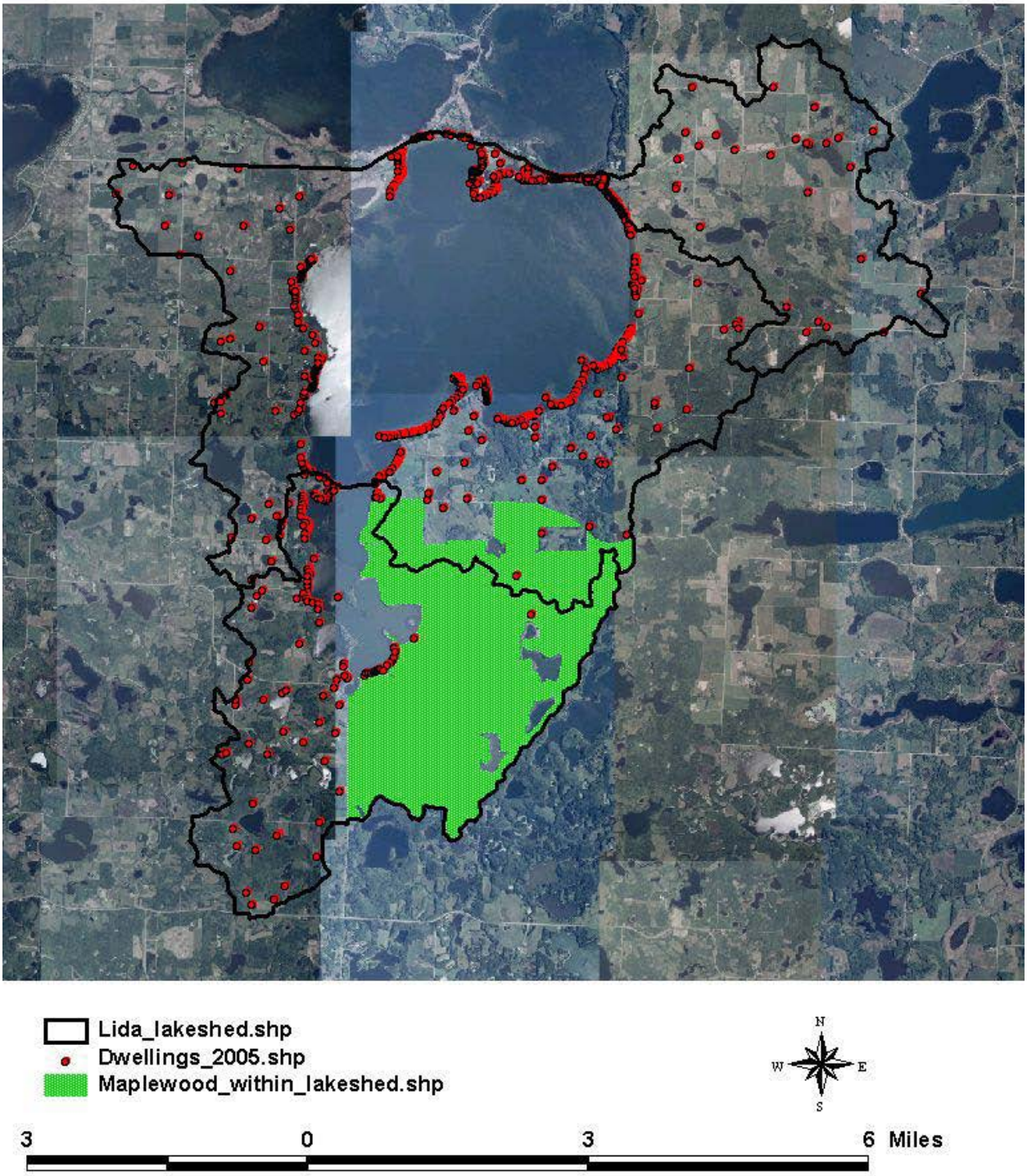


Figure 1

Priority Concerns

The LLPOA identified three priority concerns through a visioning session in August of 2004. The session was offered to the full membership and surrounding community leaders. Local and state agency staff were invited to participate in the visioning session. As a result of these inquiries, the following priorities were set: Water Quality, Land Use and Zoning, and Community. From these concerns, specific goals and actions are identified and targeted for implementation.

Education is the main component of implementation on all three Priority Concerns. The citizens participating felt presenting information to property owners would go a long way toward changing behavior. It was felt if people knew not only what the rules are, but why and how they affect the quality of the lake, they would tend to be more compliant.

Becoming more active in the county regulatory process and voicing concerns about decisions regarding these lakes was another need that became clear through this process.

The Plan was updated in 2014 and since the plan was adopted by the LLPOA in 2005, implementation was the focus of the board and members. Some of the accomplishments since adoption are as follows:

- About every 5 years a new LLPOA lake directory is published and presented free to members of the Association.
- Inlets have been surveyed to determine what materials are entering the lake that could cause pollution or other kinds of problems.
- The outlet channel has been monitored and appropriate measures to keep it open have been recommended to the DNR, and in some cases funded by LLPOA.
- LLPOA has worked with the Minnesota Pollution Control Agency to eliminate or minimize feedlot flow to the lake.
- Shoreline stabilization has been initiated and in part funded to eliminate erosion on a number of Lida properties, including the major project completed on the North Clay Bank area.
- Enhance Bass habitat through various efforts in cooperation with the DNR.
- Purchase and release many thousands of walleye fingerlings (up to 10 inches) into the lake. Currently walleye stocking takes place on years with poor natural walleye hatches.
- Funded a lakes ecology unit for 5th grade students (Books and curriculum).
- Water quality monitoring has been maintained by LLPOA volunteers each summer with samples taken monthly from May-September. Sample testing has been paid for by LLPOA.
- The Association developed the official Lake Lida Management Plan in 2003, paid for by a grant from Minnesota Waters and matched by LLPOA dues.
- Official web page for LLPOA. It is: http://poa.lakelida.com. This website had complete update in 2008 and includes the 2013 Lake Study and 2013 LLPOA Directory.
- Support the funding for a professional consultant who meets with land owners and discusses the “best” changes for their property. Also will consult and contribute time to develop and write grants for LLPOA property owner’s shoreline improvement.
- Numerous property owners secured grants from East Otter Tail to improve lakeshore through specific plantings of vegetation required by those grants. It is my recollection that total grants amounted to over $25,000.00 in the years of 2008-2009. Steve Henry was the East Otter Tail contact for helping to write and implement those grants.
- Requested Lida Township to implement a Township Storm Water Permitting Program (this is in township legal counsel)

- Obtained a permit to widen/open the clogged outlet, under County HWY4 to 10 feet wide. Water is flowing out, at a slow rate - movement will slow the spread of AIS.
- Develop a plan to help educate boaters, fisherman, and lake users to the AIS and to monitor lake access points. Monitors will be volunteer or paid, starting near opening fishing. We will be applying for grants if available.
- Continue to work on the Star Lake Classification
- Funded trash pick-up every other year for major clean-up around the lake.
- Supplied fishing rulers and refrigerator magnets to all property owners.
- Paid dues to be an official member of Ottertail COLA and Minnesota Waters.

Fast Forward to 2016: Lake Lida did accomplish Star Lake status. Much of the same issues are still identified in the Planning Session conducted as a part of the 2016 Healthy Lakes and Rivers Partnership process

- Organizational Growth;
- Water Quality;
- Lake Use; &
- Water Supply.

Organizational Growth: The group would like to see enhanced communication with (and within) the community around the lake, and increased capacity to take on the projects that will be written into the lake management plan. This can include social opportunities that can be used to promote the activities and accomplishments of the Lake Association to garner support. Improving communication will also assist in the engagement of membership and in the successful implementation of this plan.

The group also suggested enhanced communication to educate property owners of best practices for improving and sustaining the water quality of the lake.

Increased communication can also benefit our relationships with government bodies, the coordination of committees pursuing action plan items and our progress to becoming a LID (Lake Improvement District).

It may seem odd to put garbage service under organizational growth, but many feel that the Lake Association should provide this service periodically to clean up the properties and refuse to join the LLPOA unless they decide to fund it.

Water quality: This was the lengthiest category, and has a good deal of variation. While we have good data, there is a good understanding that there is a need for continued research to really understand what is going on.

Weeds is a major concern and an example of the need for further information before we can address the issue. While there is an immediate desire to address the weeds in the lake, those weeds are likely there due at least in part to an excess of nutrients. A management plan that only addresses the weeds will lead to even higher nutrient levels, and the problem will never go away (or, it could create an environment where an invasive aquatic plant could dominate). Education will be instrumental in developing an action plan for the weed situation.

Also, since fishing is an important asset to the community, we need to ensure that the management of aquatic plants doesn't cause issues for fish habitat. It is important to work with the SWCD and DNR to identify the proper course of action regarding in-lake plant control.

What we do know is that installing shoreline and rain gardens and mowing less (less area and less frequency) can improve water quality, so this is something that can be implemented in the form of education and communication to the shoreline property owners.

While we determine the impact of the livestock and farmland in close proximity to the lakes, we can begin forging relationships with the farmers in the watershed.

Other action items discussed were educating and encouraging buffers, erosion and shoreline stabilization, runoff from watershed, the culvert over the state highway, nutrient levels and the water level.

There has also been expressed a desire to address the zebra mussels infestation, though many feel that since they are already in Lake Lida, there's not much we can do. Keeping up to date with the latest research and property owner education could have a positive impact on the situation.

Lake Use: Several of the identified themes from the visioning session can be combined to reflect a larger area of work that still has manageable work areas and tangible outcomes. The action plan in this category will likely focus on identifying maintenance and management solutions, as well as communicating with lake users information on everything from water quality to aquatic invasive species to rules around jet skis and speed boats. In addition, those who work on this category will want to pass on information about shorelines being impacted by waves, and the importance of minding your wake.

Access maintenance was also discussed as a need to improve and increase lake use as well as education at access (ranging from slot limit to wake impact to laws and common courtesies when using jet skis and speed boats).

Management of the lake for sustainable fishing was identified as a priority. In regard to the slot limit, there was lots of discrepancy about what should be done ranging from finding out what can be done to eliminate it, to changing it to keeping it as is. Working with the DNR to chart out a best course of action will be an important first step.

Water Supply: While this issue wasn't a top priority, there does appear to be a strong desire to look into the option of rural water, or investigate rural water as opposed to well water.

In order to respond to the priorities listed above, the lake association needs to increase involvement of property owners, work with the proper organizations and agencies and increase education and communication to and with the shoreline lake owners.

At this time, funding is not a concern, the Lake Association is healthy financially, but increasing membership and explicitly, increasing the contact information of the membership will be key in accomplishing the issues identified.

Section 2: Plan Detail

History and purpose of Lake Lida Property Owners Association

History

Lake Lida Property Owners Association (LLPOA) was formed in the mid 1990's. The concerns that brought about the formation of the association were similar to the concerns voiced today: changes in the quality of the water from in-flows and land uses. Some of the first projects included:

- Prevent erosion off the clay banks when the water was high – work with the DNR to place rock riprap.
- Influence on non-compatible developments such as a turkey growing operation on the shoreline.
- Decrease high water problems by opening the lake outlet by creating a channel.
- Start a water quality-monitoring program that is still being done today.
- Identify the drainage basin (lakeshed) of the three lakes.
- Work with the DNR to create bass habitat.

In recent years membership has ranged from 300-420 paid members. We had 360 paid members in 2015.There is a potential of 664 members (property owners).

Recent accomplishments include:

- Grants are currently being offered to members for shoreline projects improving water quality. (2016)
- LLPOA lake directory has been published in 2009 and 2013 and presented free to members of the Association. 2017 Directory currently in production.
- Shoreline stabilization has been initiated and in part funded to eliminate erosion on a number of Lida properties, including the major project completed on the North Clay Bank area.
- Water quality monitoring has been maintained by LLPOA volunteers each summer with samples taken monthly from May-September. Sample testing has been paid for by LLPOA.
- The Association developed the official Lake Lida Management Plan in 2003, paid for by a grant from Minnesota Waters and matched by LLPOA dues. Plan was updated in 2010 and a copy is posted on the website.
- Hosted a Lake Lida Healthy Lakes Community Meeting June 10, 2016 at Lida Greens to help identify priority focus areas to improve the water quality and health of the Lake Lida community.
- Assisting with and supporting 4th of July band on the lake as an opportunity to build community within Lake Lida.
- Hosted Movie night in August, 2015- an outdoor movie at Lake Lida Township building. Family movie, starts just before dusk, free popcorn.

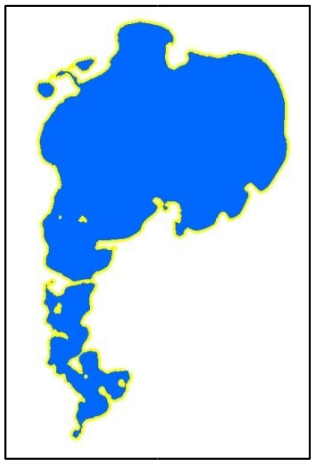
Purpose

The purpose of LLPOA and the Lake Management Plan is to identify existing problems and opportunities for protection and management. LLPOA intends to use this document as work-plan guidance for the next five years- setting priority strategies and projects for implementation.

Lida Lakes 56-0747-01 & 56-0747-02 OTTER TAIL COUNTY

Lake Water Quality

Summary



Lake Lida is located 5 miles east of Pelican Rapids, MN in Otter Tail County. It is a long lake with a large northern bay and a smaller southern bay covering 6,288 acres (Table 1).

Lake Lida has three inlets and one outlet, which classify it as a drainage lake. Water enters Lake Lida from small creeks to the east and south. Water exits Lake Lida at the north and flows into Lake Lizzie, which joins the Pelican River.

Water quality data have been collected on Lake Lida since 1975 (Tables 2 & 3). These data show that North Lida is mesotrophic (TSI = 46) and South Lida is Eutrophic (TSI = 52).

The Lake Lida Property Owners Association (LLPOA) was formed in the

mid 1990's. The concerns that brought about the formation of the association were similar to the concerns voiced today: changes in the quality of the water from in-flows and land uses. The Association is involved in many activities including water quality monitoring, website maintenance, education, and is a member of the Otter Tail County Coalition of Lake Associations (COLA).

Table 1. Lake Lida location and key physical characteristics.

Location Data		Physical Characteristics		
	North Lida: 56-0747-01	Surface area (acres):	North: 5513	South: 775
MN Lake ID:	South Lida: 56-0747-02	Littoral area (acres):	North: 2380	South: 356
County:	Otter Tail	% Littoral area:	North: 43	South: 46
Ecoregion: North Central Hardwood Forests		Max depth (ft):	North: 58	South: 48
		Inlets: North: 3	South: 1	
Major Drainage Basin:	Red River	Outlets: North: 1	South: 1	
Latitude/Longitude: North: 46.5865, -95.9672				
	South: 46.5284, -95.986	Public Accesses:	North: 1	South: 1
Invasive Species: Zebra mussels, curly-leaf pondweed				

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

Data Availability

Transparency data Excellent data		source from 1975-1976, 1995-2012.
Chemical data Excellent data		source from 1998-2012.
Inlet/Outlet data Not available.		

Lake Map

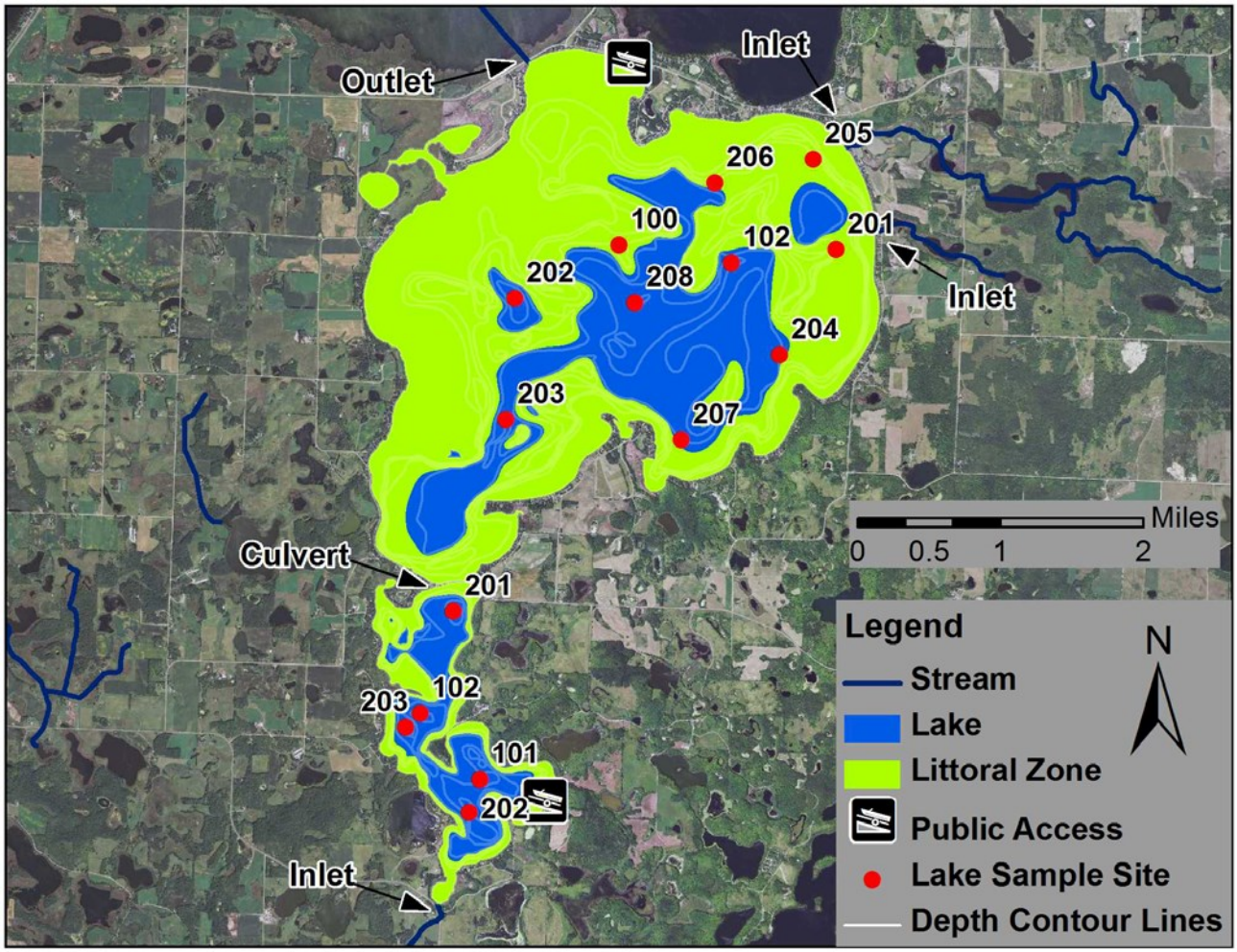


Figure 1. Map of Lake Lida with 2010 aerial imagery and illustrations of lake depth contour lines, sample site locations, inlets and outlets, and public access points. The light green areas in the lake illustrate the littoral zone, where the sunlight can usually reach the lake bottom, allowing aquatic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

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

Basin	Lake Site	Depth (ft)	Monitoring Programs
North	102	40	MPCA: 2000
North	201	30	CLMP: 1975-1976, 1992, 1995-1997
North	202	40	CLMP: 1995-1996, 2000, 2009-2010
North	203	30	CLMP: 1995
North	204	20	CLMP: 1995-2012
North	205	20	CLMP: 1995-1997
North	206	20	CLMP: 1995-1997
North	207	20	CLMP: 1995-2007
North	208*	40	CLMP: 1998-2012; RMBEL: 1998-2012
South	101	40	MPCA: 2000
South	102	40	MPCA: 2000
South	201	30	CLMP: 1995-2012
South	202*	40	CLMP: 1995-2012; RMBEL: 1998-2012
South	203	45	CLMP: 1995-1996

*primary sites

Average Water Quality Statistics

The information below describes available chemical data for Lake Lida through 2012 (Table 4). Data for total phosphorus, chlorophyll *a*, and Secchi depth are from the primary sites 208 (North) and 202 (South). All additional chemical data is from site 202 (North) and 101 (South) and reflects mean values from 2000.

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	North Lida Mean	South Lida Mean	Ecoregion Range[1]	Impaired Waters Standard[2]	Interpretation
Total phosphorus (ug/L)	20	32	23 – 50	> 40	Results are within the expected range for the ecoregion and below the impaired waters standard.
[3] Chlorophyll *a* (ug/L)	6	14	5 – 22	> 14	
Chlorophyll *a* max (ug/L)	21	33	7 – 37		
Secchi depth (ft)	12.0	9.9	4.9 – 10.5	< 4.6	

Dissolved oxygen	Dimictic *see page 9*	Dimictic *see page 9*		Dissolved oxygen depth profiles show that the deep areas of the lake are anoxic in late summer.
Total Kjeldahl Nitrogen (mg/L)	0.73	0.89	<0.60 – 1.2	Indicates insufficient nitrogen to support summer nitrogen-induced algae blooms.
Alkalinity (mg/L)	210	196	75 – 150	Indicates a low sensitivity to acid rain and a good buffering capacity.
Color (Pt-Co Units)	10	10	10 – 20	Indicates clear water with little to no tannins (brown stain).
pH	NA	NA	8.6 – 8.8	Data not available
Chloride (mg/L)	6	5.4	4 – 10	Within the expected range for the ecoregion.
Total Suspended Solids (mg/L)	3	5	2 – 6	Within the expected range for the ecoregion. Indicates low suspended solids and clear water.
Conductivity (umhos/cm)	NA	NA	300 – 400	Data not available
Total Nitrogen : Total Phosphorus	36:1	28:1	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	North Primary Site 208	North Site 204	South Primary Site 202	South Site 201
Total Phosphorus Mean (ug/L):	**20.1**		**32.7**	
Total Phosphorus Min:	7		8	
Total Phosphorus Max:	31		56	
Number of Observations:	74		74	
Chlorophyll *a* Mean (ug/L):	**6.2**		**14**	
Chlorophyll-a Min:	1		1	
Chlorophyll-a Max:	21		33	
Number of Observations:	71		72	
Secchi Depth Mean (ft):	**12.0**	**10.7**	**9.9**	**10.5**
Secchi Depth Min:	4.0	3.9	4.5	4.5

Secchi Depth Max:	26.0	26.0	28.0	32.0
Number of Observations:	209	190	353	288

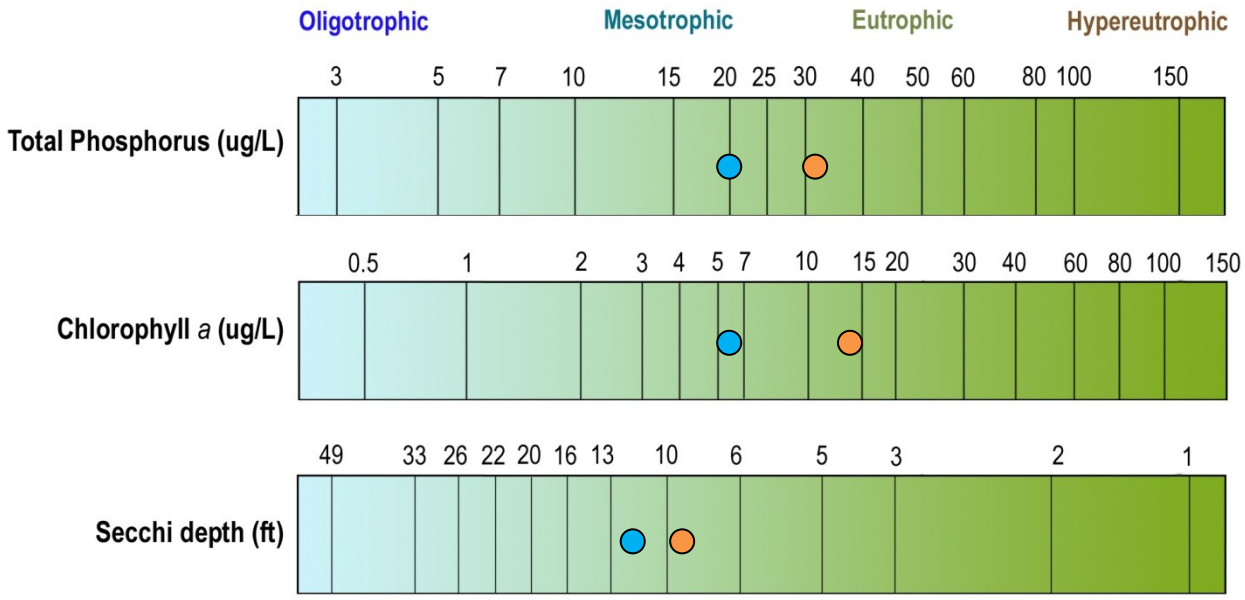


Figure 2. Lake Lida total phosphorus, chlorophyll a and transparency historical ranges. The dots Figure 2. Lake "insert" total phosphorus, chlorophyll *a* and transparency historical ranges. The arrow represent historical means for each basin. represents the range and the black dot represents the historical mean (Primary Site xxx). Figure adapted after Moore and Thornton, [Ed.]. 1988. Lake and Figure adapted

Reservoir Restoration Guidance Manual. (Doc. No. EPA 440/5-88-002) after Moore and Thornton, [Ed.]. 1988. Lake and Reservoir Restoration Guidance Manual. (Doc. No. EPA 440/5-88-002)

Transparency (Secchi Depth)

Transparency is how easily light can pass through a substance. In lakes it is how deep sunlight penetrates through the water. Plants and algae need sunlight to grow, so they are only able to grow in areas of lakes where the sun penetrates. Water transparency depends on the amount of particles in the water. An increase in particulates results in a decrease in transparency. The transparency varies year to year due to changes in weather, precipitation, lake use, flooding, temperature, lake levels, etc.

The mean transparency in Lake Lida ranges from 9.0 to 15.0 feet (Figure 3). The transparency in North Lida is better on average than the transparency in South Lida. This is most likely due to the fact that North Lida is larger and deeper than South Lida.

The transparency is somewhat affected by annual precipitation. In 2010, precipitation was the highest since 1998 and the transparency in both North and South Lida was lower (Figure 3). Transparency monitoring should be continued annually at site 208 in North Lida and 202 in South Lida in order to track water quality changes.

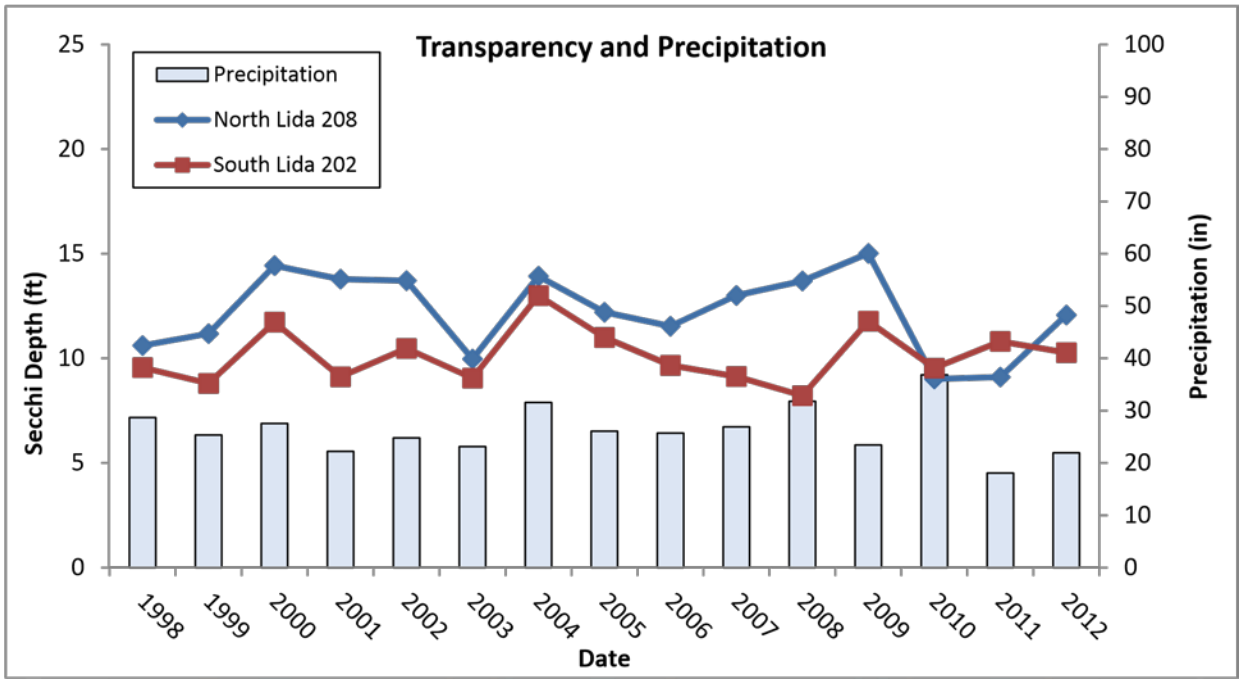


Figure 3. Annual mean transparency compared to long-term mean transparency.

Lake Lida transparency ranges from 4 to 26 ft at the primary site in North Lida (208). Figure 4 shows the seasonal transparency dynamics. The maximum Secchi reading is usually obtained in early summer. Lake Lida transparency is high in May and June, and then declines through August. The transparency then rebounds in October after fall turnover. This transparency dynamic is typical of a Minnesota lake. The dynamics have to do with algae and zooplankton population dynamics, and lake turnover.

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

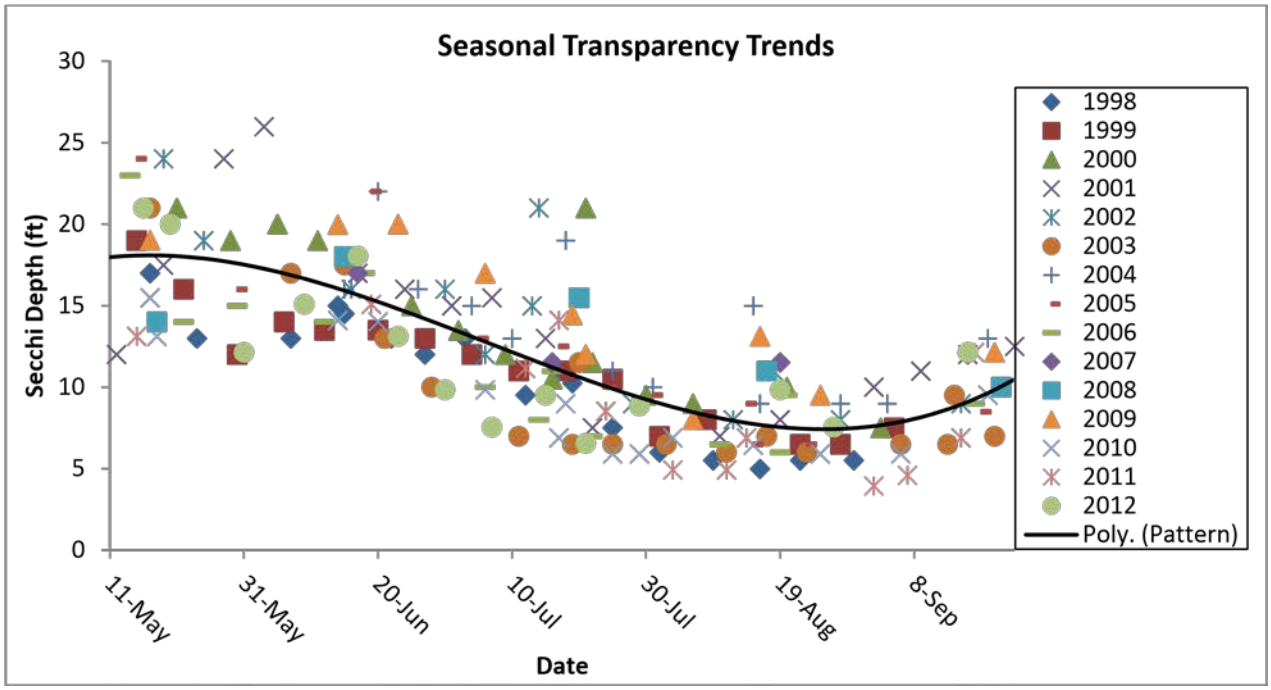


Figure 4. Seasonal transparency dynamics and year to year comparison (Primary Site 208). The black line represents the pattern in the data.

User Perceptions

When volunteers collect Secchi depth readings, they record their perceptions of the water based on the physical appearance and the recreational suitability. These perceptions can be compared to water quality parameters to see how the lake "user" would experience the lake at that time. Looking at transparency data, as the Secchi depth decreases the perception of the lake's physical appearance rating decreases. Lake Lida was rated as being either crystal clear or not quite crystal clear most of the time by samplers in 1998-2012 (Figure 5).

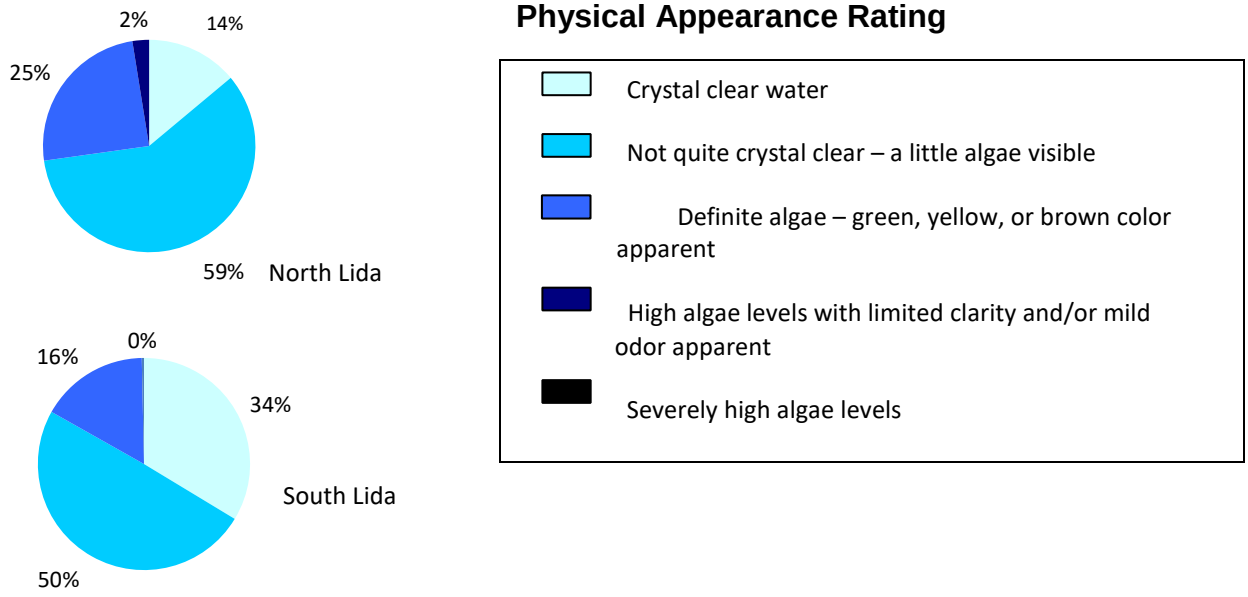


Figure 5. Lake Lida physical appearance ratings by samplers.

As the Secchi depth decreases, the perception of recreational suitability of the lake decreases. Lake Lida was rated as being "beautiful" or having just minor aesthetic problems in 1998-2012 (Figure 6).

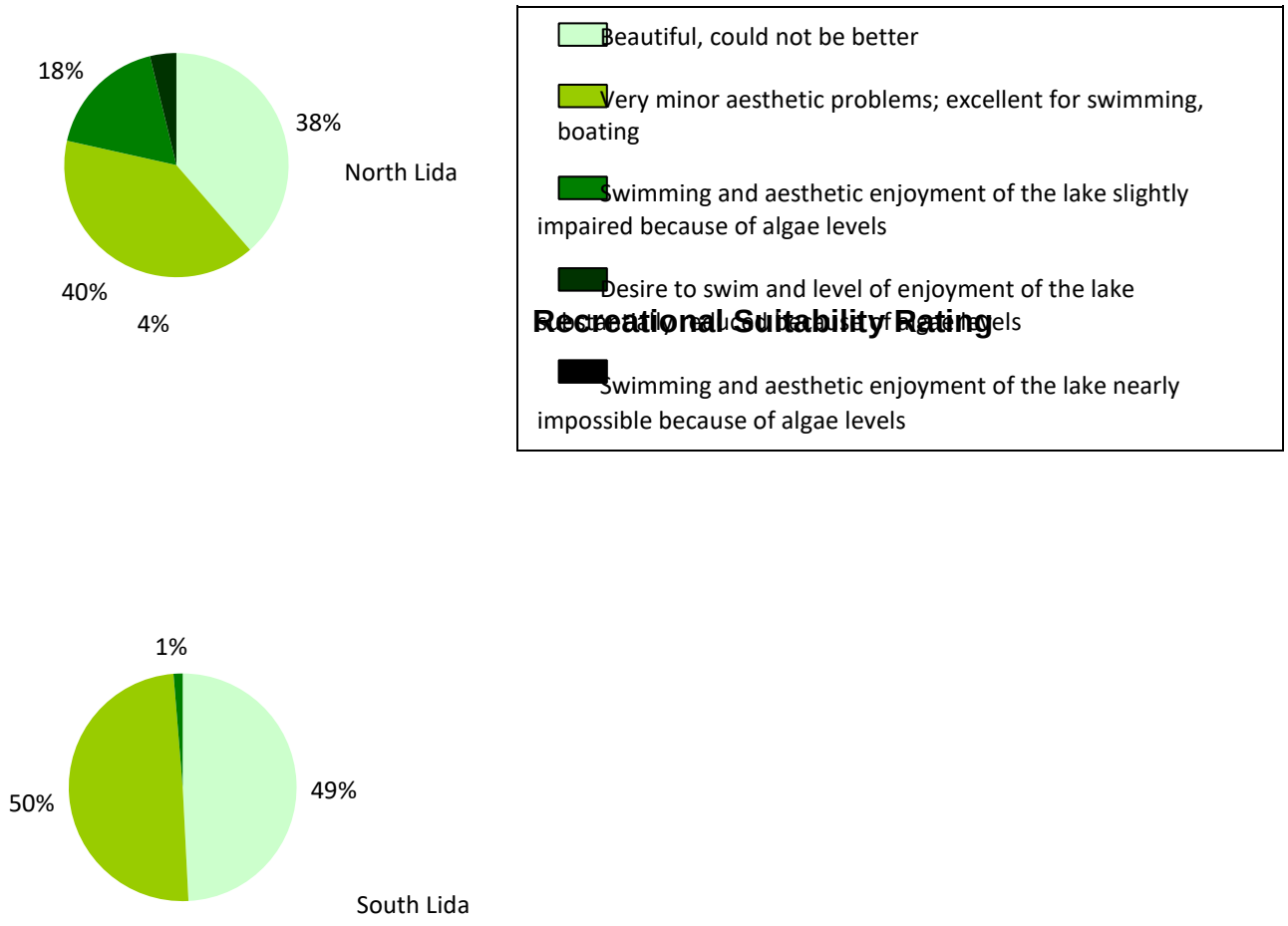


Figure 6. Recreational suitability rating, as rated by the volunteer monitor.

Total Phosphorus

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

Total phosphorus was evaluated in both North Lida and South Lida in 1998-2012.

In North Lida the majority of the data points fall into the mesotrophic range (Figure 7). There is not much of a seasonal pattern in phosphorus in North Lida.

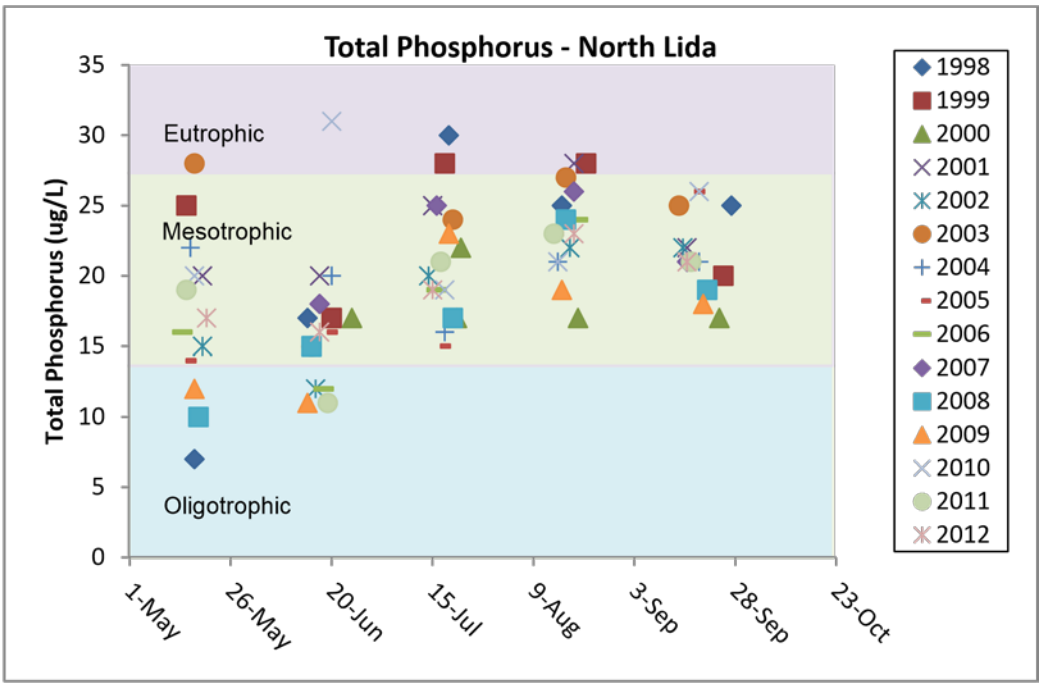


Figure 7. Historical total phosphorus concentrations (ug/L) for North Lida site 208.

In South Lida, the majority of the data points fall into the eutrophic range (Figure 8). The eutrophic nature of South Lida is most likely due to its shallow depth. The phosphorus in South Lida tends to be higher in spring and fall, which is most likely due to turnover.

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

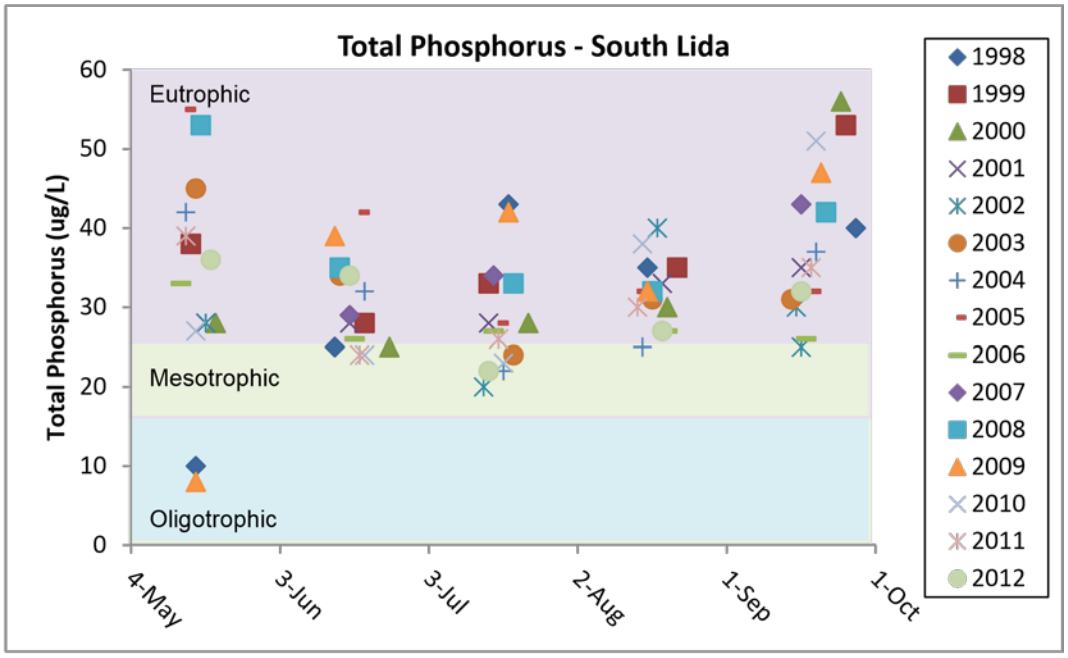


Figure 8. Historical total phosphorus concentrations (ug/L) for South Lida site 202.

Chlorophyll *a*

Chlorophyll *a* is the pigment that makes plants and algae green. Chlorophyll *a* is tested in lakes to deter mine the algae concentration or how "green" the water is.

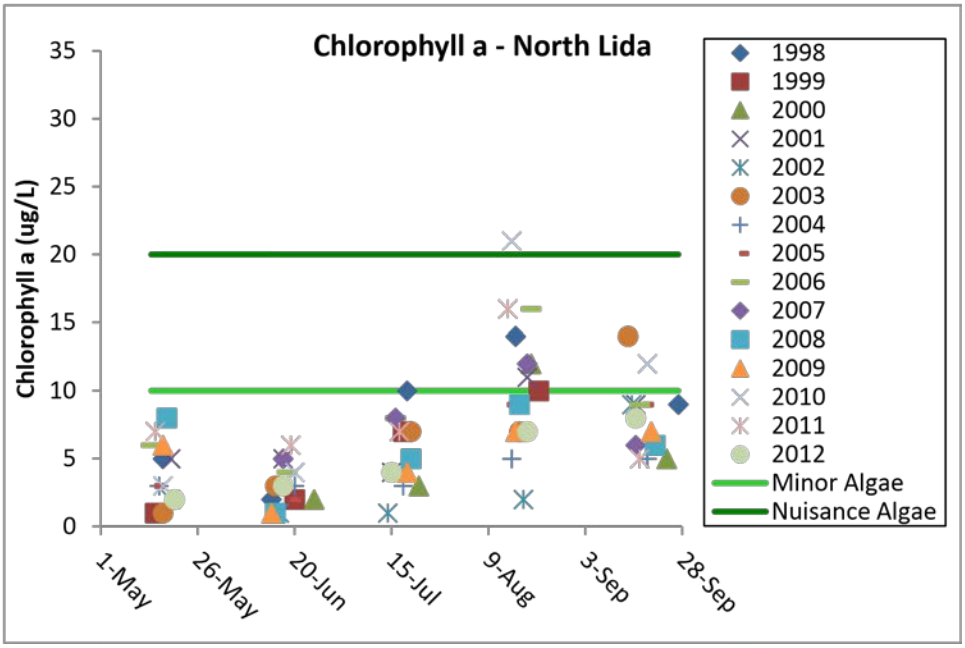


Figure 9. Chlorophyll *a* concentrations (ug/L) for North Lida at site 208.

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

Chlorophyll *a* was evaluated in Lake Lida from 1998-2012 (Figures 9-10). In North Lida, chlorophyll *a* concentrations are low in early summer and increase towards the end of summer (Figure 9). This pattern matches the transparency dynamics (Figure 4).

Chlorophyll *a* concentrations reached 10 ug/L most summers in North Lida, indicating minor algae blooms (Figure 9). In South Lida, chlorophyll a concentrations exceeded 20 ug/L in most summers, indicating nuisance algae blooms (Figure 10).

The higher algae concentration in South Lida is due to the higher phosphorus concentration (Figure 8).

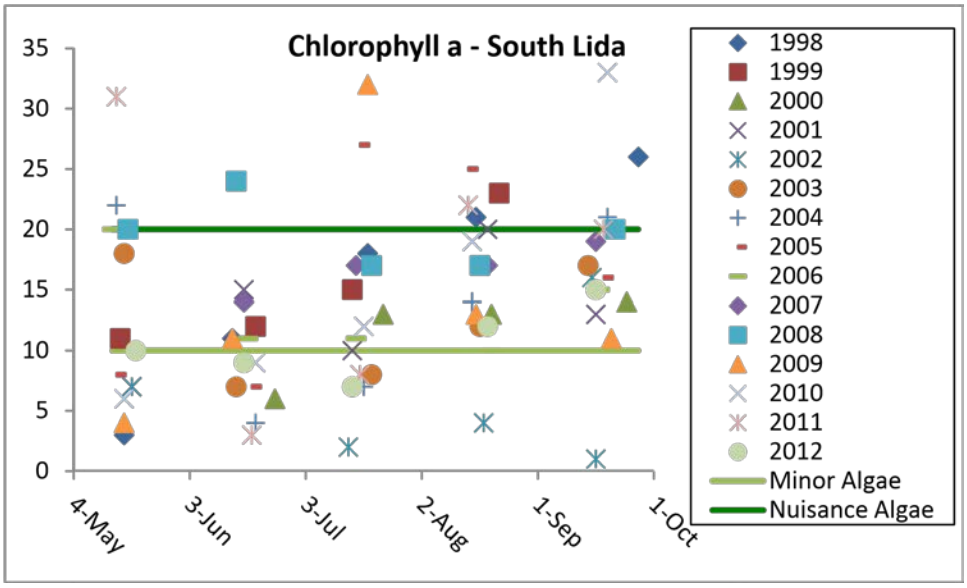
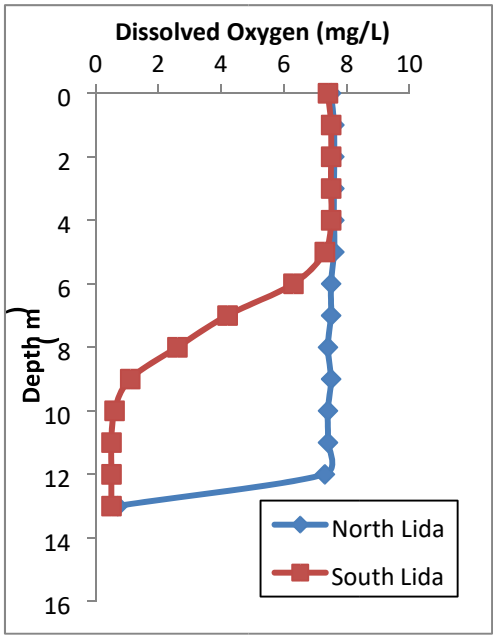


Figure 10. Chlorophyll a concentrations (ug/L) for South Lida at site 202.

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.

Lake Lida is a moderately deep lake, with a maximum depth of 58 feet in North Lida and a maximum depth of 46 feet in South Lida. Dissolved oxygen profiles from data collected on 6/12/2000 show stratification developing in South Lida, but not yet in North Lida. This is most likely because the data was collected in early summer before North Lida stratified. One would expect that North Lida stratifies as well in mid-summer. The thermocline in South Lida occurs at approximately 7 meters (23 feet), which means that gamefish will be scarce below this depth. Figure 11 is a representative dissolved oxygen profile for Lake Lida and it illustrates stratification in the summer of 2000.

Figure 11. Dissolved oxygen profile for Lake Lida.

Trophic State Index (TSI)

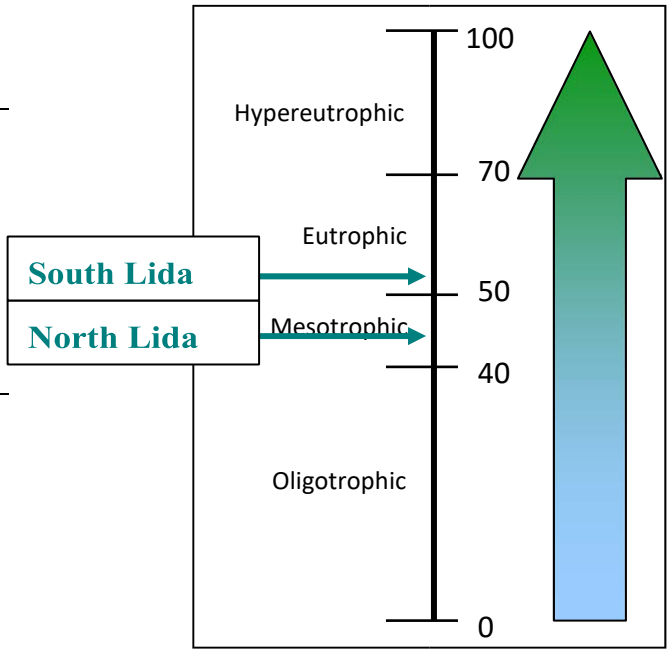
TSI is a standard measure or means for calculating the trophic status or productivity of a lake. More specifically, it is the total weight of living algae (algae biomass) in a waterbody at a specific location and time. Three variables, chlorophyll a, Secchi depth, and total phosphorus, independently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

Phosphorus (nutrients), chlorophyll *a* (algae

Table 6. Trophic State Index for Lake Lida.

Trophic State Index	North Lida	South Lida
TSI Total Phosphorus	47	54
TSI Chlorophyll-a	48	56
TSI Secchi	41	44
TSI Mean	46	52
Trophic State:	Mesotrophic	Eutrophic

Numbers represent the mean TSI for each parameter.



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. If all three TSI numbers are within a few points of each other, they are strongly related. If they are different, there are other dynamics influencing the lake's productivity, and TSI mean should not be reported for the lake.

The mean TSI falls into the mesotrophic range for North Lida and the eutrophic range for South Lida (Figure 12). In both bays the transparency TSI is lower than the phosphorus and chlorophyll a (Table 6). This could be due to larger algae cells dominating the algal community, selective grazing of smaller algal cells by zooplankton, or loss of rooted vegetation.

Figure 12. 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 wet years and dry years, water levels, weather, etc, that affect the water quality naturally.

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

Table 8. Trend analysis Lake Lida.

Lake Site	Parameter	Date Range	Trend
208 – North Lida	Total Phosphorus	1998-2012	No trend
208 – North Lida	Chlorophyll *a*	1998-2012	No trend
208 – North Lida	Transparency	1998-2012	No trend
202 – South Lida	Total Phosphorus	1998-2012	No trend
202 – South Lida	Chlorophyll *a*	1998-2012	No trend
202 – South Lida	Transparency	1998-2012	No trend

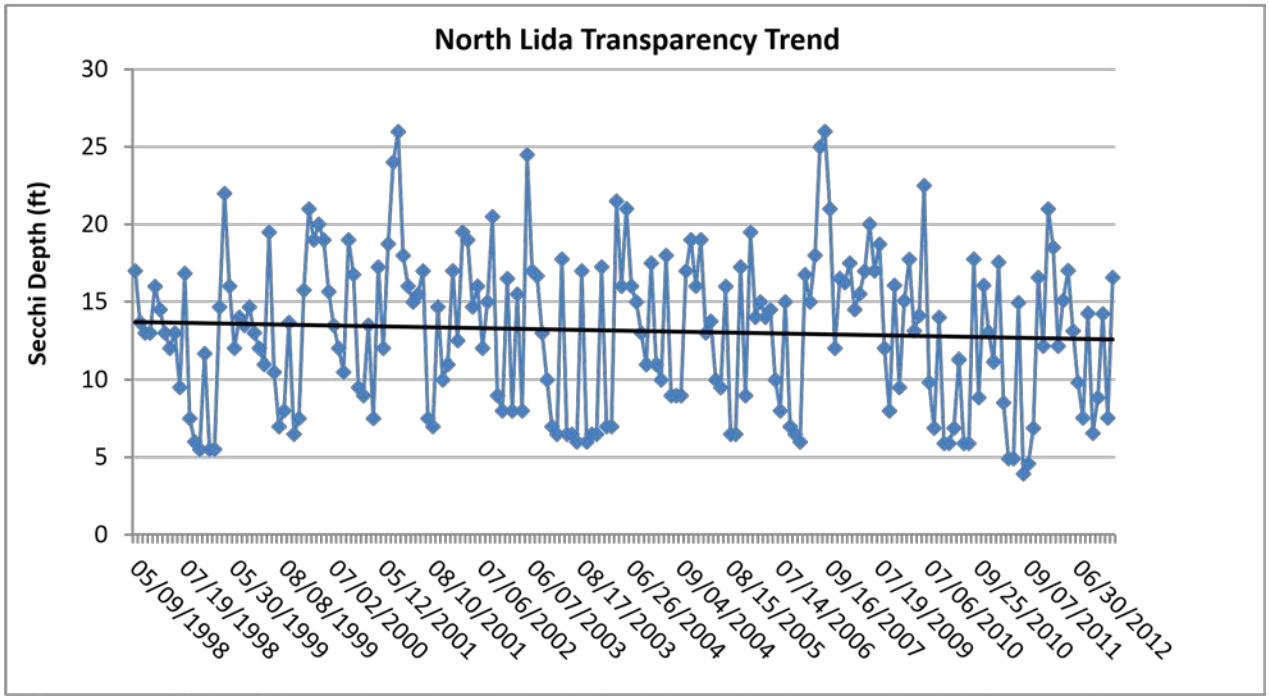


Figure 13. Transparency (feet) trend for site 208 from 1998-2012.

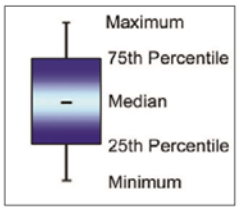
Lake Lida shows no evidence of water quality trends (Figure 13). That means that the water quality is stable. Transparency monitoring should continue so that this trend can be tracked in future years.

Ecoregion Comparisons

Minnesota is divided into 7 ecoregions based on land use, vegetation, precipitation and geology (Figure 14). The MPCA has developed a way to determine the "average range" of water quality expected for lakes in each ecoregion. From 1985-1988, the MPCA evaluated the lake water quality for reference lakes. These reference lakes are not considered pristine, but are considered to have little human impact and therefore are representative of the typical lakes within the ecoregion. The "average range" refers to the 25th

For the purpose of this graphical representation, the means of the reference lake data sets were used.

- 75th percentile range for data within each ecoregion.



Lake Lida is in the Northern Lakes and Forest Ecoregion. The mean total phosphorus, chlorophyll *a* and transparency (Secchi depth) for Lake Lida are within the ecoregion ranges (Figure 13).

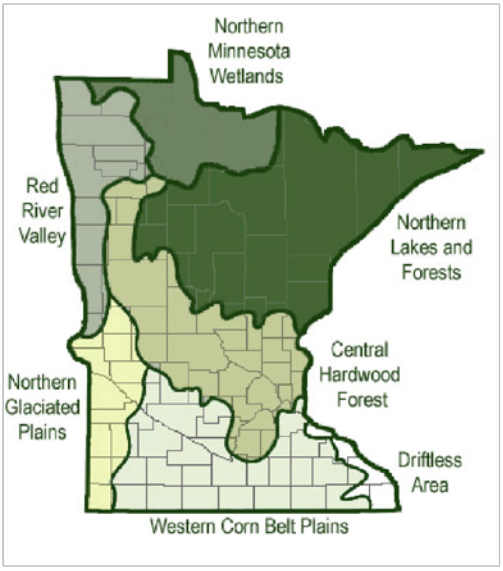


Figure 14. Minnesota Ecoregions.

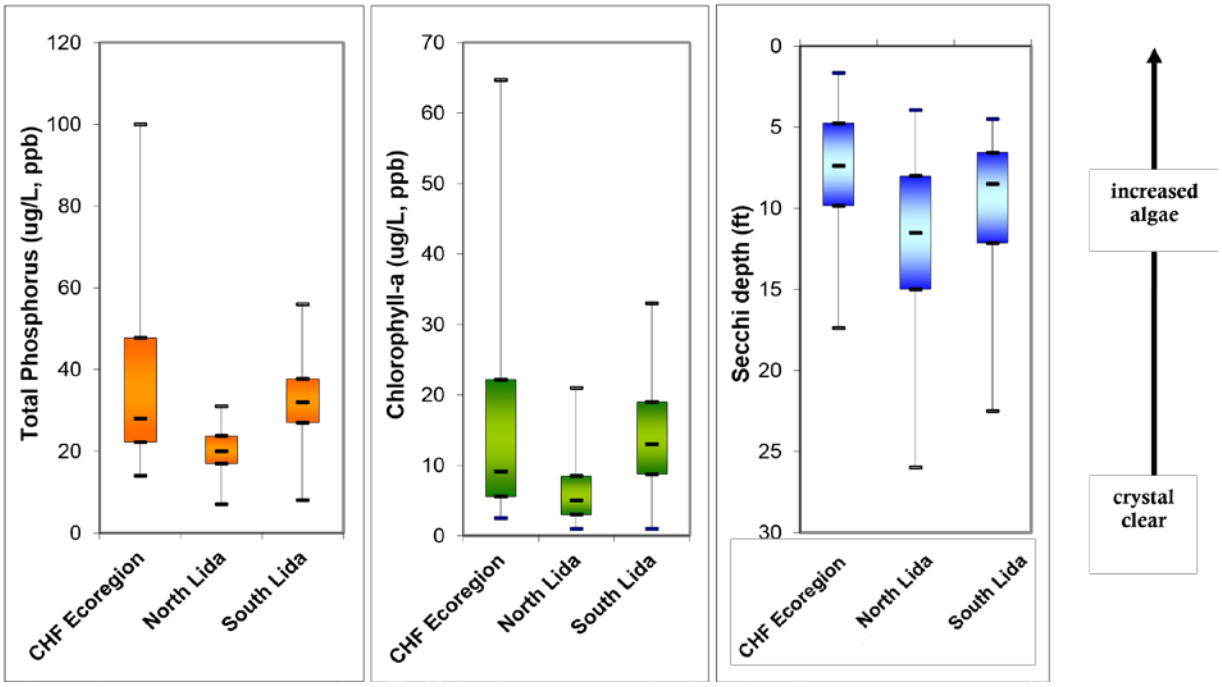


Figure 15. Lake Lida ranges compared to Northern Lakes and Forest Ecoregion ranges. The Lake Lida total phosphorus are from 74 data points while the chlorophyll *a* ranges are from 71 data points, both collected in May-September of 1998-2012. The Lake Lida Secchi depth range is from 198 data points collected in May-September of 1998-2012.

Lakeshed Data and Interpretations

Lakeshed

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

The Otter Tail River Major Watershed is one of the watersheds that make up the Red River Basin, which drains north to Lake Winnipeg (Figure 16). This major watershed is made up of 106 minor watersheds. Lake Lida is located in minor watershed 56029 (Figure 17).

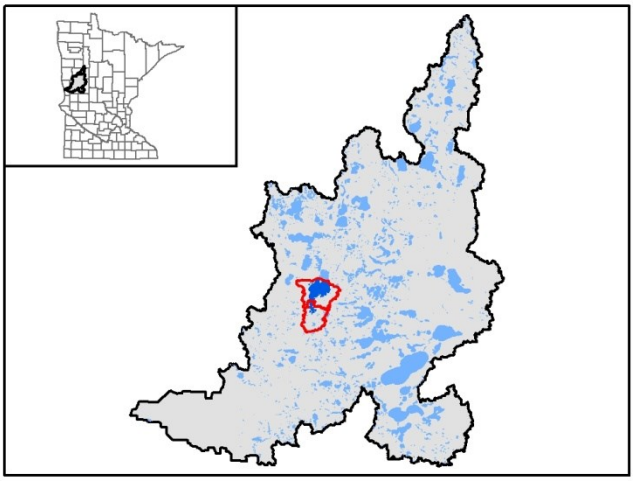


Figure 16. Otter Tail River Watershed.

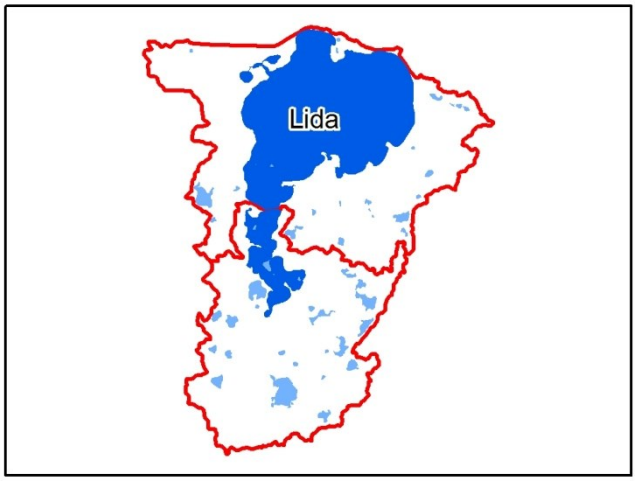


Figure 17. Minor Watershed 56029.

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. Lake Lida falls within lakeshed 5602900 & 5603000 (Figure 18). Though very useful for displaying the land and water that contribute directly to a lake, lakesheds are not always true watersheds because they may not show the water flowing into a lake from upstream streams or rivers. While some lakes may have only one or two upstream lakesheds draining into them, others may be connected to a large number of lakesheds, reflecting a larger drainage area via stream or river networks. For further discussion of Lake Lida's watershed, containing all the lakesheds upstream of the Lake Lida lakeshed, see page 19. The data interpretation of the Lake Lida lakeshed includes only the immediate lakeshed as this area is the land surface that flows directly into Lake Lida.

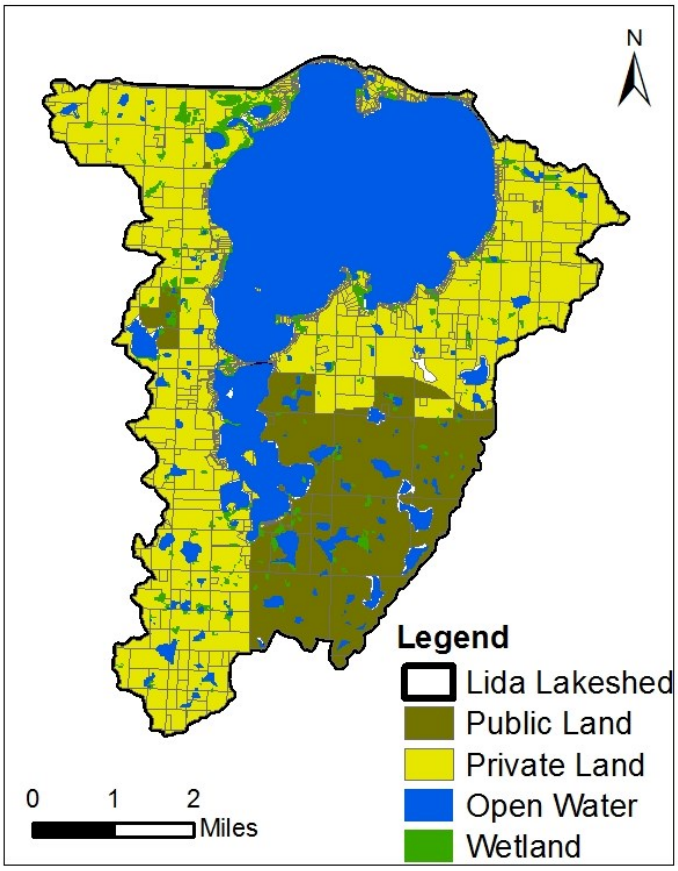


Figure 18. Lida lakesheds (5602900 & 5603000) with land ownership, lakes, wetlands, and rivers illustrated.

The lakeshed vitals table (next page) 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. Lake Lida lakeshed vitals table.

Lakeshed Vitals			Rating
Lake Area (acres)	North: 5513	South: 775	descriptive
Littoral Zone Area (acres)	North: 2380	South: 356	descriptive
Lake Max Depth (feet)	North: 58	South: 48	descriptive
Lake Mean Depth (feet)	North: 18	South: 18	
Water Residence Time (years)	North: 12.5	South: 4.5	
Miles of Stream	North: 0.5	South: 2.4	descriptive
Inlets	North: 3	South: 1	
Outlets	North: 1	South: 1	
Major Watershed	56 – Otter Tail River		descriptive
Minor Watershed	North: 56029	South: 56030	descriptive
Lakeshed	North: 5602900	South: 5603000	descriptive
Ecoregion	North Central Hardwood Forests		descriptive
Total Lakeshed to Lake Area Ratio (total lakeshed includes lake area)	North – 2:1	South – 9:1	
Standard Watershed to Lake Basin Ratio (standard watershed includes lake areas)	North – 4:1	South – 12:1	
Wetland Coverage (NWI)	North: 13%	South: 17%	
Aquatic Invasive Species	Zebra mussels, curly-leaf pondweed		
Public Drainage Ditches	None		
Public Lake Accesses	North: 1	South: 1	
Miles of Shoreline	North: 19	South: 9.3	descriptive
Shoreline Development Index	North: 1.8	South: 2.4	
Public Land to Private Land Ratio	North – 0.2:1	South – 1.1:1	
Development Classification	General Development		
Miles of Road	North: 42	South: 24	descriptive
Municipalities in lakeshed	None		
Forestry Practices	None		
Feedlots	North: 3	South: 3	
Sewage Management	Individual Subsurface Sewage Treatment Systems (The county last inspected the entire lake in 1984, however in 2011 & 2012 they did rechecks of septic systems that were 20+ years old)		
Lake Management Plan	Last updated in 2005		
Lake Vegetation Survey/Plan	DNR, 2003 & 2005		

Land Cover / Land Use

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

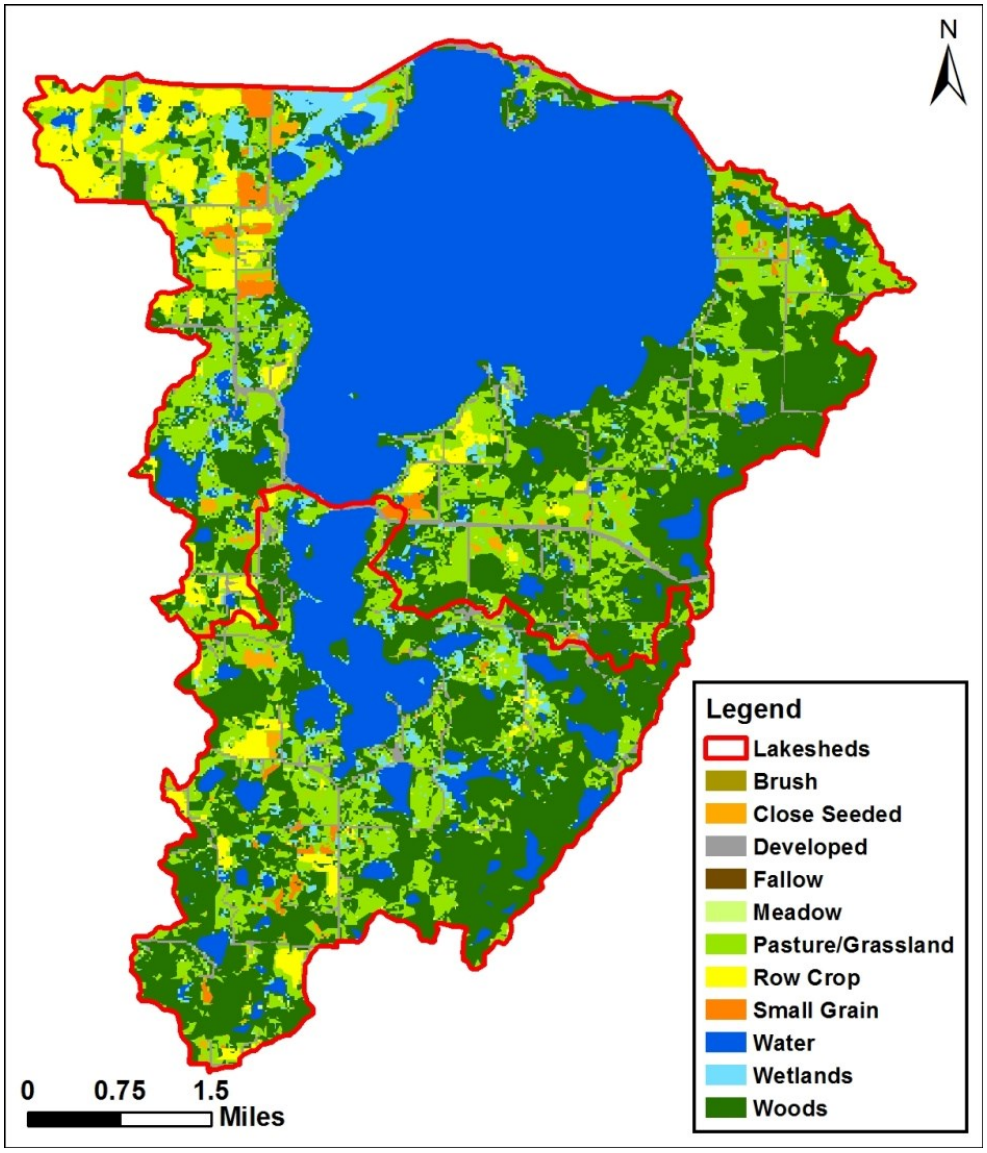


Figure 19. Lida lakeshed (5602900 & 5603000) land cover (NASS, 2012).

Changes in land use, and ultimately land cover, impact the hydrology of a lakeshed. Land cover is also directly related to the land's ability to absorb and store water rather than cause it to flow overland allowing nutrients and sediment to move towards the lowest point, typically the lake. 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). Even though the entire lakeshed has the potential to drain towards the lake, the land use occurring directly around the lakeshore will most likely have the greatest impact to the lake.

Developed land cover (Table 10) mostly describes impervious surface. In impervious areas, such as roads and houses, the land is unable to absorb water and it runs off the landscape carrying with it any nutrients or sediment in its path. The higher the impervious intensity the more area that water cannot penetrate in to the soils. Impervious areas can contribute 0.45 – 1.5 pounds of phosphorus per year in runoff. North Lida Lake has 3.85% of its lakeshed classified as developed, and South Lida has 4.23% of its lakeshed classified as developed (Tables 10-11). This doesn't sound like much area, but if it is mainly concentrated on the lakeshore, the runoff from impervious areas can run directly into the lake. Table 10. Land cover in the North Lida lakeshed

Potential Category		Specific Landcover	Acres	Percent
High	Agriculture	**Row Crop**	863.26	6.08%
High	Urban	**Developed**	545.92	3.85%
High	Agriculture	**Close Seeded**	136.58	0.96%
High	Agriculture	**Small Grain**	141.69	1.00%
High	Agriculture	**Fallow**	0.60	0.00%
Low	Forest	**Woods**	3600.42	25.38%
Low	Water	**Water**	5851.13	41.24%
Low	Agriculture	**Pasture/Grassland**	2468.31	17.40%
Low	Wetlands	**Wetlands**	504.64	3.56%
Low	Agriculture	**Meadow**	70.67	0.50%
Low	Grass/Shrub	**Brush**	4.41	0.03%
Total area with low runoff potential			12499.58	88.11%
Total area with high runoff potential			1688.05	11.89%
Total			14187.63	100.00%

Table 11. Land cover in the South Lida lakeshed.

Potential Category		Specific Landcover	Acres	Percent
High	Agriculture	**Row Crop**	201.07	2.82%
High	Urban	**Developed**	301.56	4.23%
High	Agriculture	**Close Seeded**	58.35	0.82%
High	Agriculture	**Small Grain**	58.65	0.82%
High	Agriculture	**Fallow**	0.82	0.00%
Low	Forest	**Woods**	3452.69	48.47%
Low	Water	**Water**	1296.71	18.20%
Low	Agriculture	**Pasture/Grassland**	1440.80	20.23%
Low	Wetlands	**Wetlands**	238.78	3.35%
Low	Agriculture	**Meadow**	69.04	0.97%
Low	Grass/Shrub	**Brush**	4.37	0.06%
Total area with low runoff potential			6502.38	91.28%
Total area with high runoff potential			620.45	8.70%
Total			7122.84	100.00%

Runoff

Agricultural land use has the potential to contribute nutrients to a lake through runoff, but the amount of phosphorus runoff depends on the type of agricultural land use. Generally, the highest concentration of agricultural nutrient runoff comes from animal feedlots. There are three animal feedlots in the North Lida lakeshed and three in the South Lida lakeshed (Table 9). The second highest agricultural runoff generally comes from row crops. There are some row crops along the northwest and southeast shore of North Lida, although it looks like there is some forested buffer and wetlands between the row crops and the lake (Figure 19). This buffer is important for filtering the runoff and helping it infiltrate into the ground. Pasture land has less nutrient runoff, and most likely doesn't impact the lake as much as other agricultural uses. Therefore, the statistics in Table 10 are valuable for evaluating runoff in the lakeshed. Overall, 88% of the North Lida lakeshed and 91% of the South Lida lakeshed is classified in low nutrient runoff land uses (Tables 10-11).

The University of Minnesota has online records of land cover statistics from years 1990 and 2000 (http://land.umn.edu). Although this data is 12 years old, it is the only data set that is comparable over a decade's time. In addition, a lot of lake development occurred from 1990 to 2000 when the US economy was booming. Tables 12-13 describes Lida's lakeshed land cover statistics related to development and percent change from 1990 to 2000. Due to the many factors that influence demographics, one cannot determine with certainty the projected statistics over the next 10, 20, 30+ years, but one can see the impervious area has increased, which has implications for storm water runoff into the lake. The increase in impervious area is consistent with the increase in urban acreage.

Table 12. North Lida lakeshed land cover statistics and % change from 1990 to 2000 (http://land.umn.edu).

	1990		2000		
Land Cover	**Acres**	**Percent**	**Acres**	**Percent**	**Comments**
Urban	482	3.4%	598	4.2%	Increase of 116 acres
Total Impervious Area*	88	1.05%	129	1.55%	Increase of 41 acres

*Percent Impervious Area Excludes Water Area

Table 13. South Lida lakeshed land cover s :atistics and › change from 1 990 to 2000 (ıttp://land.umn.edu).

	1990		2000		
Land Cover	**Acres**	**Percent**	**Acres**	**Percent**	**Comments**
Urban	238	3.34%	314	4.41%	Increase of 76 acres
Total Impervious Area*	29	0.49%	57	0.98%	Increase of 28 acres

*Percent Impervious Area Excludes Water Area

Demographics

Lake Lida is classified as a general development lake. General development lakes usually have more than 225 acres of water per mile of shoreline, 25 dwellings per mile of shoreline, and are more than 15 feet deep.

The Minnesota Department of Administration Geographic and Demographic Analysis Division extrapolated future population in 5year increments out to 2035. Compared to Otter Tail County as a whole, Lida and Maplewood Townships have a higher growth projection (Figures 20, 21).

(source:http://www.demography.state.mn.us/resource.html?Id=19332)

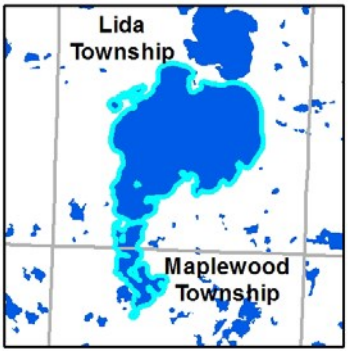


Figure 20. Lake Lida showing adjacent township boundaries.

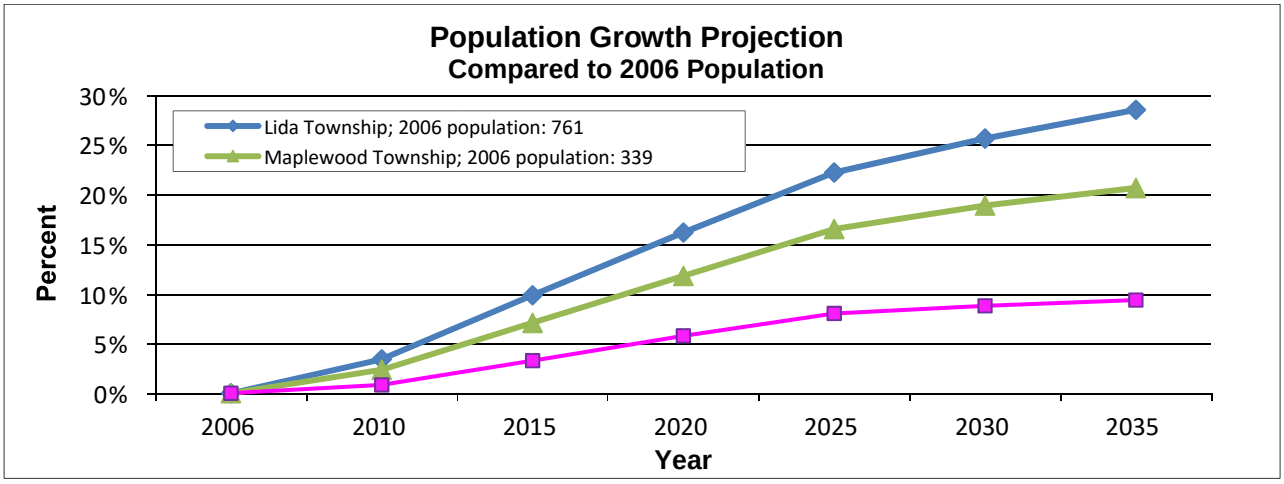


Figure 21. Population growth projection for Lida Township, Maplewood Township and Otter Tail County.

Lakeshed Water Quality Protection Strategy

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

The majority of the land within Lake Lida's lakeshed is privately owned and used for agricultural production (Tables 14-15). This land can be the focus of development and protection efforts in the lakeshed.

Table 14. North Lida Land ownership, land use/land cover, estimated phosphorus loading, and ideas for protection and restoration in the lakeshed (Sources: Otter Tail County parcel data, 2006 National Land Cover Dataset).

	Private (51%)					41%	Public (8%)		
	Developed	Agriculture	Forested Uplands	Other	Wetlands	Open Water	County	State	Federa
Land Use (%)	3.2	23	18.1	3.7	3	41	0.7	6.3	1
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	204–680	849–2940	231		36		9	81	14
Description	Focused on Shoreland	Cropland	Focus of develop-ment and protection efforts	Open, pasture, grassland, shrubland	Protected				
Potential Phase 3 Discussion Items	Shoreline restoration	Restore wetlands; CRP	Forest stewardship planning, 3rd party certifica-tion, SFIA, local woodland cooperatives		Protected by Wetland Conservation Act		County Tax Forfeit Lands	State Forest	National Forest

Table 15. South Lida Land ownership, land use/land cover, estimated phosphorus loading, and ideas for protection and restoration in the lakeshed (Sources: Otter Tail County parcel data, 2006 National Land Cover Dataset).

	Private (40%)					16%	Public (44%)		
	Developed	Agriculture	Forested Uplands	Other	Wetlands	Open Water	County	State	Federa
Land Use (%)	2.3	13.4	18	5	1.3	16	0.3	43.7	0
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	74–247	247–856	115		9		2	289	0
Description	Focused on Shoreland	Cropland	Focus of develop-ment and protection efforts	Open, pasture, grassland, shrubland	Protected				
Potential Phase 3 Discussion Items	Shoreline restoration	Restore wetlands; CRP	Forest stewardship planning, 3rd party certification, SFIA, local woodland cooperative s		Protected by Wetland Conservation Act		County Tax Forfeit Lands	State Forest	National Forest

DNR Fisheries approach for lake protection and restoration

Credit: Peter Jacobson and Michael Duval, Minnesota DNR Fisheries

In an effort to prioritize protection and restoration efforts of fishery lakes, the MN DNR has developed a ranking system by separating lakes into two categories, those needing protection and those needing restoration. Modeling by the DNR Fisheries Research Unit suggests that total phosphorus concentrations increase significantly over natural concentrations in lakes that have watershed with disturbance greater than 25%. Therefore, lakes with watersheds that have less than 25% disturbance need protection and lakes with more than 25% disturbance need restoration (Table 16). Watershed disturbance was defined as having urban, agricultural and mining land uses. Watershed protection is defined as publicly owned land or conservation easement.

Table 16. Suggested approaches for watershed protection and restoration of DNR-managed fish lakes in Minnesota.

Watershed Disturbance (%)	Watershed
< 25%	
25-60%	
> 60%	

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.

Lake Lida's lakeshed is classified with having 52.1% of the lakeshed protected and 32.8% of the lakeshed disturbed (Figure 22). Therefore, this lakeshed should have a full restoration focus. This lake is just over the 25% disturbed threshold. Goals for the lake should be to limit any increase in disturbed land use.

Figure 23 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 Lake Lida, whether through direct overland flow or through a creek or river. There are 2 lakesheds upstream of the Lake Lida lakeshed.

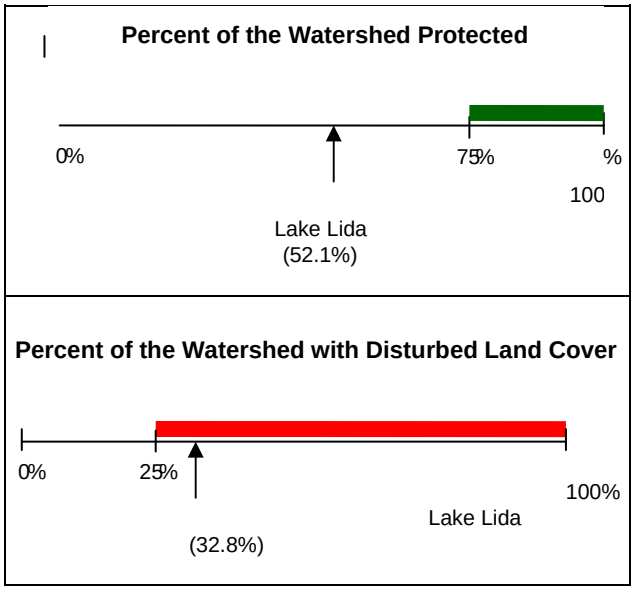


Figure 22. Lake Lida's lakeshed percentage of watershed protected and disturbed.

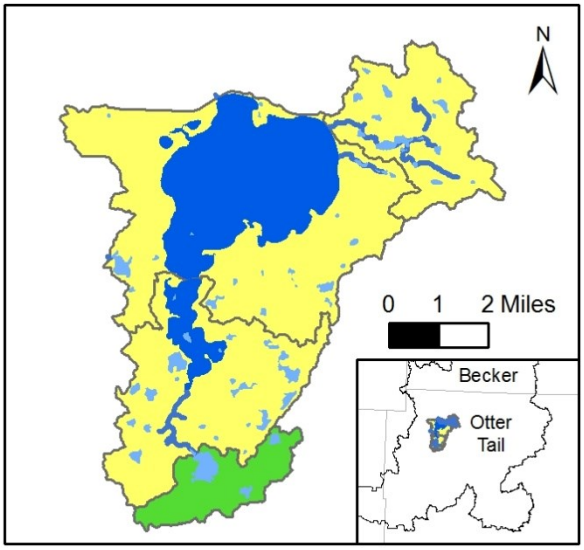


Figure 23. Upstream lakesheds that contribute water to the Lake Lida lakeshed. Color-coded based on management focus (Table 16).

Surface Runoff Analysis (East Otter Tail SWCD)

The maps below (Figures 24-27) show the different catchments that drain into Lake Lida. These catchments are delineated by land elevation, as everything drains downhill. Each catchment was evaluated for potential surface erosion. Catchments that are colored red have a relatively high potential for surface erosion and soil loss and catchments that are colored dark green have a relatively low potential for soil loss. Shoreline in red areas would be good candidates for shoreline restoration, rain gardens, grassed waterways, filter strips and other best management practices addressing overland flow and erosion. Contact the Otter Tail SWCD for help with these areas.

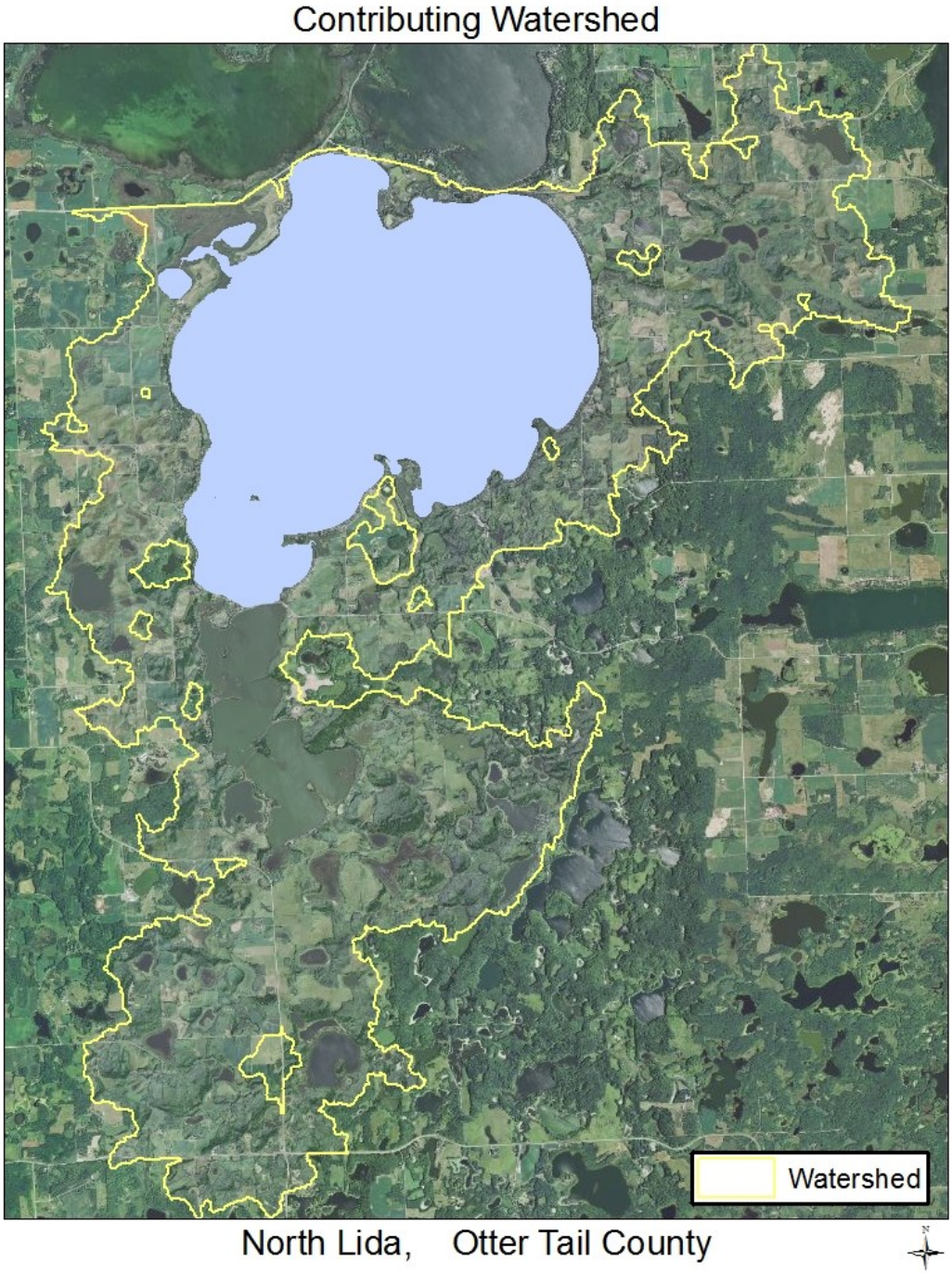


Figure 24. Contributing watershed to Lida Lake. The area inside the yellow box is all the land area that drains into North Lida Lake.

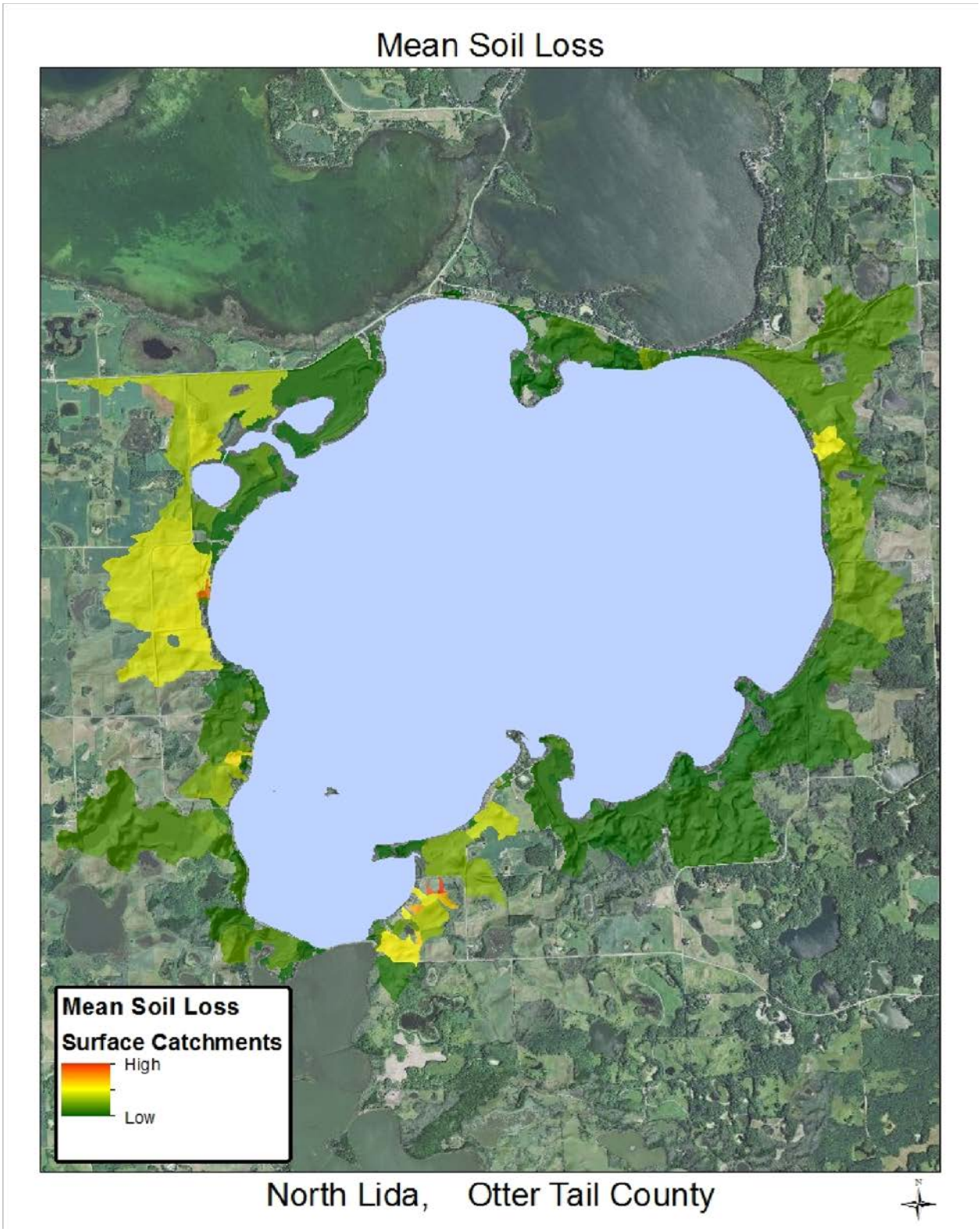


Figure 25. Potential for erosion in the surface catchments for North Lida Lake.

Figure 26. Contributing watershed for South Lida Lake. Inside the yellow box is all the land area that drains to South Lida Lake.

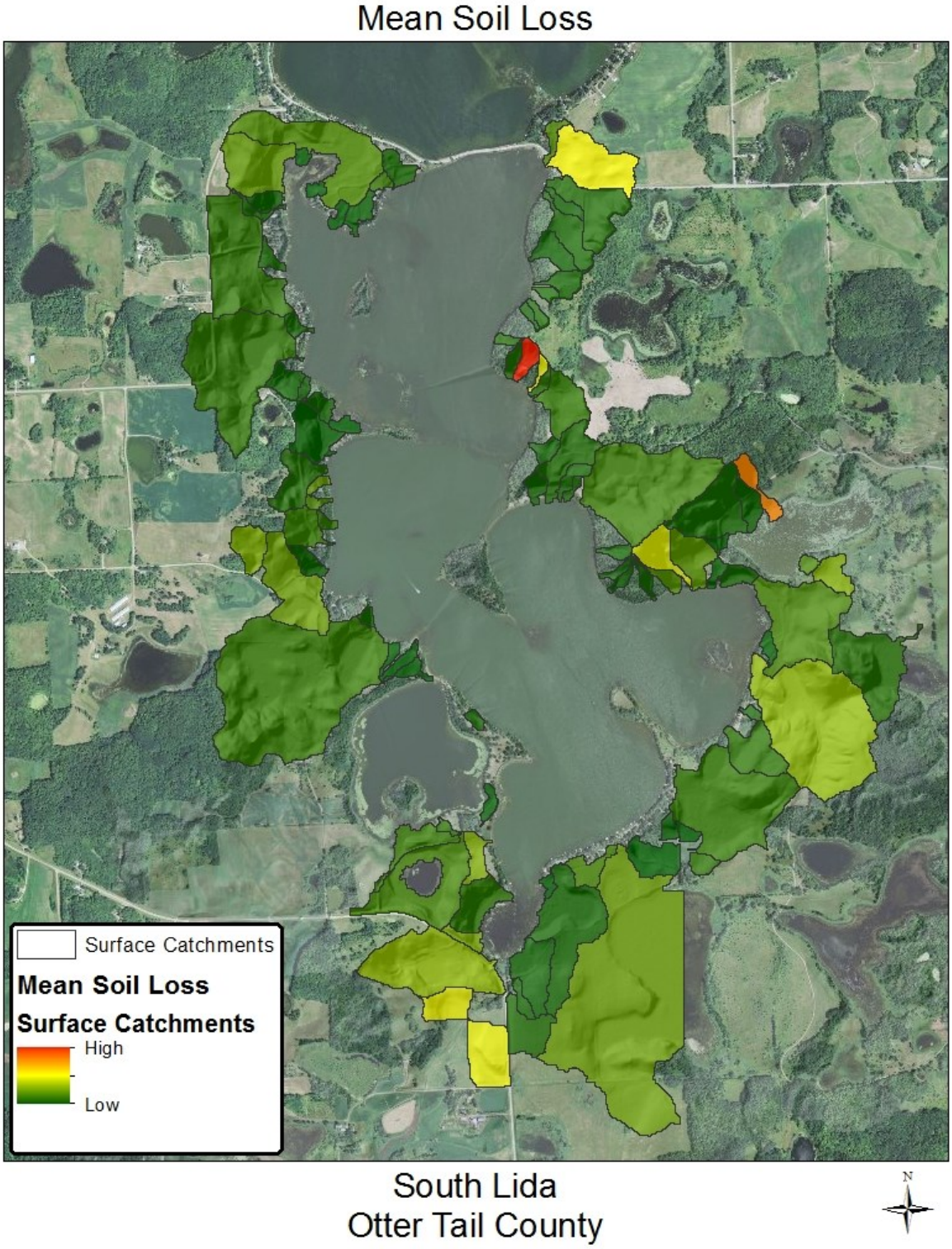


Figure 27. Potential for erosion in the surface catchments for South Lida Lake.

Status of the Fishery

North Lida, (DNR, 08/06/2009)

North Lida Lake is a 5,564-acre mesotrophic (moderately fertile) lake located in northwestern Otter

Tail County approximately five miles east of Pelican Rapids, MN. North Lida Lake is connected to

South Lida Lake by a navigable culvert under State Highway 108 along the south shoreline. North Lida Lake is also connected to Lizzie Lake via a non-navigable culvert under County Road 4. The immediate watershed is composed primarily of agricultural land interspersed with hardwood woodlots. The maximum depth is 58 feet; however, 43% of the lake is 15 feet or less in depth. The secchi disk reading during the 2012 lake survey was 6.5 feet. Previous secchi disk readings have ranged from 6.0 to 9.5 feet.

A majority of the shoreline on North Lida Lake has been developed. Homes, cottages, and resorts compose the development. A DNR owned concrete public water access is located off of County Road 4 along the north shoreline.

Large stands of hardstem bulrush are scattered throughout the lake. Emergent aquatic plants such as bulrush provide valuable fish and wildlife habitat, and are critical for maintaining good water quality. They protect shorelines and lake bottoms, and can actually absorb and break down polluting chemicals. Emergent plants provide spawning areas for fish such as northern pike, largemouth bass, and panfish. They also serve as important nursery areas for all species of fish. Because of their ecological value, emergent plants may not be removed without a DNR permit.

North Lida Lake is one of the best all-around angling lakes in Otter Tail County. Walleye, northern pike, smallmouth bass, black crappie, and bluegill are the dominant gamefish species. Data from recent lake surveys indicate that these species are abundant and have good size distributions as well.

Walleye abundance is the highest recorded for this lake. Walleyes ranged in length from 7.2 to 24.6 inches with an average length and weight of 13.7 inches and 1.2 pounds. Age and catch data indicate that the 2011 year class is very strong and should provide consistently good walleye angling for several years. Walleyes attain an average length of 14.2 inches at four years of age.

Pike abundance has remained at a moderate density and natural reproduction has continued to be consistently good. Pike ranged in length from 15.0 to 27.2 inches with an average length and weight of 20.4 inches and 1.8 pounds. Pike attain an average length of 21.8 inches at four years of age.

Age and catch data indicate that a balanced smallmouth bass population exists. Smallmouth bass ranged in length from 5.8 to 18.1 inches with an average length and weight of 12.6 inches and 1.3 pounds. Age and length data indicate that reproduction is consistently good. Smallmouth bass attain an average length of 13.8 inches at five years of age.

Data from a spring trapnetting assessment indicate that the black crappie population is very abundant and has a good size distribution. Crappies ranged in length from 2.2 to 13.0 inches with an average length of 10.3 inches. Forty-seven percent of the sample was 11.0 inches or greater in length. Crappies attain an average length of 11.4 inches at six years of age.

Age and catch data indicate that the bluegill population is very abundant and that reproduction is consistently good. Twenty-nine percent of the bluegills were 7.0 inches or greater in length. Bluegills attain an average length of 7.9 inches at seven years of age.

The DNR and the Lida Lakes Association have been involved in several cooperative projects designed to improve and protect water quality and fish habitat. In 1998, a shoreline stabilization project was completed. Rock rip-rap was used to stabilize several areas of shoreline that were experiencing varying degrees of erosion. In 1997, 160 smallmouth bass nesting structures were constructed and placed in North Lida Lake. These structures help smallmouth bass reproduce more successfully.

Harvest regulations for walleye and black crappie have been implemented on North Lida Lake. The walleye regulation is a 17.0 to 26.0 inch protected slot limit with one fish over 26.0 inches allowed in possession. The black crappie regulation is an 11-inch minimum length limit. The intent of these regulations is to improve the size structures of these populations. Anglers can also maintain the quality of angling by practicing selective harvest. Selective harvest 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 that the lake will have enough spawning age fish on an annual basis and will provide 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=56074701

South Lida, (DNR, 07/02/2012)

South Lida Lake is connected to North Lida Lake by a navigable culvert under State Highway 108 along the north shoreline of the lake. The immediate watershed is composed primarily of hardwood forest. The maximum depth is 48 feet; however, 42% of the lake is 15 feet or less in depth. The secchi disk reading during the 2012 lake survey was 7.0 feet. Previous secchi disk readings have ranged from 4.5 to

9.3 feet. The south and west shorelines of South Lida Lake have been extensively developed with homes and cabins. A majority of the east shoreline is located within the boundaries of Maplewood State Park. A DNR owned public water access is located within the state park along the southeast shoreline and a private access is located along the north shoreline. A public swimming beach and campground are also located along the east shoreline in the state park.

Large stands of hardstem bulrush and common cattail are scattered along the undeveloped sections of shoreline. Emergent aquatic plants such as bulrush and cattail provide valuable fish and wildlife habitat, and are critical for maintaining good water quality. They protect shorelines and lake bottoms, and can actually absorb and break down polluting chemicals. Emergent plants provide spawning areas for fish such as northern pike, largemouth bass, and panfish. They also serve as important nursery areas for all species of fish. Because of their ecological value, emergent plants may not be removed without a DNR permit.

South Lida Lake can be ecologically classified as a walleye-centrarchid type of lake and this is reflected in the assemblage of the fish community. Walleye, northern pike, largemouth bass, black crappie, and bluegill are the dominant gamefish species. Walleyes ranged in length from 7.4 to 28.0 inches with an average length and weight of 18.1 inches and 2.3 pounds. Age data indicate that the 2011 year class is strong and should provide good walleye angling in the future. Walleyes attain an average length of 16.5 inches at five years of age.

The general trend over recent surveys has been an increase in northern pike abundance. Age and length data indicate that pike reproduction is consistently good. Pike ranged in length from 17.5 to 34.6 inches with an average length and weight of 22.1 inches and 2.4 pounds. Pike attain an average length of 22.1 inches at four years of age.

Data from a spring trapnetting assessment indicate that black crappies are abundant and have a good size distribution. Black crappies ranged in length from 6.1 to 13.0 inches with a mean length of 10.2 inches. Thirty-seven percent of the crappies were 11.0 inches or greater in length. Crappies attain an average length of 10.6 inches at five years of age.

The bluegill population is very abundant and has a good size structure. Twenty-six percent of the bluegills were 7.0 inches or greater in length. Bluegills reach an average length of 7.9 inches at age-VI.

Harvest regulations for walleye and black crappie have been implemented on South Lida Lake. The walleye regulation is a 17.0 to 26.0 inch protected slot limit with one over 26.0 inches allowed in possession. The black crappie regulation is an 11-inch minimum length limit. The intent of these regulations is to improve the size structures of these populations. Anglers can also maintain the quality

of angling by practicing selective harvest. Selective harvest 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 that the lake will have enough spawning age fish on an annual basis and will provide 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=56074702

Key Findings / Recommendations from the RMB Laboratories Report

Monitoring Recommendations

Transparency monitoring at site 208 in North Lida and 202 in South Lida should be continued annually. It is important to continue transparency monitoring weekly or at least bimonthly every year to enable year-to-year comparisons and trend analyses. Total Phosphorus and chlorophyll *a* monitoring should continue at the same sites, as the budget allows, to track trends in water quality.

Overall Summary

North Lida is a mesotrophic lake (TSI = 46) and South Lida is a eutrophic lake (TSI =52). Both lakes have no evidence of a trend in water quality, meaning the water quality is stable. The total phosphorus, chlorophyll *a* and transparency ranges are within the ecoregion ranges.

For North Lida, only 11.9% of the lakeshed is classified as high runoff land use (Table 10). For South Lida, 44% of the lakeshed is public land, and only 8.7% of the lakeshed is classified as high runoff land use (Table 11). Almost the entire east shoreline of South Lida is bordered by Maplewood State Park, which protects it from development and vegetation loss.

The septic systems around Lake Lida should be in good working order. The county last inspected the entire lake in 1984, however in 2011 & 2012 they did rechecks of septic systems that were 20+ years old and brought them up to compliance.

The potential for erosion and soil loss into the lake appears low from Figures 24-27. There are not many red drainage areas indicated on the maps.

Even though they're in the same geographic location and have similar land use in their lakesheds, North Lida is mesotrophic and South Lida is eutrophic. The main differences between the lakes are the size, volume of water, and size of the lakeshed. North Lida has a volume of 105,716 acrefeet and a

watershed area to lake surface ratio of 3:1. South Lida has a volume of 17,976 acrefeet and a watershed area to lake surface ratio of 11:1. So South Lida has much less volume and a larger watershed than North Lida, therefore there is less water in South Lida to dilute runoff into the lake. In addition, the MPCA LAP study in 2000 concluded that South Lida retains much of the phosphorus from the inlet before it flows into North Lida. As such, the South Lida is expected to have higher concentrations of phosphorus and poorer Secchi disk readings.

Priority Impacts to the Lake

The priority impact to Lake Lida is expansion of residential housing development in the lakeshed and second tier development along the lakeshore. The majority of first tier shoreline parcels have been developed, and the majority of the current residences are seasonal (2005 Lake Management Plan). Conversion of seasonal residences to permanent residences can alter the use of the property and increase the pressure on the water quality of Lake Lida. In addition, a significant portion of properties in the second tier remain in large parcels and have not been subdivided for development; however development pressure is expected for these properties. From 1990-2000, the urban area around the lake increased by 192 acres, and the impervious area increased by 69 acres (Table 11). Second tier development in the future should be done in large lot sizes with minimal impervious surface. Once a lake is developed into the second tier, it can significantly change the drainage to the lake and funnel more nutrients directly.

Best Management Practices Recommendations

The management focus for Lake Lida should be to protect the current water quality and restore the lakeshed. This can be done by 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.

In addition, partnering with farmers in the lakeshed to implement conservation farming practices, increase shoreline buffers, restore wetlands, or place priority parcels into land retirement programs can decrease the impacts of agriculture in the lakeshed.

Native aquatic plants stabilize the lake's sediments and tie up phosphorus in their tissues. When aquatic plants are uprooted from a lake, the lake bottom is disturbed, and the phosphorus in the water column gets used by algae instead of plants. This contributes to "greener" water and more algae blooms. Protecting native aquatic plant beds will ensure a healthy lake and healthy fishery.

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)
- Conservation easements

Lake Associations

- Lake condition monitoring
- Ground truthing – visual inspection upstream on stream inlets
- Watershed mapping by a consultant
- Shoreline inventory study by a consultant
- Conservation easements

Soil and Water Conservation District (SWCD) and Natural Resources Conservation Service (NRCS)

- Shoreline restoration
- Stream buffers
- Wetland restoration

- Work with farmers to o
    - o Restore wetlands
    - o Implement conservation farming practices
    - o Land retirement programs such as Conservation Reserve Program

Aquatic Invasive Species

Zebra mussels were found in Lake Lida in 2013. Zebra mussels have the potential to affect water quality by filtering out algae and clearing out the water column. This can result in increased transparency. Increased transparency can allow rooted plants to grow in deeper areas of the lake than previously found. In addition, the removal of plankton in the water column can affect the food chain.

Curly-leaf pondweed was documented in Lake Lida during a 2005 DNR aquatic plant survey. Curly-leaf pondweed is usually the first aquatic plant to get established in the lake in early spring and then it dies off in late June to early July. At its peak growth, curly-leaf pondweed can form mats on the surface that can interfere with boating and other recreational activities. When the plant dies off, it releases phosphorus into the water column. This phosphorus can cause algae blooms. When you see mats of dead curly-leaf pondweed floating on the lakes surface in late June, it is best to remove them from the lake, which will remove some of the phosphorus. Curlyleaf pondweed can be successfully managed by aquatic herbicidal treatment by a hired professional.

Organizational contacts and reference sites

Lake Lida Property Owners Association
http://www.lakelida.com/news/

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
East 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

Areas of aquatic vegetation have been mapped by Otter Tail County and are shown on ***Figure Thirteen (A and B)***. Due to the shallowness of the bay areas, there is abundant aquatic vegetation located around the shoreline of Lida Lakes. This vegetation acts not only as a buffer for incoming nutrients, it also provides habitat for waterfowl, fish, and small aquatic mammals such as muskrats. Macro invertebrates such as mayflies have a safe place to hatch, providing food for fish, thus providing a "food chain" that exists in a healthy ecosystem. This vegetation includes cattails, hardstem bulrush, arrowhead, and a variety of sedges. This "good" vegetation is crucial to a healthy lake system.

Buffers along the shoreline including upland vegetation are rapidly deteriorating. The upland buffer is as important as the aquatic for habitat, and more important for filtering out nutrients before they enter the lake. It also solidifies the shoreline, decreasing the likelihood of erosion. This is nature's way of stabilizing the banks surrounding the lake.

North Lida dwellings and Emergent Aquatic Vegetation

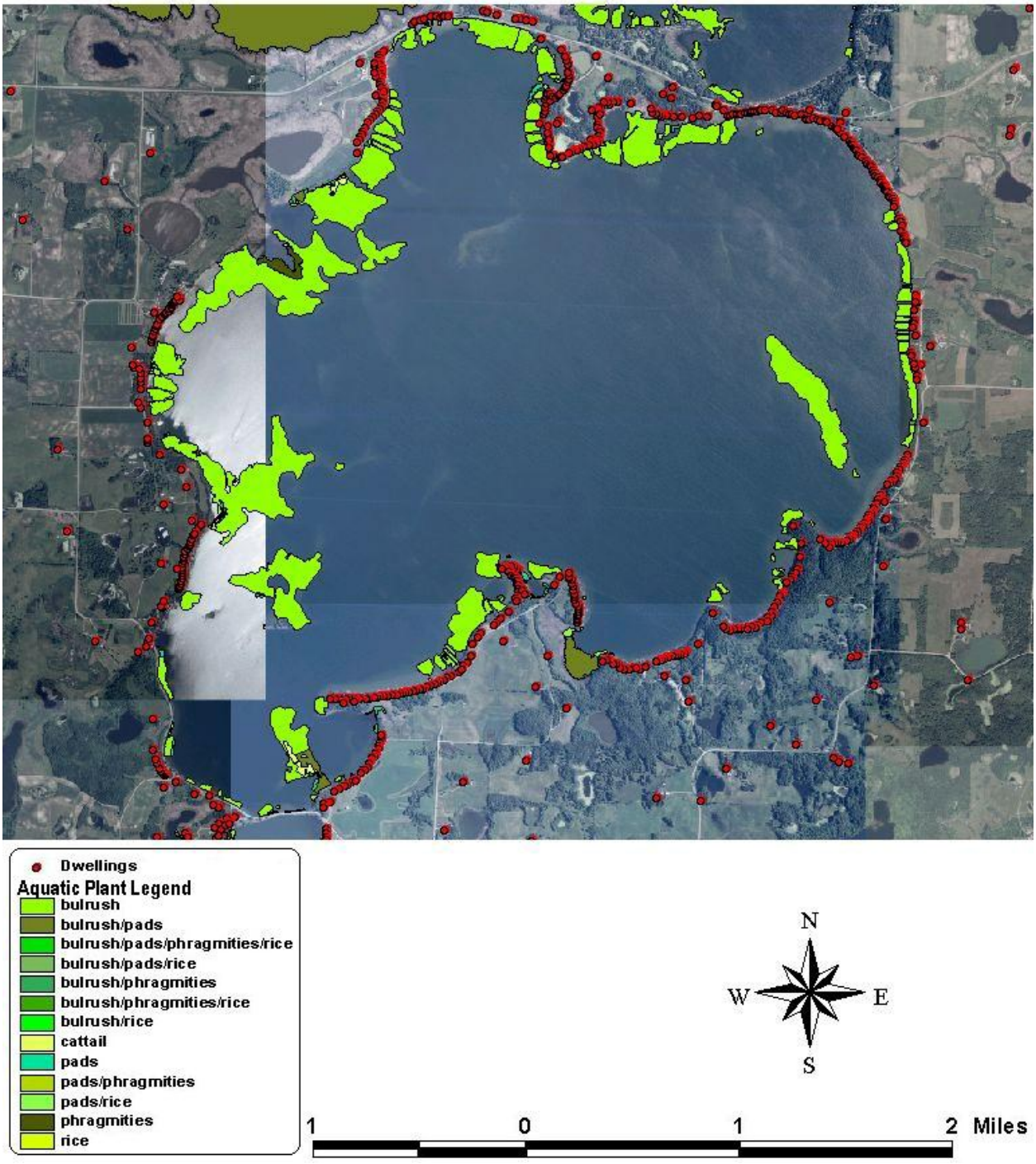


Figure 13A

South Lida Lake dwellings and Emergent Aquatic Vegetation

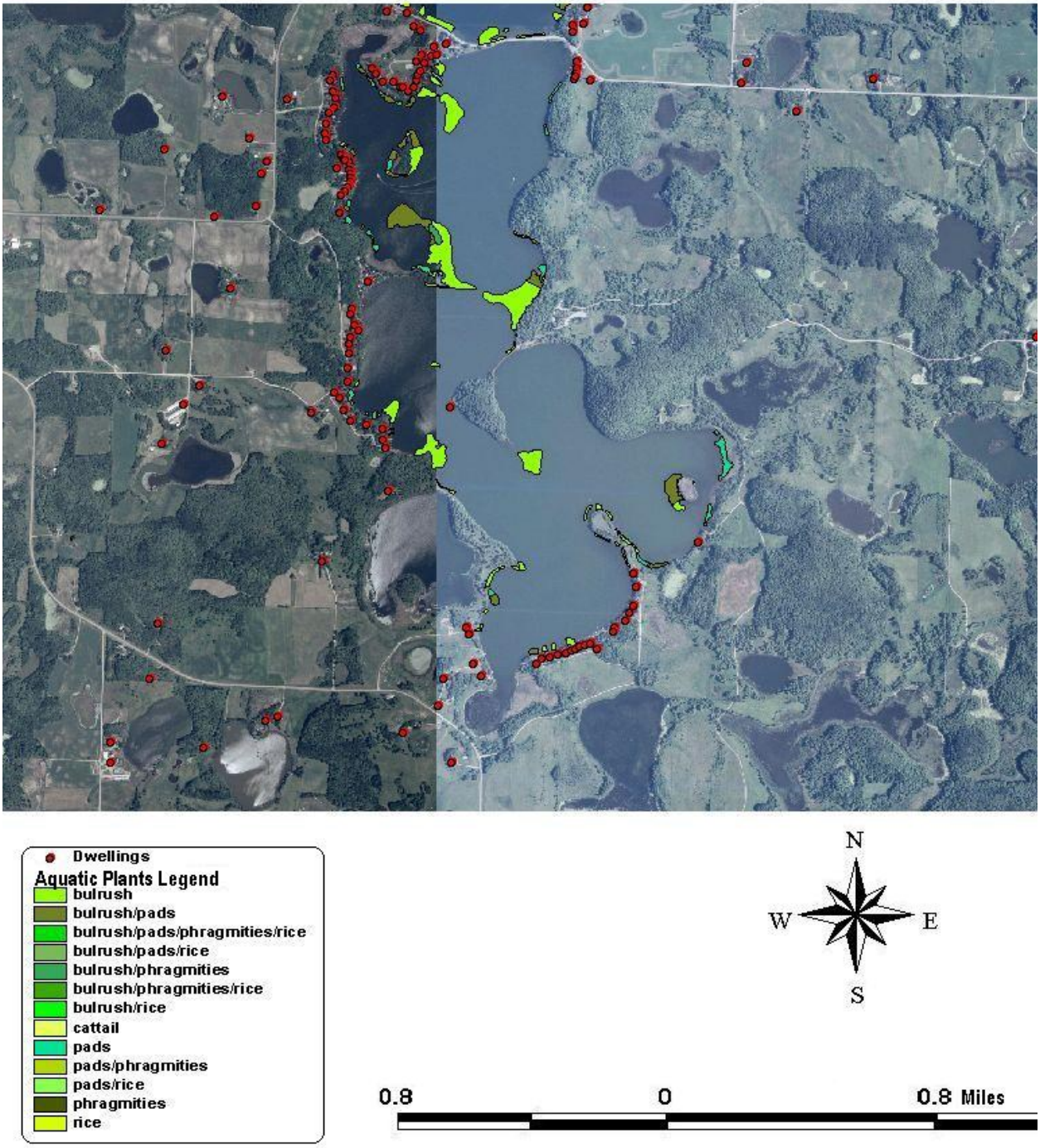


Figure 13B

Exotic Species

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.

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 sedges along the

shoreline provide both feeding and nesting areas for wildlife. Loons 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. There are more than fifteen loon-nesting sites on these lakes.

Various species of Canada geese, egrets, blue herons, green heron, gulls, pelicans and cormorants are common on the lake. Bluebills, Mallard, Wood duck teal golden eye, and wild turkey have also been seen. Bald Eagles are known to nest within the shoreland area. Trumpeter Swans, Golden Eagles and Osprey migrate through the area.

Mammals noted include deer, skunk, raccoon, mink, beaver, and muskrat Black bears, coyotes, fox and a cougar with cubs has been spotted in Maplewood Park. Otters have been seen in the South Lida area. These animals exist where habitat makes it possible.

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 Lida Lakes, the Area Wildlife Manager is Don Schultz, 1509 1st Avenue North, in Fergus Falls. Phone: (218) 739-7576. Email: don.schultz@dnr.state.mn.us.

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 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."

6. Land Use and zoning

The water quality of a lake or river is ultimately a reflection of the land uses within its watershed. Martin County Soil and Water Conservation District recognizes the multiple areas that impact water health including residential development, agriculture and shoreline management. The Martin County Local Water Plan was created by the SWCD in partnership with Martin County Planning and Zoning 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 East 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 East 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.

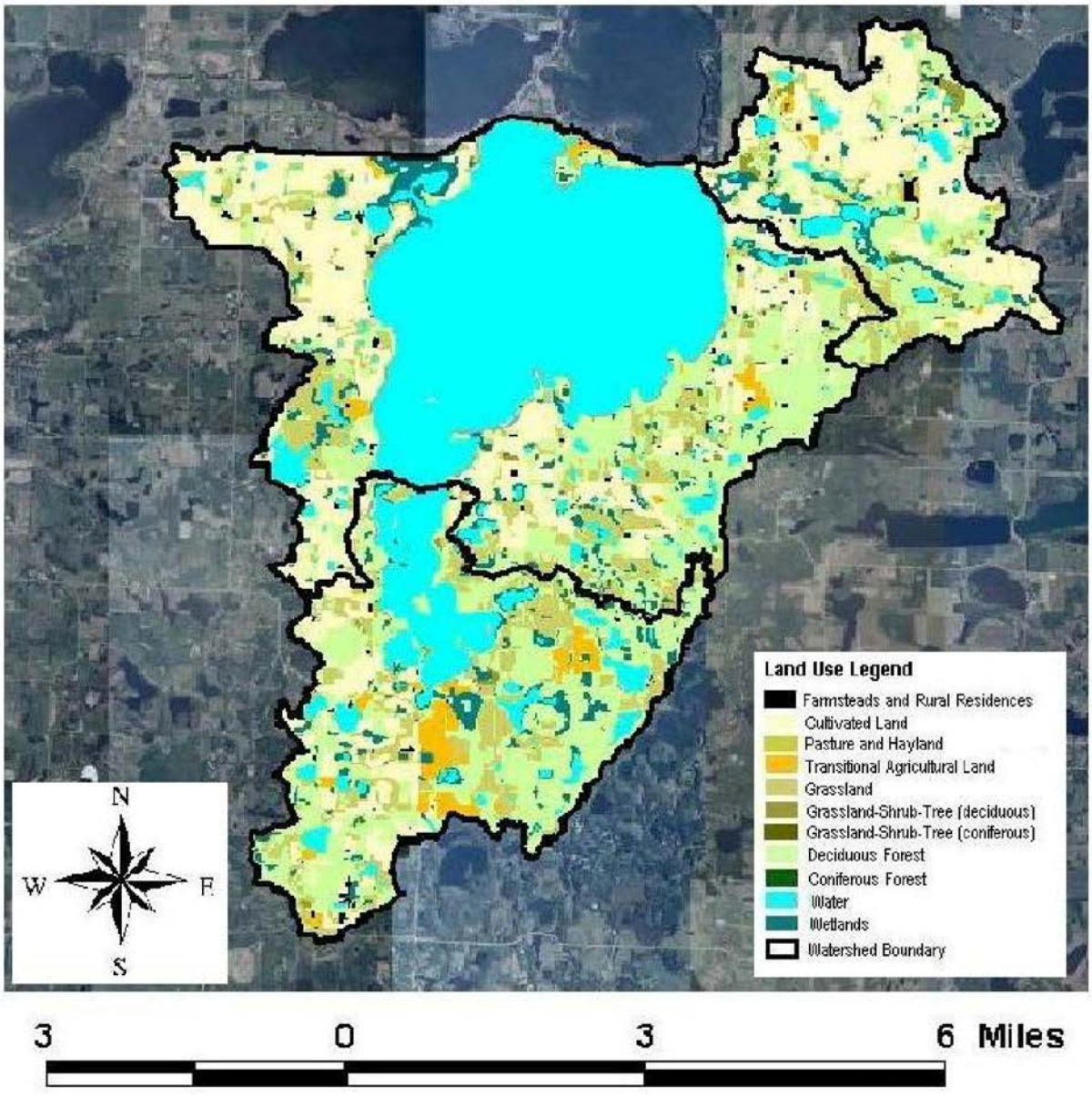
- **Education Promotion**

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.

Landuse within the Lakeshed

Lida Lake



Lake Lida is classified by Otter Tail County as a General Development Lake.

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 Lake Lida. The Otter Tail County Zoning staff can determine the zoning district and the specific regulations that apply to your property.

	General Development (Lake Lida)
Structure Setback from OHWL	75 ft
Water Frontage/Lot Width	100 ft
Lot Area*	20,000 ft²
Buildable Area	8,400 ft²
Sewage Treatment Area	2,500 ft²

Please Note: Shoreline ordinances are subject to change. The Otter Tail County Land and Resource Management Department can give us updates.

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.

Additional 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

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 are two public access points on Lake Lida.

Organizational Development and Communication

NOTES AND OUTCOMES OF THE VISIONING PROCESS

Summary of Visioning/Planning Session

Lake Lida hosted an inclusive community planning/visioning session designed to identify key community concerns, assets, opportunities, and priorities. The Lake Lida Property Owners Association held this planning session on Friday, June 10, facilitated by Jen Kader. Approximately 40 people were in attendance. Details of the public input received at this session are provided within this plan.

The final chapter of our lake management plan summarizes the conclusions and priority action we have chosen to work on at this time. Specifically, for each priority action we have down our best to answer (<u>for each goal presented</u>):

- What are the criteria for measuring success (measured as outcomes, not effort)?
- What is our schedule for implementation (What needs to happen in the next 30 days, 60 days, one-year out)?
- Who is responsible for implementation or measurement (name names!)?
- What is the budget for this action/goal?
- Is this an ongoing action/goal, or a one-time effort? If on-going will we require additional funds for full implementation?

Following this format, the remaining pages identify our top priorities, what our goals for each priority are, and how, who, and when we will implement action for each of these priorities.

Process: The Lake Lida Property Owner's Association Lake Management planning process of addressing priorities has included the following actions based on the issues identified by the attendees of the Visioning session:

- Organizational Growth;
- Water Quality;
- Lake Use; &
- Water Supply.

Organizational Growth: The group would like to see enhanced communication with (and within) the community around the lake, and increased capacity to take on the projects that will be written into the lake management plan. This can include social opportunities that can be used to promote the activities and accomplishments of the Lake Association to garner support. Improving communication will also assist in the engagement of membership and in the successful implementation of this plan.

The group also suggested enhanced communication to educate property owners of best practices for improving and sustaining the water quality of the lake.

Increased communication can also benefit our relationships with government bodies, the coordination of committees pursuing action plan items and our progress to becoming a LID (Lake Improvement District).

It may seem odd to put garbage service under organizational growth, but many feel that the Lake Association should provide this service periodically to clean up the properties and refuse to join the LLPOA unless they decide to fund it.

Water quality: This was the lengthiest category, and has a good deal of variation. While we have good data, there is a good understanding that there is a need for research to really understand what is going on.

Weeds is a major concern and an example of the need for further information before we can address the issue. While there is an immediate desire to address the weeds in the lake, those weeds are likely there due at least in part to an excess of nutrients. A management plan that only addresses the weeds will lead to even higher nutrient levels, and the problem will never go away (or, it could create an environment where an invasive aquatic plant could dominate). Education will be instrumental in developing an action plan for the weed situation.

Also, since fishing is an important asset to the community, we need to ensure that the management of aquatic plants doesn't cause issues for fish habitat. It is important to work with the SWCD to identify the proper course of action regarding in-lake plant control.

What we do know is that installing shoreline and rain gardens and mowing less (less area and less frequency) can improve water quality, so this is something that can be implemented in the form of education and communication to the shoreline property owners.

While we determine the impact of the livestock and farmland in close proximity to the lakes, we can begin forging relationships with the farmers in the watershed.

Other action items discussed were educating and encouraging buffers, erosion and shoreline stabilization, runoff from watershed, the culvert over the state highway, nutrient levels and the water level.

There has also been expressed a desire to address the zebra mussels infestation, though many feel that since they are already in Lake Lida, there's not much we can do. Keeping up to date with the latest research and property owner education could have a positive impact on the situation.

Lake Use: Several of the identified themes from the visioning session can be combined to reflect a larger area of work that still has manageable work areas and tangible outcomes. The action plan in this category will likely focus on identifying maintenance and management solutions, as well as communicating with lake users information on everything from water quality to aquatic invasive species to rules around jet skis and speed boats. In addition, those who work on this category will want to pass on information about shorelines being impacted by waves, and the importance of minding your wake.

Access maintenance was also discussed as a need to improve and increase lake use as well as education at access (ranging from slot limit to wake impact to laws and common courtesies when using jet skis and speed boats).

Management of the lake for sustainable fishing was identified as a priority. In regard to the slot limit, there was lots of discrepancy about what should be done ranging from finding out what can be done to eliminate it, to changing it to keeping it as is.

Water Supply: While this issue wasn't a top priority, there does appear to be a strong desire to look into the option of rural water, or investigate rural water as opposed to well water.

In order to respond to the priorities listed above, the lake association needs to increase involvement of property owners, work with the proper organizations and agencies and increase education and communication to and with the shoreline lake owners.

At this time, funding is not a concern, the Lake Association is healthy financially, but increasing membership and explicitly, increasing the contact information of the membership will be key in accomplishing the issues identified.

Prioritized Goals and Action Plan

PRIORITY ISSUE: WATER QUALITY

Water Quality Goal:

Improve water quality of North and South Lida Lakes through education, decrease of runoff, wetland restorations, compliant ISTS, and more visible vegetation along the shoreline.

Water Quality Objectives:

Objective A: Continue the collection of data for future water clarity protection.

Action

1. Review past water quality testing within lake to determine trends. Develop educational visuals for annual meeting and post on website for property owners & Facebook page regarding the results.

   Timeline: 2017
   Agency (Who): LLPOA
   Cost: Cost of WQ monitoring ($1000/yr); Hire analyst & designer for materials ($1000)

2. Conduct a survey of shoreline status. Photos will be taken of existing shoreline to be utilized for determination of existing vegetation, future reference on developments, assessment of existing erosion problems and to determine need for increased education of residents.

   Timeline: Summer 2017
   Agency (Who): LLPOA / Intern / GIS
   Cost: Cost TBD for mapping, cost TBD for intern

3. Work with WOTSWCD to establish program to correlate lake level monitoring with rain gauge data.

   Timeline: 2017 and ongoing
   Agency (Who): LLPOA, WOTSWCD
   Cost: TBD

4. Inventory the lakeshed area for culverts, intermittent inlets and exposed soil areas and prioritize for their potential to reach the lake. Work with WOTSWCD and landowner to vegetate these areas.

   Timeline: 2018-2019
   Agency (Who): LLPOA, WOTSWCD
   Cost: Cost TBD for Intern

5. Map and prioritize restorable wetlands within the lakeshed of North and South Lida Lakes for water quality benefits.

Timeline: 2017-2018
Agency (Who): LLPOA, WOTSWCD, GIS, DU, USFWS
Cost: Agency Time

Objective B: Ten percent of un-vegetated shoreline will be returned to its native state.

Action

1. Educate lakeshore residents in the benefits of lakescaping. Present workshop through the Minnesota Extension Services. Make educational materials on Water Quality management available to members. Supply articles about the benefits in the lake association website.

Timeline: 2017-2018
Agency (Who): LLPOA, Extension
Cost: $100 for supplies

2. Provide information and incentive about the DNR Shoreland Habitat restoration grants and Lake Lida Association grants to residents along North and South Lida Lakes shoreline. Encourage both in-lake and upland plantings of native vegetation to decrease erosion into the lake and improve both water quality and habitat. Recognize participants at annual meeting and in newsletter and on the website.

Timeline: 2017 and ongoing
Agency (Who): LLPOA, DNR Wildlife Section
Cost: Dependant on funds available and landowner requests.

Objective C: Address the need for weed control.

1. Send Lake Lida Board member to Aquatic Species Summit, fall 2017, for education to share with the Board.
    a. **Timeline:** Fall 2017 attendance, spring 2018 share recommendations with Board
    b. **Agency (Who):** LLPOA
    c. **Cost:** $400
2. Develop a Committee to develop and implement plan.
    a. **Timeline:** Fall 2018
    b. **Agency (Who):** LLPOA
    c. **Cost:** Up to $100 for meeting expenses

PRIORITY ISSUE: ORGANIZATIONAL GROWTH

Community Goal:

Enhance sense of community among property owners within the lakeshed of North and South Lida Lakes. Increase engagement of property owners in Association and implementation of this Plan.

Community Objectives:

Objective A: Increase membership in LLPOA to 450 by 2019 and engagement of membership.

Action

1. Create a membership drive and collect email addresses of lakeshed members. Hire someone to solicit beaches with no Beach Captain.
    a. **Timeline:** 2017 and ongoing
    b. **Agency (Who):** LLPOA
    c. **Cost:** Dependent on Beach Captain vacancies.
2. Supply information to members such as: lists of government agencies and how to contact them, ISTS maintenance handbooks, and various brochures available for distribution through Beach Captains. Keep membership informed of current issues through a spring newsletter – include all non-members in the newsletter mailing with list of "perks" for members.
    a. **Timeline:** Spring 2018
    b. **Agency (Who):** LLPOA, Extension, MPCA, DNR
    c. **Cost:** Up to $500 per year if needed
3. Determine interest in having a lake clean-up day. Rent a large dumpster and allow all residents within the lakeshed to bring junk. Encourage owners of "junk-strewn" properties to participate and offer assistance in clean up. Encourage membership during contact.
    a. **Timeline:** 2018
    b. **Agency (Who):** LLPOA
    c. **Cost:** $6000 plus
4. Update Lake Lida Directory. Place updated directory on website for access by membership. Distribute hard copies as requested.
    a. **Timeline:** 2017
    b. **Agency (Who):** LLPOA, hired graphic artist
    c. **Cost:** Approximately $4,000 depending on number of ads secured
5. Utilize the publication Institute for Conservation Leadership's publication, *Benchmarking Your Organization's Development.*
    a. **Timeline:** 2017
    b. **Agency (Who):** LLPOA
    c. **Cost:** n/a

Objective B: Investigate viability and support of becoming a Lake Improvement District.

1. Recruit three to five members to become educated on what a LID is, the benefits to becoming a LID and the requirements to become a LID and share the information with LLPOA members at Annual Meeting, 2017.
    a. **Timeline:** July 2017
    b. **Agency (who):** LLPOA
    c. **Cost**: n/a

PRIORITY ISSUE: LAKE USE

Objective A: Educate lake property owners and general public regarding recreational use of lake/rules and regulations.

2. Set up committee to determine need & message and mode of communication.
    a. **Timeline:** Summer, 2018
    b. **Agency (Who):** LLPOA, DNR
    c. **Cost:** TBD

Objective B: Investigate pros and cons of advocating to change the slot limit and viability of implementing change.

1. Set up committee to investigate pros and cons of advocating a change in the slot limit and share findings with membership at the Annual Meeting.
    a. **Timeline:** Spring 2017, Summer 2017
    b. **Agency (Who):** DNR, LLPOA
    c. **Cost:** n/a

9. Organizational Development and Communication

III. Summary/Conclusion

Revisiting this plan

This plan is designed to be relevant for only 3-5 years. In fact, at least every 5 years, you should plan to engage in an update process. Issues change, people change, and resources change, so this plan should change, too! If you've been effective in building and maintaining relationships with your local resource experts, all you will really need to do to update this plan is the following:

1. Review your plan
    a. Make sure your membership and leadership remember the purpose of the plan (especially useful for new members)
    b. What has changed in the lake and lakeshed based on new data?
        i. Contact your resource experts for updated data if you do not have it
        ii. Review new data for changes in status or trends
    c. What is the status of the action plans
        i. Are the action plans still relevant?
        ii. If you were not successful, why? (These can help you as you identify obstacles in the new action plans)
2. Identify your new action plans
    a. Hold a community visioning session
    b. Identify your new priority issues or opportunity your group wants to work on
    c. Research new funding opportunities
    d. Draft your new action plans
3. Update the full document, 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