Lake Management Plan

For

Big McDonald Lake

Restoration of a Buffer Zone Using Native Plants

Photo by the Minnesota DNR

Big McDonald Lake Improvement District 2017

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Section 1: Overview

Aerial Photo of Big McDonald Lake Taken by Rob Campbell with his Drone

A. Letter from BMLID President regarding the Lake Management Planning Process

In late 2015, the Big McDonald Lake 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 of the Freshwater Society, with strong support from Darrin Newman of 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, attended the training sessions in order to offer their assistance to each group in developing their strategic Lake Management Plans. The Big McDonald Lake Association was represented at the Healthy Lakes and Rivers Partnership training sessions by Craig Johnson and Tim Spiess.

Following the training sessions, each lake association held an inclusive community planning/visioning session designed to identify key community concerns, assets, opportunities, and priorities. The Big McDonald Lake Association held this planning session on August 13, 2016, facilitated by Jen Kader. Approximately 50 people were in attendance, with about 15% of the participants describing themselves as year-round residents. 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 Big McDonald Lake 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," updated 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 we 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 thank the Legislative-Citizen Commission on Minnesota Resources who, through the Environment and Natural Resources Trust Fund, made this round of the program possible.

Donald Beck

Chairman of the Big McDonald Lake Improvement District (BMLID)

B. Plan Structure

The purpose of this Lake Management Plan is to provide an agreed upon set of strategies and actions BMLID can take to address issues relating to Big McDonald Lake, 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 plan, laying out the overarching issues Big McDonald Lake and the BMLID face, what are the implications of these issues for the lake and group, and what the next steps are. 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 BMLID 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 BMLID;
- RMB Environmental 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 following focus areas:
    - Aquatic Vegetation;
    - Wildlife;
    - Exotic Species;
    - Land Use and Zoning;
    - Public Water Access; and
    - 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 BMLID 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: Appendix

This section contains a glossary of terms, list of common biological or chemical abbreviations, guide to common acronyms, and supporting documents.

C. Executive Summary

Introduction

Big McDonald Lake is located in Otter Tail County near Dent, MN. The initial organization that oversaw lake issues was the Big McDonald Lake Association. It was established by Keith and Lynne Brokke in 1996 for the purposes of lake management.

The Big McDonald Lake Association was comprised of 120 lakeshore property owners (dues were $30/year). Events organized included an annual summer get together, fish stocking, water testing through COLA, and 4th of July boat parade.

The association transitioned to the Big McDonald Lake Improvement District (BMLID)under the direction of the then lake association president Roger Fenstad. The BMLID was officially established under Minnesota Statute 103B.501, approved by the Board of Otter Tail County Commissioners, and adopted on November 6, 2012. Currently the BMLID is organized as a taxing entity and has over 140 lakeshore property owners with an annual budget of $18,000 in 2017. We believe that we have put together a lake management plan that can be implemented and actively managed by all lake residents to conserve the lake resource for future generations.

Section 2: Plan Detail

A. History and Purpose of Big McDonald Lake Association and The Big McDonald Lake Improvement District

Big McDonald Lake Association

Keith Brokke was approached by Big Pine Lake and Paul Lake Association presidents to attend a COLA meeting in April 1996. At the meeting he learned that Big McDonald residents needed to form a lake association to qualify for annual water testing through COLA. Keith and his wife, Lynne, sent flyers to residents on Big McDonald and had a preliminary meeting at their home on Memorial Day 1996 to discuss the benefits of lake monitoring and to establish a lake association.

The first year the Big McDonald Lake Association meeting was held on a late afternoon. The association found that very few people wanted to attend a late afternoon meeting. Since then meetings were held at 9:00 am, giving door prizes along with coffee and pastries, which attracted people to the Big McDonald Lake Association meetings. Average attendance now is approximately 50% of lakeshore property owners.

Representatives from East Otter Tail Soil & Water Conservation District (EOT-SWCD), MN DNR, MN Fisheries, Otter Tail County Sheriff's Department, Perham Ambulance, Fresh Water Society, and others have spoken at Big McDonald Lake Association meetings.

The Big McDonald Lake Association was successful in bringing residents together to discuss community issues and to socialize once a year for 20 years. The Big McDonald Lake Improvement District (BMLID) was the next necessary step forward to address emerging lake issues. The BMLID gives the group taxing authority, which can provide financial resources to address needs as they arise.

The Bylaws for the Big McDonald Lake Association are as follows:

BYLAWS of Big McDonald Lake Association

ARTICLE I: NAME

Section I: The name of this organization shall be the **Big McDonald Lake Association.**

ARTICLE II: PURPOSE

Section I: The Association shall monitor and promote the maintenance and protection of the environment, economic and recreational properties of Big McDonald Lake and vicinity.

Section II: The Association shall work in conjunction with federal, state and local agencies, public and private, to maintain the quality of the lake.

Section III: The Association shall develop a program for the promotion of stocking Big McDonald Lake.

Section IV: The Association shall provide educational resources relating to the protection and quality of Big McDonald Lake area and its wildlife.

Section V: The Association shall inform the general membership of civil concerns relating to the purposes of the Association.

Section VI: The Association shall be a nonprofit, non-stock organization.

ARTICLE III: MEMBERSHIP

Section I: Membership shall be open to all interested parties who own property on, or a back lot to, Big McDonald Lake and who share a concern for the purposes of the Association.

Section II: Associate Membership shall be open to any interested parties who share a concern for the purposes of the Association; however, voting privileges will not be extended to Associate Members. Dues for Associate Members will be the same as for the general membership.

ARTICLE IV: DUES

Section I: Initial membership fee shall be $10 for general membership.

Section II: Annual dues shall be $20 for general membership. Annual dues shall be payable no later than July 31st of the current fiscal year to remain a voting member in good standing with the Association.

ARTICLE V: OFFICERS

Section I: The officers of the Association shall be President, Vice President, Secretary and Treasurer. There will also be 9 Directors from various areas around the lake with one Director appointed "At Large."

Section II: The immediate Past President shall serve on the Board of Directors as a voting member and to advise the Board for one year after his/her term as President expires.

Section III: Duties:

A: The President shall preside at all annual, board and special meetings of the Association and shall represent the Association at all official functions.

B. The Vice President shall, in the absence of the President, fulfill the duties of the President. Further, the Vice President shall fulfill other duties as designated by the President, the Board, or the general membership.

C. The Secretary shall record and maintain the minutes of all annual, board, and special meetings of the Association and shall manage all routine correspondence of the Association.

D. The Treasurer shall maintain all revenues of the Association and shall dispense expenditures as designated by the Board or the general membership.

1) The Treasurer shall be bonded at the expense of the Association (only if deemed necessary).

2) The Treasurer shall present a yearly report of income and expenditures at the annual meeting of the Association.

E. Board members shall fulfill all duties as directed by the President, Board of Directors, or the general membership.

Section IV: Term of Office:

A: Officers (President, Vice President, Secretary and Treasurer) shall serve a term of two years and shall be elected at the annual meeting by a simple majority.

B. Directors shall serve a three-year term and shall be elected at the annual meeting by a simple majority or may be appointed by the President.

C. An individual may not serve more than two consecutive terms in the same office.

D. The terms of Officers will be staggered so that every other year, one-half of the Officers will be replaced or re-elected to a second term.

E. The terms of Directors will be staggered so that 3 of the 9 Directors are replaced or re-elected each year.

ARTICLE VI: MEETINGS

Section I: The Association general membership shall meet annually on the second Saturday in June. The actual date and location will be posted by Directors for the area they represent.

Section II: The Board of Directors shall meet at least two weeks prior to the annual meeting to set the agenda for the annual meeting. The Board will meet again in the fall each year.

Section III: Special meetings may be called at the discretion of the Board of Directors or the request of the general membership.

ARTICLE VII: ADDRESS

Section I: The Association shall maintain a post office box in Dent, MN 56528.

ARTICLE VIII: VOTING AND QUORUM

Section I: Each paid membership is entitled to one (1) vote.

Section II: Proxy votes, in writing or preauthorized, shall be allowed.

Section III: A quorum shall consist of twenty-five percent (25%) of the general membership in attendance and voting, including allowable proxy votes.

Section IV: For the purposes of Board meetings, a quorum shall consist of seven (7) of the thirteen (13) Board members in attendance and voting, including allowable proxy votes.

ARTICLE IX: PARLIAMENTARY PROCEDURE

Section I: All meetings of the Association and the Board of Directors shall be conducted with *Robert's Rules of Order*, unless otherwise specified by these bylaws.

ARTICLE X: SUSPENSION OF THE BYLAWS

Section I: These bylaws may be suspended by a two-thirds vote of the majority of the general membership and two-thirds of the Board of Directors, present and voting for emergency situations only.

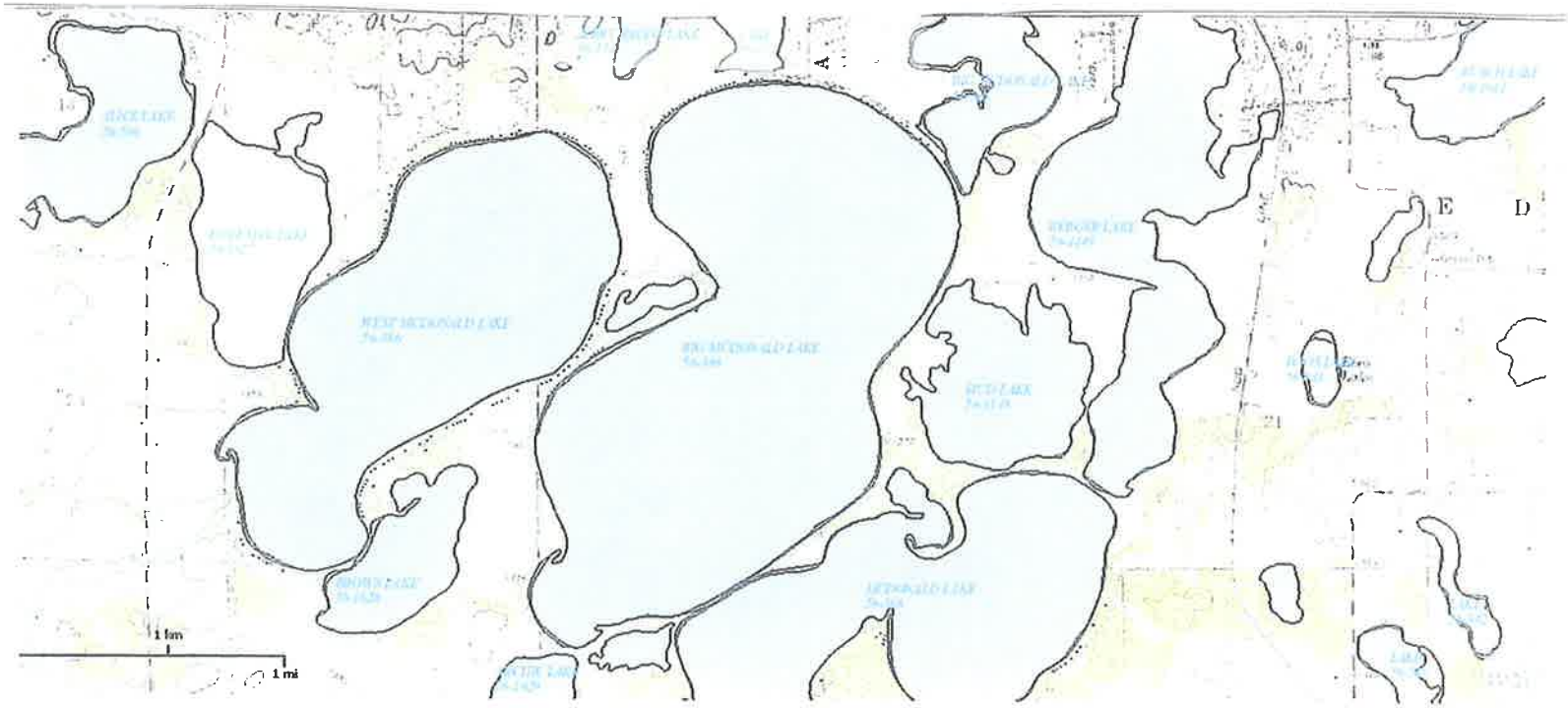
The Big McDonald Lake Association, at the time of this Lake Management Plan, is no longer active. Its purposes and responsibilities were assumed by the Big McDonald Lake Improvement District (BMLID) when it was established in 2012.

Big McDonald Lake Improvement District (BMLID)

The BMLID was discussed for several years. At the request of a large majority of the property owners of Big McDonald Lake, the Otter Tail County Board of County Commissioners established the BMLID on November 6, 2012. The BMLID is a nonprofit organization subject to county, state, and federal laws.

The first BMLID Board of Directors was appointed by the Otter Tail County Commission in July 2013. On July 14, 2013, the Board had its first organizational meeting. The first annual meeting for the BMLID was held on Saturday, August 10, 2013. At that meeting the by-laws were approved along with the first budget. A copy of the by-laws is attached.

The purpose of the BMLID is to protect and preserve the lake, and to increase and enhance the use and enjoyment of the lake. It is in the public interest that a lake improvement program is established to preserve the natural character of the lake and the shoreland environment, fish and wildlife populations, and where feasible and practical, to improve the quality of the water in the lake, to help maintain a reasonable water level in the lake, and to help protect the lake from detrimental effects of human activities and certain natural processes. The BMLID represents 100% of the shoreland around the lake.



GIS Map of Big McDonald Lake and Immediate Environs with Shoreline Highlighted by Otter Tail County

BYLAWS of the Big McDonald Lake Improvement District

ARTICLE 1: ESTABLISHMENT

Establishment under Minnesota Statute Section 103B.501 by the Ottertail County Board of County Commissioners Resolution No. 2012-47 and its order establishing the Ottertail County Big McDonald Lake Improvement District, adopted November 6, 2012, and filed with the Minnesota Office of the Secretary of State, Minnesota Pollution Control Agency, and the Minnesota Department of Natural Resources.

ARTICLE 2: NAME OF DISTRICT

The name of the organization is Big McDonald Lake Improvement District, herein after referred to as the BMLID.

ARTICLE 3: DEFINITION OF THE BIG MCDONALD LAKE IMPROVEMENT DISTRICT (BMLID)

The BMLID is a nonprofit organization subject to county, state, and federal laws.

ARTICLE 4: PURPOSE

The purpose of the BMLID is to protect and preserve the lake, and to increase and enhance the use and enjoyment of the lake. It is in the public interest that a lake improvement program is established to preserve the natural character of the lake and the shore land environment, fish and wildlife populations, and, where feasible and practical, to improve the quality of water in the lake, to help maintain a reasonable water level in the lake, and to help protect the lake from detrimental effects of human activities and certain natural processes.

The following water-related land and resource management programs and services may be undertaken by the BMLID:

a. Develop and implement a comprehensive plan to improve water quality;

b. Apply for private and public grants or enter into contracts with federal or state agencies for the study and treatment of pollution problems and related programs;

c. Enter into contracts with private contractors for the above;

d. Undertake research to determine the condition and development of the body of water included within the LID and to transmit the studies to the DNR, MPCA and other interested authorities;

e. Make cooperative agreements with federal, state, county or city to effectuate water and related land resource programs;

f. Conduct programs of water improvement and conservation;

g. Serve as local sponsor for state and federal projects or grants;

h. Regulate water surface elevation as deemed necessary and reasonable;

i. Implement a water monitoring system; or

j. Such other programs, studies, developments or implementations as are allowed or permitted by law and approved by the County Board from time to time.

ARTICLE 5: MEMBERSHIP

Section 1. Membership Qualification

Owners of properties located within boundaries stated below are members. The boundaries of the LID shall include parcels that have lake frontage on Big McDonald Lake or otherwise have riparian rights, but shall exclude agricultural land.

Section 2. Voting Rights

Each owner of one or more parcels of real estate, regardless of size with lake frontage is a member entitled to one vote at the annual membership meeting or any special BMLID meetings, however only one vote is allowed if ownership is joint, or any other type of multiple ownership. If multiple parcels are owned the member is entitled to one single vote. "Owner" means all individual natural persons who are identified on the deed or other instrument of conveyance, and who have reached the age of majority.

Section 3. Votes

Votes at all membership meetings shall be cast in person.

Section 4. Transfer of Membership

When a parcel of land is sold, BMLID membership is transferred to the new owner. When a parcel is sold on contract for deed, membership is transferred from the contract seller to the contract purchaser. When a parcel is leased, membership shall remain with the landlord.

ARTICLE 6: FUNDING

Section 1. Initial Funding

The initial first year funding of the BMLID shall be raised by the Big McDonald Lake Association and any personal donations received.

Section 2. Subsequent Funding and Special Projects

A. BMLID activities may be funded by the levying of ad valorum tax solely on property within the district. No establishment or increase in the ad valorum property tax will be allowed if it affects the county levy subject to state-imposed levy limits.

B. BMLID activities may also be funded by imposition of service charges on users of BMLID services within the district (Minnesota Statutes Section 428A.05).

C. BMLID activities may also be funded by assessment of costs of projects upon the benefited property within the district in the manor provided under Chapter 429 of the Minnesota Statutes.

D. BMLID may also finance projects and services of the District by issuing obligations (Minnesota Statutes Section 429.091).

ARTICLE 7: BOARD OF DIRECTORS

Section 1. Initial Board of Directors

The initial board of directors shall be appointed by the Otter Tail County Commissioners. There shall be 7 members, 3 persons appointed to 3 year terms, 2 persons appointed to 2 year terms, and 2 persons appointed to 1 year terms.

Section 2. Terms

After their initial term expires, each board of director member may be elected to an additional three-year term. No director may serve more than 2 successive complete terms.

Section 3. Nominating Committee

The nominating committee shall consist of any retiring board members and the chairperson and vice chairperson. The slate of nominees shall be submitted to the Board one month prior to the annual membership meeting. Effort by the committee should be given to see that the 5 beaches of Big McDonald Lake have representation on the board, insofar as there are qualified members willing to serve.

Section 4. Election of Directors

Nominees shall be elected by majority vote of the members at the annual membership meeting. Property owners not present at the meeting may participate in the election by absentee ballot. If more than one person is nominated for any office, elections shall be by secret ballot. Nominees must be present at the annual meeting or submit a letter of acceptance to be accepted for office.

Section 6. Vacancies

Vacancies on the board of directors may be filled by a majority vote of the remaining Directors, subject to approval by majority vote at the next annual meeting. A director elected to fill a vacancy shall serve the unexpired term.

Section 7. Removal of Directors

Directors may be removed by a 5/7 vote of the remaining board members, or by a majority of the property owners at the annual meeting.

ARTICLE 8: BOARD OF DIRECTORS OFFICERS

Section 1. Officers

All officers of the BMLID shall be directors.

Section 2. Officer Positions

The officers shall consist of Chair, Vice Chair, and Secretary-Treasurer. These officers are the Executive Committee. The Executive Committee may meet from time to time without notice to other board members for planning purposes and to facilitate the activities of the board.

Section 3. Election of Officers

Officers shall be elected by the Board of Directors from their numbers at the first board meeting after the annual meeting at which new directors were elected. Elections will be by secret ballot if more than one person is nominated for any office.

Section 4. Duties of Officers

A. The Chair shall preside over all board meetings and the annual membership meeting.

B. The Vice Chair shall preside in the absence of the Chair.

C. The Secretary-Treasurer shall keep accurate records of all meetings, regularly submit minutes to the Board of Directors, present a financial statement at each meeting, and perform all other duties normally associated with his office. Two signatures shall be required on all BMLID checks.

ARTICLE 9: DIRECTORS' MEETINGS

Section 1. Meetings

Directors are to meet when necessary, in addition to the annual membership meeting and shall be scheduled by the Chair, or in the Chair's absence, by a majority of the remaining members of the Executive Committee. Special meetings may be called by the Chair, or Vice Chair as directed by the Chair, or by four members of the Board of Directors, that are required or necessary to carry out the activities of the board.

Section 2. Notice of Meetings

There shall be at least 10 days' notice in writing or email to each director for any regularly scheduled meeting. In case of special meetings, written or electronic notice shall be given to the directors not less than three days before meetings. In any case, any director may waive such notice by written or electronic notice to the Secretary.

Section 3. Quorum

A majority of the Board of Directors duly serving shall constitute the necessary quorum for the transaction of business.

ARTICLE 10: COMMITTEES

Section 1. Appointment and Records

The Chair, with the approval of a majority of the Board of Directors at any regular or special meeting, may create and appoint such additional committees as deemed necessary. The chair of each such committee, upon its organization, shall be designated by the appointing authority, and each such committee chair shall report to the Board of Directors their committee's progress.

Section 2. Funds

Should any committee require funds for the purpose of its work, the committee shall make a request to the Board of Directors in writing with a full statement of the funds required and the purpose for which such funds are to be expended. Upon request to the Board of Directors, the committee shall meet with the board at any regular or special meeting thereafter to review the request and secure approval of the same. No committee shall expend any funds without the approval of the Board of Directors of the BMLID. All funds secured by any formed committee shall be turned over to the Board of Directors. All disbursement of funds, for any committee, shall be disbursed by the Secretary-Treasurer only after such approval is given by the Board of Directors.

ARTICLE 11: ANNUAL MEETING

Section 1. Time

The annual meeting of the membership of the BMLID shall be held on the second Saturday in June, preferably coinciding with the annual meeting of the Big McDonald Lake Association, unless changed by vote at a previous annual meeting.

Section 2. Notice

The annual meeting shall be preceded by a minimum of at least 2 weeks published notice in the *Perham Focus* and by written notice mailed at least 10 days in advance of the meeting to all property owners in the BMLID as well as to the county board or joint county board or joint county authority , town boards, and statutory and home rule charter cities wholly or partially in the district, the Minnesota Pollution Control Agency, and Commissioner of Natural Resources; and if there is a project of the district having a cost of greater than $5,000, 30 days written notice shall be given to all property owners within the assessment district.

Section 3. Agenda

At the annual meeting, the members shall:

A. Elect one or more members to fill vacancies to the board of directors;

B. Approve a budget for the fiscal year;

C. Approve or disapprove projects by the district having a proposed cost in excess of $5,000;

D. Take up and consider other business that comes before them;

E. Approve taxes and assessments to satisfy budget requirements.

Section 4. Annual Report

Each year the Board of Directors shall prepare and file a report of the financial condition of the district, status of all projects in the district, the business transacted by the district, other matters affecting the interest of the district, and discussion of the directors' intentions for the succeeding years. Copies of the report shall be transmitted to the county board or joint county authority, town boards and city councils of statutory and home rule charter cities wholly or partially within the district, the Commissioner of Natural Resources and the Minnesota Pollution Control Agency within four months after the annual meeting.

ARTICLE 12: SPECIAL MEETINGS

Special meetings of the BMLID may be called to discuss pending matters with the same notice required for the annual meeting, with the exception of written notice to property owners being two weeks.

ARTICLE 13: FISCAL YEAR

The district fiscal year shall be the calendar year starting January 1 and ending December 31.

ARTICLE 14: EXPENDITURE OF BMLID FUNDS

Section 1. Approval

All projects and expenditures must be submitted to the Board of Directors. All expenditures must be approved by a majority vote of the Board of Directors.

Section 2. Projects in Excess of $5,000

All projects in excess of $5,000 must be approved first by the Board of Directors, and secondly, by a majority vote of the membership at the district's annual meeting or a special meeting of the district.

Section 3. Audit

There shall be an independent audit of the financial records, submitted to the Chair, prior to the annual district meeting.

ARTICLE 15: AMENDMENT OF BYLAWS

These bylaws may be amended at any annual or special meeting for which due notice has been given and when such amendment has been approved by a majority of the Board and by a majority vote of the members at any annual or special meeting.

ARTICLE 16: RULES OF ORDER

The rules contained in the current edition of *Robert's Rules of Order* shall govern the convention in all cases to which they are applicable and which are not governed by the bylaws of the BMLID.

B. Hydrology and Geology

Location Data

MN Lake ID:	56-0386
County:	Otter Tail
Eco Region:	North Central Hardwood Forests
Major Drainage Basin:	Red River Basin
Latitude / Longitude:	46.579, -95.767
Invasive Species:	None as of 2013

Physical Characteristics

Surface area (acres):	992
Littoral area (acres):	368
% Littoral area:	37
Max depth (ft), (m):	46, 14
Inlets:	0
Outlets:	0
Public Accesses:	1

Lake Map

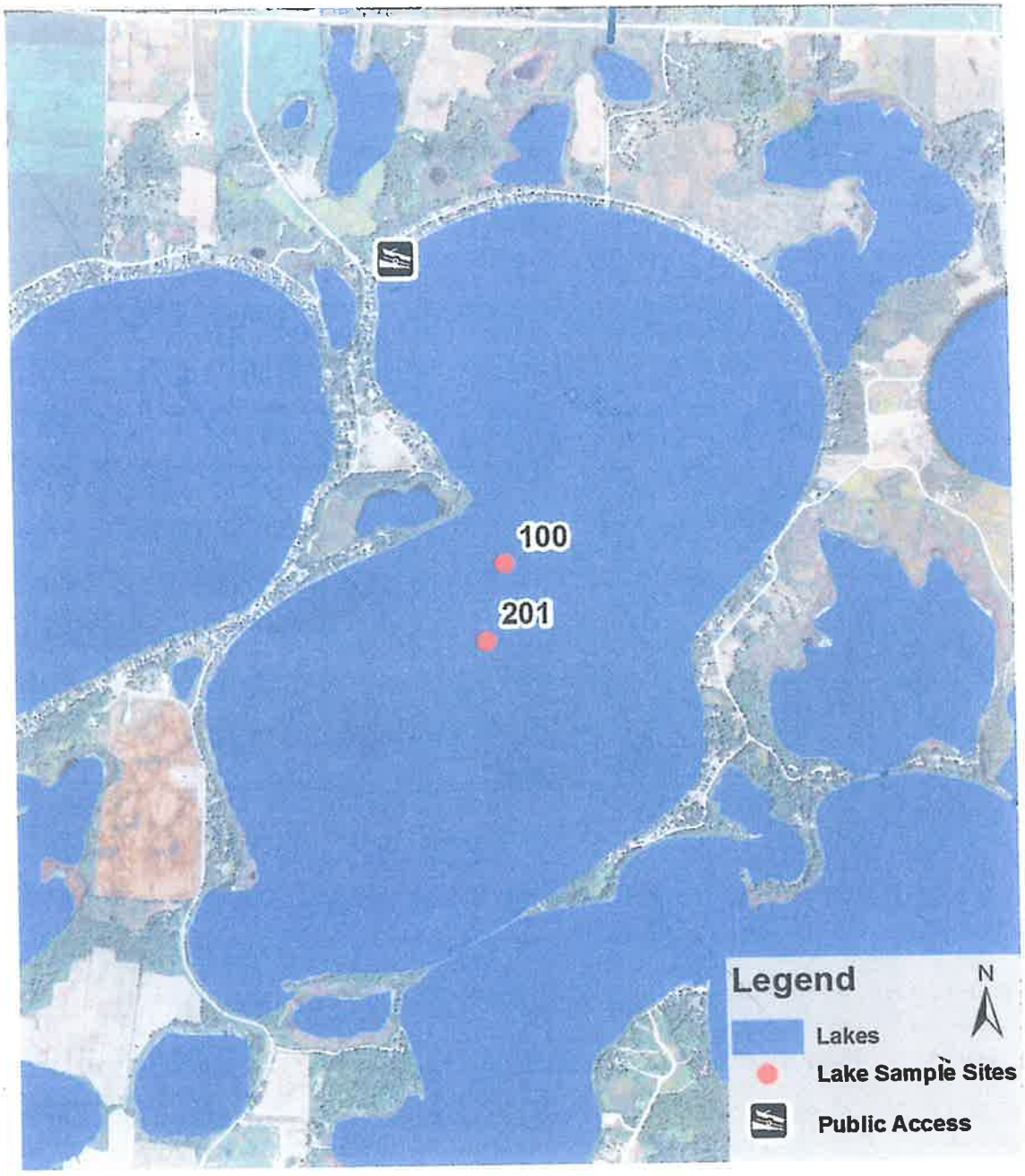


Figure 1. Map of Big McDonald Lake with 2010 aerial imagery, sample site locations, inlets and outlets, and public access points. There is no bathymetry data available electronically for this lake.

C. Historical and Existing Conditions

1. RMB Environmental Laboratories' Report

Water Quality Characteristics - Historical Means and Ranges

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

Parameters	Primary Site 201
Total Phosphorus Mean (ug/L):	**14.6**
Total Phosphorus Min:	5.0
Total Phosphorus Max:	37.0
Number of Observations:	121
Chlorophyll *a* Mean (ug/L):	**4**
Chlorophyll-a Min:	1
Chlorophyll-a Max:	11
Number of Observations:	122
Secchi Depth Mean (ft):	**16.4**
Secchi Depth Min:	9.0
Secchi Depth Max:	38.0
Number of Observations:	116

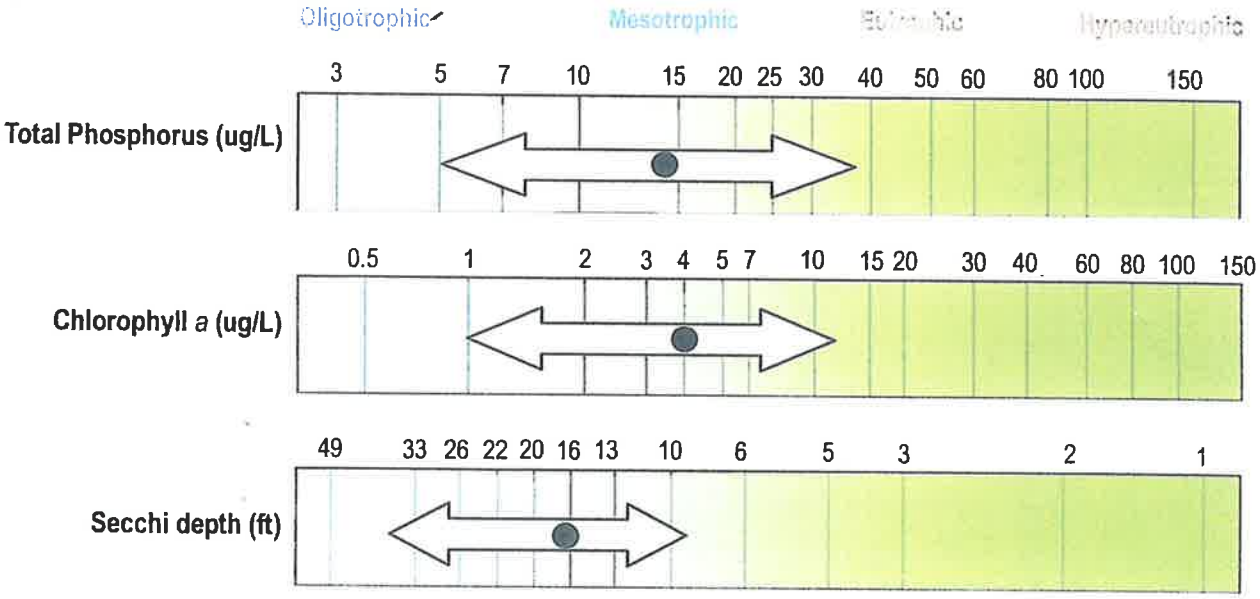


Figure 2. Big McDonald Lake total phosphorus, chlorophyll a and transparency historical ranges. The arrow represents the range and the black dot represents the historical mean (Primary Site 201). Figure adapted after Moore and Thornton, [Ed.]. 1988. Lake and Reservoir Restoration Guidance Manual. (Doc. No. EPA 440/5-88-002)

Transparency (Secchi Depth)

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

The annual mean transparency in Big McDonald Lake ranges from 13.2 to 20.4 feet (Figure 3). The transparency at site 201 appears to be relatively consistent with an average Secchi reading of 16.4 feet between 1991 and 1996- 2012. Transparency monitoring should be continued every year at site 201 in order to track future changes in water quality.

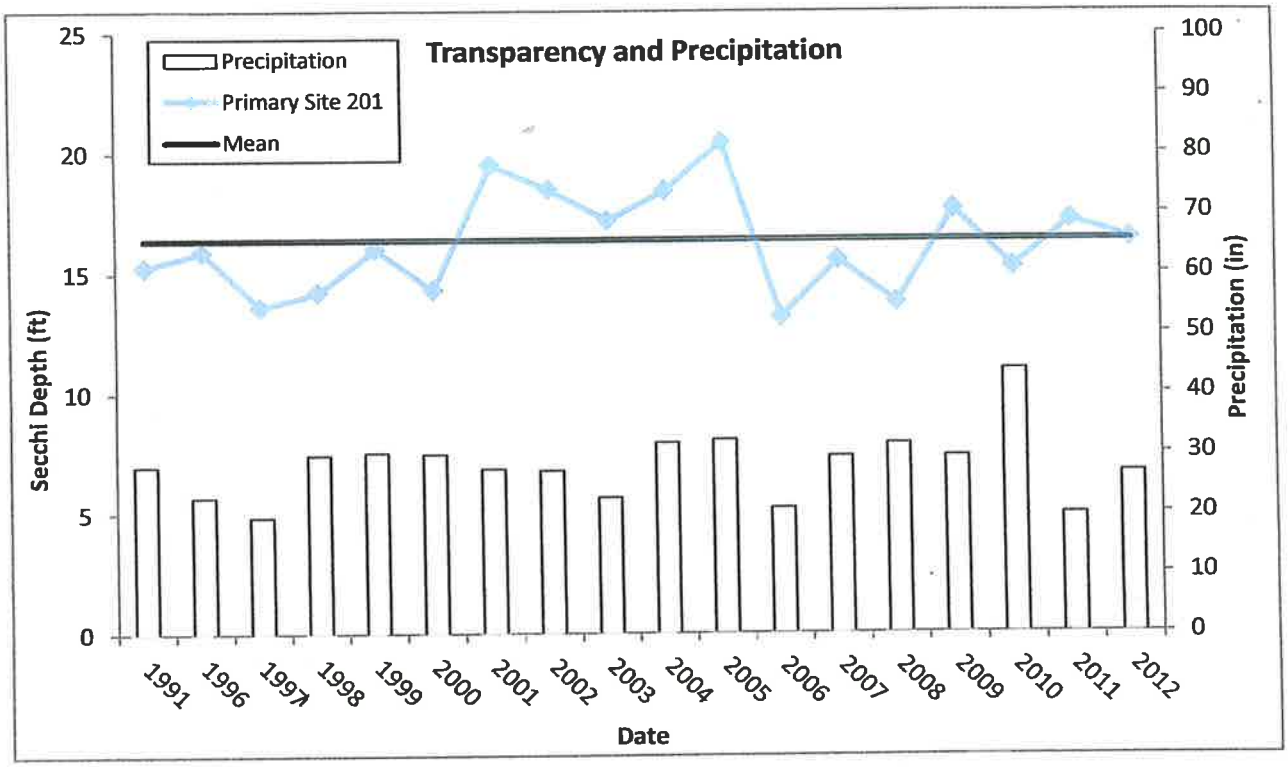


Figure 3. Annual mean transparency compared to long-term mean transparency.

Big McDonald Lake transparency ranges from 9.0 to 38 ft at the primary site (Table 4). Figure 4 shows the seasonal transparency dynamics. The maximum Secchi reading is usually obtained in early summer. Big McDonald Lake transparency is high in May and June, and then declines through August. The transparency then rebounds in late September 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.

a. Lake Water Quality

EAST OTTER TAIL SOIL AND WATER CONSERVATION DISTRICT

East Otter Tail County Water Quality Factsheet

Total Phosphorus

Big McDonald Lake is phosphorus limited, which means that algae and aquatic plant growth is dependent upon available phosphorus. Total phosphorus was evaluated in Big McDonald Lake in 1996-2012. The data show that phosphorus increases slightly as the beginning to the end of summer.

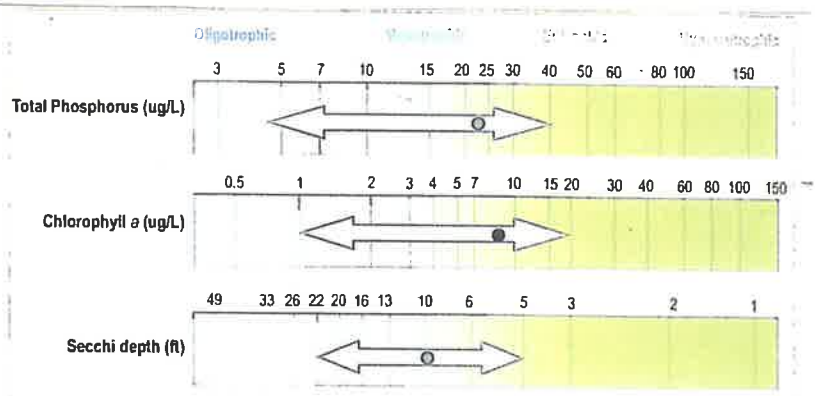


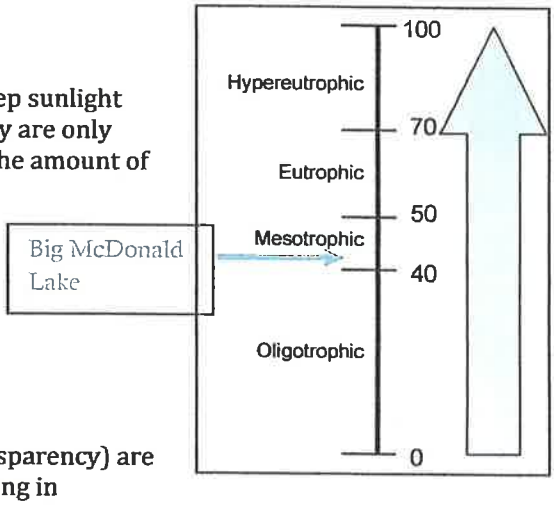
Figure 1. Big McDonald Lake total phosphorus, chlorophyll a and transparency historical ranges. The arrow represents the range and the black dot represents the historical mean (Primary Site 201). Figure adapted after Moore and Thornton, [Ed.]. 1988. Lake and Reservoir Restoration Guidance Manual. (Doc. No. EPA 440/5-88-002)

Chlorophyll *a*

Chlorophyll *a* is the pigment that makes plants and algae green. It is tested in lakes to determine the algae concentration or how green the water is. 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 Big McDonald Lake in 1996–2012. Concentrations remained below 10 ug/L on all sample dates except for two, indicating clear water most of the summer. Throughout the years of sampling, chlorophyll *a* increases every year in late summer and early fall.

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, therefore they are only found 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 annual mean transparency in Big McDonald Lake ranges from 13.2 to 20.4 feet. The transparency at site 201 appears to be relatively consistent with an average Secchi reading of 16.4 feet between 1991 and 1996-2012. Transparency monitoring should be continued every year at site 201 in order to track future changes in water quality.



Trophic State Index (TSI)

Phosphorus (nutrients), chlorophyll *a* (algae concentration), and Secchi depth (transparency) are interrelated. As phosphorus increases, there is more food available for algae, resulting in increased algal concentrations. When algal concentrations increase, the water becomes less transparent and the Secchi depth decreases. The results from these three measurements cover different units and ranges and thus cannot be directly compared or averaged. In order to standardize these measurements to make them directly comparable, we convert them to a tropic state index (TSI). The mean TSI for Big McDonald Lake is 41, and falls within the mesotrophic range. Mesotrophic lakes (TSI 40-50) are characterized by moderately clear water most of the summer. "Meso" means middle and the root "trophy" means nutrients, therefore, mesotrophic literally means a medium amount of productivity. These lakes are commonly found in Central Minnesota and have clear water with algal blooms late in the summer. They are also good walleye fishing.

Local association information: Otter Tail County Lakes Assoc.

b. Lakeshed Data and Interpretations

Land Cover / Land Use

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

Changes in land use, and ultimately land cover, impact the hydrology of a lakeshed. Land cover is also directly related to the land's ability to absorb and store water rather than cause it to flow overland 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.

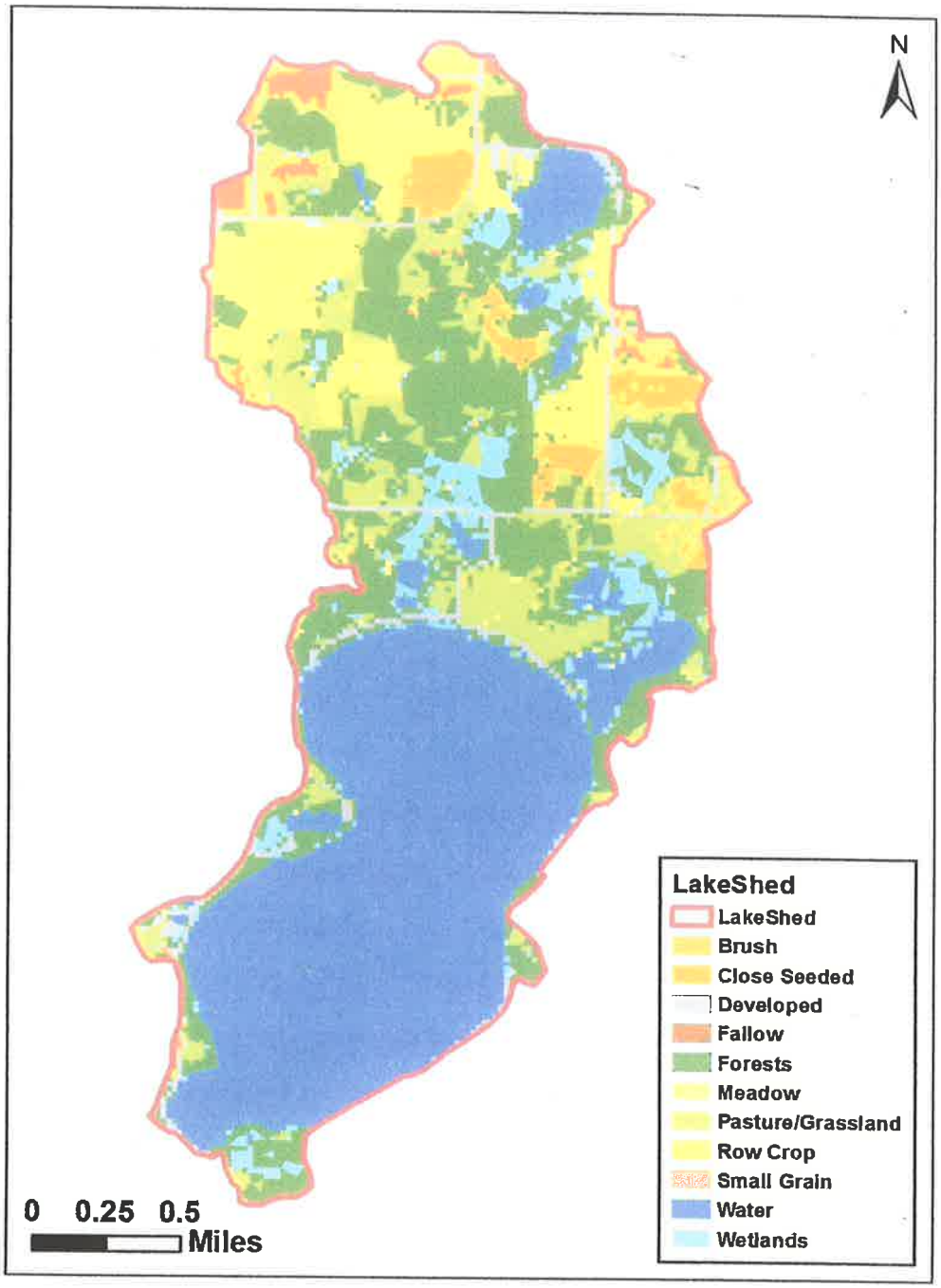


Figure 17. Big McDonald lakeshed (5603104) land cover (NASS, 2012).

Developed land cover 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. Big McDonald Lake has 4% of its lakeshed classified as developed (Table 9). 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 9. Land cover in the Big McDonald lakeshed.

Runoff Potential	Category	Specific Landcover	Acres	Percent
High	Agriculture	**Row Crop**	248.1	8.3%
High	Urban	**Developed**	119.2	4.0%
High	Agriculture	**Close Seeded**	103.4	3.5%
High	Agriculture	**Small Grain**	49.4	1.6%
High	Agriculture	**Fallow**	0.5	0.0%
Low	Forest	**Woods**	749.3	25.0%
Low	Water	**Water**	1098.9	36.7%
Low	Agriculture	**Pasture/Grassland**	454.2	15.2%
Low	Wetlands	**Wetlands**	161.0	5.4%
Low	Agriculture	**Meadow**	11.7	0.4%
Low	Grass/Shrub	**Brush**	0.8	0.0%
Total area with low runoff potential			2475.9	82.6%
Total area with high runoff potential			520.7	17.4%
Total			2996.6	100.0%

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 is one animal feedlot in the Big McDonald Lake lakeshed (Table 8). The second highest agricultural runoff generally comes from row crops. There are some row crops within the northern portion of the lakeshed but some of the nutrients may be buffered out before reaching the lake (Figure 17). Buffer areas composed of wetlands or forest are 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 9 are valuable for evaluating runoff in the lakeshed. Overall, 83% of the Big McDonald Lake lakeshed is classified as having low nutrient runoff land uses (Table 9).

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

Land Cover	1990 Acres	Percent	2000 Acres	Percent	Comments
Urban	101	3.4 %	139	4.6 %	Increase of 38 acres
Total Impervious Area*	19 acres	1.0 %	39 acres	2.1 %	Increase of 20 acres

*Percent Impervious Area Excludes Water Area

c. Key Findings and Recommendations

Monitoring Recommendations

Transparency monitoring at site 201 should be continued annually. It is important to continue transparency monitoring weekly or at least bimonthly every year to enable year-to-year comparisons and trend analyses. Total phosphorus and chlorophyll monitoring should continue at site 201, as the budget allows, to track trends in water quality.

Overall Summary

Big McDonald Lake is a mesotrophic lake (TSI = 41) with no evidence of a trend in water quality. The total phosphorus, chlorophyll and transparency ranges are better than the ecoregion ranges.

Thirty-two percent (32%) of the lake shed is disturbed by development and agriculture. The threshold of disturbance where water quality tends to decline is 25%. Big McDonald is over this threshold; however, most of the agricultural land is in pasture, which has much less runoff potential than row crops. A more accurate estimate of disturbed land is 17%, which is below the 25% threshold.

Big McDonald Lake has the advantage of a very small watershed. The lake does not have any major inlets or outlets, which means that it probably has a high residence time. Therefore, nutrients in the lake tend to stay there instead of getting flushed out. The oldest septic systems around the lake were re-checked by the county in 2010, so the septic systems around the lake should be in good working order. The land practices around the lake and the runoff from them are the main impacts to the lake.

A map showing the surface runoff potential from the different catchments around the lake show that there is a potential area for soil erosion on the southwest corner of the lake (Figure 21). This area needs to be visually inspected for high elevation and potential runoff. If this type of scenario is occurring there, shoreline restoration, rain gardens, grassed waterways, filter strips, and other best management practices could be applied to address overland flow and erosion.

Priority Impacts to the Lake

The priority impact to Big McDonald Lake is expansion of residential housing development in the lakeshed and second tier development along the lakeshore. The runoff from this development (impervious surface) delivers nutrients to the lake. The majority of first tier shoreline parcels have been developed. From 1990 to 2000 the urban area around the lake increased by 38 acres. In addition, the conversion of seasonal cottages to year-round homes increases the impervious area of the home.

The reason the lakeshed is rated as "full restoration" is surrounding agriculture. Agriculture is the dominant land use type on private lands (27.8%) within the lakeshed, but most of it is located north of the lake instead of around the lakeshore. Surface runoff mapping shows that this farmland north of the lake is likely not running directly off into the lake (Figure 21). However, the recent "cleaning" of Ditch 25 for the first time in over 100 years heightened the

probability of increased sediment and nutrient loading in the lake in the future. An initial flush of sediments was photographically documented shortly after the ditch was "cleaned" and drained through the inlet.

Best Management Practices Recommendations

The management focus for Big McDonald Lake should be to protect the current water quality and restore the lakeshed. This can be done by focusing on managing and/or decreasing the impact caused by additional development, including second tier development, and impervious surface area. Project ideas include protecting land with conservation easements, enforcing county shoreline ordinances, smart development, shoreline restoration, rain gardens, and septic system maintenance.

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

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
    - Restore wetlands
    - Implement conservation farming practices
    - Land retirement programs such as Conservation Reserve Program

d. Suggested Approaches for Watershed Protection and Restoration of DNR-Managed Fish Lakes in Minnesota

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

Big McDonald Lake's lakeshed is classified with having 41.3% of the watershed protected and 32.4% of the watershed disturbed (Figure 19). 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 20 displays the upstream lakesheds that contribute water to the lakeshed of interest. All of the land and water area in this figure has the potential to contribute water to Big McDonald Lake, whether through direct overland flow or through a creek or river. There are three lakesheds upstream of the Big McDonald Lake lakeshed.

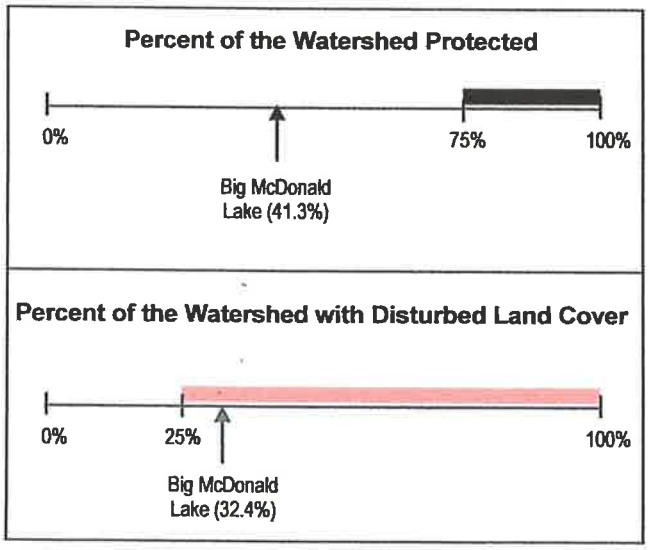


Figure 19. Big McDonald Lake's lakeshed percentage of watershed protected and disturbed.

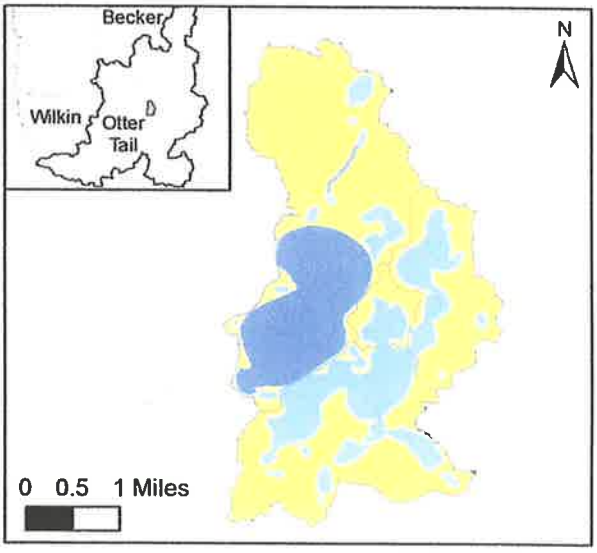


Figure 20. Upstream lakesheds that contribute water to the Big McDonald Lake lakeshed. Color-coded based on management focus (Table 12).

Surface Runoff Analysis (East Otter Tail SWCD)

The map below (Figures 21) shows 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.

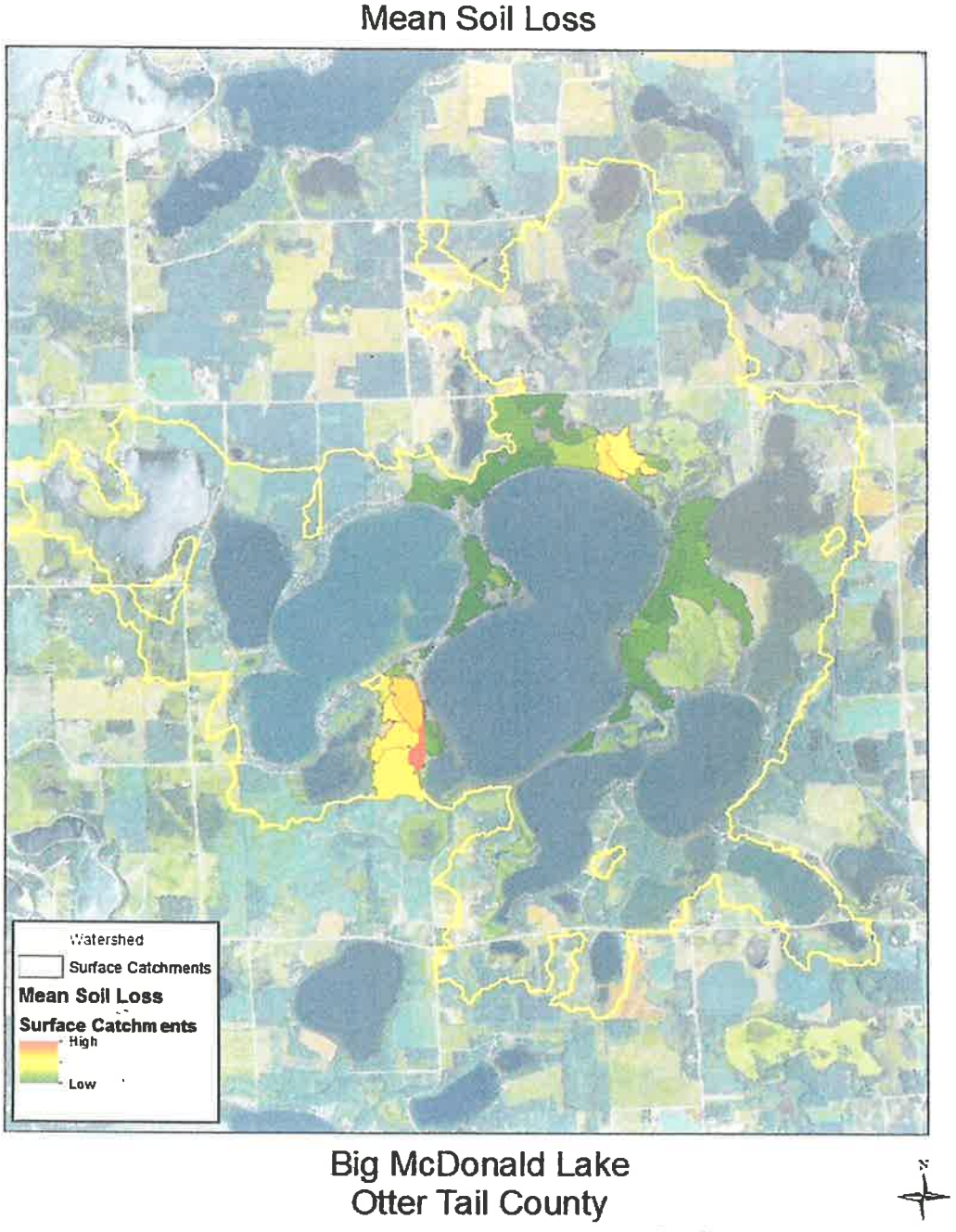


Figure 21. Potential for erosion in the surface catchments for Big McDonald Lake.

e. Organizational Contacts and Reference Sites

Big McDonald Lake Improvement District

bmlid.org

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

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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

801 Jenny Avenue SW, Suite 2, Perham, MN 56573

218-346-4260, ext. 3

http://www.eotswcd.org/

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2. Aquatic Vegetation

We are unaware of any scientific surveys that identify existing aquatic species, estimate the quantity of existing aquatic species, or assess the quality of the aquatic plant community. The aquatic plant community is not actively managed as habitat for fish, wildlife, or beneficial aquatic insects.

Some protection is afforded beneficial aquatic plants by MN DNR and Otter Tail County shoreline regulations. Despite these regulations, beneficial plants, bulrush in particular, have periodically been removed over the past ten years, as evidenced by large windrows of freshly cut stems washed ashore.

The following aquatic vegetation observations were compiled by a retired professor of landscape architecture and wildlife biologist, who is a year-round resident of Big McDonald Lake. Additional data was compiled by RMB Laboratories and included in the Big McDonald Lake status report. The RMB lake status report notes that 37% of the lake is classified as being littoral, "less than 15 feet in depth – usually dominated by aquatic plants." The littoral zone is critical habitat for panfish, bass, and northern pike. It is equally important for many resident species of amphibians, toads, and migratory birds that feed on insects produced in the littoral zone. The shoreline edges between the littoral zone and uplands are home to nesting birds, mink, muskrats, and other species. Research suggests 75% – 80% of all vertebrates in the watershed live in the shoreline edge zone during their life cycle.

Other lakeland interface characteristics include the following:

- Shoreline: 5.8 miles;
- Riprap: ≥1.25 miles (estimate);
- Bulrush: 2 miles (estimate) 10 feet to ≥300 feet stand widths (estimate); bulrush stands have thinned in stem density over the last 20 years, likely caused by high water levels during that period.
- Hybrid and Native Cattails: ≤1 mile;
- Submergent Vegetation: 400 acres;
- Emergent Vegetation: Much of the remaining shoreline edge is manicured turf or ornamental landscaping. Remnant natural landscapes can be found along the south shore, Skunk Bay, southwest shoreline, and south shoreline of Lundstrom Point. The most common emergent aquatic species in order of abundance include bulrush, reed canary grass (also occupies upland shore edges), cattail, water lilies, phragmites, and sedges.
- Key Emergent: Hard stem bulrush is the key species for many reasons. It is critical spawning habitat for pan fish and largemouth bass. Loons, grebes, and other waterfowl nest in bulrush patches. Bulrush seed is an important fall food source for waterfowl, and stems are eaten by muskrats. Bulrush patches also dampen wave action, thus reducing shoreline erosion. Except for boat access and space for swimming, bulrush removal should comply with MN DNR regulations, 50 lineal feet maximum. Less is better.

- Water Lilies: Water lilies are beneficial. They are important protective cover habitat for young fish of all species. Like bulrush, water lilies dampen wave action and reduce shore erosion.
- Cattails, Hybrid Cattails, Reed Canary Grass, and Phragmites: These species are discussed in the exotic species section.
- Submergent Vegetation: Little is known about the species composition of the submergent aquatic plant community in Big McDonald Lake. However, observations suggest that Chara (Carpetweed) appear to be covering more shallow water areas. Chara has one positive effect: it grows into fine sediments fixing them in place. The negative impacts are not well understood. Observations indicate that Chara over-grows traditional pan fish spawning beds and covers habitat for native clams. It also negatively affects the swimming experience for some residents.

More needs to be known about Chara. There is one lake lot demonstration site (private) on the north shore of Big McDonald Lake. The Pelican Lake Garden Club and numerous Big McDonald Lake residents have toured the property over the past ten years. Design features include:

- 100 feet of restored shoreline using native trees, shrubs, and sedges; matting and stakes used came from East Otter Tail Soil and Water Conservation District (EOT SWCD).
- 100 feet by 20 feet of sand prairie buffer strip planting;
- 60 feet of grass bioswale;
- Rain garden;
- Restored oak woodland understory planting of native plants.

In addition to the demonstration site, there is a narrow strip of relatively undisturbed native vegetation acting as a buffer at the MN DNR access site. There are also numerous native lakeshore plant communities (good reference sites) around the lake at the:

- Northeast corner;
- Skunk Bay and points on either side of the sand bar;
- Southwest highlands shoreline;
- South side shoreline of Lundstrom Point.

These native plant communities have persisted for decades and protected the shoreline. All of these sites are privately owned. Observing them, even from a distance off shore, can be educational in regard to plant community structure and species composition.

Two University of Minnesota Master Gardeners, one a retired professor of Landscape Architecture, reside on Big McDonald Lake. They have taught, and continue to teach, courses on landscaping and gardening for wildlife at East Otter Tail Horticultural Days, COLA meetings, and the Prairie Wetland Center in Fergus Falls. They are willing to do the same for the BMLID.

Several property owners on Big McDonald Lake have partnered with EOT SWCD on shoreline restoration projects. EOT SWCD is an excellent resource for technical advice, materials, and funding. Much more could be done by continued partnering with EOT SWCD to encourage "lake friendly" shoreline restoration projects and buffer strips, as noted in the recommendation section.

Fresh Water Society Draft Lake Management Report: The following landscape design elements and management techniques have significant positive impacts, such as protecting and enhancing water quality, aquatic ecology, and wildlife habitat:

- Shoreline restoration;
- Buffer strips;
- Reduced turf areas;
- Minimum or no mow zones; and
- Reduced or integrated riprap (rock and shrubs).

The University of Minnesota Cooperative Extension Service, Otter Tail County Extension Office, and the County Agent are also valuable sources of information and advice. Education courses on Aquatic Invasive Species (AIS) identification and their control are available through the Extension Service, US Fish and Wildlife Service, Otter Tail County Coalition of Lake Associations, and others. Trained observers living on the lake are key to early detection of AIS, and early detection followed immediately by an appropriate response is key to controlling the problem.

3. Wildlife

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

"Minnesota's lakes are home to many species of wildlife. From our famous loons and bald eagles to muskrats, otters, and frogs, wildlife is an important part of our relationship with lakes. In fact, Minnesota's abundant wildlife can be attributed largely to our wealth of surface water. From small marshes to large lakes, these waters are essential to the survival of wildlife.

The most important wildlife habitat begins at the shoreline. The more natural the shoreline, with trees, shrubs and herbaceous vegetation, the more likely that wildlife will be there. Just as important is the shallow water zone close to shore. Cattail, bulrush, and wild rice along the shoreline provide both feeding and nesting areas for wildlife. Loons, black terns, and red-necked grebes are important Minnesota birds that are particularly affected by destruction of this vegetation. Underwater vegetation is also important to wildlife for many portions of their life cycle, including breeding and rearing of their young."

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

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

The primary agency charged with the management of Minnesota's wildlife is the Department of Natural Resources, Division of Fish and Wildlife, Wildlife Section.

Many residents around Big McDonald Lake are birders, most casual, some ardent. The spring waterfowl and warbler migrations are much anticipated events. Loons, trumpeter swans, bald eagles, sand hill cranes, and terns are species of special interest; all nest in the watershed. Sadly, the long-occupied eagle nest near the sandbar was destroyed in 2015. Eagles, however, constructed a new nest nearby in 2016. Species typically attracted to feeders put out by lake residents include warblers, finches, hummingbirds, orioles, cardinals, blue jays, chic-a-dees, and nut hatches. Nest boxes attract bluebirds, wrens, swallows, wood ducks, and hooded merganzers.

There are no apparent trends in most wildlife species or populations that are resident or migrate through the Big McDonald Lake watershed. Observations around Big McDonald Lake, however, as well as adjacent lakes and uplands, suggest:

- Incremental development of approved platted subdivisions;
- Continued removal of desirable shoreline vegetation;
- Clearing of native wooded upland and understory vegetation in the watershed;
- Increased acreage devoted to manicured turf;
- Expanding populations of invasive species; and
- Increase in shoreline riprap could significantly reduce the quantity and quality of habitat for wildlife in the watershed. A long term trend for declining local populations of some species is likely.

Regional populations of species already in decline include: monarch butterflies, European honey bees, and various native bee species, and warbler species that require healthy riparian habitat or large patches of ungrazed woodland with undisturbed native species. Wildlife species around the lake considered to be a "nuisance" by many include: Canadian geese (numbers are increasing), raccoons, skunks, moles, voles, cottontail rabbits, and whitetail deer. Geese, cottontail rabbits, and whitetail deer are classified as game species; taking of these species is regulated. If issues with any of these species arise on your property, contact the MN DNR.

Beavers are an ongoing problem at the inlet and outlet from Big McDonald Lake. Dams at the Ditch 25 inlet cause flooding of back lots on the north shore. Dams on the outlet ditch raise the lake water level, causing wave-induced beach erosion in the spring and ice damage to shorelines in the winter.

A contracted trapper with the necessary permits has been helpful in controlling beaver population. For the outlet, however, trapping is a short- term fix. The Big McDonald Lake community still awaits the construction of a new outlet channel, which was approved by the

Otter Tail County Commission in 2015. (Note: on wildlife habitat the "lake friendly" landscape practices and maintenance suggestions described in the Aquatic Vegetation section directly benefit wildlife and should be considered when developing landscape plans for lakeshore properties.)

4. Exotic Species

Background

"Exotic" species -- organisms introduced into habitats where they are not native -- are severe world-wide agents of habitat alteration 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 1950's and 1980's.

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.

No survey nor scientific study of exotic species in Big McDonald Lake has been conducted. Exotic species in the immediate area and known to exist include:

- Zebra Mussels: have been found in neighboring lakes, including Little McDonald, Paul, Krebs, and Reush. None of these lakes are in the Big McDonald watershed. Researchers continue to seek an effective treatment for Zebra Mussels.
- Chinese Mystery Snails: Mystery snails exist in Big McDonald Lake. Observations by lake residents suggest that population is increasing. Although this species is not currently considered a threat to lake ecology, it is perceived by residents as a nuisance.
- Vegetation Hybrid Cattails: Hybrid cattails are more aggressive than the native species. Patches of hybrid cattails dominate the shoreline around Skunk Bay. Smaller patches exist in the northeast corner of the lake and along the south shore of Lundstrom Point. Hybrid cattails also encircle most wetlands in the watershed. Cattails temporarily stabilize lake shorelines and provide habitat for some wildlife species. They out-compete more desirable native species, however, such as wild rice, sedges, and bulrush. These native species are effective shoreline stabilizing plants and provide quality wildlife and fish habitat.
- Phragmites: Small patches of phragmites exist in the northeast corner of Big McDonald Lake. They are more abundant on the south shoreline of Skunk Bay. This species has little habitat value, is very aggressive, and expands rapidly into newly exposed beach areas when water levels recede. It is very difficult to eradicate.
- Reed Canary Grass: is very common around the lake. It has little or no habitat value. The dense rooting structure of this species, however, has effectively stabilized shorelines in several locations. Removing canary grass and replacing it with higher

habitat value shoreline stabilizing shrubs and sedges is difficult. Consult with EOT SWCD or contact a private restoration specialist before undertaking removal of large patches of this species.

- Buckthorn: Common and Glossy Leaf Buckthorn are common in some wooded lake and woodlands in the watershed. These species are spread by birds. Birds eat the fruit, fly away, and defecate the seed in a new location. If left unchecked, Buckthorn will dominate the woodland understory, eliminating all desirable native plant species. This change in plant community structure causes rain-induced flushing of fine sediments and debris, which is transported by runoff and washed into the lake.
- Fish: European Carp are present in Big McDonald Lake. Population levels are unknown. Also unknown are preferred carp spawning areas (most likely Skunk Bay) and the reproductive success of lake spawning carp. In the past, lake residents have observed carp spawning in wetlands to the north of Big McDonald Lake linked to the lake by Ditch 25. In 2010 a carp barrier was installed north of Big McDonald Lake. Its intent was to prohibit carp access to upstream spawning habitat. Carp have been observed in these wetlands uprooting beds of wild rice and other desirable aquatic species. Further, carp foraging activity floats detrital material up into the wetland water column. From there it is transported by wave action and water currents through the outlet and into the lake. In 2011 the barrier was vandalized. An estimated 20 to 30 very large carp entered the wetlands, and to the best of our knowledge, have not returned to the lake. Each year the resident carp population is supplemented by fish migrating upstream from Round Lake and other downstream lakes linked by Ditch 25. An outlet carp barrier is needed! MN DNR specifications would apply, and their approval is needed.

5. Land Use and Zoning

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

Surface Water Quality

- To improve the water quality of surface waters in 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.

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

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

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

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

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

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

Below are zoning standards associated with each of you lakes. Please note that this chart does not represent all the zoning requirements that are involved with land use and property development. You will want to contact the Otter Tail County Zoning staff to determine the zoning district and the specific regulations that apply to your property.

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

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

Please Note: Otter Tail County is in the process of revising their shoreland ordinance. As you make plans, be sure to check in with the Otter Tail County Land and Resource Management Department for any 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.

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

6. 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% 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 (MN DNR), Trails and Waterways Unit. They are responsible for the acquisition, development, and management of public water access sites. The MN 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 MN DNR's efforts to establish and manage public water access sites are guided by Minnesota Statutes and established written MN 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 the MN DNR Fisheries Survey, there is one public access on Big McDonald Lake. The public access on Big McDonald Lake includes the following facilities:

- Launch ramp and docking;
- Parking for 6 to 8 vehicles with trailers (there are seldom more than 3 parked at the access at any one time);
- Standard signage on AIS, boat / trailer cleaning; and
- Nesting loon habitat advisory.

MN DNR manages the access site. The access receives constant but relatively low levels of use. Busier periods include:

- Memorial Day and Labor Day holidays;
- Mondays when resort patrons arrive and Fridays when resort patrons depart;
- Occasional fishing derbies.

The MN DNR is responsible for access upkeep. North shore residents pick up incidental litter, as needed. In general, the access site is well-kept and maintained. MN DNR staff periodically inspects boats for AIS. Opportunities for a graphic display of AIS species and boater information regarding Big McDonald Lake, which would help protect water quality and fish and wildlife habitat, would require coordination with MN DNR.

D. Notes and Outcomes of the Visioning Process

Big McDonald Lake Improvement District

Healthy Lakes and Rivers Partnership
Community Visioning Session Summary
Prepared by Jen Kader of the Freshwater Society
August 2016

Nearly 250 comments were received by participants in the Community Visioning Session on August 6, 2016. While several categories were identified by attendees during the session so as to facilitate conversation, further review of the comments across categories has demonstrated that three major categories actually exist. Those categories, and the themes in each, are detailed below.

Strong Lake Improvement District

Comments in this category generally focused on two major themes: increasing the LIDs engagement with the community, and coordinating with local government. Both are needed to increase the participation of the local community in behaviors and activities that can promote a healthier Big McDonald now and into the future.

- Sub-themes
    - Community engagement:
        - Education and communication
        - Active Membership
    - Governmental engagement
        - Lobbying and follow-through
        - Coordinated lake management
        - Partnership
- Who should be at the table (no suggestions were identified by the group, so some suggestions to start with are included below in italics)
    - *Lake residents*
    - *Local government*
        - *Towns*
        - *County*
    - *Local businesses*
    - *DNR*
    - *MPCA*
    - *East Otter Tail SWCD*
    - *Neighboring lakes*
- Next 30/60/90 days
    - (30) Flyer and home visits
    - (30) Volunteer groups for compliance and education about benefits
    - (30) Set meeting between LID and county: find out what the plan isn't being implemented or get an update on the proposed implementation timeline.
    - (30) Review Jen's summary report
    - (30) Form committee to put together education and communication plan (Rob Campbell nominated to participate)
    - (30) Complete management plan *(I would recommend 90 days here)*
    - (60) Education and Communication Plan (Glen Swanton nominated to participate
    - (90) Have a firm action plan
    - (90) Send out beginning of education and plea for cooperation

Water Quality

By far, the largest number of comments from the session dealt in some way with the topic of water quality. There is a shared understanding of the need to better understand what is happening in the water and why, and then share that information with neighbors. There is also wide recognition of the impact runoff is having on the quality of the water and stability of the shoreline. As you seek answers to the problems you are facing, it will be important to work with the SWCD to identify the proper course(s) of action. In the meantime, there is a lot that can be done to encourage shoreline property owners to install shoreline and rain gardens, mow less (less area and less frequency), and otherwise adopt practices that can improve water quality. While there are a large number of sub-themes, there is a lot of overlap between them. As you write out your plan for how to address issues in this category, look for opportunities to support multiple sub-themes at the same time.

- Sub-themes
    - Shoreline management
        - Shoreline stabilization
        - Shoreline gardens and buffer strips
    - In-lake and on-shore habitat and wildlife protection
    - Runoff reduction
    - Reduction of the amount of phosphorus and nitrogen in the water
    - Ditches
    - Septic tanks
- Who should be at the table (no suggestions were identified by the group, so some suggestions to start with are included below in italics)
    - *Lake residents*
    - *DNR*
    - *East Otter Tail SWCD*
    - *Farmers*
    - *County*
    - *University of Minnesota Extension*
    - *Angling clubs*
- Next 30/60/90 days
    - (30) Contact Craig Johnson about showing us his place and what he did to his shore
    - (30) Establish a filter through the DNR
    - (60) Approach EOTSWCD about having a seminar to educate us on shoreline restoration
    - (60) Resolution around Ditch 25

Use of Lake Six

Comments in this category range from management of lake level to etiquette for lake use. All are geared towards preserving and enhancing the enjoyment of the lake by various users.

- Sub-themes
  - Surrounding area
    - Road traffic speeds
    - Campground atmosphere
    - Property values
  - Aquatic Invasive Species
    - Awareness
    - Research and monitoring
  - Managing water quantity/lake level
  - Lake etiquette/competing lake use
- Who should be at the table
  - Volunteers
  - Sheriff's department
  - DNR
- Next 30/60/90 days
  - (30) Look for AIS regulations
  - (30) Identify damage caused by Chinese mystery snails
  - (30) Write up generic lake use etiquette
  - (90) Meetings and discussion about lake use

Other – Regulation & Education

Pervasive throughout each of the themes were two additional themes that merit their own section in this summary: regulation and education. They are included together here as they fall along a spectrum that relates to level of authority and control, in that as legal authority to regulate an act decreases, education (and incentives) are needed to create behavior change.

- Sub-themes
  - Water quantity and quality
  - Aquatic Invasive Species
  - Zoning
    - Current and future land use
    - Overlays
- Who should be at the table
  - NRCS and UFWS
  - *DNR and MPCA*
  - *County and Town*
  - *University of Minnesota Extension*
  - *East Otter Tail SWCD*

E. Detailed Action Plans

Prioritized Goals and Action Plans

The final chapter of our Lake Management Plan summarizes the conclusions and priority actions we have chosen to work on at this time. Below we will 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.

Goal Area: #1- Preserve and protect, and where practical, enhance the water quality of Big McDonald Lake and its aquatic ecosystem for current and future generations

Discussion Recorder: Jon Lundby

Discussion Reporter: Jon Lundby

Outcome: Our desired outcome is to maintain or improve the water quality and healthy aquatic vegetation that we have enjoyed.

Obstacles:

a. **Obstacle**: Ditch 25 maintenance and drainage into Big McDonald Lake
Overcome by: Inventory, analyze, assess, and monitor water quality inflow from Ditch 25 (RMB Lab)

b. **Obstacle**: Lack of resources
Overcome by: Recruitment of participants, grants (grant for aquatic vegetation survey), and volunteers to sample water quality)

c. **Obstacle**: Lack of septic monitoring by County
Overcome by: Coordinating with Otter Tail County

d. **Obstacle**: Lack of information on aquatic vegetation in the lake
Overcome by: Get general information from the residents; conduct a survey, mapping, and assessment of aquatic vegetation; do sampling and ongoing monitoring

e. **Obstacle**: Lack of resident knowledge about aquatic invasive species
Overcome by: Distribution of AIS information to lake residents

Measuring Success: What are the two most important and measurable "indicators of success" for an activity associated with this goal area? How will you know you achieved the desired outcome?

a. Water test results
b. Health of the lake aquatic ecosystem

These indicators of success should be evident by improved water quality; the results of periodic aquatic vegetation sampling and DNR Fisheries surveys; and property owners' survey results.

1. **Activities / Programs:** Educate residents at the annual meeting, through newsletters, distribution of AIS literature, and by the website postings, about the importance of preventing runoff into the lake and stabilizing their shoreline through the use of rain gardens, rain barrels, and native buffers. Include information about cost-sharing options for installation of these practices through Eastern Otter Tail Soil and Water Conservation District (EOT-SWCD). An on-site tour of a restored shoreline, buffer strip, and rain garden on Big McDonald Lake will be offered to Big McDonald residents.

Who's Leading: Craig Johnson with assistance from EOT-SWCD

Resources Needed: Information about technical assistance and funding for projects

***Activity Timeline**: Summer 2017

Result: Increased awareness and motivation to act; evidence of shoreline and buffer projects; and other practices noted above.

*The 2017 tour was canceled due to significant storm damage to the tour site. It will be rescheduled for June 2018.

2. **Activity / Program:** Water quality testing and monitoring

Who's Leading: Rob Campbell, Craig Johnson, and Don Beck

Resources Needed: Testing equipment from RMB Labs; volunteers

Activity Timeline: 4 times per summer

Result: Ongoing data to track trends in Ditch 25 water quality entering the lake. If issues arise seek funding.

3. **Activity / Program:** Provide all BMLID members and lakeshore property owners with *F.W.S. Guide to Lake Protection and Management*

Who's Leading: Cyndy Wedrick

Resources Needed: Guides from F.W.S.

Activity Timeline: Annual Meeting of BMLID

Result: Education; motivation; resources available on BMLID website; Resident survey presented at the BMLID annual meeting

4. **Activity / Program:** Continued annual monitoring of Big McDonald Lake water quality

Who's Leading: Steve and Junelle Christiansen, Steve and Suzanne Wilson

Resources Needed: BMLID support

Activity Timeline: May – September annually; annual report presented at the BMLID annual meeting

5. **Activity / Program:** Encourage best management practices on lakeshore properties; Reduce nutrient flow into Big McDonald Lake by promoting and coordinating with EOT-SWCD to provide cost-sharing for property owners to install rain gardens, rain barrels, and/or native buffers.

Who's Leading: BMLID Board

Resources Needed: EOT-SWCD; technical experts

Activity Timeline: Annual BMLID meetings

Result: Increased awareness of conservation practices and opportunities to implement them; resources available on BMLID website; reference map of website

6. **Activity / Program:** Septic inspection – check with septic inspectors about the cost of conducting septic system inspections on Big McDonald Lake. Consider a cost-sharing program with residents.

Who's Leading: Rob Campbell

Resources Needed: County cost-sharing

Activity Timeline: Ongoing

Result: Removal and replacement of faulty systems (over time)

Goal Area: #2- To promote appropriate or safe recreational activities on or around Big McDonald Lake

Discussion Recorder: Jon Lundby

Discussion Reporter: Jon Lundby

Obstacles: What barriers/ obstacles could prevent making the above changes? How can they be addressed or overcome?

a. **Obstacle**: Lack of public awareness
Overcome by: Education; information distributed at public access and resort; reminder and discussion at annual meeting

b. **Obstacle**: BM Lake residents do not always practice safe boating practices
Overcome by: Distribution of DNR's *Safe Boating Guide;* reminder and discussion at annual meeting

c. **Obstacle**: Occasional disrespect of anglers' fishing space
Overcome by: Education at annual meeting

Goal Area #3: To preserve and enhance habitat for fish and wildlife in the Big McDonald Lake watershed

Discussion Recorder: John Lundby

Discussion Reporter: John Lundby

a. **Obstacle:** Lack of public awareness
Overcome by: Education by distribution of information regarding wildlife habitat and native plants; habitat site visit

b. **Obstacle:** Funding for project implementation
Overcome by: Encouraging lake residents to attend COLA Annual Lakescaping Workshop and EOT-SWCD funding presentation

c. **Obstacle:** Technical assistance
Overcome by: EOT-SWCD, Master Gardeners, DNR USFWS

1. **Activity / Program:** Educate residents about safe boating practices and on the water etiquette

   Who's Leading: Jon Lundby

   Resources Needed: DNR's *Safe Boating Guide*

   Activity Timeline: Annual meeting and on BMLID website

   Result: Increase awareness of safe boating practices and courtesy; respect for anglers' fishing space; respect by anglers of shoreland property owners

2. **Activity / Program:** Educate residents about damage caused by wakes and activities too close to the shoreline

   Who's Leading: Rob Campbell

   Resources Needed: Information dispenser at the public access

   Activity Timeline: Annual meeting of BMLID

   Result: Wildlife, fish, and their habitats in and around Big McDonald Lake are protected

3. **Activities / Programs:** Educate residents about the importance of lakeshore habitat to a diverse community of wildlife species and the role pollenators play in sustaining a healthy environment. In regard to wildlife habitat, provide information about the importance of pollinators (bees and butterflies) at the annual meeting of BMLID, through site visits, newsletters, and the BMLID website. Encourage residents to plant native plants to provide habitat for insect pollinators, birds, and other wildlife species and to minimize the use of pesticides and herbicides.

   Who's Leading: Craig Johnson

   Resources Needed: Information on lakeshore habitat, pollinators, protection of existing quality habitat; an increase in wildlife-friendly plantings on lakeshore properties; and opportunities for other habitat improvements, including bird nesting boxes.

   Activity Timeline: Annual meeting

Result: Increased awareness of pollinators' plight and appropriate plantings on lakeshore properties.

4. **Activity / Program:** Identify and control wild noxious and invasive shoreline and terrestrial plant species.

   Who's Leading: Craig Johnson

   Resources Needed: Information and funding for website manager

   Activity Timeline: Distribute noxious and invasive weed identification; site visit; and information posted on BMLID website

   Result: Evidence of noxious and invasive plant species declines

5. **Activity / Program:** Educate residents about the loons' life cycle and the importance of staying away from them while boating on the lake. Identification of existing loon nesting sites (if any) and potential new locations outside present home ranges.

   Who's Leading: Don and Lori Beck

   Resources Needed: location of existing loon nesting sites; Information about making nesting sites for loons and materials; assistance from DNR biologist and knowledgeable residents

   Activity Timeline: Spring 2018

   Result: To protect existing loon nesting sites, if any, and to attract loons to Big McDonald Lake and provide nesting structures in suitable locations; loon nesting update posted on BMLID website and DNR contact information should issues arise

Future Activities / Programs: To achieve the desired outcomes for this priority focus area, we need the following people or organizations to get involved:

F. Approach for Revisiting and Refreshing this Plan

This plan is designed to be relevant for only three to five years. In fact, at least every five years, we should plan to engage in an update process. Issues change, people change, and resources change, so this plan should change, too! Though it was developed through the Lakes and Rivers Partnership Program, we do not need to go through the program again to get an updated plan. If we've been effective in building and maintaining relationships with our local resource experts, all we will really need to do to update this plan is the following:

1. Review our plan
    a. Make sure our 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 our resource experts for updated data if we 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 we were not successful, why? (These can help us as we identify obstacles in the new action plans.)
2. Identify our new action plans
    a. Hold a community visioning session
    b. Identify our new priority issues or opportunities our group wants to work on
    c. Research new funding opportunities
    d. Draft our new action plans
3. Update the full document, and approve it at an upcoming meeting!

That's it! A lot of this can be done working collaboratively with EOT- SWCD and the different staff listed in the agency roster—we do not have to worry about updating all the data alone. Other than that, it's just bringing people together in the same way we did during the initial drafting of this plan. Of course, as we work on this, we are encouraged to reach out to the HLRP facilitators with any questions or concerns.

G. Summary and Conclusions

The modest goals outlined in this initial Lake Management Plan are important. Once completed they become the first blocks in building a community culture committed to lake stewardship. Future plan updates should emphasize on-the-ground projects around the lake. This will continue progress toward: preserving, protecting, and enhancing water quality, fish and wildlife habitat, and the lake recreation experience.

Section 3: Appendix

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.

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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.

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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